



From insight to foresight

Using data to improve food and nutrition outcomes in protracted food crises in the Horn of Africa

Julius Kaut, Eelke Bakker, Gerrit-Jan van Uffelen, Frans Crujssen, Charleen Malkowsky

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This position paper gives an overview of methods and resources for assessing and addressing food and nutrition security (FNS) with a focus on the Horn of Africa (HoA). The authors reflect on the potential use of data science, focusing on moving from reactive interventions (often humanitarian) to anticipatory actions, and on using a food systems approach to build more resilience for improved FNS outcomes in protracted food crisis situations.

The paper finds that existing approaches to assessing FNS should be streamlined. The Integrated Food Security Phase Classification (IPC) is important for humanitarian and development purposes but faces challenges. Incorporating integrated risk management is essential when designing programmes. Current mechanisms to address food crises could be improved by strengthening the evidence base; data and data science, including descriptive and diagnostic analytics, could make a transformative contribution to aid architecture. Local contexts, livelihood activities, coping strategies, resilience capacities, and overall demographic and socio-economic developments in any given place must be considered. Using a quantitative data-driven approach to improve our understanding of past food crises, and to forecast those of the future, would support the design of effective, contextual, preventive actions that would include addressing some of the root causes of food insecurity.

The main policy recommendations are to follow the localisation agenda; to shift from reactive interventions to preventive actions; to build data literacy of all stakeholders; and to encourage awareness of the monitoring and legitimacy effects of programmes.

From an analytical perspective, recommendations are to follow the localisation agenda (contextualise all work); to use foresight to inform FNS modelling and responses, build food system resilience, and identify critical tipping points; to correlate hazard occurrences with FNS dynamics; and to explore interface dynamics between IPC phases to support strategic responses.

Keywords: Data Analytics, Foresight, Protracted Food Crises, Food Systems Resilience, Food and Nutrition Security, Integrated Phase Classification, Horn of Africa

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Tilburg University's Zero Hunger Lab wants to contribute to the attainment of sustainable development goal 2 (Zero hunger by 2030) based on data science. Only by working together intelligently can we put an end to hunger in the world. We do this by advising aid organizations, companies, and government institutions through mathematics and smart algorithms: we call it Bytes for Bites. Our mission is to make people independent from food aid and to ensure sustainable food security. We do this not only in Africa, Asia, or the Middle East but also in the Netherlands, where 150,000 people depend on the 170 food banks for their daily meal.

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The views and opinions expressed in this report are those of the authors and do not necessarily reflect those of Tilburg University, Wageningen University, or any other parties involved in the making of this position paper.

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List of abbreviations and acronyms

ACLED	Armed Conflict Location & Event Data Project
ATARI	Advanced Technology and Artificial Intelligence Working Group
BMI	Body mass index
CBDRR	Community-based disaster risk reduction; see also CMDRR
CBO	Community-based organisation
CH	Cadre Harmonisé
CMDRR	Community-managed disaster risk management; see also CBDRR
COVID-19	Coronavirus disease 2019
DRR	Disaster risk reduction
DQI	Diet quality index
EM-DAT	Emergency database
FAO	Food and Agricultural Organization
FAOSTAT	FAO Statistics Division
FCS	Food consumption score
FEWS NET	Famine Early Warning Systems Network
FIES	Food insecurity experience scale
FNS	Food and nutrition security
FNS-REPRO	Food and Nutrition Security Resilience Program
FS	Food system
FSA	Food systems approach
FSNAU	Food Security and Nutrition Analysis Unit
GDP	Gross domestic product
GFSI	Global Food Safety Initiative
HDDS	Household dietary diversity score
HLPE	High Level Panel of Experts on Food Security and Nutrition
HNO	Humanitarian needs overview
HFA	Hyogo Framework for Action
HoA	Horn of Africa
IDMC	Internal Displacement Monitoring Centre
IFAD	International Fund for Agricultural Development
IGAD	Intergovernmental Authority on Development
IIRR	International Institute of Rural Reconstruction
IPC	Integrated food security phase classification
IPCC	Intergovernmental Panel on Climate Change
NGO	Non-governmental organisation
NRC	Norwegian Refugee Council
Nuffic	The Dutch organisation for internationalisation in education
OECD	Organisation for Economic Co-operation and Development
SDGs	Sustainable development goals
TiU	Tilburg University
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
UNISDR	United Nations Office for Disaster Risk Reduction
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UNSC	United Nations Security Council
USAID	United States Agency for International Development
WCDI	Wageningen Centre for Development Innovation, Wageningen University & Research
WFP	World Food Program

WHO	World Health Organisation
WUR	Wageningen University & Research
ZHL	Zero Hunger Lab

Executive summary

Chapter 1: Introduction

In 2021 global levels of hunger surpassed all previous records, with close to 193 million people acutely food insecure and in need of urgent assistance across 53 countries/territories (GRFC, 2022). Food and nutrition security (FNS) is a key challenge, especially in protracted crisis situations. The Horn of Africa (HoA) has been affected for a long time, with more than 32 million people facing high levels of acute food insecurity in 2021 (WFP and FAO, 2021).

New technologies, including data science and artificial intelligence, have become available in recent years. These have the potential to transform the way FNS is analysed and approached; from merely assessing FNS, to forecasting FNS levels and designing more efficient programmes to improve FNS outcomes.

These new technologies also have the potential to support the following: programming to local contexts (the localization agenda promoted by the Grand Bargain)¹; engaging humanitarian, development, and peace actors (the HDP-nexus), as poor FNS outcomes are often the cause and consequence of conflict impacting on food systems; and taking a food systems approach to improve FNS outcomes.

This position paper therefore reflects on the potential use of data science for assessing and addressing FNS in the Horn of Africa, with an emphasis on how to move from reactive (often humanitarian) interventions to anticipatory actions, and on taking a food systems approach to building more resilient food systems for improved food and nutrition outcomes in protracted food crisis situations.

PART I – ASSESSING FNS

Chapter 2: Methods to address FNS

This overview of methods and resources concludes that the availability of a wide range of approaches, indicators, and indices make it challenging to adequately assess and address FNS; recommends that existing approaches need to be streamlined; and explains and recommends the use of the food systems approach (a relatively new approach to address FNS which leads to better understanding of the factors involved).

Chapter 3: IPC analysis and current use of data

This chapter shows how different data sources are integrated in the 'Integrated Food Security Phase Classification' (IPC), a commonly accepted measure to assess and visualize FNS levels in selected countries. It was originally developed by FAO in 2004 for application in Somalia, but over the years has become a global standard in FNS analyses in countries that are consistently in food crises.

IPC is implemented in 30 countries and publishes three classifications (*acute food insecurity*, *chronic food insecurity* and *acute malnutrition*), of which *acute food insecurity* is most frequently used, particularly by the humanitarian community. IPC identifies five phases, ranging from *food secure* (phase 1) to *famine* (phase 5). Data feeding into the analysis is not primarily collected by IPC itself; rather, IPC integrates existing sources of data and evidence.

IPC is used to improve decision-making and policy development. IPC Phases 4 (Emergency) and 5 (Catastrophe / Famine) are typically the phases where donors are triggered to provide funding for emergency humanitarian support.

IPC is a very important resource for humanitarian and, increasingly, development purposes. However, it faces challenges. For instance, the construction of the IPC levels is a tedious process relying partly on human judgment; it is difficult to keep up with recent technological advances; the availability and quality of data differs between countries. It typically prescribes a grain-based response to food crises which may not reflect

¹ <https://interagencystandingcommittee.org/grand-bargain>

the realities of local food systems and what is required, so that the response merely addresses the consequences of the crisis rather than its root causes.

Chapter 4: FNS risk landscape

This overview of the risk landscape in HoA shows how FNS outcomes are influenced by shocks and stressors which, alongside socio-economic and environmental drivers, are a major driver of food and nutrition insecurity. It recommends that incorporating integrated risk management is essential when designing programmes to improve FNS outcomes; that current mechanisms to anticipate, prepare for, respond, and recover from food crises could be improved by strengthening the evidence base; and that data and data science can make an important contribution.

Chapter 5: Descriptive and diagnostic analytics

This chapter focuses on the use of data in assessing FNS. Descriptive analytics enable us to review and understand past IPC phase dynamics by reviewing IPC time series and investigating correlations with possible explanatory variables. Building on the outcomes of the descriptive analytics phase, diagnostic analytics can then be used to assess whether the statistically significant correlations encountered indeed represent true drivers of IPC phase changes, and for example are not just a coincidence or a result of poor data quality. The diagnostic analytic phase can also be used to search for explanations of spatial and temporal patterns in the IPC time series.

PART II – ADDRESSING FNS

Chapter 6: Livelihoods, coping and resilience

This chapter focuses on why these are important factors when designing programmes addressing FNS. Affected people can exert influence over the impact of a food crisis/disaster and reduce its impact, as the presence or absence of coping strategies and resilience capacities influence the extent to which people can mitigate and prepare for the impact of food crisis and potential food disasters. Thus, when addressing FNS, livelihood activities, coping strategies, resilience capacities, and overall demographic and socio-economic developments in any given place must be considered.

This means that a more quantitative approach is needed. Based on this, IPC time series and the impact of responses triggered by IPC findings can be reviewed, and lessons learned on how to improve FNS in protracted food crises.

Quantitative methods in themselves are, however, no silver bullet; addressing FNS also requires adopting methods to capture qualitative elements and to better integrate quantitative and qualitative approaches to achieve FNS. Considering local capacities in the light of the localization agenda also highlights the need to programme to local contexts in protracted crisis settings that are often volatile and dynamic.

Chapter 7: Programming for improved FNS outcomes

This chapter shows how the risk landscape, livelihood strategies, coping, and resilience are all important considerations for successful programming in FNS. It recommends that ideally, the provision of aid should be evidence-based and should inform adaptive programming. Using a quantitative data-driven approach to improve our understanding of past food crises, and to forecast those of the future, would support the design of effective preventive actions that would address root causes of food insecurity contextually.

Currently, many programmes targeting food insecurity in the Horn of Africa are reactive, focusing on the distribution of humanitarian aid (Duguma, et al., 2017). Forecasting and programming to prevent and mitigate food crises would reduce future food insecurity levels and the need for reactive interventions. It would also be more economical; as a rule of thumb, every dollar spent on preventing food crisis saves five to six dollars in humanitarian response (BenDor, et al., 2020).

Chapter 8: Using data for anticipatory action and optimized FNS programming

This chapter shows how predictive and prescriptive data analysis can improve the design of preventive actions to improve FNS in several different ways. Predictive analytics is more developed in food security literature than prescriptive analysis; it focuses on how a particular variable is expected to develop and

thereby assists FNS policy makers and practitioners with data insights to improve decisions. Prescriptive analytics goes one step further. It focuses on finding the best strategies to improve FNS by coming up with concrete suggestions for both policymakers and practitioners when designing preventive strategies and action.

PART III – IMPROVING FNS

Chapter 9: Recommendations

The position paper concludes with a list of recommendations, making a distinction between policy and data science recommendations. Key recommendations include:

- Shift from reactive interventions (addressing consequences), to include preventive actions (contextually addressing root causes).
- Take a food systems approach, as food crises constitute context specific complex and dynamic situations, and data science can contribute to analytical and prescriptive perspectives.
- Use data science in support of the localisation agenda and working across the HDP- nexus (including conflict sensitivity).
- Through data science explore key determinants as to why people in food crises move from IPC Phase 3 (food crisis) to IPC Phase 4 (food emergency) to IPC Phase 5 (catastrophe/famine).

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1 Introduction

How can data be used to assess and address FNS insecurity in protracted crisis regions of the Horn of Africa?

This report is for policy makers, practitioners, and researchers.

It gives an overview of current practice in data analytics; explores the factors that determine and influence food and nutrition security outcomes; and explores what could be done to improve analysis and foresight in the future.

It argues that we need to improve existing systems of assessing and addressing FNS by making use of data sciences and using food systems resilience thinking as an integral part of programming.

In bringing together experts from different disciplines - data sciences and social sciences - this position paper takes a new direction, with the aim of encouraging interdisciplinary research and thinking in academia and in practice to improve FNS analysis and response in protracted food crisis situations.

This paper is the first outcome of a planned series of publications on this emerging field of research by partners working on the Food and Nutrition Security Resilience Programme (FNS-REPRO), implemented by Food and Agricultural Organization (FAO), the Wageningen Centre for Development Innovation (WCDI), and various NUFFIC programmes in the Horn of Africa implemented by WCDI, Zero Hunger Lab (ZHL) and partners with projects funded by the Netherlands Ministry of Foreign Affairs.

Topic:

The role of data analytics and foresight in food systems resilience analysis in protracted food crises for improved food and nutrition outcomes in the Horn of Africa

Type of Paper:

Position paper

Research Question:

How can data be used to assess and address FNS insecurity in protracted crisis regions?

Target Group:

Policy makers, practitioners, and researchers in the field of FNS

Geographic Focus:

Horn of Africa

Objectives:

1. To inform the reader about the potential usages of data to optimize food and nutrition security (FNS) assessments for better FNS outcomes for populations in protracted crises.
2. To detail current practice in data analytics and food systems resilience analysis in protracted crises; to explore which factors determine and influence FNS outcomes; and to explore what could be done to improve FNS analysis in the future.
3. To argue that there is a need to improve existing systems of assessing and addressing FNS by making use of data sciences and food systems resilience thinking as an integral part of FNS programming.

1.1 FNS in the Horn of Africa

HoA is one of the regions most affected by **acute and chronic food insecurity**, with more than 50 million people expected to face high levels of acute food insecurity in 2022 (FAO, IGAD & WFP, 2022). The consequences are far reaching; they impact individuals' health, hinder people in developing and fulfilling their potential, and impact the economies of those countries most at risk.

Several HoA countries suffer from **protracted crisis**. This is a situation characterized by longevity or duration (Ethiopia, Sudan, South Sudan, and Somalia have been in crisis for decades), weak governance or public administration (in the face of overwhelming constraints), breakdown of local institutions, and conflict. The deterioration in the sustainability of livelihood systems can be a contributing factor to conflict, which may in turn trigger a protracted crisis (FAO, et al., 2010).

Food and nutrition insecurity is the most common manifestation of protracted crises: unsustainable livelihood systems and poor food security contribute to malnutrition and increased mortality rates. Poor food and nutrition security is often endemic in protracted crisis situations because of a complex interplay of factors within local food systems including climate change, hazards and disasters, environmental drivers, and often intractable conflict (FAO, et al., 2010).

Food and nutrition insecurity can be both a cause and a consequence of civil **conflict**; food and nutrition insecurity are becoming increasingly concentrated in conflict-affected countries, affecting millions of people. **Protracted conflicts** (in HoA, mainly border disputes, violent clan clashes, and conflicts between farmers and herders) are also a major barrier to stable FNS levels (Cottyn & Meester, 2021).

UN Security Council resolution 2417 (UNSC, 2018) reminds governments and non-state actors of their responsibility to ensure safe, stable, and equal access to food. Adopting UN resolution 2417-created mechanisms enables the UN Security Council to act on starvation by requiring the United Nations Secretary General to provide information on conflict-induced food insecurity and famine whenever such risks arise.

1.2 Why do we focus on localisation?

The term 'localisation' refers to the process of giving more power to and better engaging local and national actors in all phases of humanitarian action, including greater support for locally led action.

UN resolution 2417 'recalls the link between armed conflict and violence and conflict-induced food insecurity and the threat of famine, and calls on all parties to armed conflict to comply with their obligations under international humanitarian law regarding respecting and protecting civilians and taking constant care to spare civilian objects, including objects necessary for food production and distribution such as farms, markets, water systems, mills, food processing and storage sites, and hubs and means for food transportation, and refraining from attacking, destroying, removing or rendering useless objects that are indispensable to the survival of the civilian population, such as foodstuffs, crops, livestock, agricultural assets, drinking water installations and supplies, and irrigation works, and respecting and protecting humanitarian personnel and consignments used for humanitarian relief operations.' (UNSC, 2018)

The localisation agenda was decided on in the World Humanitarian Summit in 2016. For a thorough overview of progress since then, and recommendations to increase localisation in the future, see the report commissioned by the Netherlands Ministry of Foreign Affairs and published in 2021.²

As part of the localisation agenda, then, this position paper focuses on using data to analyse and programme for local contexts in the Horn of Africa.

² https://humanitarianadvisorygroup.org/wp-content/uploads/2021/07/Localisation_lit_review_WEB-1.pdf

1.3 Why do we focus on data?

In recent years a whole range of new advanced technologies, including innovations in artificial intelligence and data science, have appeared. With larger computing power becoming more and more accessible, these technologies have the potential to transform assessments of FNS and forecasts of IPC phases; design more efficient programmes; and support the localization agenda by taking a food systems approach to improve FNS outcomes.

There is a need to use data in support of the localization agenda, exploring the potential use of FNS data in taking a food system approach to improve FNS outcomes.

The Integrated Food Security Phase Classification (IPC) is a global standard in FNS analyses, so in this report we focus on exploring how IPC data informs the design of medium- and long-term programmes and the assessment /improvement of FNS programming.

To do so we provide an analysis of current IPC phases, focus on forecasting IPC developments, and dive into the complex interplays between shocks and stressors and their impacts on food systems and coping capacities of people.

To structure our discussion, we use the Gartner analytics ascendancy model (2012, Figure 1). This is a widely used model suggesting that a company or organisation passes through four levels of analytics (descriptive, diagnostic, predictive, and prescriptive) before reaching state-of-the-art data analysis. (Maoz, 2013). This model is widely used in academia and the private sector and is particularly helpful in translating the questions policymakers or businesses have into specific data analytics and data science techniques (El Morr & Ali-Hassan, 2019).

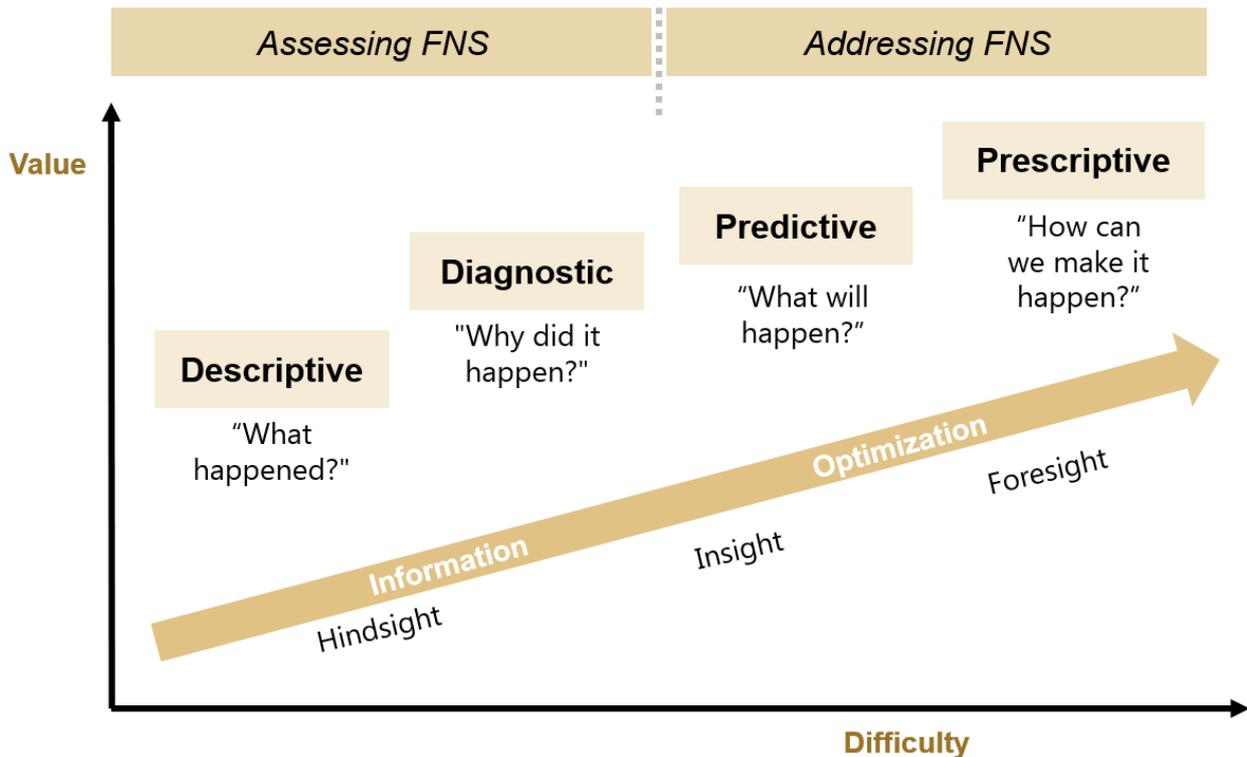


Figure 1 Gartner's ascendancy model (2012), adapted

Descriptive analytics focus on the question 'what happened?' Diagnostic analytics focus on answering 'why did it happen?' In predictive analytics we use historical data to answer the question 'what will happen in the future?.' In prescriptive analytics, we focus on a specific goal and ask, 'how can we make it happen?' Related

to FNS, descriptive and diagnostic analytics mostly help to *assess* the FNS situation; predictive and prescriptive analytics help to *address* FNS through designing programmes; that is, what is likely to happen if we look at (time-series) data and how can we make improved FNS outcomes. We will use this distinction to structure the report.

