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AGROBIODIVERSITY INDEX REPORT 2021: ASSESSING MEDITERRANEAN FOOD SYSTEMS

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The Agrobiodiversity Index Team

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Chiara Villani (MSc International Relations) is a global engagement and executive communication officer. Until recently, she supported communications and partnerships for the Agrobiodiversity Index.

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Preface

Today like never before, the world is waking up to the fact that agendas previously treated as barely connected - like food and biodiversity - are deeply enmeshed. The Covid-19 crisis has spotlighted the unintended consequences of treating nature, food, and health as isolated topics. We need to find ways to bring them together analytically and through policy recommendations.

2021 was the year of the United Nations Food Systems Summit and also the year that the post-2020 Global Biodiversity Framework of the Convention on Biological Diversity started to be developed. This is a golden opportunity for food to become a central part of the biodiversity framework and biodiversity to become central to sustainable food systems. At CGIAR, through the Alliance of Bioversity International and CIAT, we are galvanizing global efforts to embed an ambitious target on food systems in the new biodiversity framework. We are also supporting transformation towards nature-positive production in the UNFSS, by co-leading Action Area 2 (Manage sustainably existing food production systems) within Action Track 3 on Boosting nature-positive production.

The Agrobiodiversity Index can contribute to operationalizing both of these ambitions.

The Mediterranean basin, as well as being home to some of the world's most loved cuisines (Italian, French, Lebanese to name but three), is also a biodiversity hotspot, with 15,000 to 25,000 species, 60% of which are unique to the area, and a center of diversity for many cultivated food crops. It is an ideal area to analyse the intersect of biodiversity and food.

The Agrobiodiversity Index Mediterranean Food Systems report applies an agrobiodiversity lens to the food systems of ten countries around the Mediterranean to assess the extent of food system sustainability. The Index reveals through scientific analysis the contribution of agrobiodiversity to healthy diets, sustainable production, and agrobiodiversity conservation, and how policy choices and actions block or enable the realization of that contribution.

The Agrobiodiversity Index is written and analysed by a multidisciplinary team of top researchers integrating evidence from topics as diverse as diets for good nutrition, multifunctional and regenerative landscapes, and long-term conservation of genetic resources, underpinned by modelling and policy specialists.

This is the third Agrobiodiversity Index report. It builds on the report *Mainstreaming Agrobiodiversity in Sustainable Food Systems* in 2017 and the *Risk and Resilience* report in 2019. Starting from scientific foundations, the methodology has been refined and simplified over the years in response to feedback from users. It is now clearer and easier to understand, so that policymakers and decision makers in countries in the Mediterranean and beyond, can learn from concrete examples of how mainstreaming agrobiodiversity in sustainable food systems can make a difference towards healthy diets from sustainable production, which maintain options for the future.

This report is written for all key players interested in biodiversity, food, or both, from the worlds of science, business, policy, healthcare and academia, as well as farmers, indigenous people, youth organizations, consumers, environmental activists, and other stakeholders. It is for those who want to identify game-changing solutions to transform food systems. One game-changing solution is increasing agrobiodiversity for improved production and resilience.

We trust that you will enjoy reading this report and that it helps you think about how to make your own contribution to combining food and biodiversity for the future of our people, planet and prosperity.

Juan Lucas Restrepo

Director General of the Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT).

Global Director for Partnerships & Advocacy, CGIAR

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Introduction

Sarah K. Jones, Roseline Remans, M. Ehsan Dulloo,
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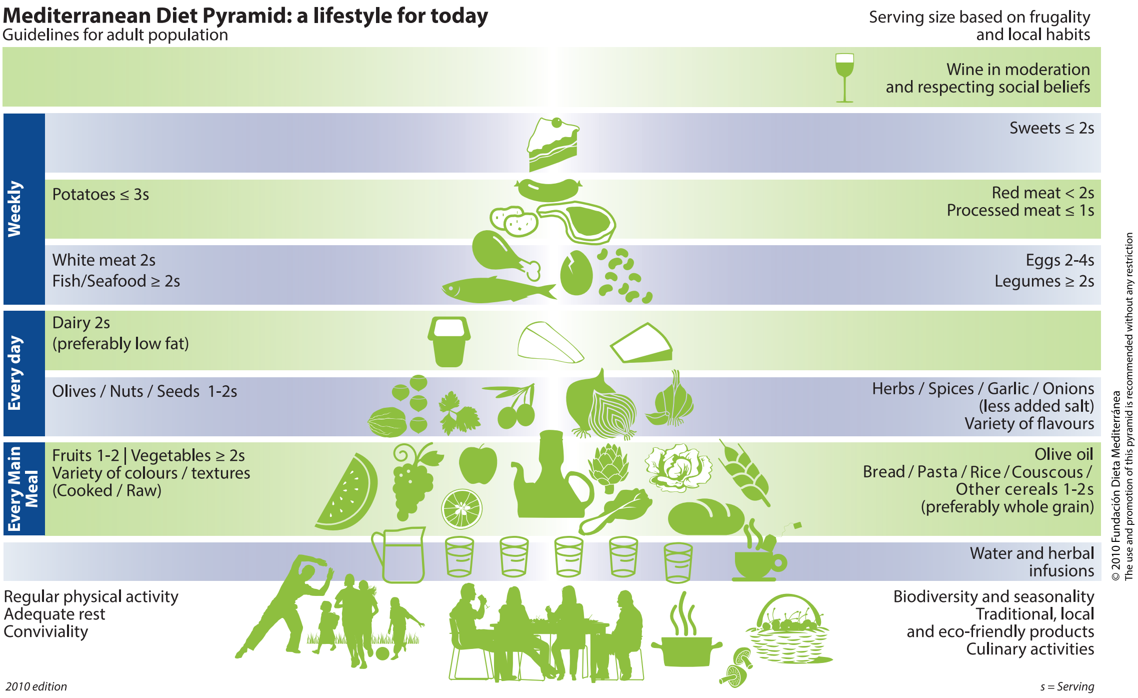
Introduction

The traditional Mediterranean diet is a plant-based dietary pattern with common characteristics shared by countries around the Mediterranean Sea.[1] It consists of eating mainly unprocessed plant foods (grains, vegetables, fruits, legumes, nuts, seeds and extra virgin olive oil), moderate amounts of fish or shellfish and wine, and low amounts of meat and dairy products, eggs and animal fats.[2] It is associated with regular consumption of home-cooked meals, meals as social events, low temperature cooking methods, reduced snacking, fasting, owning a vegetable garden, using traditional foods and recipes, and a post-lunch nap.[1]

Figure 1: Mediterranean diet pyramid[1]



The Mediterranean diet is considered one of the healthiest and most sustainable diets[I] in the world. Since 2010, it has been recognized as an intangible cultural heritage of humanity.[1,3,4] A greater adherence to the Mediterranean diet is associated with significant improvements to people's health and nutritional status.[5–7] Because it focuses on a balanced consumption of diverse foods, with high dependency on plants and reduced consumption of animal-based foods,[1] adherence to the Mediterranean diet reduces the environmental footprint of food production and processing compared to other Western diet patterns.[8–10] Benefits include lower greenhouse gas emissions, water consumption, land use and energy requirements. Beyond encouraging eco-friendly agriculture, the Mediterranean diet also promotes local food production and consumption with societal, economic, and cultural benefits.[11,12]

Despite the well-documented health and environmental benefits of a Mediterranean diet, data show a marked decline in adherence to it across all Mediterranean countries.[12,13] For instance, healthy *Brassica* species, which abound in the Mediterranean, are being replaced by tasteless and nutritiously poor lettuce and similar species, which require less preparation or cooking before being consumed.[14] Abandoning traditional habits and emerging new lifestyles associated with socio-economic changes are threatening the preservation and transmission of the Mediterranean diet to future generations.[12] While populations in southern Mediterranean countries face problems of undernutrition and micronutrient deficiencies, both southern and northern Mediterranean countries in the region are burdened with obesity and overweight.[13,15] At the same time, the region altogether is seeing a rise in chronic diet-based diseases, such as heart disease and diabetes, linked to disability and death.

While the Mediterranean food culture is being fast eroded, so is the plant and animal genetic diversity that underpins its healthfulness. Shrinking levels of agrobiodiversity make farmers more vulnerable to climate risks, since less diversity in farming systems translates into reduced options to cope with change. The Mediterranean is one of the world's eight 'centers of origin', identified by the Russian botanist and geneticist Nikolai Vavilov in the early twentieth century: geographical areas where today's crops originated, and where, as a result, the genetic diversity of those crops is exceptionally high. In particular, wheats, barleys, forage plants, vegetables, fruits, spices and ethereal oil plants show extremely high diversity in the Mediterranean.[16,17] These plants have developed resilience traits that enable them to cope with the Mediterranean region's hot and dry summers. Hundreds of varieties selected by generations of farmers, especially small and medium farmer enterprises, represent the ingredients to prepare the recipes that make the Mediterranean diet healthy, tasty and culturally rich.[18] Losing this diversity undermines the very survival of the Mediterranean diet and an opportunity to build a sustainable food system in the region.

Bringing the Mediterranean diet back to the table is the best solution for counteracting the effects of climate change, malnutrition and biodiversity losses that are jeopardizing the food and security of the Mediterranean region. A first step is understanding the current status of agrobiodiversity in the region and to what extent countries are contributing to its sustainable use and conservation through their policies and actions.

The *Agrobiodiversity Index report 2021: Assessing Mediterranean Food Systems* analyses the state of agrobiodiversity in a set of Mediterranean countries, looking at agrobiodiversity in food consumption, production, and genetic resource conservation. It sheds light on the actions and policies countries are already taking to use and preserve their agrobiodiversity. It also provides concrete recommendations on what practices and policies countries could strengthen or put in place to mainstream agrobiodiversity into their food systems.

The report focuses on ten target countries: Algeria, Egypt, France, Italy, Lebanon, Libya, Morocco, Spain, Syria, and Tunisia. These countries were selected to include all countries with at least 1% of the Mediterranean region population and where the official language could be understood by the Agrobiodiversity Index team (to enable analysis of commitment levels in policy documents), namely: English, French, Spanish, Italian or Arabic. The report contributes to strengthening evidence on the benefits of agrobiodiversity in Mediterranean countries for healthy people and a healthy planet. The report also fed into the second international Agrobiodiversity Congress, held in 2021, to inform and guide the discussions during the event. Key messages from the report will be used to stimulate discussions at country level on the policy actions needed to better integrate agrobiodiversity into the food system and increase adherence to the Mediterranean diet.

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End notes

I. Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources.[11]

How to read the Agrobiodiversity Index country profiles

The Agrobiodiversity Index Report 2021: Assessing Mediterranean Food System is based on the methodology described in Jones et al. (2021)[1] and readers are referred to this paper for full methodological details. For a glossary of terms see Annex 1. For a list of the indicators see Annex 2. To see the distribution of scores across countries and additional details of the cross-country analysis, see Annex 3. We invite constructive feedback on any parts of this report to help us improve the next round of measurements and help make the information generated useful for countries to find and validate their pathways towards sustainable and resilient food systems.

The Agrobiodiversity Index is an innovative tool that helps measure agrobiodiversity and identify concrete actions to help achieve diverse, sustainable, and resilient food systems.

The structure of the Agrobiodiversity Index

The Agrobiodiversity Index is designed to include a minimum set of indicators that capture agrobiodiversity across three pillars:

- agrobiodiversity in **consumption**, contributing to healthy diets
- agrobiodiversity in **production**, contributing to sustainable agriculture
- agrobiodiversity in **conservation**, contributing to securing future use options.

These pillars reflect three key functions of agrobiodiversity in our food systems. A sustainable food system needs agrobiodiversity in all three functions.

Across the three pillars, the Agrobiodiversity Index measures three categories:

- *Status*: the actual state of agrobiodiversity in terms of species, varieties, landscape complexity and functional diversity.
- *Actions*: what countries are doing to increase agrobiodiversity across the food system. It shows where countries put policies into action to achieve their commitments.
- *Commitments*: the extent to which a country's strategies and policies are improving the management of and enabling the potential of agrobiodiversity for healthy diets, sustainable agriculture and future use options. The country receives more credit for commitments that have a specific agrobiodiversity strategy and measurable target.

The scores are presented by pillar. Each pillar has a total score between 0 and 100, aggregating the Status, Action and Commitment scores (Figure 2).

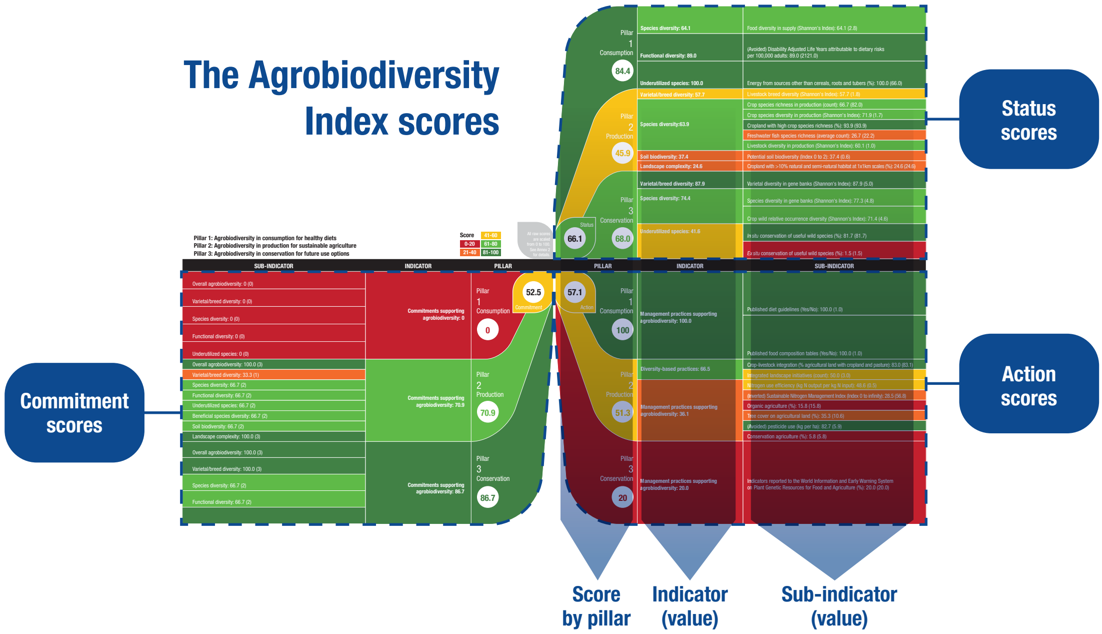
Each category (Status, Actions and Commitments) receives a score out of 100. Traffic light colors are assigned based on the position of scores relative to other countries. They are intended to flag highlights and areas of concern. The lower the score the most concern. The higher the score, the better the performance, relative to other countries. Colors indicate that scores are:

- very low (0–20; red)
- low (21–40; orange)
- moderate (41–60; yellow)
- high (61–80; light green)
- very high (81–100; dark green).

The full list of indicators is in Annex 2.

Note that in the 2019 run of the Agrobiodiversity Index, Actions and Commitments were combined into one metric called Progress. The 2021 issue reports Action and Commitments separately.

Figure 2: The Agrobiodiversity Index scores



Context

The Context section provides an outline of the main characteristics of each country in terms of diets, production systems, and genetic resource conservation.

Understanding the Agrobiodiversity Index scores

For each category, we dig down into the individual indicators and sub-indicators to comment on:

- Status: What does the status score reveal about the use and conservation of agrobiodiversity?
- Actions: What actions are being taken to maintain and increase agrobiodiversity?
- Commitments: How supportive are policies for agrobiodiversity?

Recommendations

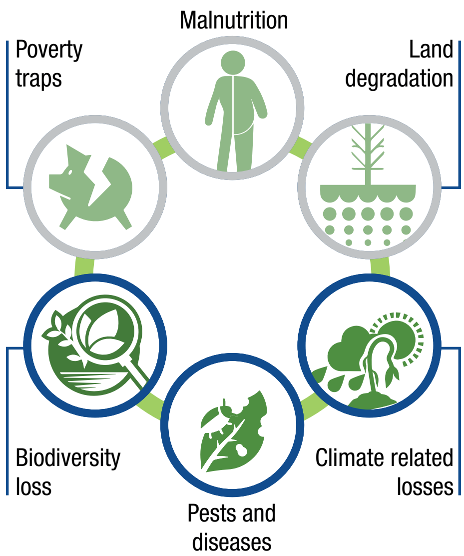
Based on an analysis of the low and high indicators and sub-indicators, and the potential risks associated with no action, we make a set of recommendations aimed at opening dialogue within and between countries for action towards more sustainable agrobiodiversity-based food systems.

For each of the three areas (consumption, production, and conservation) we indicate which of six risks might be reduced through increased integration of agrobiodiversity (Figure 3).

Recommendations have two ambitions:

1. To help countries achieve commitments to global policies such as the Sustainable Development Goals, the goals and targets of the Convention on Biological Diversity, and the FAO Second Plan of Action on Plant Genetic Resources for Food And Agriculture.
2. To reduce risks where evidence exists that low levels or certain configurations of agrobiodiversity can increase risks of malnutrition, farmer poverty traps, climate-related agricultural losses, biodiversity loss (wider than agrobiodiversity alone), pest and disease prevalence and transmission, and land degradation.

Figure 3: Risks associated with low levels of agrobiodiversity in the country



For more information about the role of agrobiodiversity in managing risk and resilience, see the 2019 issue of the Agrobiodiversity Index.[2]

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Cross-country analysis

Sarah K. Jones, Roseline Remans,
M. Ehsan Dulloo, Natalia Estrada Carmona, Arwen Bailey

In this chapter, we compare Agrobiodiversity Index scores across the ten Mediterranean countries to stimulate dialogue, feedback, learning, and collaboration between food system stakeholders both within and between countries to strengthen the sustainable use and conservation of agrobiodiversity in Mediterranean food systems.

Context

The ten countries included in this report have food systems that revolve around a similar set of agricultural commodities, yet the countries span a variety of socio-economic, political, and agronomic contexts (Table 1). These contextual factors are likely to play a role in determining how agrobiodiversity is dispersed, reported, and managed in each country.

For example, Algeria, Libya, and Egypt have a much larger land area than the other countries, ranging from 1 to 2.4 million km^2, but a relatively small proportion of this land (4%–17%) is used for agriculture. Agriculture nonetheless constitutes an important part of the economy in Algeria and Egypt (less so in Libya), contributing 12.4% and 11.5% of the gross value added in 2020, respectively, which is higher than in all of the other countries except Morocco and Syria. Syria, Morocco, Lebanon, and Tunisia have the largest share of agricultural land, which covers 63%–76% of each country's land area. The share of agricultural land and agriculture's economic importance may influence the type and scale of policies and interventions taken to manage agrobiodiversity in production and markets. For instance, higher proportions of the national budget may be needed to diversify production systems at scale in countries with a higher share of agricultural land. Or, incentives and recommendations to improve nutritional outcomes by favoring local species and varieties in production and diets will need to be sensitive to food system reliance on a few economically important commodities.

Another example is that France, Italy, and Spain have more than double the proportion of forest cover compared to other countries, with forest covering between 31% and 38% of each country. The share of forest loosely follows mean annual rainfall, which is less than 100mm in Egypt, Libya, and Algeria, yet more than 500mm in Spain, Lebanon, France, and Italy. Forest cover and climate affect ecosystem functioning and productivity altering the potential levels of agrobiodiversity that can be sustained and represented in national reporting.

Also of note, countries that are wealthier (according to the Human Development Index), and more politically stable, are likely to have more advanced agrobiodiversity monitoring and reporting mechanisms, such as for tracking which food items are available in markets for local consumption. In some cases, low Agrobiodiversity Index scores will reflect a need for capacity building to effectively monitor agrobiodiversity.

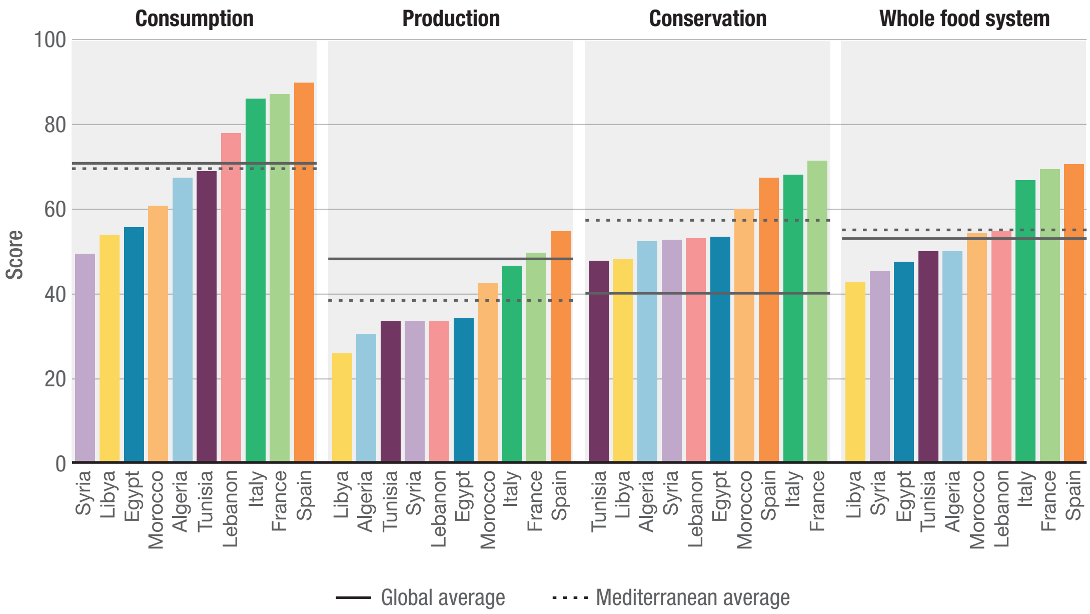
Table 1: Context comparison of Mediterranean countries

Country	Land area (in million sq km)[1]	% Agricultural land (in 2018)[2]	% Forest land (in 2018)[3]	Agriculture (% of gross value added in 2020)[4]	Employment in agriculture (% of employed in 2020)[5]	Mean precipi-tation (mm/year, 1986-2016)[6]	Population size (million people, in 2020)[7]	Human Development Index rank (in 2020)[8]
Algeria	2.381	17.4	0.8	12.4	9.7	82	44	91
Egypt	1.002	3.9	0.1	11.5	23.3	31	102	116
France	0.551	52.3	31.2	1.8	2.4	839	65	26
Italy	0.302	41.7	31.8	2.2	3.6	914	60	29
Lebanon	0.01	64.3	13.9	3.3	13.4	536	6.8	92
Libya	1.676	8.7	0.1	0.9	18.8	42	6.9	105
Morocco	0.447	67.4	12.8	13.9	34.1	302	37	121
Spain	0.506	52.4	37.2	3.1	4.0	597	47	25
Syria	0.185	75.8	2.8	20.6	10.5	275	18	151
Tunisia	0.164	62.7	4.5	10.4	12.7	266	12	95

Cross-country Agrobiodiversity Index scores

Agrobiodiversity Index Status scores across the ten countries illustrate that agrobiodiversity is well represented in some parts of Mediterranean food systems. This includes agrobiodiversity levels in consumption, where all countries score above 50 (out of 100), indicating a high diversity of food contributing to healthy diets in markets and consumption, though this is comparable (and not better than) the global average (Figure 4). In production, the Mediterranean average is well below the global average, suggesting that production systems lack diversity, which in turn hinders efforts to achieve environmentally sustainable production systems. Agrobiodiversity is very well represented in conservation systems, with the regional average well above the global average. This indicates that a higher diversity of crop wild relatives and domesticated species from Mediterranean countries are safeguarded relative to the average for all countries in the world, reflecting both conservation efforts and the wealth of genetic resources that support food and agriculture in the region.

Figure 4: Agrobiodiversity Index status scores in consumption, production, conservation pillars and across the whole food system, for the ten countries together with the cross-country average



Scores represent an aggregate measure of the level of agrobiodiversity in the food system where this contributes to healthy diets, sustainable agriculture, or maintaining future use options. Scores are scaled from 0 (least desirable) to 100 (most desirable). For more information on how the scores are derived, see Annexes.

Box 1: The Agrobiodiversity Index in a nutshell

Across the three pillars (consumption, production, and conservation), the Agrobiodiversity Index measures three categories:

- *Status*: the actual state of agrobiodiversity in terms of species, varieties, landscape complexity and functional diversity.
- *Actions*: what countries are doing to increase agrobiodiversity across the food system. It shows where there is evidence that countries have put policies into action to achieve their commitments.
- *Commitments*: the extent to which a country's strategies and policies are improving the management of and enabling the potential of agrobiodiversity for healthy diets, sustainable agriculture, and future use options. The country receives more credit for commitments that have a specific agrobiodiversity strategy and measurable target.

Depending on data availability, up to 22 indicators (15 status, 4 action, 3 commitment) each with one or more associated sub-indicators are used to measure agrobiodiversity across the three categories. For more information on how the Index is structured and how to read it, refer to chapter 'How to read the Agrobiodiversity Index'. For further details on the methodology including the scientific basis, refer to Jones et al. (2021).[9]

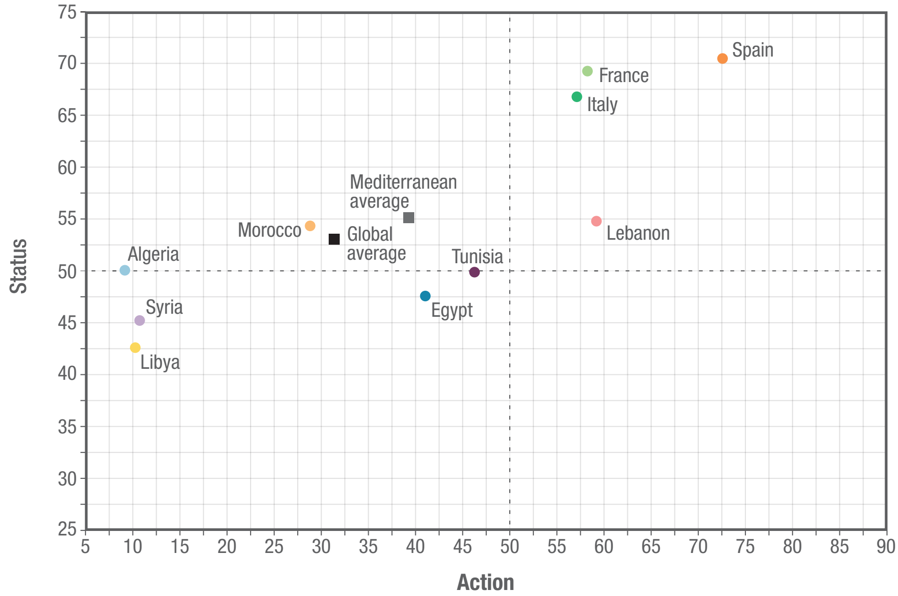
Across the ten countries, higher Status scores tend to correlate with higher Action scores (Figure 5a), suggesting that countries which are effectively implementing activities on use and conservation of agrobiodiversity are improving the status of agrobiodiversity across their food systems. Spain, France, Italy, and Lebanon score higher than 50 (out of 100) for both Actions and Status and are ahead in terms of mainstreaming agrobiodiversity for more sustainable food systems. Libya and Syria have the most work to do to improve Agrobiodiversity Index scores, but these countries are at a major disadvantage due to prolonged civil unrest and political instability.

High Action scores tend also to correlate with high Commitment scores (Figure 5b), although the relationship is weak. This suggests that commitments might not always, or yet, be translated into actions. Morocco, for example, has a relatively high Commitment score but a low Action score. It also shows that actions to better manage agrobiodiversity can take place without strong or explicit national commitments. France is an example of a country with a relatively high Action score but a low Commitment score.

There are many factors that can contribute to relations between Status, Action, and Commitment scores. For example, commitments may be relatively recent, so there has not been time to translate these into action, or a country may sign up to commitments in an attempt to stem the abandonment of traditional agrobiodiversity-friendly actions. Regardless of the exact dynamics, for long-term and large-scale sustainability, countries are encouraged to embed agrobiodiversity into both their policies and actions and to monitor trends in status, actions, and commitments.

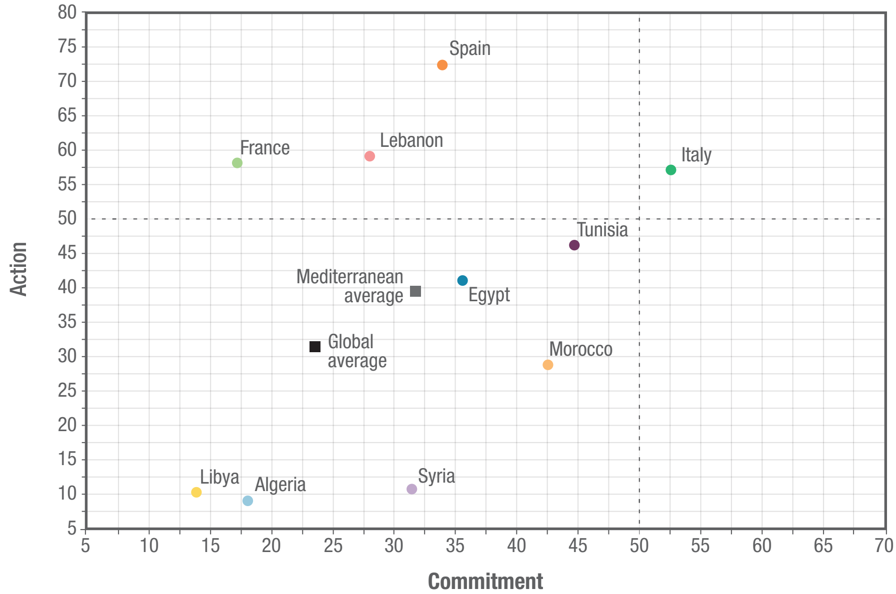
Figure 5: Agrobiodiversity Index (a) Status and Action and (b) Action and Commitment scores across the ten countries

Figure 5a



Strength of Status–Action relationship: y=41.2+0.35x, R2 = 0.66, p=0.012

Figure 5b



Strength of Action–Commitment relationship: y=17.2+0.70x, R2 = 0.14, p=0.279

What explains the differences?

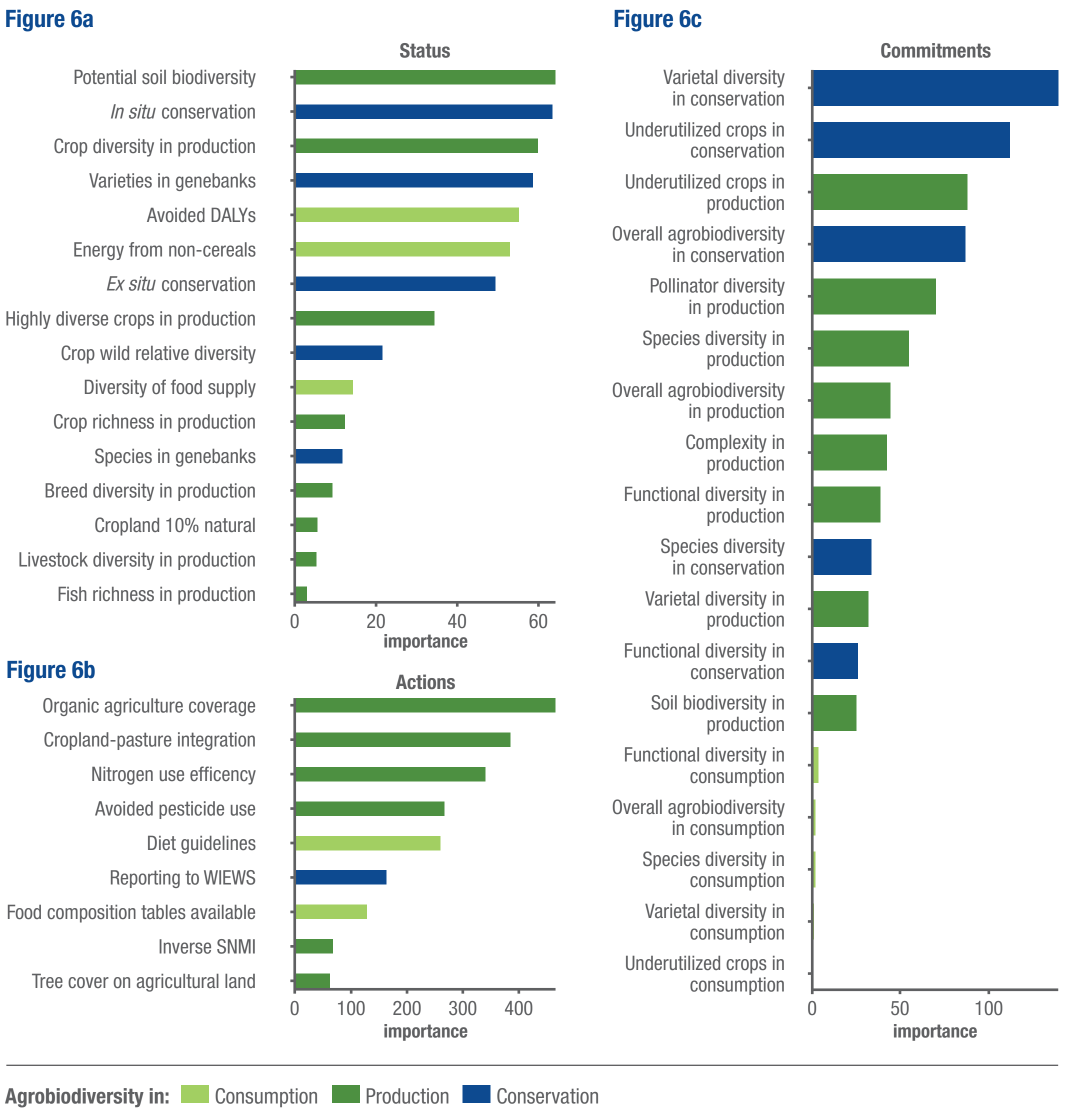
Driven in part by contextual differences (Table 1), Agrobiodiversity Index scores will vary because of the values of underlying indicators and associated sub-indicators that were used in the calculations. Depending on the country, up to 22 indicators and up to 44 sub-indicators were used to calculate the Agrobiodiversity Index scores (see Annex 2 for the extant list). We used a classification algorithm called 'random forest' to explore which sub-indicators appear most important for determining the Status, Action, and Commitment scores for eight of the ten Mediterranean countries (there were insufficient data to include Syria and Libya). See Box 2 for analysis details. Figure 6 shows the importance, as assessed by random forest, of each sub-indicator for determining overall Status, Action, and Commitment scores. For more details about the distributions of scores, see Annex 3.

Box 2: The analysis behind the explanations

Random forest is a statistical technique we used to provide insights into which sub-indicators were most and least important in determining Status, Action, and Commitment scores All calculations were performed using the *randomForest* package [10] in R [11].

Data on all available sub-indicators were used to determine Agrobiodiversity Index scores for each individual country profile in this report. However, sometimes no data were available for a sub-indicator in a given country. Data were unavailable for five sub-indicators in Syria and Libya, while the other eight countries were missing data for up to two sub-indicators. We therefore limited the random forest analysis to the sub-indicators with complete data for eight countries, excluding Syria and Libya since these countries did not have enough data. These two countries also have unique political and social conditions compared to the rest of the countries in our analysis. Overall, of the 44 sub-indicators used in one or more country profiles, we excluded two Action sub-indicators from the random forest analysis (number of landscape initiatives, and percentage of agricultural land under conservation agriculture). For completeness, we present scores used for all sub-indicators and countries and show the strength of correlation between them in Annex 3.

Figure 6: Results of the random forest analysis used to explore which sub-indicators are the most important in explaining variations in Mediterranean country Agrobiodiversity Index Status, Action, and Commitment scores



DALYs refer to disability-adjusted life-years; WIEWS to the World Information and Early Warning System on plant genetic resources for food and agriculture; and SNMI to the Sustainable Nitrogen Management Index. A full list of sub-indicators is provided in Annex 2.

Status

Seven of the fifteen Status sub-indicators were more important than others in driving differences in cross-country Status scores (Figure 6a). For example, energy from non-cereals in food supply was the most important sub-indicator in the consumption pillar. Many countries have a high proportion of energy from non-cereals, although Algeria, Egypt, and Morocco report much lower values.

Soil biodiversity had a strong influence in driving Status scores, which may be explained by differences in agroclimatic conditions across production systems. Production systems in more humid, milder countries on the north coast of the Mediterranean, notably France and Italy (Table 1), have relatively high soil biodiversity as measured using the potential soil biodiversity index, while drier, hotter countries with large desert areas in the southern Mediterranean, notably Algeria and Egypt (Table 1), have lower levels of soil biodiversity. We note, however, that biodiversity in soils is notoriously difficult to monitor and the patterns identified here may change as data improve. For example, recent research has identified that up to 70% of desert land may be covered with biological soil crusts teeming with microorganisms[12], but this is not reflected in the score.

The four least important sub-indicators were measures of agrobiodiversity in production — fish richness, livestock diversity, crop richness, and percentage of natural habitat around cropland —which had similar values across all countries.

Action

Differences in Action scores were mainly explained by the percentage of organic agriculture, the share of crop–livestock integration, and nitrogen use efficiency (Figure 6b). Countries that are part of the EU — France, Italy, and Spain — report higher percentages of land under organic agriculture. Organic agriculture also relates to improved nitrogen use efficiency and integration of crops and livestock (to use organic manure for cropping systems). Hence these three action indicators potentially reinforce each other and together explained most of the differences in country scores.

The Sustainable Nitrogen Management Index (SNMI) and percentage of tree cover in agricultural landscapes were the Action sub-indicators that were least important for explaining differences between country Action scores. Mediterranean countries perform similarly in terms of SNMI (a measure of environmental resource use efficiency) and tree cover in agricultural landscapes, though there is a slightly poorer environmental resource use efficiency and a slightly higher tree cover in Egypt, France, and Italy.

Commitments

Commitment scores were based on an assessment of agrobiodiversity-related policies mentioned in each country's National Biodiversity Strategies and Action Plans (NBSAPs). Policies mentioning conservation of underutilized species, of varietal diversity, or underutilized species in production, were the three types of policy that explained most of the variance between country Commitment scores (Figure 6c). Cross-country scores were highly variable for each of these. Most countries had strong policies (i.e. specific targets) related to conservation of underutilized species; however, no relevant policies were identified for Algeria or France. Several countries, including Egypt, Italy, and Tunisia, had strong policies aimed at conserving varietal diversity, while there were no such policies in Lebanon and weak policies (i.e. varietal diversity is mentioned but no strategies or targets in place) in Algeria, France, and Spain. Only half of the ten countries had policies related to production of underutilized species, ranging from weak policies in Lebanon to moderate policies (i.e. strategies in place but no targets) in Italy, Morocco, Spain, and Tunisia. These insights support cross-learning on how underutilized crops and varietal diversity can be integrated into country policies.

Policies on agrobiodiversity in consumption explained least of the variation in cross-country scores. Most countries had no or only weak policies related to agrobiodiversity for healthy diets. This likely reflects that NBSAPs tend to focus on conservation of agrobiodiversity in terms of preventing extinctions and reducing threats, in line with traditional approaches to conserving non-domesticated biodiversity. It highlights the need for countries to explicitly prioritize inclusion of a wider range of varieties and species in markets and consumption as part of their conservation strategies, to promote healthy diets and ensure demand (and therefore on-farm conservation) for underutilized domesticated species and varieties.

Box 3: Notes on the data

In addition to substantial differences in use or management of agrobiodiversity, sub-indicator values may vary because of data reporting issues. Two data reporting issues for the Mediterranean countries are observed, which should be considered in the interpretation of the cross-country comparison. First, data are of varying completeness and detail due to the way agrobiodiversity is monitored. For example, livestock breed diversity may vary across countries because one country collected population data for a higher proportion of its livestock breeds than another. Second, sub-indicator scores may vary because of how data are reported and collated into global repositories. For example, data on food diversity in consumption was sourced from FAO and limited to the food items that countries report on and FAO include in their global repository. This means that local varieties, wild foods and minor crops that are important in people's diets in some countries are poorly represented, and the level of diversity will be higher than reported. Similarly, the Commitment analysis was based on the National Biodiversity Strategies and Action Plans (NBSAPs),[1] where countries plan and state their commitments to conserving and using their biological diversity sustainably. However, NBSAPs do not capture the full spectrum of policies regulating and promoting agrobiodiversity in consumption, production, and conservation. This means that each country's level of commitment is likely to be underestimated.[1]

Conclusions and way forward

Cross-country Agrobiodiversity Index scores show that Mediterranean countries are heterogeneous, excelling in integrating agrobiodiversity in different ways. There are some promising areas common to many countries, such as the generally high levels of food item diversity in markets and relatively high diversity of crop wild relatives found growing in each country. Yet in this era of rapid climate changes, increasing malnutrition and declining biodiversity, countries may need to accelerate actions to make real progress in integrating agrobiodiversity for more sustainable food systems.

Good practices and policies in one country can be informative for other countries, and clusters of similar countries may be able to deploy similar strategies to improve the contribution of agrobiodiversity to healthy diets, sustainable agriculture, and resilient futures. The Agrobiodiversity Index can be used to build bridges across ministries, sectors, and stakeholders within countries for orchestrated actions and accelerated change. For example, multiple ministries can work collectively to identify the types and configurations of plant, animal, and microorganism diversity at the plate, field, and landscape level that can contribute the most to food and nutrition security and environmental goals simultaneously.

To achieve real change, policymakers need to identify, develop, and support food-based dietary guidelines, educational programs, conservation and use strategies, investments that will shift diets towards bringing back to life the foods that are needed the most for healthy diets (e.g. neglected fruits, vegetables, nuts, pulses) and that are best suited to the growing conditions in each country. Agricultural extension programs need to be adapted in tandem to educate technical service providers and expand their mandate to facilitate access to seeds, and encourage sustainable production practices and mechanisms that enable farmers and land managers to achieve target plant, animal, and microorganism diversity at field, farm, and landscape levels. Public funding needs to support research and training centers to close evidence gaps and support change.

While agrobiodiversity alone is not sufficient for food system sustainability, there will be no food system sustainability without it. Retaining and increasing the use of agrobiodiversity on plates, in fields, and for future use is a competitive strategy for achieving and contributing synergistically to sustainable development goals (SDGs) and agendas for global and regional food systems, biodiversity conservation, climate change mitigation and sustainable development. Mobilizing agrobiodiversity offers locally relevant solutions for global problems.

There are several upcoming opportunities for Mediterranean countries to stimulate the mainstreaming of agrobiodiversity in food systems as part of global and regional policy agendas. For agriculture in France, Italy, and Spain, which are members of the European Union (EU), the next decade will be shaped by changes to the Common Agricultural Policy (CAP) agreed in 2021, which will come into force in 2023. The new implementation presents an opportunity for EU countries to develop national strategic plans (NSP CAP) that integrate agrobiodiversity-based solutions in line with the European Green Deal Farm to Fork Strategy[13] and the EU Biodiversity Strategy for 2030[14]. The NSP CAP will define actions and the implementation modalities of the CAP at national level for the next seven years.

Other opportunities open to all ten countries include policy commitments made as part of the UN Food Systems Summit, held in September 2021, which pay explicit attention to biodiversity-based solutions, and the new country action plans that countries will develop to meet the post-2020 Convention on Biological Diversity goals and targets agreed at the fifteenth meeting of the Conference of the Parties (COP 15). Integrated spatial planning that seeks to achieve biodiversity and climate change mitigation goals in tandem is part of the solution to help countries meet commitments to halt deforestation made at the UN's 26th Climate Change Conference in 2021.

With tools like the Agrobiodiversity Index, agrobiodiversity is not invisible anymore. Joint and collaborative work across the food system is vital to report, mobilize, conserve, and use one of the most precious assets that each country has for increasing their food system sustainability: their agrobiodiversity.

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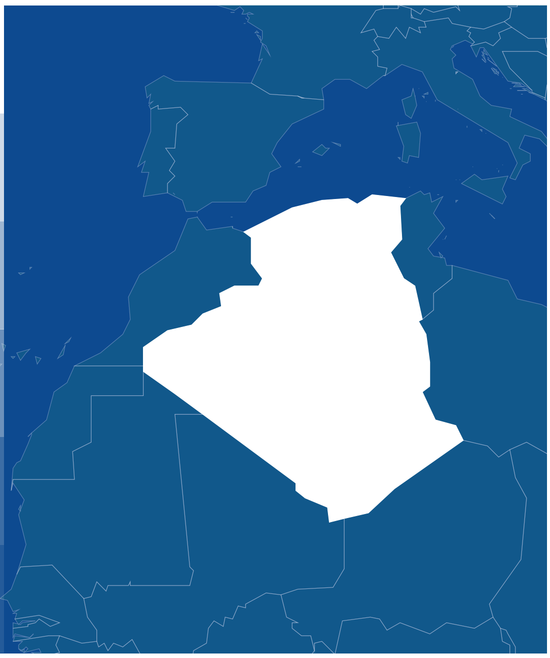
Credit: Pixabay/Fabio Grandis

Algeria

Country profile



AGROBIODIVERSITY INDEX

Key messages

- **Algeria has an Agrobiodiversity Index status score of 49.2 reflecting moderate to low integration of agrobiodiversity in the food system.**
- **In consumption, there is a high diversity of food items available for consumption resulting in relatively low prevalence of diet-related diseases.**
- **In production, crop species and varietal richness are low indicating a great potential to substantially increase the diversity of livestock breeds in production, improve soil biodiversity, and increase the proportion of natural habitat in cropped landscapes.**
- **In conservation, *ex situ* conservation of plant species diversity is relatively high compared to other countries around the world, but useful wild plants and varietal diversity are poorly represented in genebanks and botanical gardens.**
- **There is potential for more diverse and stronger policies for integrating agrobiodiversity across the whole food system.**

Pillar 1: Agrobiodiversity in consumption for healthy diets
Pillar 2: Agrobiodiversity in production for sustainable agriculture
Pillar 3: Agrobiodiversity in conservation for future use options

Score	
	41-60
0-20	61-80
21-40	81-100

All raw scores are scaled from 0 to 100. See Annex 2 for details.

