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**MAKING AGRI-FOOD SYSTEMS
MORE RESILIENT TO SHOCKS
AND STRESSES**

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COVER PHOTOGRAPH ©123RF/bvh2228

VIET NAM. Farmers working in terraced rice fields in Mu Cang Chai, Yen Bai.

CONTENTS

CORE MESSAGES

FOREWORD

SUMMARY

Resilient agri-food systems are a strategic part of the world's response to ongoing and future challenges

Truly resilient agri-food systems address all dimensions of food security

FIGURE FROM BOX 1 A conceptual framework for agri-food systems

Shocks have immediate impact, while stresses gradually undermine systems' coping capacity

The ability to withstand shocks and stresses and bounce back is key in an uncertain environment

FIGURE 1 Agri-food systems' resilience and the six dimensions of food security

FIGURE 2 Conceptual framework for agri-food systems' resilience analysis

Understanding systems' functions and vulnerabilities

Diversity in production and trade partners can help minimize risk

Ensuring physical and economic access to food is a key aspect of agri-food systems' resilience

FIGURE 3 PPFI for protein, 2016–2018

FIGURE 4 DSFI for kilocalories, 2016–2018

Diverse, redundant, well-connected food supply chains underpin resilience

TABLE 1 Indicators of resilience and vulnerability of food transport networks for selected countries

TABLE 2 Indicators of unaffordability of healthy diets

Resilience-building strategies may involve trade-offs with efficiency and inclusiveness

FIGURE 6 Placement of selected countries based on the level of economic access to a healthy diet and DSFI for tonnes of fruits and vegetables, 2016–2019

FIGURE 8 A simplified illustration of three types of food supply chains regarding vulnerability to shocks and stresses and their resilience capacities

Robust rural livelihoods strengthen entire systems

Helping rural households cope better with shocks and stresses

Small-scale producers need organization, sustainable practices and social protection

FIGURE 9 RIMA resilience pillars by country profile

Guiding principle for policymakers: prepare for disruption

Diversity in food sources and output markets creates multiple pathways for absorbing shocks

The heterogeneity of farms and businesses must be recognized

TABLE 5 Entry points to manage agri-food systems' risk and uncertainty

Risk management, crop insurance and social protection enhance household resilience

4	Diverse, redundant, well-connected food supply chains underpin resilience	16
5	TABLE 1 Indicators of resilience and vulnerability of food transport networks for selected countries	17
9	TABLE 2 Indicators of unaffordability of healthy diets	18
9	Resilience-building strategies may involve trade-offs with efficiency and inclusiveness	18
9	FIGURE 6 Placement of selected countries based on the level of economic access to a healthy diet and DSFI for tonnes of fruits and vegetables, 2016–2019	19
10	FIGURE 8 A simplified illustration of three types of food supply chains regarding vulnerability to shocks and stresses and their resilience capacities	20
10	Robust rural livelihoods strengthen entire systems	21
11	Helping rural households cope better with shocks and stresses	22
11	Small-scale producers need organization, sustainable practices and social protection	22
12	FIGURE 9 RIMA resilience pillars by country profile	23
12	Guiding principle for policymakers: prepare for disruption	24
12	Diversity in food sources and output markets creates multiple pathways for absorbing shocks	24
13	The heterogeneity of farms and businesses must be recognized	24
14	TABLE 5 Entry points to manage agri-food systems' risk and uncertainty	25
15	Risk management, crop insurance and social protection enhance household resilience	26

CORE MESSAGES

1 To preserve their functionality and ensure the food security, nutrition and livelihoods of millions of people, agri-food systems must become more resilient to increasing shocks and stresses of diverse origins, both biophysical and socio-economic.

2 Because agri-food systems are complex – including primary production, food supply chains, domestic transport networks and households – and involve many interlinked actors, a shock in any component can spread rapidly throughout systems.

3 The fragility of agri-food systems can affect large numbers of people: already 3 billion people cannot afford a healthy diet and an additional 1 billion would join their ranks if a shock reduced their income by one-third. Food costs could increase for up to 845 million people if a disruption to critical transport links were to occur.

4 Of the five distinct resilience capacities agri-food systems must have – to prevent, anticipate, absorb, adapt and transform – absorptive capacity is critical in confronting unforeseen shocks and is complementary to risk management of shocks that can be anticipated.

5 Key to building the absorptive capacity of agri-food systems is diversity in food sources (domestic production, imports or existing stocks), diversity of actors in food supply chains, redundant and robust transport networks, and affordability of a healthy diet for all households, particularly the poorest and most vulnerable.

6 Risk management strategies for shocks such as droughts, floods and pests – including multi-risk assessments, timely forecasts, early warning systems and early action plans – are key to help all agri-food systems' actors prevent and anticipate major disruptions to systems and avoid human suffering and costly recovery interventions.

7 Enhancing the resilience of food supply chains requires government support to develop small and medium agri-food enterprises, cooperatives, consortia and clusters, as well as social protection programmes.

8 Resilience capacities of rural low-income households, in particular small-scale producers whose livelihoods are increasingly vulnerable to climate shocks and depletion of natural resources, can be significantly strengthened through education, non-farm employment and cash transfers.

9 Ensuring economic access to sufficient food for a healthy diet at all times is a key dimension of agri-food systems' resilience. Policies and investments that reduce poverty, generate decent employment and expand access to education and basic services, as well as social protection programmes when needed, are essential building blocks of resilience.

10 Building resilient agri-food systems should be a key policy objective and must ensure that all agri-food systems' components function well over time. This requires mainstreaming resilience in agri-food policies and greater coordination across all relevant sectors and layers of government institutions to ensure policy coherence.

FOREWORD

The novel coronavirus disease (COVID-19) pandemic has had profound impacts on all our lives and we continue to struggle with it. Border closures and curfews to contain the spread of the SARS-CoV-2 virus stopped international travel, shut down countless businesses and left millions of people unemployed. Restrictions on the movement of people and goods, particularly in the initial stages of the pandemic, impeded the flow of inputs to farmers and of their produce to markets. Where harvesting and transport were blocked, huge quantities of fresh fruits and vegetables were left to decay in farmers' fields.

Restrictions have harmed not only agri-food trade, agri-food supply chains and agri-food markets, but also people's lives, livelihoods and nutrition. After initial disruptions and uncertainty, many supply chains showed a remarkable degree of resilience in absorbing and adapting to the shock caused by the pandemic; however, lack of access to adequate food for millions of people emerged as a huge and persistent problem. Many rural people were unable to travel for seasonal work – an important source of income in poor communities. Immobilized by lockdowns, low-income urban households saw their incomes and spending on food fall sharply.

Even before the COVID-19 pandemic, the world was not on track to meet the shared commitment to end global hunger and malnutrition in all its forms by 2030, but the pandemic has sent us even further off track. This year's *State of Food Security and Nutrition in the World* estimates that between 720 and 811 million people were affected by hunger in 2020, up to 161 million more than in 2019, with the increase largely propelled by the COVID-19 crisis. Tragically, women and children have often borne the brunt of the crisis. According to the *Sustainable Development Goals Report 2020*, the disruption of health services and access to adequate food has added to the toll of under-five and maternal deaths. The United Nations' *Policy Brief: The Impact of COVID-19 on Food Security and Nutrition* suggests that 370 million children have been denied school meals owing to school closures. There is no doubt that the impact of the pandemic on food security and nutrition will be felt for many years.