1.4 Assessing and addressing FNS

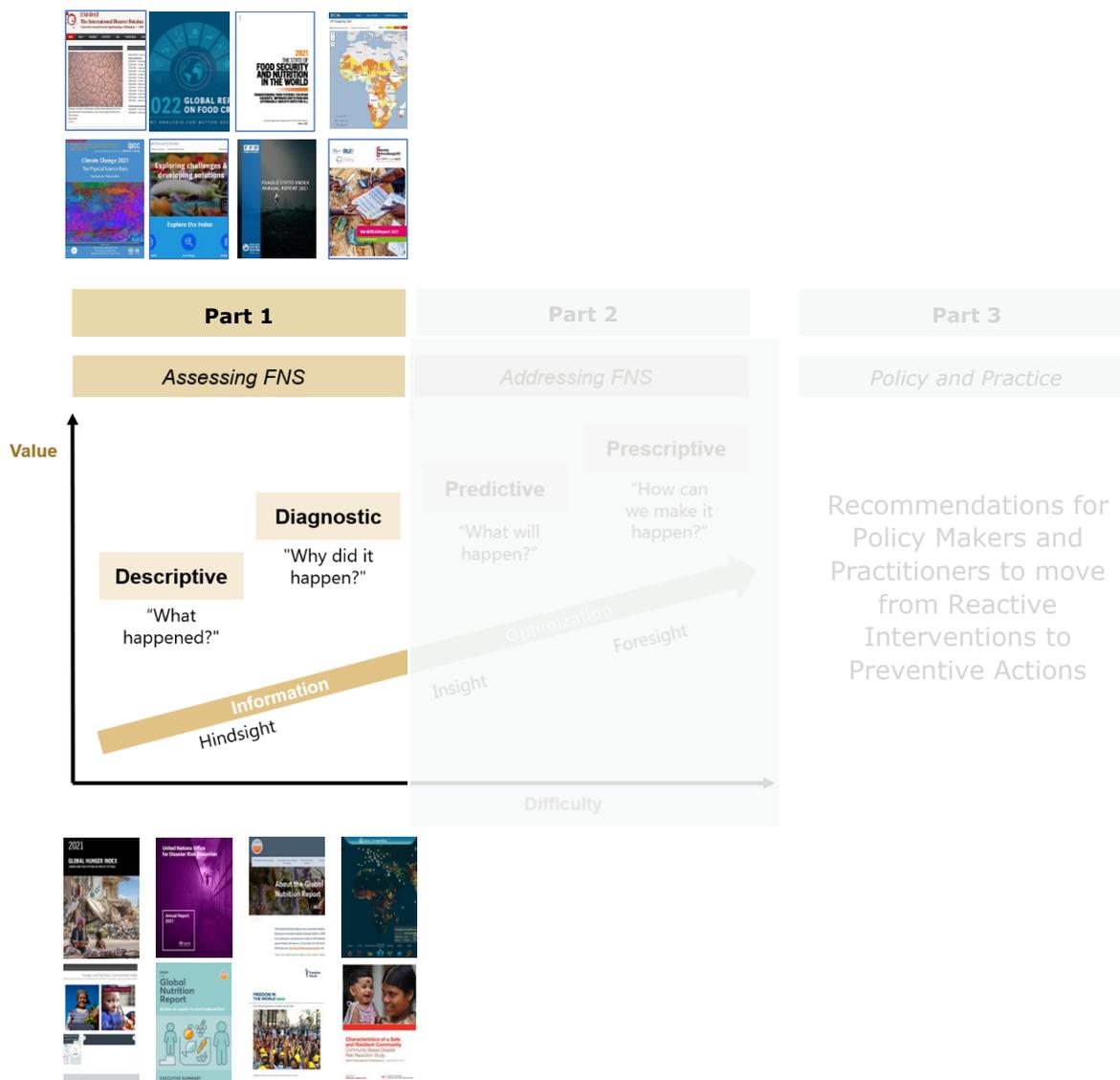
This position paper is divided into three parts and is structured using Gartner’s ascendancy model. The first part focuses on the use of data in the **assessment** of FNS in a region. The second part focuses on **addressing** food insecurity to improve FNS outcomes. The third part consists of **recommendations**.

Part 1 (assessing FNS) starts with **Chapter 2**, in which existing data sources and methods are described. This includes a description of a food system analysis framework, the four dimensions of food security, and indicators relating to those dimensions. **Chapter 3** shows how different data sources are integrated in the IPC analysis and classification. The IPC process is introduced, and some of its current uses are described, as well as challenges. **Chapter 4** is an overview of the risk landscape in the Horn of Africa and discusses multiple risk factors. **Chapter 5** elaborates on the use of data (both descriptive and diagnostic analytics).

Part 2 (addressing food insecurity) starts with **Chapter 6**, which explains why it is important to consider coping strategies in the design of programmes. **Chapter 7** discusses programmes, especially the differences between reactive interventions and preventive actions. Currently, many programmes targeting food insecurity in the Horn of Africa are reactive, focusing on the distribution of humanitarian aid (Duguma, et al., 2017). However, forecasting (thus preventing and mitigating) food crises, reduces future food insecurity levels and the need for reactive interventions, and is more economical. As a rule of thumb, every dollar that is being spent on preventing food crisis, saves five to six dollars in humanitarian response (BenDor, et al., 2020). **Chapter 7.8**, therefore elaborates on the use of data in designing preventive actions.

Part 3 concludes the report with recommendations in **Chapter 9**.

PART I: ASSESSING FNS



Part one (assessing FNS) starts with Chapter 2, describing existing data sources and methods to assess FNS. Chapter 3 focuses on assessment with Integrated Food Security Phase Classification (IPC); the process, current uses, and challenges. Chapter 4 introduces the risk landscape and multiple risk factors in HoA. Chapter 5 discusses how descriptive and diagnostic analytics can be used.

2 Methods, datasets, and indicators to assess FNS



Figure 2 A family shading under their grain store in South Sudan

Contents of this chapter

- 2.1 Introduction to FNS
- 2.2 Dimensions of food security
- 2.3 Food systems approach
- 2.4 FNS indicators
- 2.5 Overview of relevant data sources and reports
- 2.6 Summary

Globally, many governmental and non-governmental organisations are involved in assessing FNS. With this variety of actors also comes a variety of philosophies, approaches, and methodologies. But given the relevance and complexity of assessing FNS there is a need for a structured, holistic, and transparent approach. Reviewing methods and approaches and being aware of data/reports is also important for looking into possibilities for improved forecasting of future food crises.

In this chapter we introduce common methods of assessing FNS that we deem most relevant and applicable, paying attention to strengths and weaknesses and revealing how far current practices are designed for reactive interventions, or are suitable for forecasting future trends and events to enable anticipatory action. We discuss the possibilities of combining elements of these methods.

Finally, this chapter provides an overview of some key resources to serve as a starting point when looking for relevant indicators and input to assess FNS on an international, national, or regional level in protracted crises.

2.1 Introduction to FNS

Globally, FNS remains a major challenge. In 2020, approximately 12 percent of the global population was severely food insecure, representing 928 million people – 148 million more than in 2019 (FAO, et al., 2021). Further, recent studies show that there has been a 94% increase in people in IPC Phase 3 or worse acute food insecurity since 2016; these numbers are still excluding the anticipated impacts of the war in Ukraine on global FNS (WFP, 2022). Ensuring food security directly contributes towards achieving the United Nations' sustainable development goals (SDGs), most notably goal 2 (zero hunger).

Food security is commonly assumed when '*all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*' (FAO, 1996).

This definition considers **four dimensions or pillars of food security: availability of food, accessibility to food, utilization of food, and stability of the other dimensions over time** (FAO, 2008). Only if all four pillars are stable, is food security assumed to be given in a certain country or region. If one or several of the dimensions are unstable or absent, populations in the respective region might be considered as food insecure.

Chronic food insecurity refers to long-term or persistent situations of food insecurity and commonly occurs when people are unable to meet their minimum food requirements over a sustained period. Root causes are often extended periods of poverty, protracted crises, an absence of assets, and inadequate access to productive or financial resources (FAO, 2008).

Acute food insecurity, in contrast, is short-term and temporary and occurs when there is a sudden drop in the ability to produce or access enough food to ensure a good nutritional status. Root causes are commonly short-term shocks and sudden fluctuations in the availability of food and food access, which may result from year-to-year variations in domestic food production, prices, and household incomes (FAO, 2008).

Food and nutrition security or insecurity can be seen as the outcome of **food systems** - the complex interplays between markets, environmental drivers, human activities, and other factors. Food systems '*comprise all the processes associated with food production and food utilization: growing, harvesting, packing, processing, transporting, marketing, consuming and disposing of food remains (including fish)*' (van Berkum, et al., 2018). All these activities require inputs and result in products and/or services, income and access to food, and environmental impacts. A food system operates in, and is influenced by, social, political, cultural, technological, economic, and natural environments (HLPE, 2017). Section 2.3 elaborates on a food systems approach.

2.2 Dimensions of food security

One way of assessing FNS is to break down the Food and Agriculture Organization of the United Nations (FAO)'s working definition for FNS into its four elements and to look at indicators on these that directly influence FNS outcomes. In line with the FAO definition of FNS, they are; availability of food, accessibility to food, utilization of food, and stability of the other dimensions over time (FAO, 2008).

Indicators may include frequency of vegetable or meat consumption (availability), food expenditure/ budget share of total household expenditure (accessibility), Body Mass Index (BMI) or prevalence of stunting, wasting or underweight (utilization), and variability of food prices (stability). In line with the different indicators, FNS outcomes for each dimension can be divided into short-term and long-term outcomes, and

the different dimensions analysed on an individual, household and macro level (Pangaribowo, et al., 2013). A comprehensive list of indicators can be found in Appendix 1.

While looking at different dimensions of food security and related indicators allows for a thorough analysis of current and past FNS outcomes, drivers, and risks, it remains a challenge to understand how these indicators are interlinked/ interdependent. There have been attempts by scholars (e.g. Pangaribowo et al. (2013), to theorize and operationalize the four dimensions approach, yet there is no standardized agreement on which indicators to include and which ones to exclude when assessing FNS. Further, even if there is standardization in terms of indicators, we must expect fluctuations in data availability for each indicator depending on the situation or particular context of the target area/country.

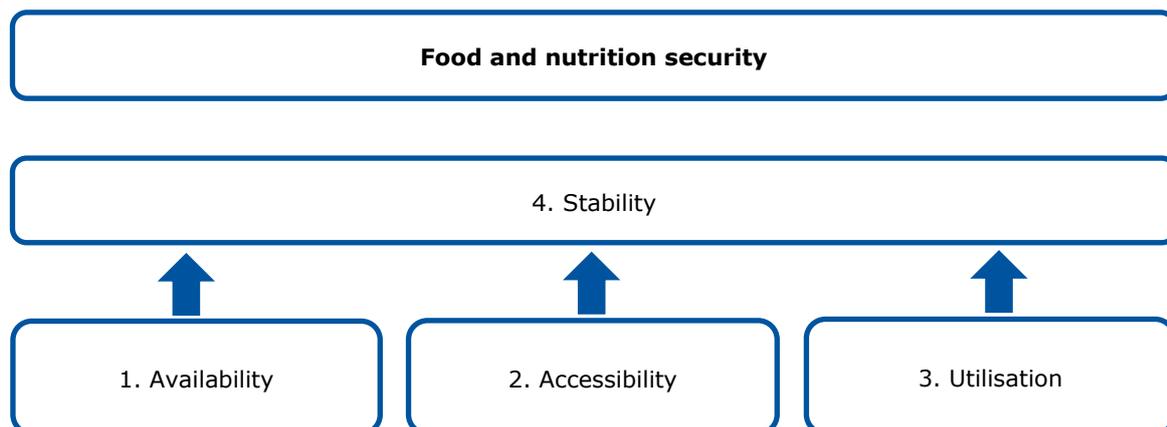


Figure 3 The four dimensions of food and nutrition security

Lastly, as compared to the food systems approach, focusing on the four-dimensions of FNS does not factor in dynamics in the macro environment (for example global market developments or conflict dynamics) so it neglects looking at the root causes of food insecurity. The dimension approach therefore allows for an overview of current FNS outcomes, drivers of food insecurity and programmes, but not for making interlinkages that allow forecasting of future FNS developments. It has been argued, however, that the stability dimension is meant to also capture conflict and market trends, since they influence the stability dimension. For the time being, focusing on the dimensions of FNS remains important as it is an approach that is known by FNS actors because it directly refers to the commonly used working definition of FNS as proposed by FAO.

2.3 Food systems approach

Recently, as highlighted by the 2021 UN Food Systems Summit (<https://www.un.org/en/food-systems-summit>) there has been a shift away from analysing FNS outcomes by themselves towards analysing food systems as a whole. This new perspective sees FNS outcomes as part of wider food systems and allows a more analytic approach towards accountable programming and planning of initiatives to assess and address FNS.

Box 1 Food systems approach

'A food systems approach (FSA) is a useful interdisciplinary conceptual framework for research and policy aimed at sustainable solutions for the sufficient supply of healthy food. An FSA analyses the relationships between the different parts of the food system and the outcomes of activities within the system in socio-economic and environmental/climate terms. Feedback loops are a distinguishing factor in systems thinking; they occur between parts of the food chain (production, processing, distribution, and consumption) and from the socio-economic and environmental outcomes of food production and consumption (such as food security and soil depletion) back to that production and consumption.

The FSA sheds light on non-linear processes in the food system, and on possible trade-offs between policy objectives. Systems thinking also broadens the perspective when seeking solutions for the root causes of problems such as poverty, malnutrition, and climate change.

The framework offers at least three benefits. First, it provides a checklist of topics that should at the very least be addressed when it comes to improving food security, certainly in relation to other policy objectives. Second, FSA helps to map the impact of environmental and climate changes on food security by pointing to the various vulnerabilities of the food system. In that sense the approach can contribute to the search for possibilities for strengthening the system's resilience to climate changes. Third, it helps to determine the most limiting factors for achieving food security, and hence identify effective interventions aimed at improving food security.'

(van Berkum & Ruben, 2018)

While FNS outcomes are at the core of any food systems approach, it is also possible to focus on certain elements of food systems. Most commonly, FNS analyses focus on FNS outcomes (Posthumus, et al., 2021); the result of the availability, access, utilisation, and stability of food. For assessing FNS outcomes, there is a wide range of indicators available that are most linked to the four dimensions of food security as in line with the FAO definition for FNS. It is further possible to assess FNS by focusing on **food system activities**; this encompasses all activities that contribute to any given food item value chain, from agricultural production to transport, food processing, packaging, and marketing. Lastly, one can focus on **socio-economic and environmental drivers** that ultimately determine FNS outcomes. Again, there is a wide range of indicators available for doing so, ranging from political systems, climatic and economic situation, and the risk (natural and man-made hazards) landscape.

Which approach to take for effective FNS analysis depends on these variables; who (which actor) is assessing FNS; in which context (country/ region/ target group and associated socio-economic and environmental drivers); and for what purpose (objective). It is important to stress the difference between food system outcomes and FNS outcomes. FNS outcomes directly concern people's ability to fulfil their energy and dietary needs. Food system outcomes include FNS outcomes, but also look beyond these to the environmental and socio-economic outcomes of food systems.

An FSA aims at factoring in as many indicators as possible to create a holistic overview of food systems and their outcomes and the connections between various elements within a food system, such as human activities, value chains, environmental and socio-economic drivers, as outlined in Figure 4.

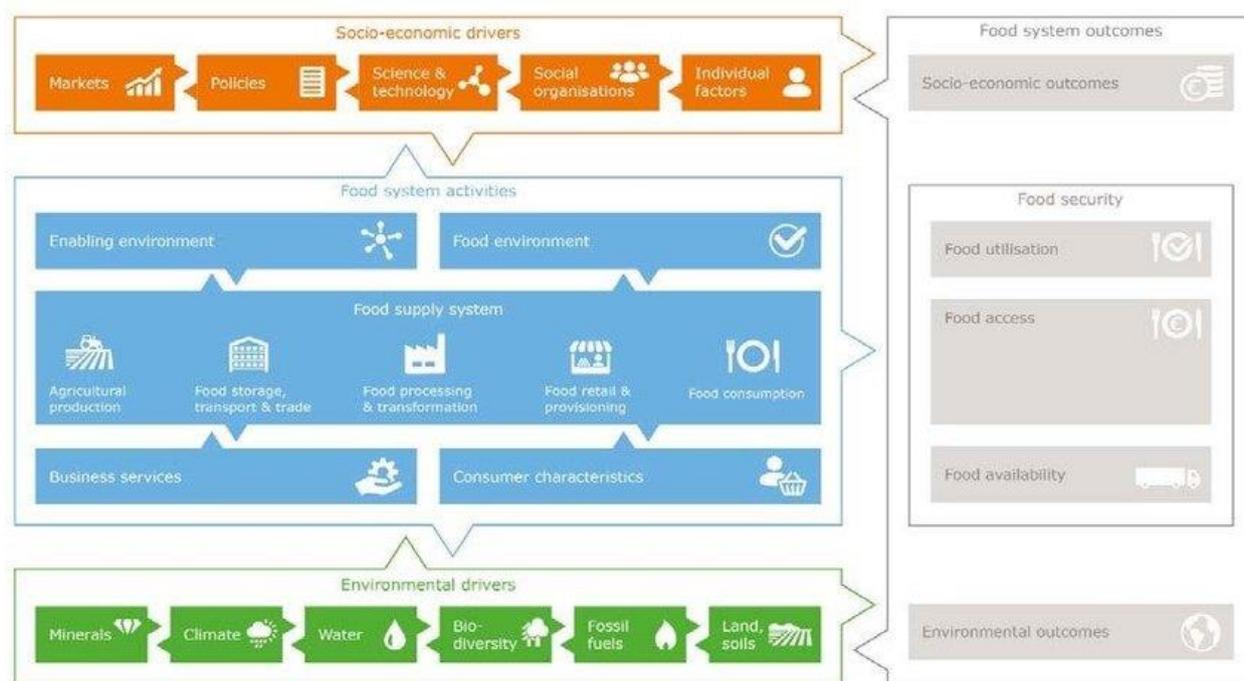


Figure 4 Example of a food system framework: the van Berkum framework (2018)

This allows for gaining in-depth insights about the functioning of regional, national, or local food systems and analysing root causes of food security. It reveals connections and interlinkages between drives and factors, between human activities, environmental drivers, markets, and food system outcomes; it considers all three categories of indicators that influence outcomes. Yet a challenge remains in selecting an FSA framework, as there are several available that emphasize different elements of food systems. For instance, some focus on FNS outcomes, while others put an emphasis on environmental or socio-economic drivers. In addition, while conducting an FSA allows for in-depth insights, it is a lengthy process that can only be done to better understand food systems; it does not allow for direct forecasting of developments. However, this better understanding of a food system does lead to better understanding of factors in each region and more precise collection of data which can eventually feed into forecasting developments.

2.4 FNS indicators

To analyse and address FNS, many indicators can be factored in and considered. One can generally divide between three categories: indicators measuring FNS outcomes; indicators measuring FNS drivers and risks; and indicators measuring FNS programmes.

2.4.1 Indicators measuring FNS outcomes

These are the most considered. Simplified, they provide an overview of acute or chronic malnutrition in each area and thus allow for designing programmes of a reactive nature, such as the provision of humanitarian assistance and relief (IPC Global Partners, 2012). Indicators can be collected on various levels, from national to regional, household, individual, or market level, and on different dimensions of food insecurity. They include, for instance: the household dietary diversity score (HDDS), food consumption score (FCS), household food insecurity access scale (HFIAS), diet quality index (DQI), dietary energy supply, depth of food deficit and dietary exposure assessments. Clicking on the respective indicators leads to a weblink explaining the indicator.³

³ There is a wide range of other indicators available. An overview of such indicators can be visited by visiting the International Dietary Data Expansion Project: <https://index.nutrition.tufts.edu/data4diets/data-sources-and-methods>

2.4.2 Indicators measuring FNS drivers and risks

These look at the macro-environment influencing FNS outcomes, such as socio-economic and environmental drivers and the risk landscape of a given area. According to the Global Report on Food Crises, the main drivers of FNS are conflict and insecurity; economic shocks including COVID-19; weather extremes; hazards; diseases; and poor care practices (FSIN, 2021). Analysing these drivers allows for deep insights into the complex interplays between macro-environment and FNS outcomes and has the potential to forecast food crises before they occur. Indicators measuring FNS drivers and risks include the following: indicators on hazard occurrence and intensity (number of people affected, number of people killed by hazard type); political stability; the economy (GDP, economic growth); and health (life expectation).

2.4.3 Indicators measuring FNS

Looking at these can lead to better programming and targeting of ongoing programmes to improve FNS, as well as learning for future programming (Marivoet, et al., 2019). Such indicators include the percentage of a population dependent on food aid, or the number of people affected by food crises versus the number of beneficiaries targeted. Humanitarian organisations such as the World Food Programme (WFP) have such data available.

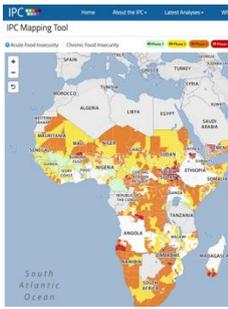
2.5 Overview of relevant data sources and reports

Data and reports on the topic of FNS are widely available, but it is a major challenge to identify relevant sources that suit the specific needs of a programme or initiative. The following sections provide an overview of data sources (quantitative) and reports (descriptive) that serve as input when researching on the topic of FNS. It is important to note that the following sections do not aim to be complete, but instead to introduce datasets and reports that the authors deem relevant. There are many more sources available; this selection of data sources and research input is context specific.

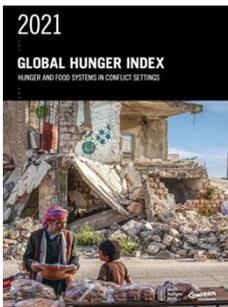
2.5.1 Overview of important datasets

This section provides an overview of some selected publicly available datasets and indices that are of use when analysing FNS and drivers of FNS.

Data on FNS outcomes



Most notably, and at the centre of this report, [IPC data](#) for selected countries is available, providing an overview of the recent FNS situation.



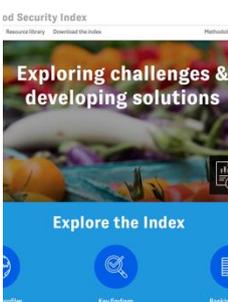
The [Global Hunger Index](#) appears on an annual basis and contains data on undernourishment, child stunting, child wasting and child mortality. It is a tool to measure and track hunger at different levels (global, regional, and national).



[HungerMap live](#) is a tool developed by WFP that tracks and predicts hunger in near real-time.



Data on nutrition can be found through the [country nutrition profiles](#) of the Global Nutrition Report, although coverage differs from country to country.



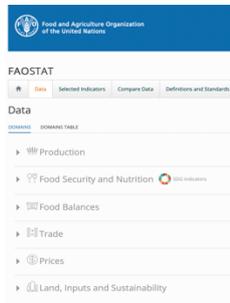
The [Global Food Security Index](#) contains data on 58 indicators, focusing on natural resources, resilience, and the four dimensions of food security.



The World Food Program has published an only-data explorer on economic information, called the [Economic Explorer](#). This includes data on macro-economic indicators such as GDP and food prices on markets around the world.



The [Hunger Reduction Commitment Index](#) ranks governments on their political commitment to tackling hunger and undernutrition.

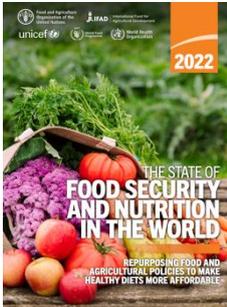


The open data portal of the FAO ([FAOSTAT](#)) brings together data on various indicators such as crop production, livestock, food balances, and land cover. It also contains information on SDG2 indicators such as prevalence of **stunting** and **wasting**. Importantly, FAOSTAT mostly has data on a national level. For regional data, data sources may vary from country to country. For example, for Somalia, food security related data is published by the [FNS Analysis Unit \(FSNAU\)](#).

2.5.2 Overview of important reports on FNS

This section provides an overview of selected comprehensive reports that appear on an annual basis and are published by renowned actors in the humanitarian sector. These reports can be consulted for a descriptive overview of recent FNS developments in different regions.