SUB-INDICATOR (raw scores)	INDICATOR	PILLAR
Overall agrobiodiversity: 0 (0)	Commitments supporting agrobiodiversity: 0	Pillar 1 Consumption 0
Varietal/breed diversity: 0 (0)		
Species diversity: 0 (0)		
Functional diversity: 0 (0)		
Underutilized species: 0 (0)		
Overall agrobiodiversity: 100.0 (3)	Commitments supporting agrobiodiversity: 16.7	Pillar 2 Production 16.7
Varietal/breed diversity: 33.3 (1)		
Species diversity: 0 (0)		
Functional diversity: 0 (0)		
Underutilized species: 0 (0)		
Pollinator diversity: 0 (0)		
Soil biodiversity: 0 (0)		
Landscape complexity: 0 (0)		
Overall agrobiodiversity: 33.3 (1)	Commitments supporting agrobiodiversity: 33.3	Pillar 3 Conservation 33.3
Varietal/breed diversity: 33.3 (1)		
Species diversity: 100.0 (3)		
Functional diversity: 0 (0)		
Underutilized species: 0 (0)		

Commitment 16.7

Status 49.2

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 67.4	Species diversity: 53.7	Food diversity in supply (Shannon's Index): 53.7 (2.6)
	Functional diversity: 70.3	(Avoided) Disability Adjusted Life Years attributable to dietary risks per 100,000 adults: 70.3 (5713)
	Underutilized species: 78.3	Energy from sources other than cereals, roots and tubers (%): 78.3 (47.0)
Pillar 2 Production 28.9	Varietal/breed diversity: 41.5	Livestock breed diversity (Shannon's Index): 41.5 (1.3)
	Species diversity: 33.6	Crop species richness in production (count): 48.0 (59.0)
		Crop species diversity in production (Shannon's Index): 44.1 (1.0)
		Cropland with high crop species richness (%): 11.0 (11.0)
		Freshwater fish species richness (average count): 33.2 (27.5)
		Livestock diversity in production (Shannon's Index): 31.8 (0.5)
	Soil biodiversity: 9.1	Potential soil biodiversity (Index 0 to 2): 9.1 (0.2)
	Landscape complexity: 31.4	Cropland with >10% natural and semi-natural habitat at 1x1km scales (%): 31.4 (31.4)
Pillar 3 Conservation 51.4	Varietal diversity: 54.4	Varietal diversity in genebanks (Shannon's Index): 54.4 (3.1)
	Species diversity: 62.7	Species diversity in genebanks (Shannon's Index): 58.9 (3.7)
		Crop wild relative occurrence diversity (Shannon's Index): 66.5 (4.3)
	Underutilized species: 37.2	*In situ* conservation of useful wild species (%): 72.1 (72.1)
		Ex situ conservation of useful wild species (%): 2.2 (2.2)

Action 9.0

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 0	Management practices supporting agrobiodiversity: 0	Published diet guidelines (Yes/No): 0 (0)
		Published food composition tables (Yes/No): 0 (0)
Pillar 2 Production 27.3	Diversity-based practices: 6.3	Crop-livestock integration (% agricultural land with cropland and pasture): 12.5 (12.5)
		Integrated landscape initiatives (count): 0 (0)
	Management practices supporting agrobiodiversity: 48.2	Nitrogen use efficiency (kg N output per kg N input): 85.3 (0.9)
		(Inverted) Sustainable Nitrogen Management Index (Index 0 to infinity): 43.6 (44.8)
		Organic agriculture (%): 0 (0)
		Tree cover on agricultural land (%): 14.0 (4.2)
		(Avoided) pesticide use (kg per ha): 97.9 (0.7)
Pillar 3 Conservation 0	Management practices supporting agrobiodiversity: 0	Indicators reported to the World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (%): 0 (0)

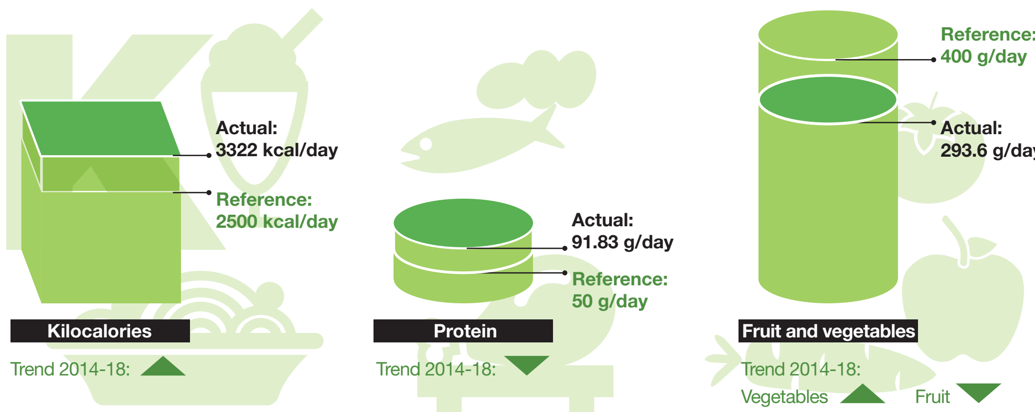
Context

Algeria is a lower middle income country with an annual GDP of US$ 171.091 billion in 2019.[1] Its population, estimated at around 4.3 million individuals, has a density of 17.7 people per square kilometer of land area.[2,3] Algeria is the largest country in Africa, with a land area of 2.4 million km^2.[4] The country has a semi-arid geography and is subdivided into three contrasting zones: the fertile northern "Tell" region, the semi-arid highlands, and the Sahara, which is severely arid due to scarcity of rainfall.[5] An estimated 5.5% of Algeria's population live below the national poverty line.[6] In the country, 5.8% of the population is vulnerable to multidimensional poverty according to the latest survey data in 2013.[6,1]

Consumption for healthy diets

Typical ingredients of Algerian cuisine include lamb, chicken, fish, grains, vegetables, and dried fruit (Figure 1). Couscous is a main Algerian staple food usually accompanied by a vegetable sauce. However, the consumption of traditionally prepared couscous has declined compared to industrial couscous.[7] A variety of traditionally manufactured dairy products, such as fermented milk, cheese, and butter are also part of the traditional Algerian diet, but are slowing disappearing.[8] The average life expectancy of an Algerian person is estimated at 77 years old.[9] During the period 2017–2019, approximately 1.2 million people were undernourished in Algeria[10] with 9.3% of the population facing severe food insecurity.[11] Healthwise, about 36% of women of reproductive age suffer from anemia[12] and 12.6% of women and 12.3% of men are diabetic.[13] As of 2012, the national prevalence of under-five stunting was 11.7%,[14] and under-five wasting prevalence was 4.1%.[15] An estimated 34.9% of adult women (aged 18 years and over) and 19.9% of adult men are living with obesity.[16]

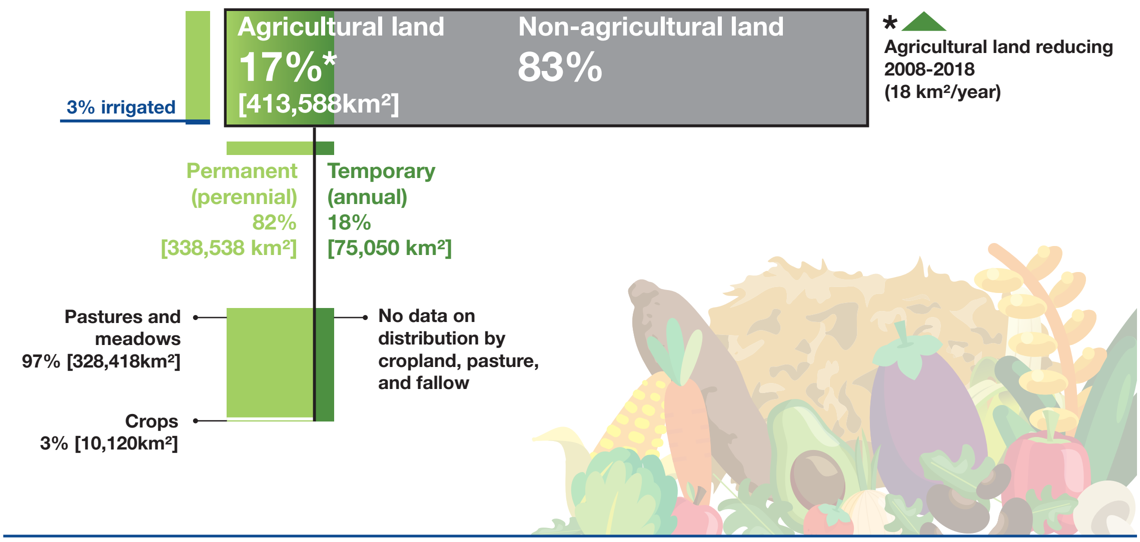
Figure 1: Kilocalorie, protein, fruit and vegetable supply



Production for sustainable agriculture

In Algeria, about 17.4% (413,588 km^2) of the total land area is under agricultural use, of which 75,050 km^2 is used as arable land (~18% of the total agricultural land area).[17] About 61% of the arable land is under temporary crops and 39% under temporary fallow[18] (Figure 2). Agriculture contributes to 12% of Algeria's annual GDP[19] and represents 10% of the Algerian labor force,[20] of whom 3% are female workers and 7% are male.[21] In 2016, annual fisheries capture and aquaculture (fish, crustaceans, molluscs) production were estimated at 95,000 tonnes and 1,361 tonnes, respectively[22] (Figure 2).

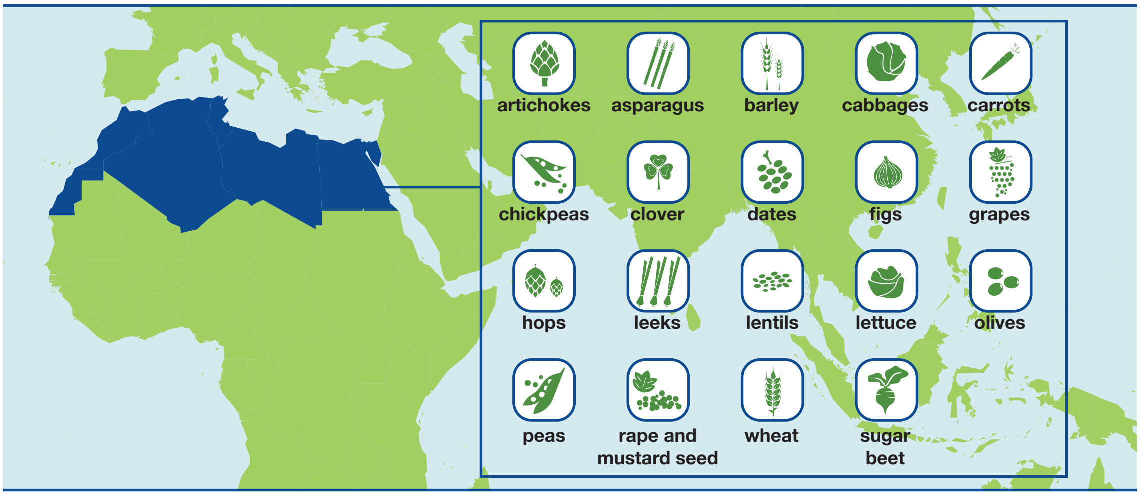
Figure 2: Land used for agriculture



Conservation for future use options

About 107,865 km² of Algeria's total land and above 128,993 km² of its marine area are protected, respectively 4.64% of terrestrial land and 0.07% of the marine area.[23] Only 0.8% of Algerian land area (19,636 km²) is forested and net tree cover loss from 2001 to 2019 was 1,580 km², equivalent to a loss of 13% since 2000.[24] The country has 22 hotspots of plant diversity and a rich diversity of fauna, which is however threatened by agricultural activities among other factors. The northern part of the country, beyond the Tell Atlas mountain chain, is an area identified as a center of origin of cultivated plants[25] (Figure 3). In terms of biodiversity *in situ* conservation, Algeria has nine national parks, four nature reserves, four hunting reserves, 50 wetlands of international importance and one marine nature reserve, accounting for 44% of the country's surface area and 1% of its marine areas.[26] Marine ecosystems represent a key source of both animal protein and income for the Algerian population, as many depend on small-scale fishery and trade.[27] In 2010, the country predicted that by 2020, fishery resources (tuna, anchovies, sardines and langoustines) would decrease by 30%, even if only exploiting a third of the authorized stock available.[28] This reduction is driven mostly by the increased number of fishing vessels, climate change and narrowing of exploited areas which affect commercial species such as sardines, anchovies, and pikes.[29]

Figure 3: Crops originating from South and East Mediterranenan



Agrobiodiversity Index score

Algeria has an Agrobiodiversity Index status score of 49.5.

Status: What's driving the Agrobiodiversity Index score?

Algeria's status score reflects variable levels of agrobiodiversity in consumption, production, and conservation, with some high scores in each area except for production, the pillar with the lowest scores.

Consumption

Species diversity in diets: Food species diversity is moderate in Algeria relative to other countries in the world and lower than most other Mediterranean countries. While consumption of fruits is relatively high, consumption of vegetables, nuts, and whole grains is lower than in the region and could be increased to ensure a balanced diet and drive food system diversity.

Functional diversity: Algeria's functional diversity score of 70 reflects a moderate number of Disability Adjusted Life Years attributable to dietary risk factors, indicating that diets are functionally relatively diverse. We note, however, that Algeria is 'off course' to meet targets for maternal, infant and young child nutrition[30]. No progress has been made towards achieving the target of reducing anemia among women of reproductive age, with 35.7% of women aged 15 to 49 years now affected. Consumption of sugar-sweetened beverages is higher than in other countries in the region.[16]

Underutilized species: 47% of energy in Algerian diets is obtained from sources other than cereals, roots, and tubers. This is 78% of the 60% recommended threshold, explaining the high score for consumption of underutilized species. Consumption of whole grains is low, however, indicating that cereals are mainly consumed as highly processed products.

There were no data available on varietal diversity in consumption.

Production

Varietal diversity: A relatively low number of livestock breeds are maintained in production in Algeria. Algeria has a livestock breed diversity of 1.3, which is much lower than the current global maximum recorded at 3.08 (in the USA). The score for Algeria is driven up mainly by the diversity of sheep breeds in production, of which the most numerous are Ouled Jellal, Rembi, and Berbere. The country has lost 94% of cattle breeds, 60% of horse breeds, and 40% of sheep breeds since records began[31], so Algeria has the potential to produce a much wider range of sheep and other livestock. In addition to averting the loss of animal genetic resources, keeping multiple breeds in production should help farmers maintain livelihoods in times of pest and disease outbreaks or other production challenges, because different breeds have different resistance to pests and diseases.

Species diversity: Crop species richness in Algeria's production systems is moderately high at 59 but lower than the Mediterranean average value of 74 crop species (global minimum and maximum values range from 0 to 123 species). However, there is a very low percentage (11%) of cropped land containing a high diversity of crop species at 10x10km scales, which suggests that cropped landscapes lack crop diversity. The top ten crops in production by area, constituting 87% of the harvested area, are wheat, barley, olives, dates, potatoes, oats, grapes, watermelon, vegetables (mixed), and oranges. The potential to increase crop species and varietal diversity is highlighted by national records documenting shrinking crop diversity in production over time. For example, Algeria estimates it has lost 51%-66% of its 4,209 crop species or varieties documented when records began, including 64% of the 109 cereal (wheat, oat, rye, barley) species or varieties, 69% of its 151 olive tree species or varieties, and 95% of its 1,376 grape species or varieties. Reintroducing traditional species and cultivars into production would help recover crop species richness and diversity with potential benefits including healthier soils and improved yield stability. With just 28 recorded freshwater fish species, fish richness is lower than in most other countries globally. Livestock species diversity is low at 0.5 compared to the global maximum of 1.62 (in Curaçao). Actions to boost fish and livestock richness in areas of the country where these are low would help ensure farmers in all regions rely on a wide species base, helping shield them against pests and diseases and other production challenges.

Soil biodiversity: Soil biodiversity is very low for most of the country, averaging 0.2 on a scale of 0.11 to 1.35 (representing the minimum and maximum global extremes). Adopting integrated plant nutrient management practices, like using cover crops, applying mulch and animal manure, and intercropping with legumes, would be beneficial to maintain and restore soil health throughout the country.

Landscape complexity: 31.4% of Algeria's cropped landscapes have more than 10% natural vegetation at a 1x1 km scale, meaning that natural habitat is integrated into cropland in these landscapes. Maintaining natural vegetation in and around cropland helps maintain habitat connectivity and ecosystem functioning to sustain nature's contributions to agriculture, including reducing the risk of pest and disease outbreaks, maintaining pollinators, and safeguarding crop wild relatives. Retaining at least 10% natural habitat at local (1x1 km) and landscape (10x10 km) scales could be achieved through practices on farm, such as live fences (trees, hedgerows), woodlots, flower strips, riparian vegetation and set aside, and off-farm practices like safeguarding portions of natural or semi-natural forests, wetlands and grasslands around cultivated areas.

There were no data on functional diversity, underutilized species, or pollinator and natural enemies in production.

Conservation

Varietal diversity: Algeria scores moderately (54.4) for varietal diversity in genebanks, relative to the globally best performing country (France). This indicates that there are a substantial number of crop samples (accessions) of Algerian origin conserved in genebanks. Nonetheless, there is a need for concerted efforts to ensure all local varieties are conserved *ex situ* given the well documented loss of many varieties from production systems.

Species diversity: The score for species diversity is moderate (62.7), indicating that a moderate diversity of Algeria's cultivated and wild species are conserved in genebanks and there is a high diversity of crop wild relatives growing in Algeria relative to other countries in the world. Efforts to include samples of all cultivated species and crop wild relatives in genebanks are advised to safeguard plant genetic resources for food and agriculture.

Underutilized species: Algeria has a low score (37.2) for the underutilized species indicator (measured as 'wild useful plants'). While 72.1% of known wild useful plants are conserved *in situ*, their representativeness in *ex situ* repositories is very low (2.2%).

No data were available for functional diversity of genetic resources in conservation.

Credit: ©IFAD/Martine Zaugg

Actions: What actions are being taken to maintain and increase agrobiodiversity?

For **consumption**, actions to use agrobiodiversity in consumption are lacking. Algeria does not have published dietary guidelines and no national food composition tables are available to support dietary diversity for healthy diets.

Action scores in **production** are low (27.3) reflecting a low adoption of diversity-based practices and variable implementation of agrobiodiversity-supporting management practices. The main findings are as follows:

- **Diversity-based practices:** Available data indicate that diversity-based practices are not widespread in Algeria. Only 12.5% of its agricultural landscapes (10x10 km areas) have both cropland and pasture, facilitating crop–livestock integration. An Africa-wide assessment of integrated landscape initiatives in 2014,[32] did not find initiatives actively promoting agrobiodiversity in Algeria.
- **Production management practices supporting agrobiodiversity:** Current data indicate nitrogen use efficiency is very good, with Algeria scoring 85.3, reflecting a nitrogen use efficiency of 0.9 kg N output per kg N input. This is close to the highest levels recorded globally (1.08 kg N output per kg N input). Land use efficiency could be made more sustainable by increasing yields, as indicated by a moderate score of 44.8 on the Sustainable Nitrogen Management Index (which combines data on nitrogen use efficiency and crop yields). The very high score for the sub-indicator on avoided pesticide use (97.9) reflects a very low use of pesticides, estimated at 0.7 kg per hectare. This is likely to be having a strong positive impact on soil biodiversity, pollinators and natural enemies of pests. Based on national statistics, no organic agriculture is practiced in Algeria and there were no data available on conservation agriculture adoption. Trees are integrated into only 4.2% of agricultural land in Algeria. Evidence suggests tree coverage on farm could be increased to up to 30% with limited impacts on yield,[33] while providing valuable carbon sequestration services and helping maintain tree, soil and animal biodiversity in agricultural landscapes. Drought-resistant and native tree varieties could be prioritized to minimize water consumption while providing other benefits to farmers.

Conservation: It was not possible to properly evaluate the action indicators for Algeria, given that the country has not reported its progress towards the implementation of the second Global Plan

of Action for the conservation and sustainable utilization of plant genetic resources in the country, developed by the UN Food and Agriculture Organization (FAO). The Algeria FAO country report in 2006 stated that conservation of local genetic resources was not subject to any organized action by the state, but farmers in the oases continued to maintain diversity of local wheat varieties, date palms, and fruit trees (olive, figs, pomegranate). Local farmers also conserved and protected biodiversity, including wild relatives, around their fields. However, there is a declining trend in traditional means of conservation.[34]

Commitments: How supportive of agrobiodiversity are national policies?

The commitments analysis for Algeria was based on their *National Biodiversity Strategy and Action Plan for 2016-2030.*[35]

Consumption: No commitments to agrobiodiversity in consumption were identified. This is based on a review of Algeria's NBSAP; other national documents may include commitments to promoting the use of food diversity for healthy diets. Nonetheless, it highlights a potential gap in agrobiodiversity policy.

Production: Algeria has a very low score (16.7) for commitments to enhancing agrobiodiversity in production. The loss of the varietal diversity of the date palm, a key species for people's livelihoods, is of great concern in the country. The NBSAP mentions the need to document and foster *in situ* conservation of date palm for the sustainability of production systems. Likewise, the NBSAP mentions that biological corridors should be developed to guarantee ecological connectivity between natural and protected habitats. Organic agriculture is mentioned as a strategy for adding value to the local and artisanal heritage and experts are involved, yet there is a lack of targets in terms of area, production systems, or diversification strategy. Overall, Algeria has planned to protect biological diversity by sustainably managing agriculture, aquaculture, and silviculture in the coming years. This includes developing strategies to halt the genetic erosion of crops, livestock, domestic animals, and their wild relatives.

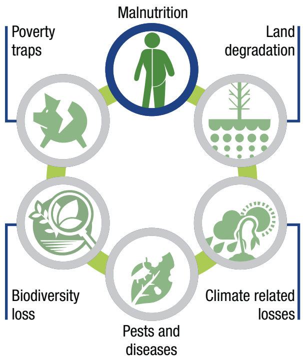
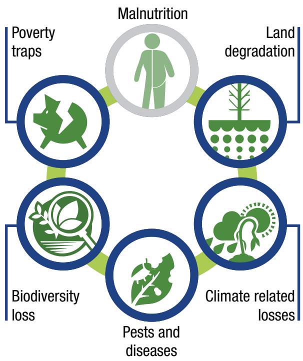
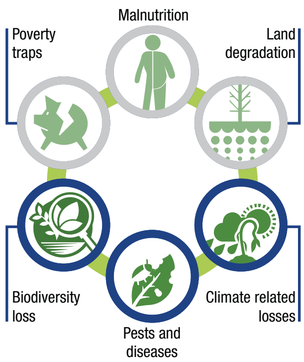
Conservation: Algeria has a low score (33.3) for commitments to enhance agrobiodiversity in conservation. Algeria was one of the first African countries to ratify all the international environmental protection agreements, including the Kyoto Protocol and the Barcelona Convention. However, their application and monitoring has been inadequate[34]. Genetic erosion of agrobiodiversity remains a national concern.

Credit: ©IFAD/Giuseppe Bizzarri

Recommendations

This section suggests concrete actions that can be taken to improve the use and conservation of agrobiodiversity for more sustainable food systems (Table 1). The list of actions is by no means exhaustive or prescriptive. It is intended for review, discussion, and improvement by in-country policy specialists.

Table 1: Recommended actions to enhance agrobiodiversity in the national food system

		Contributing to:	
Food system pillar in the Agrobiodiversity Index	**Recommendations**	**Risk and resilience**	**Global policy**
Consumption for healthy diets	Develop food-based dietary guidelines including a rich diversity of local foods. Give special emphasis to vegetables, nuts, legumes, whole grains and fruits. Develop food composition tables that demonstrate the diversity in nutritional value of local products. Reduce the dependency on major staples and promote whole grains, versus highly processed cereals.		SDG2 Zero Hunger SDG12 Responsible Consumption and Production WHO Decade of Action on Nutrition
Production for sustainable agriculture	Improve monitoring and reporting of organic and conservation agriculture practices to FAO, and actively promote their uptake through policy and incentives. Promote integration of drought-resistant and native tree varieties into agricultural land through policies and training courses. Reintroduce traditional crop species and varieties, and livestock breeds, into production.		Convention on Biological Diversity (CBD) Post-2020 Goal 1[1] No Net Loss SDG 1 No Poverty, 2 Zero Hunger, 14 Life Below Water, 15 Life on Land
Conservation for future use options	Take action to report on progress in implementing the FAO second Global Plan of Action on Plant Genetic Resources for Food and Agriculture through the online reporting format established by FAO for this purpose. Develop a national program to promote *in situ* and on-farm conservation of genetic resources, including undertaking a systematic inventory of agrobiodiversity in the country and building the capacity of staff for effective conservation of genetic resources in the country.		CBD Post-2020 Goal 3 Genetic Diversity & 4 Nature's benefits SDG 15 Life on Land FAO second Global Plan of Action on Plant Genetic Resources for Food and Agriculture

Agrobiodiversity highlight

***Ghouts* – using dunes and water management for green islands in the desert**

In the deserts of Algeria, local communities are faced with farming arid and semi-arid land that is threatened by desertification. Algeria loses a few thousand hectares of land each year.[36] However, thanks to innovative farming techniques and groundwater deep under the soil, farmers have succeeded in using dunes and water management to grow food plants and livestock since the 15th century.

The *ghout* traditional hydro-agricultural system consists of digging into the soil and using knowledge of the wind to plant date palm at the top of the groundwater resources. This system integrates vegetables, cereals, fruit trees, and date palm production through a complex multilayered organization. Divided into three levels, these mixed crops are sustainable from the perspective of soil and water resources.

There are more than 9,500 ghouts shaping the landscape of the desert. Not exceeding 0.5 hectares, these green, living 'islands' turn the Souf region into a unique place. Indeed, *ghouts* play a role as a habitat to maintain biodiversity of plants, insects, and animals. However, even though they are sustainable and adapted to dry conditions, *ghouts* – and the biodiversity they maintain - are currently threatened by the use of groundwater for cities.

Sources: [37]

Credit: ©IFAD/Martine Zaugg

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End notes

I. The Convention on Biological Diversity is an international treaty for the sustainable use and conservation of biological diversity. In 2010 it launched a strategic plan, running from 2011 to 2020, with 20 ambitious targets known as the Aichi Targets from the city in which they were signed. The international community has developed new targets, but their signature has been delayed due to the COVID-19 crisis.

Credit: ©IFAD/Alessandro Rosati

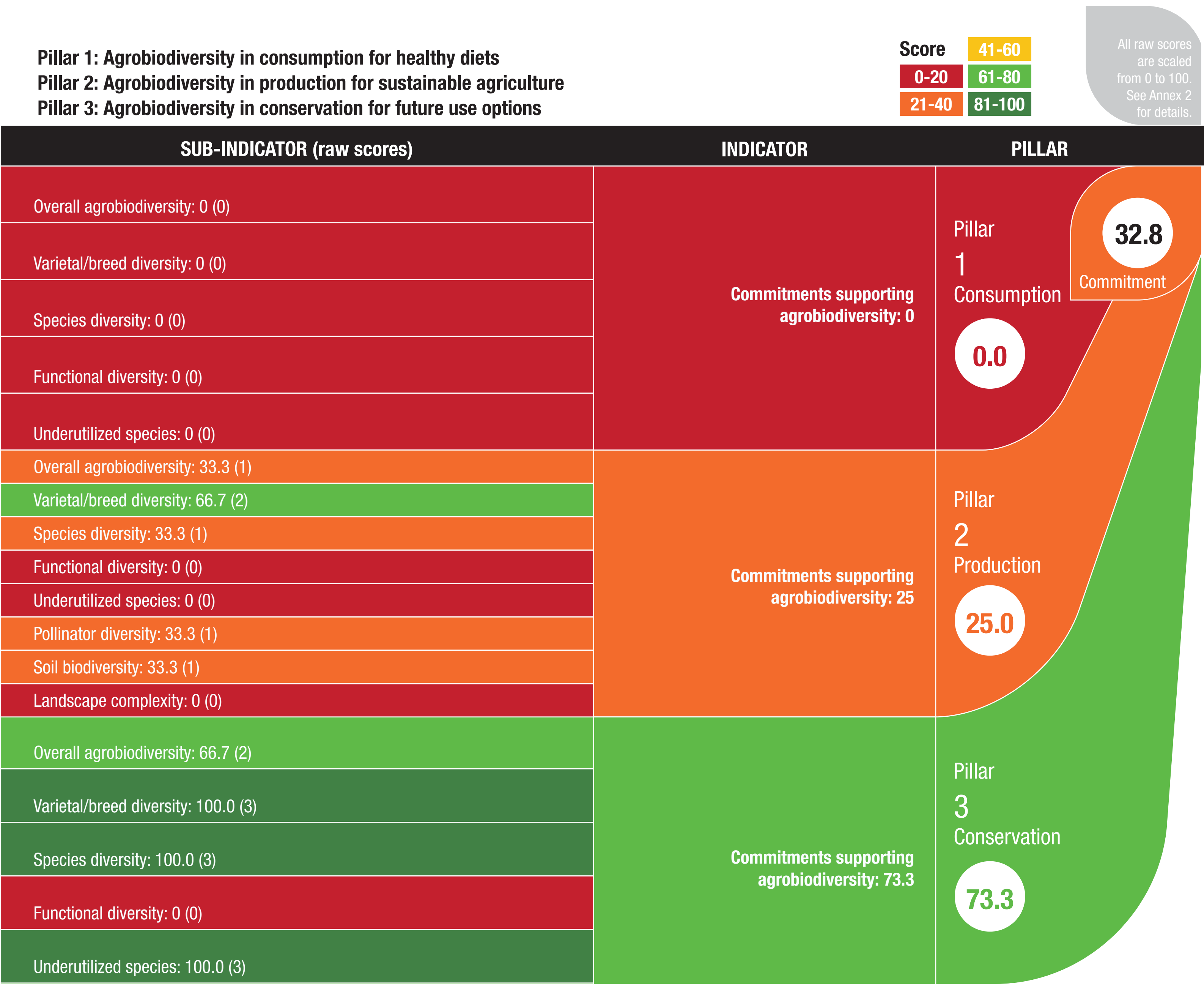
Egypt

Country profile

AGROBIODIVERSITY INDEX

Key messages

- **Egypt has an Agrobiodiversity Index status score of 47.6 reflecting a moderate to low integration of agrobiodiversity into the food system.**
- **In consumption, there is relatively high diversity in the food items available for consumption; nonetheless, the country experiences a moderate prevalence of diet-related diseases.**
- **In production, varietal and species diversity are high relative to other Mediterranean countries, yet there is potential to substantially integrate crop diversity and livestock in production, improve soil biodiversity, and increase the proportion of natural habitat in cropped landscapes.**
- **In conservation, varietal diversity in genebanks and crop wild relative occurrence diversity are relatively high compared to other countries, yet there is substantial room to improve *ex* and *in situ* conservation and species diversity, which are poorly represented in genebanks.**
- **There is potential for more diverse and stronger policies for integrating agrobiodiversity across the whole food system.**



Status 47.6

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 56.8	Species diversity: 75.2	Food diversity in supply (Shannon's Index): 75.2 (2.9)
	Functional diversity: 38.4	(Avoided) Disability Adjusted Life Years attributable to dietary risks per 100,000 adults: 38.4 (11,837)
	Underutilized species: 56.7	Energy from sources other than cereals, roots and tubers (%): 56.7 (34.0)
Pillar 2 Production 32.9	Varietal/breed diversity: 67.5	Livestock breed diversity (Shannon's Index): 67.5 (2.1)
	Species diversity: 50.5	Crop species richness in production (count): 61.0 (75.0)
		Crop species diversity in production (Shannon's Index): 51.4 (1.2)
		Cropland with high crop species richness (%): 13.2 (13.2)
		Freshwater fish species richness (average count): 75.7 (62.8)
		Livestock diversity in production (Shannon's Index): 51.3 (0.8)
	Soil biodiversity: 9.8	Potential soil biodiversity (Index 0 to 2): 9.8 (0.2)
	Landscape complexity: 3.9	Cropland with >10% natural and semi-natural habitat at 1x1km scales (%): 3.9 (3.9)
Pillar 3 Conservation 53.2	Varietal diversity: 72.6	Varietal diversity in genebanks (Shannon's Index): 72.6 (4.1)
	Species diversity: 60.8	Species diversity in genebanks (Shannon's Index): 56.8 (3.6)
		Crop wild relative occurrence diversity (Shannon's Index): 64.8 (4.2)
	Underutilized species: 26.1	*In situ* conservation of useful wild species (%): 49.0 (49.0)
		Ex situ conservation of useful wild species (%): 3.2 (3.2)

Action 41.0

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 50.0	Management practices supporting agrobiodiversity: 50	Published diet guidelines (Yes/No): 0.0 (0.0)
		Published food composition tables (Yes/No): 100.0 (1.0)
Pillar 2 Production 24.3	Diversity-based practices: 8.7	Crop-livestock integration (% agricultural land with cropland and pasture): 17.3 (17.3)
		Integrated landscape initiatives (count): 0.0 (0.0)
	Management practices supporting agrobiodiversity: 39.8	Nitrogen use efficiency (kg N output per kg N input): 33.2 (0.4)
		(Inverted) Sustainable Nitrogen Management Index (Index 0 to infinity): 33.3 (53.0)
		Organic agriculture (%): 3.0 (3.0)
		Tree cover on agricultural land (%): 35.7 (10.7)
		(Avoided) pesticide use (kg per ha): 93.9 (2.1)
Pillar 3 Conservation 48.8	Management practices supporting agrobiodiversity: 48.8	Indicators reported to the World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (%): 48.8 (48.8)

Context

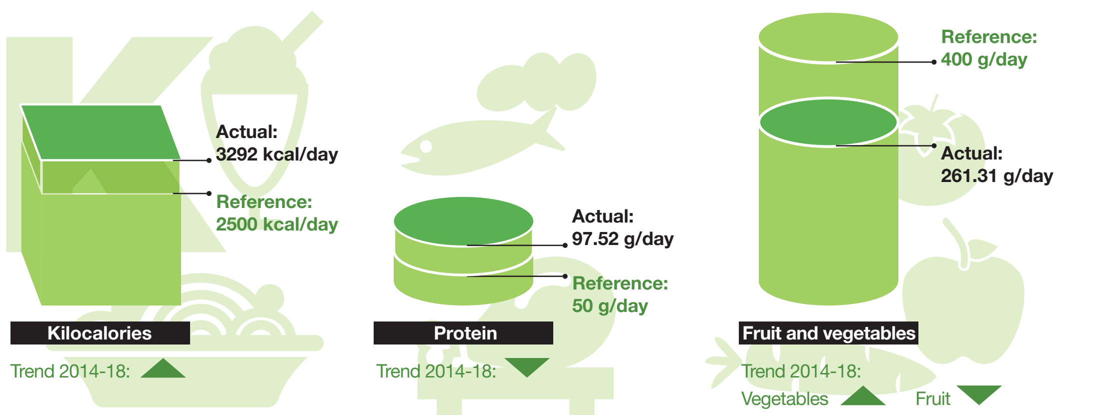
Egypt is a lower middle-income, developing country, with an annual GDP of about US$ 303.092 billion in 2019.[1] Egypt spans around one million km^2 of land area,[2] divided into agricultural land, barren land, urban areas, natural vegetation (aquatic and terrestrial), and water bodies.[3] Over 90% of Egyptian soils are desert; agricultural land represents only around 4% of the total area and it is mainly restricted to the Nile Valley and Delta.[4] Egypt counts above one hundred million inhabitants,[5] 43% of whom reside in urban areas.[6] Its population density is 99 people per km^2.[7] About 32.5% of the population were estimated to be living below the national poverty line in 2017,[8] and 6.1% of the population are vulnerable to multidimensional poverty[9] according to the latest survey data from 2014.[10]

Consumption for healthy diets

The Egyptian diet constitutes principally of cereals, fruit, legumes, vegetable, fish, meat, grains, and aromatic seeds and condiments (Figure 1).[11] Fava beans are the most widely consumed food, while dark green leafy vegetables and herbs are commonly used in various dishes. Bread made of wheat flour or wheat mixed with other ingredients is a key staple. Eggs, poultry, fish, and red meat are occasionally eaten. Fruit is consumed seasonally, and large quantities of nuts (along with peanuts) and dried fruit (including local dates) are traditionally eaten. The traditional diet is normally low in saturated fats and includes several traditional drinks and beverages based on natural products like fenugreek, as well as tea and unsweetened coffee.[12]

In Egypt, the average life expectancy of a healthy person is 72 years.[13] In 2018, 5% of the Egyptian population were undernourished[14] and in the period 2017–2019, 34.2% and 7.8% were facing moderate to severe food insecurity respectively.[15] Moreover, 2% of the population aged 20–79 suffered from diabetes[16] and, in 2016, 31% of reproductive women were anemic.[17] In 2014, the prevalence of stunting and wasting in children under five was 22.3% and 9.5% respectively.[18,19] An estimated 41.1% of adult women (aged 18 years and over) and 22.7% of adult men are living with obesity.[20]

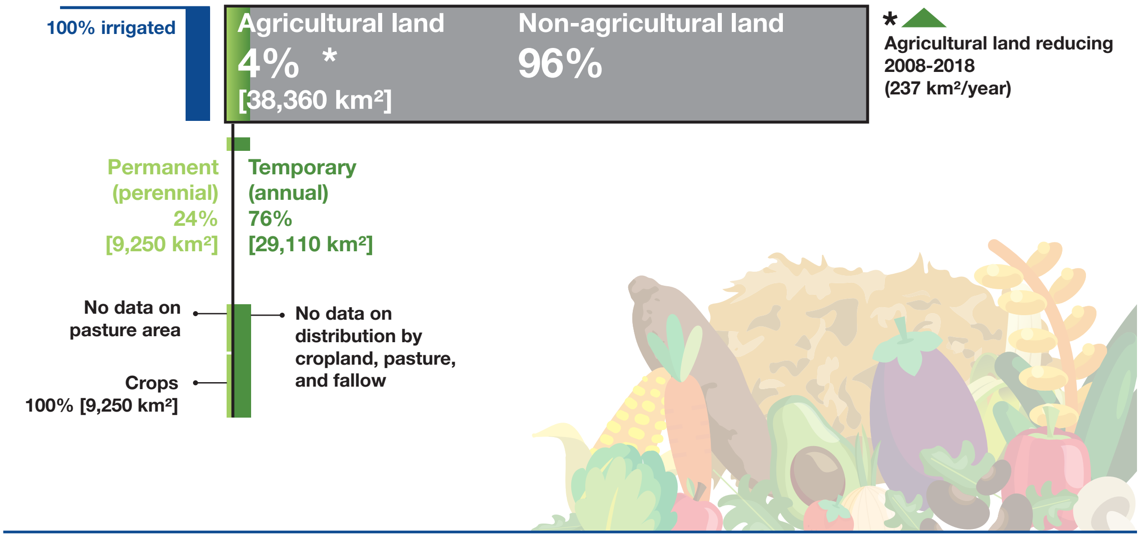
Figure 1: Kilocalorie, protein, fruit and vegetable supply



Production for sustainable agriculture

Only 3.9% of land area in Egypt (38,360 km^2) is under agricultural activities, with nearly 76% of that is used as arable land (Figure 2).[21,22] Agriculture is an important economic sector in Egypt, supporting the livelihoods of over half of the rural population and contributing to 23% of employment, of which 35% is female labor.[23,24] The agricultural sector has an annual contribution of 11% to the country's GDP.[25] Egypt's agricultural land is subdivided into the Oldlands, characterized as highly fertile areas that rely on the Nile Valley and Delta for irrigation, and the less fertile and more fragile Newlands, which are reclaimed desert lands.[26] The top three crops in terms of economic value contributing to GDP (in % of total contribution from agriculture) are wheat, maize, and rice.[27] Urban sprawl is a main cause of agricultural land loss, predicted to reach 18% by 2030 (~6,720 km^2).[26] Egypt produces about 1.5 million tonnes of fish and fishery products (mainly tilapia, catfish, grass carp, and mullet) through 25% of catch and 75% aquaculture.[28,29] Fish loss and waste is an important concern, driven by poor capacity in fish hygiene and basic fish technology.[29] Eggs, milk, and meat (chicken) are the three main animal-sourced food produced in Egypt, with an annual livestock production of approximately 16.3 million tonnes.[30]

Figure 2: Land used for agriculture

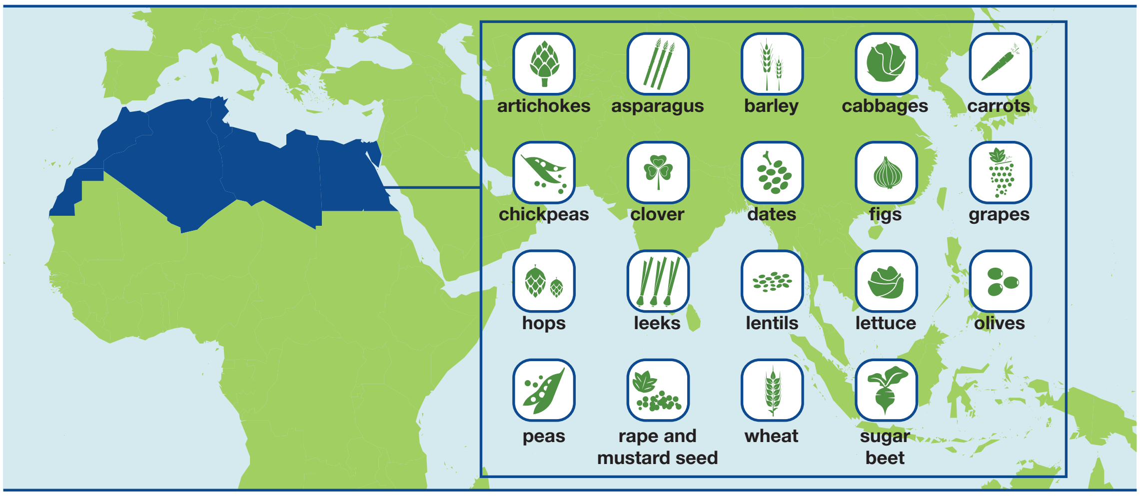


Conservation for future use options

In Egypt, 13.1% of terrestrial land (129,390 km²) and nearly 5% of marine areas (236,612 km²) are protected.[31] Egypt has rich flora and fauna diversity, with over 2,000 plants, 480 birds, above 1,000 fish species and 10,000–15,000 insects.[32] Most of these species can be found in the 30 designated protected areas, however over 300 species from different taxonomic groups have been assessed as threatened with extinction in Egypt.[33] The Nile river plains are one of the centers of origin for cultivated plants[34] (Figure 3). [31]

Biodiversity loss is mainly attributed to overhunting, overgrazing, overfishing, and impacts of invasive alien species, logging, and urban development. Loss of genetic diversity in agricultural crop lands on the other hand is associated with land-use changes, intensification of crop and livestock production, and abandonment of rural areas for urban ones. In 2000, only 0.16% of Egyptian's area (1,540 km²) was forested and between 2001 and 2020, Egypt lost 17.3 km² of forest cover, mainly owing to deforestation, wildfires, and shifts in agriculture.[35]

Figure 3: Crops originating from South and East Mediterranenan



Agrobiodiversity Index score

Egypt has an Agrobiodiversity Index status score of 47.6.

Status: What's driving the Agrobiodiversity Index score?

Egypt's status score reflects variable levels of agrobiodiversity in consumption, production, and conservation, with some high scores in each area. The lowest scores are in production.

Consumption

Species diversity: Food species diversity is high in Egypt relative to other countries in the world and compared to other Mediterranean countries. High consumption of vegetables stands out as a positive.

Functional diversity: Egypt's functional diversity score of 38 reflects a high number of avoided Disability Adjusted Life Years attributable to dietary risk factors, indicating that diets are not in balance with human health needs. While consumption of vegetables is relatively high in Egypt, consumption of fruits, nuts, and whole grains is lower than other countries in the region and could be increased to ensure a balanced diet and drive food system diversity. Also, consumption of sugar-sweetened beverages and red meat are very high in Egypt, which contributes to dietary health risks.

Underutilized species: Despite high species diversity, only 34% of energy in Egyptian diets is obtained from sources other than cereals, roots, and tubers, indicating that diets are heavily dominated by main staples and explaining the relatively low score for underutilized species (60% is the recommended threshold). Consumption of whole grains is low, indicating that cereals are mainly consumed as highly processed foods.[36]

There were no data available on varietal diversity in consumption.

Production

Varietal diversity: A relatively high diversity of livestock breeds are maintained in production in Egypt. Egypt has a livestock breed diversity of 2.1, which is high relative to other countries in the world (global maximum is 3.08, in Spain) and above average for the ten Mediterranean countries (average 1.5). Farmed livestock include 11 breeds of chicken, six of goat, four of dromedary, and three or fewer breeds each of cattle, sheep, buffalo, horse, and rabbits. Keeping multiple breeds in production should help farmers maintain livelihoods in times of pest and disease outbreaks or other production challenges, because different breeds have different resistance to pests and diseases.

Species diversity: Crop species richness in Egypt's production systems is moderate at 75 compared to the global maximum of 123 species (in China). However, there is a very low percentage (13%) of cropped land containing a high diversity of crop species at 10x10 km scales, which suggests that arable landscapes lack crop diversity. With 63 recorded freshwater fish species, fish richness is relatively low compared to other countries. Livestock species diversity is moderate at 0.8 compared to the global maximum of 1.62 (in Curaçao). Actions to maintain and boost crop, fish, and livestock diversity in areas of the country where these are low would help ensure that farmers in all regions rely on a wide species base, helping shield them against pests and diseases and other production challenges.

Soil biodiversity: Soil biodiversity is very low for most of the country, averaging 0.2 on a scale of 0.11 to 1.35 (representing the minimum and maximum global extremes). Integrated plant nutrient management to help maintain and restore soil health would be beneficial throughout the country, such as through increased use of cover crops, application of mulch, and intercropping with legumes.

Landscape complexity: Only 3.9% of Egypt's cropped landscapes have more than 10% natural vegetation at a 1x1 km scale, meaning that natural habitat is largely absent in cropped landscapes. Maintaining natural vegetation in and around cropland helps maintain habitat connectivity and ecosystem functioning to sustain nature's contributions to agriculture, including reducing the risk of pest and disease outbreaks, maintaining pollinators, and safeguarding crop wild relatives. Retaining at least 10% natural habitat at local (1x1 km) and landscape (10x10 km) scales could be achieved through on-farm practices such as live fences (trees, hedgerows), woodlots, flower strips and set aside, and off-farm by safeguarding portions of natural or semi-natural forests, wetlands, and grasslands around cultivated areas.

There were no data on functional diversity, underutilized species, or pollinator diversity in production.

Conservation

Varietal diversity: Egypt achieves a high score for varietal diversity in genebanks (72.6), indicating that a significant number of crop samples of Egyptian origin are conserved in genebanks.