Agri-food production and supply chains have historically been vulnerable to shocks – from droughts and floods to armed conflict and food price hikes – and are under growing pressure from longer-term stresses, including the climate crisis and

environmental degradation. But the COVID-19 pandemic is exceptional in that it has shown how a shock of global proportions can occur suddenly, spread rapidly and compromise the food security, nutrition status and livelihoods of billions of people to an unprecedented degree and over a long period.

The COVID-19 pandemic has left the fragilities of national agri-food systems widely exposed. An obvious reason to address these fragilities is, of course, the unwelcome increase in food insecurity and malnutrition. However, agri-food systems are too large for us to believe that their fragilities, if left unaddressed, will impede only the goal of achieving Zero Hunger by 2030, however crucial this objective may be. The implications go further. Agri-food systems produce 11 billion tonnes of food a year, employing 4 billion people directly or indirectly. The agri-food sector, including forestry and fisheries, also accounts for one-third of the anthropogenic greenhouse gas emissions driving climate change and occupies 37 percent of the Earth's land area. Agri-food systems have, therefore, an essential role to play in realizing other Sustainable Development Goals (SDGs) related to poverty, resource and energy efficiency, cleaner economies, and healthy aquatic and terrestrial ecosystems, among others.

International consensus has grown around the idea that transforming agri-food systems – towards greater efficiency, resilience, inclusiveness and sustainability – is an essential condition for realizing the 2030 Agenda for Sustainable Development. Momentum for change led to the first ever United Nations Food Systems Summit in September 2021, which agreed on innovative solutions and strategies to transform agri-food systems and leverage those changes to deliver progress across all the SDGs. The Summit's call to action focused on five objectives, one of which is building resilience to vulnerabilities, shocks and stresses to ensure the continued functioning of healthy, sustainable agri-food systems.

The theme of this year's report responds to the United Nations Food Systems Summit's call to bring forward a series of concrete actions that people from all over the world can take to support transformation of the world's agri-food systems. More specifically, the report provides evidence and guidance on actions that can help actors in agri-food systems manage their vulnerability to shocks and stresses, and strengthen the capacity of these systems to support livelihoods and sustainably provide continuous access to sufficient, safe and nutritious food to all in the face of disruptions.

To this end, the Food and Agriculture Organization of the United Nations (FAO) has developed a suite of resilience indicators designed to measure the robustness of primary production, the extent of food availability, and the degree of people's physical

and economic access to adequate food in countries worldwide. These indicators can help assess the capacity of national agri-food systems to absorb the impact of any shock, which is a key aspect of resilience. Analysis shows that a country's primary production sector is more resilient when it produces a diverse mix of food and non-food products and sells them to a wide range of markets, both domestic and international, a configuration mainly seen in higher-income countries or those with a large agri-food base. In terms of food availability, however, analysis of multiple sourcing pathways for crop, fish and livestock commodities shows that lower-income countries have a diversity that is comparable to that of larger, higher-income countries.

Another important aspect underscored by this report is that low-income countries face much bigger challenges in ensuring physical access to food through transport networks, key to keeping agri-food supply chains active. Analysis of data from 90 countries shows that if main transport routes were disrupted, many low-income countries in particular would have limited capacity to decentralize food distribution or use alternative delivery routes. For nearly half the countries analysed, the closure of critical network links would increase local transport time by 20 percent or more, thereby increasing costs and food prices for consumers.

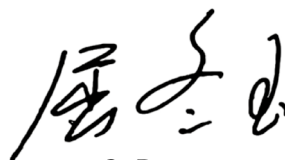
Taking an agri-food systems approach, the report also notes that risks associated with economic access to food are even more worrisome. Globally, we already know that around 3 billion people cannot afford a healthy diet to protect against malnutrition. Since low-income households spend most of their income on food, any significant loss of purchasing power – from food price hikes, crop failures or loss of income – poses a threat to their food security and nutrition. In fact, this report finds that an additional 1 billion people are at risk as they would not be able to afford a healthy diet if a shock were to reduce their incomes by one-third. The burden of this shock would fall mostly on middle-income countries, but the report also notes that, in the event of such an income shock, proportionately many more people in low-income countries would be unable to afford even an energy-sufficient diet. These risks are unacceptable in a world that produces enough food to feed its entire population.

The report finds that diverse, redundant and well-connected agri-food supply chains are needed to increase resilience, as they provide multiple pathways for producing, sourcing and distributing food. However, some actors in these agri-food supply chains are more vulnerable than others. The vulnerability of small and medium agri-food enterprises (SMAEs) is critical, as well as the fact that the resilience capacity of rural households – especially those involved in small-scale agricultural production – is increasingly put to the test in the face of adverse climatic events and depletion of natural resources.

Based on the evidence of this report, FAO is in a strong position to recommend that governments make resilience in agri-food systems a strategic part of national and global responses to ongoing and future challenges. A guiding principle is diversity – input sources, production mixes, output markets and supply chains – because diversity creates multiple pathways for absorbing shocks. Connectivity multiplies benefits: well-connected agri-food networks overcome disruptions faster by shifting sources of supply and channels for transport, marketing, inputs and labour.

Governments should encourage better coordination and organization of SMAEs within agri-food supply chains through, for example, forming consortia, which increase their scale, visibility and influence. Similarly, small-scale food producers can stay competitive and resilient by integrating into supply chains through producer associations and cooperatives, and by adopting resource-conserving practices. Social protection programmes may be needed to improve rural households' resilience in the event of shocks. Policies should also address issues beyond agri-food systems, including the need for better health and education services, gender equality and women's participation, and must recognize agri-food's role as a steward of the natural environment.

FAO stands firmly committed to taking advantage of the opportunity offered by events such as the United Nations Food Systems Summit and others to move from commitments to action in order to transform agri-food systems to make them more efficient, more inclusive, more resilient and more sustainable for better production, better nutrition, a better environment and a better life for all, leaving no one behind. This report offers evidence and guidance to take concrete steps in this important direction.



Qu Dongyu
FAO Director-General

SUMMARY

RESILIENT AGRI-FOOD SYSTEMS ARE A STRATEGIC PART OF THE WORLD'S RESPONSE TO ONGOING AND FUTURE CHALLENGES

Agri-food systems encompass primary agricultural production of food and non-food products, the production of food of non-agricultural origin, the food supply chain from producer to consumer and the final consumer of food (Figure from Box 1).

Globally, these systems produce some 11 billion tonnes of food each year and form the backbone of many economies. In an ideal world, agri-food systems would be resilient, inclusive and sustainable, producing sufficient, safe and nutritious food for all, and generating livelihoods that guarantee people's economic access to that food. Today, however, agri-food systems fail to keep about 10 percent of the world's population free from hunger.