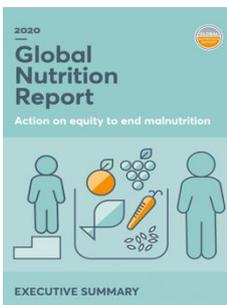
Reports on FNS outcomes



The [State Of FNS In The World Report](#) contains a global assessment of food insecurity and malnutrition and some indication of what hunger might look like by 2030 in a scenario complicated by the enduring effects of the COVID-19 pandemic.
Source: (FAO, et al., 2022)

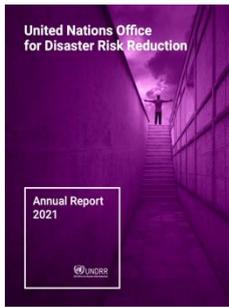


The [Global Report On Food Crises](#) highlights the severity and numbers of people in crisis or worse (IPC/CH Phase 3 or above) in (currently) 55 countries/territories, driven by persistent conflict, pre-existing and COVID-19-related economic shocks, and weather extremes.
Source: (FSIN, 2022)



The [Global Nutrition Report](#) looks at global and national patterns, revealing significant inequalities in nutrition outcomes within countries and populations.
Source: (Development Initiatives, 2021)

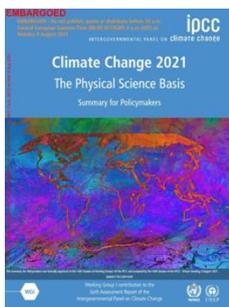
Reports on FNS drivers



The UNDRR Annual Report is the annual report of the United Nations Office for Disaster Risk Reduction, providing insights into the global impacts of natural and man-made hazards.
Source: (UNDRR, 2021)



The World Risk Report looks at links between natural events, climate change, development, and preparedness. Each annual edition focuses on a main topic and creating links between natural events, climate change, development and preparedness at a global level, providing future-oriented conclusions regarding relief measures, policies and reporting.
Source: (Bündnis Entwicklung Hilft, 2021)



The IPCC publishes assessment *reports* on knowledge on climate change, its causes, potential impacts, and response options. The most recent (6th) report of the IPCC contains recent developments and forecasts.
Source: (IPCC 2021)



The Freedom in the World Report measures freedom and political rights globally, assessing the condition of political rights and civil liberties around the world.
Source: (Freedom House, 2022)

2.6 Summary

This chapter defines food and nutrition security (FNS); discusses different ways to assess and analyse it; and gives an overview of data sources and reports.

FNS

- FNS remains a major challenge. In 2020, approximately 12 percent of the global population was severely food insecure. The Horn of Africa frequently sees food crises, reflected by high IPC levels.
- **Food security** is commonly assumed when *'all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.'*
- There are **four dimensions** of food security: **availability** of food, **accessibility** to food, **utilization** of food and **stability** of the other dimensions over time (FAO, 2008).
- There is a distinction between **chronic** and **acute** food insecurity. Chronic food insecurity refers to long-term or persistent situations of food insecurity. Acute food insecurity on the other hand is short-term and temporary.

Indicators

- **Indicators measuring FNS** inform decision-makers and policymakers on how and where to design FNS programmes.
- There are indicators available for each of the four dimensions of food security, on different levels: national, household, and individual.
- There is a wide range of different indicators available, some used more commonly than others; but no standardized agreement on which indicators to include and which ones to exclude when assessing FNS. There is a need to better streamline and align approaches to assess FNS.
- In addition to indicators measuring FNS outcomes, there are **indicators measuring FNS drivers and risks** as well as **indicators measuring FNS**.

Food system approach

- Food and nutrition security or insecurity can be seen as the outcome of **food systems** and the complex interplays between markets, environmental drivers, human activities, and other factors. Recently there has been a shift away from analysing individual FNS outcomes towards analysing food systems as a whole. This allows for a more analytic approach towards accountable programming and the planning of initiatives to assess and address FNS.

Datasets and reports on FNS

- There is a wide range of datasets and reports on FNS. Table 1 and Table 2 below summarise some of these datasets and reports.

Table 1 Overview of datasets on FNS

Name	Link
IPC	click here
Global Hunger Index	click here
HungerMap Live	click here
Country Nutrition Profiles	click here
Global Food Security Index	click here
EM-DAT	click here
ACLED	click here
Fragile States Index	click here
Global Peace Index	click here
Economic Explorer	click here
Hunger Reduction Commitment Index	click here
FAOSTAT	click here

Table 2 Overview of datasets on FNS

Name	Link
State of FNS in the World	click here
Global Report on Food Crises	click here
Global Nutrition Report	click here
UNDRR Annual Report	click here
World Risk Report	click here
IPCC Assessment Report	click here
Freedom in the World Report	click here
State of FNS in the World	click here
Global Report on Food Crises	click here
Global Nutrition Report	click here
UNDRR Annual Report	click here
World Risk Report	click here

3 IPC analysis and the current use of data

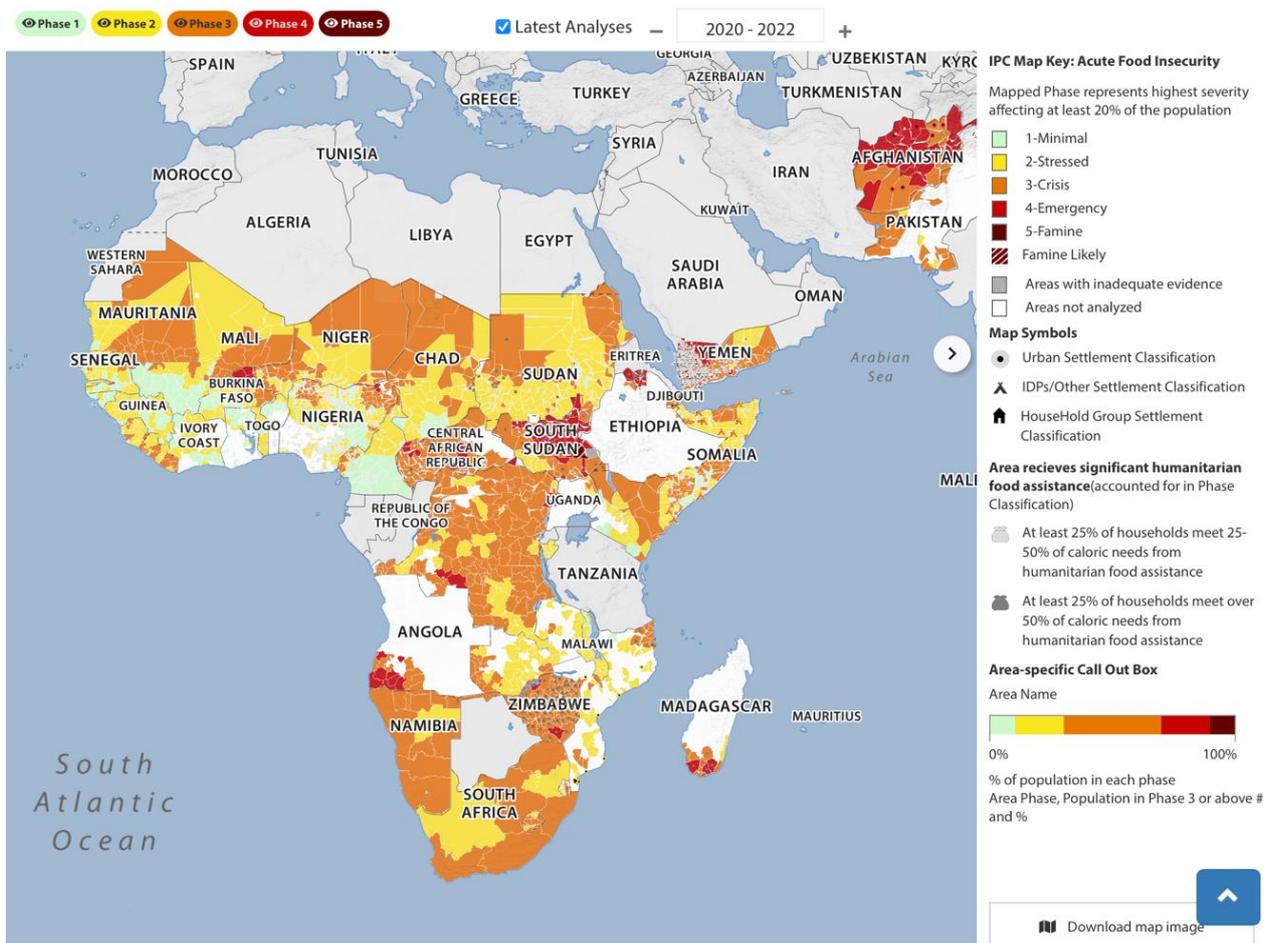


Figure 5 Overview of the IPC situation in Africa, early 2022

Contents of this Chapter

- 3.1 What is the IPC?
- 3.2 Data incorporated in the IPC analysis
- 3.3 How is the IPC currently used?
- 3.4 Challenges of using IPC data
- 3.5 Ongoing IPC developments
- 3.6 Summary

This chapter focuses on the approach which is most used for the assessment of FNS, especially regions that see frequent food insecurity and are often characterized by protracted crises: the Integrated Food Security Phase Classification (IPC) analysis. It introduces IPC analysis, important concepts, and how data is incorporated in the IPC process.

3.1 What is the IPC?

The IPC was developed in 2004 by the Food Security and Nutrition Analysis Unit (FSNAU), managed by FAO in Somalia (IPC, 2022a). The request for a food security measurement tool was motivated by a growing need for rigorous, evidence-based, consensus-based, and actionable food security information to facilitate an

effective humanitarian response in the Somali context. The IPC became more widely applicable in the following years, as it served as a 'common currency' for food security and nutrition analysis (IPC, 2022a).

The IPC collaborates with Cadre Harmonisé (CH), a unified tool for consensual analysis of acute food and nutrition insecurity in the Sahel and West Africa, as both initiatives produce relevant, consensual, rigorous, and transparent analyses of current and projected food and nutrition situations in different parts of the world. Over the years, collaboration has led to increased similarities and convergence between CH and the IPC that have resulted in comparable analyses findings in 52 countries. The primary way decision-makers use the IPC is to inform resource allocation at global and country levels, particularly humanitarian resources associated with food security and nutrition (IPC, 2022).

IPC has become a common, globally accepted scale to determine the severity and magnitude of food insecurity and malnutrition situations in a country or region. The IPC has three separate scales capturing the classifications: 1) acute food insecurity 2) chronic food insecurity, and 3) acute malnutrition. These classifications are used in 30 countries (with the Acute Food Insecurity Scale being implemented in 32 countries) some of which are experiencing the world's worst food crises (IPC, 2022a). The chronic food insecurity and acute malnutrition scales were added to answer to demands from countries which did not experience food emergencies but did experience chronic malnutrition (Frankenberg & Verduijn, 2011). This report, however, mostly focuses on the acute food insecurity scale, which is still the most used.

To position regions in these classifications, the IPC has developed a set of protocols which describe how groups of experts and analysts can assess the reliability of evidence, classify regions into severity categories, identify key drivers of food insecurity, and communicate analysis results (IPC, 2021). The IPC protocol describes how to consolidate several types of data and information - ranging from malnutrition rates, levels of water access, and measures of livelihood assets, to dietary diversity scores - into a single score on a five-point scale (Frederiksen, 2016).

Figure 6 summarizes the five IPC acute food insecurity reference phase name descriptions.

Phase name and description	Phase 1 None/Minimal	Phase 2 Stressed	Phase 3 Crisis	Phase 4 Emergency	Phase 5 Catastrophe/ Famine
	Households are able to meet essential food and non-food needs without engaging in atypical and unsustainable strategies to access food and income.	Households have minimally adequate food consumption but are unable to afford some essential non-food expenditures without engaging in stress-coping strategies.	Households either: • Have food consumption gaps that are reflected by high or above-usual acute malnutrition; or • Are marginally able to meet minimum food needs but only by depleting essential livelihood assets or through crisis-coping strategies.	Households either: • Have large food consumption gaps which are reflected in very high acute malnutrition and excess mortality; or • Are able to mitigate large food consumption gaps but only by employing emergency livelihood strategies and asset liquidation.	Households have an extreme lack of food and/or other basic needs even after full employment of coping strategies. Starvation, death, destitution and extremely critical acute malnutrition levels are evident. (For Famine Classification, an area needs to have extreme critical levels of acute malnutrition and mortality).
Priority response objectives	Action required to build resilience and for disaster risk reduction	Action required for disaster risk reduction and to protect livelihoods	Urgent action required to: Protect livelihoods and reduce food consumption gaps Save lives and livelihoods Revert/prevent widespread death and total collapse of livelihoods		

First-level outcomes refer to characteristics of food consumption and livelihood change. Thresholds that correspond as closely as possible to the Phase description are included for each indicator. Although cut-offs are based on applied research and presented as global reference, correlation between indicators is often somewhat limited and findings need to be contextualized. The area is classified in the most severe Phase that affects at least 20% of the population.

Figure 6 IPC food insecurity classification (IPC, 2022b)

3.2 Data incorporated in the IPC analysis

The IPC does not collect its own primary data. Rather, it integrates existing sources of evidence. The result of the IPC analysis is an overview of the number of people per geographic region per food insecurity phase. Based on the proportions of the households in a certain region that belong to each individual phase, a final IPC phase for the region is allocated. This is determined by the severity of food insecurity that affects at least 20 percent of households that are worst off (IPC, 2021).

IPC integrates evidence on several different indicators. A complete overview of these indicators can be found in the IPC Technical Manual (IPC, 2021, p. 37). In short, IPC distinguishes between first level and second-

level inputs. First-level inputs refer to characteristics of food consumption and livelihood change. These can be, for example, the dietary energy intake, the food consumption score, household hunger scale, and dietary diversity scores. Second-level inputs refer to area-level estimations of nutritional status and mortality. It includes data on the weight-for-height Z-score, mid-upper arm circumference (MUAC), BMI, crude death rates and under-five death rates. Finally, the IPC also integrates evidence on context-specific factors such as access to safe water and exposure to hazards.

The IPC acute food insecurity classification analysis is generally carried out twice a year, resulting in two data points per year that can be used for further analysis. Furthermore, scores are defined at national, admin 1 (regional) and admin 2 (district) levels. All IPC data is public and can be accessed through the IPC Population Tracking Tool on the IPC website (see Figure 7).

The IPC Population Tracking Tool

The IPC Population Tracking Tool is an online platform that gives the public access to population data from more than 30 different countries. It allows users to download resource data for offline IPC analyses since 2017. All national population figures are based on official country population estimates. IPC estimates are those published in country IPC reports.

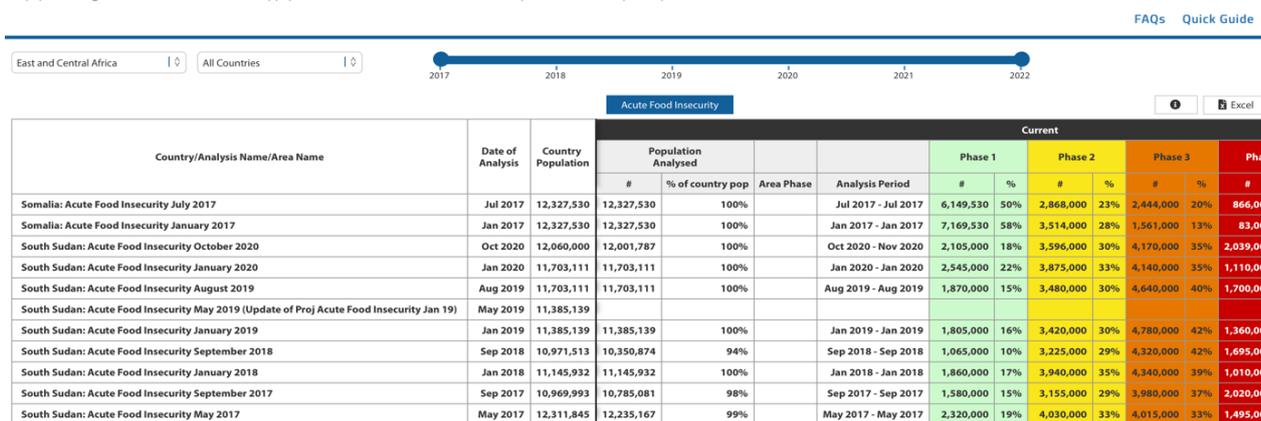


Figure 7 The IPC population tracker tool

3.3 How is the IPC currently used?

IPC is treated as the international standard by governments, UN Agencies, NGOs, and others. It is used to improve decision-making, programming, and policy development. For example, IPC data is used by the United Nations to draft the annual Humanitarian Needs Overview (HNO) and the subsequent Humanitarian Appeals (to provide humanitarian assistance to the number of people in need) by FAO to decide on high-level resource allocations, and by some larger NGOs for advocating and fundraising purposes. IPC phases are now commonly regarded as objective indications of food insecurity levels (FAO, 2019) and are used in many processes. Therefore IPC phases can have far-reaching consequences for the countries concerned, especially when declaring famine. For example, in the July 2011, the food security situation in Somalia, which had been severe for months, deteriorated and was suddenly reclassified from IPC Phase 4 ('Humanitarian Emergency') to IPC Phase 5 ('Famine'), triggering agencies and donors into large-scale life-saving humanitarian action (Frederiksen, 2016).

Besides driving global consensus and sparking media and donor attention, the IPC previously also provided strategic guidance for each IPC phase. These were recommendations to mitigate immediate negative outcomes, support livelihoods, and address structural causes through the so-called 'strategic response framework.' For example, for IPC Phase 2 ('Stressed'), the strategic response framework recommended focusing on the provision of safety nets for high-risk groups, and for IPC Phase 4 it recommended providing complementary sectoral support (e.g., water, shelter, sanitation, health, etc.) (IPC, 2006). However, this strategic response framework was removed from the IPC analyses as it was considered too broad to provide decision-makers with practical advice on how to react to rising IPC levels.

3.4 Challenges of using IPC data

Although the IPC has found global recognition as a classification tool for food security, it has some limitations and constraints. Some of these challenges have been pointed out by the IPC itself in self-evaluations by specific working groups such as the Advanced Technology and Artificial Intelligence for IPC working group (ATARI). In its first report, published in 2020, the ATARI working group identified eleven challenges to the IPC as a global standard (ATARI, 2020). Key challenges are as follows.

3.4.1 Human factors

The current IPC analytical process is currently very lengthy and time-consuming. The complete IPC process can take between one to three months, and the analysis requires 20-40 or more people attending five to ten-day workshops. It is also based on consensus-building, which may be prone to bias and may give disproportionate influence by specific individuals or organizations. Furthermore, people in the national technical working groups carrying out the analysis need constant training and skills coaching to apply the most recent IPC protocols correctly to ensure a consistent global way of working.

3.4.2 Underlying data

Because the IPC classification is integrating different data sources, there may be different datasets or pieces of evidence behind a specific classification that also depends on the specific location. This is what makes the IPC flexible and applicable in different regions. However, this is also the reason why it is not always clear to outsiders at first glance what data has served as an input for the IPC classification. To ensure the trustworthiness of data, the IPC communicates evidence levels for each classification. The reported evidence levels in the IPC communications specify the quality of the evidence. For example, evidence level 2 (out of 3) requires at least two pieces of 'somewhat reliable' evidence, or one piece of 'reliable' evidence (IPC manual). But whether this evidence relates to for example the Household Dietary Diversity Score, dietary energy intake, or the Food Insecurity Experience Scale (FIES), is not specified. The IPC has recently however (February 2022) published a series of documents that aim at explaining the underlying processes and how data is being used.

Because the IPC working groups already invest a lot of time and effort into the collection and assessment of different pieces of evidence, this report recommends that the IPC should provide a clear overview of the different pieces of evidence and the actual data they use. A problematic dietary diversity score may require different programmes than a problematic dietary energy intake. Having indicator-specific data, in addition to the final classification, would therefore be of great importance to policymakers and programming teams. It would also greatly increase the possibilities for carrying out descriptive analytics on IPC information.

3.4.3 Advanced techniques

It is a challenge for the IPC to effectively connect to and keep up with recent technological advances. The ATARI working group, for example, recognizes that the IPC does not always effectively connect to recent innovations in data science. Furthermore, the data collected through the IPC analysis must be entered manually and this process is not standardized. The amount of data supporting the classification also differs greatly between countries.

In a 2014-2018 evaluation of the IPC, authors noted that data coverage may be well-developed in countries where acute food insecurity persists. In those countries, larger investments can be made to create large quantitative surveys. But in countries with only occasional food insecurity, these surveys are generally not in place, and data availability is therefore limited. Furthermore, quantitative analysis on this data is also limited. For example, causes for food insecurity may be identified, but only in a qualitative way. Therefore, a strategic goal of the IPC is to increase global coverage to include any country potentially facing food insecurity, and to increase the frequency of updates.

Another challenge, pre-empting the discussion of reactive interventions and preventive actions in Section 7.3, is to put much more emphasis on dynamics between IPC phases. As mentioned above, regions

moving from IPC Phase 2 to IPC Phase 3, and in particular from IPC Phase 3 to IPC Phase 4, can be early warnings for eventual famine. Therefore, for those cases smart programmes such as strengthening food systems are very important. In other words, there is still untapped potential in taking immediate actions in the 'lower' phases of the IPC. This will then raise the use of IPC beyond the typical 'humanitarian response' addressing IPC Phase 3 and above (Crisis, Emergency, and Catastrophe/Famine).

3.5 Ongoing IPC developments

One of the priorities is 'early warning – early action.' While national hazard early warning systems frequently feed into the IPC analysis, regional early warning systems often do not. Indicators on regional level are often very valuable, but on a scale too small to integrate them with national systems. The IPC is exploring possibilities to better integrate such regional early warning systems with national early warnings for further improving analyses and forecasts in the future. This is key as early warnings can inform early actions directly.

In addition, there is ongoing debate on the cycles in which IPC is published. Currently IPC analyses are published twice a year, but it has been proposed to move towards a more flexible approach in which IPC analyses are published on a needs-based basis. The idea is to allow for a more flexible and timely analysis, allowing decision makers to make informed decisions and to react quickly to emerging crises. However, limitations remain in the availability of data and funding.

Similarly, it remains challenging to directly correlate IPC levels with hazard occurrences. Doing so would be desirable but remains difficult as there are too many different hazards in addition to a lack of historical data to run regressions, making trend analysis difficult. However, in the future this might be a potential to explore.

Generally, data availability and reliability remain one of the key issues in IPC analysis. As data is sometimes not reliable, IPC has set minimum requirements to inform the IPC. This includes certain indicators as defined in the IPC manual. If these minimum requirements are not met, no analysis is released. Where possible, additional indicators beyond minimum requirements are considered; for instance, where possible, climate forecasts as well market forecasts are integrated into the analysis. The IPC uses its expertise, as well as its links to existing partners such as universities and research institutes specialized in data sciences, to address these constraints in data availability and reliability. Such links are also explored in an ongoing discourse on how to better link IPC analyses with the humanitarian-peace-development-nexus.

A very interesting development is that the IPC proactively responds to global shocks that may affect the food and nutrition situation at country level, for example IPC has produced a guidance note as a resource for IPC analysts to factor in the impact of the war in Ukraine, as a potential key driver affecting food security and nutrition situation.⁴ The guidance notes provide direct recommendations for incorporating the impact of the conflict for the HoA countries Somalia and Sudan.