Species diversity: The score for species diversity in conservation is high (60.8). This reflects that Egypt has conserved a moderate proportion of its cultivated and wild species in genebanks, and a high diversity of crop wild relative species have been identified growing in-country, relative to other countries in the world.

Underutilized species: Egypt has a low score (26.1) for conservation of underutilized species (useful wild species). While 49% of useful wild species are conserved *in situ*, their representativeness in *ex situ* repositories is very low (3.2%).

There were no data on functional diversity of genetic resources in conservation.

Credit: © IFAD/Marco Salustro

Actions: What actions are being taken to maintain and increase agrobiodiversity?

In consumption, Action scores are medium at 50. Egypt has food-based dietary guidelines in place but is lacking national food composition tables. This limits the potential to leverage the available rich species diversity to benefit diets and fill dietary gaps.

Action scores in production are low (24.3) indicating that there is low adoption of diversity-based practices and of agrobiodiversity-supporting management practices. The main findings are as follows:

- **Diversity-based practices:** Available data indicate that diversity-based practices are not widespread in Egypt. Only 17.3% of its agricultural landscapes (10x10 km areas) have both cropland and pasture facilitating crop–livestock integration. Based on an Africa-wide assessment in 2014,[37] no integrated landscape initiatives actively promote agrobiodiversity in Egypt.
- **Production management practices supporting agrobiodiversity:** Current data indicate nitrogen use efficiency is moderate, with Egypt scoring 33.2 (based on 0.4 kg nitrogen output per kg nitrogen input) putting Egypt among the bottom third of countries for nitrogen use efficiency levels recorded globally. Land use efficiency is also moderate, as indicated by a low score (33.3) on the Sustainable Nitrogen Management Index. Nitrogen and land use efficiency could be made more sustainable through following best management practices for applying fertilizers, replacing chemical fertilizers with integrated plant nutrient management, and using other agroecological practices to boost yields. The very high score for the sub-indicator on avoided pesticide use (93.9) reflects a very low use of pesticides, estimated at 2.1kg per hectare. This is likely to be having a strong positive impact on soil biodiversity, pollinators, and natural enemies of pests. Based on national statistics, organic agriculture is practiced on 3% of arable land in Egypt while there are no data available on the adoption of conservation agriculture. Trees are integrated into 10.7% of agricultural land in Egypt. Evidence suggests tree coverage on farm can be increased to up to 30% with limited impacts on yield,[38] while providing valuable carbon sequestration services and helping maintain tree, soil, and animal biodiversity in agricultural landscapes. Drought-resistant and native tree varieties could be prioritized to minimize water consumption while providing other benefits to farmers.

Conservation: Egypt has reported on 48.8% of the indicators which monitor progress on the implementation of the second Global Plan of Action of the UN Food and Agriculture Organization of the United Nations. An analysis of conservation actions reveals that Egypt has effectively carried

out surveys and inventories of its plant genetic resources for food and agriculture, established conservation sites with management plans for *in situ* conservation of crop wild relatives and wild plants. It has also carried out significant collecting missions for long-term conservation of its plant genetic resources for food and agriculture in its genebank.

The national documentation system for plant genetic resources for food and agriculture in the country, for both *ex situ* and *in situ* conservation, is poorly developed and there is no national system to systematically monitor and safeguard genetic diversity, which undermines efforts to effectively conserve and use genetic resources and reduce genetic erosion in the country.

Commitments: How supportive of agrobiodiversity are national policies?

The Commitments analysis for Egypt was based on their *National Biodiversity Strategy and Action Plan for 2015-2030.*[39]

Consumption: No commitments to agrobiodiversity in consumption were identified. However, this is based only on an analysis of the national biodiversity strategy and action plan (NBSAP); other national documents may exist that include commitments to promoting the use of plant diversity for healthy and sustainable diets. Nonetheless, it highlights a potential gap in agrobiodiversity policy.

Production: Egypt has a low (25) score for commitments to enhancing agrobiodiversity in production. The country recognizes the importance of agrobiodiversity (aquatic and terrestrial) for sustainable production and ecosystem service provisioning (e.g. pollination, soil formation, culture). Multiple, complex threats are driving the erosion of local agrobiodiversity at a rapid pace. Hence, the NBSAP mentions focusing more attention on using and reintroducing agrobiodiversity in production systems. One key target indicates the development of a “national agrobiodiversity conservation program” to increase knowledge, capacity, and agrobiodiversity use across public organizations. Additionally, preserving and valuing wild relatives and cultivars, given the current key role they play in farming systems, is also mentioned.

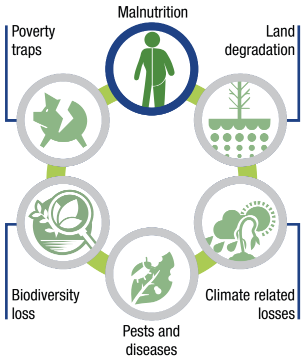
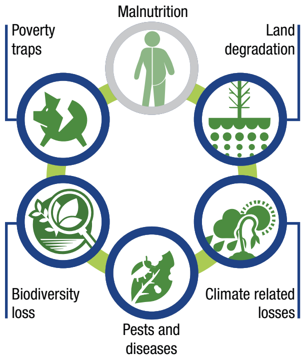
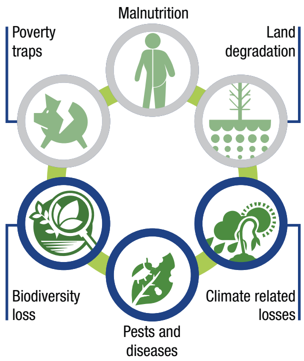
Conservation: Egypt has a high score (73.3) for commitments to conservation of agrobiodiversity. The country set conservation targets to protect and safeguard varietal diversity (i.e. cultivars and wild relatives) through *ex situ* conservation efforts and genebanks by 2020, and to give priority to native and near-native rare and endangered species.

Credit: ©Pixabay/Nadine Doerlé

Recommendations

This section suggests concrete actions that can be taken to improve the use and conservation of agrobiodiversity for more sustainable food systems (Table 1). The list of actions is by no means exhaustive or prescriptive. It is intended for review, discussion, and improvement by in-country policy specialists.

Table 1: Recommended actions to enhance agrobiodiversity in the national food system

		Contributing to:	
Food system pillar in the Agrobiodiversity Index	**Recommendations**	**Risk and resilience**	**Global policy**
Consumption for healthy diets	Develop national food composition tables to demonstrate and increase awareness of the nutritional function of the available agrobiodiversity and support uptake of this in national nutrition programs. Reduce dependency on major staple crops.		SDG2 Zero Hunger SDG12 Responsible Consumption and Production WHO Decade of nutrition – reducing overweight, obesity and anemia
Production for sustainable agriculture	Incentivize farmers to grow a wider range of crop species and varieties, particularly in regions that have a low crop species richness, to help increase crop diversity and enable shorter food supply chains while improving pest control and soil health. Policies, training, and incentives to promote integrated plant nutrient management, including use of organic fertilizers and intercropping complementary plants, would help improve Egypt's nitrogen use efficiency for economic and environmental benefits.		Convention on Biological Diversity (CBD) Post-2020 Goal 1[1] No Net Loss SDG 1 No Poverty 2 Zero Hunger 14 Life Below Water 15 Life on Land
Conservation for future use options	Greater efforts are needed to ensure that underutilized and crop wild relative species in the country are adequately sampled and conserved in the national genebank The national information system on plant genetic resources for food and agriculture should be improved. In this respect a national information-sharing mechanism should be set up for monitoring the conservation and use status of agrobiodiversity in the country. More efforts should be made to promote the use of diversity conserved in genebanks by breeders in the country. It is recommended that a National Strategy and Action Plan for agrobiodiversity be developed to position Egypt towards implementing the post 2020 Global Biodiversity Framework.		CBD Post-2020 Goal 3 Genetic Diversity & 4 Nature's benefits SDG 15 Life on Land FAO second Global Plan of Action on Plant Genetic Resources for Food and Agriculture

Agrobiodiversity highlight

The Egyptian honeybee

The Egyptian honeybee (*Apis mellifera lamarckii*) is considered a 'primary race' of bees, from which all yellow honeybee races of Africa, the Orient and Italian honeybees (*A. m. ligustica*) descend. It is a very small, slender bee, characteristic of sub-Saharan bees. It is short-tongued, short-winged, and short-legged. The drones are smaller than in any other race.

Drawings dated from 2600 BC tell us that this was the first bee managed by humankind, using a technique that is still practiced in Egypt today. Originally from the Nile valley, colonies of this bee were shipped to Germany, England, and North America as early as the 1860s. The reason for this zeal in the apicultural world was the bee's good behavior and its conspicuous color pattern: shining white, 'silvery' hair on the thorax and abdomen, and bright copper-yellow bands with shining black margins on the abdomen.

Over the years, however, the population of the Egyptian honeybee has dwindled. While about 96,000 colonies were counted in 1995, ten years later the population was reduced to just 15,500, mainly in the Assiut region of central Egypt. It has been displaced in much of its native range through the deliberate importation and propagation of European subspecies (especially Carniolan honeybees) in modern beekeeping and the corresponding elimination of traditional mud-tube hives. The Carniolan honeybee is tolerant to Egyptian conditions, but susceptible to the parasitic mite, *Varroa destructor*. As a result, there has been widespread use of chemical pesticides in beehives.

Recently, there has been increased interest in revitalizing the use of the native Egyptian honeybee, both for its adaptation to climatic conditions and the possibility that it, like other African subspecies, may be tolerant to parasitic mites.

Sources: [40]

Credit: Pixabay

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End notes

I. The Convention on Biological Diversity is an international treaty for the sustainable use and conservation of biological diversity. In 2010 it launched a strategic plan, running from 2011 to 2020, with 20 ambitious targets known as the Aichi Targets from the city in which they were signed. The international community has developed new targets, but their signature has been delayed due to the COVID-19 crisis.

Credit: © IFAD/Marco Salustro

France

Country profile

AGROBIODIVERSITY INDEX

Key messages

- France has an Agrobiodiversity Index status score of 68.8 reflecting a moderate to high integration of agrobiodiversity into the food system.
- In consumption, there is a high diversity of food items available for consumption resulting in relatively low prevalence of diet-related diseases.
- In production, crop species richness is high relative to other Mediterranean countries, yet there is potential to substantially increase the diversity of livestock breeds in production, improve soil biodiversity, and increase the proportion of natural habitat in cropped landscapes.
- In conservation, *ex situ* conservation of a diversity of crop cultivars and plant species is high compared to other countries around the world, but useful wild plants are poorly represented in genebanks and botanical gardens.
- There is potential for more diverse and stronger policies for integrating agrobiodiversity across the whole food system.

Pillar 1: Agrobiodiversity in consumption for healthy diets
Pillar 2: Agrobiodiversity in production for sustainable agriculture
Pillar 3: Agrobiodiversity in conservation for future use options

Score: 0-20 | 21-40 | 41-60 | 61-80 | 81-100

All raw scores are scaled from 0 to 100. See Annex 2 for details.

SUB-INDICATOR (raw scores)	INDICATOR	PILLAR
Overall agrobiodiversity: 0 (0)	Commitments supporting agrobiodiversity: 0	Pillar 1 Consumption 0.0
Varietal/breed diversity: 0 (0)		
Species diversity: 0 (0)		
Functional diversity: 0 (0)		
Underutilized species: 0 (0)		
Overall agrobiodiversity: 33.3 (1)	Commitments supporting agrobiodiversity: 25.0	Pillar 2 Production 25.0
Varietal/breed diversity: 33.3 (1)		
Species diversity: 33.3 (1)		
Functional diversity: 0 (0)		
Underutilized species: 0 (0)		
Pollinator diversity: 33.3 (1)		
Soil biodiversity: 33.3 (1)		
Landscape complexity: 33.3 (1)		
Overall agrobiodiversity: 33.3 (1)	Commitments supporting agrobiodiversity: 26.6	Pillar 3 Conservation 26.6
Varietal/breed diversity: 33.3 (1)		
Species diversity: 33.3 (1)		
Functional diversity: 33.3 (1)		
Underutilized species: 0 (0)		

Commitment 17.2

Status 68.8

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 85.2	Species diversity: 65.3	Food diversity in supply (Shannon's Index): 65.3 (2.8)
	Functional diversity: 90.2	(Avoided) Disability Adjusted Life Years attributable to dietary risks per 100,000 adults: 90.2 (1,887)
	Underutilized species: 100.0	Energy from sources other than cereals, roots and tubers (%): 100.0 (70.0)
Pillar 2 Production 49.8	Varietal/breed diversity: 59.1	Livestock breed diversity (Shannon's Index): 59.1 (1.8)
	Species diversity: 64.6	Crop species richness in production (count): 69.1 (85.0)
		Crop species diversity in production (Shannon's Index): 67.2 (1.6)
		Cropland with high crop species richness (%): 96.1 (96.1)
		Freshwater fish species richness (average count): 39.0 (32.3)
		Livestock diversity in production (Shannon's Index): 51.5 (0.8)
	Soil biodiversity: 42.1	Potential soil biodiversity (Index 0 to 2): 42.1 (0.6)
	Landscape complexity: 33.2	Cropland with >10% natural and semi-natural habitat at 1x1km scales (%): 33.2 (33.2)
Pillar 3 Conservation 71.3	Varietal diversity: 100.0	Varietal diversity in genebanks (Shannon's Index): 100.0 (5.7)
	Species diversity: 70.4	Species diversity in genebanks (Shannon's Index): 70.0 (4.4)
		Crop wild relative occurrence diversity (Shannon's Index): 70.8 (4.6)
	Underutilized species: 43.6	*In situ* conservation of useful wild species (%): 86.2 (86.2)
		Ex situ conservation of useful wild species (%): 0.9 (0.9)

Action 58.3

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 100.0	Management practices supporting agrobiodiversity: 100.0	Published diet guidelines (Yes/No): 100.0 (1.0)
		Published food composition tables (Yes/No): 100.0 (1.0)
Pillar 2 Production 53.5	Diversity-based practices: 70.2	Crop-livestock integration (% agricultural land with cropland and pasture): 90.4 (90.4)
		Integrated landscape initiatives (count): 50.0 (3.0)
	Management practices supporting agrobiodiversity: 36.8	Nitrogen use efficiency (kg N output per kg N input): 61.7 (0.7)
		(Inverted) Sustainable Nitrogen Management Index (Index 0 to infinity): 18.0 (65.2)
		Organic agriculture (%): 7.1 (7.1)
		Tree cover on agricultural land (%): 45.8 (13.7)
		(Avoided) pesticide use (kg per ha): 87.0 (4.5)
		Conservation agriculture (%): 1.1 (1.1)
Pillar 3 Conservation 21.3	Management practices supporting agrobiodiversity: 21.3	Indicators reported to the World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (%): 21.3 (21.3)

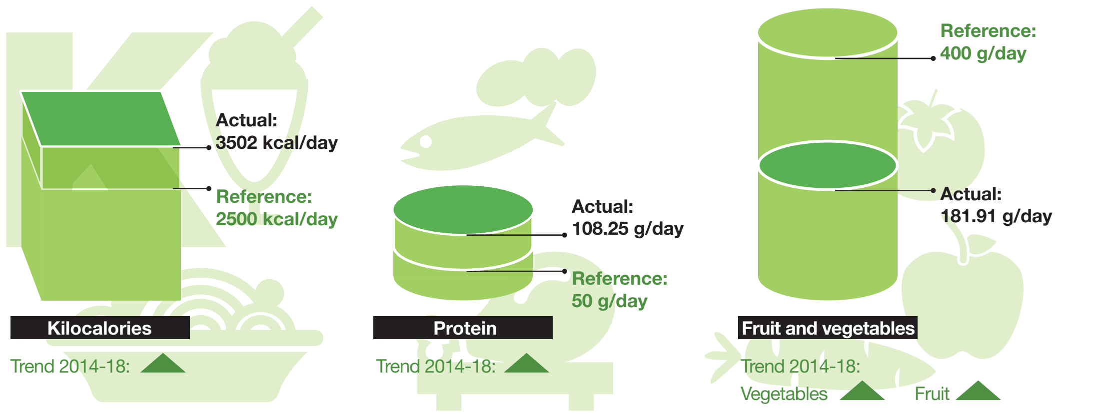
Context

France is a high-income country in Western Europe covering an area of 549,087 km^2.[1] With 67 million inhabitants, France has a population density of 122 people per km^2 and a primarily urban population (81%).[2–4] France has a mixed economy with a gross domestic product (GDP) of US$2.7 trillion in 2019.[5] Agriculture, forestry, and fishing contribute only about 1.6% to GDP, but are still a key sector of the country's economy.[6] In 2016, 0.1% of the French population lived below the poverty line,[7] no data are available on the country's multidimensional poverty index.[8]

Consumption for healthy diets

Important ingredients of the French diet include fresh fruits, vegetables, meat, fish and seafood, cheese, bread, rice, pasta, and red wine (Figure 1).[9] The traditional meal forms part of France's culture and intangible heritage, and follows a specific order: aperitif (alcoholic beverage served before a meal), starter, main course (meat/fish and a vegetable), cheese, dessert, digestif.[10,11] On average, a healthy person in France lives up to 83 years. In 2019, 2.5% of the French population was undernourished and in 2018, 6% were facing moderate to severe food insecurity, a 0.3% decrease compared to 2017.[12,13] The latest 5-year average (2012–2016) of anemia prevalence in reproductive women was 16.3%, with an average annual increase of 0.7%[14] and almost 5% of the population suffers from diabetes.[15] No data on prevalence of stunting and wasting in children were found.[16,17] An estimated 21.1% of adult women (aged 18 years and over) and 22.0% of adult men are living with obesity.[18]

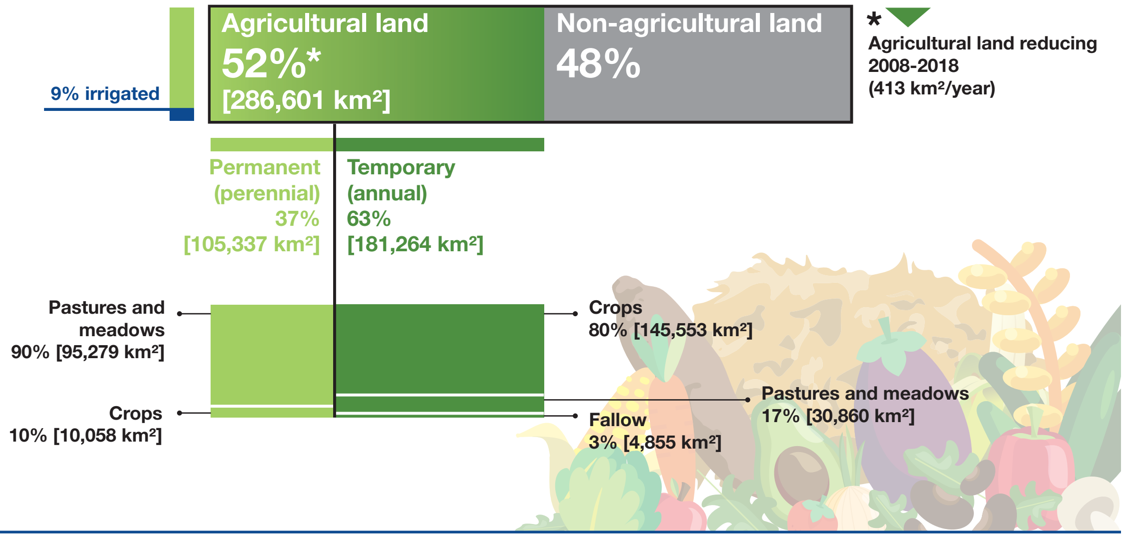
Figure 1: Kilocalorie, protein, fruit and vegetable supply



Production for sustainable agriculture

The agricultural sector represented 2.4% of employment in 2019, a decrease of 0.9% since 2010.[19] France has over 400,000 agricultural holdings, where 824,000 people live, 70% of whom are farmers. 30% of the permanent agricultural workforce is female. In 2019, agri-food was the sector that generated the third largest trade surplus of EUR 7.9 billion.[20] France owns the biggest cattle herd in Europe with 19 million head of cattle, including 3.6 million dairy cows. Agricultural land in France spans over 286,601 km² (Figure 2).[21] The top three crops in terms of economic value contributing to GDP (in % of total contribution from agriculture) are grapes (0.6%), wheat (0.3%) and potato (0.1%).[22] Fish production by capture in 2016 was 561,173 tonnes and for aquaculture in 2018 amounted to 185,150 tonnes.[23,24] Livestock production, consisting mainly of eggs, milk, and meat (pig), was around 69.5 million tonnes in 2018.[25] Crop yields in France are predicted to be adversely affected by climate change under a wide range of climate models and emission scenarios. For instance, under the worst-case scenario (business as usual), it is predicted that the yields of winter wheat, winter barley, and spring barley will face a decline of between 17% and 33%.[26] Climate-induced land-use change is expected to cause crop land expansion at the expense of forests and pastures, in the event of a temperature rise[27] and will negatively impact freshwater ecosystems by lowering their biodiversity.[28] Soft wheat, a popular arable crop, faces both soil-borne (eyespot, take-all) and foliar (mainly Septoria leaf spot, rusts and Fusarium foot rot) fungal diseases, which will affect yield, although future climate scenarios also predict a decline in such infections.[29]

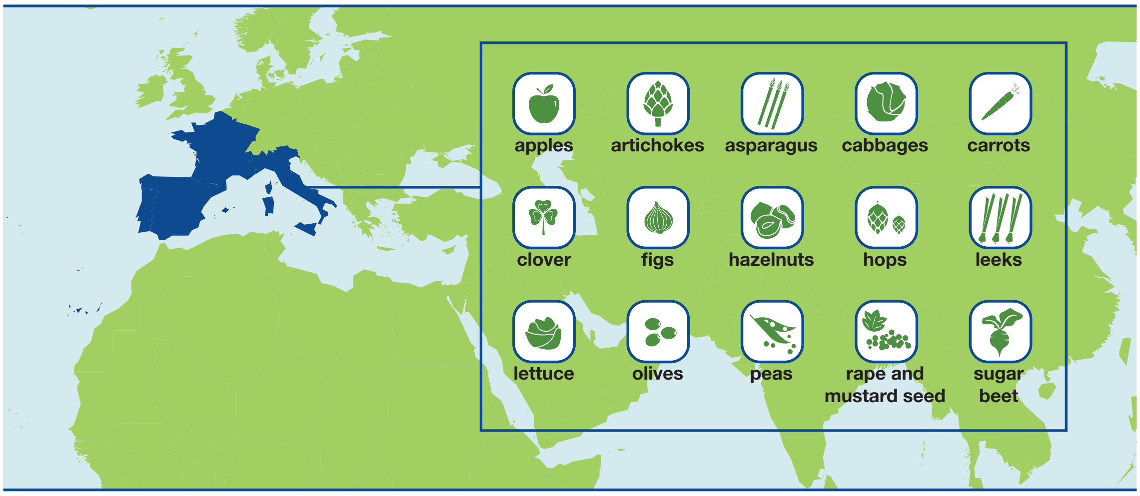
Figure 2: Land used for agriculture



Conservation for future use options

France forms part of several global biodiversity hotspots (Atlantic, Continental, Mediterranean and Alpine), with several types of ecosystems and landscapes (Figure 3).[30] The country's rich and diverse flora count around nearly 4,900 native plant species (~40% of European flora).[31,32] France has 1,755 sites which fall under 'Natura 2000', a network of protected sites for biodiversity conservation across Europe, which is equivalent to 13% of its terrestrial land and 11% of its marine exclusive economic zone.[33] From 2001 to 2019, France lost 11,400 km² of forest cover. This loss is attributed to forestry, shifting agriculture, wildfires and to a lesser extent urbanization.[34] The main pressures driving agrobiodiversity and biodiversity loss in France are habitat degradation, impact of invasive alien species and climate change.[35]

Figure 3: Crops originating from Southwestern Europe



Agrobiodiversity Index score

France has an Agrobiodiversity Index status score of 68.8.

Status: What's driving the Agrobiodiversity Index score?

For France, we see that scores are highest in consumption (85.2), followed by conservation (71.3), and production (49.8). This indicates that agrobiodiversity is relatively effectively used in consumption for healthy diets and conserved for current and future use options, while there is potential for much better use of agrobiodiversity in production for sustainable agriculture. We can take a closer look at the indicator scores to understand what underlies the differences in status of agrobiodiversity across the pillars of France's food system.

Consumption

Species diversity: Food species diversity is high in France relative to other countries in the world and average compared to the nine other Mediterranean countries. Consumption of fruits, vegetables, nuts, and wholegrains is, however, below global average values and can be further increased.[36]

Functional diversity: The functional diversity score of 90 reflects a low number of Disability Adjusted Life Years attributable to dietary risk factors, indicating that diets are quite well in balance for human health needs. Consumption of fruits, vegetables, whole grains, legumes, and nuts can still be further increased to reduce dietary health risks.[36] Consumption of red meat is high and can be lowered to reduce dietary health risks.[36]

Underutilized species: Over 60% of energy in French diets is obtained from sources other than major cereals, roots, and tubers, explaining the 100 score for underutilized species in this category and indicating that diets are not overly dependent on major staples. This does not mean that the potential of underutilized and local species is at its maximum but that the diet is not overly dependent on the major staples.

There were no data available on varietal diversity in consumption.

Production

Varietal diversity: The diversity of livestock breeds maintained in production in France is moderate relative to other countries in the world and above average for the ten Mediterranean countries. France has over 50 breeds of horse, sheep, and chicken in production, but fewer than ten breeds of donkey, duck, goose, and turkey. In addition to averting the loss of animal genetic resources, keeping multiple breeds in production should help farmers maintain livelihoods in times of pest and disease outbreaks or other production challenges, e.g. because different breeds have different resistance to pests and diseases.

Species diversity: With 85 distinct commodities in production, crop species richness is high relative to the Mediterranean average value of 74 crop species, which is moderate compared to the global maximum of 123 (in China). The top ten crops by harvested area are wheat, barley, rapeseed, maize, grapes, sunflower seed, sugar, triticale, peas, and potatoes. The area coverage of different crops in production per 10x10 km is relatively even, meaning cropped landscapes have a high diversity relative to other countries in the world. Also, a very high percentage (96%) of agricultural land contains a high diversity of crop species at 10x10 km scales. This does not mean that crop diversity is at its maximum, and seeking ways to enhance crop diversity at field, farm, and landscape levels is recommended to enhance natural pest and disease controls, yield stability, biodiversity, and other ecosystem services.[37] With 32 recorded freshwater fish species, fish richness is low relative to other countries in the world, but average compared to the nine other Mediterranean countries. Livestock species diversity in production is moderate compared to other countries in the world and average compared to the nine other Mediterranean countries. Actions to boost livestock richness in areas of the country where it is low would help ensure farmers in all regions rely on a wide species base, helping shield them against pests and diseases and other production challenges.

Soil biodiversity: Soil biodiversity is moderate for most of the country, averaging 0.6 on a scale of 0.11 to 1.35 (representing the minimum and maximum global extremes). Integrated plant nutrient management can help maintain and restore soil health, such as through increased use of cover crops, application of mulch and animal manure, and intercropping with legumes.

Landscape complexity: 33.2% of France's cropped landscapes have at least 10 ha of natural vegetation at 1x1 km scales, which is well below the 100% recommendation, but average compared to the nine other Mediterranean countries. Maintaining natural vegetation in and around cropland helps maintain habitat connectivity and ecosystem functioning to sustain nature's contributions to agriculture, including reducing the risk of pest and disease outbreaks, maintaining pollinators, and safeguarding crop wild relatives. Retaining at least 10% natural habitat at local (1x1 km) and landscape (10x10 km) scales could be achieved on farm through practices such as live fences (trees, hedgerows), woodlots, flower strips and set aside, and off farm by safeguarding portions of natural or semi-natural forests, wetlands and grasslands around cultivated areas.

There were no data on functional diversity, underutilized species, or pollinator diversity in production.

Conservation

Varietal diversity: France scores the highest varietal diversity score globally (100), meaning that the there is a high diversity of crop species of French origin in crop samples relative to other countries in the world safely stored in genebanks. This does not mean, however, that all local landraces in France are safely conserved.

Species diversity: The species diversity score is high (70.4), indicating that France has a high diversity of its cultivated and wild species conserved in genebanks, and a high number of known crop wild relative species have bene found in-country, relative to other countries in the world.

Underutilized species: France has a moderate score (43.6) for the underutilized species indicator (wild useful plants). While 86.2% of known wild useful species are conserved *in situ*, their representativeness in *ex situ* repositories is very low (0.9%).[38]

There were no data available on functional diversity of genetic resources in conservation.

Credit: Pixabay/RD Law

Actions: What actions are being taken to maintain and increase agrobiodiversity?

Consumption: France has food-based dietary guidelines in place. These can be further improved by explicitly taking into account sustainability measures including biodiversity. France has national food composition tables. These can be regularly updated and expanded.

Production:

- **Diversity-based practices:** Available data indicate that diversity-based practices are widespread in France, with 90.4% of its agricultural landscapes (10x10 km areas) containing both cropland and pasture, facilitating crop–livestock integration. Three known integrated landscape initiatives actively promote agrobiodiversity in France: Sensibilization to landscape of the Natural Regional Park of the Golfe du Mobihan; Association Pour La Defense du Patrimoine et de l'Environnement de Sainte-Mere, and; UNISCAPE - the Network of Universities especially dedicated to the implementation of the European Landscape Convention.
- **Production management practices supporting agrobiodiversity:** Nitrogen use efficiency is high relative to other countries in the world, at 0.7 kg nitrogen output per kg nitrogen input, putting France among the top 40% of countries for nitrogen use efficiency levels recorded globally. However, the environmental efficiency of production is very low based on the Sustainable Nitrogen Management Index (SNMI) score, which combines data on both nitrogen use efficiency and land use efficiency (crop yields). Given the high nitrogen use efficiency in France, the low SMNI score likely reflects that more nitrogen is being removed from the soil than is being added, degrading soil fertility and resulting in lower yields. Soil fertility can be improved by measures such as applying manure, mulching, and planting leguminous cover crops. The very high score for the sub-indicator on avoided pesticide use (87) reflects a very low use of pesticides, estimated at 4.5 kg per hectare, well below the highest global user (28.0 kg per ha in Mauritius). France has played a leading role in driving forward discussions on an EU-wide ban on glyphosate and encouraging farmers to reduce agrochemical applications through initiatives such as 'EcoPhyto'.[39] It has, however, endorsed the use of neonicotinoids until 2023, a class of insecticides linked to widespread bee and other insect mortalities, which could represent a significant setback.[40] Reduced pesticide use has a strong positive impact on soil biodiversity, pollinators, and natural enemies of pests, with benefits for agriculture and biodiversity. Based on national statistics, organic agriculture is practiced on 7.1% of agricultural land in France, which is well below the 100% recommendation, but third highest across the ten Mediterranean countries, behind Italy and Spain. Conservation agriculture adoption is very low at 1.1% of agricultural land, again putting France at third highest of the ten countries. Trees are integrated into 13.7% of

agricultural land in France, which is moderate relative to other countries in the world and high compared to the nine other Mediterranean countries. Evidence suggests tree coverage on farm can be increased to up to 30% with limited impacts on yield,[41] while providing valuable carbon sequestration services and helping maintain tree, soil and animal biodiversity in agricultural landscapes. Drought-resistant and native tree varieties could be prioritized to minimize water consumption while providing other benefits to farmers.

Conservation: While France has reported on only 21.3% of the indicators to the World Information and Early Warning System (WIEWS) on Plant Genetic Resources for Food and Agriculture (PGRFA) for monitoring progress on the implementation of the FAO second Global Plan of Action (GPA) on PGRFA, its country report shows that it has been very active in the conservation and management of its plant genetic resources on all the priority actions of the second GPA.[42] France is a large country and has several overseas territories. It has a large network of Biological Research Centers and other actors which operate independently from each other, and there is no central national coordinating body for the conservation of plant genetic resources. However, France is in the process of establishing a national coordinating structure to provide support to the PGR networks within its territory.[43]

Overall, France has taken considerable actions towards agrobiodiversity conservation: surveying and inventorying local genetic resources and conducting *in situ* and *ex situ* conservation. It has also promoted use of its plant genetic resources for food and agriculture, for example characterizing and evaluating resources.[43]

Commitments: How supportive of agrobiodiversity are national policies?

The commitments analysis for France was based on their *National Biodiversity Strategy and Action Plan for 2011-2020 (NBSAP).*

Consumption: No policy commitments were found which support agrobiodiversity in consumption for healthy diets, resulting in a score of 0. This is likely to reflect that policies on nutrition are not well reported in France's National Biodiversity Strategy and Action Plan.

Production: France has a low score for commitments to agrobiodiversity in production (25.0). France mentions varietal diversity, species diversity, soil biodiversity, pollinator diversity and landscape complexity in the context of making agriculture more sustainable. However, these and other elements of agrobiodiversity are not explicitly incorporated into any strategies or targets.

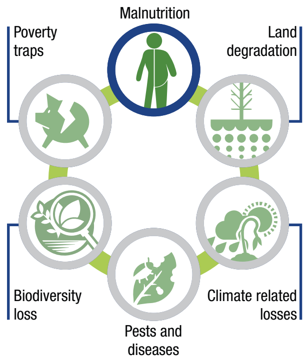
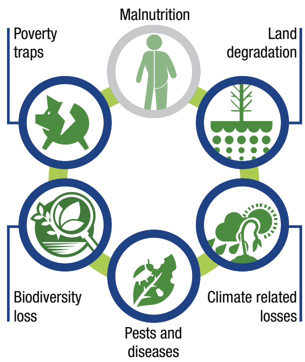
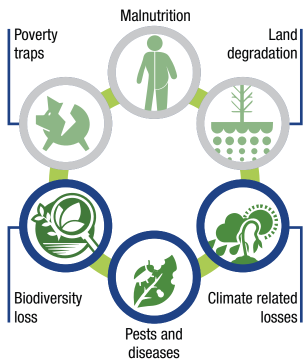
Conservation: France has a low score for commitments to agrobiodiversity in conservation (26.6). France mentions the importance of conserving food and agricultural genetic resources including varietal diversity, species diversity, and functional diversity, yet there are no specific strategies or targets in the NBSAP to help drive forward these ambitions.


Credit: Pixabay/Siala

Recommendations

This section suggests concrete actions that can be taken to improve the use and conservation of agrobiodiversity for more sustainable food systems (Table 1). The list of actions is by no means exhaustive or prescriptive. It is intended for review, discussion and improvement by in-country policy specialists.

Table 1: Recommended actions to enhance agrobiodiversity in the national food system

		Contributing to:	
Food system pillar in the Agrobiodiversity Index	**Recommendations**	**Risk and resilience**	**Global policy**
Consumption for healthy diets	Maintain, safeguard and further expand the rich diversity in diets with special emphasis on vegetables, fruits, nuts, and whole grains. Collect data on varietal diversity and underutilized species in diets to further drive food system diversification.		SDG2 Zero Hunger SDG12 Responsible Consumption and Production United Nations (UN) Decade of Action on Nutrition - reducing overweight obesity and anemia
Production for sustainable agriculture	Collect data on local and traditional crop species and varieties in production to improve monitoring. Improve land use efficiency by restoring soil health using agroecological farming practices such as applying organic fertilizer, mulching, intercropping with legumes. Reinforce commitments to reducing harmful pesticide use to safeguard soil biodiversity, pollinators, and natural enemies of pests, with benefits for agriculture and biodiversity.		Convention on Biological Diversity (CBD) Post-2020 Goal 1[I] No Net Loss SDG 1 No Poverty 2 Zero Hunger 14 Life Below Water 15 Life on Land
Conservation for future use options	Pursue the establishment of a national coordinating structure for Plant Genetic Resources for Food and Agriculture (PGRFA) to more effectively monitor the status of PGRFA within France and its overseas territories.		CBD Post-2020 Goal 3 Genetic Diversity & 4 Nature's benefits SDG 15 Life on Land FAO second Global Plan of Action on Plant Genetic Resources for Food and Agriculture

Agrobiodiversity highlight

Florilège: providing access to all of France's crop diversity information

Florilège is the name of a web portal established to provide information on all France's plant genetic diversity held in crop collections around the mainline country and in Corsica and the French overseas regions. The portal was set up by the French agricultural research and international cooperation organization (CIRAD), the national institute for agricultural research (INRA) and the French Research Institute for Development (IRD) under a program called ARCAD (Agropolis Resource Centre for Crop Conservation, Adaptation and Diversity).

France's crop diversity is held in 37 crop collections in 18 Biological Resources Centers (BRGs) throughout the country. As well as providing online access to this information, the portal also promotes the conservation and study of Mediterranean and tropical crop genetic resources in France and its territories. The collections in mainland France comprise samples of apricot, cherry, melon, tomato, cereals, rapeseed, wheat, barley, oat, rye, maize, legumes, and rice, among others. The Corsican one focuses on Citrus, and the French overseas region collections include banana, sugarcane, mango, coffee, cocoa, pineapple, vanilla, yam, and rubber. The collections total 27,000 live plant samples, living in the form of plants in fields, seeds, and *in vitro* tissue culture.

Sources: [44]

Credit: Pixabay/David Mark

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End notes

I. The Convention on Biological Diversity is an international treaty for the sustainable use and conservation of biological diversity. In 2010 it launched a strategic plan, running from 2011 to 2020, with 20 ambitious targets known as the Aichi Targets from the city in which they were signed. The international community has developed new targets, but their signature has been delayed due to the COVID-19 crisis.

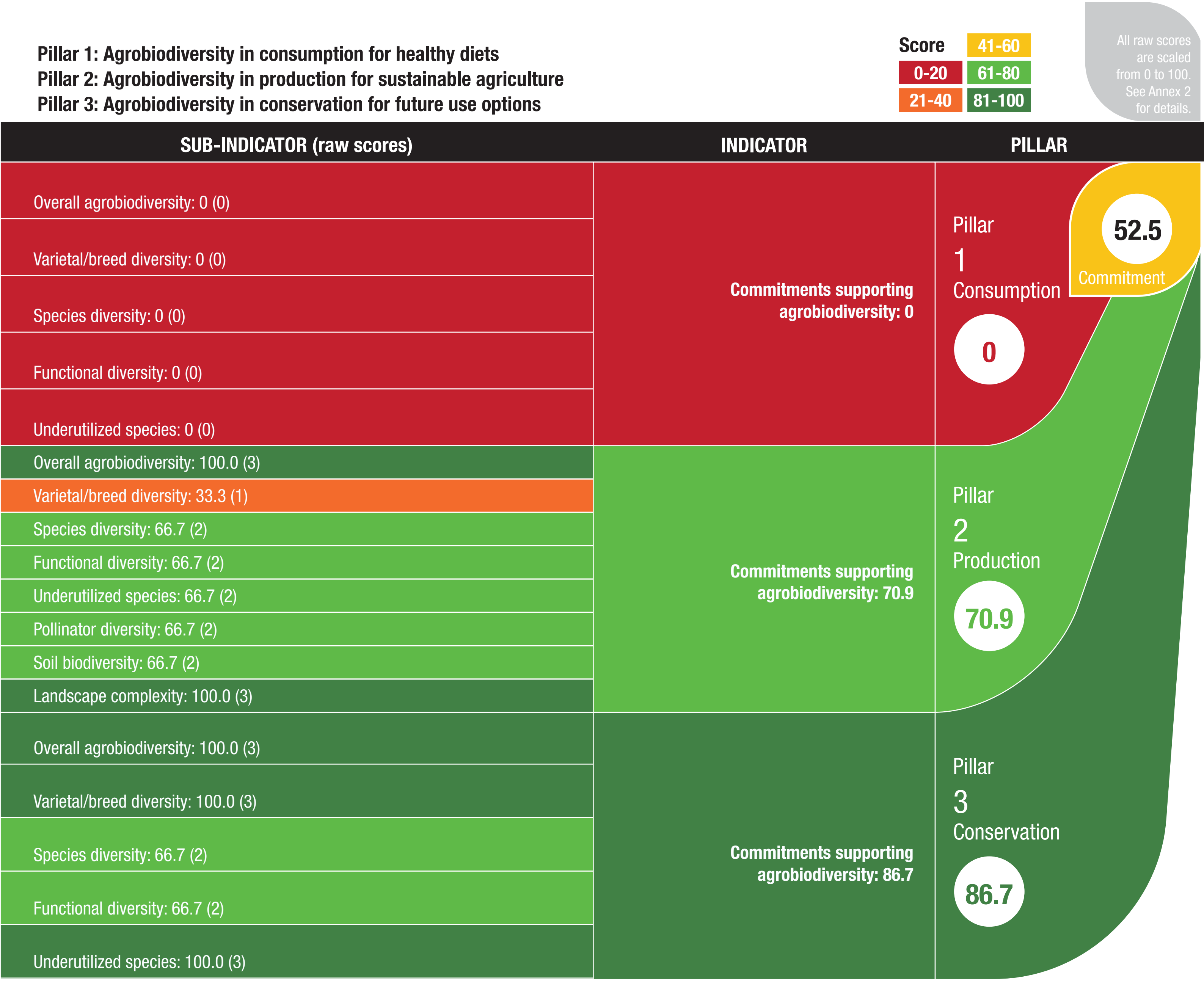
Credit: Pixabay/Peter H

Italy

Country profile

Key messages

- **Italy has an Agrobiodiversity Index status score of 66.1 reflecting a moderate to high integration of agrobiodiversity into the food system.**
- **In consumption, food species and nutritional functional diversity are high, and supported by national food-based dietary guidelines and food composition tables, but stronger policies are needed to maintain and enhance food diversity in markets and diets.**
- **In production, agrobiodiversity could be better supported by increasing adoption of organic agriculture (currently at 16%), tree cover in agriculture (11%) and integrated plant nutrient management.**
- **In conservation, varietal and species diversity are well conserved in genebanks, but the diversity of wild useful plants are poorly represented in the *ex situ* collections**
- **There is potential for more diverse and stronger policies for integrating agrobiodiversity across the whole food system.**



Status: 66.1

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 84.4	Species diversity: 64.1	Food diversity in supply (Shannon's Index): 64.1 (2.8)
	Functional diversity: 89.0	(Avoided) Disability Adjusted Life Years attributable to dietary risks per 100,000 adults: 89.0 (2,121)
	Underutilized species: 100.0	Energy from sources other than cereals, roots and tubers (%): 100.0 (66.0)
Pillar 2 Production 45.9	Varietal/breed diversity: 57.7	Livestock breed diversity (Shannon's Index): 57.7 (1.8)
	Species diversity:63.9	Crop species richness in production (count): 66.7 (82.0)
		Crop species diversity in production (Shannon's Index): 71.9 (1.7)
		Cropland with high crop species richness (%): 93.9 (93.9)
		Freshwater fish species richness (average count): 26.7 (22.2)
		Livestock diversity in production (Shannon's Index): 60.1 (1.0)
	Soil biodiversity: 37.4	Potential soil biodiversity (Index 0 to 2): 37.4 (0.6)
	Landscape complexity: 24.6	Cropland with >10% natural and semi-natural habitat at 1x1km scales (%): 24.6 (24.6)
Pillar 3 Conservation 68.0	Varietal/breed diversity: 87.9	Varietal diversity in genebanks (Shannon's Index): 87.9 (5.0)
	Species diversity: 74.4	Species diversity in genebanks (Shannon's Index): 77.3 (4.8)
		Crop wild relative occurrence diversity (Shannon's Index): 71.4 (4.6)
	Underutilized species: 41.6	*In situ* conservation of useful wild species (%): 81.7 (81.7)
		Ex situ conservation of useful wild species (%): 1.5 (1.5)

Action: 57.1

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 100	Management practices supporting agrobiodiversity: 100.0	Published diet guidelines (Yes/No): 100.0 (1.0)
		Published food composition tables (Yes/No): 100.0 (1.0)
Pillar 2 Production 51.4	Diversity-based practices: 66.6	Crop-livestock integration (% agricultural land with cropland and pasture): 83.1 (83.1)
		Integrated landscape initiatives (count): 50.0 (3.0)
	Management practices supporting agrobiodiversity: 36.1	Nitrogen use efficiency (kg N output per kg N input): 48.6 (0.5)
		(Inverted) Sustainable Nitrogen Management Index (Index 0 to infinity): 28.5 (56.8)
		Organic agriculture (%): 15.8 (15.8)
		Tree cover on agricultural land (%): 35.3 (10.6)
		(Avoided) pesticide use (kg per ha): 82.7 (5.9)
		Conservation agriculture (%): 5.8 (5.8)
Pillar 3 Conservation 20	Management practices supporting agrobiodiversity: 20.0	Indicators reported to the World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (%): 20.0 (20.0)

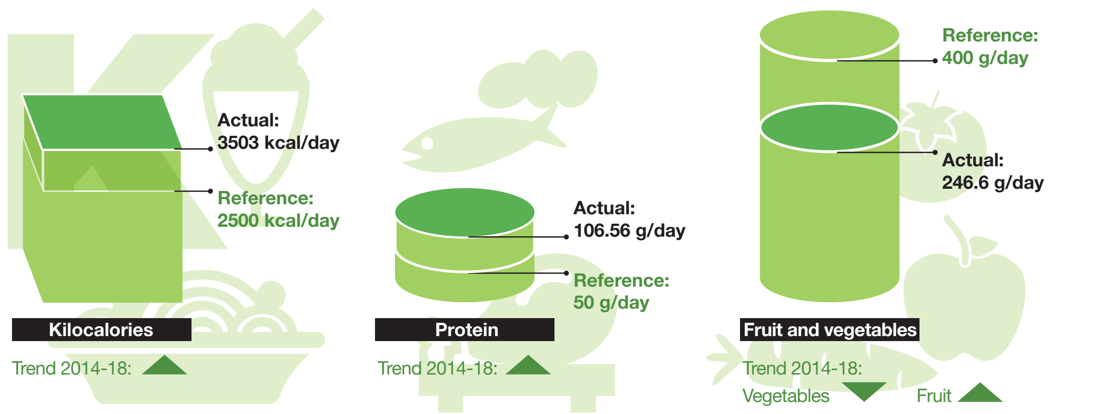
Context

Italy is a high-income country, with a mixed economy and a gross domestic product (GDP) of about 2 trillion US dollars in 2019.[1] Italy covers an area of 301,340 km^2 hosting a population of about 60 million people, about 70% of whom inhabit urban areas.[2,3] Its population density is 205 people per km^2.[4] In 2019, nearly 8% of Italy's population was living below the poverty line.[5] No data were recorded regarding its multidimensional poverty index.[6] Italy ranked 6.387 out of 10 on the national life evaluation, ranking 30 out of 153 countries in the United Nation's 2020 global happiness report, putting Italian's among the top quartile of the world's happiest people.[7]

Consumption for healthy diets

The Italian diet is typically Mediterranean, comprised of cereals, vegetables, fruit, fish, and olive oil. A traditional meal would ideally be a first course consisting of pasta or rice, a second course of meat, fish or eggs, a vegetable side dish, and a final dessert or piece of fruit. Sometimes the first and second courses are substituted by one sole dish rich in ingredients of various origins.[8] The average Italian adult consumes above the recommended dietary calorie intake, over two times the recommended protein intake, and 62% of the recommended fruit and vegetables intake (400g/day). The average life expectancy of a healthy Italian is 83 years.[9] In Italy, 3% of individuals were reported to be undernourished in 2019 and 8.4% are facing either moderate or severe food insecurity.[10,11] Around 17% of women aged between 15 and 49 are anemic[12] and 5% of the population is diabetic.[13,14] The prevalence of stunting and wasting among children under five is not reported.[15]

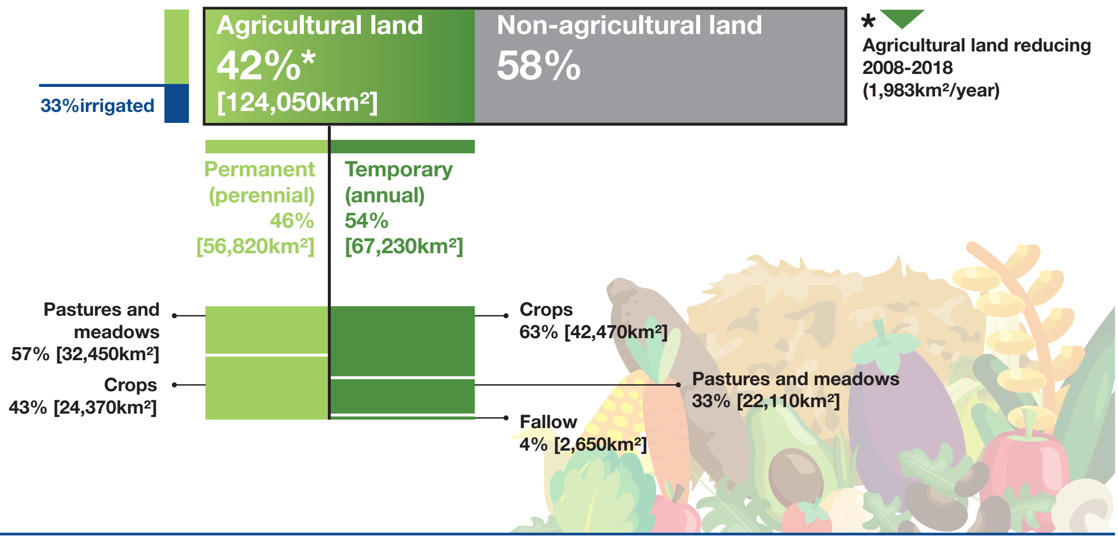
Figure 1: Kilocalorie, protein, fruit and vegetable supply



Production for sustainable agriculture

Approximately 42% (124,050 km^2) of Italy's total land area is dedicated to agriculture, of which 46% is used for perennial crops or permanent pasture (Figure 2). Italy has the third highest number of people employed in agriculture in Europe after Poland and Romania, with above a million employees in the sector.[16] About half of agricultural land (67,230 km^2) is used for arable crops, the most important being cereals, dried legumes, industrial crops and vegetables. Permanent crops, mainly vineyards, olive trees and fruit trees, occupy a further 24,370 km^2 (8.3%). In 2018, the total marine capture production was 205,731 tonnes.[17] As for livestock, eggs, milk and meat (pig) are the main products, with an annual production of 36.6 million tonnes.[18] Italy has one of the highest mean annual soil loss rates in Europe at 7.4 tonnes per hectare per year.[19] This can be explained by high rainfall erosivity and steep slopes.[20]

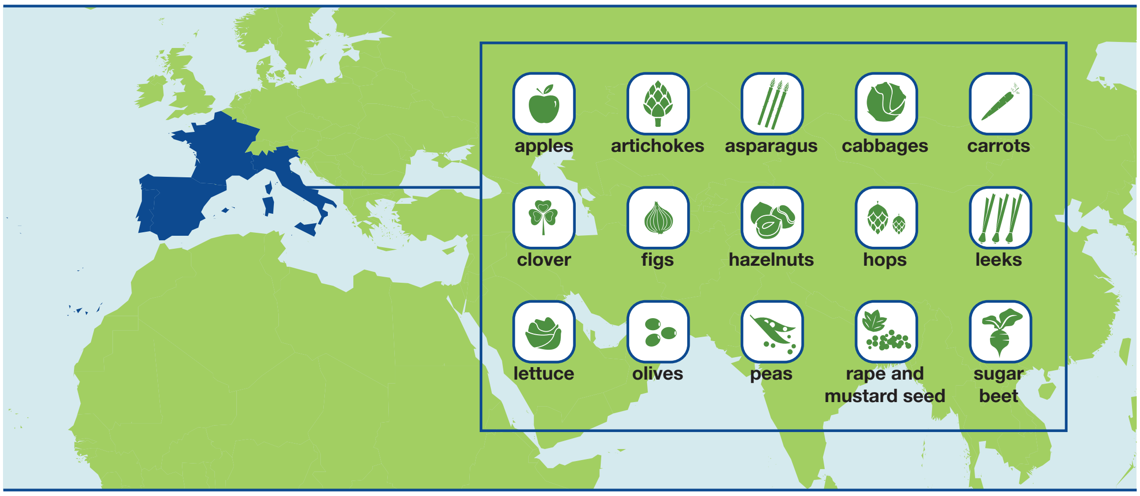
Figure 2: Land used for agriculture



Conservation for future use options

Italy is highly diverse in terms of genetic diversity. It is part of Vavilov's Mediterranean center of origin of cultivated plants[21] and hosts half of the known European plant families.[22] At least 29 food crops originate from southwestern Europe, including several that remain mainstays of Italian diets such as figs and olives (Figure 3). Up to 20% of its plants are native to the country.[23] About 21% of its land is dedicated to the protection of biodiversity,[24] however plants are under threat, with nearly 45% of plants falling under 'critical' conservation status.[25, I] From 2001 to 2019, Italy lost 3,590 km² (3.8%) of tree cover, mainly due to wildfire, urbanization, shifting agriculture and forestry.[26] In Italy, plant diversity is threatened by human activities like infrastructural development, intensive farming, recreational activities, introduction of alien species and poor management of forestry and agriculture.[27] Only 9.7% of the marine area (52,463 km²) falls under marine protected areas.[28] At the national level, over 75% of fish stocks are overexploited or have collapsed.[29]

Figure 3: Crops originating from southwestern Europe



Agrobiodiversity Index score

Italy has an Agrobiodiversity Index status score of 66.1.

