E

联合国粮食及农业组织 | Food and Agriculture Organization of the United Nations | Organisation des Nations Unies pour l'alimentation et l'agriculture | Продовольственная и сельскохозяйственная организация Объединенных Наций | Organización de las Naciones Unidas para la Alimentación y la Agricultura | منظمة الأغذية والزراعة للأمم المتحدة

FAO REGIONAL CONFERENCE FOR THE NEAR EAST

Thirty-seventh Session

Amman, Jordan, 5-8 February 2024 and 4-5 March 2024

Anticipatory Action to address the impacts of compounded crises

Executive Summary

The Near East and North Africa (NENA) region is characterized by a combination of structural vulnerabilities and exposure to natural and man-made hazards that make the region extremely prone to the compounded impacts of shocks, stresses, and crises. Moreover, climate change, political instability, demographic pressures, degraded natural resources and heavy dependence on food imports are serious long-term stresses that further aggravate risks and vulnerabilities and weaken existing capacities. Combined with the increasing frequency and severity of climate change related events, water scarcity, economic instability and conflict, the threat to food insecurity in the region cannot be underestimated.

The recurrent nature of most hazards such as drought, floods and animal and plant pests and diseases can be confronted by taking both proactive preventative and anticipatory actions to reduce risks and mitigate impacts.

The key elements of an anticipatory action system include an early warning system that reflects deep understanding and prioritization of hazards and risks, complemented by triggers to anticipatory actions that are well planned; flexible financing mechanisms to fund anticipatory actions; effective institutional arrangements and coordination; and effective implementation, monitoring, and evaluation to inform learning and support evidence-based recommendations. While some of these elements are implemented in the NENA region at country and regional levels, there are rather limited examples, if any, of a holistic anticipatory action system that adopts all key elements.

This paper calls for wide adoption of holistic and muti-hazards anticipatory action systems in the NENA region within the overarching framework of effective and proactive disaster risk management.

Suggested action by the Regional Conference

Recommendations to Members:

a. Fully integrate anticipatory actions in national disaster risk reduction and management and climate change adaptation policies, strategies, plans and programmes.
b. Establish/strengthen hazard-specific and multi-hazard risk information systems (including early warning systems) at national and regional levels, complemented with triggers to initiate anticipatory actions.
c. Establish flexible financing mechanisms for timely and appropriate anticipatory actions including evidence-based forecast, disbursement facilities and monitoring systems.
d. Invest in social protection mechanisms such agriculture insurance and credit schemes that are primarily tailored to smallholders exposed to hazards with particular focus on the most vulnerable groups, including women, youth, internally displaced persons, refugees and vulnerable host communities.
e. Establish a regional disaster preparedness and emergency trust fund.

Recommendations to FAO:

a. strengthen anticipatory action into all emergencies and resilience programmes, develop anticipatory action protocols and contingency plans, and strengthen capacity of FAO Country Offices to design and implement anticipatory action interventions and related projects such as agriculture insurance and credit for smallholders.
b. Continue to build the capacities of Members on anticipatory actions and support their integration within and across development, disaster risk reduction, climate change adaptation policies, strategies, plans, and programmes.
c. Technically support Members, based on their requests, in establishing early warning systems/observatories at country, sub-regional and regional levels, and in developing anticipatory action protocols and contingency plans.
d. Promote exchange of knowledge and good practices among Members on topics related to anticipatory actions and resilience building at large.
e. Promote anticipatory action programming in the region, including through: a) contributing to building evidence base on the benefits of anticipatory action, b) promoting coordination among various stakeholders working on anticipatory action, c) advocating for increased donors' funding for anticipatory action in the agriculture sector.

Queries on the content of this document may be addressed to:

RNE NERC Secretariat

FAO-RNE-NERC@fao.org

I. Introduction

A. Agrifood systems' related hazards and food security trends in NENA region

1. The Near East and North Africa (NENA) region is threatened by serious, complex, and overlapping shocks and stresses of diverse origins that have severely undermined food security and nutrition of millions of people. Conflicts, climatic extremes (particularly localized drought and flash floods), environmental hazards, transboundary animal and plant pests and diseases, and economic shocks, are among the most significant shocks that drive risks and vulnerabilities throughout the agrifood systems.