⁴ To conduct country analysis, the guidance note recommends that analysts consider the different risks the Ukraine crisis poses to food security in the country, e.g. through impact on imports and increasing inflation, mainly linked to high food and fuel prices. However, potential mitigating factors should also be considered such as high self-sufficiency in food products, good trade relations or increasing revenue for the country due to high prices received for exports. (taken from the IPC report on the Guidance Note).

3.6 Summary

This chapter introduces the IPC framework, including its origin and its current use; notes that does not collect its own primary data but integrates existing sources through a carefully designed process; and discusses challenges faced by the IPC like adjusting to new technological developments.

What is the IPC?

- The Integrated Food Security Phase Classification (IPC) is the 'common currency' for food security and nutrition analysis.
- It is implemented in 30 countries.
- IPC publishes three classifications (acute food insecurity, chronic food insecurity, and acute malnutrition), of which the acute food insecurity is the most used.
- IPC acute food insecurity has five phases ranging from 'food secure' (phase 1) to 'famine' (phase 5).

Data incorporated in the IPC analysis

- IPC does not collect its own primary data but integrates existing sources of evidence.
- IPC distinguishes between first level and second-level inputs:
 - first level inputs refer to characteristics of food consumption and livelihood change. These can be, for example, the dietary energy intake, the food consumption score, household hunger scale, and dietary diversity scores.
 - second level inputs refer to area-level estimations of nutritional status and mortality. It includes data on the weight-for-height Z-score, mid-upper arm circumference, BMI, crude death rates, and under-five death rates.

How is the IPC currently used?

- IPC is used to improve decision-making and policy development.
- IPC typically informs humanitarian appeals and humanitarian response plans.
- IPC phases 4 and 5 are typically the phases where donors are willing to quickly provide funding for humanitarian support.

Challenges of using IPC data

- IPC is a very important resource, for both development and humanitarian purposes. However it does face some challenges.
 - The construction of the IPC phases is a lengthy and tedious process that relies partly on human judgment.
 - It is difficult to effectively connect to and keep up with recent technological advances.
 - The availability and quality of data differs per country.

At the intervention level it is difficult to generate action in response to regions moving up to IPC Phase 2 or 3.

4 The FNS risk landscape



Figure 8 Flooding following drought, both common threats to FNS in HoA

Contents of this chapter

- 4.1 Disaster management theory
- 4.2 Classifying disaster
- 4.3 Horn of Africa risk profile
- 4.4 Hazards and IPC
- 4.5 Limitations in assessing natural hazards and conflict
- 4.6 Case study
- 4.7 Summary

This chapter is on the current risk landscape influencing IPC dynamics in HoA. It introduces hazard and disaster management theory and terminology; gives an overview of the current risk landscape for individual

countries, including an overview of how natural and man-made shocks and stressors impact FNS outcomes; and illustrates how the risk landscape influences FNS outcomes with a case study.

FNS and food system outcomes are the result of food system activities, socio-economic and environmental drivers. The socio-economic and environmental drivers that contribute to FNS outcomes are influenced by natural and man-made hazards. For instance, natural hazards such as droughts are major environmental drivers, and violent conflicts in various countries are significant socio-economic drivers, both negatively impacting FNS outcomes in the Horn of Africa.

These connections between the risk landscape and FNS outcomes mean that shocks and stressors need to be considered to identify and mitigate food crises. To better forecast FNS developments, represented by IPC, the specific regional/local risk landscape must be considered, as natural and man-made hazards are inextricably linked to developments in FNS outcomes and IPC levels.

4.1 Disaster management theory

The risk landscape of a given location is made up of the hazards (either natural or man-made) that might turn into disaster.

Globally, including in the Horn of Africa, natural and man-made hazards are increasing in frequency and intensity (Coronese, et al., 2019). Where hazards meet vulnerable populations, there is potential for disaster (Flanagan, et al., 2011). In disaster risk management theory, an often-used quotation to assess risks is the **risk equation**:

$$\text{risk} = \frac{\text{hazard} \times \text{vulnerability}}{\text{capacity}}$$

This chapter focuses on the hazard component of this equation. Here, it is important to make a distinction between **hazard** and **disaster**. A hazard is an event that can potentially cause a disaster; but only where a hazard meets a vulnerable population is there risk of disaster. For instance, a drought impacting a vulnerable population in the Horn of Africa may result in the disaster of famine. While there is no agreement on what type of event is to be considered a disaster, one way to assess an event is to look at the classification of a disaster according to the International Disaster Database (EM-DAT). According to EM-DAT, a hazard has turned into a disaster, if at least one of the following criteria is fulfilled:

- 10 or more people dead;
- 100 or more people affected;
- The declaration of a state of emergency;
- A call for international assistance (EM-DAT , 2021).

Hazards can further be divided into **shocks** or **stressors** that have the potential to either cause rapid-onset or slow-onset disasters (Sagara, 2018). Stressors result in slow-onset disasters and shocks result in rapid-onset disasters. While it is often shocks that affect and kill people in a short time span and create significant media attention, stressors create complex and long-lasting protracted humanitarian emergencies, often resulting in high numbers of people affected or killed over a prolonged period (Cornish, 2020). These complex humanitarian emergencies are often protracted crises. Notably, stressors, even though often deadlier than shocks, receive less attention than shocks as the disaster happens gradually rather than instantly (Chapter 7 looks more into the relations between types of disaster, media attention, and humanitarian aid).

Climate change and socio-economic pressures lead to an increase in meteorological disasters such as cyclones, droughts, floods, and conflict. Here it is important to make a distinction between hazards themselves and the factors reinforcing or exacerbating them which impact hazard dynamics but are not hazards in themselves. Such factors include, for instance, climate change, environmental degradation,

changing demographics, and human activities. While these factors are important elements surrounding the risk landscape, it is beyond the scope of this paper to discuss their influence on disasters and ultimately FNS outcomes.

4.2 Classifying disaster

Disasters can be classified by group, sub-group, type, and sub-type. This classification is according to EM-DAT and is widely used and accepted (EM-DAT , 2021). Appendix 2 contains a comprehensive overview.

Group

It is important to note that the EM-DAT classification does not include conflict and war events in its classification, but only man-made hazards that are caused by technological factors, for example industrial or transport accidents. Hence, for assessing the important factors of conflict and war, the report looks at different classifications in a separate section, making use of the ACLED data base.

Sub-group

There are multiple subgroups of natural and man-made hazards: geophysical, meteorological, biological, climatological, hydrological, and technological.

Type

Types of disasters include further specifications, for example whether a geophysical event was associated with an earthquake, volcanic activity, or a mass-movement.

Sub-type

The subtype, or secondary hazard, provides a specification of the type. For instance, a disastrous event triggered by a volcano (the type, or primary hazard) can be associated with ash-fall, a Lahar ⁵, pyroclastic flows, or lava flows (the subtypes, or secondary hazards).

4.3 Horn of Africa risk profile

This section provides an overview of the risk landscape of the Horn of Africa and outlines disasters affecting the region since the beginning of the 21st century (2000-2021).

It is important to be aware of a region's risk landscape when analysing FNS outcomes and to consider localized perspectives, as often within a given region there are a large variety of cultures and ecological zones that may affect people's risk landscape.

Natural hazards and resulting disasters impact the environmental and socio-economic drivers of FNS. Thus, to improve the use of IPC data for forecasting and better programming, one needs to look at what is below the surface to analyse which shocks and stressors are impacting food systems and their outcomes.

The Horn of Africa frequently sees both natural and man-made hazards turning into disaster and at times true humanitarian emergencies. The track-record of disasters is long, and the impacts on livelihoods and FNS outcomes of people are severe. As we write, Ethiopia has been experiencing a devastating conflict in Tigray; Sudan has had a coup d'état; Somalia has been affected by locust and South Sudan by the worst floods in decades; the whole region is still being affected by the impacts of the ongoing COVID-19 pandemic; and Russia's war in Ukraine is affecting grain exports on which HoA countries are highly dependent.

⁵ A violent type of mud flow or debris flow originating from a volcano composed of a slurry of pyroclastic material, rocky debris, and water.

4.3.1 Natural hazards and disasters in the Horn of Africa

EM-DAT data provides numbers on cases in which natural hazards have resulted in disaster. This quantification includes the number of disaster occurrence by group and type as well as the number of people affected and killed. In addition, for each hazard there is a short description of its impact on FNS if it turns into a disaster. All hazards have a potential impact on FNS outcomes, either directly or indirectly. Some hazards directly interfere with food system activities, such as locusts, droughts, or floods, which all bear the potential to destroy and disrupt agricultural activities, regularly reducing yields. Other hazards, such as conflicts, impact indirectly FNS outcomes by affecting the macro-environment of food systems. In addition, when large-scale disasters occur, they can both impact directly and indirectly on FNS outcomes, destroying yields and causing disruptions in the macro environment alike. The impacts of natural hazards on FNS outcomes are described in 4.3.4 Natural Hazards and FNS.

The following sub-sections are ordered by the number of people in HoA affected (highest to lowest) between the years 2000 and 2021. Insect infestation is placed in third place, as even though the dataset consulted did not contain numbers for people affected by insect infestation, it is reasonable to assume that the number of people affected were high. The disaster types that affected more than 500,000 people in total and caused significant impacts on FNS outcomes are elaborated on in more detail.⁶

Disasters in HoA (Ethiopia, Kenia, Somalia, Djibouti, Sudan, and South Sudan) in numbers, 2000-21: EM-DAT data and criteria

327 natural hazard events were classified as a disaster.

Of these, 171 were classified as of hydrological, 104 biological, 37 climatological, 11 meteorological and 4 of geophysical origin.

Disaster type: flood was listed 160 times; epidemic 98; drought 35; landslide 11; storm 10; insect infestation 6; wildfire, earthquake, and volcanic activity, each 2; and extreme temperature 1. According to the database, the total number of people killed was 35 127 and the total number of people affected exceeded 137 million.

People affected: drought affected by far the most people (exceeding 114 million), followed by floods (20 million), biological events (1.6 million), and other types of disaster. Similarly, drought was associated with some 20,000 deaths, followed by epidemics (9000+) and floods (4700+).

Disasters were classified by EM-DAT because an event fulfilled the criteria of 10 or more people dead, a total of 179 times; because 100 or more people were affected, 269 times; because a state of emergency was declared, 12 times; and because there was an appeal for international assistance, 7 times.

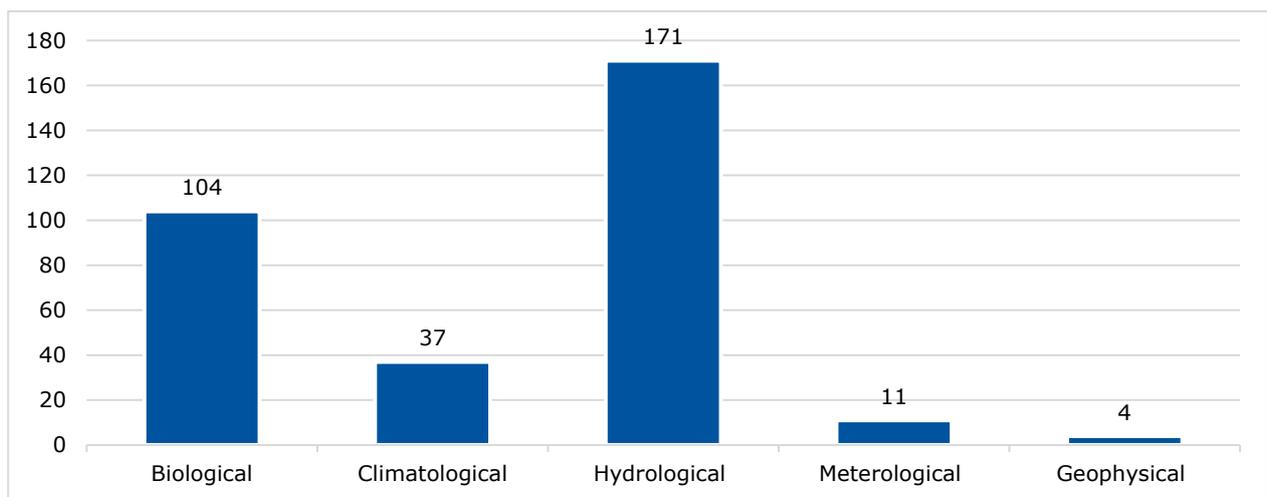


Figure 9 Disaster occurrence in HoA 2000-2021, shown by subgroup

⁶ Numbers for epidemics are surprisingly low considering the COVID19 pandemic. They are unlikely to accurately reflect reality, given the insufficient availability of adequate testing capacities.

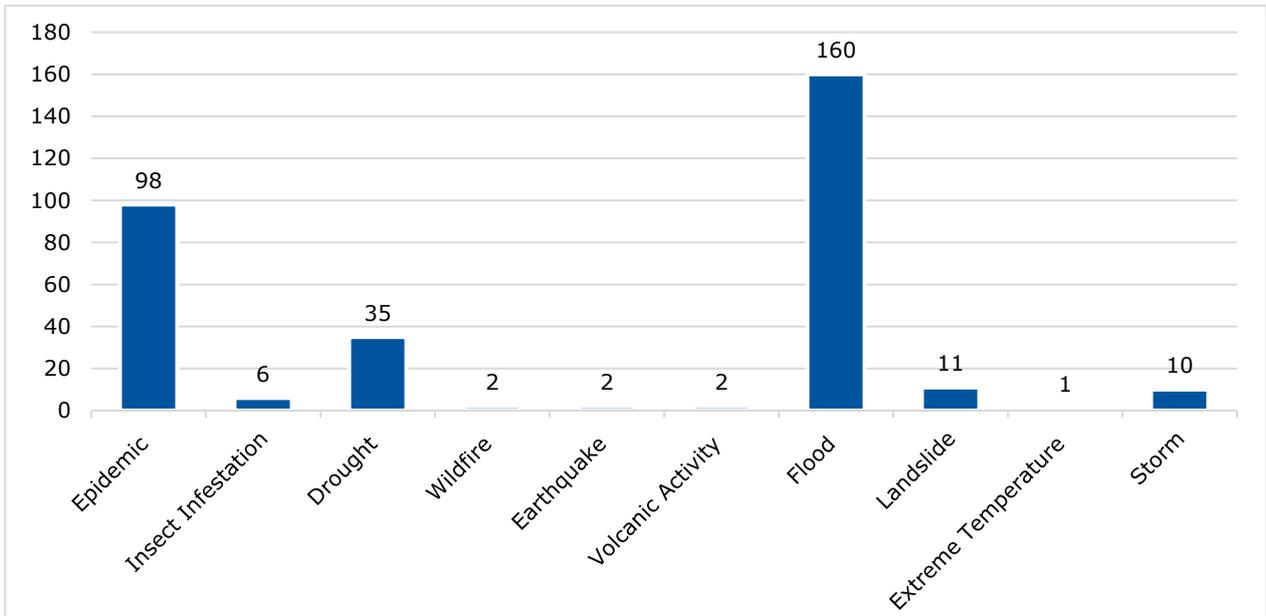


Figure 10 Disaster occurrence in HoA 2000-2021, shown by type

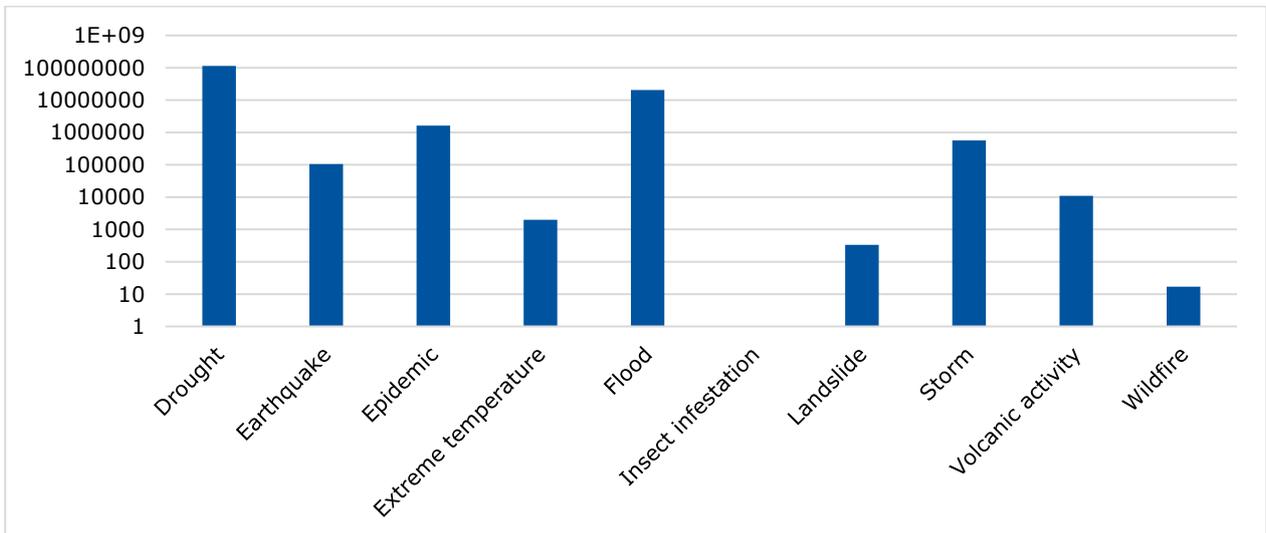


Figure 11 Numbers of people affected by disaster in HOA 2000-2021, shown by type



Figure 12 *Drought impacting vegetation in Sanaag, Somaliland*

4.3.1.1 Droughts

Droughts are slow onset climatological stressors and are the most severe hazard faced by populations in the Horn of Africa; they frequently cause complex humanitarian crises, including loss of lives and livestock and damage to infrastructure and economies, thereby affecting FNS outcomes.

Reasons for its recurring vulnerability to drought include geographical location (close to the equator), its fragile eco-systems and the variable climate (Kairu, 2021). Rainfall in the Horn has historically been low and inconsistent; descending motion of air, resulting in low humidity, is considered the main cause for a strong variability in rainfall (Nicholson, 2017). Somalia has low rainfall because it is located on the leeward side of Kenyan and Ethiopian highlands. Orographic and coastal influences are also regarded as significant and affect the pattern of rainfall in the country (UNDP, 2018). The combination of excessive heat and low rainfall leads directly to higher-than-normal evaporation rates, reducing the availability of already scarce water resources.

Human activities, such as deforestation, grazing, overgrazing and rudimentary cropping methods worsen the effects of drought, as these activities further reduce the water retention capacities of soil and lead to soil erosion (Hrachowitz, et al., 2020).

An analysis of droughts in Somaliland indicate that droughts have intensified over the past 20 years in terms of frequency, severity, and coverage (Ogallo, et al., 2018). This trend is expected to apply for most of the Horn of Africa.

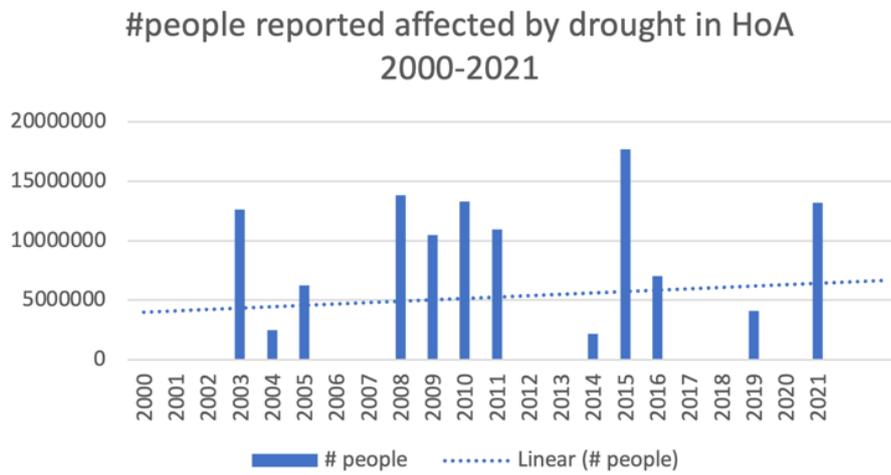


Figure 13 People reported affected by drought in HoA

According to EM-DAT, 35 droughts have affected a total of 114 million people and killed at least 20,000 people in the Horn of Africa between 2000-2021. Drought is by far the most severe hazard in the Horn of Africa when looking at numbers of people affected and killed. It is further a major driver of IPC levels and food insecurity.

4.3.1.2 Floods

Floods are hydrological rapid onset hazards and can have devastating effects on people and environment alike. Flash floods, in particular, because of their rapid onset, pose a threat to people’s life’s, livelihoods and FNS situation.

In the Horn of Africa, there are two major types of floods: flash floods, that follow heavy precipitation events (storms, cyclones) and occur in areas with a high surface run-off; and riverine floods, which occur when water volume exceeds a stream’s capacities and water bursts or overflows the riverbanks. Flash floods are more localized events while riverine floods can affect entire regions, especially near river deltas.

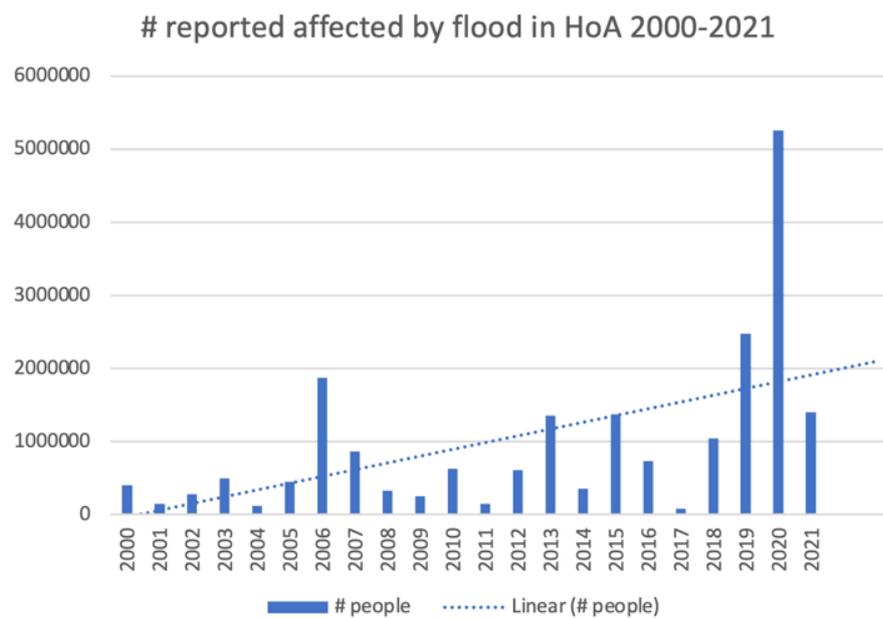


Figure 14 People reported affected by flood

According to EM-DAT, 160 floods have affected more than 20 million people in the Horn of Africa between 2000-2021 and killed more than 4700 people. Of the 160 events, 100 have been classified as riverine floods, 30 as flash floods and another 30 have not been classified.