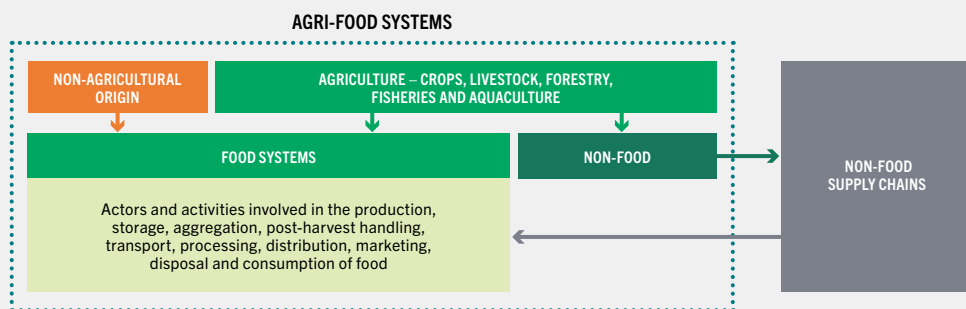
Increasingly, food supply chains and the livelihoods of agri-food systems' actors are disrupted by shocks – from droughts and floods to armed conflict and food price hikes – and long-term stresses, including climate change and environmental degradation. Risk and uncertainty are inherent in agri-food systems. The vulnerability of agri-food systems became starkly clear in 2020,

when measures to contain the novel coronavirus disease (COVID-19) pandemic disrupted global and national supply chains and caused economic downturns in many countries. Loss of purchasing power harmed the food security and nutrition of billions of people, particularly in low-income countries and among the poorest.

Truly resilient agri-food systems address all dimensions of food security

This report examines the challenge of building more resilient agri-food systems and defines agri-food systems' resilience as “the capacity over time of agri-food systems, in the face of any disruption, to sustainably ensure availability of and access to sufficient, safe and nutritious food for all, and sustain the livelihoods of agri-food systems' actors”.

Agri-food systems have three main components: (i) primary production; (ii) food distribution, linking production to consumption through food supply chains and transport networks; and (iii) household consumption. Key actors are: primary producers; those providing input supply, post-harvest, storage, transport and food processing services; food distributors, wholesalers and retailers; and households and individuals as final consumers.

FIGURE FROM BOX 1 A CONCEPTUAL FRAMEWORK FOR AGRI-FOOD SYSTEMS

NOTES: Food of non-agricultural origin includes meat analogues produced through synthetic biology.

SOURCE: FAO elaboration for the report.

Truly resilient agri-food systems must have a robust capacity to prevent, anticipate, absorb, adapt and transform in the face of any disruption, with the functional goal of ensuring food security and nutrition for all and decent livelihoods and incomes for agri-food systems' actors (Figure 1). Such resilience addresses all dimensions of food security, but focuses specifically on stability of access and sustainability, which ensure food security in both the short and the long term.

Shocks have immediate impact, while stresses gradually undermine systems' coping capacity

Compared to other economic sectors, agriculture is disproportionately exposed and vulnerable to adverse natural hazards, especially those climate related.

Shocks have immediate impact, while stresses are slow processes that gradually undermine the capacity of systems to cope with change and which render them more vulnerable. Agri-food systems' components and actors are exposed to shocks and stresses of various types and intensity, which can spread quickly throughout systems with different impacts on different systems' components and actors. Among producers, shocks are most likely to affect the livelihoods of low-income, small-scale operators; among food consumers, the poorest will be the most affected by rising food prices.

Risk management strategies that reduce exposure and vulnerability to a known, specific shock – such as drought preparedness – help build agri-food

FIGURE 1 AGRI-FOOD SYSTEMS' RESILIENCE AND THE SIX DIMENSIONS OF FOOD SECURITY

In relation to food security, agri-food systems' resilience is



SOURCE: FAO elaboration based on HLPE. 2020, Figure 1.

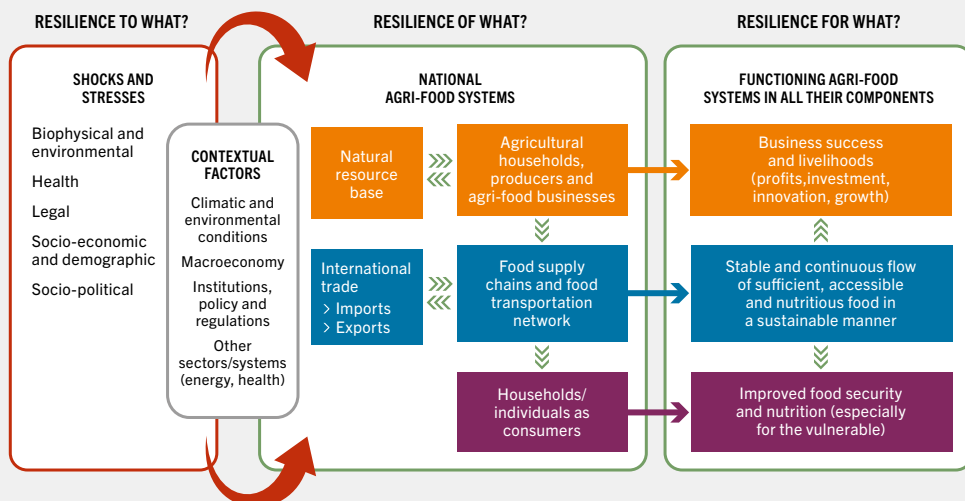
systems' resilience. However, the COVID-19 crisis has shown that some shocks are unpredictable in terms of timing and extent. Building resilience is, therefore, more than risk management: resilient agri-food systems are a strategic component of the world's response to ongoing and future challenges.

The ability to withstand shocks and stresses and bounce back is key in an uncertain environment

A key focus of the report is building the capacity of agri-food systems to absorb the impacts of shocks and stresses. Absorptive capacity refers to the ability

to withstand shocks and stresses and bounce back in the aftermath, using predetermined responses to preserve and restore essential basic structures and functions. It is particularly important to address unforeseeable shocks.

The magnitude of the impact of shocks and stresses is shaped by the specific vulnerabilities and resilience capacity of agri-food systems' components and actors, as well as the surrounding context and external sectors, such as energy and health (Figure 2). Complex, bidirectional linkages mean that disruptions to food production eventually

FIGURE 2 CONCEPTUAL FRAMEWORK FOR AGRI-FOOD SYSTEMS' RESILIENCE ANALYSIS

SOURCE: FAO elaboration for the report.

impact on household food security, while shocks affecting food consumption can ripple back to affect producers; this in turn will affect the environment.

UNDERSTANDING SYSTEMS' FUNCTIONS AND VULNERABILITIES

The report analyses the absorptive capacity of agri-food systems at the national level using a series of indicators linked to four key systems' functions, that is, to ensure: (i) robust primary production; (ii) availability of food; (iii) physical access to food; and (iv) economic

access to food. Each national system is unique, comprising numerous components and actors, operating on several interlinked levels, and often including international trade. Policymakers need to understand systems' functioning and be aware of potential vulnerabilities.

Diversity in production and trade partners can help minimize risk

To measure the capacity of primary producers to absorb shocks, FAO developed a primary production flexibility index (PPFI) to measure the extent of diversity in production across crop and

livestock commodities and the potential to produce for domestic and export markets. A high PPFI value indicates multiple potential pathways for generating agricultural value and for finding final outlets for primary food production. For most of countries, the PPFI is driven by domestic market diversity, and countries with the lowest diversity values are strongly skewed towards the domestic market (Figure 3). Most are low-income countries, with little external trade. Greater diversification is found in high-income countries or in those with a large agricultural base. These rely on a mix of comparative advantage in producing and exporting agricultural products, openness to international trade, and a sizeable domestic demand.

However, even countries with a sizeable agricultural base and export demand may reveal a low capacity to absorb shocks if the number of trading partners or exported commodities is limited. If those partners or commodities suffer a shock, the country is left with limited options.