2. Shocks, stresses, and crises on the one hand, and food insecurity on the other hand, are strongly correlated. The collision of conflict with rapid or slow onset hazards (e.g. floods and droughts), is among the key drivers of the global rise of food insecurity which dramatically increased from 2019 to 2022. According to the *State of Food Security and Nutrition in the World* (SOFI) 2023, 29.6 percent of the global population, equivalent to 2.4 billion people, did not have constant access to food, as measured by the prevalence of moderate or severe food insecurity. Among them, around 900 million individuals faced severe food insecurity.[1] The same worrying increase has been observed in the NENA region, with hunger reaching its highest in 2022 affecting 59.8 million people (12.9 percent of the population). This is higher than the world average of 9.2 percent and up by 75.9 percent from 2000, before the region was hit by multiple shocks.[2]

3. Since 2011, conflict has been the key driver of acute food insecurity in the region[1]. While conflict has a direct impact on food insecurity, food insecurity can potentially cause or deepen conflict. Beside political conflicts, conflicts related to the exploitation of natural resources are rather common in the region. Approximately 40 percent of internal conflicts over the past six decades can be attributed to the exploitation of natural resources, including competition over scarce resources, such as fertile land and water.[3]

4. In addition to conflict, climate-related natural hazards and transboundary animal and plant pests and diseases are among the main drivers of food insecurity in the NENA region (Figure 1).[4]

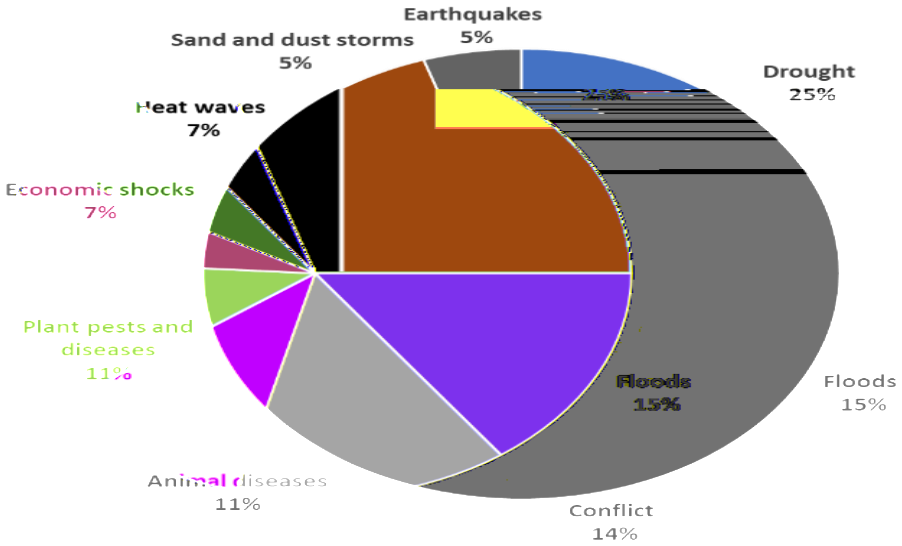
[1] FAO, IFAD, UNICEF, WFP and WHO. 2023. *The State of Food Security and Nutrition in the World 2023*. Urbanization, agrifood systems transformation and healthy diets across the rural–urban continuum. Rome, FAO. https://doi.org/10.4060/cc3017en

[2] FAO. 2023. *Food Policy Monitoring in the Near East and North Africa Region*. 2nd Quarter 2023 | Bulletin. Cairo

[3] UNEP, 2009. From *Conflict to Peacebuilding: the role of natural resources and the environment.* https://wedocs.unep.org/20.500.11822/7867

[4] FAO. 2023. *NENA Disaster Risk Reduction Profile 2023*

Figure 1: Major hazards to agrifood systems in NENA region



Source: Rapid survey conducted for this paper, FAO, 2023.[5]

5. Floods, including flash floods, account for the highest share of combined economic losses out of the natural hazards globally[6]and are considered the second worst natural hazard to agrifood systems in the NENA region.

6. Each year, plant pests and diseases cause an estimated 40 percent loss in production of food crops globally and agricultural trade loss of over USD 220 billion.[7] A review of 15 plant pests and diseases concluded that climate change will increase risk of pests spreading in agricultural and forestry ecosystems as pests change their migratory routes and geographical distribution.[8] Animal pests and diseases have profound negative impacts on production, disturb livestock farming systems, markets and trade. Approximately 20 percent of livestock production is lost annually due to diseases, resulting in an estimated economic loss of around USD 300 billion.[9] Animal production accounts for an average of 40 percent of total agricultural Gross Domestic Product (GDP)[10] and is a significant factor in sustaining the livelihoods of many rural dwellers in the NENA region. Diseases such as blue tongue, lumpy skin, White Nile fever, Rif Valley fever and *la Peste des petits ruminants* (PPR) are among the most economically significant animal diseases in the region, the spread of which are through climate-induced migration or vectors during extended drought and rains.