Figure 15 Floods following heavy rainfall in Sanaag, Somaliland

4.3.1.3 Insect infestation (locusts)

Insect infestations are biological hazards and include grasshopper and locust plagues, the latter of which is a common hazard in the Horn of Africa.

The desert locust (*Schistocerca gregaria*) is a short-horned grasshopper (Acridoidea) that is known to form swarms which can be dense and highly mobile. During plagues, desert locusts may spread over enormous areas, potentially extending over parts of up to 60 countries, equalling more than 20% of the total land surface of the world. During these times, the desert locust can cause damage to livelihoods of up to a tenth of the world's population (FAO, 2009).

Locusts are known to be the world's most destructive migratory pest. They can travel up to 145 kilometres in one day. A swarm can have any size, from less than one square kilometre to up to several hundred square kilometres. One square kilometre usually contains between 40 million and 80 million locust adults. This means, that occasionally a single swarm can entail up to several billion insects, consuming an amount of vegetation equal to that which a large city eats in a day (Kray & Shetty, 2020).

According to EM-DAT, six insect infestations have occurred between 2000-2021. The number of people that have been affected or killed by insect infestations are unknown.

Of the six events recorded, all insect infestations have been associated with locusts.

4.3.1.4 Epidemics

Epidemics and pandemics are biological hazards and include bacterial, viral, and parasitic diseases (N.B. the EM-DAT classification does not consider animal or livestock disease or epidemics, which can have a

significant impact on FNS outcomes as food systems and whole economies in the HoA, especially those of pastoralists, heavily depend on livestock).

According to EM-DAT, 98 epidemics have affected more than 160,000 people in the Horn of Africa between 2000-2021 and killed more than 9,300 people. Of the 98 epidemics recorded, 57 have been classified as bacterial disease, 24 as viral disease, 4 as parasitic disease and 13 have not been classified. As previously noted, these numbers are surprisingly low considering the COVID19 pandemic. They are unlikely to accurately reflect reality given the insufficient availability of adequate testing capacities.

4.3.1.5 Storms

Storms are meteorological hazards and storms. Tropical cyclones have significantly increased in the Horn of Africa in recent decades, a trend that is generally attributed to climate change (Salih, et al., 2020). Tropical cyclones bring with them strong winds and heavy precipitation events, triggering secondary hazards such as flooding and landslides.

According to EM-DAT, ten storms have affected a total of nearly 600,000 people in the Horn of Africa between 2000-2021 and killed at least 285 people. Of the ten recorded storm events, seven have been classified as tropical cyclone and three as convective storm events.



Figure 16 Camels on a livestock market in Hargeisa

4.3.1.6 Other natural hazards

The Horn of Africa is in a seismic active region, with smaller and larger **earthquakes** occurring frequently (Bartel & Muller, 2007).

According to EM-DAT, two earthquakes have affected a total of 105,000 people in the Horn of Africa between 2000-2021 and killed at least 299 people. Both events have been classified as tsunamis (secondary hazard).

Volcanic activity is another hazard in the region.

According to EM-DAT, two events relating to volcanic activity have affected a total of more than 11,000 people in the Horn of Africa between 2000-2021, killing five people. The volcanic events have been classified as ash-fall (secondary hazard).

Extreme heat. According to EM-DAT, one extreme heat event has affected a total of more than 2,000 people in the Horn of Africa between 2000-2021 and killed at least 29 people. This event has been classified as a heat wave.

Sometimes resulting from either volcanic activity or extreme heat, **wildfires** occur which can destroy agricultural lands and kill livestock. According to EM-DAT, two wildfires have affected a total of 17 people in the Horn of Africa between 2000-2021 and killed at least 50 people.

Lastly, **landslides** are often secondary hazards, resulting from either geophysical activity (dry mass movements) or heavy precipitation events (wet mass movements) (Varnes, 1978). According to EM-DAT, 11 landslides have affected a total of 332 people in the Horn of Africa between 2000-2021 and killed more than 246 people. Of the 11 landslides recorded, ten were considered landslides and one a mudslide. All events were associated with wet mass movements as opposed to dry mass movements and are therefore considered hydrological rather than geophysical events.

4.3.2 Natural hazards and FNS

All the hazards listed above impact FNS in the Horn of Africa. **Drought**, for instance, directly leads to significant damage to crop production. Water scarcity in times of drought causes crop failure, which in turn can lead to a lack of animal fodder available for livestock production; animal death is related to a lack of water and pastures; and drought benefits the spreading of animal pests (UNICEF, 2011). Drought eradicates both crops and livestock; crops fail at times of drought, and income needed for the purchase of food decreases drastically with a declining number and quality of livestock. With both sources of food falling away, drought can have severe impacts on FNS outcomes.

Floods in the Horn of Africa are known to impact FNS by destroying soil and vegetation, removing plant nutrients, and negatively altering soil texture, resulting in reduced capacity of the land to produce pasture. In some floodplains there is a proliferation of unpalatable plant species (Erfanian, et al., 2021), or of plants with little economic value in areas where nutritious pasture was growing before. Further, de-vegetation is conducive to wind erosion (Gomes, et al., 2006). Floods pose a direct threat to FNS outcomes, as they cause damage to crops (for food and livestock fodder) and further erode the land needed for agricultural production and livestock grazing.

In addition, **locusts** can cause significant damage to crops. The amount of food consumed by locust swarms is hard to grasp. A single desert locust adult consumes roughly its own weight in food (up to about two grams) each day. Assuming that an average person eats an average of 2.3 kg of food per day, a swarm the size of one square kilometre, containing 40 million locusts, eats an amount of food per day equal to 35,000 people (Mamo & Bedane, 2021). Locust outbreaks have a direct and potentially severe impact on FNS outcomes. Large outbreaks decimate crops and pastures, rapidly leading to no vegetation being available for human or animal consumption. This puts FNS outcomes and livelihoods at risk, especially in countries affected by fragility or conflict such as Somalia (World Bank, 2020).

Biological events affecting people do not directly impact FNS but can limit people's ability to utilise food or engage in food system activities, thus reducing food system activities. Large-scale epidemics or pandemics such as COVID-19 can have a significant impact on FNS outcomes by disrupting food systems, associated activities, and (global) value chains (HLPE, 2020).

Tropical cyclones bring with them strong winds and heavy precipitation events, triggering secondary hazards such as flooding and landslides. In addition, cyclones can carry with them swarms of locust (Biggar, 2021). All these secondary hazards of storms can have devastating effects on FNS outcomes by destroying crops and killing livestock.

Earthquakes can impact FNS outcomes of people by destroying livelihoods and causing widespread damage to infrastructure and agricultural lands. **Volcanic activity** can destroy crops and agricultural lands as well as livelihoods. Further, **extreme heat** (heat wave) and wildfire events can damage crops and kill livestock, negatively impacting FNS outcomes. Lastly, **landslides**, while being rather localised events, impact FNS

outcomes. Those who are immediately affected by a landslide may lose agricultural lands that are required for crop production.

4.3.3 Man-made hazards: intractable conflict, war, and political economy

Conflict is a main driver of food insecurity, impacts food systems in fundamental ways, and contributes to poor FNS outcomes.

In the Horn of Africa, several countries have seen years and decades of **intractable** conflict - conflicts that are vicious, difficult to resolve, and typically resistant to peaceful resolution (Coleman, 2000). A major attribution of such conflicts is their **protracted** and durable nature (Halperin & Pliskin, 2015). They are further characterized by the formation of a conflictive ethos that enables a society to adapt to the conflict situation, survive the stressful period, and struggle successfully with the adversary (Bar-Tal, 2000). Conflicts in Somalia, Ethiopia, Sudan, and South Sudan are examples of intractable conflicts, where there is a continued risk of conflict (re-) escalating.



Figure 17 Enclosed land in the border region of Ethiopia and Somalia

The Armed Conflict Location and Event Data Project (ACLED) collects and analyses data on conflict events. They differentiate between six event-types: battles, explosions, violence against civilians, riots, protests, and strategic development. The definitions for each event type are provided in their documentation (ACLED, 2022). ACLED allows data until three years in the past; as a result, the analysis is of events which occurred in Ethiopia, Somalia, Kenya, Djibouti, Sudan, and South Sudan between 11.12.2018 and 10.12.2021.

In total, there were 18,222 events. Most conflict events took place in Somalia, between Al Shabaab and the military forces of Somalia. The most common event types were battles, protests (67.27% of which took place in Sudan) and violence against civilians (mostly in South Sudan and Somalia). See Figure 18 and Figure 19.

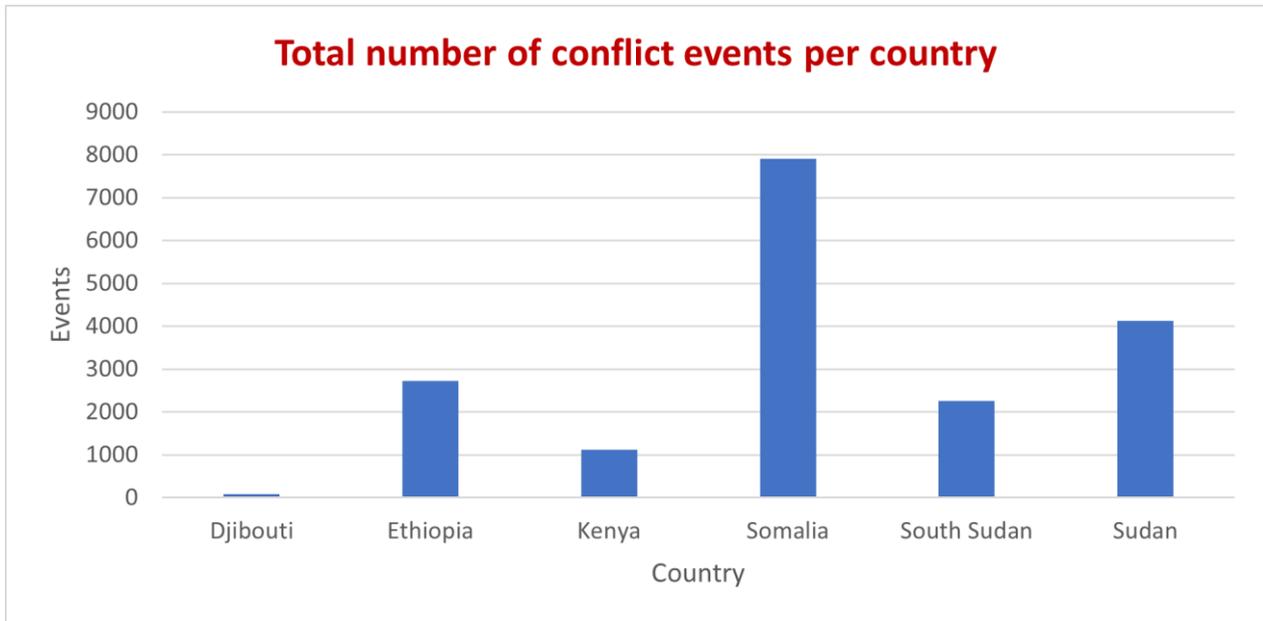


Figure 18 Conflict events per country

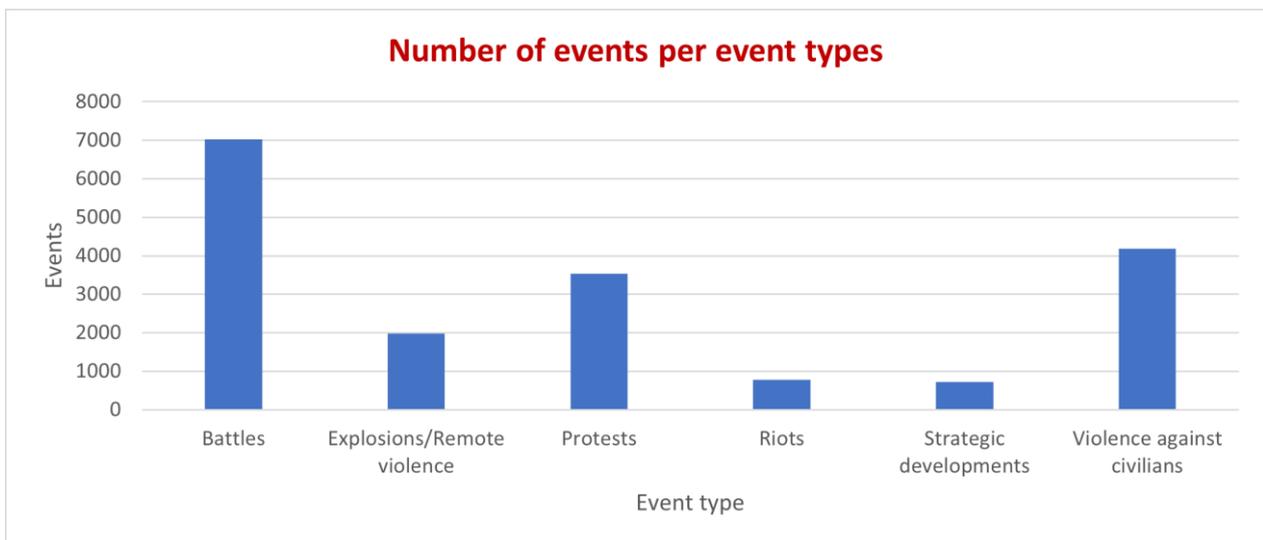


Figure 19 Events per type

4.3.4 Man-made hazard impacts on FNS

It is beyond the scope of this position paper to conduct a full analysis but it can be stated that conflict is an important socio-economic driver that impacts FNS outcomes of people in the region (FAO, et al., 2021). Countries in protracted crises generally show high levels of food insecurity (FAO, IFAD and WFP, 2015).

Further, conflicts can be fuelled by disaster occurrence and where conflict coincides with natural hazards the situation is often dire; for instance, violent conflict exacerbated drought-related food insecurity between 2009 and 2019 in sub-Saharan Africa (Anderson, et al., 2021).

Yet, the opposite can apply too; disaster occurrence can lead to conflict settlement or resolution (Sinulingga, et al., 2020).

Conflict and (civil) war have a direct impact on a country's or region's internal stability and the macro-environment surrounding food systems; so they indirectly influence food system outcomes by influencing the factors and actors in which food system activities take place.

Beyond this, conflict can also have direct impacts on FNS outcomes; for instance, where people lose or are refused access to food or where food availability is limited due to conflict.

Delgado et al. (2021) state that violent conflict impacts food systems and FNS outcomes of people who depend on them and negatively impacts FNS outcomes on the food production side by destroying assets and resources needed for food production, destroying human capital, and increasing risks/diverting resources in the wider operating environment. Further, on the distribution and food sales side, violent conflict impacts negatively on FNS outcomes by disrupting the distribution of food and market links, by reducing availability of goods, by shifting market dynamics, and by changing the institutional market environment (Delgado, et al., 2021).

Of particular concern are situations in which food is used as a weapon of war. UN resolution 2417 addresses this issue, as explained in Chapter 1. In current conflicts in the Horn of Africa it is likely that food is being used as a weapon of war and that the provision of relief goods, including food aid, can be politicised (although there is no current direct evidence of this).

4.3.5 Hazards in the Horn of Africa at a glance

Table 3 Hazards in HoA at a glance (EM-DAT, 2021)

Disaster Type	Group	Sub-Group	Impact on FNS	Numbers 2010-2021
Drought	Natural	Climatological	Direct and severe (loss of harvest and livestock)	Events: 35 Affected: 114 million+ Killed: 20,000+
Conflict	Man-made	-	Indirect, socio-economic impacts	Events: 18,222 Affected: - Killed: 34,695
Floods	Natural	Hydrological	Direct and severe (loss of harvest and livestock)	Events: 160 Affected: 20 million+ Killed: 4700
Insect Infestation	Natural	Biological	Direct and severe (loss of harvest and livestock)	Events: 6 Affected: unknown Killed: unknown
Epidemic	Natural	Biological	Indirect, socio-economic impacts	Events: 98 Affected: 9300+ Killed: 160,000+
Storm	Natural	Meteorological	Direct and severe (loss of harvest and livestock)	Events: 10 Affected: 600,000+ Killed: 285

4.4 Hazards and IPC

When hazards turn into disasters, they often negatively affect FNS outcomes. This is reflected by higher IPC phase levels in affected areas. Figure 20 illustrates how, in Somalia, disaster occurrence seems to coincide with rising IPC phase levels. It contains the time series for acute food insecurity and acute malnutrition (the chronic food insecurity scale is not included as there is currently no data for this on Somalia). For instance, IPC phase levels in Somalia were particularly high in 2017, which was also a year of severe drought.

While it is known that disasters (and in the context of the Horn of Africa in particular, drought and conflict related events) are major drivers of food insecurity and IPC phase levels, there is limited hard data available to calculate correlations or to visualise these interlinkages.

Timeline of the occurrences of acute food insecurity, acute malnutrition, and shocks and stressors, Somalia 2014-2022

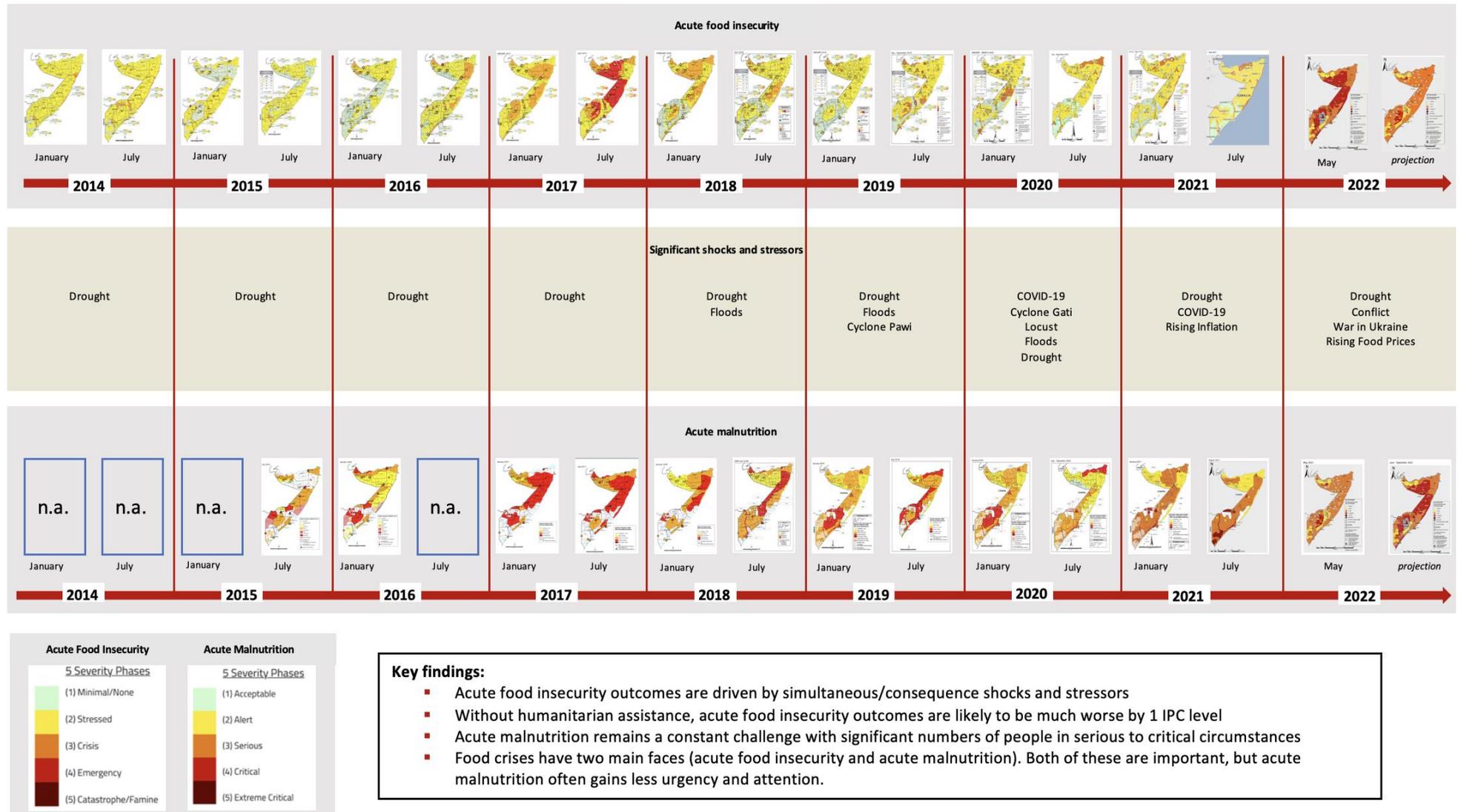


Figure 20 IPC timeline, Somalia. Image by the authors using IPC images and data (IPC, 2022)

4.5 Limitations in assessing natural hazards and conflict

It is generally a challenge to monitor, classify and quantify disasters, their occurrence, frequency, and impacts. While the EM-DAT database is perhaps the most comprehensive overview for hazards to date, there are several limitations to be considered. First, all numbers need to be put in perspective. For instance, there have been a total of 160 floods in the target area from 2000-2021, and only 35 reported droughts; yet droughts (one in particular) have killed by far the most people.

While it is beyond the scope of EM-DAT to clarify such points, this highlights a need to look beyond the data to local context and realities. In addition to having a minimum level of data literacy to correctly interpret EM-DAT data, it is of crucial importance to be familiar with local realities.

In addition, the data itself has its limitations. It is not known how many disastrous events remain unreported and thus are not represented in the EM-DAT dataset. Disastrous events can remain unreported either because there is simply no coverage about an event or because it does not officially match at least one of the four criteria to be classified by EM-DAT as a disaster. This can, for example, be the case if either data is missing (for example 9 people are reported dead, but the true number is higher) or because data is (intentionally or unintentionally) withheld by authorities. In addition, nations are in general hesitant about asking for international assistance or declaring a national state of emergency, which can make a country appear as weak or unable to appropriately respond to a crisis (Carnegie & Dolan, 2020). These are just some of the factors that might lead to underreporting the occurrences of disaster.

It is reasonable to assume that the real numbers of people affected and killed by disasters, as well as the number of events that could be classified as disasters, are significantly higher than reported (Cuthbertson, et al., 2021). In addition, it is questionable how far the criteria for declaration of a state of emergency, or call for international assistance, are suitable for categorizing an event as a disaster.

Assessing conflict is even more challenging than assessing natural hazards. There is no clear definition of what is considered a conflict; and conflict occurs on all levels, from international level to household level. It is just as challenging to identify the type of conflict, or to make a distinction between perpetrator and victim. In addition, while direct consequences of large-scale conflicts (e.g. war or civil war) are often visible (people reported dead or injured in battle), indirect consequences remain unreported, such as trauma impacting people's productivity. It is difficult to correlate food insecurity directly with conflict, especially in situations where the risk landscape is diverse and includes natural hazard occurrences, and/or where socio-economic systems are generally weak. In addition, smaller conflicts such as clan clashes often remain unreported and are not represented in data. Yet, the role of conflict in achieving FNS must not be underestimated, as many of the world's most food-insecure places are in conflict zones.