Status: What's driving the Agrobiodiversity Index score?

For Italy, we see that scores are highest in consumption (84.4), followed by conservation (68), and production (45.9). This indicates that agrobiodiversity is relatively effectively used in consumption for healthy diets and conserved for current and future use options, while there is potential for much better use of agrobiodiversity in production for sustainable agriculture. We can take a closer look at the indicator scores to understand what underlies the differences in status of agrobiodiversity across the pillars of Italy's food system.

Consumption

Species diversity in diets: Food species diversity is high in Italy relative to other countries in the world.

Functional diversity: Italy's functional diversity score of 89 reflects a low number of Disability Adjusted Life Years attributable to dietary risk factors, indicating diets are functionally diverse. We note however, that Italian diets have become increasingly high in sugar and animal fats since the 1960s,[30] which may contribute to the high obesity rate. Ranked as first in Europe, child obesity reaches up to 21% in Italy while nearly 46% of people aged 18 years and above are either overweight (35.5%) or obese (10.4%).[31]

Underutilized species: Over 60% of energy in Italian diets is obtained from sources other than cereals, roots and tubers, explaining the very high score for consumption of underutilized species. We note, however, that the increasing availability of high-energy foods has contributed to progressive rise in obesity rates in Italy.[30] Consumption of high-energy foods should be moderated, while consumption of foods such as nuts, legumes, and leafy vegetables could be increased, to maintain food system diversity and ensure a balanced diet.

There were no data available on varietal/breed diversity in consumption.

Production

Varietal/breed diversity: A relatively high diversity of livestock breeds is maintained in production in Italy. Diversity is a measure of both the number and relative proportion of different breeds. Keeping multiple breeds in production should help farmers maintain livelihoods in times of pest and disease outbreaks or other production challenges, because different breeds have different resistance to pests and diseases. While not included in the Agrobiodiversity Index due to lack of comparable data across Mediterranean countries, it is encouraging that Italy grows an estimated 2,365 landraces, principally of fruit trees (73%), grain legumes (12%) and vegetables (9%), with highest numbers recorded in Umbria (378), Calabria (288), Sicily (251), Basilicata (212), and Campania (203).[32]

Species diversity: The diversity of different crop species, and the richness (number of unique species), in Italy's production systems are moderate to high, while the richness of fish species and diversity of livestock species are low or very low and could be increased. Actions to boost fish and livestock diversity in areas of the country where these are low would help ensure farmers in all regions rely on a wide species base, helping shield them against pests and diseases and other production challenges.

Soil biodiversity: Soil biodiversity is moderate and varies from place to place. Integrated plant nutrient management (e.g. through increased use of cover crops, application of mulch, and intercropping with legumes) would help maintain and restore soil health and be beneficial to production systems.

Landscape complexity: Only 25% of Italy's cropped landscapes have more than 10% natural vegetation at a 1x1 km scale, suggesting that cropland is not well integrated into the surrounding environment. Maintaining natural vegetation in and around cropland helps maintain habitat and connectivity for animals such as birds and insects, which help agriculture thrive. Keeping natural vegetation reduces the risks of pest and disease outbreaks, pollinator declines impacting on crop yields, and loss of crop wild relatives reducing options for future food production. Retaining at least 10% natural habitat for biodiversity at local (1x1 km) and landscape (10x10 km) scales could be achieved on farm through using practices such as live fences (trees, hedgerows), woodlots, flower strips and set aside, and off farm by safeguarding portions of natural or semi-natural forests, wetlands and grasslands around cultivated areas.

There were no data available on functional diversity, underutilized species, or pollinator and natural enemies in production.

Conservation

Varietal diversity: Italy has a high score for varietal diversity in genebanks (87.9), relative to the globally best performing country (France), indicating that there is a high number of crop samples (accessions) of Italian origin conserved in genebanks.

Species diversity: The score for species diversity is also very high (74.4) reflecting that a high proportion of native plant species are conserved in genebanks and a high diversity of crop wild relative species have been identified growing in country relative to other countries in the world.

Underutilized species: Italy has a moderate score (41.6) for the diversity of underutilized species (measured as 'wild useful plants'). While 82% of known wild useful plants are conserved *in situ* (inside protected areas), their representativeness in *ex situ* repositories (genebanks and botanical gardens) is very low (1.5%).

Functional diversity: There were no data available for functional diversity in conservation.

Credit: Pixabay/Rudy and Peter Skitterians

Actions: What actions are being taken to maintain and increase agrobiodiversity?

Consumption: Actions to use agrobiodiversity in consumption are in place. Italy has published dietary guidelines and maintains food composition tables to support dietary diversity for healthy diets.

Production: Action scores are moderate (21.4) for agrobiodiversity use in production. The score for production reflects moderate adoption of diversity-based practices and low adoption of agrobiodiversity-supporting management practices.

- **Diversity-based practices:** Italy has a relatively homogeneous production system. An estimated 83% of its agricultural landscapes contain both cropland and pasture facilitating crop–livestock integration (at 10x10 km scale). It has at least four integrated landscape initiatives that actively promote agrobiodiversity.
- **Agrobiodiversity-supporting management practices:** Based on national statistics, conservation agriculture is practiced on 5.8% of agricucltural land in Italy, while organic agriculture is practiced on 16% of agricultural land. Current data indicate nitrogen use efficiency countrywide could be improved and nitrogen management could be more sustainable. Overuse or improper use of chemical fertilizers has a strong negative impact on agrobiodiversity. Promotion of organic and conservation agriculture practices and integrated plant nutrient management could greatly reduce the use of fertilizers, improve their efficiency, or both, creating a more favorable environment for agrobiodiversity. Trees are integrated into only 11% of agricultural land. Increasing tree coverage would provide carbon sequestration services and help maintain tree, soil, and animal biodiversity in agricultural landscapes.

Conservation: Action scores are low for agrobiodiversity in conservation (20), reflecting a lack of reporting on 80% of indicators to the World Information and Early Warning System (WIEWS), the UN Food and Agriculture Organization's information system for countries to report on the conservation and use of plant genetic resources for food and agriculture. The indication that Italy is not adequately reporting to WIEWS may hinder its progress in implementing the international second Global Plan of Action for plant genetic resources for food and agriculture which promotes priority actions for reversing the erosion of genetic resources. This severely undermines global and national efforts to monitor genetic diversity in the food system. Italy has, however, actively supported the International Treaty on Plant Genetic Resources for Food and Agriculture through voluntary donations of over US$10 million between 2005 and 2018.[33]

Commitments: How supportive of agrobiodiversity are national policies?

Consumption: In the National Biodiversity Strategy and Action Plan, no commitments were found to leverage or support biodiversity for diets and nutrition. It is recommended that linkages between the biodiversity strategy and the national food and nutrition strategies be developed. This can on one hand further leverage the potential of biodiversity for food and nutrition, and on the other hand, mobilize consumer demand for agrobiodiversity conservation and management for sustainable production.

Production: Italy has a high score for commitments to agrobiodiversity in production (70.9). In 2008, Italy developed a national plan for agrobiodiversity "to coordinate the combination of initiatives and relations with national and international organisms involved in agricultural biodiversity".[34] Many of Italy's policies are exemplary of the types of strong commitments that are needed to create a supportive environment to mainstream agrobiodiversity in production for sustainable agriculture. Italy's commitments include targets to better use agrobiodiversity in general and for greater landscape complexity specifically. For example, in relation to landscape complexity, Italy identified priority objectives to be achieved within ten years (2009–2019), which include "the preservation of the integrity and health of forest ecosystems, conservation of biodiversity and landscape diversity".[34] Italy has strategies to enhance species diversity, functional diversity, crop wild relatives, soil biodiversity, and pollinator diversity in production, although varietal diversity is not yet explicitly incorporated into these strategies. Exemplar strategies include, in relation to functional diversity and overall agrobiodiversity, Italy's National Program to Combat Drought and Desertification, which defines measures to combat desertification and requires "incentive measures for promoting the cultivation of species according to the function of the environment (climate, soil, topography) with maximum energy eco-efficiency and minimum chemical support; adoption of farming systems compatible with the environment; implementation of strategies to achieve truly sustainable agriculture".[34]

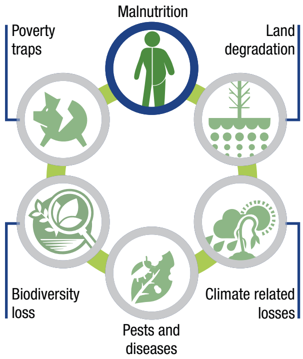
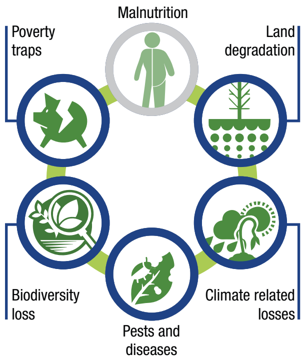
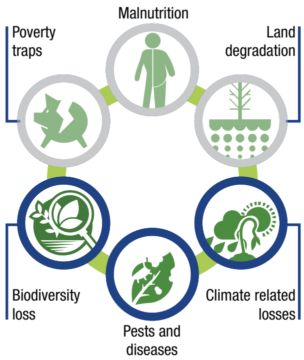
Conservation: Italy has a very high score for commitments to agrobiodiversity in conservation (86.7), including targets to conserve varietal diversity and underutilized species (measured as crop wild relatives and traditional crops) both where they naturally occur and in genebanks. Such targets include "Protecting some ancestral species of crops and livestock at risk of extinction or genetic pollution [by 2020]" and "defining and validating the knowledge and assessment methods for the genetic heritage of local varieties and breeds/livestock of limited animal population through genetic markers [by 2020]".[34] There are also strategies to improve species and functional diversity in conservation. For the latter, this includes "we intend to contribute to preserving biodiversity through: preserving threatened species and communities, or those having medicinal, agricultural, forestry, etc. value".[34]

Credit: alefolsom/Pixabay

Recommendations

This section suggests concrete actions that can be taken to improve the use and conservation of agrobiodiversity for more resilient and sustainable food systems (Table 1). The list of actions is by no means exhaustive or prescriptive. It is intended for review, discussion, and improvement by in-country policy specialists.

Table 1: Recommended actions to enhance agrobiodiversity in the national food system

		Contributing to:	
Food system pillar in the Agrobiodiversity Index	**Recommendations**	**Risk and resilience**	**Global policy**
Consumption for healthy diets	Make explicit policies and programs to promote healthy diets building on the rich food diversity available in Italy, with a specific focus on fruits, vegetables and whole grain diversity to combat obesity, overweight and anemia		SDG2 Zero Hunger and SDG12 Responsible Consumption and Pro-duction WHO Decade of nutrition – reducing overweight, obesity and anemia
Production for sustainable agriculture	Make explicit policies to integrate agri-cultural and natural lands, e.g. future agricultural expansion should ensure at least 10% natural vegetation is integrated into agricultural landscapes		Post-2020 CBD Goal 1[ii] No Net Loss SDG 2 Zero Hunger
Conservation for future use options	Make explicit policies for both *in situ* and *ex situ* conservation of crop wild relatives and other useful wild plants, e.g. by 2030, ensure that crop wild relatives in Italy are conserved inside protected areas or formally protected and backed up in gene-banks or other repositories.		Post-2020 CBD Goal 3 Genetic Diversity Post-2020 CBD Goal 4 Nature's Benefits SDG 15 Life on Land FAO second Global Plan of Action on Plant Genetic Resources for Food and Agriculture

Agrobiodiversity highlight

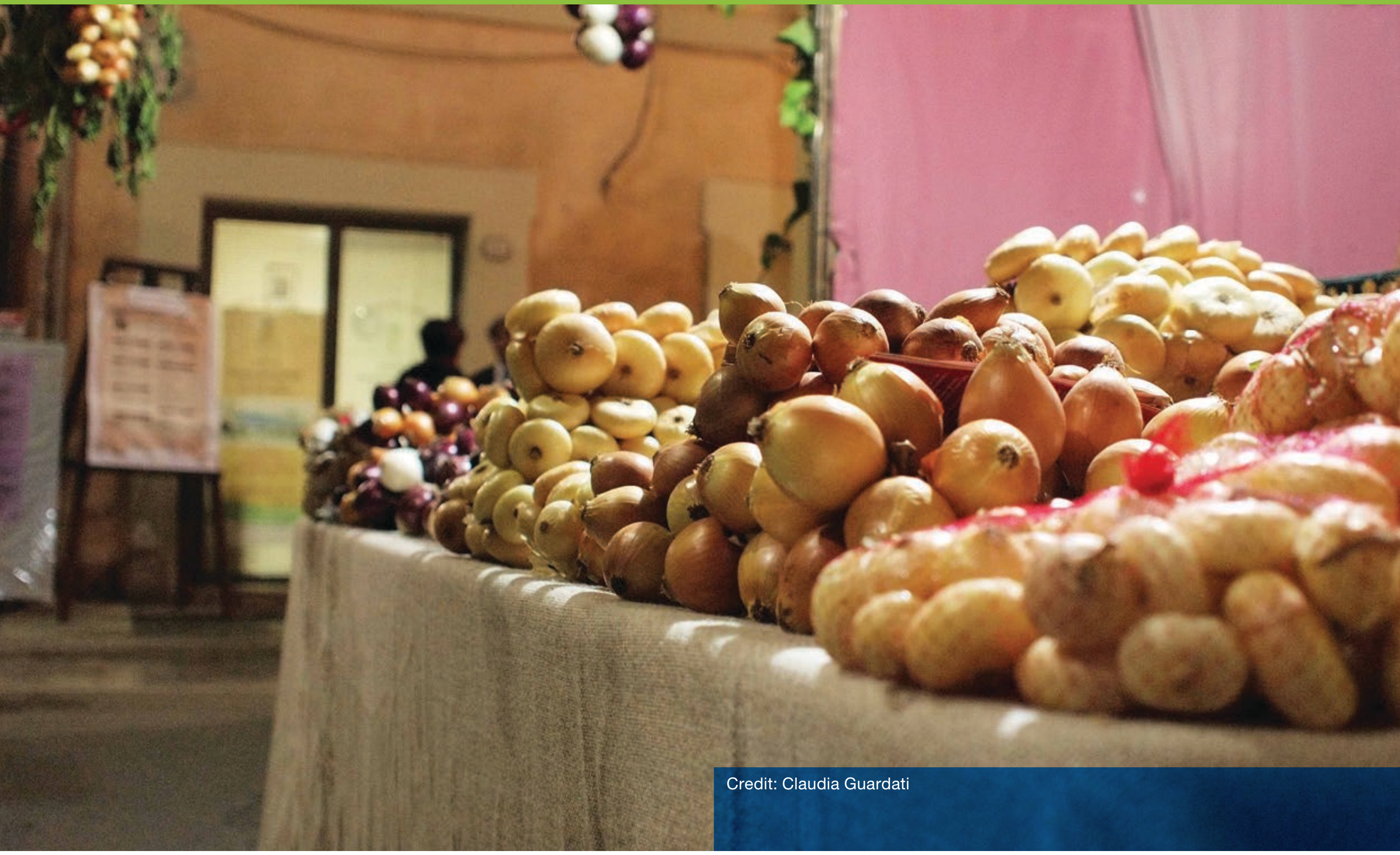
Italy's tradition of '*sagre*' gastronomic festivals

Italy's history marked by provincial loyalties and cultural variety strongly influences its gastronomic traditions, leading to a rich and diverse culinary heritage. One expression of this heritage is the phenomenon of *sagre*. Originally dedicated to local saints (*sagra* is etymologically related to 'sacred'), they are now mainly secular gastronomic festivals celebrating local cuisine.

Throughout Italy every weekend, newspapers are full of ads for these local festivals, where you learn about (and taste) local dishes and seasonal products, part of the tradition of a region or town. *Sagre* contribute to agrobiodiversity by promoting local varieties, sometimes on the verge of extinction, for example cherry varieties of *ciliegia di Lari* and the local bovine breed of Calvana. Villages celebrate their own varieties of crops – for example lentil festivals (*sagra della lenticchia*) are held throughout Italy from North to South in Onano, Altamura, Foligno, Rascino and Clitunno – each vaunting the precious qualities of their lentil types and the dishes prepared from them.

Sagre also offer a way of connecting marginalized rural communities to urban economies, and at the same time transmitting traditional knowledge of local gastronomy and foods to younger generations and to people outside the area. In this way the *sagre* raise awareness about the individual foods, but also about the huge diversity available and contribute to the general knowledge of the population at large about Italian biocultural heritage.

Sources: [35,36]



Credit: Claudia Guardati

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End notes

I. The International Union for the Conservation of Nature (IUCN) ranks species according to how threatened they are. Rankings range from 'extinct', through 'critically endangered', 'endangered' and 'vulnerable', to 'near threatened' and 'least concern'.

II. The Convention on Biological Diversity is an international treaty for the sustainable use and conservation of biological diversity. In 2010 it launched a strategic plan, running from 2011 to 2020, with 20 ambitious targets known as the Aichi Targets from the city in which they were signed. The international community has developed new targets, but their signature has been delayed due to the COVID-19 crisis.

Credit: Pixabay/Samuele Schirò

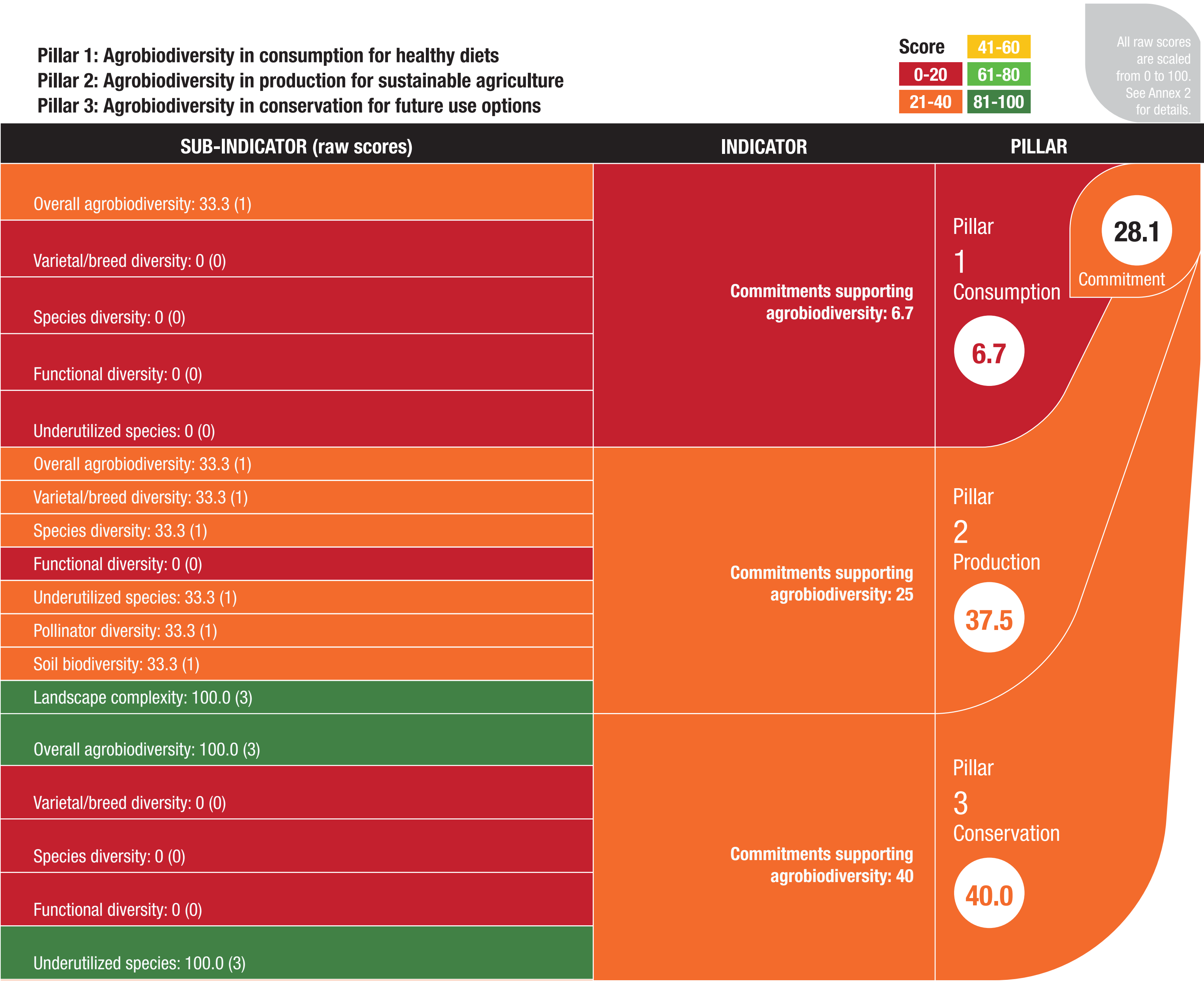
Lebanon

Country profile

AGROBIODIVERSITY INDEX

Key messages

- **Lebanon has an Agrobiodiversity Index status score of 54.8 reflecting a moderate integration of agrobiodiversity into the food system.**
- **In consumption, food species diversity is high but a shift towards more high-sugar, high-fat dietary patterns contributes to dietary risks and moderate functional diversity.**
- **In production, fish species diversity is high in Lebanon compared to other countries worldwide and in the Mediterranean region. Crop species richness is moderate, and there is potential to increase the diversity of farming systems and improve soil biodiversity. Natural habitat in cropped landscapes is above average but it is important to further manage and increase this.**
- **In conservation, *ex situ* conservation of a diversity of plant species is very high compared to countries around the world. While there is well documented use and *in situ* conservation of a broad range of useful wild plants, their representation in genebanks is very low.**
- **While there is a recognition of the importance of agrobiodiversity in national policies and reporting, there is potential for more explicit policies and actions to support agrobiodiversity across the whole food system.**



PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Status 54.8		
Pillar 1 Consumption 78.1	**Species diversity: 71.7**	Food diversity in supply (Shannon's Index): 71.7 (2.9)
	Functional diversity: 71	(Avoided) Disability Adjusted Life Years attributable to dietary risks per 100,000 adults: 71.0 (5,570)
	Underutilized species: 91.7	Energy from sources other than cereals, roots and tubers (%): 91.7 (55.0)
Pillar 2 Production 33.4	**Varietal/breed diversity: 0.0**	Livestock breed diversity (Shannon's Index): 0.0 (0.0)
	Species diversity: 64.5	Crop species richness in production (count): 51.2 (63.0)
		Crop species diversity in production (Shannon's Index): 61.0 (1.4)
		Cropland with high crop species richness (%): 95.9 (95.9)
		Freshwater fish species richness (average count): 63.3 (52.5)
		Livestock diversity in production (Shannon's Index): 50.9 (0.8)
	Soil biodiversity: 27.3	Potential soil biodiversity (Index 0 to 2): 27.3 (0.4)
	Landscape complexity: 41.6	Cropland with >10% natural and semi-natural habitat at 1x1km scales (%): 41.6 (41.6)
Pillar 3 Conservation 52.9	**Varietal diversity: 51.4**	Varietal diversity in genebanks (Shannon's Index): 51.4 (2.9)
	Species diversity: 74.2	Species diversity in genebanks (Shannon's Index): 84.8 (5.3)
		Crop wild relative occurrence diversity (Shannon's Index): 63.6 (4.1)
	Underutilized species: 33.2	*In situ* conservation of useful wild species (%): 61.6 (61.6)
		Ex situ conservation of useful wild species (%): 4.7 (4.7)
Action 59.2		
Pillar 1 Consumption 50.0	**Management practices supporting agrobiodiversity: 50**	Published diet guidelines (Yes/No): 100.0 (1.0)
		Published food composition tables (Yes/No): 0.0 (0.0)
Pillar 2 Production 60.1	**Diversity-based practices: 89.8**	Crop-livestock integration (% agricultural land with cropland and pasture): 89.9 (89.9)
	Management practices supporting agrobiodiversity: 30.2	Nitrogen use efficiency (kg N output per kg N input): 32.5 (0.4)
		(Inverted) Sustainable Nitrogen Management Index (Index 0 to infinity): 57.1 (34.1)
		Organic agriculture (%): 0.2 (0.2)
		Tree cover on agricultural land (%): 11.3 (3.4)
		(Avoided) pesticide use (kg per ha): 79.4 (7.0)
		Conservation agriculture (%): 0.9 (0.9)
Pillar 3 Conservation 67.5	**Management practices supporting agrobiodiversity: 67.5**	Indicators reported to the World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (%): 67.5 (67.5)

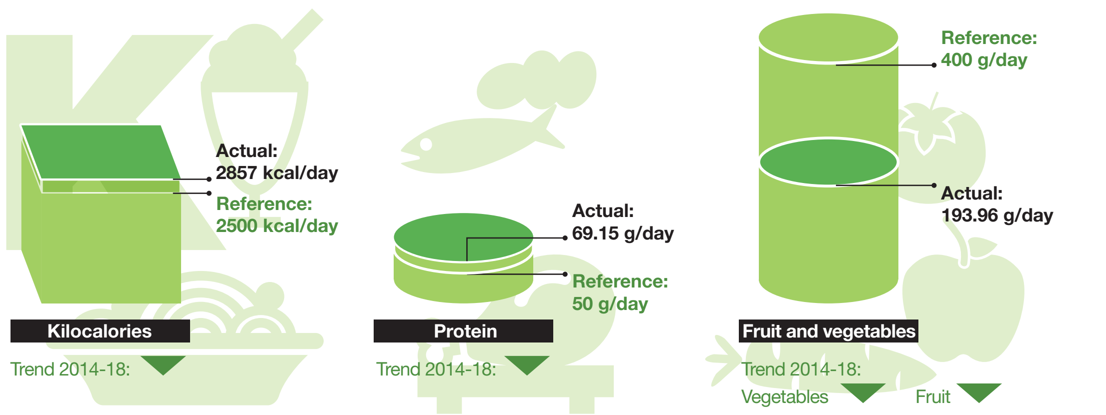
Context

Lebanon is an upper middle-income country, covering an area of 10,400 km^2 [1] with a current GDP of about US$52 billion[2] and a population of approximately 6.8 million.[3] The population density is estimated at 669 inhabitants per km^2 and the population is largely urban (89%).[4,5] The most recent figures, from 2012, report that 27.4% of Lebanon's population live below the poverty line,[6] while there are no data available to assess multidimensional poverty.[7] In the last decade, Lebanon's population has increased rapidly due to an influx of Syrian refugees.

Consumption for healthy diets

Lebanon's traditional cuisine typically comprises minimally processed vegetarian recipes rich in fruit, vegetables, cereals, legumes, and nuts, including wild edible plants, lemon, garlic and mint.[8] Olive oil is the main fat used; fish, poultry and red meat are consumed in low amounts; and wine is consumed in low to moderate quantities (Figure 1). Modern Lebanese consumers' tastes and demands have slightly shifted toward an increased intake of fat, milk, and animal protein and a decreased intake of whole wheat bread and cereals.[9] Although the current Lebanese dietary habit has retained many of its Mediterranean features, the diet appears to be adopting a pattern high in saturated fat, sugar, and refined foods and low in fiber.[10] In Lebanon, a healthy person may live up to an average of 79 years.[11] The prevalence of undernourishment in the Lebanese population was 6% in 2018[12] but no data were recorded on the percentage of the population suffering from moderate to severe food insecurity.[13] Around 31% of Lebanese women of reproductive age are anemic[14] and 11% of the population suffer from diabetes.[15] Data for children under five dates to 2004, when the prevalence of wasting and stunting was 6.6% and 16.5% respectively.[16,17] An estimated 37% of adult women (aged 18 years and over) and 27.4% of adult men are living with obesity.[18]

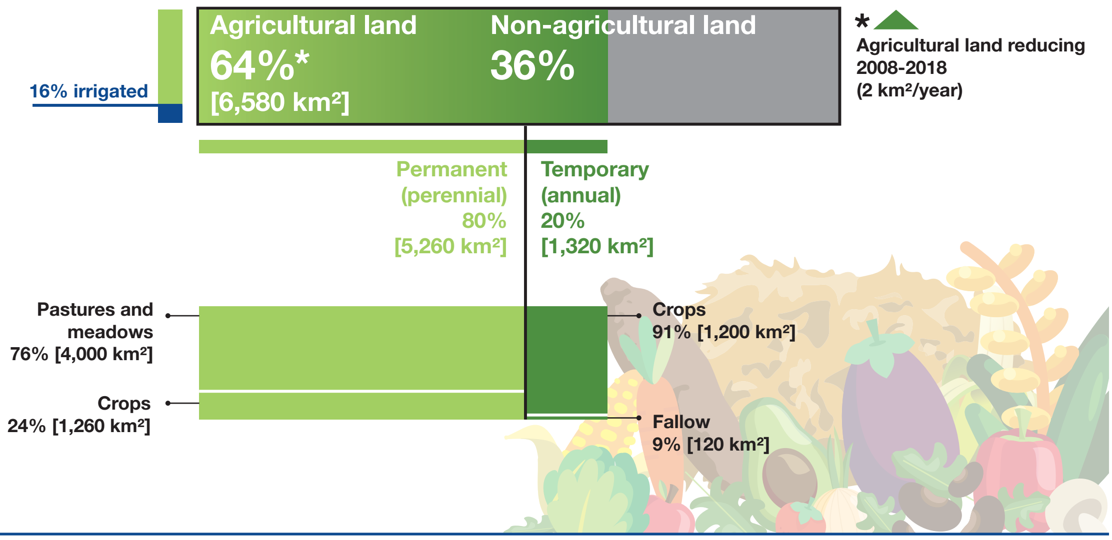
Figure 1: Kilocalorie, protein, fruit and vegetable supply



Production for sustainable agriculture

In Lebanon, agriculture, forestry, and fishing play a minor role in the economy and contribute 5.3% of annual GDP.[19] Despite being a water-stressed country, around 64% of Lebanon's land (6,580 km^2) is dedicated to agriculture,[20] of which nearly 20% is arable land (1,320 km^2), divided into temporary crops (90.9%) and temporary fallows (9.1%) (Figure 2).[21] Currently, the agricultural sector employs 13.4% of the Lebanese population, 14% of whom are women, with a general decrease of 5.3% over the past two decades (2000–2020).[22,23] The top three crops in terms of economic value contributing to GDP (in % of total contribution from agriculture) are tomatoes (0.4%), potatoes (0.4%) and olives (0.4%).[24] In 2016, fish production in Lebanon was 5,306 tonnes, with 80% from capture fisheries and 20% aquaculture.[25,26] Climate projection models predict that by 2040 temperatures will increase by around 1°C on the coast to 2°C in the mainland, and by 2090 they will be 3.5°C to 5°C higher than today. Precipitation on the other hand will decrease by 10%–20% by 2040 and by 25%–45% by the year 2090, compared to the current trend. This will result in significantly warmer and less wet conditions, causing longer periods of drought in Lebanon.[27] The predicted increase in temperatures will exacerbate the desertification rate of Lebanese soils, which are highly vulnerable to erosion processes.[28] These will have significant consequences on crop geographic distributions and yields.[29]

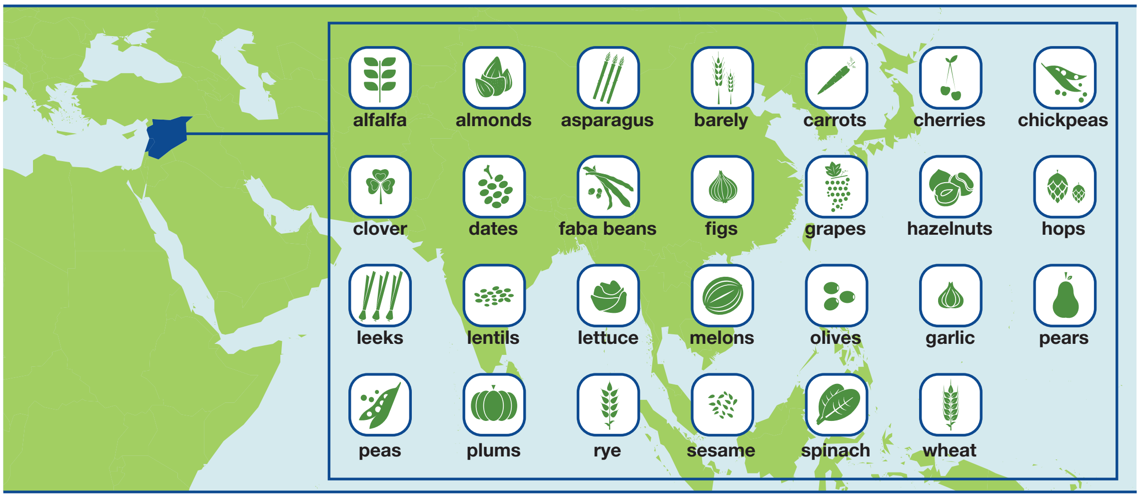
Figure 2: Land used for agriculture



Conservation for future use options

Lebanon hosts a rich faunal and floral diversity despite its small land area, with 2,612 vascular plants (108 endemic),[30] 390 bird species, 900 fish species and 1,300 insect and butterfly species.[31] More than 80 plant species are cultivated for food and agriculture (Figure 3). In addition, Lebanon is rich in wild plant species and wild harvested plants include leafy vegetables and aromatic plants.[32] The Mediterranean Red List, compiled by the International Union for the Conservation of Nature (IUCN) to assess threat levels[l], indicates that 356 (7%) of terrestrial plants growing in Lebanon are considered threatened.[30] Lebanese flora is facing rapid genetic erosion because of human-induced pressures like lack of awareness, adoption of new high-yielding varieties, land reclamation, climate change, and overgrazing.[31] Lebanon has been increasingly working towards *in situ* and on-farm conservation of genetic resources in recent years. The country has established 14 nature reserves, with the largest one covering about 2% of Lebanese land and containing 26 key biodiversity areas.[30] In response to on-farm surveys showing a major decline in the use of farmer varieties due to changing food demands and markets, local nurseries and seed-cleaning units have been established to support production and use of local crop varieties.[33]

Figure 3: Crops originating from West Asia



Agrobiodiversity Index score

Lebanon has an Agrobiodiversity Index status score of 54.8.

Status: What's driving the Agrobiodiversity Index score?

For Lebanon, we see that scores are highest in consumption (78.1), followed by conservation (52.9), and production (33.4). This indicates that agrobiodiversity is relatively effectively used in consumption for healthy diets and conserved for current and future use options, while there is potential for much better use of agrobiodiversity in production for sustainable agriculture. We can take a closer look at the indicator scores to understand what underlies the differences in status of agrobiodiversity across the pillars of Lebanon's food system.

Consumption

Species diversity: Food species diversity is high in Lebanon relative to other countries in the world and also compared to other Mediterranean countries.

Functional diversity: The functional diversity score of 71 reflects a moderate number of Disability Adjusted Life Years attributable to dietary risk factors. Recent studies on food consumption patterns of young Lebanese people show a shift in diets toward increased intake of fat, milk, and animal protein and decreased intake of wholewheat bread and cereals.[34] It seems that the Lebanese Mediterranean diet may be converging with a pattern high in saturated fat, sugar, and refined foods and low in fiber, associated with an increased risk of non-communicable diseases such as obesity, cardiovascular disease, diabetes, and hypertension.

Underutilized species: Almost 60% of energy in Lebanese diets is obtained from sources other than major cereals, roots, and tubers, explaining the score of 92 for underutilized species in this category and indicating that diets are not overly dependent on staples. This does not mean that the potential of underutilized and local species is at its maximum but that the diet is not overly dependent on major staples.

There were no data available on varietal diversity in consumption.

Production

Species diversity: With 63 distinct commodities in production, crop species richness is moderate relative to the global maximum of 123 species (in China) and below average compared to the nine other Mediterranean countries. Olives, wheat, potatoes, barley, apples, grapes, tobacco, almonds, cherries, and oranges constitute the top ten crops by harvested area and together account for 72% of the 0.2 million ha harvested cropland. Cropped landscapes have a moderate crop species diversity relative to other countries in the world, and just below average compared to the other nine Mediterranean countries. There is a very high percentage (96%) of agricultural land that contains a high diversity of crop species at 10x10 km scales.[35] With 53 recorded freshwater fish species, fish richness is high relative to other countries in the world and above average compared to the nine other Mediterranean countries. Livestock species diversity in production is moderate compared to other countries in the world and average compared to the nine other Mediterranean countries.

Soil biodiversity: Soil biodiversity is low for most of the country, averaging 0.4 on scale of 0.11 to 1.35 (representing the minimum and maximum global extremes). Integrated plant nutrient management can help maintain and restore soil health, such as through increased use of cover crops, application of mulch and animal manure, and intercropping with legumes.

Landscape complexity: 41.6% of Lebanon's cropped landscapes have at least 10ha of natural vegetation at 1x1 km scales, which is well below the 100% recommendation, but above average for Mediterranean countries. Maintaining natural vegetation in and around cropland helps maintain habitat connectivity and ecosystem functioning to sustain nature's contributions to agriculture, including reducing the risk of pest and disease outbreaks, maintaining pollinators, and safeguarding crop wild relatives. Retaining at least 10% natural habitat at local (1x1 km) and landscape (10x10 km) scales could be achieved through on-farm practices such as live fences (trees, hedgerows), woodlots, flower strips and set aside, and off farm by safeguarding portions of natural or semi-natural forests, wetlands and grasslands around cultivated areas.

There were no data on varietal diversity, functional diversity, underutilized species, or pollinator diversity in production.

Conservation

Varietal diversity: Lebanon has a moderate score for varietal diversity (51.4), relative to the globally best performing country (France) indicating that there are a fair number of crop samples of Lebanese crop varieties conserved in genebanks.

Species diversity: The species diversity score is very high (74.2), making it second highest among the ten Mediterranean countries. This reflects that a high proportion of Lebanon's cultivated and wild crop species are conserved in genebanks, and a high diversity of crop wild relatives have been identified growing in country, relative to other countries in the world.

Underutilized species: Lebanon has a low score (33.2) for conservation of underutilized species (useful wild species). While 61.6% of known useful wild species are conserved *in situ*, their representativeness in *ex situ* repositories is very low (4.7%).

There were no data available for functional diversity, so this sub-indicator was not assessed.

Credit: ©IFAD/Jon Spaull

Actions: What actions are being taken to maintain and increase agrobiodiversity?

Consumption: Lebanon has food-based dietary guidelines in place, but national food composition tables, which could support the use of local species and varieties in diversifying diets, are not yet available.

Production: Action scores are high (60.1) for agrobiodiversity use in production. This score reflects widespread adoption of diversity-based practices together with low adoption of agrobiodiversity-supportive management practices.

- **Diversity-based practices:** Available data indicate that integrated farming approaches are widespread in Lebanon, with 89.8% of its agricultural landscapes (10x10 km areas) containing both cropland and pasture, thus facilitating crop–livestock integration.
- **Production management practices supporting agrobiodiversity:** Current data indicate nitrogen use efficiency is low relative to other countries in the world, at 0.4kg nitrogen output per kg nitrogen input. The environmental efficiency of production is moderate relative to other countries in the world, based on the Sustainable Nitrogen Management Index (SNMI) score, which combines data on both nitrogen use efficiency and land use efficiency (crop yields). These scores together suggest that there is an overuse of nitrogen, e.g. on soils which already have sufficient nitrogen quantities to support reasonable crop yields, and more targeted applications could reduce costs and environmental externalities while still providing good harvests. Lebanon has low levels of pesticide use relative to other countries in the world, estimated at 7kg per hectare, far below the highest global user (28kg per ha in Mauritius). Efforts to further reduce chemical pesticides, for example through integrated pest management, would have a positive impact on soil biodiversity, pollinators, and natural enemies of pests, with benefits for agriculture and biodiversity.