B. The strategic need for anticipatory actions in the NENA region

7. In the dynamic and complex context of the NENA region, the need for anticipatory action has become increasingly evident as a proactive approach to address interconnected challenges. With the

[5] Respondents of light survey were FAO programme colleagues in the country with reasonable knowledge and engagement of the disaster risk reduction (DRR) structures and processes.

[6] United Nations Office for Disaster Risk Reduction (UNISDR). 2017. *Disaster Loss Data and Linkage to Climate Change Impacts for the Arab Region*. RICCAR Technical Report, Beirut, E/ESCWA/SDPD/2017/RICCAR/ TechnicalReport.3.

[7] FAO. 2021. *Climate change fans spread of pests and threatens plants and crops, new FAO study*. In: *FAO*. Rome. Cited 18 June 2022. www.fao.org/news/story/en/item/1402920/icode/

[8] IPPC Secretariat. 2021. *Scientific review of the impact of climate change on plant pests – A global challenge to prevent and mitigate plant pest risks in agriculture, forestry and ecosystems*. Rome, FAO on behalf of the IPPC Secretariat. https://doi.org/10.4060/cb4769en

[9] WTO. 2020. *Information note on future resilience to diseases of animal origin: the role of trade*. https://www.wto.org/english/tratop_e/covid19_e/resilience_report_e.pdf

[10] FAO. 2023. In: *FAO Animal Production* [online]. Rome. Cited 13 September 2023. https://www.fao.org/animal-production/en/

demand for food predicted to increase by 70 to 100 percent by 2050[11], the agriculture sector needs to meet the pressures for increasing food production against a backdrop of population growth, scarce and degraded resources and worsening negative impacts of climate change, with the additional risk of increased conflicts.

8. The recurrent nature of most hazards such as drought, floods and animal and plant pests and diseases can be confronted by taking both proactive preventative and anticipatory actions to reduce risks and mitigating their impacts to the most vulnerable populations.

9. Anticipatory action could also prevent conflict that might emanate from competition over scarce resources and economic distress. This is recognizing that contexts susceptible to conflict or protracted crisis are often the most prone to the impact of climate change, and have the least coping capacity, where institutional and social mechanisms have been eroded.

10. The combined impact of conflict and climate change has driven up the number of displaced and refugee populations in the NENA region. By middle of 2023, internally displaced persons (IDPs) and refugees in the region were at 23.6 million[12], affecting not only those displaced but also putting direct pressure on host countries and communities. Therefore, it is important to understand how internal displacement and refugee migration shape the adaptive capacity of IDPs, refugees and the host communities, in order to identify opportunities for building resilience and supporting food security for these vulnerable groups. [13] Anticipatory systems would inform timely and effective actions to address the particular needs of these vulnerable groups in the region.

11. In the agriculture sector, the main goal of anticipatory action is to protect the assets and agency of farmers, fishers and herders so they can withstand different shocks without going hungry and ensure their livelihoods remain intact well beyond the shocks.

12. By shifting the focus from response to livelihood protection, anticipatory action provides a chance to invest in resilience and the continuation of upward cycles of development. That means it protects not only target families and communities but also existing investments in peace and prosperity.[14]

II. Key elements of anticipatory action

13. Anticipatory action is defined as acting ahead of predicted hazards to prevent or reduce acute humanitarian impacts before they fully unfold. This requires pre-agreed plans that identify partners and activities, reliable early warning information, and pre-agreed financing released predictably and rapidly when an agreed trigger-point is reached.[15] While anticipatory actions come in many shapes and sizes, they are always highly time-sensitive, connected to forecasts and implemented before a shock has impacted people.

14. Anticipatory action comes within the framework of effective disaster risk reduction and management, straddling both preparedness and early response; it is essentially acting ahead of a foreseen crisis. While it cannot substitute for programmes that reduce existing disaster risk and risk-informed development at a large scale, timely and risk-informed anticipatory action also has the potential to reduce existing disaster risk, a function of hazard, exposure, vulnerability and coping capacity.