Other factors that pose challenges in assessing conflict are competing narratives of the conflicting parties. Propaganda and the prevalent ethos of conflict (glorifying the ingroup and demonising the outgroup) further contribute to opacity.

Limitations in assessing natural as well as man-made hazards also indirectly result in limitations in forecasting food insecurity and IPC phase levels, as the risk landscape of a region is inextricably linked to food system outcomes and IPC developments.

4.6 Case study: the 2021/2022 drought and need for more localized data

In March 2022 a field mission was conducted in Sanaag in the north of the self-declared republic of Somaliland. The mission found that despite some regions being severely affected by drought, the region of Sanaag was under 'normal' drought conditions. There were some initial signs of starvation of livestock related to drought conditions, but in-depth interviews with pastoralists revealed that they perceived the drought conditions as not unusual and far from previous droughts such as the one in 2017.

This example highlights the strengths of qualitative local assessments of situations which can take local perceptions into account and potentially challenge the focus on national/regional data which may otherwise lead to some regions being unnecessarily targeted (undermining the credibility of international actors), while some that urgently need aid are left out.

However, when it comes to qualitative local assessments, local perceptions may also reflect the normalisation of situations. For example, a population's prolonged exposure to drought conditions, and their lack of outcry (because it has become the new normal), might lead to local/national leaders and/or humanitarian actors leaving them out of the response conversation.

This example shows just how important it is to have and use a combination of good localised quantitative as well as qualitative data. For instance, it would have been useful for those interviewing the pastoralists to construct a timeline of shocks and stressors together, using the quantitative and qualitative information that each had at their disposal, so that information and perceptions could be shared by both parties. These considerations will be returned to in our upcoming studies.

Data analysis needs to be improved to make real-time, regional information available on where humanitarian assistance is needed the most. The IPC is therefore currently exploring this possibility, for instance integrating regional and national early warning systems for more timely and accurate forecasts of food crises.

In addition, partnerships are being built between universities in the HoA and Europe aiming at addressing data gaps/ building capacity to enable more localised / accurate drought assessment and forecasting.

4.7 Summary

This chapter introduces disaster risk management theory and disaster classification; outlines the HoA risk landscape, including hazards and disasters since 2000; gives the IPC classifications for this data; discusses the limitations of assessment; and gives a case study.

Risk landscape and FNS

- Socio-economic and environmental drivers that contribute to FNS outcomes are influenced by natural and man-made **hazards**.
- **'Risk landscape'** refers to the wide range of risks to which people are exposed.
- **Hazards and disasters:**
- **Natural and man-made hazards** are inextricably linked to developments in FNS outcomes and IPC levels.
- A **hazard** is an event that can potentially cause a disaster.
- A hazard has turned into a **disaster**, if at least one of the following criteria is fulfilled: 10 or more people dead; 100 or more people affected; declaration of a state of emergency; or a call for international assistance (EM-DAT , 2021).
- **Shocks** create significant (media) attention, and **stressors** create complex, and long-lasting protracted humanitarian emergencies, often resulting in high numbers of people affected or killed over a prolonged period (Cornish, 2020). These complex humanitarian emergencies are often protracted crises.

Disasters in HoA

- Frequent disasters in HoA include drought, conflict, floods, locusts and other shocks and stressors, regularly leading to or contributing to food crises.

The impacts of disasters on FNS in the HoA

- These include the destruction of crops, livestock, and other assets; shortage of water; impact on markets; disruption of food system activities; damage to soils and vegetation; and other socio-economic and environmental impacts.

Limitations in assessing the risk landscape

- A minimum level of **data literacy** is needed to correctly interpret EM-DAT data. Lack of such knowledge limits people's ability to anticipate food crises.
- There is a need to look beyond the data, to local context and realities.
- It is not known how many disastrous events remain unreported and thus are not represented.
- Limitations in assessing hazards limits the forecasting of food insecurity, as food system outcomes are inextricably linked to the risk landscape.

5 Using data to assess FNS: descriptive & diagnostic analytics

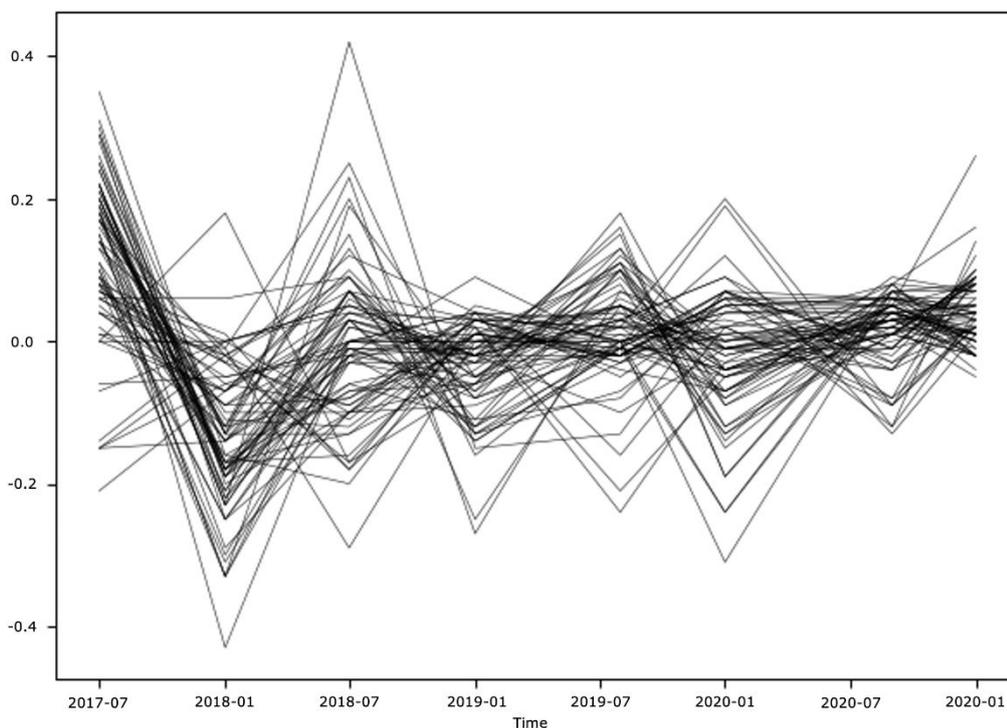


Figure 21 Fraction of population in IPC phase 3 or higher (admin 2 regions) in Somalia over time

Contents of this chapter:

- 5.1 Descriptive analytics
- 5.2 Diagnostic analytics
- 5.3 Summary

This chapter turns from the measurement of IPC data to learning from and assessing these data sets, separated into two distinct types of quantitative analyses based on the Gartner analytics ascendancy model. Following this model, the current chapter covers the first two variants of data analytics; descriptive analytics and diagnostic analytics.

5.1 Descriptive analytics

In general terms, descriptive analytics of IPC and related data aims at answering the question: 'what happened?' or 'what is happening?' Because of this, descriptive analytics can help in assessing the levels of FNS of a region. To assess FNS, any of the indicators mentioned in the previous chapter (or a combination of these) can be used with a food systems approach (Figure 4), or the four dimensions of food security approach (availability, accessibility, utilization, and stability, see Figure 3).

The IPC is widely used for acute food insecurity classification (Tendall, et al., 2015). As a result, the most recently published IPC data is seen as a reliable assessment of the current food security situation in a region, and current IPC phase levels and population tracking data are used for descriptive analytics to answer questions such as: How many people are food insecure, and where are these people located? In addition, historical IPC data can be used to look back at how IPC phase levels developed in the past, and to assess the stability of FNS levels over time.

Descriptive statistics such as the ones presented in the IPC population tracking tool or mapping tool (see Figure 7, page 35), are useful starting points for understanding the FNS situation in a region. They may help humanitarian organizations and governments to monitor local food security levels, and to understand the extent of food insecurity problems. This in turn helps organizations such as the World Food Programme to estimate how many people are likely to need immediate food assistance. Within the IPC population tracker and mapping tool, many organizations focus predominantly on numbers of populations in IPC Phase 3 ('Crisis'), 4 ('Emergency') or 5 ('Catastrophe/Famine'). The information collected on populations in IPC Phase 1 ('no/minimal food insecurity') and IPC Phase 2 ('Stressed') is often excluded from these descriptive analyses. For example, in the UN humanitarian needs overview on Somalia, these numbers are excluded explicitly, stating that although people in IPC Phase 2 should be approached with tailored resilience-building programmes, they should not be included in the humanitarian needs assessment (OCHA, 2021).

To get a full understanding of what is truly happening it is worth going beyond phase classification. Looking at the population tracking data, for example, may also help understand the stability of regions. As an example, Xudun and Taleex, both in the Sool region in Somaliland, went through identical overall IPC phases between 2017 and 2021. When looking at the IPC data in more detail, however, important differences appear. For example, the population percentages in each IPC phase in Xudun were much more variable than those of Taleex. The percentage of population in IPC Phase 1 in Xudun, moved from 46% in January 2017, down to 26% in July 2017, and back to 46% by 2018, whereas percentages in Taleex stayed stable. Similarly, the number of people in IPC Phase 3 and higher also differed, as can be seen Figure 22. Detailed descriptive analytics help uncover these particularities to give a more accurate answer to the question of 'what happened.'

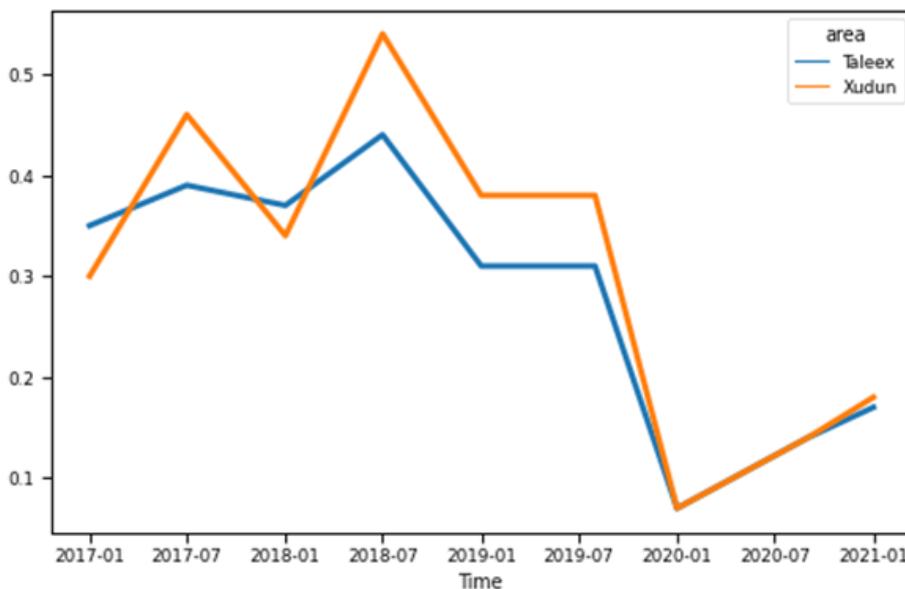


Figure 22 Fraction of population in IPC phase 3+ in Xudun and Taleex, Sool Region, Somalia (source: authors)

Visualizing the data also helps to get a quick overview of the situation, thereby improving the value of descriptive analytics. In Figure 23 below, the percentage of population in IPC Phase 3 or higher is plotted for each Admin 2 region in Somalia between 2017 and 2021. The visualization shows the distinct patterns for each of the regions, as well more global patterns such as the increase in food insecurity in the summer of 2017.

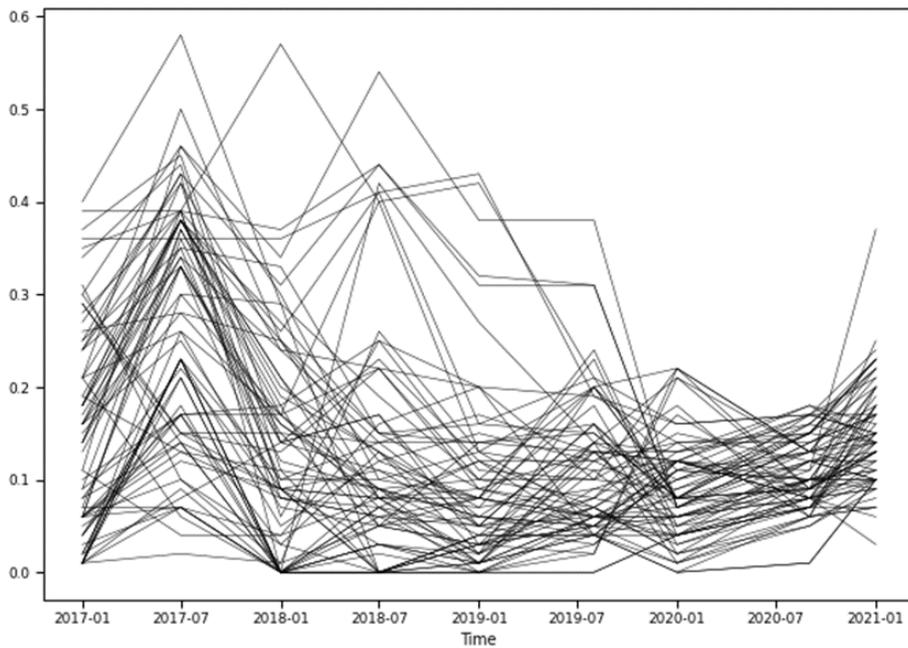


Figure 23 Fraction of population in IPC phase 3 or higher (admin 2 regions) in Somalia over time (source: authors)

Because the full IPC assessment is carried out twice a year, there are relatively few data points to formally calculate trends or patterns of seasonality. It is possible however to **difference** the data. This means that the previous observations of a variable are subtracted from a current observation, thus stabilizing the mean of a time series, and eliminating (or reducing) trend and seasonality. A visualization of the differenced time series can be found in Figure 24. This shows a different, and perhaps 'cleaner,' overview of recent shocks and stressors than the plots in Figure 23. It shows more clearly that there is a general trend in the development of FNS across the country of Somalia. In follow-up by Zero Hunger Lab, (van Wanrooij, forthcoming) this trend is linked to shock and stressors that occurred during the period 2017-2021. Separating the impact of these shocks and the general trend in FNS is crucial to come up with accurate forecasts *ceteris paribus*. These forecasts can then be used to initiate (localized) programmes in the regions that are expected to see the highest levels of food insecurity.

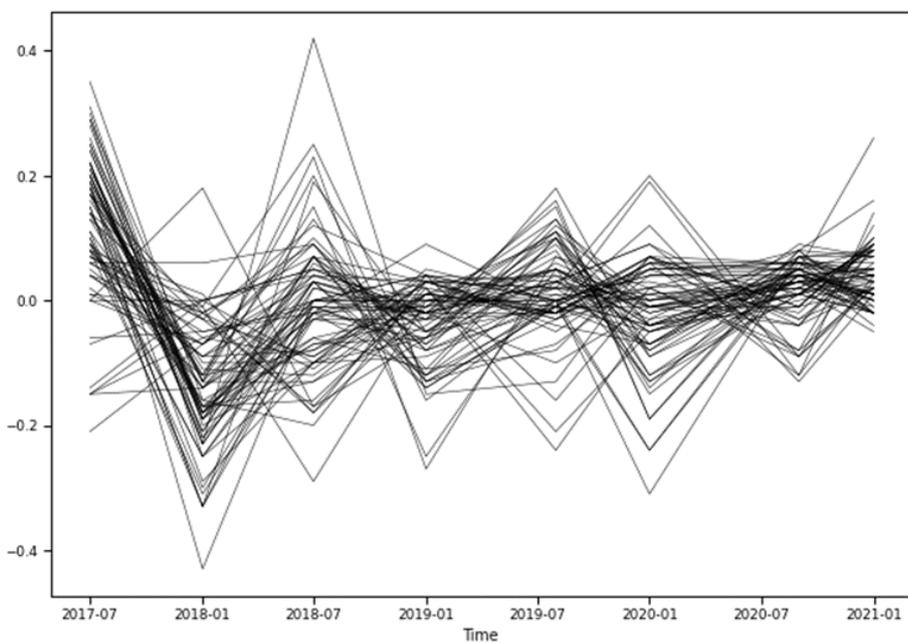


Figure 24 Difference in fractions of population in IPC Phase 3 or higher

5.2 Diagnostic analytics

In diagnostic analytics, the aim is to answer the more challenging question of 'why did it happen?' Here, the outputs of descriptive analytics are investigated to see why food security levels developed the way they did. Doing so aims at finding patterns within IPC data or related datasets. Potentially correlated variables can be found in datasets on environmental conditions, conflict and other shocks or stressors, and/or economic indicators. These have been described in detail in 4.

Understanding the relationships and interplay between various parts of food systems and shocks and stressors on FNS levels is of great importance for optimizing humanitarian programmes, but the relationships may differ for different food systems or regions and may also change over time. When organizations are more aware of these complex relationships, a more accurate assessment of the FNS situation can be made. For example, if it is known from data analysis that a specific land ownership policy has a proven (i.e. statistically significant) negative influence on food security, one can more confidently advocate for change.

It is important to realize that there are many factors that cannot be influenced. It is generally recognized that environmental disasters such as persistent floods and droughts have a negative impact on food security levels, but it is often not possible to prevent those environmental phenomena from happening. Being aware of both the probability of a hazard occurring and the relationship between hazards and food security can help to better mitigate and prepare for the impacts of a hazard and minimize the risk of a disaster.

Data science techniques can help create an understanding of these complex relationships and patterns. Importantly, many of the predictive and prescriptive analytics described later in this paper are built around the idea that patterns and relationships are detected. These patterns are then used to create predictions. In this section, several ways to detect these patterns are described. While doing so, there is a distinction between analyses of the IPC data as a standalone dataset, and analyses of the IPC data in relation to other datasets.

5.2.1 Diagnosing IPC data

Looking at the IPC data itself, one can first focus on extracting spatial and temporal patterns. Because the IPC acute food insecurity analysis is done only twice a year, a full time series decomposition to extract trend and seasonality is not possible. However, lag values can for example be calculated and checked for patterns of autocorrelation. Further, these lag values can be used to calculate transition probabilities. For example, when a region is classified as IPC Phase 3, what is the probability it will move to IPC Phase 4? A small case study on admin 2 level IPC phases in Somalia shows, for example, that regions rarely move from IPC Phase 2 directly to IPC Phase 4. However, regions who are in a state of emergency (IPC Phase 4), are more likely to transition back directly to IPC Phase 2 rather than IPC Phase 3. The follow-up research to this report will dive deeper into this type of insights.

Spatial patterns are equally interesting, since they might provide insights into how regions are dependent on each other or have food systems with similar characteristics. One way to understand spatial patterns is by looking at the correlation of IPC phases with IPC phases in other districts. The outcome is a Pearson's R correlation score (a score between -1 and 1). The further away this value is from 0, the larger the relationship between two districts. In Figure 25, the Pearson R correlation scores of the percentage of population in IPC Phase 3 or higher is plotted, for four different admin 2 regions in Somalia. The yellow pins in the visualizations indicate the admin 2 region at the centre of the analysis. The colour of the regions indicates how much IPC phases in those districts are correlated with the IPC phases of the region with the yellow pin. Regions which are close to each other often display similar IPC classification patterns; this can be used to construct overall 'risk profiles' of certain geographical clusters of regions.

Pearson R correlation scores of IPC 3+ percentages for Admin 2 levels (no lags)

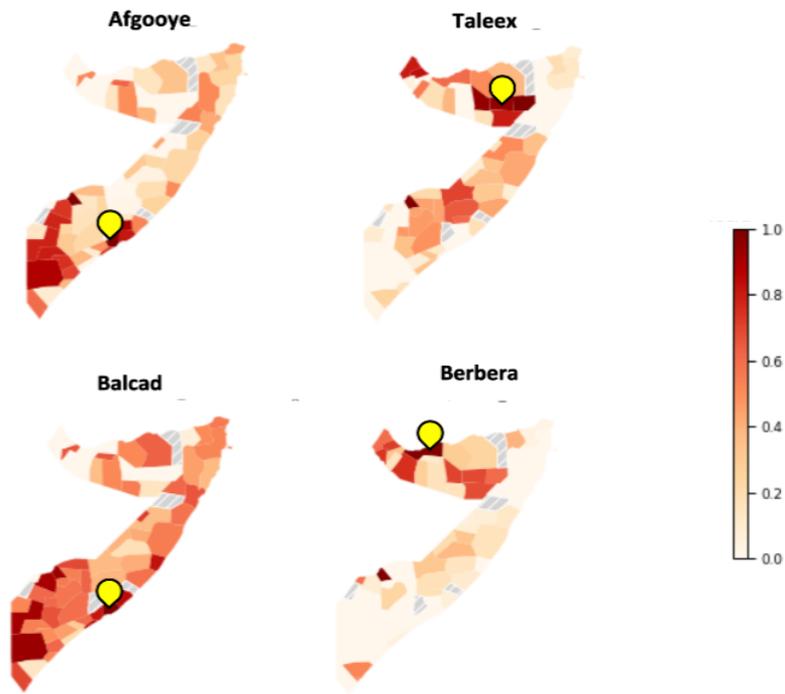


Figure 25 The role of proximity in explaining correlations between spatial patterns of food insecurity levels across regions in Somalia (yellow pins represent four reference regions) (source: authors)

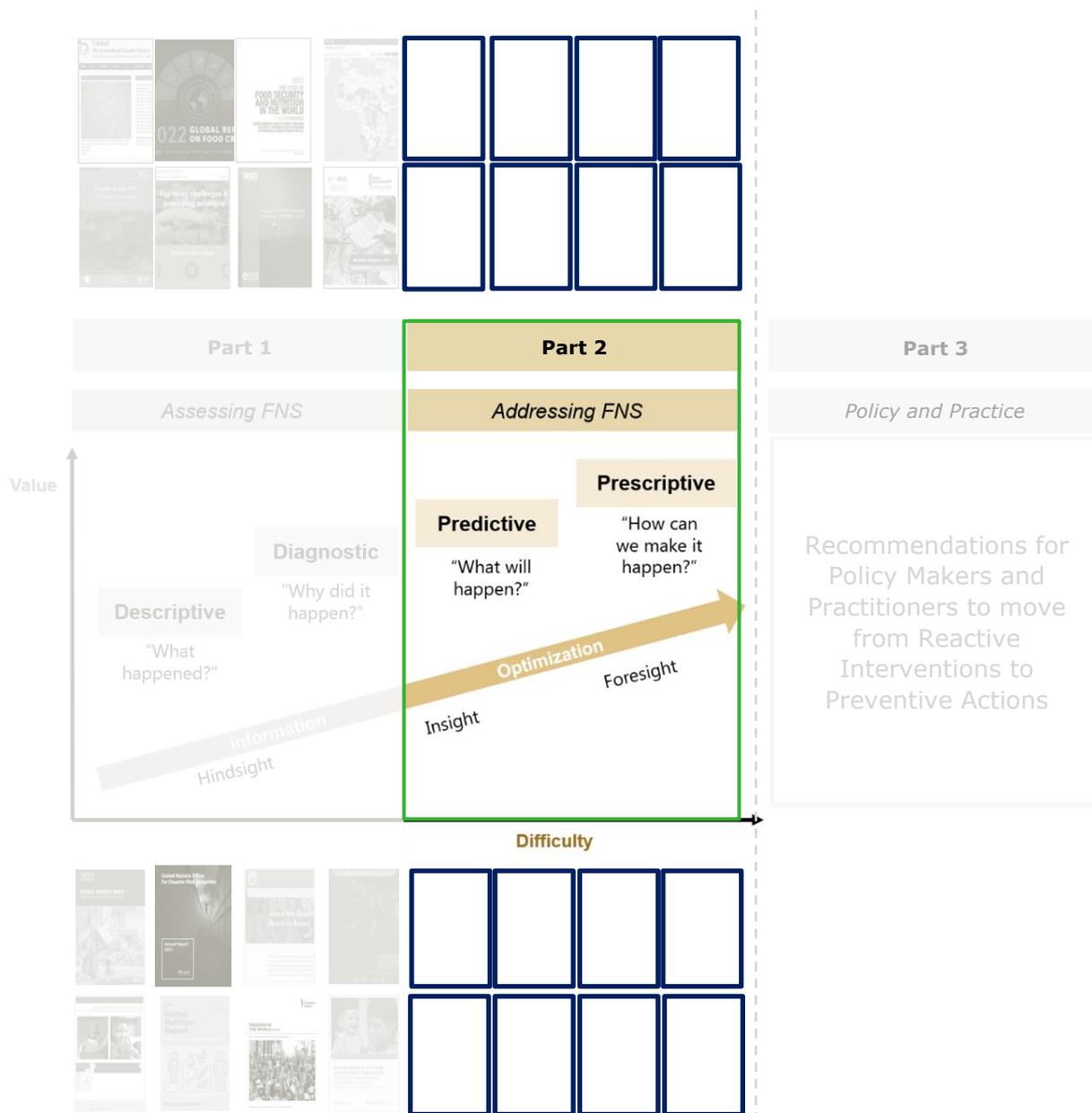
5.2.2 Diagnosing other related datasets

Further, IPC data can be connected to other datasets to find relations between food security, as captured by the IPC, and shocks / stressors. Extensive research has already been done on the drivers of food security and the interaction between economics, climate, agricultural production, and food security. A large part of this research focuses on one specific food security indicator as an outcome variable. For example, Allee et al. (2021) present contributing factors to the 2019 Global Food Security Index (GFSI) and the Food Insecurity Experience Scale (FIES) (Allee, Vaze, & Lynd, 2021), while others focus on factors impacting child malnutrition (Brown, et al., 2020). In addition, there has been research linking drivers of food insecurity directly to IPC phases, often in the light of the development of early warning systems. This will be discussed in more detail in Chapter 7.8.