Credit: ©IFAD/Jon Spaull

Based on national statistics, organic agriculture is practiced on 0.2% of agricultural land in Lebanon, well below the 4.2% average for the ten Mediterranean countries. Conservation agriculture adoption is very low at 0.9% of agricultural land. Trees are integrated into 3.4% of agricultural land in Lebanon, which is very low relative to other countries in the world and compared to other Mediterranean countries. Evidence suggests tree coverage on farm can be increased to up to 30% with limited impacts on yield,[36] while providing valuable carbon sequestration services and helping maintain tree, soil, and animal biodiversity in agricultural landscapes. Drought-resistant and native tree varieties could be prioritized to minimize water consumption while providing other benefits to farmers.

Conservation: Lebanon has reported on 67.5% of the indicators for monitoring progress on the implementation of the FAO second Global Plan of Action on Plant Genetic Resources for Food and Agriculture. The indicators reported reveal that Lebanon has undertaken reasonable actions to survey, inventory, and collect plant genetic resources for food and agriculture for long-term conservation, and has supported on-farm conservation of local varieties involving a large number of farmers. Some activities have been conducted to support the *in situ* conservation of crop wild relatives, although more efforts are needed to embed their conservation into protected area management plans.

The national genebank has distributed germplasm to farmers and to foreign stakeholders, but no distribution has been reported to private sector or national breeders.

While the documentation and monitoring of plant genetic resources for food and agriculture in *ex situ* repositories is well covered, the documentation of crop wild relatives and local farmer varieties remains very limited in the country. There is no national system to systematically monitor and safeguard genetic diversity, which undermines efforts to effectively conserve and use these genetic resources and to reduce genetic erosion in the country.

Commitments: How supportive of agrobiodiversity are national policies?

The commitments analysis for Lebanon was based on their *National Biodiversity Strategy and Action Plan for 2016.*[37]

Consumption: While Lebanon's National Biodiversity Strategy and Action Plan (NBSAP) is one of the few to refer to food diversity in markets as well as crop and edible plant diversity, indicating an awareness of agrobiodiversity's importance for markets and consumption, there are no specific strategies or targets to make better use of agrobiodiversity for healthy diets.

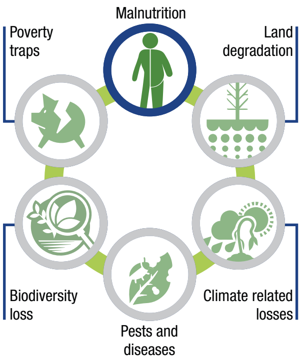
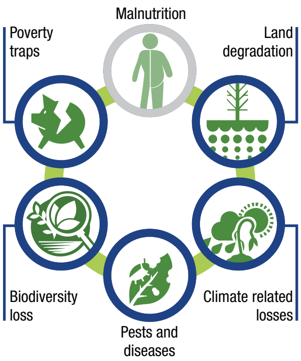
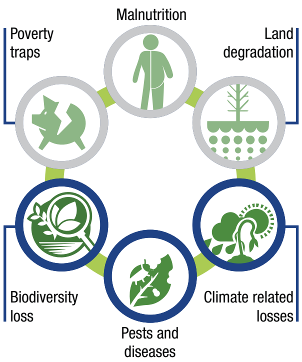
Production: Lebanon has a low score (37.5) for commitments to enhancing agrobiodiversity in production relative to other countries in the world, but above average compared to other Mediterranean countries. Lebanon has made strong commitments to landscape complexity, focusing on safeguarding and restoring natural habitat and planting native trees to boost biodiversity and ecosystem functioning. For example, Lebanon aims, by 2030, to ensure that all biodiversity is valued and sustainably managed to safeguard species, and ensure Lebanese citizens equal access to ecosystem goods and services. However, the NBSAP lacks strategies or targets to promote on-farm agrobiodiversity, such as crop varietal or species diversity, livestock breeds, or soil biodiversity.

Conservation: Lebanon has a moderate score (40) for commitments to conserving agrobiodiversity relative to other countries in the world, but below average compared to other Mediterranean countries. A national strategy for conservation and management of plant genetic resources for food and agriculture in Lebanon (2015–2035) has been developed under the coordination of the Ministry of Agriculture. Lebanon has objectives for promoting *in situ* conservation of crop wild relatives and monitoring and early warning systems for the loss of plant genetic resources for food and agriculture.[38] For example, the country commits to protecting by 2030 at least 50% of its native fauna and flora, including crop wild relatives, through *in situ* and *ex situ* conservation efforts. Stronger commitments could be made to conserving Lebanon's native varietal, species and functional diversity particularly *ex situ* (in genebanks).

Recommendations

This section suggests concrete actions that can be taken to improve the use and conservation of agrobiodiversity for more sustainable food systems (Table 1). The list of actions is by no means exhaustive or prescriptive. It is intended for review, discussion, and improvement by in-country policy specialists.

Table 1: Recommended actions to enhance agrobiodiversity in the national food system

		Contributing to:	
Food system pillar in the Agrobiodiversity Index	**Recommendations**	**Risk and resilience**	**Global policy**
Consumption for healthy diets	Promote the traditional Lebanese diet and leverage the potential of local or regional species and varieties (e.g. by developing related food composition tables) to maintain and increase dietary diversity.		SDG2 Zero Hunger SDG12 Responsible Consumption and Production WHO Decade of nutrition – reducing overweight, obesity and anemia
Production for sustainable agriculture	Continue and extend the 40 Million Trees Program to support planting of functionally useful native trees on and around farmland to support biodiversity and increase farm resilience to climate change by providing temperature regulation services for crops and livestock and improving water infiltration and storage in soils. Support farmer adoption of agroecological practices to maintain and reduce agrochemical inputs and enhance natural pest control and pollinators.		Convention on Biological Diversity (CBD) Post-2020 Goal 1[ii] No Net Loss SDG 1 No Poverty SDG2 Zero Hunger SDG14 Life Below Water SDG15 Life on Land
Conservation for future use options	Make the conservation of agrobiodiversity a national priority. Develop legislation, regulations, policies to support conservation and use of agrobiodiversity. Develop a properly resourced national agrobiodiversity program. Establish a national monitoring system for local crop diversity (farmer varieties and crop wild relatives) and domestic animal genetic resources. Promote the conservation and use of underutilized species.		CBD Post-2020 Goal 3 Genetic Diversity 4 Nature's Benefits SDG 15 Life on Land FAO second Global Plan of Action on Plant Genetic Resources for Food and Agriculture

Agrobiodiversity highlight

Wild species for food

Lebanese people generally make good usage of wild edible plants, in their food systems and lifestyles, for example through fishing, hunting, honeymaking, charcoal, recreation and eco-tourism.

Despite its small size, the country is home to a remarkable number of wild species still regularly used by people for food. As a result of traditional food consumption habits and the local ethno-botanical heritage, about 212 species in Lebanon have an economic value and are considered as medicinal plant species or wild edible crops. Rural communities, including poor farmers with low incomes, rely on wild food they harvest directly for food and nutrition security and some benefit through selling the collected products to urban communities.

These species are now all under threat, however, from urbanization, pressure from refugees from the war in Syria, and overharvesting. Loss of wild food species seriously affects the diet, food basket and income of local people.

Lebanon is taking action to save its rich range of wild food species. Traditional knowledge about wild food species is being documented through leaflets, booklets or articles and healthy diets based on wild species are being promoted by some dieticians and NGOs.

The genetic diversity of Lebanon's plant species is being preserved *ex situ* in the Lebanese Agricultural Research Institute (LARI) national genebank which has 1,380 seed collections representing 881 different Lebanese wild species stored under long-term conditions, with duplications held at Kew's Millennium Seed Bank of the Royal Botanic Gardens. More than 1,969 samples of wild wheat relatives and forage from Bekaa valley have been collected for long-term storage in genebanks in collaboration with the International Center for Agricultural Research in the Dry Areas (ICARDA). Wheat and barley farmer varieties, as well as improved varieties of wheat, barley, lentil, chickpea, and vetch are also conserved as *ex situ* collections at LARI and are regularly regenerated every five years.

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Credit: ©IFAD/Jon Spaull

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End notes

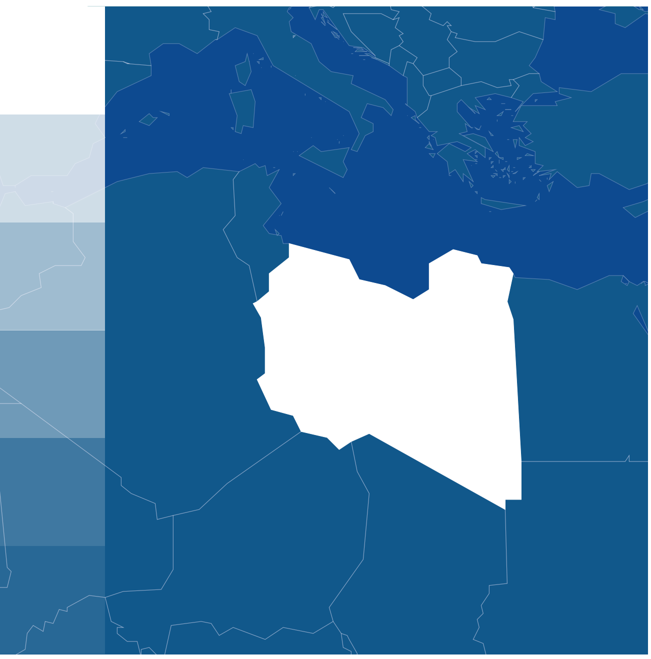
I. The International Union for the Conservation of Nature (IUCN) ranks species according to how threatened they are. Rankings range from 'extinct', through 'critically endangered', 'endangered' and 'vulnerable', to 'near threatened' and 'least concern'.

II. The Convention on Biological Diversity is an international treaty for the sustainable use and conservation of biological diversity. In 2010 it launched a strategic plan, running from 2011 to 2020, with 20 ambitious targets known as the Aichi Targets from the city in which they were signed. The international community has developed new targets, but their signature has been delayed due to the COVID-19 crisis.

Credit: ©IFAD/Jon Spaull

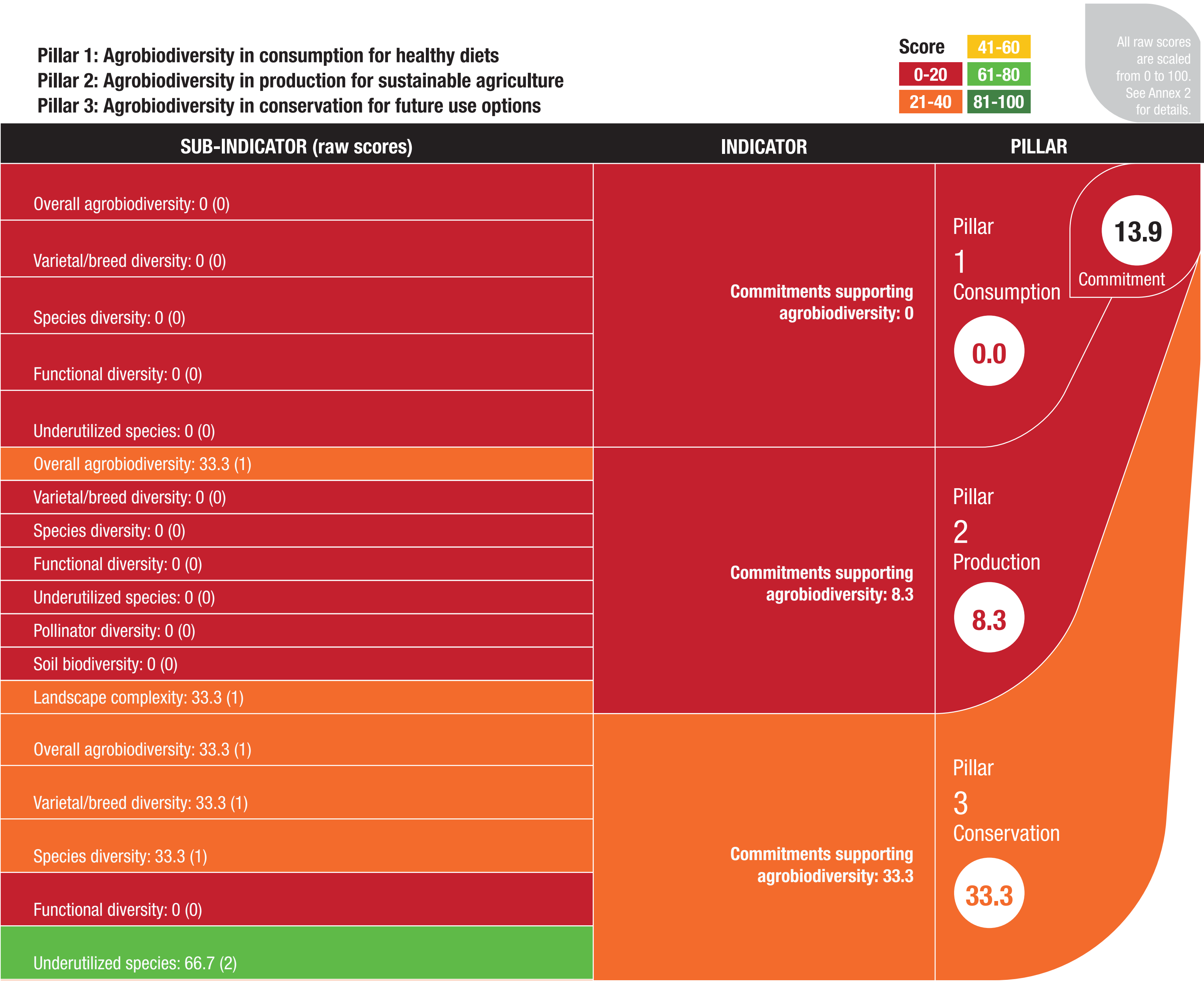
Libya

Country profile



Key messages

- Libya has an Agrobiodiversity Index status score of 42.7.
- There is a lack of data on several indicators that makes it difficult to assess the status of agrobiodiversity as comprehensively as for other Mediterranean countries.
- In consumption, there is an overdependence on cereals, oil, and sugars, which provide almost three-quarters of people's energy supply, and may increase the risk of malnutrition, dietary health problems, and vulnerability of food supply to import disruptions.
- In production, crop and livestock diversity are moderate relative to other countries, yet this is quite impressive given that Libya is almost entirely desert and has extensive infertile soils. The proportion of natural vegetation in cropped landscapes could be substantially increased to boost ecosystem functions important for agriculture, including pollination, natural pest controls, soil erosion control, water infiltration, and local climate regulation.
- In conservation, native crop varieties are relatively well conserved while conservation of crop wild relatives, particularly in genebanks, should be substantially improved to safeguard plant genetic resources for food and agriculture.



Status 42.7

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 54.0	**Functional diversity: 54.0**	(Avoided) Disability Adjusted Life Years attributable to dietary risks per 100,000 adults: 54.0 (8,845)
Pillar 2 Production 22.7	**Varietal/breed diversity: 13.2**	Livestock breed diversity (Shannon's Index): 13.2 (0.4)
	Species diversity: 40.2	Crop species richness in production (count): 33.3 (41.0)
		Crop species diversity in production (Shannon's Index): 47.0 (1.1)
		Cropland with high crop species richness (%): 6.9 (6.9)
		Freshwater fish species richness (average count): 66.9 (55.5)
		Livestock diversity in production (Shannon's Index): 47.0 (0.8)
	Soil biodiversity: 10	Potential soil biodiversity (Index 0 to 2): 10.0 (0.2)
	Landscape complexity: 27.4	Cropland with >10% natural and semi-natural habitat at 1x1km scales (%): 27.4 (27.4)
Pillar 3 Conservation 51.3	**Varietal diversity: 71.0**	Varietal diversity in genebanks (Shannon's Index): 71.0 (4.0)
	Species diversity: 52.0	Species diversity in genebanks (Shannon's Index): 46.2 (2.9)
		Crop wild relative occurrence diversity (Shannon's Index): 57.8 (3.7)
	Underutilized species: 30.8	*In situ* conservation of useful wild species (%): 58.5 (58.5)
		Ex situ conservation of useful wild species (%): 3.0 (3.0)

Action 10.2

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 0.0	**Management practices supporting agrobiodiversity: 0**	Published diet guidelines (Yes/No): 0.0 (0.0)
		Published food composition tables (Yes/No): 0.0 (0.0)
Pillar 2 Production 26.9	**Diversity-based practices: 2.0**	Crop-livestock integration (% agricultural land with cropland and pasture): 3.9 (3.9)
		Integrated landscape initiatives (count): 0.0 (0.0)
	Management practices supporting agrobiodiversity: 51.8	(Inverted) Sustainable Nitrogen Management Index (Index 0 to infinity): 56.3 (34.8)
		Tree cover on agricultural land (%): 0.7 (0.2)
		(Avoided) pesticide use (kg per ha): 98.5 (0.5)
Pillar 3 Conservation 3.8	**Management practices supporting agrobiodiversity: 3.8**	Indicators reported to the World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (%): 3.8 (3.8)

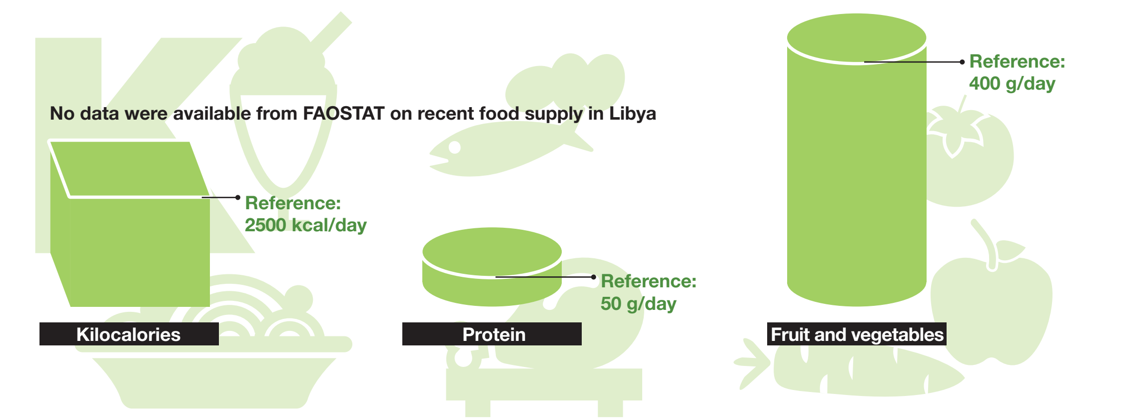
Context

Libya is a country with an upper middle income. In 2019, its annual GDP was US$52 billion equating to an annual per capita GDP of US$7,684.[1] Libya covers an area of about 1.8 million km^2 [2] and is home to more than 6 million people.[3] Population density is low, estimated at four people per km^2 in 2018.[4] Eighty percent of the population live in urban areas.[5] An estimated 11.4% of the population are vulnerable to multidimensional poverty according to the latest survey data from 2014.[6] Since 2014, Libya has been badly affected by civil war.

Consumption for healthy diets

The Libyan diet typically includes wholewheat and barley flour, couscous and low intakes of rice, dairy products such as cheese and buttermilk, and lamb meat (Figure 1). Consumption of vegetables, such as tomatoes, pumpkin, potatoes, and chickpeas, and fruit, especially dates, is common. Olive oil is widely used in local dishes. Tea is the most popular beverage.[7] In Libya, the overall life expectancy of an average person is 73 years.[8] No data are available on the percentage of Libyans who were undernourished in 2019,[9] however, 16.8% and 35.9% of the population were estimated to be suffering from severe or moderate to severe food insecurity between 2017 and 2019.[10] The prevalence of stunting and wasting for Libyan children under five was reported as 38.1% and 10.2% respectively in 2014.[11,12] Around 33% of women aged between 15 and 49 are anemic[13] and 10.2% of the population between 20 and 79 are diabetic.[14] Obesity prevalence is estimated at 39.6% of adult women and 25.0% of adult men.[15] In Libya, the overall life expectancy of an average person is 73 years.[8] No data are available on the percentage of Libyans who were undernourished in 2019,[9] however, 16.8% and 35.9% of the population were estimated to be suffering from severe or moderate to severe food insecurity between 2017 and 2019.[10] The prevalence of stunting and wasting for Libyan children under five was reported as 38.1% and 10.2% respectively in 2014.[11,12] Around 33% of women aged between 15 and 49 are anemic[13] and 10.2% of the population between 20 and 79 are diabetic.[14] Obesity prevalence is estimated at 39.6% of adult women and 25.0% of adult men.[15]

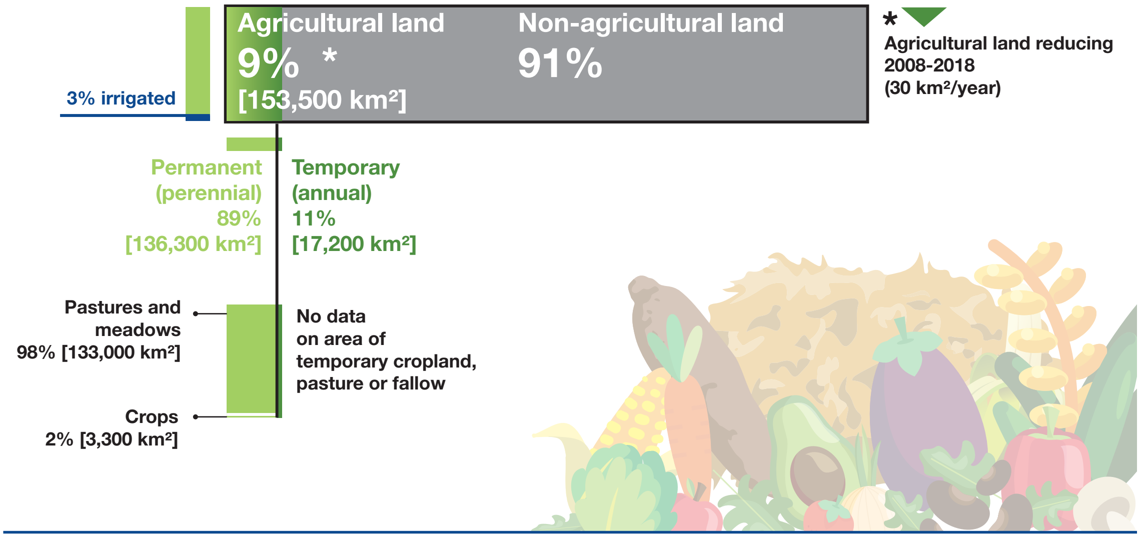
Figure 1: Kilocalorie, protein, fruit and vegetable supply



Production for sustainable agriculture

In Libya, approximately 8.7% (153, 500 km^2) of the total land area is dedicated to agriculture, of which a small 11.2% (17,200 km^2) is arable land (Figure 2). No data are available on other land uses.[16,17] Agriculture, forestry, and fishing contribute 1.8% of the country's GDP. Olives, barley, wheat, almonds, dates, watermelon, potatoes, onions, plums (and sloes), and tomatoes constitute the top ten commodities by harvested area and together account for 91.5% of the 0.8 million hectares of harvested land area. Approximately 19% of the Libyan population is employed in the agricultural sector, and of these 22% are women. Regarding Libyan fisheries production, in 2018, capture production and aquaculture were estimated at 30,266 tonnes and 10 tonnes respectively.[18] In the same year, annual livestock production, with eggs, milk and meat as the three main animal-sourced food produced, was estimated at over 1 million tonnes.[19]

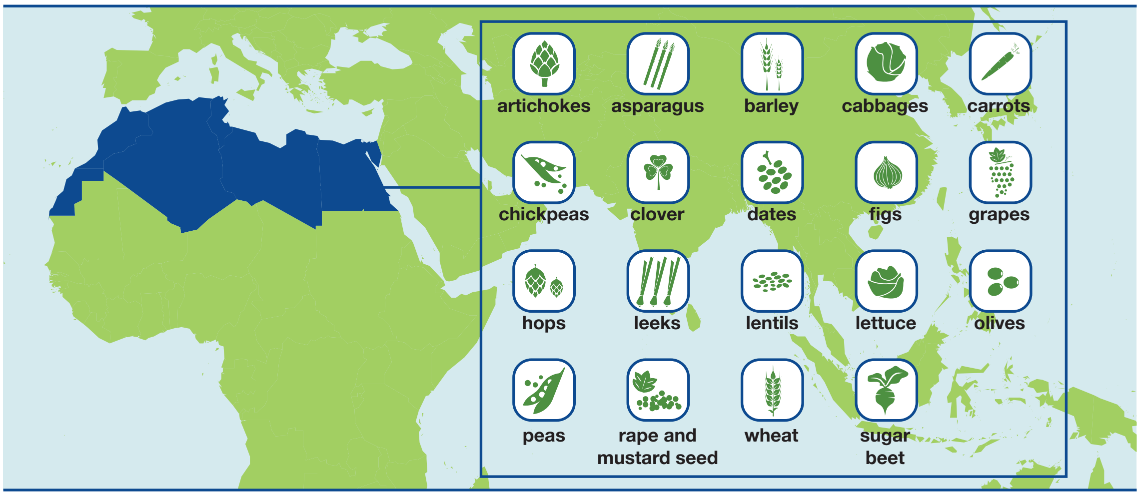
Figure 2: Land used for agriculture



Conservation for future use options

About 3,437 km² of terrestrial areas (0.21% of total land) and 357,895 km² of marine areas are protected in Libya.[20] Only 2,170 km² of its land area[21] is forested. The country lost 2.72 km² of its tree cover from 2001 to 2019, showing a decrease of 4% since 2000.[22] In Libya, the distribution and populations of 239 plant and 862 animal species have been assessed, of which nine plants, 11 mammals and eight birds are considered threatened.[23–25I] Libya is part of the south and east Mediterranean center of origin for a number of crop species, including artichokes, barley, dates, grapes and olives (Figure 3). Among plant genetic resources for food and agriculture, native species of barley and wheat are among those considered threatened.[26] Droughts, fires, and encroachment are among the major threats to plant genetic resources for food and agriculture.

Figure 3: Crops originating from South and East Mediterranenan



Agrobiodiversity Index score

Libya has an Agrobiodiversity Index status score of 43.

Status: What's driving the Agrobiodiversity Index score?

Consumption

Species diversity in diets: There is a lack of FAO data on species diversity available for human consumption.

Functional diversity: The functional diversity score of 54 reflects a relatively high number of Disability Adjusted Life Years attributable to dietary risk factors. The three most important food groups that Libyan people consume are cereals, oils, and sugars, and these provide almost three-quarters of the energy supply. This diet, dense in energy and poor in micronutrients, is conducive to malnutrition and dietary health risks. The overreliance on cereals also adds to vulnerability in terms of food supply, particularly because currently Libya is highly dependent on cereal imports.

Underutilized species: There is a lack of FAO data on underutilized and local species available for human consumption.

There were no data available on varietal diversity in consumption.

Production

Varietal diversity: The diversity of livestock breeds maintained in production in Libya (0.4) is very low relative to other countries in the world and compared to the average for the ten Mediterranean countries (1.5). Libya has two breeds of cattle in production, one breed of sheep, and one of goat, though other species and breeds may exist whose population counts are not reported to FAO. Keeping multiple breeds in production would help farmers maintain livelihoods in times of pest and disease outbreaks or other production challenges, because different breeds have different resistance to pests and diseases.

Species diversity: With 41 distinct commodities in production, crop species richness is low relative to the global maximum of 123 species (in China) and below average across the ten Mediterranean countries. Cropped landscapes have moderate crop species diversity relative to other countries in the world, and just below average across the ten Mediterranean countries. A very low percentage (6.9%) of agricultural land contains a high diversity of crop species at 10x10 km scales. Enhancing crop diversity at field, farm, and landscape levels is recommended to enhance natural pest and disease controls, yield stability, biodiversity, and other ecosystem services.[27] With 56 recorded freshwater fish species, fish richness is high relative to other countries in the world and above average compared to the nine other Mediterranean countries. Livestock species diversity in production is moderate compared to other countries in the world and average compared to the nine other Mediterranean countries. Actions to boost livestock richness in areas of the country where these are low would help ensure farmers in all regions rely on a wide species base, helping shield them against pests and diseases and other production challenges.

Soil biodiversity: Soil biodiversity is very low for most of the country, averaging 0.2 on scale of 0.11 to 1.35 (representing the minimum and maximum global extremes). This makes Libya a country with one of the lowest soil biodiversity levels in the world. Targeted use of crop species with restorative traits (e.g. using deep-rooted trees to reverse salinization, application of mulch and animal manure to restore nutrients, and intercropping with legumes) together with low or no tillage and addition of organic material could help restore soils affected by salinization, low fertility, and soil erosion to improve soil health.

Landscape complexity: 27.4% of Libya's cropped landscapes have at least 10 ha of natural vegetation at 1x1km scales, which is average for Mediterranean countries, even though well below the 100% recommended. Maintaining natural vegetation in and around cropland helps maintain habitat connectivity and ecosystem functioning to sustain nature's contributions to agriculture, including reducing the risk of pest and disease outbreaks, maintaining pollinators, and safeguarding crop wild relatives. Retaining at least 10% natural habitat at local (1x1 km) and landscape (10x10 km) scales could be achieved on farm through practices suited to local soils and climates, such as drought-resistant grass, shrub and tree field borders and set aside, and off farm by safeguarding native trees and grasslands around cultivated areas.

There were no data available on functional diversity, underutilized species, or pollinator diversity in production.

Conservation

Varietal diversity: Libya has a high score of 71 for varietal diversity relative to the globally best performing country (France), and above average compared to the ten Mediterranean countries. This means that accessions of Libyan crop varieties are relatively well conserved in genebanks in terms of number of different varieties and their abundance.

Species diversity: The species diversity score of 52 indicates Libya has a moderate amount of its cultivated and wild plant species conserved in genebanks, and a moderate diversity of crop wild relative species have been identified growing in-country, relative to other countries in the world.

Underutilized species: Libya has a low score (30.8) for conservation of underutilized species (useful wild species). While above half (58.5%) of known useful wild plants in Libya are conserved *in situ*, only 3% are conserved *ex situ*.

There were no data available for functional diversity of genetic resources in conservation.

Credit: ©IFAD/H. N. Serra

Actions: What actions are being taken to maintain and increase agrobiodiversity?

Consumption: For consumption, Libya has not reported on food-based dietary guidelines or food composition tables for supporting agrobiodiversity for healthy diets.

Production: Action scores are low (26.9) for agrobiodiversity use in production. This score reflects very low adoption of diversity-based practices together with moderate adoption of agrobiodiversity-supportive management practices.

- **Diversity-based practices:** Available data indicate that there is low potential for integrated farming in Libya, with 3.9% of its agricultural landscapes (10x10 km areas) containing both cropland and pasture facilitating crop-livestock integration. This is much lower than the Mediterranean average (33.5%) and likely reflects the difficulty in growing crops in the 90% of the country that is desert, while these areas still include camels and other water-efficient livestock populations.
- **Production management practices supporting agrobiodiversity:** The environmental efficiency of production is moderate relative to other countries in the world, based on the Sustainable Nitrogen Management Index (SNMI) score, which combines data on both nitrogen use efficiency and land use efficiency (crop yields). Libya has very low levels of pesticide use relative to other countries in the world, estimated at 0.5 kg per hectare, far below the highest global user (28.0kg per hectare in Mauritius). The avoided use of pesticides has a positive impact on soil biodiversity, pollinators, and natural enemies of pests, with benefits for agriculture and biodiversity. Trees are integrated into 0.2% of agricultural land in Libya, which is extremely low relative to other countries in the world and likely reflects the difficulty in sustaining plants needing much water, such as trees, in extreme arid climates. Setting aside small areas of farmland for planting functionally and nutritionally diverse drought-resistant trees can provide multiple benefits for farmers in arid climates.[28] Drought-resistant, native tree varieties could be prioritized to minimize water consumption while providing other benefits to farmers. No data are available on the level of adoption of organic or conservation agriculture.

Conservation: It has not been possible to properly evaluate the action indicators for Libya, given that the country has not reported its progress towards the implementation of the Second Global Plan of Action for Plant Genetic Resources for Food and Agriculture in the country.

Commitments: How supportive of agrobiodiversity are national policies?

The commitments analysis was based on Libya's *Fourth National Report on the Implementation of the Convention on Biological Diversity29.*[29]

Consumption: No commitments to enhancing agrobiodiversity in consumption for healthy diets were identified. This is based only on a review of Libya's national report to the CBD, and other national documents may include commitments to promoting the use of food diversity for healthy diets. Nonetheless, it highlights a potential gap in agrobiodiversity policy.

Production: Libya has a very low score (8.3) for commitments to enhancing agrobiodiversity in production. Libya mentions in their report that the government aims to preserve natural habitats from degradation and loss, particularly through environmental impact assessments, which would help maintain landscape complexity. However, there are no commitments to enhancing farmer use of local breeds and varieties, protecting pollinators or soil biodiversity, or improving species or functional diversity in Libyan's production systems.

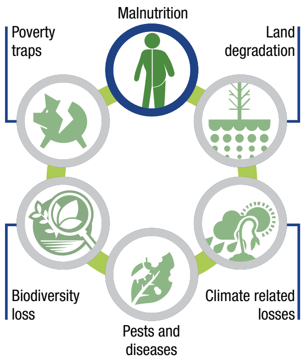
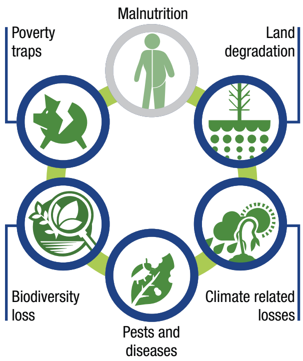
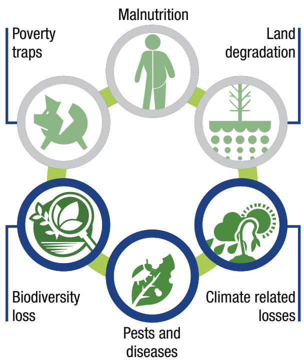
Conservation: Libya has a low score (33.3) for commitments to enhance agrobiodiversity in conservation. The strongest commitments are to protect crop wild relatives and local crop and livestock breeds, including through maintaining the national genebank where the germplasm of different crops is protected and bred to develop new varieties. The report indicates an intention to expand protected areas and natural reserves to protect wildlife including crop and livestock wild relatives. The report mentions the importance of protecting its marine fish resources, particularly through reducing sea pollution. However, stronger commitments with measurable targets are needed to help safeguard varietal, species and functional diversity of crops, fish, and livestock.

Credit: Pixabay/Gero Birkenmaier

Recommendations

This section suggests concrete actions that can be taken to improve the use and conservation of agrobiodiversity for more sustainable food systems (Table 1). The list of actions is by no means exhaustive or prescriptive. It is intended for review, discussion, and improvement by in-country policy specialists.

Table 1: Recommended actions to enhance agrobiodiversity in the national food system

		Contributing to:	
Food system pillar in the Agrobiodiversity Index	**Recommendations**	**Risk and resilience**	**Global policy**
Consumption for healthy diets	Increase diversity in food supply and reduce dependence on cereals, oils, and sugars. Develop nutrition programs and food-based dietary guidelines to support dietary diversification using locally available products.		SDG2 Zero Hunger SDG12 Responsible Consumption and Production WHO Decade of nutrition – reducing overweight, obesity and anemia
Production for sustainable agriculture	Target use of plant functional traits and agroecological farming practices to restore soil biodiversity, such as: deep-rooted drought-tolerant trees to reverse salinization, applying mulch and animal manure, and intercropping with legumes. Increase the proportion of natural habitat embedded in agricultural land.		Convention on Biological Diversity (CBD) Post-2020 Goal 1[ii] No Net Loss SDG 1 No Poverty 2 Zero Hunger 14 Life Below Water 15 Life on Land
Conservation for future use options	There seems to be no active plant genetic resources program in Libya. There is thus a need to develop a national program and build capacities to promote the effective conservation and use of genetic resources in the country.		CBD Post-2020 Goal 3 Genetic Diversity 4 Nature's benefits SDG 15 Life on Land FAO second Global Plan of Action on Plant Genetic Resources for Food and Agriculture

Agrobiodiversity highlight

The remarkable date diversity of Libya

An increasing demand for date fruits worldwide leading to the need to fulfil the market demand with high quality products has resulted in severe genetic erosion with loss of cultivars. Consequently, conservation of date palm germplasm is a fundamental topic for date production and food security in desert and semi-desert areas.

Libya, though only the eleventh most important country for date production, representing a tiny 2.5% of total production, has remained a repository of a rich date diversity. Past and recent political events deeply affected trade and consequently export is quite limited in comparison with the neighboring countries. Such a circumstance, which beyond question represents a limit from the economic point of view, resulted in a benefit for the conservation of date palm germplasm.

Unlike other North African countries, in which the predominance of elite cultivars determined severe genetic erosion and the overall impoverishment of date palm agrobiodiversity, Libya, free from market incentives, preserves a huge richness of date palm germplasm.

More than 400 different date varieties still grow in the country of which about one hundred are of commercial interest. This incredible genetic richness has served as a highly effective natural defence for the plantations, which have remained safe from pathogens such as *Fusarium oxysporum* f. sp. albedinis (Bayoud disease).

Libya's date varieties fall into three major groups: the fleshy-fruited coastal varieties, the semi-soft varieties from the central zone, mostly consumed fresh (Kathari, Abel, Tagiat) and the less succulent varieties from the southern oases (Amjog, Emeli, Awarig, Tascube, Intalia, Tamjog). These latter cultivars are suited for drying and can be stored for up to ten years, making them highly appreciated by the caravans that formerly crossed the desert.

Sources: [30]

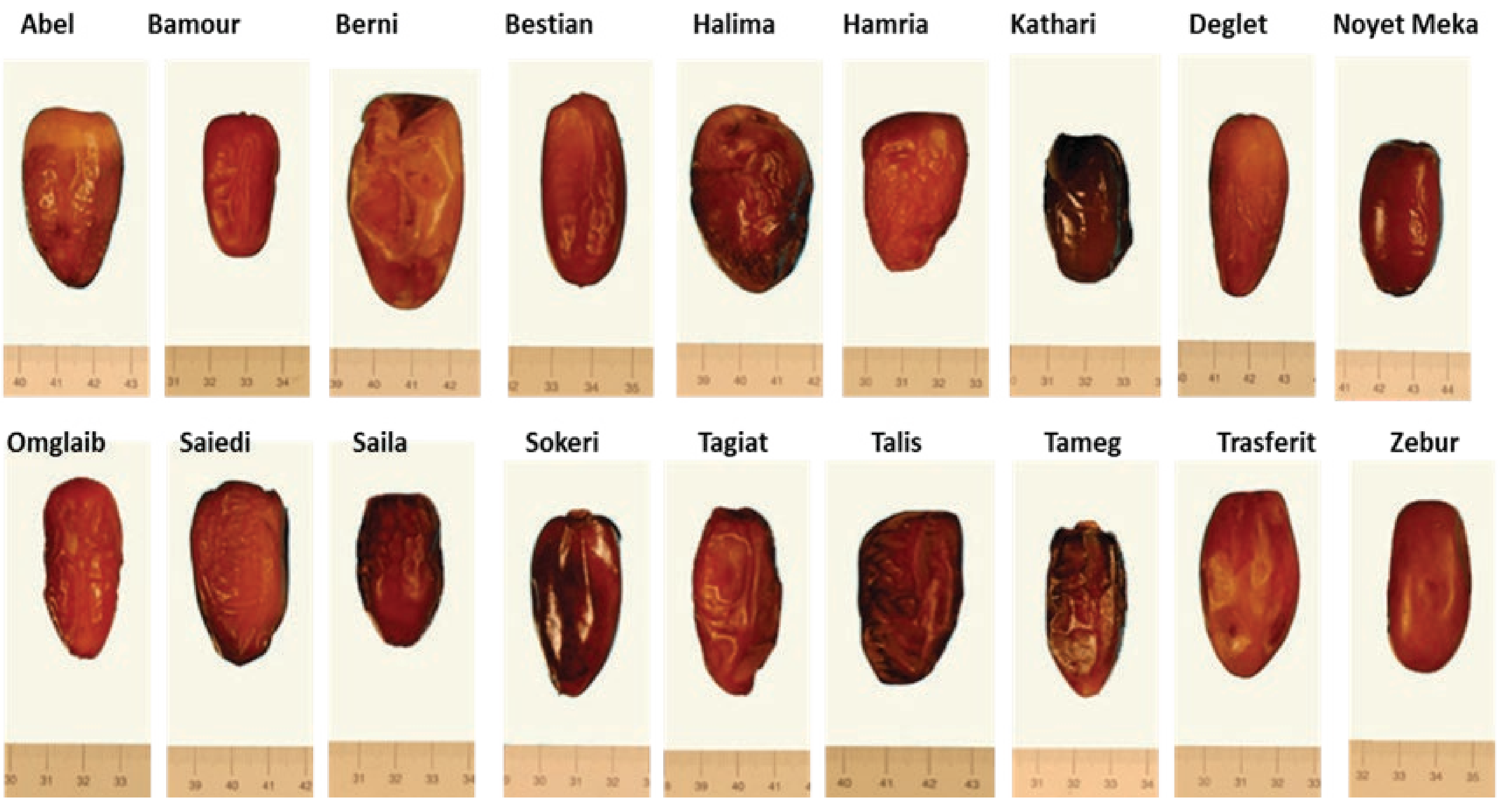


Photo: Fruits of date palm cultivars grown in Libya.

Credit: (IAO photograph archive)

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End notes

I. The International Union for the Conservation of Nature (IUCN) ranks species according to how threatened they are. Rankings range from 'extinct', through 'critically endangered', 'endangered' and 'vulnerable', to 'near threatened' and 'least concern'.

II. The Convention on Biological Diversity is an international treaty for the sustainable use and conservation of biological diversity. In 2010 it launched a strategic plan, running from 2011 to 2020, with 20 ambitious targets known as the Aichi Targets from the city in which they were signed. The international community has developed new targets, but their signature has been delayed due to the COVID-19 crisis.


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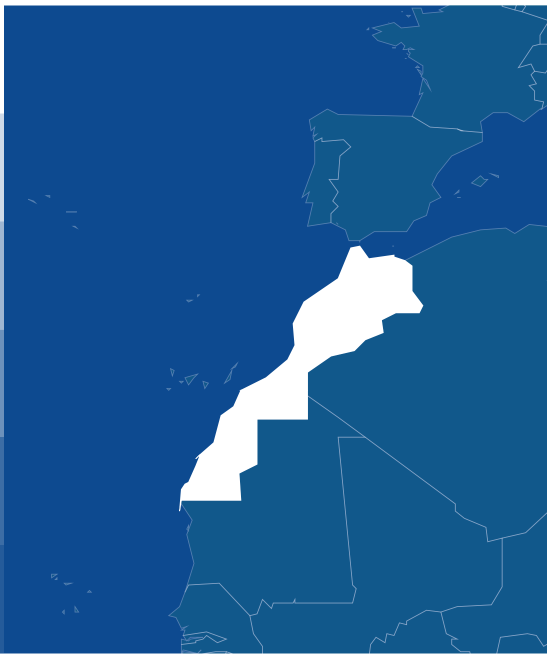
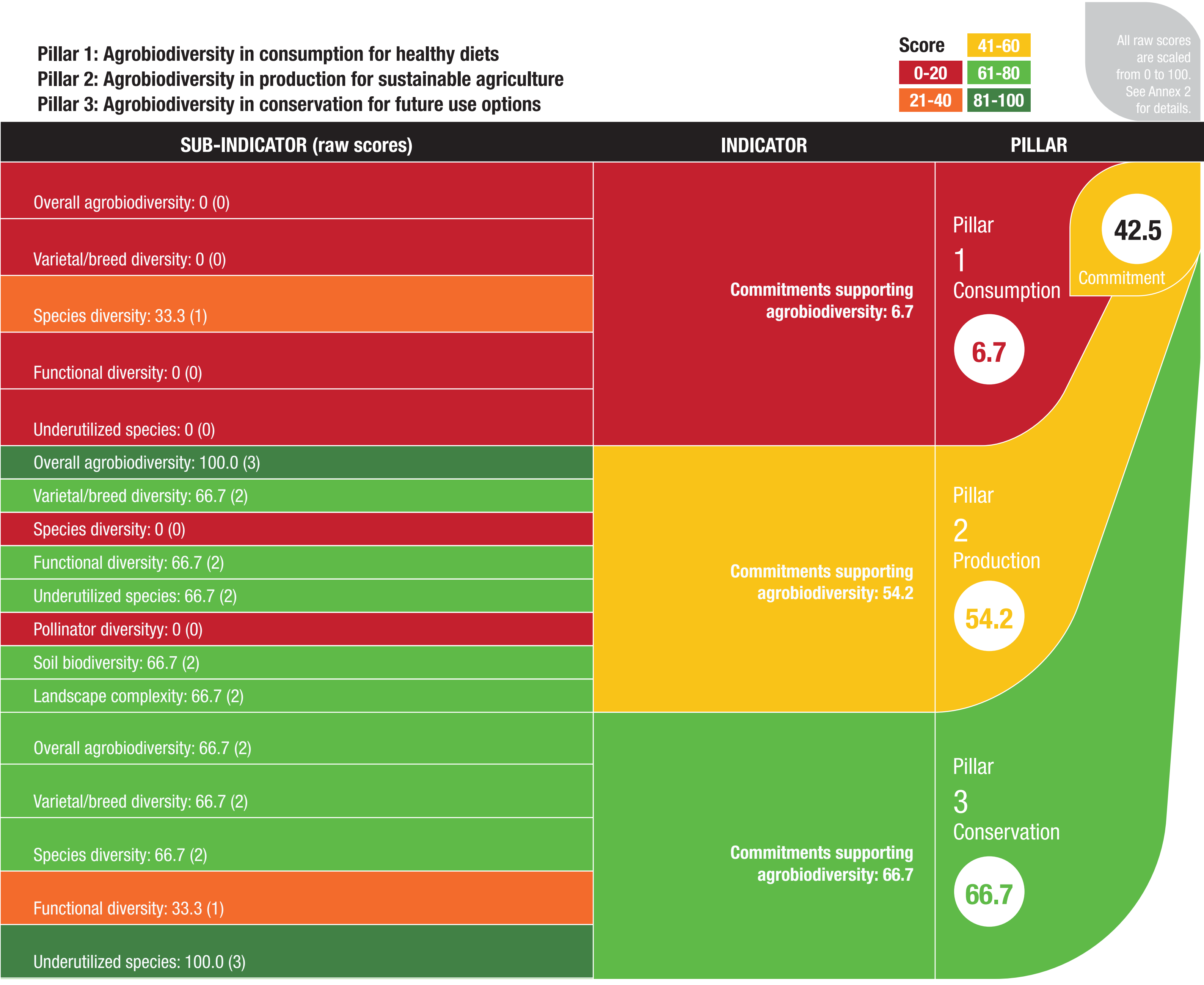
Morocco

Country profile



Key messages

- Morocco has an Agrobiodiversity Index status of 54.1, reflecting a moderate integration of agrobiodiversity into the food system.
- In consumption, while food species diversity is relatively high, diets are heavily dependent on major staple crops and red meat. Consumption of underutilized and local species, nut species and whole grains is relatively low. These dietary patterns contribute to dietary risks.
- The production system is characterized by high livestock breed diversity while crop species and livestock species diversity are moderate, and fish species richness is low compared to other Mediterranean countries. Soil biodiversity is very low. Morocco has low levels of landscape complexity and natural vegetation could be better integrated in and around croplands.
- Although a considerable number of Morocco's species and varietal diversity are conserved in genebanks compared to other Mediterranean countries, the *in situ* diversity of its underutilized species and other useful wild socioeconomically and culturally valuable species are poorly represented in genebanks.



PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Status 54.1		
Pillar 1 Consumption 60.5	**Species diversity: 65.1**	Food diversity in supply (Shannon's Index): 65.1 (2.8)
	Functional diversity: 53.1	(Avoided) Disability Adjusted Life Years attributable to dietary risks per 100,000 adults: 53.1 (9,017)
	Underutilized species: 63.3	Energy from sources other than cereals, roots and tubers (%): 63.3 (38.0)
Pillar 2 Production 41.6	**Varietal/breed diversity: 62.3**	Livestock breed diversity (Shannon's Index): 62.3 (1.9)
	Species diversity: 51.3	Crop species richness in production (count): 71.5 (88.0)
		Crop species diversity in production (Shannon's Index): 39.2 (0.9)
		Cropland with high crop species richness (%): 61.2 (61.2)
		Freshwater fish species richness (average count): 8.3 (6.9)
		Livestock diversity in production (Shannon's Index): 76.1 (1.2)
	Soil biodiversity: 15.0	Potential soil biodiversity (Index 0 to 2): 15.0 (0.3)
	Landscape complexity: 37.9	Cropland with >10% natural and semi-natural habitat at 1x1km scales (%): 37.9 (37.9)
Pillar 3 Conservation 60.1	**Varietal diversity: 70.2**	Varietal diversity in genebanks (Shannon's Index): 70.2 (4.0)
	Species diversity: 71	Species diversity in genebanks (Shannon's Index): 70.4 (4.4)
		Crop wild relative occurrence diversity (Shannon's Index): 71.5 (4.6)
	Underutilized species: 39.1	*In situ* conservation of useful wild species (%): 76.2 (76.2)
		Ex situ conservation of useful wild species (%): 2.0 (2.0)

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Action 28.8		
Pillar 1 Consumption 0.0	**Management practices supporting agrobiodiversity: 0.0**	Published diet guidelines (Yes/No): 0.0 (0.0)
		Published food composition tables (Yes/No): 0.0 (0.0)
Pillar 2 Production 26.5	**Diversity-based practices: 16.7**	Crop-livestock integration (% agricultural land with cropland and pasture): 33.3 (33.3)
		Integrated landscape initiatives (count): 0.0 (0.0)
	Management practices supporting agrobiodiversity: 36.3	Nitrogen use efficiency (kg N output per kg N input): 64.4 (0.7)
		(Inverted) Sustainable Nitrogen Management Index (Index 0 to infinity): 51.0 (38.9)
		Organic agriculture (%): 0.03 (0.03)
		Tree cover on agricultural land (%): 6.9 (2.1)
		(Avoided) pesticide use (kg per ha): 95.6 (1.5)
		Conservation agriculture (%): 0.05 (0.05)
Pillar 3 Conservation 60.0	**Management practices supporting agrobiodiversity: 60.0**	Indicators reported to the World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (%): 60.0 (60.0)

Context

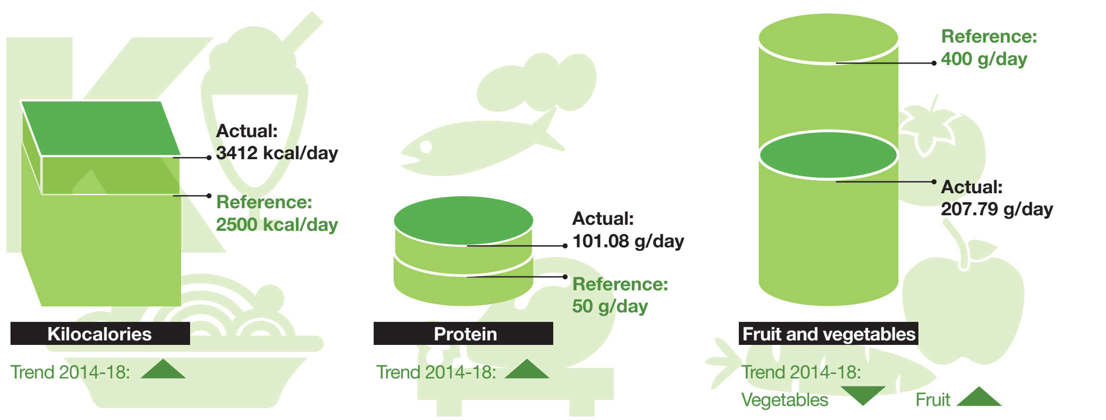
Morocco is a lower middle-income country. In 2019, its annual and per capita GDP were US$119 billion and US$3,204 respectively.[1] Morocco's land area covers 446,550 km^2.[2] The country's population is over 36 million people,[3] with an estimated population density of 81 inhabitants per km^2 in 2018.[4] About 63% of Morocco's population reside in urban areas.[5] Latest estimates, from 2019, indicated that 4.8% of the population lived below the national poverty line,[6] while data from 2011 estimated 13.1% of the population was vulnerable to multidimensional poverty.[7]

Consumption for healthy diets

The Moroccan diet typically exhibits high to moderate consumption of wholewheat and barley flour, couscous, dairy products, such as cheese and buttermilk, lamb meat, and low intake of rice (Figure 1). Vegetables such as tomatoes, pumpkin, potatoes, and chickpeas, and fruit, especially dates, are commonly consumed, however use of olive oil and tea is low.[8]

In Morocco, the overall life expectancy of an average person is 76 years.[9] In 2019, 4% of the Moroccan population was reported to be undernourished[10] and 25.9% was estimated to be suffering from moderate to severe food insecurity between 2017 and 2019.[11] The prevalence of stunting and wasting for Moroccan children under five was reported as 15.1% and 2.6% respectively in 2017.[12,13] Around 37% of women aged between 15 and 49 are anemic[14] and 7% of the population between 20 and 79 is diabetic.[15] An estimated 32.2% of adult women (aged 18 years and over) and 19.4% of adult men are living with obesity.[16]

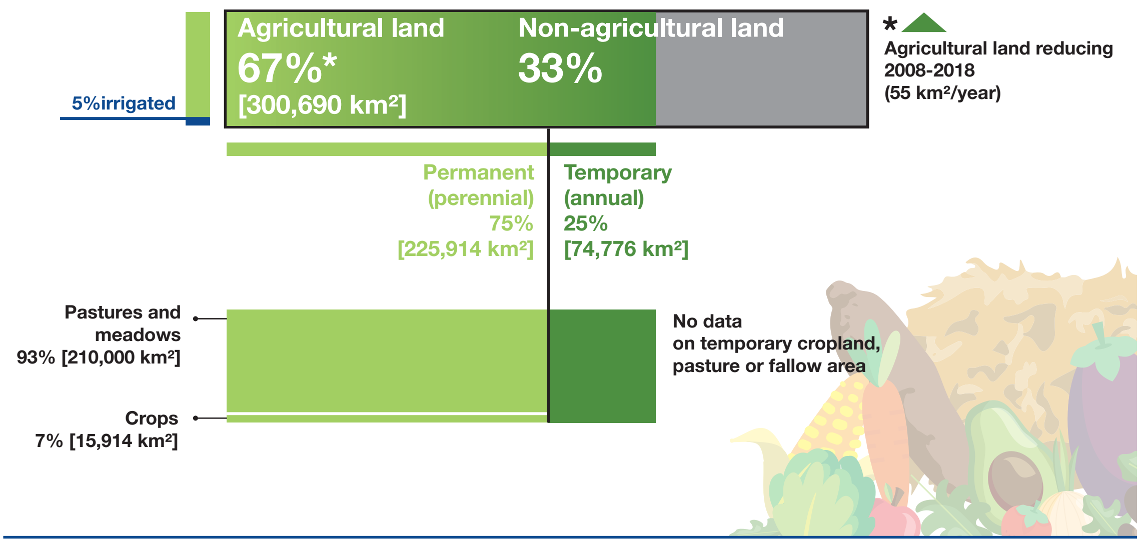
Figure 1: Kilocalorie, protein, fruit and vegetable supply



Production for sustainable agriculture

In Morocco, 67% (300,690 km^2) of its total land area is dedicated to agriculture, of which only 74,776 km^2 is used as arable land, of which 16% is under temporary fallow (Figure 2).[17,18] The agriculture, forestry and fishing sectors contribute 11.4% of Morocco's GDP.[19] The level of employment in the agricultural sector reaches up to 34% of the overall working population, and of these more than half (53%) are women.[20,21] The main crops in terms of economic value contributing to annual GDP (in % of total contribution from agriculture) are wheat (1.9%), olives (0.7%), and barley (0.5%).[22] The average cereal yield in Morocco is 1,758kg /ha.[23] In 2018, capture fisheries and aquaculture production were estimated at about 1.4 million metric tons and 1,267 tons respectively.[24,25] In the same year, annual livestock production - with eggs, milk, and meat the three main animal-sourced food produced - was estimated at over 8.4 million tons.[23]

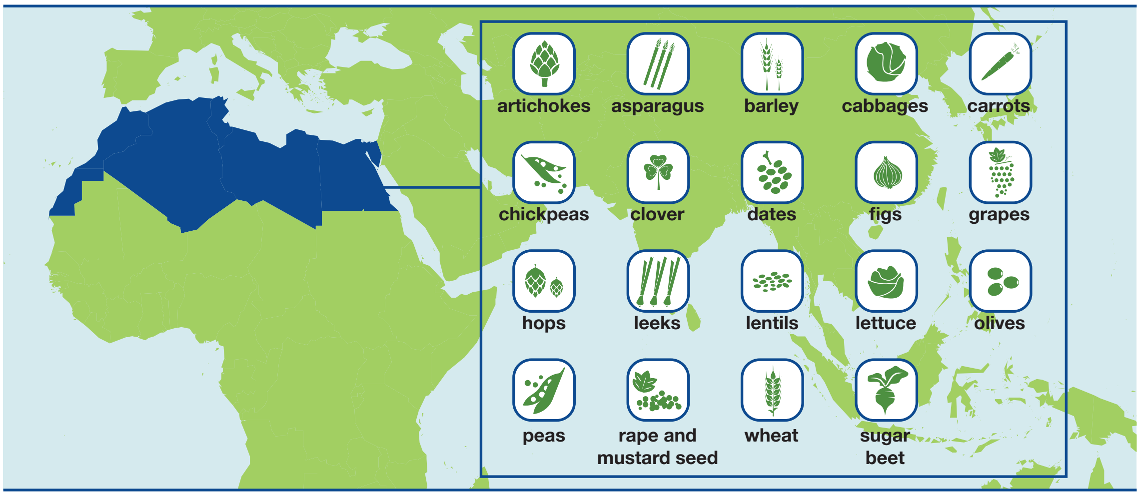
Figure 2: Land used for agriculture



Conservation for future use options

Morocco has a geographically varied climate and topography, which includes part of the Sahara desert, several high (>2000 m altitude) mountain chains and nearly 3500 km of coastline, providing habitat for over 7,000 plant species and over 24,000 animal species and spanning a range of agroclimatic zones (Figure 3).[26] Currently, only 4.27% of Morocco's total land area (~17,382 km²) and 0.69% (276,136 km²) of its marine area is protected.[27] An estimated 56,240 km² (13%) of its land area was forested in 2015,[28] with the country having lost 6.3% of its tree cover since 2000.[29] For plants, 57 of the 588 species assessed in Morocco for overall extinction risk are threatened, while for animals, of the 1,891 species assessed, 19 mammals and 18 birds are considered threatened.[30] While information is not readily available on the threat status of cultivated crops or their wild relatives, a national association is in the process of surveying and characterizing local crop varieties in Morocco to improve the knowledge base.[26] Climate change and loss of both prime agricultural land and natural habitat due to unchecked urban expansion are among the primary causes of biodiversity loss, including agrobiodiversity.[26] Fish populations and other marine life along the Moroccan coastline are degraded to varying degrees, due to overexploitation and pollution.[26]

Figure 3: Crops originating from South and East Mediterranenan



Agrobiodiversity Index score

Morocco has an Agrobiodiversity Index status score of 54.1.

Status: What's driving the Agrobiodiversity Index score?

For Morocco, we see that scores are highest in consumption (60.5), followed by conservation (60.1), and production (41.6). This indicates that agrobiodiversity is relatively effectively used in consumption for healthy diets and conserved for current and future use options, while there is potential for much better use of agrobiodiversity in production for sustainable agriculture. We can take a closer look at the indicator scores to understand what underlies the differences in status of agrobiodiversity across the pillars of Morocco's food system.

Consumption

Species diversity in diets: Food species diversity is moderately high in Morocco relative to other countries in the world and average compared to other Mediterranean countries. Consumption of fruits, vegetables, and legumes are above the global average[16] and almost meet dietary recommendations. Consumption of nut species is relatively low.

Functional diversity: The functional diversity score of 53 reflects a moderate number of avoided Disability Adjusted Life Years[I] attributable to dietary risk factors relative to other countries in the world and above average across the ten Mediterranean countries. Consumption of fruits, vegetables, whole grains, legumes, and nuts can still be further increased to reduce dietary health risks[16]. Consumption of red meat is high and can be lowered to reduce dietary health risks[16].

Underutilized species: Only 38% of energy in Moroccan diets is obtained from sources other than major cereals, roots, and tubers, explaining the moderately low score for underutilized species and indicating that diets are quite heavily dependent on major staples. Consumption of whole grains is particularly low in Morocco,[16] indicating that cereals are mainly consumed as highly processed foods.

There were no data available on varietal diversity in consumption.

Production

Varietal diversity: The diversity of livestock breeds maintained in production in Morocco is high relative to other countries in the world and above average for the ten Mediterranean countries. Morocco has 11 breeds of cattle and six of goat in production but only one or two breeds of other species including dromedary, horse, sheep, and guinea fowl. In addition to averting the loss of animal genetic resources, keeping multiple breeds in production should help farmers maintain livelihoods in times of pest and disease outbreaks or other production challenges because different breeds have different resistance to pests and diseases.

Species diversity: With 88 distinct commodities in production, crop species richness is high relative to the global maximum of 123 species (in China) and above average across the ten Mediterranean countries. The top ten crops by harvested area are wheat, barley, olives, almonds, maize, broad beans, lupins, chickpeas, and tangerines. The area coverage of different crops in production per 10x10km is unevenly distributed, meaning cropped landscapes have low diversity relative to other countries in the world and compared to other Mediterranean countries. A moderately high percentage (61%) of agricultural land contains a high diversity of crop species at 10x10km scales. However, crop diversity is not at its maximum, and enhancing crop diversity at field, farm, and landscape levels is recommended to enhance natural pest and disease controls, yield stability, biodiversity, and other ecosystem services.[31] With only seven recorded freshwater fish species, fish richness is very low both relative to other countries in the world and compared to the nine other Mediterranean countries. Livestock species diversity in production is high compared to other countries in the world and compared to the nine other Mediterranean countries. Actions to boost livestock richness in areas of the country where these are low would help ensure farmers in all regions rely on a wide species base, helping shield them against pests and diseases and other production challenges.

Soil biodiversity: Soil biodiversity is very low for most of the country, averaging 0.3 on a scale of 0.11 to 1.35 (representing the minimum and maximum global extremes). Integrated plant nutrient management can help maintain and restore soil health, such as through increased use of cover crops, application of mulch and animal manure, and intercropping with legumes.

Landscape complexity: 40% of Morocco's cropped landscapes have at least 100ha of natural vegetation at 1x1 km scales, which is well below the 100% recommended, but above average compared to the nine other Mediterranean countries. Maintaining natural vegetation in and around cropland helps maintain habitat connectivity and ecosystem functioning to sustain nature's contributions to agriculture, including reducing the risk of pest and disease outbreaks, maintaining pollinators, and safeguarding crop wild relatives. Establishing at least 10% natural habitat at local (1x1 km) and landscape (10x10 km) scales could be achieved on farm through practices such as live fences (trees, hedgerows), woodlots, flower strips and set aside, and off farm by safeguarding portions of natural or semi-natural forests, wetlands and grasslands around cultivated areas.

There were no data on functional diversity, underutilized species, or pollinator diversity in production.

Conservation

Varietal diversity: Morocco has a high score for varietal diversity (70.2), relative to the globally best performing country (France) indicating that a significant number of samples of Moroccan crop varieties are conserved in genebanks.

Species diversity: The species diversity score is high (71), reflecting that Morocco has a high proportion of its cultivated and wild species conserved in genebanks and that a high number of known crop wild relatives have been identified in-country, relative to other countries in the world.

Underutilized species: Morocco has a low score (39.1) for conservation of underutilized species (useful wild species). While 76.2% of useful wild species are conserved *in situ*, their representativeness in *ex situ* repositories is very low (2%).

There were no data available for functional diversity of genetic resources in conservation.

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Actions: What actions are being taken to maintain and increase agrobiodiversity?

Consumption: For consumption, Morocco does not have food-based dietary guidelines or food composition tables to support biodiversity for healthy diets.

Production: Action scores are low (26.5) for agrobiodiversity use in production. This score reflects very low adoption of diversity-based practices together with low adoption of agrobiodiversity-supportive management practices.

- **Diversity-based practices:** Available data indicate that there is moderate potential for integrated farming in Morocco, with 33% of agricultural landscapes (10x10 km areas) containing both cropland and pasture, facilitating crop–livestock integration. This is average compared to other Mediterranean countries.
- **Production management practices supporting agrobiodiversity:** The environmental efficiency of production is moderate relative to other countries in the world, based on the Sustainable Nitrogen Management Index (SNMI) score. Given that nitrogen use efficiency is relatively high, the moderate SNMI score suggests that there is potential to improve land use efficiency (yields) to reduce the environmental impacts of production, with measures such as intercropping, agroforestry, or double cropping. Morocco has very low levels of pesticide use relative to other countries in the world, estimated at 1.5 kg per hectare, which is far below the highest global user (28.0kg per ha in Mauritius). The avoided use of pesticides will be having a positive impact on soil biodiversity, pollinators, and natural enemies of pests, with benefits for agriculture and biodiversity. Trees are integrated into 2.1% of agricultural land in Morocco, which is extremely low relative to other countries in the world and likely reflects the difficulty in sustaining plants that need a lot of water, such as trees, in extreme arid climates. Setting aside small areas of farmland for planting functionally and nutritionally diverse trees can provide multiple benefits for farmers in arid climates.[32] Drought-resistant and native tree varieties could be prioritized to minimize water consumption while providing other benefits to farmers. Organic agriculture is practiced on 0.03% of agricultural land and conservation agriculture on 0.05% of agricultural land, which is very low relative to other countries globally and in the Mediterranean. However,

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the very low use of pesticides indicates organic agriculture may be more widespread than suggested by official records.

Conservation: Morocco has reported on 60% of the indicators used in the World Information and Early Warning System (WIEWS) to monitor the status of plant genetic resources for food and agriculture, which is better than most Mediterranean countries. An analysis of conservation actions reveals that Morocco has effectively established conservation sites with management plans for *in situ* conservation of crop wild relatives and wild plants. It has also carried out significant collecting missions for long-term conservation of plant genetic resources for food and agriculture in genebanks. Morocco has distributed to other users a significant number of crop samples from the national genebank. The country has been active in breeding activities and releasing varieties.

There are, however, few pre-breeding activities using genebank material. The national documentation system for plant genetic resources for food and agriculture in the country for both *ex situ* and *in situ* conservation is poorly developed and it lacks the capacity to systematically monitor and safeguard genetic diversity. This undermines efforts to effectively conserve and use Moroccan genetic resources and to reduce genetic erosion in the country.

Commitments: How supportive of agrobiodiversity are national policies?

The text mining for Morocco was based on their *National Biodiversity Strategy and Action Plan for 2016-2020* (NBSAP).[33]

Consumption: Morocco has a very low score (6.7) for commitments to enhancing the use of agrobiodiversity in consumption, similar to other Mediterranean countries. While the NBSAP discusses the risks to dietary diversity associated with losing agrobiodiversity, there are no explicit strategies or targets to enhance agrobiodiversity in consumption. This is based only on a review of Morocco's NBSAP and other national documents may include commitments to promoting the use of food diversity for healthy diets. Nonetheless, it highlights a potential gap in agrobiodiversity policy.

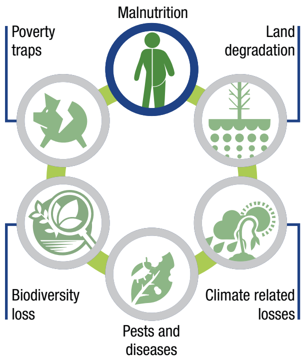
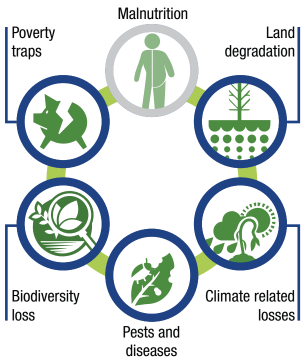
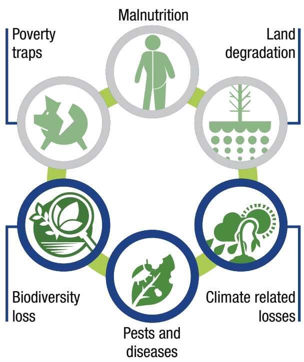
Production: Morocco has a moderate score (54.2) for commitments to enhancing agrobiodiversity in production relative to countries around the world, which is above average compared to the nine other Mediterranean countries. The NBSAP includes commitments to breeding and increasing adoption of local varieties adapted to their environment and anticipated changes in climate, together with raising awareness and improving farmer access to these varieties. It also includes commitments to reinforcing soil microorganisms to reverse soil degradation and programs to increase the use of local, underutilized and native crop, tree, and livestock species. Planned actions include distributing tree species to farmers willing to implement agroforestry systems, developing and adding value to local varieties and products, and making available seed stocks of local varieties. More generally, Morocco aims to develop and value organic production and encourage sustainable agriculture, making it mandatory to conduct an impact assessment of mariculture, inland aquaculture, and agriculture activities to guarantee their sustainability and biodiversity conservation.

Conservation: Morocco has a high score (66.7) for commitments to enhancing agrobiodiversity in conservation relative to countries around the world, and also above average compared to the other nine Mediterranean countries. Morocco's conservation strategies include programs for *ex situ* and *in situ* conservation of agrobiodiversity with a socioeconomic value, to safeguard crop wild relatives and local breeds and varieties, and native fish populations. This includes commitments to developing programs to protect habitats for wild plant and animal relatives, add value to local cattle breeds, and to protect and conserve autochthonous fish populations in continental waters.

Recommendations

This section suggests concrete actions that can be taken to improve the use and conservation of agrobiodiversity for more sustainable food systems (Table 1). The list of actions is by no means exhaustive or prescriptive. It is intended for review, discussion, and improvement by in-country policy specialists.

Table 1: Recommended actions to enhance agrobiodiversity in the national food system

		Contributing to:	
Food system pillar in the Agrobiodiversity Index	**Recommendations**	**Risk and resilience**	**Global policy**
Consumption for healthy diets	Promote dietary diversity and reduce overreliance on major staples for dietary energy. Develop food-based dietary guidelines and food composition tables to help increase awareness and build programs that support dietary diversity.		SDG2 Zero Hunger SDG12 Sustainable Production and Consumption WHO Decade of nutrition – reducing overweight, obesity and anemia
Production for sustainable agriculture	Promote a wider diversity of crop species in production, favoring locally adapted varieties. Use agroecological practices to improve soil health and boost biological pest controls to improve yields for higher land use efficiency.		Post-2020 CBD Goal 1[ii] No Net Loss SDG 2 Zero Hunger
Conservation for future use options	Ensure that underutilized and crop wild relative species in the country are adequately sampled and conserved in the national genebank. The national information system on plant genetic resources for food and agriculture should be improved. In this respect a national information-sharing mechanism should be set up to monitor the status of conservation and use of agrobiodiversity in the country. More efforts should be made to promote the use of diversity conserved in genebanks by breeders in the country by promoting pre-breeding activities.		Post-2020 CBD Goal 3 Genetic Diversity & 4 Nature's benefits SDG 15 Life on Land Second Global Plan of Action on Plant Genetic Resources for Food and Agriculture[35]

Agrobiodiversity highlight

Agrobiodiversity at the heart of agroecology in Morocco

Morocco has been enacting an agroecological vision by improving the conservation and sustainable management of five oasis systems with a focus on strengthening the role of these systems in household food security, through the preservation and use of agrobiodiversity.

The project, 'Biodiversity conservation and mitigation of land degradation through adaptive management of agricultural heritage systems', was funded by the Global Environment Facility (GEF). Its work so far has achieved remarkable results in the context of agroecology, including in terms of:

- **Preservation and enhancement of agrobiodiversity**
  Surveys were conducted at each of the sites to inventory 144 local varieties, 57 of which were well characterized. A regulatory framework for seed development of local varieties was developed and submitted to the country's competent authorities and a local seed production, storage and distribution network established at each of the five sites. This represents a considerable strengthening of local seed systems as a basis for agroecology and organic farming.
- **Development of sustainable water and land management practices**
  About 700 farmers (30% women), from more than 56 villages and representing more than 28 associations and 40 cooperatives, participated in training to improve skills in agroecological approaches, such as organic farming techniques and site certification or techniques of seed production and conservation and participatory breeding to improve local varieties and preserve a broad genetic base for *in situ* conservation.

Sources: [34]

Credit: ©IFAD/Giulio Napolitano

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End notes

I. The overall burden of disease is assessed using the disability-adjusted life year (DALY), a time-based measure that combines years of life lost due to premature mortality (YLLs) and years of life lost due to time lived in states of less than full health, or years of healthy life lost due to disability (YLDs). One DALY represents the loss of the equivalent of one year of full health. DALYs for a disease or health condition are the sum of the years of life lost to due to premature mortality (YLLs) and the years lived with a disability (YLDs) due to prevalent cases of the disease or health condition in a population.

II. The Convention on Biological Diversity is an international treaty for the sustainable use and conservation of biological diversity. In 2010 it launched a strategic plan, running from 2011 to 2020, with 20 ambitious targets known as the Aichi Targets from the city in which they were signed. The international community has developed new targets, but their signature has been delayed due to the COVID-19 crisis.

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Spain

Country profile

Key messages

- Spain has an Agrobiodiversity Index status of 70.5, making it one of the most agrobiodiverse Mediterranean countries.
- In consumption, Spain has high food species diversity relative to other countries in the world, with consumption of fruits, vegetables, and nuts above the global average and diets that are not overly dependent on major staples. In contrast, the consumption of legumes is relatively low, and consumption of whole grains is below average, which can increase diet-related health risks.
- Spain's levels of livestock breed diversity and crop species richness are among the highest in the world. Its production system is characterized by a highly diverse and relatively evenly distributed crop species diversity. However, its fish species richness is relatively low and livestock species diversity is moderate compared to other countries in the world. Its soil biodiversity, landscape complexity, and natural vegetation are low compared to other Mediterranean countries.
- A significant number of Spanish cultivated and wild species and crop varieties are conserved in genebanks compared to other Mediterranean countries. However, the *in situ* diversity of its underutilized species (understood as other wild socioeconomically and culturally valuable species) are not well represented in genebanks.

Pillar 1: Agrobiodiversity in consumption for healthy diets
Pillar 2: Agrobiodiversity in production for sustainable agriculture
Pillar 3: Agrobiodiversity in conservation for future use options

Score: 0-20 | 21-40 | 41-60 | 61-80 | 81-100

All raw scores are scaled from 0 to 100. See Annex 2 for details.

SUB-INDICATOR (raw scores)	INDICATOR	PILLAR
Overall agrobiodiversity: 0 (0)	Commitments supporting agrobiodiversity: 0	Pillar 1 Consumption 0.0
Varietal/breed diversity: 0 (0)		
Species diversity: 0 (0)		
Functional diversity: 0 (0)		
Underutilized species: 0 (0)		
Overall agrobiodiversity: 66.7 (2)	Commitments supporting agrobiodiversity: 41.7	Pillar 2 Production 41.7
Varietal/breed diversity: 0 (0)		
Species diversity: 33.3 (1)		
Functional diversity: 0 (0)		
Underutilized species: 66.7 (2)		
Pollinator diversity: 33.3 (1)		
Soil biodiversity: 66.7 (2)		
Landscape complexity: 66.7 (2)		
Overall agrobiodiversity: 66.7 (2)	Commitments supporting agrobiodiversity: 46.7	Pillar 3 Conservation 46.7
Varietal/breed diversity: 33.3 (1)		
Species diversity: 66.7 (2)		
Functional diversity: 0 (0)		
Underutilized species: 66.7 (2)		

Commitment 29.5

Status: 70.5

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 88.7	**Species diversity: 76.5**	Food diversity in supply (Shannon's Index): 76.5 (2.9)
	Functional diversity: 89.7	(Avoided) Disability Adjusted Life Years attributable to dietary risks per 100,000 adults: 89.7 (1,980)
	Underutilized species: 100.0	Energy from sources other than cereals, roots and tubers (%): 100.0 (73.0)
Pillar 2 Production 55.4	**Varietal/breed diversity: 95.2**	Livestock breed diversity (Shannon's Index): 95.2 (2.9)
	Species diversity: 67.5	Crop species richness in production (count): 82.1 (101.0)
		Crop species diversity in production (Shannon's Index): 72.7 (1.7)
		Cropland with high crop species richness (%): 96.5 (96.5)
		Freshwater fish species richness (average count): 31.1 (25.9)
		Livestock diversity in production (Shannon's Index): 55.1 (0.9)
	Soil biodiversity: 30.0	Potential soil biodiversity (Index 0 to 2): 30.0 (0.5)
	Landscape complexity: 28.7	Cropland with >10% natural and semi-natural habitat at 1x1km scales (%): 28.7 (28.7)
Pillar 3 Conservation 67.3	**Varietal diversity: 80.3**	Varietal diversity in genebanks (Shannon's Index): 80.3 (4.6)
	Species diversity: 79.7	Species diversity in genebanks (Shannon's Index): 78.3 (4.9)
		Crop wild relative occurrence diversity (Shannon's Index): 81.0 (5.2)
	Underutilized species: 42.0	*In situ* conservation of useful wild species (%): 82.9 (82.9)
		Ex situ conservation of useful wild species (%): 1.1 (1.1)

Action: 72.6

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 100	**Management practices supporting agrobiodiversity: 100.0**	Published diet guidelines (Yes/No): 100.0 (1.0)
		Published food composition tables (Yes/No): 100.0 (1.0)
Pillar 2 Production 65.3	**Diversity-based practices: 95.2**	Crop-livestock integration (% agricultural land with cropland and pasture): 90.3 (90.3)
		Integrated landscape initiatives (count): 100.0 (6.0)
	Management practices supporting agrobiodiversity: 35.3	Nitrogen use efficiency (kg N output per kg N input): 39.8 (0.4)
		(Inverted) Sustainable Nitrogen Management Index (Index 0 to infinity): 54.5 (36.2)
		Organic agriculture (%): 8.6 (8.6)
		Tree cover on agricultural land (%): 13.2 (4.0)
		(Avoided) pesticide use (kg per ha): 89.3 (3.7)
		Conservation agriculture (%): 6.4 (6.4)
Pillar 3 Conservation 52.5	**Management practices supporting agrobiodiversity: 52.5**	Indicators reported to the World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (%): 52.5 (52.5)

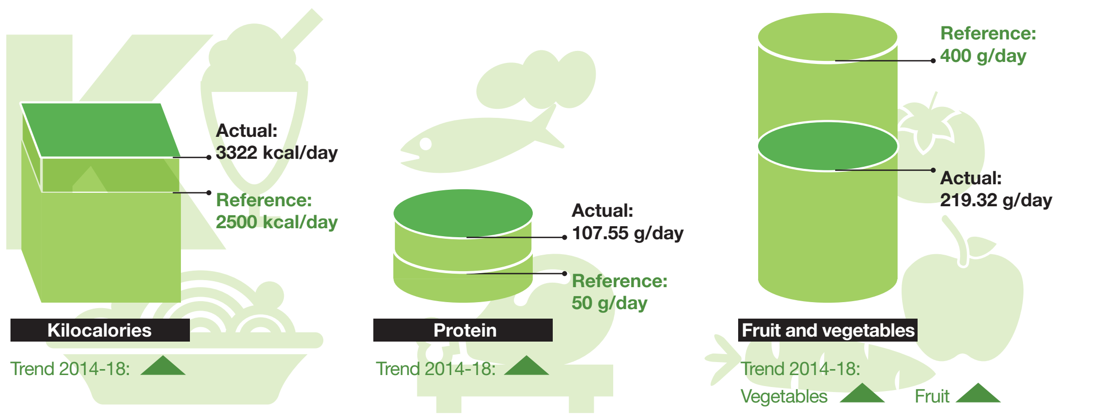
Context

Spain is a high-income country, with an annual GDP of US$1.393 billion and a GDP per capita of US$29,613 in 2019.[1] Spain's surface area covers 505,935 km^2.[2] Around 47 million people inhabit the country,[3] with 81% living mostly in urban areas,[4] and an estimated population density of 94 inhabitants per km^2 in 2018.[5] Estimates from 2017 indicated that 0.7% of Spain's population lived below the poverty line,[6] however its multidimensional poverty index has not been assessed.[7,8]

Consumption for healthy diets

Food consumption in Spain covers a range of food groups. Cereals are mostly consumed as processed flour, except for rice. Butter and cheese are the main dairy products, while pulses and vegetables, such as broccoli, potatoes, eggplant, tomatoes and artichokes, and citrus fruits and apples are frequently consumed (Figure 1). Moderate consumption of meat, including pork, chicken, and lamb, and fish is common.[9] In Spain, an average healthy person lives up to 83 years.[10] In 2019, 3% of the Spanish population was reported to be undernourished[11] and 1.8% and 8.6% were assessed as threatened by severe or moderate to severe food insecurity respectively between 2017 and 2019.[12] The prevalence of stunting and wasting for Spanish children under 5 has not been reported.[13,14] 13% of females aged between 15 and 49 were reported to be anemic[15] and almost 7% of the population between 20 and 79 were diabetic in 2019.[16] An estimated 22.8% of adult women (aged 18 years and over) and 24.6% of adult men are living with obesity.[17]

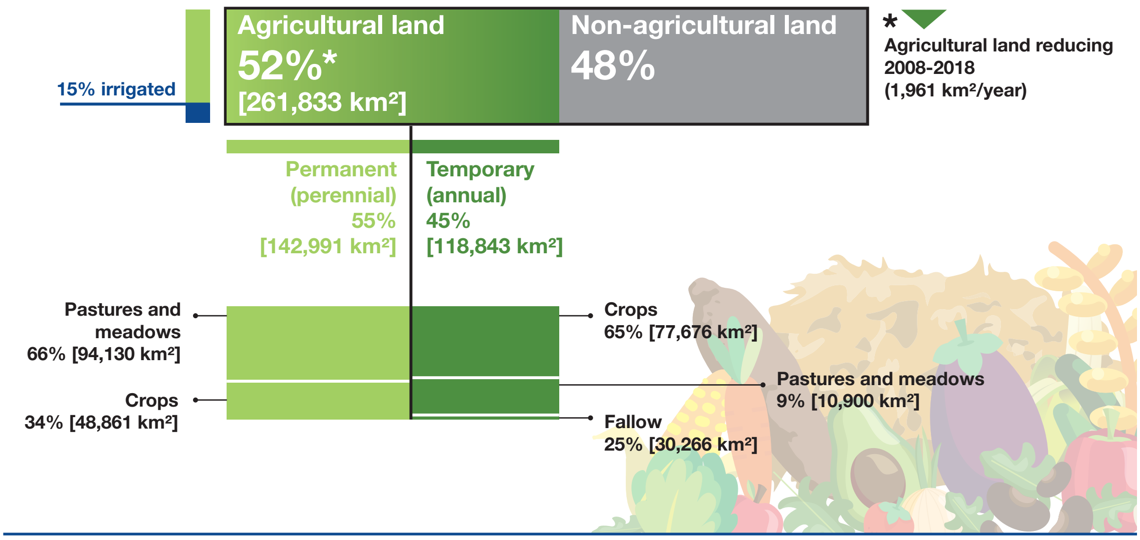
Figure 1: Kilocalorie, protein, fruit and vegetable supply



Production for sustainable agriculture

About 52.4% of land area in Spain (261,833 km^2) is devoted to agriculture, with 45% accounting for arable land (which is split into 65.4% temporary crops, 25.5% temporary fallow, and 9.2% under temporary pastures and meadows) (Figure 2).[18,19] In 2019, agriculture, forestry, and fishing contributed to 2.7% of Spain's GDP.[20] Only 4% of the Spanish population is employed in the agricultural sector, and the percentage of female employment is only 2%.[21,22] Olives (0.6%), grapes (0.4%) and barley (0.1%) are the three main contributors to GDP.[23] The estimated average cereal yield in 2017 was 2,769 kg/ha.[24] In 2016, fish capture production was estimated at about 900,000 tonnes and, in 2018, the estimated aquaculture production was nearly 350,000 tonnes.[25] Eggs, milk, and meat (pig) are the three main animal-sourced foods produced in Spain, with an annual livestock production of above 34 million tonnes.[26]

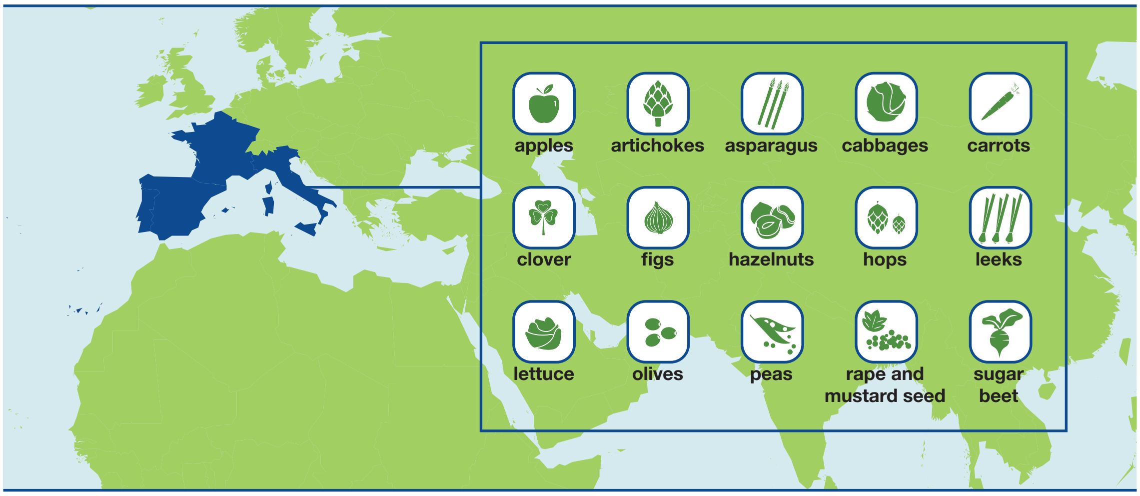
Figure 2: Land used for agriculture



Conservation for future use options

In Spain, 28% (142,573 km²) of the total land area and 12.8% (128,316 km²) of marine areas are protected.[27] Nearly 37% of Spain's land area (184,520 km²) was forested in 2015. The net tree cover loss from 2001 to 2019 was 12,300 km², showing a decrease of 11% tree cover since 2000.[28] A total of 1,262 plant and 3,376 animal species have been assessed in Spain for risk of extinction. Of these, 281 plants, 18 mammals and 19 birds are threatened.[29] Spain harbors one of the richest flora of the Mediterranean region. It is a centre of edible and wild plant diversity (Figure 3) and particularly rich in leguminous plants including Trifolium, Medicago, Lupinus and Vicia species.[27]

Figure 3: Crops originating from Southwestern Europe



Agrobiodiversity Index score

Spain has an Agrobiodiversity Index status score of 70.8.

Status: What's driving the Agrobiodiversity Index score?

For Spain, we see that scores are highest in consumption (88.7), followed by conservation (67.3), and production (55.4). This indicates that agrobiodiversity is relatively effectively used in consumption for healthy diets and conserved for current and future use options, while there is potential for much better use of agrobiodiversity in production for sustainable agriculture. We can take a closer look at the indicator scores to understand what underlies the differences in status of agrobiodiversity across the pillars of Spain's food system.

Consumption

Species diversity in diets: Food species diversity is high in Spain relative to other countries in the world and also compared to other Mediterranean countries. Consumption of fruits, vegetables, and nuts are above global average values.[30] Consumption of legumes species is relatively low and can be increased.

Functional diversity: The functional diversity score of 89.7 reflects a moderate number of avoided Disability Adjusted Life Years attributable to dietary risk factors. Consumption of fruits, vegetables, whole grains, legumes, and nuts can be further increased to reduce dietary health risks.[30] Consumption of red meat is high and can be lowered to reduce dietary health risks.[30]

Underutilized species: Over 60% of energy in Spanish diets is obtained from sources other than major cereals, roots, and tubers, explaining the maximum score for underutilized species in this category (60% is what we use as a threshold) and indicating that diets are not overly dependent on major staples. This does not mean that the of underutilized and local species is at its maximum but that the diet is not overly dependent on the major staples. Consumption of whole grains is slightly under the average global value, indicating that processing of cereals for human consumption can be further reduced.

There were no data available on varietal diversity in consumption.

Production

Varietal diversity: The diversity of livestock breeds maintained in production in Spain is one of the highest in the world. Spain has 52 breeds of sheep in production, 49 of cattle, 23 of pig, 20 of goat, 19 of horse, 15 of chicken, although fewer than eight breeds of other species including only one domesticated duck breed and one camel breed. Keeping multiple breeds in production should help farmers maintain livelihoods in times of pest and disease outbreaks or other production challenges, because different breeds have different resistance to pests and diseases.

Species diversity: With 101 distinct commodities in production, crop species richness is high relative to the global maximum of 123 species (in China) and well above average compared to the nine other Mediterranean countries. The area coverage of different crops in production per 10x10 km is evenly distributed, meaning cropped landscapes have a high diversity relative to other countries in the world and compared to other Mediterranean countries. A very high percentage (97%) of agricultural land contains a high diversity of crop species at 10x10 km scales. This does not mean that crop diversity is at its maximum potential level, so seeking ways to enhance crop diversity at field, farm, and landscape levels is recommended to enhance natural pest and disease controls, yield stability, biodiversity, and other ecosystem services.[31] With 26 recorded freshwater fish species, fish richness is low relative to other countries in the world and compared to the nine other Mediterranean countries. Livestock species diversity in production is moderate compared to other countries in the world and average compared to the nine other Mediterranean countries. Actions to boost livestock richness in areas of the country where these are low would help ensure farmers in all regions rely on a wide species base, helping shield them against pests and diseases and other production challenges.

Soil biodiversity: Soil biodiversity is low for most of the country, averaging 0.5 on a scale of 0.11 to 1.35 (representing the minimum and maximum global extremes). Integrated plant nutrient management can help maintain and restore soil health, such as through increased use of cover crops, application of mulch and animal manure, and intercropping with legumes.

Landscape complexity: 29% of Spain's cropped landscapes have at least 10ha of natural vegetation at 1x1 km scales, which is well below the 100% recommended here, and average compared to the nine other Mediterranean countries. Maintaining natural vegetation in and around cropland helps maintain habitat connectivity and ecosystem functioning to sustain nature's contributions to agriculture, including reducing the risk of pest and disease outbreaks, maintaining pollinators, and safeguarding crop wild relatives. Establishing at least 10% natural habitat at local (1x1km) and landscape (10x10 km) scales could be achieved on farm through practices such as live fences (trees, hedgerows), woodlots, flower strips and set aside, and off farm by safeguarding portions of natural or semi-natural forests, wetlands, and grasslands around cultivated areas.

There were no data on functional diversity, underutilized species, or pollinator and natural enemies in production.