15. The FAO anticipatory action approach uses risk analysis and forecasts to trigger interventions before a crisis escalates into a humanitarian emergency. This is particularly critical in the agriculture

[11] FAO. 2022. *The State of Land and Water Resources for Food and Agriculture in the Near East and North Africa region – Synthesis report*. Cairo. https://doi.org/10.4060/cc0265en
[12] https://www.unhcr.org/refugee-statistics/download/?url=86NeJc
[13] FAO. 2023. *Climate change, migration and rural adaptation in the Near East and North Africa region*.
[14] FAO. 2021. *Anticipatory action: Changing the way we manage disasters*. Rome. https://doi.org/10.4060/cb7145en
[15] G7. 2023. G7 *Foreign Ministers' Statement on Strengthening Anticipatory Action in Humanitarian Assistance - Federal Foreign Office*. In: Federal Foreign Office. Cited 13 September 2023. https://www.auswaertiges-amt.de/en/newsroom/news/g7-anticipatory-action/2531236

sector. For small-scale farmers, heeding early warning signals spell the difference between a shock and a crisis, ensuring that a hazard does not necessarily trigger a widespread disaster.[16]

16. FAO's anticipatory action system integrates a deep understanding of hazards and risks, supported by active Early Warning Systems, with clear triggers for action. This facilitates proactive anticipatory actions planning and implementation, supported by flexible financing for swift response. The system effectiveness is further heightened by impact evaluation evidence generation to inform policy decisions and scalability.

17. FAO's five key elements of an anticipatory action system include i) understanding of hazards and risks; ii) Early Warning System; iii) identification and planning of anticipatory actions; iv) flexible financing; and v) evidence for policy and scale up.[14,17] These elements integrate a deep understanding of hazards and risks, supported by an active Early Warning System with clear triggers to guide the implementation of proactively identified and planned actions using well-established flexible financing for swift response. The system effectiveness is further heightened by the generation of evidence for impact evaluation to inform policy decisions and allow for scalability.

18. Understanding hazards and risks is the first step in the establishment of any anticipatory action framework as this determines how well actions are contextualized and implemented at the most critical time. This means identifying major hazards that could impact the agriculture sector (national) or livelihoods and food security (community level). This also includes understanding the impacts of various hazards over time, what actions were taken or not, and which actions would be best fit to take at specific times and at different levels. It should be accompanied by a wider understanding of the broader risk landscape, including specific exposure, vulnerabilities and coping capacities of various population groups.

19. Early Warning Systems are an integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities systems and processes that enable individuals, communities, governments, businesses and others to take timely action to reduce disaster impacts in advance of hazardous events.[18] Early Warning Systems inform the development of predefined thresholds that will trigger anticipatory action, based on likely impacts of compounded hazards. For instance, a multi-hazard approach could involve monitoring weather patterns beyond drought and flood events but also linking them to desert locust breeding, potential sand and dust storms or vector-borne animal diseases. This will allow actors to collectively take anticipatory action in addition to implementing prevention and mitigation measures that minimize the compounded impacts of these very interrelated hazards.

20. Anticipatory actions can be a variety of different interventions that must be risk-informed, contextualized, and flexible. For FAO, this means actions designed to protect the productive assets of farmers, herders and fishers, which must be adjustable in case the context changes. In some cases, this means planning for multiple scenarios and hazards at once.

21. Flexible financing enables agile programming and delivery of anticipatory actions. Given that hazards and disasters are dynamic, financing should also allow for adjustments to ensure that time-sensitive and risk-informed actions can be taken and adjusted to the specificities of context and location.

22. For anticipatory action to become a standard *modus operandi*, evidence of its effectiveness and benefits beyond the event need to be communicated to convince stakeholders that acting early makes economic sense, while also providing other added co-benefits. Experience from FAO's interventions

[16] FAO. 2023. In: *FAO emergencies and resilience Anticipatory Action*[online]. Rome. Cited 13 September 2023. www.fao.org/emergencies/our-focus/anticipatory-action

[17] FAO. 2023. *Guidance note: Community engagement in Anticipatory Action*. Rome. https://doi.org/10.4060/cc5966en

[18] UNGA. 2015. *Establishment of an open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction*. A/RES/69/284. https://documents-dds-ny.un.org/doc/UNDOC/GEN/N15/167/23/PDF/N1516723.pdf?OpenElement

around the world show that every dollar invested in anticipatory action has the potential return of seven dollars or more in avoided losses or added benefits.[19]

III. State of anticipatory actions in the NENA region

23. FAO undertook a rapid review of anticipatory action in the NENA region focusing on: a) existence of early warning systems which reflect good understanding and prioritization of disaster risk and are linked to triggers and warning levels; and b) existence of anticipatory action planning and implementation mechanisms including institutional and coordination arrangements, and sources of financing actions.