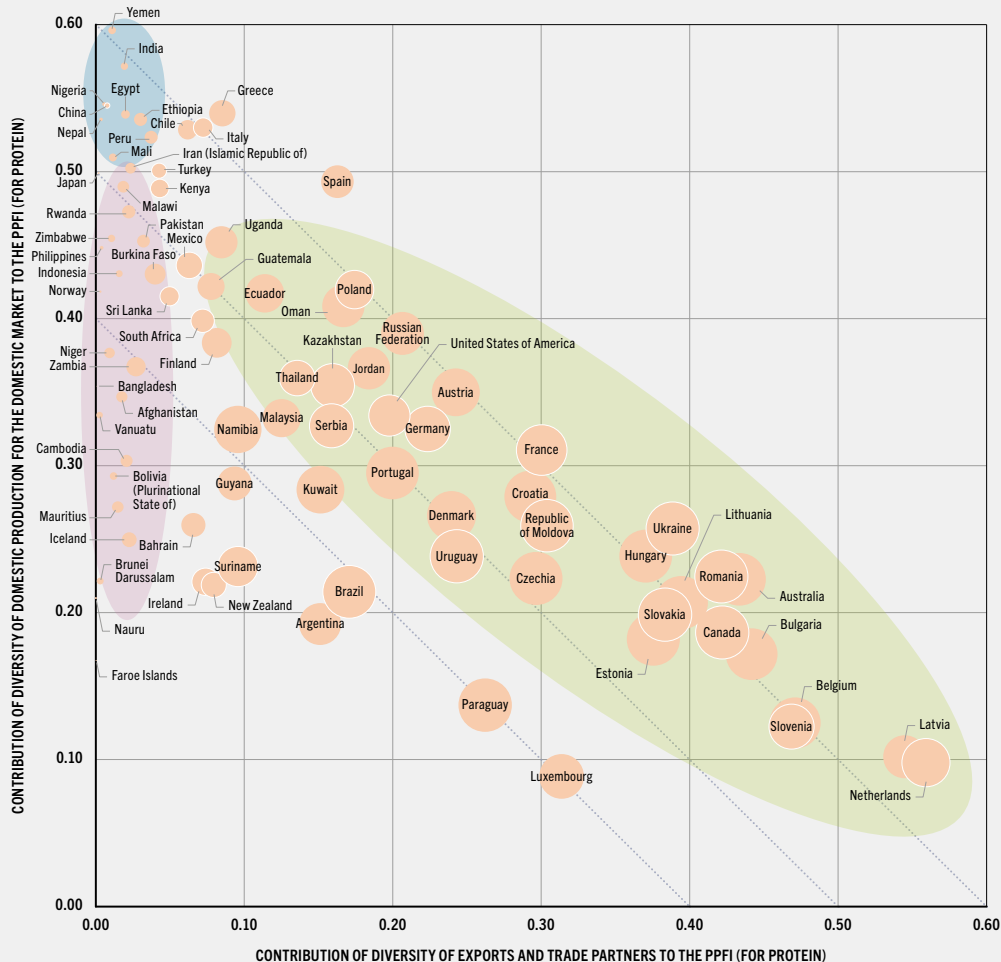
Another important function of agri-food systems is to make available a diverse range of foods that provide the nutrients essential for human health. To measure their capacity to absorb shocks and ensure the availability of food necessary for a nutritious diet, FAO also developed the dietary sourcing flexibility index (DSFI) for this report. The indicator captures the multiple sourcing pathways of crop, fish and livestock commodities available from domestic production, food imports and available stocks. What

emerges is that countries diversify their sources of food in different ways and effectiveness in diversifying does not depend on country size or income level (Figure 4). Where income does matter is in diversifying sources of fruits and vegetables, which is limited in low-income countries due to logistical constraints associated with transporting and storing perishables.

Those importing from multiple trade partners and across multiple commodities attain among the highest DSFI scores by buffering any supply shocks over many partners and commodities. Conversely, countries dependent on food imports from only a few major sources are vulnerable to shocks that hit their trading partners. In this case, diversifying import baskets and international trade partners, and possibly investing in domestic stocks, would be prudent.

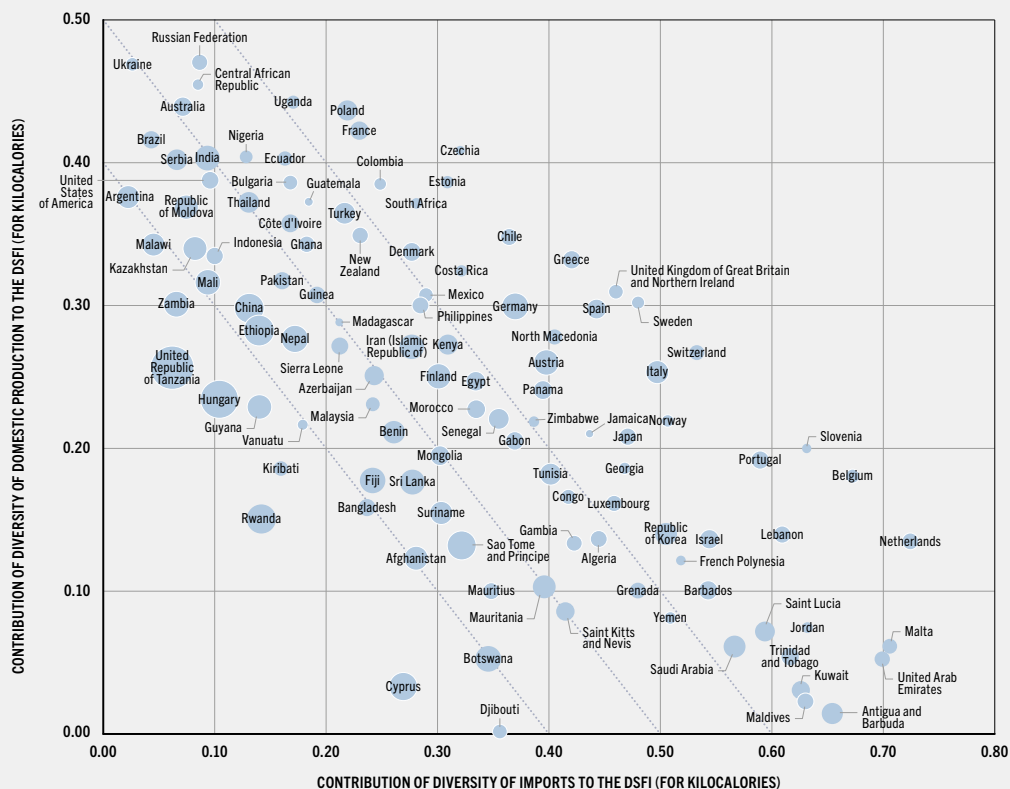
Ensuring physical and economic access to food is a key aspect of agri-food systems' resilience

An efficient, flexible transport network with optimal redundancy guarantees physical access to food at subnational level. FAO analysed the structural vulnerabilities of food transport networks around the world by examining how transport networks connect food demand nodes to where food is produced. The analysis measured food systems' capacity to respond locally to disruptions, the availability of alternative routes, and systems' sensitivity to the closure of critical links owing to shocks or stresses. »

FIGURE 3 PPFI FOR PROTEIN, 2016–2018

NOTES: The graph plots the contribution of diversity of exports and trade partners against the contribution of diversity of domestic production for the domestic market, both to the total value of the PPFI, for protein terms. The size of the orange bubbles represents the balance between the two (i.e. the balance between what is exported and what goes to the domestic market). Countries placed in the same diagonal line report the same value for export and domestic diversity – 0.4, 0.5 and 0.6, respectively. Results include all crop and livestock commodities for which FAOSTAT production and trade data were available. Fisheries and aquaculture are excluded due to the lack of trade partner data and protein conversion factors for fish species. Due to limited producer price data, non-food agricultural commodities are also excluded and the protein content of food commodities is a proxy for agricultural value. Protein conversion factors are calculated based on FAOSTAT data and then used to convert tonnes of food into tonnes of protein. To simplify graphic presentation, 90 countries that overlapped in the graph were dropped. Results are the three-year average of 2016, 2017 and 2018. Results for the full set of countries are in Annex 3 of the report. See Annex 1 of the report for methodology and data sources.