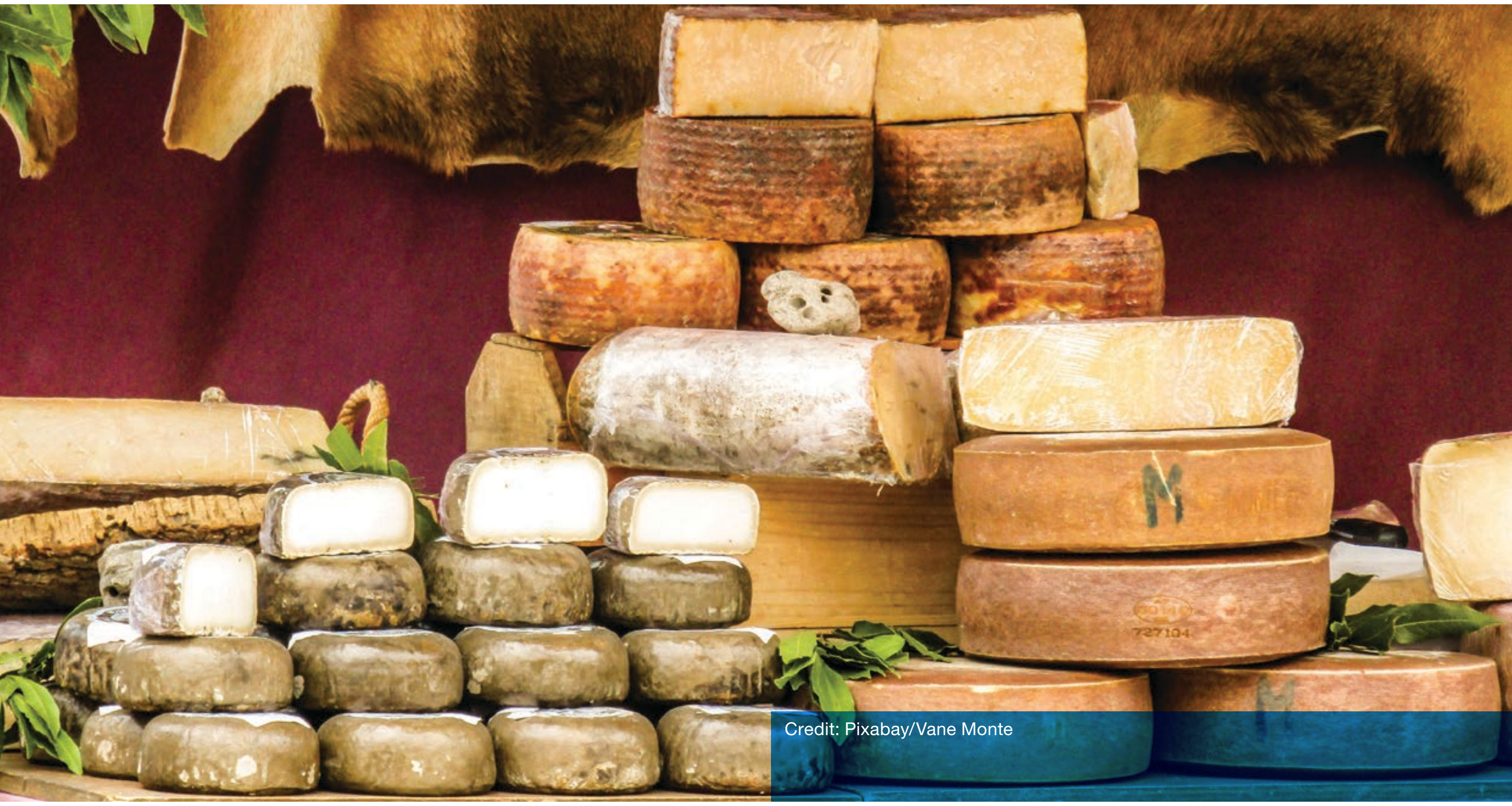
Conservation

Varietal diversity: Spain has a high score for varietal diversity (80.3), relative to the globally best performing country (France) indicating that a significant number of samples of crop varieties are conserved in genebanks.

Species diversity: The species diversity score is high (79.7), reflecting that a high proportion of Spain's cultivated and wild species are conserved in genebanks, and a very high diversity of crop wild relative species have been identified growing in-country, relative to other countries in the world.

Underutilized species: Spain has a moderate score (42) for conservation of underutilized species (useful wild species. While 82.9% of useful wild species are conserved *in situ*, their representativeness in *ex situ* repositories is very low (1.1%).

There were no data available for functional diversity of genetic resources in conservation.



Credit: Pixabay/Vane Monte

Actions: What actions are being taken to maintain and increase agrobiodiversity?

Consumption: Spain has local food-based dietary guidelines and food composition tables in place, supporting the promotion and awareness of the dietary benefits of dietary diversity at functional and species level.

Production: Action scores are high (65.3) for agrobiodiversity in production. This score reflects widespread adoption of diversity-based practices together with low adoption of agrobiodiversity-supportive management practices.

- **Diversity-based practices:** Available data indicate that there is high potential for integrated farming in Spain, with 90% of agricultural landscapes (10x10 km areas) containing both cropland and pasture, facilitating crop–livestock integration. This is above average compared to other Mediterranean countries.
- **Production management practices supporting agrobiodiversity:** The environmental efficiency of production is moderate relative to other countries in the world, based on the Sustainable Nitrogen Management Index (SNMI) score. Given that nitrogen use efficiency is relatively low, the moderate SNMI score suggests that improving nitrogen use efficiency is more important than improving land use efficiency (yields) to reduce the environmental impacts of production. Spain has very low levels of pesticide use relative to other countries in the world, estimated at 3.7 kg per hectare, far below the highest global user (28.0 kg per ha in Mauritius). The avoided use of pesticides will be having a positive impact on soil biodiversity, pollinators, and natural enemies of pests, with benefits for agriculture and biodiversity. Trees are integrated into 4% of agricultural land in Spain, which is extremely low relative to other countries in the world and likely reflects the difficulty in sustaining plants that need a lot of water, such as trees, in the arid climates that prevail over much of Spain. Setting aside small areas of farmland for planting functionally and nutritionally diverse trees can provide multiple benefits for farmers in arid climates.[32] Drought-resistant and native tree varieties could be prioritized to minimize water consumption while providing other benefits to farmers. Organic agriculture is practiced on 8.6% of agricultural land and conservation agriculture on 6.4% of arable land, which is very low relative to other countries globally and in the Mediterranean.

Conservation: Spain has reported on 52% of the indicators for monitoring progress on the implementation of the second Global Plan of Action on Plant Genetic Resources for Food and Agriculture of the UN Food and Agriculture Organization.[33] An analysis of the data in the plant genetic diversity monitoring system WIEWS maintained by FAO for Spain shows some active conservation actions for its plant genetic resources. It has taken measures to survey and conserve both crop wild relative species and farmer varieties *in situ*. Spain has also collected a considerable number of samples for long-term conservation in genebanks. Spain's reporting also shows that

actions have been taken to regenerate their genebank samples, as well as to characterize and evaluate them so they can be used. Efforts have been made to distribute genetic materials from the genebank to various stakeholders, including national research institutes, the private sector, farmers, and foreign stakeholders. Farmer varieties and underutilized species have been identified for potential commercialization. Spain has a good documentation system in place for both *in situ* conservation of crop wild relatives and for its *ex situ* collections, with over 150,000 crop samples documented and published on the web.

Commitments: How supportive of agrobiodiversity are national policies?

The commitments analysis was based on Spain's *National Biodiversity Strategy and Action Plan* (2011).[34]

Consumption: Spain's National Biodiversity Strategy and Action Plan (NBSAP) mentions a few times the important role of agrobiodiversity for nutritious and secure diets. In addition, Spain has a 'Seed, Nursery Plants and Plant Genetic Resources Law' which enables the development of a plan to safeguard species and varieties of food plants and animals. The country also has a strategy to document and share the status of genetic resources for agriculture and food, and action plans for using and consuming them. Nonetheless, specific targets or strategies to increase species or varietal diversity in diets are lacking.

Production: Overall, the plan discusses the need for more sustainable management of wild and domesticated aquatic and terrestrial species. The country mentions the importance of putting in place strategies that increase diversity on the farms and in the landscapes where agriculture, aquaculture, and silviculture exist to integrate the linkages between production and conservation further. Strategies targeted at restoring fragmentation and degradation in agricultural landscapes primarily include creating, improving, and maintaining ecological connectivity. The multifunctionality of farms (e.g. food and ecosystem services) is mentioned. Nonetheless, the only specific strategy for on-farm diversification is linked to fostering agroforestry (one mention of hedges). Strategies for improving and protecting soil biodiversity also exist through soil protection and management, and biocontrol (using methods such as naturally occurring predators to manage pests, see agrobiodiversity highlight below) is seen as an environmentally friendly practice that should be further promoted. Organic farming is also mentioned and linked to better livelihoods for farmers, but specific strategies or targets to increase this production system are lacking. Finally, strategies to better monitor local fish and their extraction are also put forward.

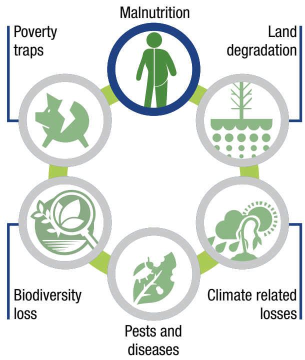
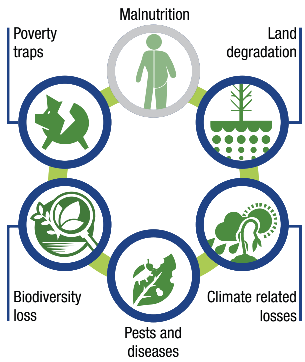
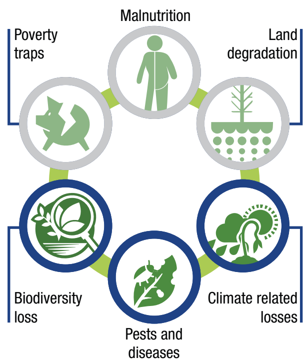
Conservation: Targets to safeguard and preserve agrobiodiversity are mainly linked with crop wild relatives and *ex situ* conservation efforts. Similarly, the country targets better protection of wildlife and local aquatic and terrestrial species in relation to hunting and fishing activities. The NBSAP plan recognizes a lack of actions around *in situ* conservation.

Credit: Pixabay/Nikolaiy

Recommendations

This section suggests concrete actions that can be taken to improve the use and conservation of agrobiodiversity for more sustainable food systems (Table 1). The list of actions is by no means exhaustive or prescriptive. It is intended for review, discussion, and improvement by in-country policy specialists.

Table 1: Recommended actions to enhance agrobiodiversity in the national food system

		Contributing to:	
Food system pillar in the Agrobiodiversity Index	**Recommendations**	**Risk and resilience**	**Global policy**
Consumption for healthy diets	Actively support and maintain the rich species and functional diversity in consumption, e.g. through specific policies and programs linking biodiversity and nutrition. Promote consumption of legumes and whole grains.		SDG2 Zero Hunger SDG12 Sustainable Consumption and Production United Nations (UN) Decade of Action on Nutrition - reducing overweight, obesity and anemia
Production for sustainable agriculture	Maintain and further increase Spain's crop richness and livestock breed diversity to ensure resilient productive systems. Promote tree planting on and around farmland, favoring native and drought-resistant varieties, and practices that increase the proportion of natural habitat proximate to farmland, e.g. flower strips, hedgerows, set aside.		Post-2020 CBD Goal 1[1] No Net Loss SDG 2 Zero Hunger
Conservation for future use options	Greater effort is required to fully report on the progress of conservation and use of plant genetic resources for food and agriculture (PGRFA) in the reporting format of the second Global Plan of Action on PGRFA. Spain possesses a high diversity of minor crops and crop wild relatives so a National Conservation Strategy and Action Plan, involving key stakeholders (from different sectors e.g. environment, forestry, agriculture etc.) should be developed to enhance their conservation and use across the country to fulfil commitments to global conservation treaties, strategies and plans.		Post-2020 CBD Goal 3 Genetic Diversity Post-2020 CBD Goal 4 Nature's Benefits SDG 15 Life on Land FAO second Global Plan of Action on PGRFA[37]

Agrobiodiversity highlight

Integrated pest management in horticultural production in Almería

Almeria in Spain hosts one of the world's largest horticultural areas (approximately 36,000ha). Globally, it is also the location where integrated pest management (IPM) is most widely applied. Farmers release biological control agents, such as aphid-eating wasps or predatory bugs, to reduce the pest pressure on chestnuts, citrus trees, and squashes, among other crops. The release of the biological control agents is strictly monitored and regulated by national and European laws.

In 2013, pests were regulated using biological control on 27,000ha of land (75% of the total area). In 2016, 10,000ha of peppers (nearly 100% of the total), 9,500ha of tomatoes (more than 80%), 3,500ha of cucumbers and substantial areas of zucchini (courgettes), eggplant (aubergine), melon and green beans, among other crops, were managed under biological control practices.

Sources: [35]

Credit: Pixabay/Kai Pilger

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End notes

I. The Convention on Biological Diversity is an international treaty for the sustainable use and conservation of biological diversity. In 2010 it launched a strategic plan, running from 2011 to 2020, with 20 ambitious targets known as the Aichi Targets from the city in which they were signed. The international community has developed new targets, but their signature has been delayed due to the COVID-19 crisis.

Credit: Pixabay/Royber99

Syria

Country profile

AGROBIODIVERSITY INDEX

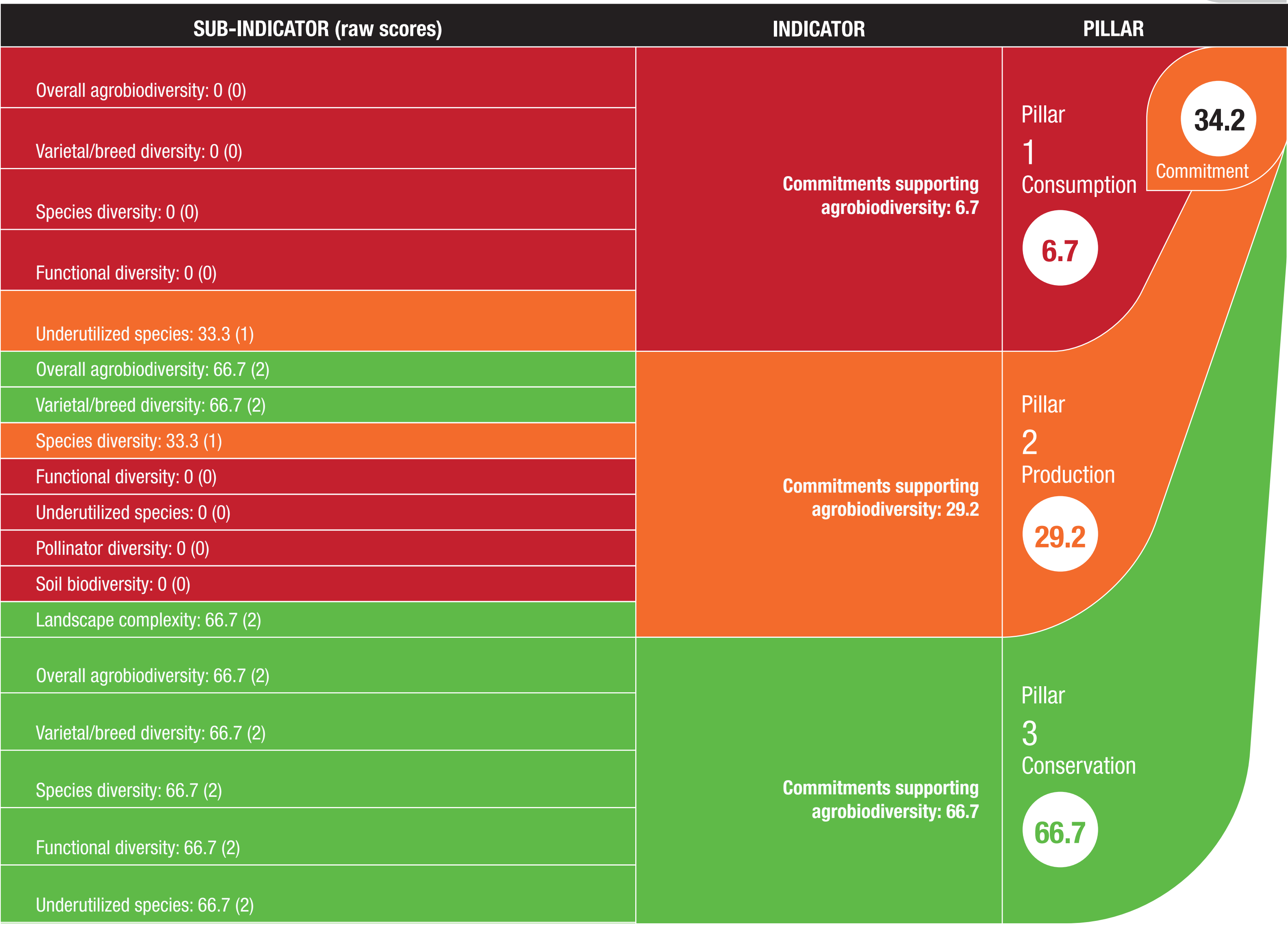
Key messages

- Syria has an Agrobiodiversity index score of 45.1, reflecting a moderate integration of agrobiodiversity into the food system. There are significant gaps in data on levels and management of agrobiodiversity meaning that the assessment is less comprehensive than for most other Mediterranean countries.
- In consumption, food diversity could be better utilized for healthier, more balanced diets. Syria is currently not on course to meet targets for maternal, infant, and young child nutrition.
- The Syrian production system is characterized by high livestock diversity and freshwater fish richness, moderate crop species richness and diversity, and low livestock breed diversity, compared to other countries around the world. Soil biodiversity is very low. Syria has low levels of landscape complexity, and natural vegetation could be better integrated in and around croplands.
- Although a considerable number of Syria's plant species and crop varieties are conserved in genebanks compared to other Mediterranean countries, its crop wild relatives and other useful wild species are poorly represented in genebanks.

Pillar 1: Agrobiodiversity in consumption for healthy diets
Pillar 2: Agrobiodiversity in production for sustainable agriculture
Pillar 3: Agrobiodiversity in conservation for future use options

Score: 0-20 | 21-40 | 41-60 | 61-80 | 81-100

All raw scores are scaled from 0 to 100. See Annex 2 for details.



Status 45.1

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 49.6	**Functional diversity: 49.6**	(Avoided) Disability Adjusted Life Years attributable to dietary risks per 100,000 adults: 49.6 (9,675)
Pillar 2 Production 33.2	**Varietal/breed diversity: 35.6**	Livestock breed diversity (Shannon's Index): 35.6 (1.1)
	Species diversity: 65.6	Crop species richness in production (count): 59.3 (73.0)
		Crop species diversity in production (Shannon's Index): 57.7 (1.4)
		Cropland with high crop species richness (%): 55.9 (55.9)
		Freshwater fish species richness (average count): 94.8 (78.7)
		Livestock diversity in production (Shannon's Index): 60.1 (1.0)
	Soil biodiversity: 15.0	Potential soil biodiversity (Index 0 to 2): 15.0 (0.3)
	Landscape complexity: 16.7	Cropland with >10% natural and semi-natural habitat at 1x1km scales (%): 16.7 (16.7)
Pillar 3 Conservation 52.6	**Varietal diversity: 61.6**	Varietal diversity in genebanks (Shannon's Index): 61.6 (3.5)
	Species diversity: 65.2	Species diversity in genebanks (Shannon's Index): 60.6 (3.8)
		Crop wild relative occurrence diversity (Shannon's Index): 69.7 (4.5)
	Underutilized species: 31.0	*In situ* conservation of useful wild species (%): 56.8 (56.8)
		Ex situ conservation of useful wild species (%): 5.2 (5.2)

Action 10.7

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 0.0	**Management practices supporting agrobiodiversity: 0.0**	Published diet guidelines (Yes/No): 0.0 (0.0)
		Published food composition tables (Yes/No): 0.0 (0.0)
Pillar 2 Production 32.2	**Diversity-based practices: 25.2**	Crop-livestock integration (% agricultural land with cropland and pasture): 25.2 (25.2)
	Management practices supporting agrobiodiversity: 39.1	Nitrogen use efficiency (kg N output per kg N input): 72.5 (0.8)
		(Inverted) Sustainable Nitrogen Management Index (Index 0 to infinity): 53.6 (36.8)
		Organic agriculture (%): 0.1 (0.1)
		Tree cover on agricultural land (%): 8.2 (2.5)
		(Avoided) pesticide use (kg per ha): 99.3 (0.3)
		Conservation agriculture (%): 0.6 (0.6)
Pillar 3 Conservation 0.0	**Management practices supporting agrobiodiversity: 0.0**	Indicators reported to the World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (%): 0.0 (0.0)

Context

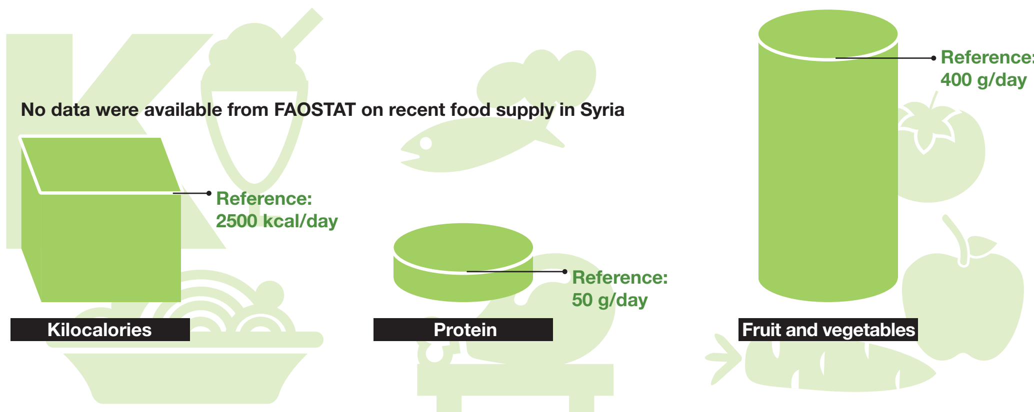
The Syrian Arabic Republic is a low-income country. The last estimates of its annual GDP and GDP per capita date to 2007, when they were valued at US$40.4 billion and US$2,033 respectively.[1] Syria covers a land area of about 185,180 km^2,[2] and had an estimated population of about 17 million inhabitants in 2019[3] with a population density in 2018 of 92 people per km^2.[4] Fifty-five percent of the Syrian population live in urban areas.[5] Syria has been drastically affected by civil war since 2011. The poverty level in Syria was last estimated in 2004, before the conflict, and represented 1.7% of the population.[6] In 2018, Syria's multidimensional poverty index was 0.029.[7,8]

Consumption for healthy diets

The Syrian diet typically comprises cereals, often as processed white flour. The most consumed dairy products are yoghurt and cheese, and vegetables, such as zucchini (courgettes), potato, eggplant (aubergine), and cabbage, are frequently consumed. Chicken forms a common part of the diet, in addition to beef, lamb, and cured meats. Fresh and dried dates and nuts form key components of the diet, and coffee is the most widely consumed beverage (Figure 1).[9]

In Syria, the average life expectancy of a healthy person reaches 72 years.[10] No data were available regarding the level of undernourishment in the Syrian population[11] nor on the prevalence of severe or moderate to severe food insecurity.[12] The prevalence of stunting and wasting in children under five reported in 2010 were 27.9% and 11.5% respectively.[13] In 2016, 34% of women between 15 and 49 suffered from anemia[14] and in 2019, almost 13.5% of the population between 20 and 79 were diabetic.[15] An estimated 34.8% of adult women (aged 18 years and over) and 20.9% of adult men are living with obesity.[16]

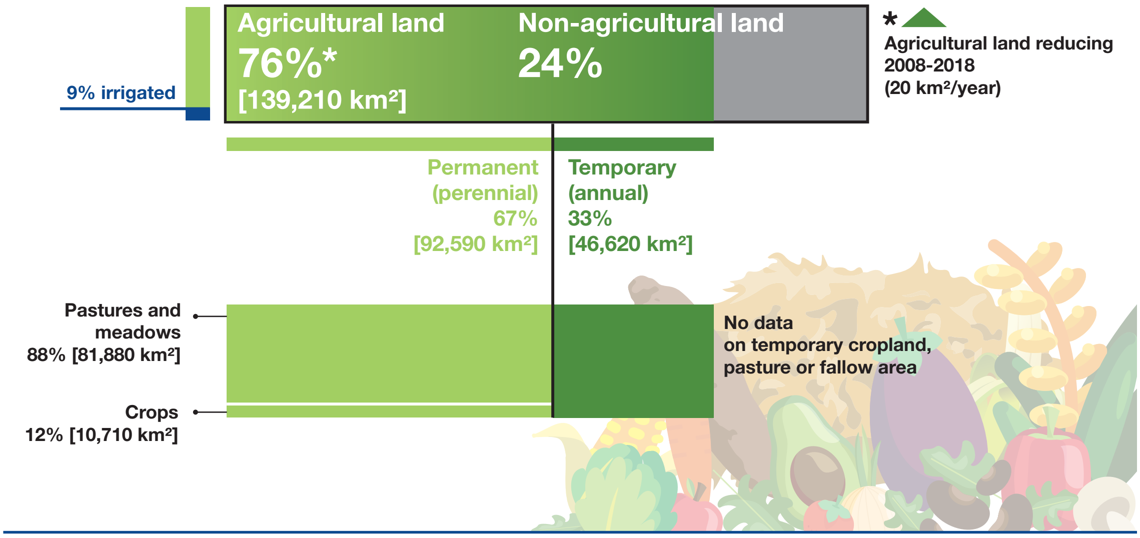
Figure 1: Kilocalorie, protein, fruit and vegetable supply



Production for sustainable agriculture

In Syria, 75.8% of land area (139,210 km^2) is devoted to agriculture, with 33.5% accounting for arable land[17] (Figure 2). In 2007, agriculture, forestry, and fishing contributed 19.5% of Syrian GDP.[18] Latest estimates from 2020 report that 10% of the Syrian population is employed in the agricultural sector, of whom 8% are women.[19] In 2016, fish capture production was estimated at 4,500 tonnes and the estimated aquaculture production was 2,500 tonnes.[20] Eggs, milk, and meat (sheep) are the three main animal-sourced foods produced in Syria, with an annual livestock production of above 5.7 million tonnes.[21]

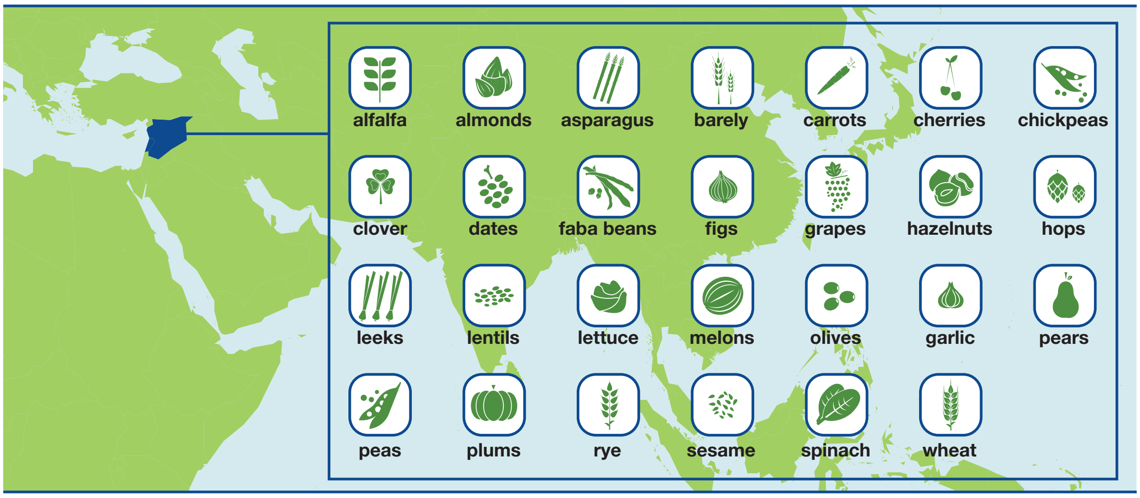
Figure 2: Land used for agriculture



Conservation for future use options

In Syria, 1,293 km² of the total land area and over 10,204 km² of the marine area are protected.[22] Nearly 3% of the land area (4,910 km²) is forested. Net tree cover loss from 2001 to 2019 was 207 km², showing a decrease of 20% in tree cover since 2000.[23] An estimated 370 plant species and 1,110 animal species have been assessed by the International Union for the Conservation of Nature's 'Red List', which assesses the risk of extinction.[1] It found that 32 plants, 15 mammals and 17 birds are threatened.[24] Syria is part of the fertile crescent and is an important centre of the origin of crop species especially wheat and barley[25] (Figure 3).

Figure 3: Crops originating from West Asia



Agrobiodiversity Index score

Syria has an Agrobiodiversity Index status score of 45.1, putting it among the least agrobiodiverse Mediterranean countries. The assessment is more limited than for most other countries because of missing or incomplete data on several dimensions of agrobiodiversity, which is unsurprising given the country has suffered more than a decade of conflict.

Status: What's driving the Agrobiodiversity Index score?

For Syria, we see that scores are highest in conservation (52.6), followed by consumption (49.6), and production (33.2). This indicates that agrobiodiversity is relatively effectively used in consumption for healthy diets and conserved for current and future use options, while there is potential for much better use of agrobiodiversity in production for sustainable agriculture. We can take a closer look at the indicator scores to understand what underlies the differences in status of agrobiodiversity across the pillars of Syria's food system.

Consumption

Functional diversity: The functional diversity score of 49.6 is relatively low and reflects a moderate number of avoided Disability Adjusted Life Years attributable to dietary risk factors.[26] Syria is 'off course' to meet all targets for maternal, infant, and young child nutrition. Limited information is currently available about the composition of food consumption patterns.

There were no data available on varietal diversity, species diversity, underutilized species, or local species in consumption.

Production

Varietal diversity: The diversity of livestock breeds maintained in production in Syria is low relative to other countries in the world and below average for the ten Mediterranean countries. Syria has two breeds each of cattle, goat, horse, and sheep in production and one breed each of other livestock including the Arab Camel and Ghab buffalo. We note that other species and breeds may be in production in Syria but not registered in the database used for the analysis (FAO DADIS), as the last population counts for all breeds are from 2006. Keeping multiple breeds in production should help farmers maintain livelihoods in times of pest and disease outbreaks or other production challenges, because different breeds have different resistance to pests and diseases.

Species diversity: With 73 distinct commodities in production, crop species richness is moderate relative to the global maximum of 123 species (in China) and in line with the average across the ten Mediterranean countries. The top ten crops by harvested area are barley, olives, wheat, seed cotton, lentils, almonds, pistachios, apples, anise (grouped together with badian, fennel, coriander), and grapes. The area coverage of different crops in production per 10x10 km is moderately evenly distributed, meaning cropped landscapes have a moderate diversity relative to other countries in the world and compared to other Mediterranean countries. A moderate percentage (56%) of agricultural land contains a high diversity of crop species at 10x10 km scales. This indicates that crop diversity is not being used to its maximum potential, and increasing crop diversity at field, farm, and landscape levels is recommended to enhance natural pest and disease control, yield stability, biodiversity, and other ecosystem services.[27] With 79 recorded freshwater fish species, fish richness is very high relative to other countries in the world and compared to the nine other Mediterranean countries. Livestock species diversity in production is high compared to other countries in the world and compared to the nine other Mediterranean countries. Actions to maintain and increase livestock richness in areas of the country where these are low would help ensure farmers in all regions rely on a wide species base, helping shield them against pests and diseases and other production challenges.

Soil biodiversity: Soil biodiversity is very low for most of the country, averaging 0.3 on scale of 0.11 to 1.35 (representing the minimum and maximum global extremes). Integrated plant nutrient management can help maintain and restore soil health, such as through increasing the use of cover crops, application of mulch and animal manure, and intercropping with legumes.

Landscape complexity: 17% of Syria's cropped landscapes have at least 100ha natural vegetation at 1x1 km scales, which is well below the 100% recommended, and below average compared to the nine other Mediterranean countries. Maintaining natural vegetation in and around cropland helps maintain habitat connectivity and ecosystem functioning to sustain nature's contributions to agriculture, including reducing the risk of pest and disease outbreaks, maintaining pollinators, and safeguarding crop wild relatives. Establishing at least 10% natural habitat at local (1x1 km) and landscape (10x10 km) scales could be achieved on farm through practices such as planting live fences (trees, hedgerows), woodlots, flower strips and set aside, and off farm by safeguarding portions of natural or semi-natural forests, wetlands, and grasslands around cultivated areas.

There were no data on functional diversity, underutilized species, or pollinator diversity in production.

Conservation

Varietal diversity: Syria has a high score for varietal diversity (61.6), meaning that the number of samples of Syrian crop varieties conserved in genebanks is high relative to the number of crop varieties relative to other countries conserved in the world, but below average relative to other Mediterranean countries.

Species diversity: The species diversity score (65.2) indicates that a moderate diversity of cultivated and wild species native to Syria are conserved in genebanks, and a moderate number of crop wild relatives have been identified in country, relative to other countries in the world.

Underutilized species: Syria has a low score (31) for conservation of underutilized species (useful wild species). The score reflects that while 56.8% of known useful wild species are conserved *in situ*, their representativeness in *ex situ* repositories is very low (5.2%).

There were no data on functional diversity of genetic resources in conservation.

Credit: ©IFAD/Nadia Cappiello

Actions: What actions are being taken to maintain and increase agrobiodiversity?

Consumption: Syria has no published food-based dietary guidelines or food composition tables to support dietary diversity.

Production: Action scores are low (32.2) for agrobiodiversity in production. This score reflects low adoption of diversity-based practices together with low adoption of agrobiodiversity-supportive management practices.

- **Diversity-based practices:** Available data indicate that there is low potential for integrated farming in Syria, with only 25% of agricultural landscapes (10x10 km areas) containing both cropland and pasture, thus facilitating crop–livestock integration. This is well below the average for Mediterranean countries (48%).
- **Production management practices supporting agrobiodiversity:** The environmental efficiency of production in Syria is moderate relative to other countries in the world, based on the Sustainable Nitrogen Management Index (SNMI) score. Given that nitrogen use efficiency is relatively high, the moderate SNMI score suggests that there is potential to improve land use efficiency (yields) to reduce environmental impacts of production. Syria has very low levels of pesticide use relative to other countries in the world, estimated at 0.3kg per hectare, which is far below the highest global user (28.0kg per hectare in Mauritius) and below the Mediterranean average. The avoided use of pesticides will be having a positive impact on soil biodiversity, pollinators, and natural enemies of pests, with benefits for agriculture and biodiversity. Trees are integrated into 2.5% of agricultural land in Syria, which is extremely low relative to other countries in the world and likely reflects the difficulty in sustaining plants that need a lot of water, such as trees, in extreme arid climates. Setting aside small areas of farmland for planting functionally and nutritionally diverse trees can provide multiple benefits for farmers in arid climates.[28] Drought-resistant and native tree varieties could be prioritized to minimize water consumption while providing other benefits to farmers. Organic agriculture is practiced on 0.1% of agricultural land and conservation agriculture on 0.6% of arable land, which is very low relative to other countries globally and in the Mediterranean. However, the very low use of pesticides indicates organic agriculture may be more widespread than suggested by official records.

Conservation: It has not been possible to properly evaluate the level of conservation action in Syria, given that the country has not reported its progress towards the implementation of the Second Global Plan of Action for Plant Genetic Resources for Food and Agriculture of the UN Food and Agriculture Organization through the online monitoring framework.

Commitments: How supportive of agrobiodiversity are national policies?

The commitments analysis for Syria was based on their *National Biodiversity Strategy and Action Plan for 2002*.[29]

Consumption: We were unable to find any commitments to use of agrobiodiversity for healthier diets.

Production: In production, Syria is committed to industrial farming. Its national planning strategy states it will work towards the 'realization of the agricultural revolution and the use of modern methods in agriculture'. There are very few policies that support diversification of farms or landscapes for more sustainable agriculture, and policies to promote cotton cultivation are likely to reduce on-farm varietal diversity. For example, Syria heavily regulates cotton production, including specifying which varieties are authorized for production in each region. Farmers are not permitted to independently produce agricultural cotton seeds locally. Syria has, however, made strong commitments to afforestation and natural habitat restoration on abandoned agricultural land and degraded lands. These commitments will help increase landscape complexity, supporting a wider range of animal and plant species including pollinators and natural enemies that support agriculture.

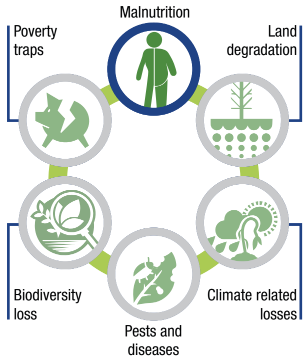
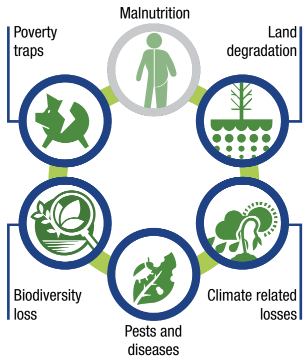
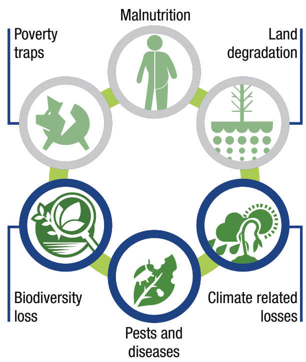
Conservation: Syria is committed to *in situ* conservation, setting several targets to increase the area of protected lands. It has a national genebank for the *ex situ* conservation of plant genetic resources.

Credit: ©IFAD/Nadia Cappiello

Recommendations

This section suggests concrete actions that can be taken to improve the use and conservation of agrobiodiversity for more sustainable food systems (Table 1). The list of actions is by no means exhaustive or prescriptive. It is intended for review, discussion, and improvement by in-country policy specialists.

Table 1: Recommended actions to enhance agrobiodiversity in the national food system

		Contributing to:	
Food system pillar in the Agrobiodiversity Index	**Recommendations**	**Risk and resilience**	**Global policy**
Consumption for healthy diets	Support increasing diversity in food supply and consumption. Find ways to avoid losing the rich diversity of traditional diets. Develop food-based dietary guidelines and related food composition tables.		SDG2 Zero Hunger SDG12 Responsible Production and Consumption WHO Decade of nutrition – reducing overweight, obesity and anemia
Production for sustainable agriculture	Introduce policies to support the production of diverse crops and livestock, favoring native and locally adapted varieties and breeds. Maintain and implement commitments to afforestation and natural habitat restoration to increase agricultural landscape complexity. Incentivize integrated plant nutrient management and integrated crop–livestock systems and best agroecological farm management practices to improve soil health and yields.		Post-2020 CBD Goal 1[ii] No Net Loss SDG 2 Zero Hunger
Conservation for future use options	Take action to report on progress made in implementing the Second Global Plan of Action on Plant Genetic Resources for Food and Agriculture (PGRFA), through the online reporting format established by the UN Food and Agriculture Organization for this purpose. Make a comprehensive assessment of existing agrobiodiversity and establish a national strategy for rebuilding the plant genetic resources program post conflict.		Post-2020 CBD Goal 3 Genetic Diversity Post-2020 CBD Goal 4 Nature's Benefits SDG 15 Life on Land FAO second Global Plan of Action on PGRFA[31]

Agrobiodiversity highlight

Saving Syria's unique seed diversity

When war broke out in Syria in 2011, the future of one of the world's most important seed collections was put at risk. What followed was an internationally coordinated rescue to ensure the preservation of this priceless heritage.

Syria's International Center for Agricultural Research in the Dry Areas (ICARDA) housed the largest collection of crop diversity from the Fertile Crescent, including barley, durum wheat, faba bean, chickpea, and lentils. In 2008, ICARDA was among the first genebanks to deposit safety duplicates of its seeds at the opening of the Svalbard Global Seed Vault. Carved into a mountain on the isolated island of Spitsbergen in the Svalbard Archipelago, Norway, the Seed Vault provides a disaster-proof place for institutes to store their precious seed collections in case something goes wrong with their own genebanks.

When the war broke out, ICARDA had successfully backed up almost 80% of its seed samples, and so it only lost 1,657 samples to the war. However, genebanks are not museums to safeguard seeds for eternity, but also act as a place where researchers and breeders can access the materials they need. That is why in 2015 ICARDA became the first depositor so far to organize a withdrawal from Svalbard to start regenerating their unique genetic diversity in their facilities in Lebanon and Morocco. Starting with only 300 precious seeds, each year since 2016, more than 30,000 samples have been regenerated, that is, grown out to provide enough seed to conserve and meet the needs of researchers and breeders.

Sources: [30]

Credit: ©IFAD/Nadia Cappiello

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End notes

I. The International Union for the Conservation of Nature (IUCN) ranks species according to how threatened they are. Rankings range from ‘extinct’, through ‘critically endangered’, ‘endangered’ and ‘vulnerable’, to ‘near threatened’ and ‘least concern’.

II. The Convention on Biological Diversity is an international treaty for the sustainable use and conservation of biological diversity. In 2010 it launched a strategic plan, running from 2011 to 2020, with 20 ambitious targets known as the Aichi Targets from the city in which they were signed. The international community has developed new targets, but their signature has been delayed due to the COVID-19 crisis.

Credit: ©Pixabay/Iyad Al Ghafari

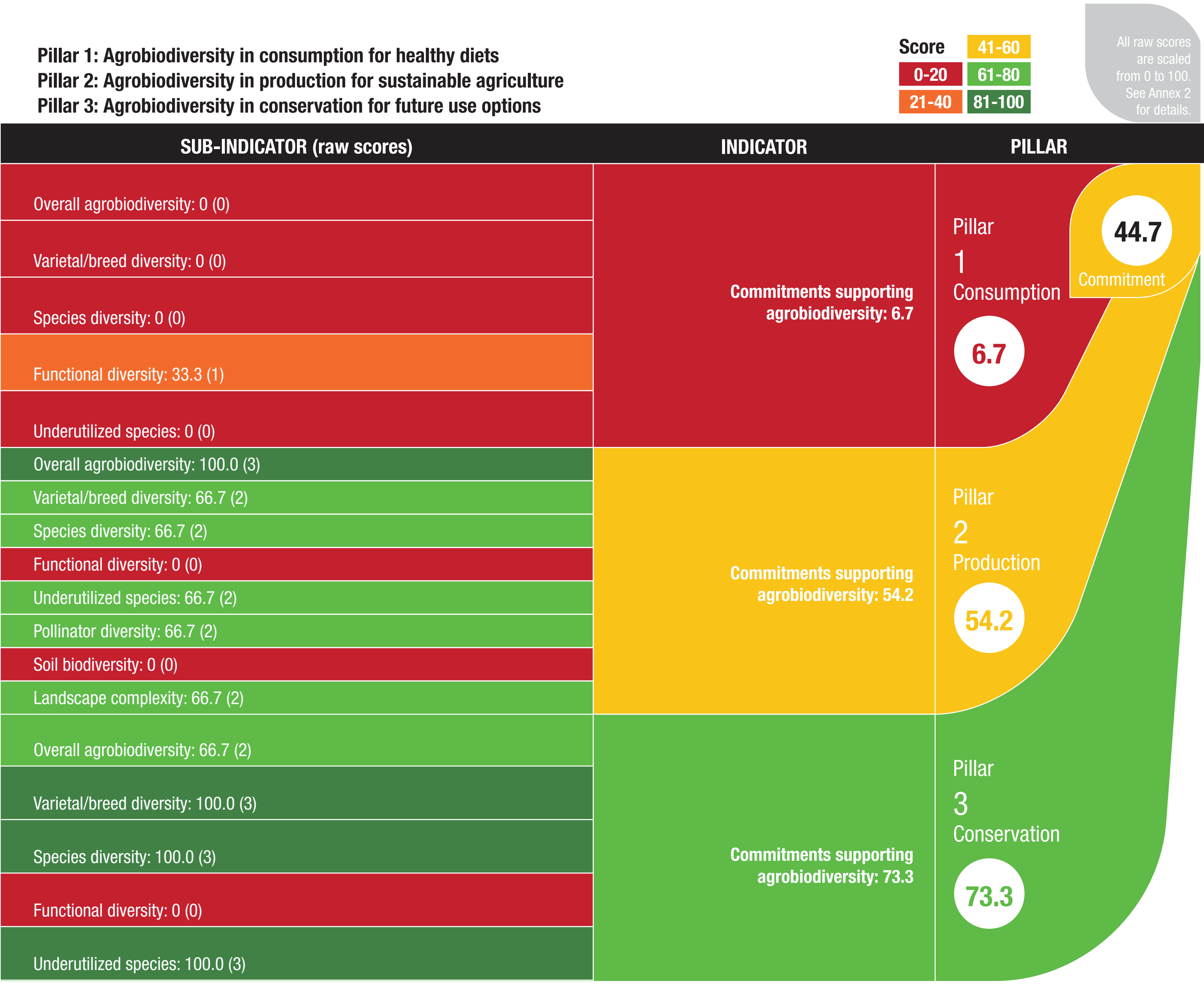
Tunisia

Country profile

AGROBIODIVERSITY INDEX

Key messages

- Tunisia has an Agrobiodiversity Index score of 50, reflecting a moderate integration of agrobiodiversity into the food system.
- In consumption, food species diversity could be improved to help ensure that all children in Tunisia have adequate diet diversity. Nonetheless diets are quite well balanced, including above average intakes of fruits, vegetables, legumes, and nuts.
- The production system is characterized by moderate crop species and livestock breed diversity, and very low freshwater fish richness, indicating diversity in production could be much enhanced. Soil biodiversity is very low, highlighting the potential for integrated crop–livestock farming systems and plant nutrient management to boost soil health. Tunisia has low levels of tree cover and landscape complexity meaning natural vegetation could be better integrated in and around croplands to support biodiversity and boost ecosystem services to and from agriculture.
- A moderate diversity of Tunisia's plant species and crop varieties are conserved in genebanks compared to other Mediterranean countries, and useful wild species are well represented in *in situ* conservation. However, the proportion of useful wild species conserved in genebanks is very low.