5.3 Summary

This chapter has discussed how descriptive and diagnostic analytics can be used to assess the FNS in a region. Descriptive analytics can be used to study what has happened in the past, ideally for both the final IPC phase and its underlying indicators. Diagnostic analytics can then be used to assess *why* things happened; here, attention is paid to underlying relationships between different drivers of food insecurity and the IPC phase, and the spatial and temporal patterns detected in the IPC phases.

PART II: ADDRESSING FNS



Part 2 (addressing FNS) starts with Chapter 6, explaining the importance of livelihoods, coping strategies and resilience when designing programmes. Chapter 7 discusses programming, especially the differences between reactive interventions and preventive actions. Most HoA interventions are reactive; but preventive actions not only reduce food insecurity levels but are also more economical. Chapter 8, therefore, elaborates on the use of data in designing these preventive actions.

6 Livelihoods, coping, and resilience



Figure 26 Pastoralist tent in Turka, Sanaag, Somaliland

Contents of this chapter:

6.1 Livelihood strategies

6.2 Coping strategies

6.3 Resilience capacities

6.4 Livelihoods, coping and resilience at a glance

6.5 Case study: the importance of integrating quantitative and qualitative approaches

6.6 Summary

This chapter introduces three different concepts which, given certain risk levels, influence peoples' FNS outcomes in the Horn of Africa: livelihood strategies, coping strategies and resilience capacities.

Looking at coping strategies and resilience capacities of people in the Horn of Africa is of relevance as they can have an influence on people's FNS; in addition (outlined in the next chapter), it is important not to undermine existing resilience capacities when designing programmes, to avoid further worsening the situation.

'To understand disasters we must not only know about the types of hazards that might affect people, but also the different levels of vulnerability of different groups of people. This vulnerability is determined by social systems and power, not by natural forces. Vulnerability needs to be understood in the context of political and economic systems that operate on national and even international scales, influencing the health, income, building safety, location of work and home of groups of people'
(Wisner, et al., 2004)

Resilience has become a central theme in assessing FNS in protracted crises. This is reflected by a novel approach of assessing 'food system resilience,' by which drawing connections between FNS and resilience allows the identification and addressing of the root causes of food insecurity and therefore allows programmes to improve links between relief and development. However, it is necessary to be aware of the power relations and dynamics between the various actors involved.

6.1 Livelihood strategies

Livelihood strategies, according to the UK Department for International Development (DFID), are

'the range and combination of activities and choices that people make to achieve their livelihood goals.'

Livelihood strategies include:

- *How people combine their income generating activities;*
- *The way in which they use their assets;*
- *Which assets they choose to invest in*
- *How they manage to preserve existing assets and income.*

Livelihoods are diverse at every level, for example, members of a household may live and work in different places engaging in various activities, either temporarily or permanently. Individuals themselves may rely on a range of different income-generating activities at the same time' (DFID, 2001).

In short, livelihood strategies are the actions taken by people to make ends meet.

For most people living in the Horn of Africa, pastoralism is a key livelihood, especially in the drylands of northern Kenya, southern Ethiopia, and southern and central Somalia (IDMC & NRC, 2014). Here, agriculture and other livelihoods are often not a viable livelihood option.

Pastoralism, by definition, is highly dependent on livestock for socio-economic purposes in environments with dynamic, non-equilibrium ecologies. (Scoones, 1994) As a result the numbers of both animals and pastoralists are constantly fluctuating because of variations in rainfall and access to fodder and water. Thus pastoralism requires strategic mobility to maintain access to pastures or sources of water (IDMC & NRC, 2014).

Food insecurity, as reflected in high IPC levels, poses a direct threat to people's FNS situation, as well as to their health, lives, and livelihoods. In times of food crisis, people's resilience capacities are under pressure; high levels of food insecurity can have a direct impact on people's livelihoods. For instance, in regions of the Horn where large percentages of people engage in traditional pastoralism, times of food insecurity can motivate or force people to sell their livestock and to settle, pursuing alternative (often agro pastoralist) livelihoods. This process of livelihood transformation comes with opportunities and risks, and the outcomes are different, depending on individual circumstances. Yet research has shown that with more pastoralists settling there is an increase in violent conflict over natural resources and access to water and pastures

between those who gave up on pastoralism and those who still engage in traditional pastoralism (Lwanga-Ntale & Owino, 2020). Where livelihood strategies are under pressure, FNS is at risk; so protecting livelihoods and assets of people is a key leverage point in addressing FNS.

6.2 Coping strategies

Coping, in a broad sense, refers to actions performed by individuals and households to solve issues that are perceived as problematic (Nabulsi, et al., 2020), (Snel & Staring, 2001). In other words, a coping strategy is a short-term response to shocks such as abnormal declines in access to food (Davies, 1993). More specifically, in the context of FNS, coping refers to actions that include food and non-food related mechanisms to overcome food shortages and economic constraints (Ibrahim, et al., 2019). Some examples of coping strategies to overcome food crises in the Horn of Africa can be found in Box 2 below. Thus, coping strategies in the context of this position paper refer to strategies adopted by people in times of disaster to meet their dietary needs and to ensure FNS (FAO, 2005). This adoption of strategies to cope with the impacts of a disaster is what sets coping strategies apart from livelihood strategies that are adopted in normal times.

There are various strategies that can be adopted, some of which are sustainable and some of which are unsustainable. Coping strategies may include a reduction in meals consumed per day, a (temporary) change of livelihood strategies, or a partial sale of livestock to generate additional income for the purchase of food items.

The following provides some examples of coping strategies that might be adopted by people affected by food crisis in the Horn of Africa. Some of these strategies might be regarded as resilience capacities, depending on individual circumstances and context.

Box 2 Examples of coping strategies

Examples of coping strategies in food crises in HoA

- migration (seasonal/ temporary/ permanent)
- relying on aid/ assistance
- receiving remittances (from urban areas/ diaspora)
- changing livelihood (e.g. from pastoralism to agro-pastoralism, engaging in charcoal cutting)
- communal sharing of resources
- destocking (partial sale of livestock)
- limiting dietary intake
- crop diversification
- herd diversification
- overgrazing of pastures

Coping strategies have direct and indirect impacts on food systems. For instance, In the case of pastoralists, the coping strategy of destocking directly impacts pastoralists' ability to purchase food. In time of crises, pastoralists might opt to destock livestock, meaning to sell parts of their herd. This serves two purposes: firstly, additional income is being generated to enable pastoralists to buy food items in times of crises and secondly, the herd size is reduced, in turn increasing the ability of the remaining herd to survive by reducing competition for scarce natural resources. Similarly, the sharing of resources between community members can ensure that FNS outcomes of the whole community remain on a relatively stable level.

6.3 Resilience capacities

Although the concept of resilience receives more and more attention (Béné, et al., 2012), there is no consensus on its definition. In terms of disaster resilience, one definition of resilience is people's ability to '(1) anticipate, minimize, and absorb potential stresses or destructive forces through adaptation or

resistance; (2) to manage or maintain certain basic functions and structures during disastrous events and (3) to recover or 'bounce back' after an event' (Twigg, 2009).

There have been attempts to define resilience in the context of food systems. Tendall et al. (2015) proposes the following definition for food system resilience: Food system resilience is the 'capacity over time of a food system and its units at multiple levels to provide sufficient, appropriate and accessible food to all, in the face of various and even unforeseen disturbances.' Wageningen Center for Development Innovation (WCDI) has proposed another definition of food system resilience: 'The concept of food system resilience analyses how system components and their actors (from producer, middleman, traders, consumers etc.), are affected by – and respond to shocks and stressors, accounting for ripple effects across the food system, providing insights into varying existing and required resilience capacities and strategies which enable system actors and components to mitigate, prepare for and recover from negative impacts ensuring desired, (improved) socio-economic, environmental and food and nutrition security outcomes' (WCDI, 2021).

In addressing FNS effectively, a major challenge remains in identifying and strengthening resilience capacities of people. In addition, the line between what is considered a resilience capacity and what is negative coping is sometimes blurry. It always depends on local context and individual circumstances. What is a resilience capacity for one person/ household might be negative coping for another; it is challenging if not even impossible to define or distinguish 'good' vs 'bad' coping strategies, as such evaluation is always context-sensitive (van der Hallen, et al., 2020).

Being aware of people's or target communities' resilience capacities requires involving people throughout the process, from designing to implementing programmes. In other words, it requires moving away from a top-down approach towards a bottom-up approach, in which local communities are consulted and where ownership is created by involving people in decision-making.



Figure 27 Improving food system resilience through beekeeping (livelihood diversification), promoting irrigation for agriculture, and communal fodder storage

As this approach (referred to by some organisations and actors as community-managed disaster risk management) is rather lengthy and costly, it is not feasible in cases where immediate action is required. Yet, in cases of anticipatory planning and programming, a community-managed approach to addressing FNS, as reflected in IPC developments, can be effective and address the structural root causes (e.g. socio-economic drivers) of food insecurity and high IPC phases by strengthening the resilience capacities of those frequently affected by food crises.

6.4 Livelihoods, coping, and resilience at a glance

Table 4 provides an overview of the similarities and differences between the concepts of livelihoods, coping and resilience. It shows how the different concepts vary in terms of their aims, their presence or absence, different categorisations, how they may change over time, the levels on which they are measured, and how they relate to FNS.

Table 4 *Livelihoods, coping, and resilience at a glance*

	Livelihood strategies	Coping strategies	Resilience capacities
Aim	Generate income / make a living / meet needs through production, trade, or income generation	Protect livelihoods / overcome or deal with pressure on livelihood to cover basic needs	Reduce vulnerability / stabilize livelihoods
Presence	Always	When faced with shocks and stressors	Always
Categories/ Types	Sustainable / unsustainable	Positive / negative	Absorptive, adaptive, transformative
Changes	Can change over time	Can change over time	Can change over time
Level	Individual / household	Individual / household	Individual / household / community
Relation to FNS	How to produce food / trade produce/service against food or generate income to purchase food	How to ensure food is available and accessible when livelihood strategy is disrupted by disaster	How to minimize disruption by a hazard

6.5 Case study: the importance of integrating quantitative and qualitative approaches

In 2014, the **Internal Displacement and Monitoring Center (IDMC) and Climate Interactive** developed a data-driven simulator to improve understanding of how drought combined with other factors influences the livelihood and displacement of pastoralists (IDMC & NRC, 2014). While this simulator was designed as a tool to anticipate displacement rather than food crises, the findings have been used for a case study in this position paper, as both displacement and food insecurity are often driven by disaster as well as by underlying socio-economic and environmental factors.

The tool was created because there was 'emerging awareness of the need to see disasters as primarily social, rather than natural, phenomena. Individuals and societies can act and take decisions to reduce the likelihood of disasters occurring or, at the very least, to reduce their impacts and the levels of loss and damage associated with them. Disasters are thus no longer being perceived as 'acts of God' but instead as something over which humans exert influence.

*Disasters are no longer being perceived as 'acts of God' but instead as something over which **humans exert influence**. This reconceptualization of disasters signifies a shift from a retrospective, post-disaster approach to an **anticipatory** way of thinking about and confronting disasters. Without the ability to **measure** disaster risk it is not possible to know if it has been reduced.*

'This reconceptualization of disasters signifies a shift from a retrospective, post-disaster approach to an anticipatory way of thinking about and confronting disasters. This conceptual development dates from the UN International Decade of Natural Disaster Reduction in the 1990s and is reflected in the 2005 Hyogo Framework for Action (HFA), a ten-year plan endorsed by the United Nations General Assembly which aims to reduce the risk of disasters globally. One important outcome of the HFA process is awareness that without ability to measure disaster risk it is not possible to know if it has been reduced.'

The authors of the tool gave the example of displacement:

'a disaster impact that is largely determined by the underlying vulnerability of people to shocks or stresses that compel them to leave their homes and livelihoods just to survive. The number of people displaced is, of course, related to the magnitude and frequency of extreme hazard events or processes. The most significant risk factors are those that leave exposed and vulnerable communities without the means to be resilient in the face of such hazards.'

*The most significant risk factors are those that leave exposed and vulnerable communities without the means to be **resilient** in the face of such hazards. it is important to stress that social science/ field testing is effective in exploring the weighting of socio-economic and environmental drivers of food systems. (IDMC & NRC, 2014)*

And explained their approach:

'Informed by this anticipatory way of thinking about disasters, the approach used in this study departs from most existing analyses by examining the myriad climatic, natural, and human factors that lead to a displacement outcome. Thus, while the efforts of many governments and other actors continue to emphasise post-disaster and post-displacement response and recovery, the following analysis is based on a holistic, systemic conceptualisation of displacement that attempts to provide entry points for humanitarian and protection actors while at the same time presenting information aimed at those responsible for policies around drought risk reduction and risk management and rural development' (IDMC & NRC, 2014).

As a result, they developed a **Pastoralist Livelihood and Displacement System**, which demonstrated the potential to estimate drought-induced displacement comparable with available empirical evidence.

In their findings, the IDMC report authors stressed that a data-driven approach (system dynamics models) can help to account for many climatic, environmental, and human factors that directly or indirectly influence displacement. They also showed that drought-induced displacement is shaped by numerous human-related factors (such as the amount of grazing land, pastoralists' ability to access it, herd sizes and composition, livestock marketing strategies, remittance flows, market prices and the scale and type of humanitarian programmes). These human factors are also main variables in determining food security levels in the Horn of Africa. The importance of such human factors was further highlighted by their findings that people can be displaced by drought even when the actual rainfall is close to the historical average; that many reports on the impacts of drought in the region appear anecdotal; and that there is a lack of historical and current data on the number of pastoralists and the sizes of their herds; all of which complicates understanding of past and future displacement trends in the Horn of Africa (IDMC & NRC, 2014).

To successfully address food crises because of disaster, there is a need to move from a post-disaster approach to an anticipatory way of thinking about addressing food crises. Livelihood activities, coping strategies and resilience capacities as well as overall demographic and socio-economic developments in any given place must be considered. (IDMC & NRC, 2014)

The IDMC/NRC findings show that there is a need for a reconceptualization of disasters more generally, shifting from a retrospective, post-disaster approach to an anticipatory way of thinking about confronting disasters that cause or contribute to food crises. This means that we need to move to a data-driven approach to anticipating disaster and food crises, while recognising that this sometimes falls short in capturing the socio-economic context. To counter this, the report recommends social science/field testing in the future, to explore the relative weighting of drivers of displacement in different locales; similarly, the use of social science/field testing to exploring the weighting of socio-economic and environmental drivers of food systems.

If it is accepted that people can exert influence over the impact of a hazard and reduce its impact and its associated loss and damage, this implies that the presence – or absence – of coping strategies and resilience capacities influences the extent to which people can prepare for or mitigate the impact of disaster. Similarly, the chosen livelihood strategy might either underpin or undermine disaster preparedness and mitigation.

To summarize; to successfully address food crises there is a need to move from a post-disaster approach to an anticipatory way of thinking about addressing food crises. Yet, at the same time it is necessary to be aware of the human components of disaster and that human activities are significant factors contributing to the impact of a disaster. Thus, livelihood activities, coping strategies and resilience capacities as well as overall demographic and socio-economic developments in any given place must be considered; that is, a more social science / qualitative approach, contributing to a data-driven approach, is needed. To address food crises effectively, there is a need to integrate quantitative, data-driven, and qualitative approaches.



Figure 28 *A community discussion*

6.6 Summary

This chapter introduces livelihood strategies, coping strategies and resilience capacities in the context of FNS in HoA and gives a case study that shows the importance of better integration of quantitative and qualitative approaches when considering these.

- **Livelihood strategies, coping strategies and resilience capacities** influence FNS outcomes.
- Resilience and thinking in terms of systems have become a central theme in assessing FNS in protracted crises.
- Drawing connections between FNS and resilience allows us to identify and address root causes of food insecurity and therefore improve links between relief, development, and peacebuilding
- **Livelihood strategies** refers to the range and combination of activities and choices that people make to achieve their livelihood goals.
- For most people living in the Horn of Africa, pastoralism is a key livelihood.
- Food insecurity, as reflected in high IPC levels, poses a direct threat to people's FNS situation, as well as to their health, lives, and livelihoods.
- Protecting people's livelihoods and assets is a key leverage point in addressing FNS.
- **Coping strategies** are short-term responses to shocks such as abnormal declines in access to food.
- **Resilience capacities** refer to long-term coping strategies (Peng, et al., 2018); that is, resilience capacities are sustainable coping strategies.
- To address FNS effectively, **identifying and strengthening people's resilience capacities** remains a major challenge.
- Being aware of peoples or beneficiaries' resilience capacities requires **involving people** throughout the process, from designing to implementing programmes.
- To successfully address the disaster of a food crisis stemming from a hazard, there is a need to **move from a post-disaster approach to an anticipatory way of thinking about addressing food crises.**
- Livelihood activities, coping strategies and resilience capacities, as well as overall demographic and socio-economic developments in any given place, must be considered when addressing FNS.
- Humans can exert influence over the impact of a disaster and reduce the impact and associated loss and damage. This means that the presence – or absence – of coping strategies and resilience capacities influences the extent to which people can prepare for or mitigate the impact of disaster.
- Thus we need a social science / qualitative approach contributing to a data-driven approach. To address food crises effectively, there is a need to integrate quantitative, data-driven, and qualitative approaches.

7 Programming for improved FNS outcomes



Figure 29 A UN convoy entering a village in rural Somaliland

Contents of this chapter:

- 7.1 Types of programming
- 7.2 Aid architecture
- 7.3 Addressing FNS: from reactive intervention to preventive action
- 7.4 The effectiveness of programming in disaster and conflict situations
- 7.5 Media attention and reactive interventions
- 7.6 Challenges to taking preventive actions
- 7.7 The need for a paradigm shift from reaction to foresight when programming for improved FNS outcomes
- 7.8 Summary

This chapter gives an overview of programmes addressing FNS deterioration; discusses disadvantages and challenges to current programmes; and emphasizes the importance of designing programmes in a way that does not undermine existing local coping strategies and strengthening people’s resilience capacities and their ability to anticipate and respond to future food crises.

Ideally, programmes are evidence-based. Using a data-driven approach to understand past food crises better and to forecast future food crises can assist in designing preventive actions that contextually address root causes of food insecurity.

7.1 Types of programming

Programmes are actions taken by various actors to address food and nutrition insecurity. There is a wide range of programming implemented by governmental and non-governmental actors on different levels. Programming can be divided into reactive interventions and preventive action. This chapter aims to provide an overview of the different types of programming and to provide a rationale for the importance of moving towards preventive action, as has been outlined in part I of this position paper.

One can further make a distinction between *humanitarian assistance* (relief) and *development cooperation* as different types of aid and programmes and the interest in peacebuilding applying a Humanitarian-Development-Peace (HDP) nexus approach, as outlined in the following sections.

7.1.1 Humanitarian assistance

Humanitarian assistance is typically provided by individual states, international organisations and NGOs and it is by far the largest category of responding to acute human suffering in contexts of extreme fragility (OECD, 2018). At its core it strives to follow the humanitarian principles of impartiality, neutrality, humanity, and independence, and includes activities such as the distribution of food, water and animal fodder, provision of shelter, and medical assistance (Barnett & Weiss, 2008).

But there are problems in practice. Humanitarian assistance has often lost its neutral character due to the emergence of 'new' civil wars, leading to aid becoming increasingly politicized (Duffield, 2005), especially in contexts of protracted crises (Jansen, 2018), highlighting that strategic considerations of donating countries are sometimes more important than humanitarian principles (Alesina & Dollar, 2000). Humanitarian assistance is in principle short-term, but in protracted food crises humanitarian assistance risks becoming a permanent feature.

7.1.2 Development cooperation

Development cooperation (formerly development aid) is long-term, aiming at systematic change, often with the overarching goal to address and alleviate poverty in low to middle-income countries (Minoiu & Reddy, 2009). In the context of FNS, the objective of development cooperation is to address the root causes of food security in developing countries, for example by contributing to food systems transformation for improved FNS.