SOURCE: FAO elaboration for the report.

FIGURE 4 DSFI FOR KILOCALORIES, 2016–2018

NOTES: The graph plots the contribution of the diversity of imports (i.e. diversity of imports and trade partners plus balance of sourcing: internal or external) against the contribution of the diversity of domestic production (for both domestic market or exports), both to the total value of the DSFI, for kilocalories. The size of the blue bubbles represents the contribution of the diversity of stocks to the DSFI. Countries placed in the same diagonal line report the same value for production and import diversity – 0.4, 0.5 and 0.6, respectively. Results include all crop, fish and livestock commodities for which FAOSTAT new food balance sheets and trade data were available. Kilocalorie conversion factors are based on FAOSTAT data and then used to convert tonnes of food into kilocalories. To simplify graphic presentation, 40 countries that overlapped in the graph were dropped. Results are the three-year average of 2016, 2017 and 2018. Results for the full set of countries disaggregated by DSFI contributions are available in **Annex 3** of the report. See **Annex 1** of the report for methodology and data sources.

SOURCE: FAO elaboration for the report.

» While several very large countries had long distribution networks, food production and distribution in others could be adjusted to more locally based systems, if needed. Low-income countries face the biggest challenges in applying system-wide resilience measures to their food transport networks. They have limited capacity to adjust to local systems and lack reliable alternative routes during disruptions (Table 1). Since proximity-based resilience depends on how production is distributed relative to demand, some large, high-income countries are also vulnerable. For nearly half the countries analysed, the closure of critical network links would increase local travel time by 20 percent or more, increasing food costs.

Providing physical access to food is not enough to ensure food security. Well-functioning agri-food systems must also ensure people's economic access to food. Globally, some 3 billion people cannot afford a healthy diet, one that protects against malnutrition in all its forms. If a shock reduced their income by one-third, a healthy diet would be beyond the financial reach of an additional 1 billion people. Out of the 1 billion people at risk, 95 percent live in lower- and upper-middle-income countries (Table 2). In low-income countries – where already a large majority cannot afford a healthy diet – the challenge is that many more people risk not being able to afford even an energy-sufficient diet, consisting mainly of starchy staples that provide the energy needed for a day's work.

To ensure the affordability of a healthy diet, either the cost of food must come down, or the incomes of the vulnerable population must increase or be supported through, for example, social protection programmes – or, ideally, both (Figure 6).

DIVERSE, REDUNDANT, WELL-CONNECTED FOOD SUPPLY CHAINS UNDERPIN RESILIENCE

The smooth functioning of food supply chains underpins the resilience of national agri-food systems. A food supply chain is composed of interconnected activities performed by various actors who, in turn, draw on lateral chains that supply inputs and logistic services. The capacity of a food supply chain to absorb shocks depends on the resilience of each of its segments. Diverse, redundant and well-connected food supply chains enhance agri-food systems' resilience by providing multiple pathways for producing, sourcing and distributing food.

Understanding how shocks and stresses are likely to affect a given food supply chain is the key to developing resilience capacities. Large-scale modern food supply chains proved resilient to COVID-19 lockdowns because they operate on a global scale, with the capacity to adjust to disruptions geographically and temporally. Transitional supply chains, with their multitude of small and medium agri-food enterprises (SMAEs) and heavy reliance on labour, were more vulnerable to labour and transport disruptions. There is also evidence that some traditional supply

TABLE 1 INDICATORS OF RESILIENCE AND VULNERABILITY OF FOOD TRANSPORT NETWORKS FOR SELECTED COUNTRIES

COUNTRY		SYSTEM-WIDE MEASURES		LOCALIZED DISRUPTION	
		Proximity-based resilience	Route redundancy	Relative detour cost (local impact)	Relative detour cost (aggregate impact)
Low-income	Democratic Republic of the Congo				
	Haiti				
	Madagascar				
	Mali				
	Niger				
	Somalia				
	South Sudan				
	Sudan				
Lower-middle-income	Bangladesh				
	India				
	Myanmar				
	Nigeria				
	Pakistan				
	Papua New Guinea				
	Philippines				
	Senegal				
Upper-middle-income	Zambia				
	Brazil				
	China				
	Indonesia				
	Russian Federation				
	South Africa				
	Thailand				
High-income	Australia				
	Canada				
	Chile				
	France				
	United States of America				

Food transport network resilience

Low  Medium  High  Very high 

NOTE: Proximity-based resilience is measured as follows: low when values are less than or equal to 0.02; medium when values range between 0.02 and 0.05; high for between 0.05 and 0.2; and very high when it surpasses 0.2. Route redundancy is measured as follows: low when values are less than or equal to 70; medium when values range between 70 and 80; high for between 80 and 90; and very high when it surpasses 90. Relative detour cost (local impact) is measured as follows: low (resilience) when values surpass 30; medium when values range between 15 and 30; high for between 5 and 15; and very high when values are less than or equal to 5. Finally, relative detour cost (aggregate impact) is measured as follows: low (resilience) when values surpass 10; medium when values range between 5 and 10; high for between 2 and 5; and very high when values are less than or equal to 2. Proximity-based resilience is corrected for tonnage. Countries were selected based on population (more than 5 million), income group and region, so as to capture as much differentiation as possible. See **Annex 1** of the report for methodology and **Annex 3** of the report for the results for the full set of countries.

SOURCE: Nelson *et al.* (forthcoming).

TABLE 2 INDICATORS OF UNAFFORDABILITY OF HEALTHY DIETS

	Number of people unable to afford a healthy diet in 2019		Number of people at risk of unaffordability of a healthy diet if incomes are reduced by one-third	
	Percent	Total number (millions)	Percent	Total number (millions)
WORLD	41.9	3 000.5	13.4	956.4
Central Asia	16.9	5.8	18.1	6.2
Eastern and South-eastern Asia	23.9	530.0	18.0	398.0
Europe	1.7	12.0	3.1	22.0
Latin America and the Caribbean	19.3	113.0	14.5	85.0
Northern Africa and Western Asia	45.0	178.0	15.1	60.0
Northern America	1.4	5.1	0.5	1.7
Oceania	1.8	0.5	0.9	0.2
Southern Asia	71.3	1 282.0	16.8	303.0
Sub-Saharan Africa	84.7	875.0	7.8	81.0
COUNTRY INCOME GROUPS				
Low-income	87.6	463.0	6.9	37.0
Lower-middle-income	69.6	1 953.0	15.9	447.0
Upper-middle-income	21.1	568.0	17.1	460.0
High-income	1.4	16.0	1.1	12.0

NOTES: The table shows the number and share of people who cannot afford a healthy diet, or who are at risk of not being able to afford one if a shock reduces their income by one-third, by region and income group in 2019. The 2019 cost of a healthy diet is taken from FAO *et al.* (2021). See **Annex 1** of the report for methodology and data sources and **Annex 3** of the report for the results for the full set of countries.