24. The review revealed the following:

24.1 *NENA region has a fair number of early warning systems both at country and regional levels, however, mostly focusing on one hazard (i.e. hazard-based systems), and are not complemented with triggers for anticipatory actions.*

a. There are about nine countries in the region that report availability of concrete steps taken to establish multi-hazard early warning systems (MHEWS). These include Egypt, Iraq, Jordan, Kuwait, Lebanon, Palestine, Qatar, Sudan, and United Arab Emirates.[20] At the country level, early warning capacities for drought and flood are relatively more established, with varying implementation capacities. Observatories and weather forecasting systems are well established and operational in Egypt, Jordan, Lebanon, Morocco, and Tunisia.

b. In most of the conflict-affected countries, existing early warning systems have been eroded, some of which are also physically damaged or in disrepair, with limited institutional capacity. This is the case of the Syrian Arab Republic's Early Warning System (EWS) within the Ministry of Agriculture and Agrarian Reform which was established prior to the conflict. There is currently an effort to improve this system through FAO's support and a plan to rebuild it into a multi-hazard early warning system.

c. At regional level, supported by FAO, the Regional Desert Locust Commissions for the Central and Western regions have established a desert locust early warning and surveillance system, enabling country and regional level dissemination of information triggering local-level anticipatory actions such as pre-positioning of pest control equipment and materials, pre-emptive pest control measures and information campaigns.

d. In addition, the Mediterranean Animal Health Network (REMESA), a network of Chief Veterinary Officers from a number of countries in the region (Algeria, Egypt, Jordan, Lebanon, Libya, Mauritania, Morocco, and Tunisia) complements established systems in countries for the prevention and control of major transboundary animal diseases and zoonoses through the strengthening of the national and regional resources and capacities, the harmonization and coordination of surveillance and control activities.[21]

e. Given the hazard-focused early warning capacities, countries and agencies tend to develop their own sectoral or hazard-specific action plans. This is the case for plant pests and animal diseases, or flood and drought. The consequence of this is limited inter-agency coordination, and lack of agreed multi-hazard triggers and organized funding for anticipatory action, which make scaling up challenging. Institutional capacity building also becomes an individual agency's responsibility. In the case of animal and plant pests and diseases, surveillance capacities and anticipatory response and control activities are performed by the specific technical teams within the ministry and often do not feature in national disaster risk profiles. Future national disaster risk profiles should be adapted to take these into account, in line with

[19] FAO. 2023. *El Niño: Anticipatory Action and Response Plan, August–December 2023*. https://www.fao.org/3/cc7267en/cc7267en.pdf
[20] UNDRR and WMO. 2022. *Global status of multi-hazard early warning systems: Target G*. https://www.undrr.org/publication/global-status-multi-hazard-early-warning-systems-target-g
[21] FAO. 2023. In: FAO REMESA – Mediterranean Animal Health Network [online]. Rome. Cited 13 September 2023. https://www.fao.org/remesanetwork/remesa/en/

the full spectrum of hazards enshrined in the *Sendai Framework for Disaster Risk Reduction 2015-2030* (Sendai Framework).[22]

24.2 *In most of the countries, if not all, there are established institutional arrangements related to disaster risk management. However, there are gaps related to the existence of clear mechanisms to finance anticipatory actions and limited coordinated actions.*

a. Most countries in the NENA region have different institutional mechanisms for climate change adaptation and disaster risk reduction and management. National disaster risk management coordination mechanisms, policies and plans have long been established as part of country commitments to the *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters* [23] and later as part of the implementation of its successor, the *Sendai Framework for Disaster Risk Reduction 2015-2030*. Most countries in the region have national disaster risk reduction (DRR) strategies and risk management plans in place as part of the implementation of the Sendai Framework, Target E that clearly indicate the roles of various agencies in the country and coordination mechanisms; however, these are in varying states of operational capacity. Currently, most DRR plans are in need of updating, with limited coordination that addresses overlapping mandates of the different agencies.

b. Most of the disaster risk management plans acknowledge the need to have well-established sources and mechanisms to finance disaster risk reduction actions. Nonetheless, there is a clear gap in terms of source of finance, budgets and financing protocols.

c. FAO is supporting countries of the region in establishing anticipatory action systems. The most established of which are in conjunction with the surveillance, monitoring and early action related to transboundary pests and diseases, where FAO has provided capacity building, equipment and regular technical advice. Additionally, FAO conducts crop and price monitoring of products and agriculture inputs.