Status 50.0

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 69.1	Species diversity: 51.5	Food diversity in supply (Shannon's Index): 51.5 (2.6)
	Functional diversity: 70.9	(Avoided) Disability Adjusted Life Years attributable to dietary risks per 100,000 adults: 70.9 (5,595)
	Underutilized species: 85.0	Energy from sources other than cereals, roots and tubers (%): 85.0 (51.0)
Pillar 2 Production 33.2	Varietal/breed diversity: 48.6	Livestock breed diversity (Shannon's Index): 48.6 (1.5)
	Species diversity: 48.2	Crop species richness in production (count): 58.5 (72.0)
		Crop species diversity in production (Shannon's Index): 48.0 (1.1)
		Cropland with high crop species richness (%): 56.6 (56.6)
		Freshwater fish species richness (average count): 7.2 (5.9)
		Livestock diversity in production (Shannon's Index): 70.7 (1.1)
	Soil biodiversity: 13.9	Potential soil biodiversity (Index 0 to 2): 13.9 (0.3)
	Landscape complexity: 22.2	Cropland with >10% natural and semi-natural habitat at 1x1km scales (%): 22.2 (22.2)
Pillar 3 Conservation 47.6	Varietal diversity: 49.7	Varietal diversity in genebanks (Shannon's Index): 49.7 (2.8)
	Species diversity: 54.6	Species diversity in genebanks (Shannon's Index): 51.8 (3.2)
		Crop wild relative occurrence diversity (Shannon's Index): 57.3 (3.7)
	Underutilized species: 38.4	*In situ* conservation of useful wild species (%): 74.6 (74.6)
		Ex situ conservation of useful wild species (%): 2.2 (2.2)

Action 46.2

PILLAR	INDICATOR	SUB-INDICATOR (raw scores)
Pillar 1 Consumption 50.0	Management practices supporting agrobiodiversity: 50.0	Published diet guidelines (Yes/No): 0.0 (0.0)
		Published food composition tables (Yes/No): 100.0 (1.0)
Pillar 2 Production 27.4	Diversity-based practices: 15.3	Crop-livestock integration (% agricultural land with cropland and pasture): 30.6 (30.6)
		Integrated landscape initiatives (count): 0.0 (0.0)
	Management practices supporting agrobiodiversity: 39.4	Nitrogen use efficiency (kg N output per kg N input): 56.7 (0.6)
		(Inverted) Sustainable Nitrogen Management Index (Index 0 to infinity): 69.4 (24.3)
		Organic agriculture (%): 3.2 (3.2)
		Tree cover on agricultural land (%): 7.1 (2.1)
		(Avoided) pesticide use (kg per ha): 99.4 (0.2)
		Conservation agriculture (%): 0.3 (0.3)
Pillar 3 Conservation 61.3	Management practices supporting agrobiodiversity: 61.3	Indicators reported to the World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (%): 61.3 (61.3)

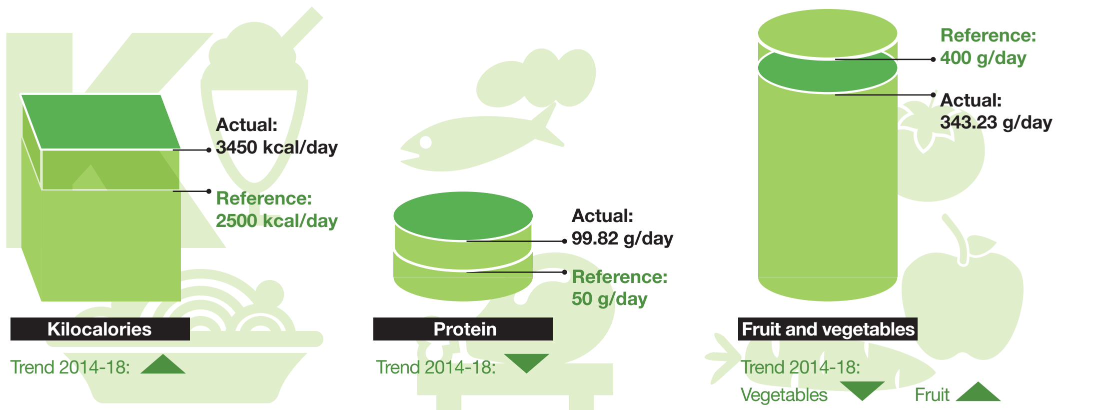
Context

Tunisia is a lower middle-income country. In 2019, Tunisian annual GDP was valued at US$38.79 billion while its GDP per capita was US$3,318.[1] Tunisia's surface area covers over 163,610 km^2.[2] In 2019, its total population was estimated at over 11 million people[3] with 74 inhabitants per km^2 in 2018.[4] Sixty-nine percent of Tunisian people live in urban areas.[5] Most recent poverty estimates, from 2015, showed that 0.2% of the Tunisian population were living below the poverty line[6] and in 2018, its multidimensional poverty index was 0.003.[7,8]

Consumption for healthy diets

In Tunisia, a diet is typically rich in wholemeal and barley flour, couscous, and rice in terms of carbohydrates. Animal-sourced products, such as cheese and buttermilk, chicken and lamb meat, are eaten frequently. Consumption of vegetables, such as tomatoes, pumpkin and potatoes, pulses (particularly chickpeas) and fruits (especially dates), is common[9] (Figure 1). Olive oil is moderately consumed, and garlic is much used in cooking.[10] The overall life expectancy of an average healthy Tunisian is 77 years.[11] Three percent of the population was undernourished in 2018,[12] while 9.1% and 20% of the population were estimated to be suffering from severe or moderate food insecurity between 2017 and 2019.[13] The prevalence of stunting and wasting for Tunisian children under the age of five were reported as 8.4% and 2.1% respectively in 2018.[14,15] Around 31% of women aged between 15 and 49 are anemic[16] and 8.5% of the population between 20 and 79 are diabetic.[17] An estimated 34.3% of adult women (aged 18 years and over) and 19.1% of adult men are living with obesity.[18]

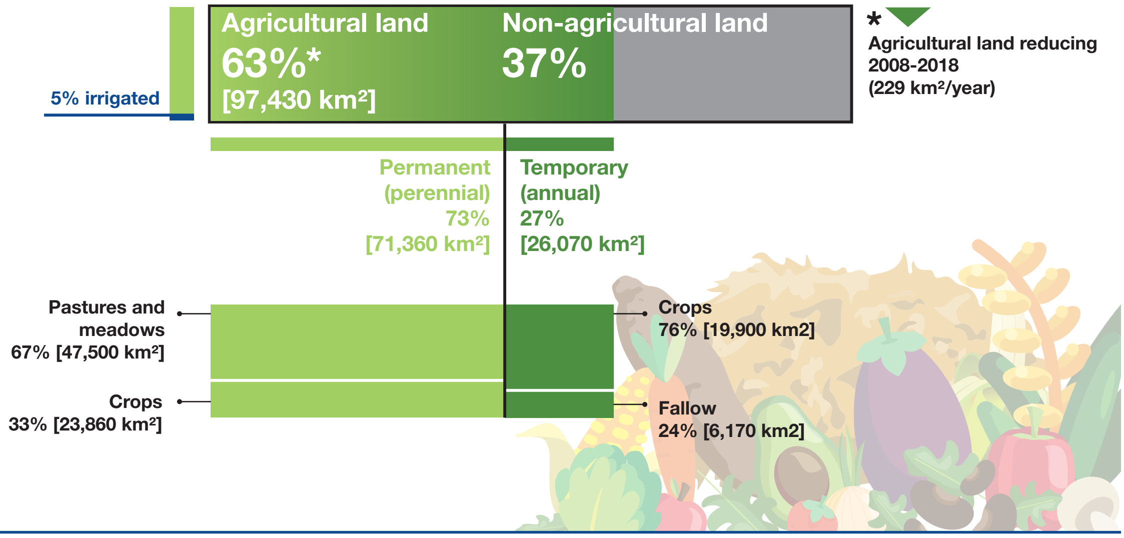
Figure 1: Kilocalorie, protein, fruit and vegetable supply



Production for sustainable agriculture

About 63% of the land area in Tunisia (97,430 km^2) is under agricultural activities, with nearly 27% accounting for arable land (76.3% temporary crops and 23.7% temporary fallow) (Figure 2).[19,20] In 2018, agriculture, forestry, and fishing contributed to 10.4% of Tunisia's GDP.[21] The latest figures, from 2020, report that 13% of the Tunisian population is employed in the agricultural sector, of whom 9% are women.[22,23] In 2016, fish capture production and aquaculture production were estimated at 115,064 tonnes and 16,166 tonnes respectively.[24,25] Eggs, milk, and meat are the three main animal-sourced food produced in Tunisia, with an annual livestock production of approximately 4 million tonnes.[26]

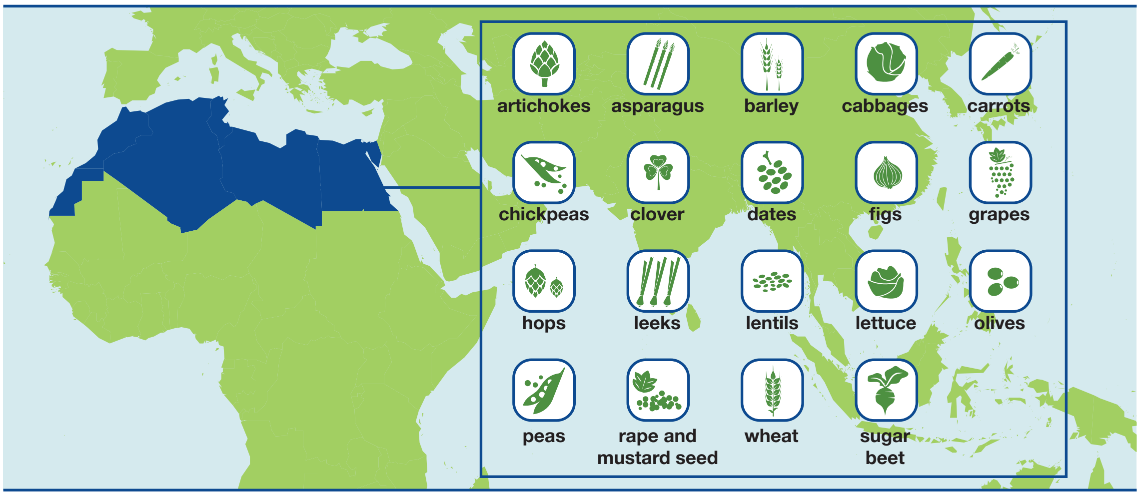
Figure 2: Land used for agriculture



Conservation for future use options

In Tunisia, 12,286 km² of total land and 100,661 km² of its marine area are protected.[27] Nearly 7% of Tunisia's land area (10,512 km²) is forested. The net tree cover loss from 2001 to 2019 was 269 km², showing a decrease in tree cover of 12% since 2000.[28] To date, 346 plant species have been assessed by the International Union for the Conservation of Nature's 'Red List', which assess the risk of extinction. It found 12 of them are threatened, while for animals, of the 1,107 species assessed, 15 mammals and 11 birds are considered threatened.[29] Tunisia is a centre of diversity for many crops, such as wheat, barley, beans, watermelon, chili, apricot, almond, pomegranate, date palm, figs, and many forage species, and it also harbours many wild relatives of crops, such as olives, figs, pears, pistachio, grapes, barley and others[30] (Figure 3). Nearly 7% of Tunisia's land area (10,512 km²) is forested.

Figure 3: Crops originating from South and East Mediterranenan



Agrobiodiversity Index score

Tunisia has an Agrobiodiversity Index status score of 50.0.

Status: What's driving the Agrobiodiversity Index score?

For Tunisia, we see that scores are highest in consumption (69.1), followed by conservation (47.6), and production (33.2). This indicates that agrobiodiversity is relatively effectively used in consumption for healthy diets and conserved for current and future use options, while there is potential for much better use of agrobiodiversity in production for sustainable agriculture. We can take a closer look at the indicator scores to understand what underlies the differences in status of agrobiodiversity across the pillars of Tunisia's food system.

Consumption

Species diversity: Food species diversity in Tunisia is moderate relative to other countries in the world and low compared to other Mediterranean countries. An estimated 63% of children under five have adequate diet diversity. The amount of fruits, vegetables, legumes, and nuts consumed are slightly above the global average.[18]

Functional diversity: The functional diversity score of 70.9 reflects a high number of avoided Disability Adjusted Life Years attributable to dietary risk factors, indicating that diets are quite balanced in terms of human health needs. Consumption of whole grains, however, is particularly low, while consumption of fruits, vegetables, legumes, and nuts can be further increased to reduce dietary health risk.[18]

Underutilized species: 51% of energy in Tunisian diets is obtained from sources other than major cereals, roots, and tubers, explaining the 85 score for underutilized species in this category (with 60% from non-staples as the recommended threshold). This indicates that diets are not overly dependent on major staples.

There were no data available on varietal diversity in consumption.

Production

Varietal diversity: The diversity of livestock breeds maintained in production in Tunisia is moderate compared to other countries in the world. Tunisia has seven breeds of horse in production, six of sheep, three of cattle, and one breed of two other species, namely the Maghrebi dromedary and Arbi goat. Keeping multiple breeds in production should help farmers maintain livelihoods in times of pest and disease outbreaks or other production challenges, because different breeds have different resistance to pests and diseases.

Species diversity: With 72 distinct commodities in production, crop species richness is moderate relative to the global maximum of 123 species (in China) and average across the ten Mediterranean countries. Cropped landscapes have a moderate diversity relative to other countries in the world and compared to other Mediterranean countries. A moderate percentage (57%) of agricultural land contains a high diversity of crop species at 10x10 km scales. This means that crop diversity has not reached its maximum potential, so seeking ways to enhance crop diversity at field, farm, and landscape levels is recommended to enhance natural pest and disease control, yield stability, biodiversity, and other ecosystem services.[31] With just six freshwater fish species recorded, fish richness is very low relative to other countries in the world and compared to the nine other Mediterranean countries. Livestock species diversity in production is high compared to other countries in the world and above average compared to the nine other Mediterranean countries. Maintaining livestock richness helps ensure farmers in all regions rely on a wide species base, helping shield them against pests and diseases and other production challenges.

Soil biodiversity: Soil biodiversity is very low for most of the country, averaging 0.3 on a scale of 0.11 to 1.35 (representing the minimum and maximum global extremes). Integrated plant nutrient management can help maintain and restore soil health, such as through increased use of cover crops, application of mulch and animal manure, and intercropping with legumes.

Landscape complexity: 22% of Tunisia's cropped landscapes have at least 100ha of natural vegetation at 1x1 km scales, which is well below the 100% recommended in the Index, and below average compared to the nine other Mediterranean countries. Maintaining natural vegetation in and around cropland helps maintain habitat connectivity and ecosystem functioning to sustain nature's contributions to agriculture, including reducing the risk of pest and disease outbreaks, maintaining pollinators, and safeguarding crop wild relatives. Establishing at least 10% natural habitat at local (1x1 km) and landscape (10x10 km) levels could be achieved on farm through practices such as live fences (trees, hedgerows), woodlots, flower strips and set aside, and off farm by safeguarding portions of natural or semi-natural forests, wetlands and grasslands around cultivated areas.

There were no data on functional diversity, underutilized species, or pollinator diversity in production.

Conservation

Varietal diversity: Tunisia has a moderate score for varietal diversity (49.7), relative to the globally best performing country (France) indicating that a significant number of samples of Tunisian crop varieties are conserved in genebanks.

Species diversity: The species diversity score is moderate (54.6), indicating that a moderate proportion of Tunisian cultivated and wild food species are conserved in genebanks and a moderate number of known crop wild relatives have been found in country, relative to other countries in the world.

Underutilized species: Tunisia has a low score (38.4) for conservation of wild useful species. While 74.6% of known wild useful species are conserved *in situ*, their representativeness in *ex situ* repositories is very low (2.2%).

There were no data available for functional diversity of genetic resources in conservation.

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Actions: What actions are being taken to maintain and increase agrobiodiversity?

Consumption: Tunisia has compiled food composition tables for local products, but has no available national food-based dietary guidelines.

Production: Action scores are low (27.4) for agrobiodiversity in production. This score reflects very low adoption of diversity-based practices together with low adoption of agrobiodiversity-supportive management practices.

- **Diversity-based practices:** Available data indicate that there is low potential for integrated farming in Tunisia, with only 31% of agricultural landscapes (10x10 km areas) containing both cropland and pasture, thus facilitating crop–livestock integration. This is well below the average for Mediterranean countries (48%).
- **Production management practices supporting agrobiodiversity:** The environmental efficiency of production in Tunisia is high relative to other countries in the world, based on the Sustainable Nitrogen Management Index (SNMI) score. A moderate nitrogen use efficiency score suggests that the overall environmental impact of production can be reduced by improving nitrogen use efficiency rather than improving yields. Tunisia has very low levels of pesticide use relative to other countries in the world, estimated at 0.2kg per hectare, which is far below the highest global user (28.0 kg per ha in Mauritius) and below the Mediterranean average. The avoided use of pesticides will be having a positive impact on soil biodiversity, pollinators, and natural enemies of pests, with benefits for agriculture and biodiversity. Trees are integrated into 2.1% of agricultural land in Tunisia, which is extremely low relative to other countries in the world and likely reflects the difficulty in sustaining plants that need a lot of water, such as trees, in extreme arid climates. Setting aside small areas of farmland for planting functionally and nutritionally diverse trees can provide multiple benefits for farmers in arid climates.[32] Drought-resistant and native tree varieties can be prioritized to minimize water consumption while providing other benefits. Organic agriculture is practiced on 3.2% of agricultural land and conservation agriculture on 0.3% of arable land, which is very low relative to other countries globally and in the Mediterranean. However, the very low use of pesticides indicates *de facto* organic agriculture may be more widespread than suggested by official records.

Conservation: Tunisia has reported on 61.3% of the indicators for monitoring progress on the implementation of the Second Global Plan of Action for Plant Genetic Resources for Food and

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Agriculture.[33] It has undertaken a fair number of *in situ* surveys of plant genetic resources for food and agriculture and targeted the collection of plant materials for long-term conservation in genebanks. However, not much has been done to survey its crop wild relatives *in situ*. Tunisia has also studied much of its crop genetic resources, evaluating them, and characterizing them so that other users can know what is available and how it might be useful. These have been published. Tunisia has shared some of its crop genetic diversity with national agricultural centers, farmers, and some foreign stakeholders, though none has been shared with the private sector. The country has conducted some activities on pre-breeding, which is the isolation of genetic traits that breeders can use to breed new varieties.

Tunisia has no national documentation system for plant genetic resources for food and agriculture either for *ex situ* or for *in situ* and there is no national system to systematically monitor and safeguard genetic diversity. This undermines efforts to effectively conserve and use genetic resources and reduce genetic erosion in the country.

Commitments: How supportive of agrobiodiversity are national policies?

The commitments analysis for Tunisia was based on their *National Biodiversity Strategy and Action Plan for 2018–2030 (NBSAP).*[34]

Consumption: In the National Strategy, the country recognizes the role of agrobiodiversity in consumption and acknowledges gendered preferences of using, consuming, and producing agrobiodiversity. For example, women consider cooking time, nutritional quality, taste, ease of collection, processing, and storage, while men favor commercial objectives. Nonetheless, the NBSAP lacks clear strategies or targets for guaranteeing agrobiodiversity on the plates and in the diets of Tunisians.

Production: Agricultural expansion and pressure on remnant natural ecosystems are leading to overexploitation of natural resources (water, fisheries, grasslands), a trend that has been worsening since independence, following the colonial period. The country's strategies include managing agroecosystems (including oases) sustainably to protect and maintain agrobiodiversity (e.g. pollinators, wild relatives), while increasing the number of cultivated species and varieties. Similarly, the country will support, integrate, and value local and traditional knowledge related to biodiversity.

Tunisia scored their actions in achieving each of the Convention on Biological Diversity targets (2011–2020) (known as the Aichi Targets) showing progress in 11 of the 19 targets. Similarly, the country has put forward multiple indicators to measure progress towards the Aichi Targets between 2018 and 2030. For example, the country is measuring forest, birds, bees, pollinators, cultivated varieties and livestock breeds, marine and endemic species diversity and abundance.

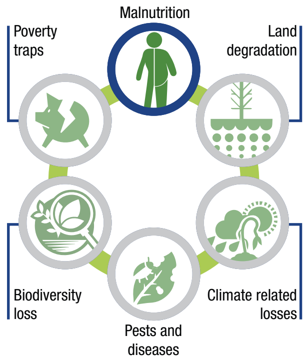
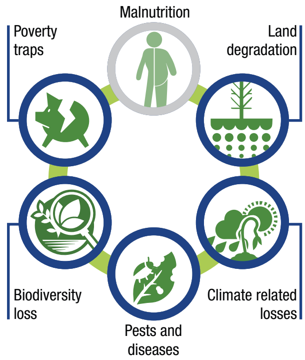
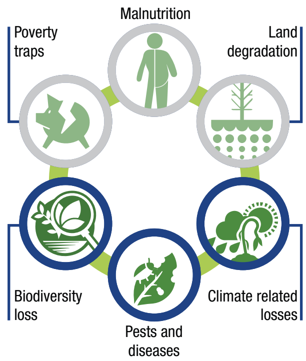
Tunisia has adopted a landscape approach for protecting biodiversity and the economic and ecological viability of agricultural systems in their NBSAP. Some practices promoted under this approach include conservation agriculture, organic agriculture, integrated pest management, agroforestry, crop species diversity, and varietal diversification. Some indicators used in these landscape approaches to track change include hedgerows, grasslands, woodland areas, organic or conservation farming areas, water-efficient techniques, nitrogen-use efficiency, and pesticide and chemical fertilizer use. The country identifies and protects agricultural systems through adhering to the 'Globally Important Agricultural Heritage Systems' program approach (See agrobiodiversity highlight below for an example). One clear target was to manage agriculture, silviculture, and aquaculture areas sustainably by 2020 to guarantee the conservation of biological diversity.

Conservation: The country aims to strengthen genetic improvement and conservation programs for traditional and local crop varieties and domestic animal breeds. Some of the indicators to measure agrobiodiversity conservation progress include number of collections of indigenous genetic resources in genebanks and seedbanks, the number of protected cultivated and domesticated plant and animal breeds, the number of new plant varieties registered, and the surface area dedicated to conservation of local plant species. Additionally, the country put in place programs to select crop varieties and livestock breeds adapted to new climate change conditions. One clear target by 2020 was to preserve the genetic diversity of crops, livestock, domestic animals, and their wild relatives, including other species of socio-economic or cultural value, while strategies to minimize genetic erosion and safeguard their genetic diversity were developed and implemented.

Recommendations

This section suggests concrete actions that can be taken to improve the use and conservation of agrobiodiversity for more sustainable food systems (Table 1). The list of actions is by no means exhaustive or prescriptive. It is intended for review, discussion, and improvement by in-country policy specialists.

Table 1: Recommended actions to enhance agrobiodiversity in the national food system

		Contributing to:	
Food system pillar in the Agrobiodiversity Index	**Recommendations**	**Risk and resilience**	**Global policy**
Consumption for healthy diets	Develop food-based dietary guidelines to support diet diversification and traditional diets. Promote and enable consumption of whole grains versus highly processed grains.		SDG2 Zero Hunger SDG12 Responsible Consumption and Production WHO Decade of nutrition – reducing overweight, obesity and anemia
Production for sustainable agriculture	Introduce policies to support the production of diverse crops, fish, and livestock, favoring native and locally adapted varieties and breeds. Increase the integration of natural habitat into cropped areas to improve agricultural landscape complexity. Encourage better fertilizer management including reduced chemical inputs and implementation of integrated plant nutrient management and other agroecological practices to improve soil health.		Post-2020 CBD Goal 1[I] No Net Loss SDG 2 Zero Hunger
Conservation for future use options	Carry out an inventory of crop wild relatives and take measures to actively conserve them in protected areas. Set up a national information-sharing mechanism for monitoring the status of conservation and use of agrobiodiversity.		Post-2020 CBD Goal 3 Genetic Diversity Post-2020 CBD Goal 4 Nature's Benefits SDG 15 Life on Land FAO second Global Plan of Action on Plant Genetic Resources for Food and Agriculture

Agrobiodiversity highlight

A unique agroforestry system balancing integrated farming

Perched on the heights of Mount el Gorrâa, the gardens of Djebba el Olia form a unique agroforestry system. At an altitude of 600m, the communities have been able to shape this mountainous landscape to their advantage by integrating agriculture on terraces derived from natural geological formations or by building them out of dry stone.

Backed by an efficient irrigation system, the hanging gardens of Djebba El Olia offer many food resources to their owners. Based on the practices of agroforestry and agroecology, fig tree cultivation is the mainstay of a varied and resilient polycultural system supported by extensive livestock farming.

The farmers of Djebba El Olia have a fine knowledge of the interactions and synergies between their crops and with the local fauna and flora. A long tradition of knowledge and practices related to food processing and preservation feeds the fascination for these farmers. Attached to their land, Djebba El Olia is a small oasis suspended in the mountains that bears witness to the ingenuity of its inhabitants.

Sources: [35]

Credit: © IFAD/Alfredo D'Amato/Panos

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End notes

I. The Convention on Biological Diversity is an international treaty for the sustainable use and conservation of biological diversity. In 2010 it launched a strategic plan, running from 2011 to 2020, with 20 ambitious targets known as the Aichi Targets from the city in which they were signed. The international community has developed new targets, but their signature has been delayed due to the COVID-19 crisis.

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Annexes

Annex 1: Glossary of terms

Terms	Description
Agrobiodiversity	The domesticated and undomesticated plants, animals, and microorganisms that contribute to food and agriculture, including those that provide pollination, nutrient cycling, pest control, and other ecological functions supporting production systems.
Convention on Biological Diversity (CBD)	The Convention on Biological Diversity (CBD) is the international legal instrument for "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources" that has been ratified by 196 nations.
Crop wild relatives	Crop wild relatives are wild plant species that are genetically related to cultivated crops. Untended by humans, they continue to evolve in the wild, developing traits – such as drought tolerance or pest resistance – that farmers and breeders can cross with domesticated crops to produce new varieties.
***Ex situ* conservation**	*Ex situ* conservation is the conservation and maintenance of plant samples outside their natural habitat, either in the form of the whole plant, or as a seed, pollen, tissue or cell culture.
***Ex situ* conservation representativeness**	The capacity of the *ex situ* conservation place to represent adequately the local variation in terms of habitats
Disability adjusted life years (DALY)	One DALY represents the loss of the equivalent of one year of full health. DALYs for a disease or health condition are the sum of the years of life lost to due to premature mortality and the years lived with a disability due to prevalent cases of the disease or health condition in a population. The lower the DALY, the better the person's health.
Functional diversity	Functional diversity is a component of biodiversity that concerns the range of things that organisms do in communities and ecosystems.
***In situ* conservation**	In situ conservation involves the maintenance of the genetic variation in the location where it is encountered naturally, either in the wild or within a traditional farming or domestic situation.
National Biodiversity Strategy and Action Plan (NBSAP)	The principal instrument for implementing the Convention on Biological Diversity at the national level (Article 6). The Convention requires countries to prepare a National Biodiversity Strategy (or equivalent instrument) and to ensure that this strategy is mainstreamed into the planning and activities of all those sectors whose activities can have an impact (positive or negative) on biodiversity.
Shannon diversity index	The Shannon diversity index is an index commonly used to characterize species diversity in a community. The Shannon index accounts for both the abundance and evenness of the species present.
Soil biodiversity index	This soil biodiversity index includes measures of richness (as bacterial richness or fungal richness) and the relative abundance of groups of soil organisms.
Species abundance	Species abundance is the number of individuals per species.
Species diversity	Species diversity is the number of species in a community weighted by their abundance.
Species evenness	Species evenness is a measure of the relative abundance of each species. An area in which all species are represented by the same number of individuals has high species evenness.
Species richness	Species richness is the number of different species represented.
Sustainable Nitrogen Management Index	The Sustainable Nitrogen Management Index is a one-dimensional ranking score that combines two efficiency measures in crop production: nitrogen use efficiency and land use efficiency (crop yield).
Underutilized species	Underutilized species are those which are entirely or almost entirely ignored by agricultural researchers, plant breeders and policymakers. Underutilized species are not normally traded as commodities. They are wild or semi-domesticated varieties and non-timber forest species adapted to particular, often quite local, environments

Annex 2: Indicators and sub-indicators

The Agrobiodiversity Index aims to capture information across 22 indicators (Table 1), first described in the Agrobiodiversity Index Methodology report in 2018[1].

For this application of the Agrobiodiversity Index to ten Mediterranean countries, we followed the methodology outlined in the paper *Agrobiodiversity Index scores show agrobiodiversity is underutilized in national food systems*[2] and summarized here. We managed to identify suitable data for 17 of the 22 Agrobiodiversity Index indicators. These include 10 Status, 4 Action, and 3 Commitment indicators (Table 1).

Table 1: Agrobiodiversity Index indicators. This shows the 22 indicators included in the Index, and which 5 of these indicators were not included in the country profiles in this report because a current lack of data ('no data')

		Pillars		
Measurement categories	**Indicators (n=22)**	**Consumption (n=6)**	**Consumption (n=10)**	**Consumption (n=6)**
Status (n=15)	Varietal diversity (x3)	No data	x	x
	Species diversity (x3)	x	x	x
	Functional diversity (x3)	x	No data	No data
	Underutilized species (x3)	x	No data	x
	Pollinators and natural enemies		No data	
	Soil biodiversity		x	
	Landscape complexity		x	
Action (n=4)	Diversity-based practices		x	
	Management practices supporting agrobiodiversity (x3)	x	x	x
Commitment (n=3)	Commitments supporting agrobiodiversity (x3)	x	x	x

Data were sourced from global repositories to enable comparability across countries and were only included in our assessment if they met seven data quality criteria described in (2). Specifically, ddatasets were included if they were:

1. relevant, i.e. the data contain information related to one of the indicators in the Agrobiodiversity Index
2. methodologically robust, i.e. data collection method is clearly documented and applied consistently
3. scientific credible, i.e. data are validated in peer-reviewed publications or data are sourced through official repositories
4. comparable, i.e. data units and coverage are comparable across countries
5. complete, i.e. datasets covered at least eight of our countries (this threshold was set to accommodate severe data gaps for two countries)
6. recent, prioritizing newer datasets and excluding data collected pre-2000
7. accessible, prioritising publicly available datasets to increase transparency.

If no datasets met these data selection criteria for a given indicator, the indicator was excluded from the analysis. The final datasets used in this report are listed in Table 2.

For the commitments analysis, we used the Agrobiodiversity Index text-mining script described in (3) and using the search terms provided in (2). All instances where a search term was identified were manually read and the level of commitment assessed by a single reviewer. This score was then cross-validated by a second reviewer. The text-mining script operates on English, Spanish or French language text. For two countries in our analysis, documents were only available in Arabic (Syria and Libya). For these countries, a translator identified all sections of text that mentioned food systems, land use or agrobiodiversity, and translated the sections into English. The translator then scored the level of commitment and this was cross-validated by a second reviewer.

Raw data used different scales of measurement, such as percentage, proportions, or ordinal scales. To make datasets comparable we scaled all raw data values to between 0 and 100, where 0 is the lowest and 100 is the highest. These scaled datasets are referred to as sub-indicators.

Following the Agrobiodiversity Index methodology[2], scaled sub-indicators were aggregated using a simple unweighted additive approach to provide scores for the 17 indicators. These indicator scores were further aggregated into nine scores corresponding to status, action, and commitment levels in consumption, production, and conservation. A final aggregation step provided summary status, action and commitment scores for the whole food system of the country.

Sub-indicator scaling involves setting minimum and maximum limits (thresholds) for each sub-indicator score. Depending on the sub-indicator, thresholds were set based on:

- the minimum or maximum possible score, e.g. 0 and 100 for the sub-indicator on percentage of organic agriculture, or 0 and 1 for the sub-indicator on presence or absence of dietary guidelines; or
- the minimum and/or maximum values achieved by any country globally where there are no clear limits to the possible data values, e.g. as is the case for scores using the Shannon diversity index which tend to infinity, or the number of disability adjusted life years (DALYs) attributable to dietary risks; or
- the minimum and/or maximum values achieved by any country globally. where the theoretical limit is meaningless for capturing agrobiodiversity's contribution to food system sustainability, e.g. percentage of energy intake from sources other than cereals, roots, and tubers, where we set the maximum threshold to 60% rather than 100%.

Thresholds used to scale each sub-indicator are provided in Table 2. The rationale for their selection is provided in Jones et al. (2021)[2]. Readers should note that for the sub-indicators that were calculated using the Shannon diversity index, the 0–100 scaled score should be interpreted as the country score relative to the globally best performing country.

Table 2: Data used in the Mediterranean Agrobiodiversity Index application. Measurement minimum and maximum thresholds show the lower and upper limits used when scaling each dataset from 0 to 100

Category	Pillar	Indicator	Sub-indicator	Measurement (min; max threshold)	Data sources	Spatial resolution	Source data collection year
STATUS	Consumption	Species diversity	Species diversity in diets	Food item diversity calculated using Shannon diversity index from kcal per capita data (1.92; 3.26)	FAO food balance sheets[4]	National level	2017
		Functional diversity	Avoided Disability Adjusted Life Years	Inverse of age-standardized Disability Adjusted Life Years attributable to dietary risks (-19,209; 0)	Dietary risk databases[5]	National level	2017
		Underutilized species	Energy from sources other than cereals and starches	Share of dietary energy supply derived from sources other than cereals, roots, and tubers (0; 60)	FAO food security indicators[6]	National level	2011–2013
	Production	Variety diversity	Livestock breed diversity	Livestock breed diversity calculated using Shannon diversity index from most recent standardized breed population counts (0; 3.08)	Domestic Animal Diversity Information System[7]	National level	2000–2020[1]
		Species diversity	Crop species diversity	Crop species diversity calculated using Shannon diversity index from physical area (0; 2.35)	Spatial Production Allocation Model (2010) crop physical areas v2.0[8]	~10 x 10 km	2010
			Freshwater fish species richness per major sub-basin	Freshwater fish species richness per major sub-basin (0; 83)	Global database on freshwater fish species occurrence in drainage basins[9]	Major sub-basins	2014
			Percentage of diversified cropland	Percentage of cropland with >= 22 crops (half of the cross-country median in national crop production statistics) (0; 100)	Spatial Production Allocation Model (2010) crop physical areas v2.0[8]	~10 x 10 km	2010
			Livestock species diversity	Livestock species diversity calculated using Shannon diversity index from standardised livestock population counts (0; 1.62)	Gridded Livestock of the World providing spatially explicit stock counts for 8 species[10]	~1 x 1 km	2007
			Crop species richness in production	Number of unique crops in crop area harvested data (0; 123)	FAO data on crop area harvested[11]	National level	2017
		Soil biodiversity	Potential soil biodiversity	Soil biodiversity index (0.11; 1.35)	Global soil biodiversity index combining data on macro and micro soil biodiversity[12]	~1 x 1 km	~2013
		Landscape complexity	Percentage of cropland with at least 10% natural or semi-natural vegetation	Proportion of cropland with at least 10% natural or semi-natural vegetation in a ~1km2 window (0; 100)	Modified from the European Space Agency Climate Change Initiative land cover map for 2015[13]	~300 x 300 m	2015

Table 2: Data used in the Mediterranean Agrobiodiversity Index application. Measurement minimum and maximum thresholds show the lower and upper limits used when scaling each dataset from 0 to 100

STATUS	Conservation	Varietal diversity	Varietal diversity in genebank accessions	Plant varietal diversity calculated using Shannon diversity index from abundance of domesticated varieties in genebanks (0; 5.68)	Plant genetic resources accession level data provided by national institutes[1,14]	National level	2020
		Species diversity	Crop wild relative species diversity	Crop wild relative species diversity calculated using Shannon diversity index from occurrence data (0; 6.44)	Global distribution of crop wild relatives[15]	National level	2020
			Species diversity in genebank accessions	Plant species diversity calculated using Shannon diversity index from abundance of domesticated and wild species in genebanks (0; 6.26)	Plant genetic resources accession level data provided by national institutes[2,14]	National level	2020
		Underutilized species	*Ex situ* conservation representativeness	*Ex situ* conservation representativeness (0; 100)	*Ex situ* conservation representativeness of useful wild plant[16]	National level	2017
			In situ conservation representativeness	*In situ* conservation representativeness (0; 100)	*In situ* conservation representativeness of useful wild plants[16]	National level	2017
ACTION	Consumption	Management practices supporting agrobiodiversity	Policies or guidelines leading to diverse diets	Presence (1) or absence (0) of dietary guidelines (0;1)	National dietary guidelines tracker[17]	National level	2020
			Resources to facilitate uptake of diverse diets	Presence (1) or absence (0) of a national food composition table (0;1)	World Nutrient Databases for Dietary Studies[18]	National level	2020
	Production	Diversity-based practices	Diversification through crop–livestock systems	Percentage agricultural land with both crop and livestock production (0;100)	Derived from pasture and cropland extents[19]	~10 x 10 km	2000
		Management practices supporting agrobiodiversity	Tree cover on agricultural land	Mean percentage tree cover on agricultural land (0; 30)	Tree cover in agricultural lands[20]	~1x1 km	2016
			Conservation agriculture	Percentage of arable land under conservation agriculture (0; 100)	Conservation agriculture on arable land[21]	National level	2005–2014
			Avoided pesticide use	Inverse of pesticide use per hectare of cropland (-28.0; 0)	Derived from FAO data on pesticide use on cropland[22]	National level	2018
			Integrated Plant Nutrient Management	Inverse of the Sustainable Nitrogen Management Index (-79.49; 0)	Sustainable Nitrogen Management Index[23] accessed via the Environmental Performance Index 2020[24]	National level	2011
			Organic agriculture	Percentage of agricultural land that is organic, including land under conversion to organic (0; 100)	Organic agriculture on arable land[25]	National level	2008–2018
	Conservation	Management practices supporting agrobiodiversity	International reporting on plant genetic resources for food and agriculture	Proportion of indicators reported in FAO World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (0; 100)	World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture	National level	2020

Table 2: Data used in the Mediterranean Agrobiodiversity Index application. Measurement minimum and maximum thresholds show the lower and upper limits used when scaling each dataset from 0 to 100

Category	Pillar	Indicator	Sub-indicator	Measurement (min; max threshold)	Data sources	Spatial resolution	Source data collection year
COMMITMENT	Consumption	Commitments supporting agrobiodiversity	Overall agrobiodiversity	Maximum level of commitment on a scale of: 0= "None", 1="Mention", 2="Strategy", 3="Target" (0;3)	National Biodiversity Strategies and Action Plans (NBSAP)* available from the Convention on Biological Diversity[26]	National level	2020[27]
			Varietal diversity				
			Species diversity				
			Functional diversity				
			Underutilized species				
	Production	Commitments supporting agrobiodiversity	Overall agrobiodiversity				
			Varietal diversity				
			Species diversity				
			Functional diversity				
			Underutilized species				
			Pollinators and natural enemies				
			Soil biodiversity				
			Landscape complexity				
	Conservation	Commitments supporting agrobiodiversity	Overall agrobiodiversity				
			Varietal diversity				
			Species diversity				
			Functional diversity				
			Underutilized species				

*For Libya, no NBSAP was identified on the CBD website or from national websites. The assessment was based on Libya's report on progress implementing their NBSAP.

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Annex 3: Data distribution and further details related to the cross-country analysis

Figures 1–3 show the distribution of scores for all sub-indicators used in the Agrobiodiversity Index application for this report. Figure 4 shows the correlation between sub-indicators within the status, action and commitment categories.

Figure 1: Status sub-indicator scores across the ten countries. Sub-indicator names are pre-fixed by 1 if they related to the consumption pillar, 2 for the production pillar, and 3 for the conservation pillar

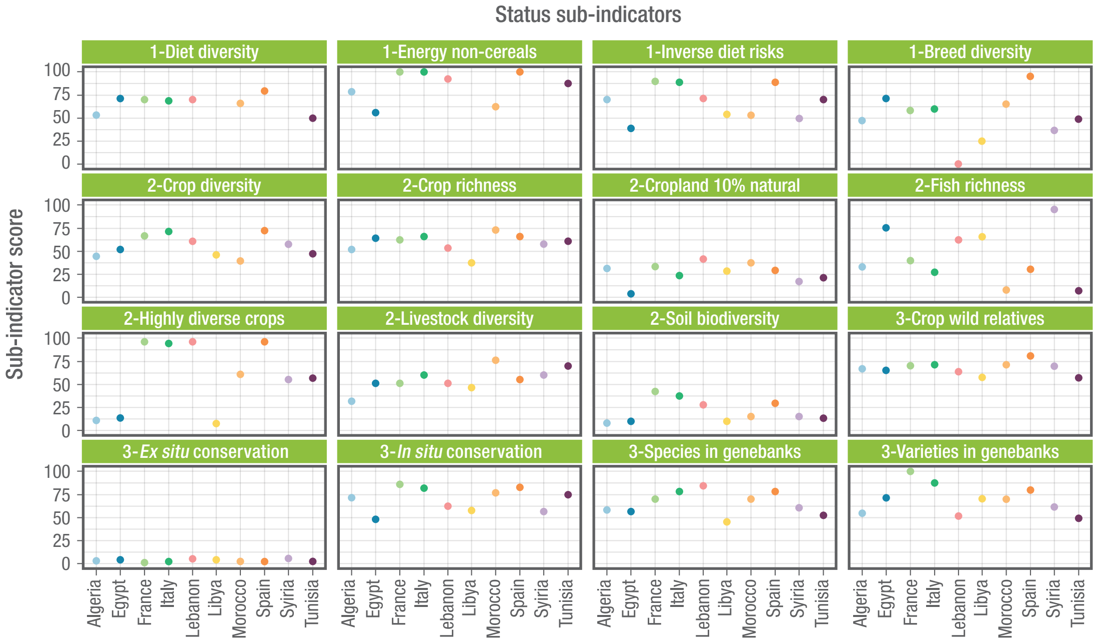


Figure 2: Action sub-indicator scores across the ten countries. Sub-indicator names are pre-fixed by 1 if they related to the consumption pillar, 2 for the production pillar, and 3 for the conservation pillar. Inverse SNMI: Sustainable Nitrogen Management Index, NUE: Nitrogen use efficiency, WIEWS: World information early warning system for plant genetic resources for food and agriculture

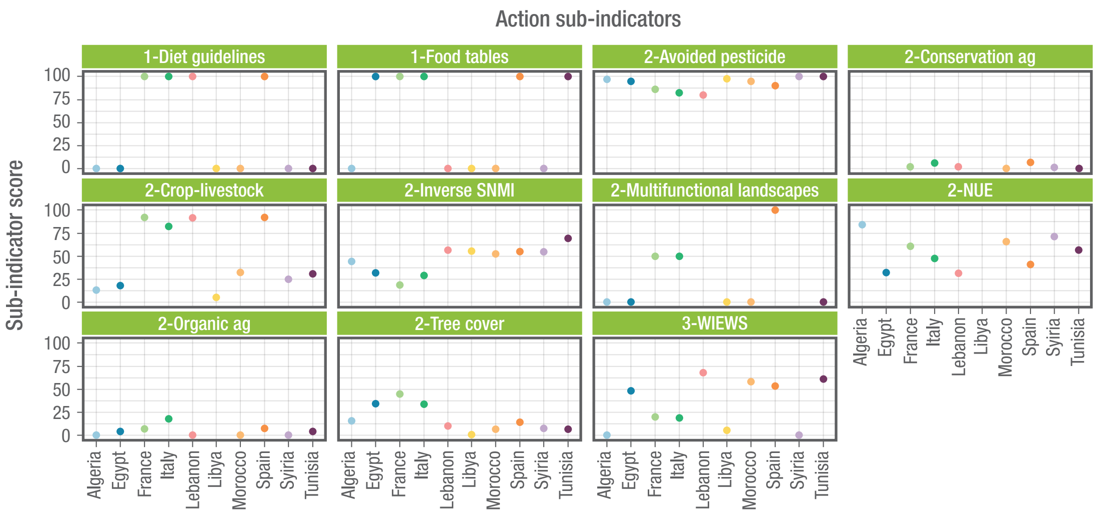


Figure 3: Commitment sub-indicator scores across the ten countries. Sub-indicator names are pre-fixed by 1 if they related to the consumption pillar, 2 for the production pillar, and 3 for the conservation pillar. ABD: Agrobiodiversity

Figure 4: Correlations between (a) status, (b) action and (c) commitment sub-indicator scores. Sub-indicator names are pre-fixed by a unique identifier where the first character indicates if the sub-indicator relates to status (S), action (A) or commitments (C), characters 2 and 3 show if the sub-indicator relates to the consumption (P1), production (P2) or conservation (P3) pillars, and the remaining characters present a unique identifier for each sub-indicator. Correlations are measured using Spearman's rank, where 1 represents complete positive correlation, 0 represents zero correlation, while -1 represents complete negative correlation

Figure a

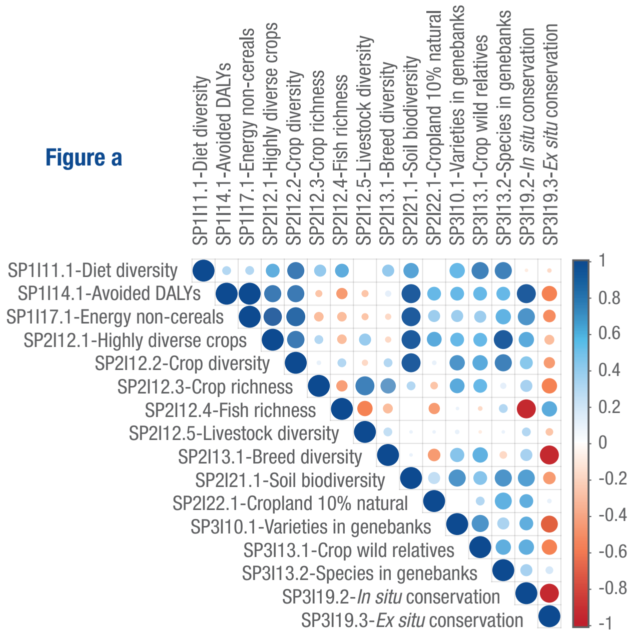


Figure b

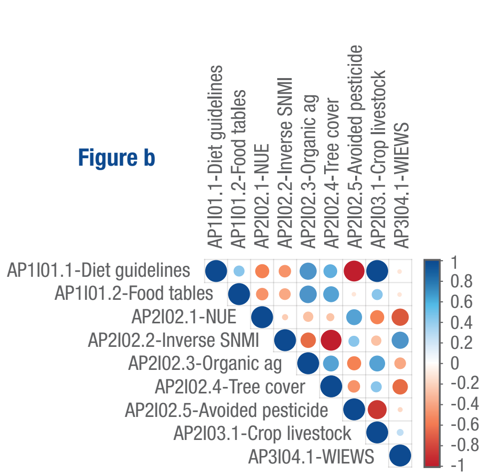
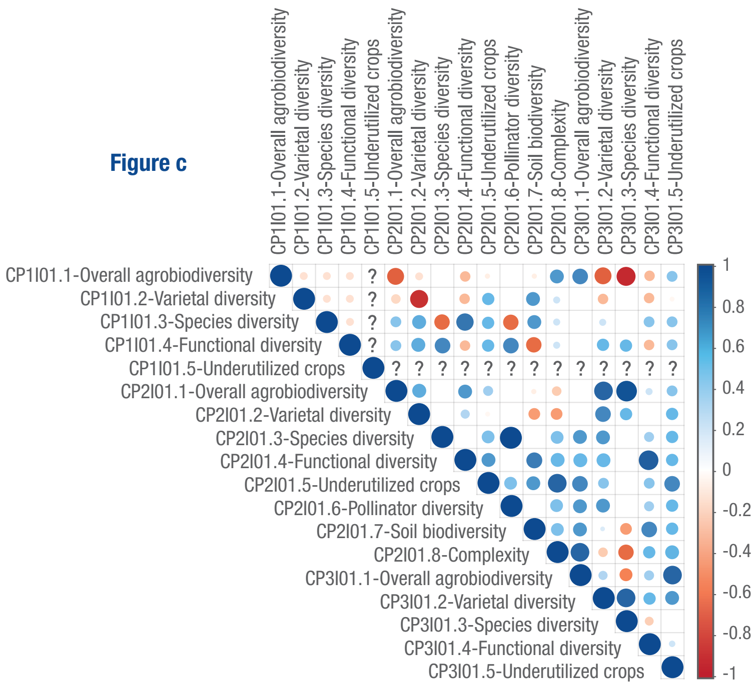


Figure c



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