SOURCE: FAO elaboration for the report.

» chains – spatially short and involving a small number of local intermediaries – filled gaps left by modern and transitional chains disrupted by lockdowns. Many proved to be nimble in their responses, especially in high-income countries. However, traditional supply chains are usually more vulnerable because, as they are often highly informal, they are invisible in national statistics, and

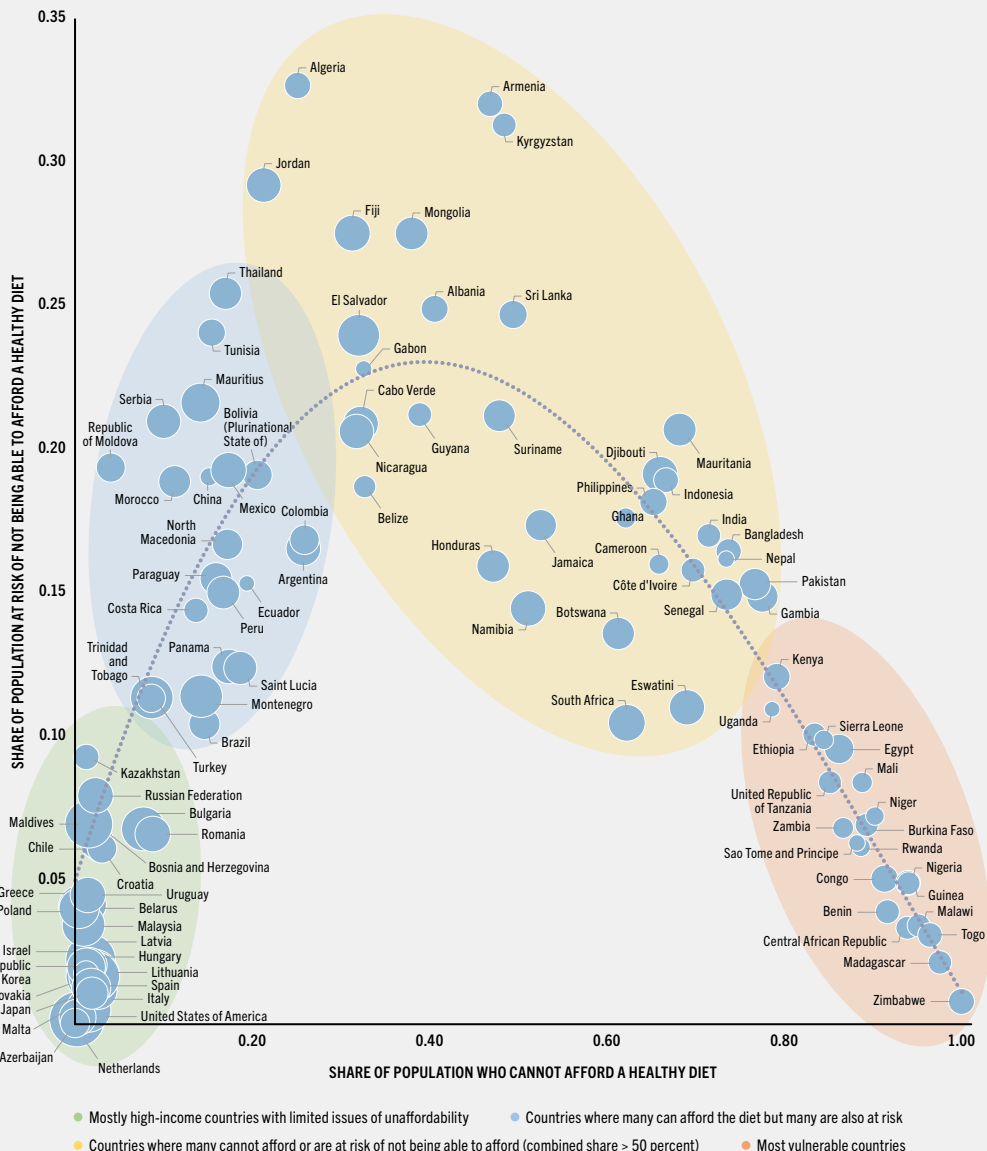
government support and social protection programmes do not reach them (Figure 8).

Resilience-building strategies may involve trade-offs with efficiency and inclusiveness

Agri-food businesses have different capacities to bear risk and make resilience-building investments.

Businesses may adopt diversification or »

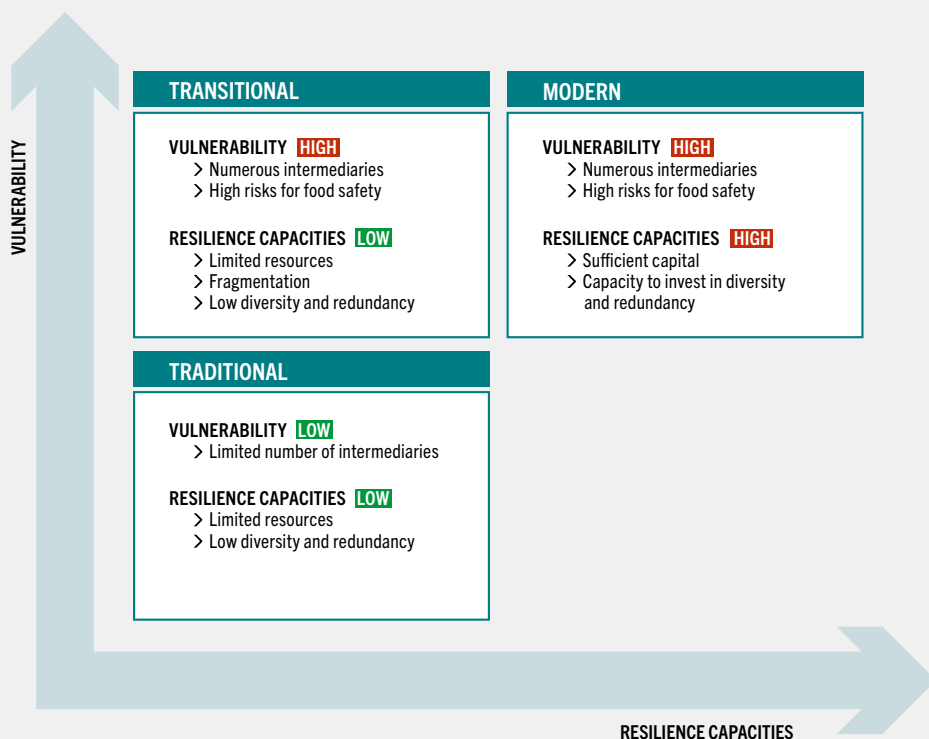
FIGURE 6 PLACEMENT OF SELECTED COUNTRIES BASED ON THE LEVEL OF ECONOMIC ACCESS TO A HEALTHY DIET AND DSFI FOR TONNES OF FRUITS AND VEGETABLES, 2016–2019



NOTES: The horizontal axis represents the share of population who cannot afford a healthy diet, while the vertical axis is the share of population at risk of not being able to afford one if a shock reduces their income by one-third or more. The size of each country's bubble indicates the value of the DSFI (see Box 5 of the report) for tonnes of fruits and vegetables. To simplify graphic presentation, 20 high-income countries with very low levels of unaffordability (up to 1 percent) were dropped. The DSFI refers to 2016–2018 averaged data and the economic access indicator refers to 2019 data. See **Annex 1** of the report for methodology and data sources and **Annex 3** of the report for the results for the full set of countries.