IV. Challenges and opportunities

25. Regional collaboration plays an integral role in improving forecasting and early warning across multiple hazards. The region has a number of regional mechanisms specializing in weather, hydrological and transboundary information, expertise and services that could potentially expand coordinated anticipatory action beyond a single country.24 There is also significant potential for collaborative learning through the sharing of perspectives among countries. The challenge will be to harmonize these different regional platforms similarly to efforts to streamline mandates and capacities at the national level. There is also potential to capitalize on learning between countries by promoting harmonized monitoring and reporting to better understand how to effectively promote resilience building through anticipatory action. Beyond early warning and delivery of actions, these regional platforms also offer an opportunity to promote the development and implementation of risk-informed policies, build evidence and capacities across the region.

26. The challenges related to the development of triggers for anticipatory actions in response to multiple hazards include lack of disaggregated data, the need to enhance monitoring systems and early warning systems that effectively trigger anticipatory action. Vulnerability-based targeting is imperative for effective anticipatory action mechanisms, and this requires increased understanding of the specific vulnerabilities of various subgroups, such as female farmers, internally displaced persons and refugees.

---

[22] UNDRR. 2015b. *Sendai Framework for Disaster Risk Reduction 2015–2030*. Geneva. www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf

[23] ISDR (UN Inter-Agency Secretariat of the International Strategy for Disaster Reduction). 2005. *Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters*. Geneva. www.unisdr.org/2005/wcdr/intergover/official-doc/L-docs/Hyogo-framework-for-action-english.pdf

[24] Some examples of this include the Regional Climate Centers and Networks and initiatives like the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR);in United Nations Office for Disaster Risk Reduction (UNISDR). 2017. Disaster Loss Data and Linkage to Climate Change Impacts for the Arab Region. RICCAR Technical Report, Beirut, E/ESCWA/SDPD/2017/RICCAR/ TechnicalReport.3.

27. Some countries have sector-specific or multi-hazard early warning systems; however, the majority of these systems are either limited in use or have yet to scale up to cover wider hazards or establish wider coordinated multi-stakeholder actions. Increased national interest in the establishment of multi-hazard early warning systems has been growing, recognizing the need for a holistic approach to risk governance. A mapping of existing systems and capacities at country and regional levels would inform the development of more comprehensive systems that build on the current strengths across the region. The Secretary General's Initiative "Early Warnings for All"[25] is an important step at the international level to raise the profile of the need for early warning systems that trigger anticipatory action and promote their use.

28. As part of the efforts to look at hazards as a continuum of interrelated factors and risks, there is an opportunity to build on the strengths of different forecast and modelling systems to expand modelling to include hazards of transboundary nature and other socioeconomic factors. For instance, meteorological models could help track vector-borne diseases in animals. Further, in conflict-affected contexts, mechanisms such as the Integrated Food Security Phase Classification (IPC) for monitoring food insecurity could be overlaid with natural hazards and food production, supply and market information, to inform tailored and anticipatory actions. The challenge is to have one established umbrella without taking away from the specific mandated work of various sectors.

29. Anticipatory action, with preparedness and contingency plans updated to include early warning, triggers, and guidelines for coordinated delivery of anticipatory action, should be systematically mainstreamed and embedded into existing and future national disaster (risk) management policies, platforms and infrastructure. Anticipatory action should also be included as part of disaster risk reduction/management actions in sectoral plans, policies and strategies, as well as aligned with other national development planning instruments and processes.

V. Recommendations

30. Investing in anticipatory action through policies and forecast-based financing and enabling anticipatory action through multi-hazard early warning systems, not only allow actors to prevent significant damage and losses from shocks, but also allow for more comprehensive development and resilience programming that contribute to reduction of future risks by safeguarding lives and livelihoods. Given agriculture's innate interactions with the environment, its direct reliance on natural resources for production, and its significance for national socioeconomic development, urgent and ambitious action is needed to build more resilient agricultural systems.[26] Anticipatory action requires coordinated effort at all levels, recognizing the importance of a solid evidence base, the development of institutional capacity for forecast-based and flexible financing that allow for early action to mitigate the impact of multiple hazards.

[25] UN. 2023. In: *UN Early warnings for all*. Cited 13 September 2023. https://www.un.org/en/climatechange/early-warnings-for-all

[26] FAO. 2021b. *The impact of disasters and crises on agriculture and food security: 2021*. Rome. https://doi.org/10.4060/cb3673en