SOURCE: FAO elaboration for the report.

FIGURE 8 A SIMPLIFIED ILLUSTRATION OF THREE TYPES OF FOOD SUPPLY CHAINS REGARDING VULNERABILITY TO SHOCKS AND STRESSES AND THEIR RESILIENCE CAPACITIES



SOURCE: FAO elaboration for the report.

» redundancy strategies that reinforce the capacity of agri-food systems to absorb shocks by duplicating critical components and functions, or both, at the expense of efficiency. To reduce such trade-offs, businesses may seek partnerships with other, complementary companies. But this may not be feasible for SMAEs, which

face the double challenge of being resilient while also remaining competitive.

Essential to all these strategies is public – and increasingly private – infrastructure that helps to avert or buffer shocks. Those with well-developed infrastructure or with the capacity to

make the necessary investments will survive and outcompete those with less capacity. Agri-food businesses, farmers and agricultural territories that are excluded lose their crucial link to urban and export markets and find themselves in a poverty trap, where the confluence of market and climate changes makes them especially vulnerable. The resulting social costs may outweigh gains from the increased resilience of large-scale firms.

The limited resources available to small-scale producers and SMAEs often make recovery following a disruption more difficult. Facilitating access to credit and information can create synergies between efficiency and resilience that accelerate recovery. Governments can also support better coordination and organization of SMAEs within food supply chains. One approach is to form consortia, which increase the scale, visibility and influence of small businesses and facilitate access to private and government funding. Nurturing inter-organizational relationships in networks or strategic alliances can generate relational, structural and cognitive capital, promote more robust and effective risk management through resource pooling, and improve access to modern technologies and know-how. Territorial development tools such as clusters can also ease credit constraints, facilitate human development programmes and the diffusion of digital technologies.

ROBUST RURAL LIVELIHOODS STRENGTHEN ENTIRE SYSTEMS

The resilience capacities of all households are important for the functioning of agri-food systems. All households have a role to play in agri-food systems, whether as food producers and suppliers or as consumers. The resilience capacities of rural households – especially low-income small-scale farm families – are particularly and increasingly put to the test in the new normal of climate change and depletion of natural resources. Those engaging in diverse and multiple activities are generally better able to cope with, and recover from, stresses and shocks.

Households that are net food producers are more vulnerable to shocks and stresses that affect agricultural and food production. On the other hand, households that are net food consumers – practising farming as a part-time activity and relying on employment mainly in the non-farm economy – are more prone to shocks such as price spikes that affect their purchasing power. Households running small-scale agri-food businesses operate under greater constraints than their larger competitors due to more limited access to information, technology, capital, assets and institutions. They also risk being excluded from productive assets and lucrative markets in the accelerating modernization of food supply chains.

Helping rural households cope better with shocks and stresses

Rural households have developed a variety of strategies to navigate disruptions and strengthen resilience. At farm level, households respond to the unpredictable interplay between natural, technological and social factors by adjusting planting dates to cope with rainfall variability and investing in risk reduction by, for example, improving irrigation, drainage and pest control. A prominent strategy is diversifying production mixes, such as crop diversification and crop–livestock integration, but this foregoes specialization and raises the issue of a trade-off with efficiency. Households also diversify their sources of income through part-time employment in the rural non-farm economy and employ coping mechanisms for the aftermath of shocks by liquidating assets, taking out loans or drawing on savings and informal insurance based on community networks. However, coping strategies that reduce household assets run the risk of aggravating vulnerability by undermining future income-generating capacity.

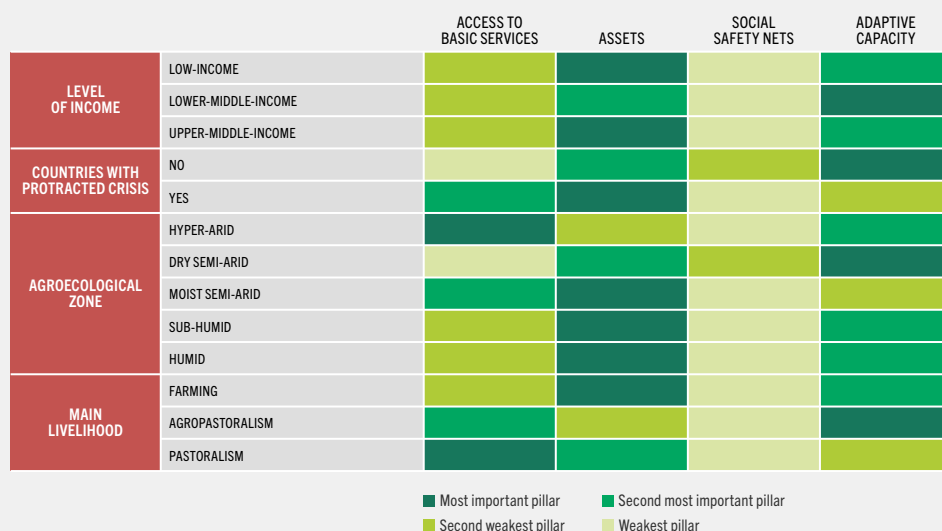
FAO's resilience index measurement and analysis (RIMA) model was used to identify the main factors underpinning resilience in rural households in 35 countries. Findings from 23 countries indicate that education, income diversification and cash transfers mainly drove gradual improvements in resilience capacity. Analysis of another 12 countries showed that in more than half of cases, the most important pillar of resilience was access to productive and

non-productive assets. Also important to household resilience was adaptive capacity, which depended critically on education and human capacity development within the household. Access to basic services, such as improved sanitation and safe drinking water, and primary services, especially schools, hospitals and agricultural markets, provided important support to household resilience, particularly in very arid zones and in pastoralist households (Figure 9).

Rural households comprising mainly women pay the heaviest toll during and after shocks. Women tend to have much less access than men to land and other assets that are crucial for resilience. Children are particularly vulnerable to shocks and stresses, which increase the rates of stunting and underweight among children under two years of age. Since child nutrition status is associated with performance in cognitive tests, school attainment and labour market outcomes later in life, shocks may generate substantial, long-term economic costs to both individuals and society.

Small-scale producers need organization, sustainable practices and social protection

To stay competitive and protect their livelihoods, small-scale agricultural producers need to be well integrated in supply chains for food, inputs and services. Producer associations and cooperatives reinforce livelihoods by allowing the pooling of resources to achieve scale, facilitating access to productive resources, and enhancing

FIGURE 9 RIMA RESILIENCE PILLARS BY COUNTRY PROFILE

NOTE: Protracted crises are contexts in which a significant proportion of the population is acutely vulnerable to hunger, disease and disruptions to livelihoods over prolonged periods.

SOURCE: d'Errico *et al.* 2021.

marketing power. Coordination with other actors is also key to managing market risks. Mutual benefits can be achieved, for example, through forward contracts: farmers receive guaranteed prices for their outputs regardless of market conditions, while processors and distributors receive products of a desired quality.

Farming households are increasingly adopting more sustainable production practices such as agroecology and climate-smart agriculture. An important

element of agroecology is food and agricultural biodiversity, which boosts resilience to shocks and stresses. Climate-smart agriculture enhances food security and livelihoods while promoting climate change adaptation and mitigation. These concepts recognize that conventional mainstream agriculture cannot feed the growing world population sustainably because it degrades the natural resource base.

Social protection programmes now emphasize reducing risks and the harmful

effects of shocks on vulnerable livelihoods. Social protection supports low-income farming households in adopting more profitable, but also riskier, economic activities and provides an alternative to negative coping strategies. Programmes that provide social protection and productive support are highly complementary and their implementation is increasing in rural areas.

GUIDING PRINCIPLE FOR POLICYMAKERS: PREPARE FOR DISRUPTION

Diversity in food sources and output markets creates multiple pathways for absorbing shocks

In a multi-risk environment, preparing for the unknown requires careful assessment of the structural characteristics of systems, including their diversity of pathways and connectivity (Table 5). Policies and investments need to recognize the distinction between risk and uncertainty. Managing risk typically involves reducing exposure and vulnerability to a specific adverse event. Managing uncertainty, on the other hand, requires that systems have sufficient diversity of actors and responses to maintain their core functions should an unforeseen shock materialize. Both approaches are needed and are complementary.

Key to building the absorptive capacity of agri-food systems is diversity in all its forms. Importing diversified foods from different countries with heterogeneous socio-economic and climatic profiles helps diversify the risks and reduce

vulnerability to external shocks.


International efforts to overcome trade barriers between countries may be needed. In countries where most food is produced and traded domestically, diversifying domestic production and imports, as well as stocks, will be essential.

Well-connected agri-food systems overcome disturbances faster by shifting sources of supply and channels for transporting and marketing of food products, inputs and labour, as well as transmission channels for knowledge and financial resources. However, connectivity and diversification should be complemented with risk management. For example, disasters and crises can impact on infrastructure and services. It is important, therefore, to assess, protect and risk-proof infrastructure and to develop new risk-sensitive and climate-resilient infrastructure.

The heterogeneity of farms and businesses must be recognized

Policies and interventions should facilitate a mix of traditional, transitional and modern food supply chains, which can buffer shocks and stresses of different types. Improvements in risk management and early warning capacity may be needed to help predict shocks and their impacts. To enhance decision-making, government at various levels should work with academia, research centres, civil society and the private sector and make data available and accessible for analysis throughout systems. Subnational and local multi-risk »

TABLE 5 ENTRY POINTS TO MANAGE AGRI-FOOD SYSTEMS' RISK AND UNCERTAINTY

	SHOCKS DIFFICULT TO FORESEE 			MORE PREDICTABLE SHOCKS
	Ensuring diversity	Managing connectivity	Managing risks	
CONTEXTUAL FACTORS	<ul style="list-style-type: none"> Promote gender equality and support youth Pursue policies and regulation to protect the environment (water, land, biodiversity, fisheries and forests) Safeguard macroeconomic stability Ensure broad access to financial services Support indigenous knowledge systems 	<ul style="list-style-type: none"> Encourage and promote effective partnerships for sustainable development Promote an open, inclusive and equitable multilateral trading system 	<ul style="list-style-type: none"> Prepare and implement national adaptation plans for mitigating and adapting to climate change Ensure well-coordinated and coherent policies for long-term macroeconomic stability 	
NATIONAL AGRI-FOOD SYSTEMS	<ul style="list-style-type: none"> Ensure diversity of food production, market channels and trade partners (both domestic and external) 	<ul style="list-style-type: none"> Invest in robust and redundant food transport networks Invest in infrastructural connections to international markets (e.g. ports) 	<ul style="list-style-type: none"> Promote disaster risk reduction and disaster risk assessment Prepare national plans for drought management Invest in food safety management systems Carry out multi-risk assessments within and across sectors and levels Adopt a One Health approach 	
FOOD SUPPLY CHAINS AND ACTORS	<ul style="list-style-type: none"> Allow for a mix of traditional, transitional, and modern food supply chains, including short, local food supply chains Promote inclusiveness for SMAEs 	<ul style="list-style-type: none"> Diversify sources of supply and output markets Enable and invest in stronger rural–urban linkages, especially for short supply chains Expand and improve access to ICT 	<ul style="list-style-type: none"> Ensure timely forecasts and tools for detecting early risk signals Establish and improve early warning systems 	
HOUSEHOLDS AND LIVELIHOODS (small-scale producers and vulnerable households)	<ul style="list-style-type: none"> Support the diversification of on- and off-farm income sources Promote good agricultural approaches and practices Expand access to credit and insurance to the most vulnerable 	<ul style="list-style-type: none"> Expand access to ICT and agricultural extension services Support collective action by small producers to develop bargaining power 	<ul style="list-style-type: none"> Promote access to productive assets Expand access to social services and education Implement targeted and timely social protection assistance for all vulnerable groups, including small-scale producers and the urban poor Fund R&D relating to agricultural adaptation strategies (e.g. climate change) 	

NOTE: ICT stands for information and communications technology, and R&D for research and development.

SOURCE: FAO elaboration for the report.

- » management strategies may also be needed to address underlying vulnerabilities and risk drivers.

Existing disaster and risk management tools in national laws, policies and regulations could be tailored to food supply chains to help stakeholders function more effectively and collaboratively within and across sectors. Policies also need to create an enabling environment to help producers and agribusinesses adopt resilience-enhancing business tools.

Risk management, crop insurance and social protection enhance household resilience

Households involved in small-scale agriculture and other primary agri-food production will benefit most from the logistical support, production innovations and inclusive governance of food supply chains. As extreme climatic events become more frequent and more pronounced, producers will also need access to agroclimatic disaster risk and early warning systems. Increasing their access to crop and weather insurance will enhance their ability to take out production loans and participate in more risky, higher-return farming activities.

Risk-informed and shock-responsive social protection systems may be needed to provide support not only to routine beneficiaries, but also at-risk and crisis-prone populations. They can expand the provision of benefits according to the emerging needs of potential beneficiaries and enable them to invest and engage in productive activities.

Ensuring the sustainability of agri-food systems is an integral part of building resilience. Policies can promote systems' sustainability by recognizing its role in stewardship of the natural environment, such as through agroecology and other resource-conserving practices.

To avoid implementing restrictions that hurt agri-food systems' actors, policymakers must understand how systems function and interact. Policy coherence is essential. Subsidies are a case in point: these can provide immediate and short-term relief to agricultural producers, but reduce their capacity to adapt to shocks when they occur. Policies also need to be fiscally sustainable. To meet the challenge of policy coherence, government institutions across all relevant sectors and different layers must be involved. ■



2021

THE STATE OF FOOD AND AGRICULTURE

MAKING AGRI-FOOD SYSTEMS MORE RESILIENT TO SHOCKS AND STRESSES

The COVID-19 pandemic exposed the vulnerability of agri-food systems to shocks and stresses and led to increased global food insecurity and malnutrition. Action is needed to make agri-food systems more resilient, efficient, sustainable and inclusive.

The State of Food and Agriculture 2021 presents country-level indicators of the resilience of agri-food systems. The indicators measure the robustness of primary production and food availability, as well as physical and economic access to food. They can thus help assess the capacity of national agri-food systems to absorb shocks and stresses, a key aspect of resilience.

The report analyses the vulnerabilities of food supply chains and how rural households cope with risks and shocks. It discusses options to minimize trade-offs that building resilience may have with efficiency and inclusivity. The aim is to offer guidance on policies to enhance food supply chain resilience, support livelihoods in agri-food systems and, in the face of disruption, ensure sustainable access to sufficient, safe and nutritious food to all.



*The State of Food and
Agriculture 2021 (full text)*



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