7.1.3 Peacebuilding and the HDP nexus

The debate on comprehensive approaches in complex and protracted crisis has renewed interest in the humanitarian-development-peace (HDP) nexus,⁷ highlighting interest in the peace pillar as an integral part of programming. This is highly relevant to FNS as food and nutrition insecurity can be both cause and consequence of civil conflict; food and nutrition insecurity are becoming increasingly concentrated in conflict-affected countries, affecting millions of people.⁸

Causal and substantive links exist between food security and violent conflict, spanning from individual up to global levels.⁹ However there is little (though fortunately increasing) agreement on how to go about peace in the HDP nexus approach. For humanitarian and civil society organisations, the peace dimension often consists of what is called "small p": the promotion of societal peace and social cohesion through conflict-sensitive project activities. Actors that are primarily concerned with security aspects and the "big P" (high-level political dialogues, diplomatic initiatives, or peace operations) hardly feature in the HDP nexus approach.¹⁰

⁷ The Humanitarian-Development-Peace (HDP) nexus emerged from a World Humanitarian Summit initiative to better link humanitarian aid and development cooperation through a New Way of Working.

⁸ https://www.ifpri.org/sites/default/files/gfpr/2015/feature_3086.html

⁹ <https://www.sciencedirect.com/science/article/abs/pii/S0305750X18302407>

¹⁰ <https://reliefweb.int/report/world/give-p-chance-peacebuilding-peace-operations-and-hdp-nexus>

Policies and programmes that build resilience in food security have the power to limit the breadth and depth of conflict and violence and strengthen national and local level governance systems and institutions for improved food and nutrition outcomes. The strong interest in food systems resilience provides a potential avenue to operationalize the HDP nexus in protracted crisis contexts.

7.2 Aid architecture

Who provides aid to whom, and in what form, is always context specific. The institutional framework and practices of channelling and distributing aid is sometimes referred to as 'aid architecture' (Roesdahl & Varughese, 2017). Most funds come from contributions of governments to multilateral organisations such as the UN or World Bank; only about 3% goes directly (*bilateral aid*) to governments of countries receiving aid (OECD, 2021). This highlights the importance of promoting the localisation agenda. In this respect it means channelling funds directly to recipient countries to change the way in which the humanitarian system operates, by enabling more locally led responses. However, to ensure that funds are being used effectively, it is important that stable organisational structures are in place in recipient countries.

Programming of all kinds are usually carried out by the implementing partners of multilateral organisations. *Preventive actions* are usually done by (I)NGOs, community-based organizations (CBOs), government agencies, and private sector companies. *Reactive interventions* are usually done through UN institutions directly (WFP, FAO), often supported by the aforementioned actors. In some cases (with *humanitarian intervention*, exclusively) militaries play a role. *Humanitarian assistance* usually happens upon request, with the consent of and in coordination with the national government of the country concerned. In cases of *development cooperation*, it is often multilateral or national donors who set the thematic scope of an intervention, which is then implemented by implementing partners, such as NGOs, CBOs, or private sector actors.

7.3 Addressing FNS: from reactive intervention to preventive action

It is important to distinguish between reactive interventions that aim at improving low FNS levels, and preventive actions that prevent FNS levels from reducing.

7.3.1 Reactive interventions

Most FNS programmes in protracted crisis contexts are reactive, addressing consequences rather than root causes. For example, when IPC scores go up, especially when they reach level 3 or higher, the humanitarian system commonly responds to it by providing interventions in the form of humanitarian assistance. These reactive interventions are important and effective in alleviating acute malnutrition and suffering, but they are not sustainable and do not address root causes of food insecurity. In addition, they might cause harm in the long run, for example by creating aid dependencies (Lensing & White, 1999; Darden, 2019). Food aid can also have unintended negative impacts, such as the destruction of local markets (Habte & Mielke, 2005). This appears to be the case especially in situations where food aid is used by donor countries as an indirect form of export dumping (FAO, 2006).

7.3.2 Preventive actions

Ideally, programmes should be preventive, addressing food crises before they occur or possibly preventing a crisis from happening. They are usually more complex and aim at addressing the root causes of food insecurity that are often hidden beneath the surface and are often of a structural nature.

Preventive actions sometimes come as 'stand-alone-programmes,' but more commonly they are themed or clustered and come as part of a larger programme and intervention package. Many of these packages aim at strengthening the coping strategies and resilience capacities of a target community to better withstand and

absorb future crises. Their details depend on a variety of factors: the organization's fields of expertise and experience; the organization's approach and philosophy; the identified problem; existing coping and resilience capacities and any absence of coping and resilience capacities; budget and time constraints; and the external environment in which the programmes are about to take place.

The list of possible actions is long and context-specific; the selection of actions to address FNS should always be tailored to local needs and consider constraints such as cultural sensitivity (Nichols, et al., 2021). Box 3 below lists some possible preventive actions to address FNS.

Box 3 Examples of actions to address FNS (Nichols, et al., 2021)

Examples of preventive actions to address food and nutrition insecurity

- Livelihood diversification
- Crop diversification
- Introduction of new agricultural practices
- Community exchange visits for best practices
- Dietary diversification
- Strengthening the socio-economic situation
- Strengthening institutions, anti-dumping regulations
- Investing in education & health care
- Improved risk management
- Upgrading infrastructure
- Promoting gender equality
- Water purification
- Irrigation systems
- Trainings such as community managed disaster risk reduction (CMDRR)

To conclude; reactive interventions address the acute consequences of food and nutrition insecurity, (hunger, malnutrition, and starvation), while preventive actions contextually address root causes and drivers of FNS, therefore aiming at prevention of these consequences.

7.4 The effectiveness of programming in disaster and conflict situations

Foreign aid can increase existing tensions between ethnic or political groups and thus exacerbate conflict, especially in cases where it has been distributed primarily to groups in favour of the government in charge (Baumann, et al., 2007). The risk of this is especially high in cases where the government is not concerned about their reputation or legitimacy or where there is only little monitoring of activities relating to aid distribution (Kim, 2021). There have been many examples of humanitarian assistance being stolen (Lung, 2019), being blocked from reaching beneficiaries (Faedlulloh, 2021), (Human Rights Watch, 2021); or simply 'disappearing' (Zürcher, 2017). These vulnerabilities and risks of foreign aid therefore can weaken the conflict-moderating effect of aid.

In addition, distribution of aid sometimes undermines resilience capacities by creating aid dependencies (Wood & Sullivan, 2015). For example, a study has found that provision of food aid to address famine can increase the incidence and duration of civil conflict (Nunn & Qian, 2014).

In some cases humanitarian response to rising IPC phase levels and an emerging crisis has failed because of questions of accountability, for example during the 2011 famine in Somalia (Salama, et al., 2012). Despite clear evidence available of predicted rising IPC phase levels and subsequent famine in Somalia, there was '*systemic failure of contingency planning and early action in response to the emergent crisis in Somalia in late 2010 and early 2011 ... in spite of the weight of early warning evidence available*' (Darcy, et al., 2012).

However, disasters and the resulting attention can also lead to foreign aid and humanitarian assistance being temporarily spent more effectively. Studies have found that aid can potentially decrease conflict in countries affected by disaster through various mechanisms. The attention drawn to disasters can alter the strategy of governments towards strengthening and sustaining their regimes by ensuring fair aid distribution. This can then lead to foreign aid reaching groups that are disadvantaged in 'normal' times, and funds being used for the purpose of socio-economic development, decreasing the risk of conflict in the country (Kim, 2021). Further, when foreign aid leads to improved economic opportunities, the opportunity costs of using conflict as a livelihood strategy rise (Collier & Hoeffler, 2004), so that the risks in participating in conflict exceed the potential gains through participating in socio-economic development (Spaniel & Malone, 2019). Aid allocation following disaster can also potentially strengthen disaster resilience (Savun & Tirone, 2012). Disasters also hold the potential to create significant media attention, mobilizing the international community to provide foreign assistance. If done well and monitored carefully, foreign aid in these circumstances can mitigate the impact of future disasters as well as conflict.

7.5 Media attention and reactive interventions

The volume of emergency assistance that any humanitarian crisis attracts depends significantly on the intensity of media coverage (Eftekhar et al, 2017; Olsen et al, 2003). Generally, rapid onset disasters such as floods and earthquakes tend to attract higher levels of international and domestic media attention as compared to slow-onset disasters such as drought (Kim, 2021).

Disasters receive significant media attention as they are considered as newsworthy due to their severity in combination with their unexpectedness (Jeong & Lee , 2019). The attention resulting from large-scale disasters can, if planned and managed well, generate 'legitimacy' and 'monitoring' effects as governments try to prove legitimization of their governance in the presence of international donors and organizations, carefully monitoring and overseeing relief activities (Kim, 2021).

7.6 Challenges to taking preventive actions

There are several reasons why preventive actions are not implemented or not implemented as well as they could be. One of these reasons is in the nature of the aid architecture and related funding mechanisms. In disaster situations and complex emergencies the core humanitarian principles are leading (needs-based response, impartiality, neutrality, and independence) and therefore do not allow to engage beyond the provision of humanitarian assistance.

It is also much harder to receive funding for preventive actions, as they aim at addressing a crisis that has not occurred yet; it is much easier to receive humanitarian funding for a crisis receiving a lot of media attention as compared to an abstract, hypothetical crisis (Wakolbinger & Toyasaki, 2011).

7.7 The need for a paradigm shift from reaction to foresight when programming for improved FNS outcomes

This chapter shows that reactive interventions deliver at first sight more obvious results and measurable success than preventive actions (McRae, 2002). While often such interventions are important to address acute suffering, a strong desire for visibility and 'quick gains,' leads to a preference for reactive interventions over preventive actions (Frank, 2012). It is however much more economical to invest in prevention rather than respond to a crisis.¹¹

¹¹ Calculations show that every dollar that is being spent on preparedness or mitigation efforts saves 5-6 dollars in later disaster response and recovery (BenDor, et al., 2020). Other estimates range from 4 dollars (Milano, 2015) to 11 dollars (Multi-Hazard Mitigation Council, 2019).

Some governments and humanitarian organizations have started to acknowledge the economic advantage of prevention, yet spending on disaster preparedness remains low, and represents only a very small proportion of total bilateral humanitarian official development assistance (OECD, 2017).

This report therefore recommends that calculations should be done on national or regional levels, predicting where disasters are likely to have the costliest impacts. This would reveal locations in which investment in preparedness and mitigation would yield the highest returns of investments by reducing human suffering and response costs. Calculations can provide decision-makers with strong arguments for investing in actions that aim at preparing for and mitigate disaster impact, including food crises. At the same time, these calculations highlight the significance of taking a data-driven approach when designing programmes.¹²

There will always be a need for reactive interventions. It is not possible to prevent all disasters; sometimes they occur without warning. Reactive interventions can, too, strengthen societies/socio-economic systems and lower the risk of conflict by addressing underlying root causes and drivers of food insecurity.

But it is possible to limit the number of people affected by disasters by addressing vulnerability, exposure, and risk up front. To do so, a paradigm shift is needed to focus on preventive actions and resilience building, ultimately reducing the need for reactive interventions in the long run.

7.8 Summary

Recommendations at a glance

This chapter discusses different types of programmes (reactive and preventive) addressing food crises, arguing for the promotion of a paradigm shift moving from reaction to prevention as being more cost-effective and better suited to addressing root causes of food insecurity.

- Programmes can be reactive or preventive. They often have a direct impact on livelihoods, potentially strengthening or undermining people's resilience capacities, altering people's future abilities to respond to food crises. Ideally, programmes addressing FNS should always be tailored to local needs, context specific, and evidence based.
- **Reactive** interventions include humanitarian assistance (e.g. distribution of food, water and animal fodder, provision of shelter and medical assistance), **preventive** actions development (including disaster risk reduction and preparedness) and peacebuilding.
- The debate on comprehensive approaches in complex and protracted crisis has renewed interest in The **Humanitarian – Development – Peace (HDP) nexus** debate highlights the interest in comprehensive approaches in participation in the Peace aspect as food and nutrition insecurity can be both cause and consequence of civil conflict.
- Disasters can create significant attention and reactive interventions, thus sometimes also increasing the effectiveness of aid through generating 'legitimacy' and 'monitoring' effects as governments try to prove legitimization of their governance in the presence of international donors and organizations who carefully monitor relief activities. Provision of aid, when designed well, can potentially decrease conflict in countries affected by disaster.
- Reactive interventions are not sustainable; do not address root causes of food insecurity; can lead to aid dependency; and aid effectiveness is at risk when there is a strong desire for visibility and 'quick gains,' leading to a preference for reactive interventions over preventive actions.
- **Preventive actions** are much more economical. Calculations show that every dollar that is being spent on preparedness or mitigation efforts saves 5-6 dollars in later disaster response and recovery.
- Methods and tools for early identification of emerging hazards potentially impacting food security need to be developed. Using a **data-driven approach** to understand past food crises better and forecast future food crises can assist in designing preventive actions that effectively address the root causes of food insecurity.
- Preventive actions address root causes of food and nutrition insecurity and can strengthen food systems resilience.

It remains a major challenge to **provoke a paradigm shift**, moving the focus from reactive to preventive actions. There will always be a need for reactive interventions; but focusing on prevention and resilience building will ultimately reduce.

¹² For more information on how to calculate return on investment when investing in disaster preparedness and mitigation, look for example at the UNICEF/ WFP report on return of investment for emergency preparedness.

8 Using data for anticipatory action and optimized FNS programming



Figure 30 Satellite image

Contents of this chapter:

- 8.1 Using predictive analytics to move from reactive interventions to preventive actions
- 8.2 Using prescriptive analytics to optimize FNS programming
- 8.3 Summary

8.1 Using predictive analytics to move from reactive interventions to preventive actions

Predictive analytics focus on what is expected to happen in the future, a valuable tool to improve response in protracted food crises. Accurate predictions can for example help to shape early warning systems for the onset of a food security crisis (Krishnamurthy, et al., 2020). The main tool for this since 1985, the Famine Early Warning Systems Network (FEWS NET), monitors food security and their forecasts have proven to be useful. However, it is not fully data-driven and relies largely on human judgment and scenario building (Westerveld, et al., 2021).

There are numerous articles focusing on developing a more data-driven approach to predict food crises. The goal is usually to predict an outcome variable like the IPC phase based on many different variables. Because

these articles study the importance of different features in the prediction models they often provide valuable information on factors which increase or decrease the likelihood of an upcoming food crisis.

A World Bank working paper has proposed a statistical approach to predict the outbreaks of new food crises 4, 8 and 12 months ahead, using machine learning (in particular the **random forest** technique) with several input features (environmental factors, food price inflation, violent conflict, and structural factors such as population counts and land area). This predicts moving from IPC phase 1 or 2 to IPC phases 3, 4 or 5. Results are promising, with relatively stable and accurate forecasts up to 12 months in advance, and a given tolerance for (false) alarms (Andrée, et al., 2020).

Alternatively, to predict transitions between IPC phases, Westerveld et al. (2021) generated 130 variables from different datasets. These variables included changes in climate, land usage, markets, conflict, infrastructure, demographics, and livelihood zone characteristics, and were used to generate predictions on transitions of IPC phases in Ethiopia using an **extreme gradient-boosting machine learning model**. The authors found that 7- month prediction performed better than 3-month prediction and that different predictors were of importance for each. For example, information on food price developments was more powerful for long-term than short-term predictions.

Other researchers have focused on specific factors; for example, specific **regions** such as Ethiopia (Vestal, 2016) and Uganda (Okori & Obua, 2011); the value of **tipping point theory** applied to remote sensing data on drought, to improve early warning systems (Krishnamurthy et al., 2020a) or the relationships between food security and **violent conflict** (Bruck & Errico, 2019).

Despite these efforts, many challenges remain, including the limited availability of local data and the high uncertainty associated with shocks and stressors. For instance, a comparison of food security forecasts from FEWS NET with actual food security found that forecasts were inaccurate in pastoral and agro-pastoral areas; in areas not often transitioning into crises; and in the presence of complex weather or conflict (Krishnamurthy et al., 2020b).

In the second half of 2022, Zero Hunger Lab will publish a follow-up to the current report, which will focus on predictive analytics using machine learning (Van Wanrooij, forthcoming). Detailed analyses are conducted to find meaningful correlations with FNS variables and indicators in the public domain. In addition, raw satellite data are analysed to search for developments in soil conditions that might partly explain FNS developments on the longer term. Finally, for the shorter term, news media (the Guardian newspaper) and social media (twitter) data are analysed to find 'early warning' signals of FNS deteriorations.

8.2 Using prescriptive analytics to optimize FNS programming

The last stage in the Gartner analytics ascendancy model is prescriptive analytics. Prescriptive analytics is about the question 'how can we make it happen?' Is it possible to prescribe an action or set of actions that help to attain an objective?

There has been comparatively little research on how prescriptive analytics can improve FNS, perhaps because it is often more context-dependent than other forms of data analytics. Swaminathan (2018) states that for humanitarian operations prescriptive analytics 'can be utilized in alert and dispatch, prepositioning of supplies, routing, supplier selection, scheduling, allocation, and capacity management.' Sophisticated prescriptive analytics tools are still rare in the humanitarian and disaster sector (Kondraganti, 2021) and mostly applied to humanitarian aid. An example is the OPTIMUS model, developed at Tilburg University and the WFP (Peters, et al., 2021). This model optimizes food aid under certain dietetic, budget and food availability constraints.

However, there are possibilities of developing and applying prescriptive analytics tools to help create a more accurate, data-driven overview of the key drivers of food insecurity in a specific region. Some types of development cooperation aim at reducing key drivers, others aim at reducing vulnerability to the drivers; for both these types, prescriptive analytics could be used to optimize the impact of programmes at the lowest

possible cost. A big challenge is, however, to connect specific programmes to specific drivers, as programmes can address multiple drivers of food insecurity simultaneously and key drivers relate to each other through reinforcing or balancing feedback loops.

Since the literature on FNS optimization modelling is still in its infancy, there is a need for a deeper dive into the possibilities of this type of data analytics, as prescription and/or optimization are important for proposing improvements in FNS.

8.3 Summary

This chapter discusses how predictive and prescriptive data analysis (step 3 and 4 of Gartner’s data analytics ascendancy model) can help in the design of preventive actions to improve FNS. Predictive analytics is more developed in the literature than prescriptive analytics. There is a need to dive deeper in the possibilities of FNS optimization modelling.

Zero Hunger Lab will publish a follow-up report later in 2022 focusing on predictive analytics using machine learning, including detailed analyses of raw satellite data, news media, and FNS variables and indicators in the public domain.

PART III: POLICY AND PRACTICE RECOMMENDATIONS



Part 3 (recommendations) brings together recommendations that have been made throughout the report. The recommendations focus on enabling policy makers and practitioners to move from reactive interventions to preventive actions.

9 Recommendations

9.1 Policy and practice recommendations

(1) Promote and build data literacy across relevant stakeholders at all levels

Data literacy will enable local stakeholders (especially decision makers) to better collect, process, and interpret FNS data. It will increase their awareness of the potential that lies within predictive and prescriptive analytics, from the forecasting of food crises, to informing effective FNS programming.

(2) Programme to local contexts and realities

The localisation agenda (giving more power to and better engaging local and national actors) was agreed at the World Humanitarian Summit in 2016.

- Programme to local contexts, as these are highly relevant to situations that are complex and volatile.
- Use data to support the localization agenda.
- Explore the potential of FNS data for taking a food system approach to improve on FNS outcomes.
- Use qualitative methods to increase awareness of livelihoods, coping strategies and resilience capacities, as these have a profound impact on FNS outcomes and are difficult to capture making use of quantitative methods. This will optimize programmes and strengthen rather than weakening the existing local capacities.

(3) Shift from reactive interventions to preventive actions

We should work towards a paradigm shift - moving from reactive interventions to preventive actions by applying predictive and prescriptive analytics.

- For food crises, this means using an integrated risk management approach. Instead of addressing consequences with humanitarian assistance, proactively intervene to mitigate and prepare, addressing root causes through development and peace-building initiatives.

(4) Encourage awareness of monitoring and legitimacy effects

Aid for frequent natural disasters, including aid to end protracted food crises, can have a legitimacy effect and monitoring effect, as these disasters and crises enable foreign aid to be channelled to marginalised groups and used for its intended development purpose, also lowering the likelihood of conflict. Aid can thus be an entry point to design more effective and preventive actions.

9.2 Analytics research recommendations

(1) Enhance use of data analytics and foresight to build food system resilience

As food system approaches are becoming more common in assessing FNS, appropriate data analytics should be used to build resilient food systems for improved FNS outcomes. This should include

- Assess how key elements of the food systems approach can benefit from data-driven and evidence-based programming
- Research which quantitative indicators can be used to explore interactions between key elements of a food system (e.g. correlations between socio-economic drivers, environmental drivers, food system activities and their disrupters such as conflicts and disasters, and food system outcomes).

(2) Explore interface dynamics to strengthen development of a strategic response framework that reduces the number of people moving to higher IPC phases

Prevention is better than cure; we must aim to avoid the unnecessary suffering and relatively expensive interventions that come with IPC Phase 3/4/5 programming. At present most funding and programmes are focused on reactive interventions in regions that face food crisis, emergency, or catastrophe/famine (IPC Phase 3 and above). We must also look for ways to reduce the number of people that move from IPC Phase 2 to IPC Phase 3 and include this in creating a strategic response framework that reduces the number of

people that move to higher IPC phases. Interface dynamics from IPC Phase 2 (stressed food security) to IPC Phase 3 (food crisis), in addition to interface dynamics for IPC Phase 3 and above (crisis/emergency/famine), can support the development of a strategic response framework through preventive action.

(3) Correlate hazard occurrence and FNS dynamics

This will improve forecasting and inform anticipatory action.

(4) Publish time series of underlying IPC indicators

Making this available publicly will enable descriptive analytics on IPC information (by third parties) which can enhance FNS quantitative analysis and, in the end, also improve local FNS programming.

(5) Localize and contextualize data analytics

It is important to localize and contextualize calculations about how preparedness and mitigation would save response costs. Doing so will

- provide strong arguments to invest in predicting emerging food crises by implementing cost-effective programs aimed at preparedness and mitigation
- allow identification of those areas that are (financially) most at risk if food crises occur.

(6) Explore use of predictive analytics to identify critical tipping points to spark anticipatory action

- Tipping points occur in nonlinear dynamic systems, such as FNS measured by IPC, where an incremental change in a variable can trigger a different state. Because climate, food systems, and humanitarian situations in areas of protracted crisis are highly nonlinear, tipping point theory might be a worthwhile direction of thought. For example, droughts and famine are not always the result of gradual deterioration; tipping points can trigger dramatic flips in a food system, causing acute food insecurity.

(7) Validate /apply recent advances in data analytics to inform FNS modelling and response

- The ATARI working group recognizes that 'the IPC does not always effectively connect to recent innovations in data science.'
- Since the literature on FNS optimization modelling is still in its infancy, it is worthwhile to explore the potential of emerging techniques such as machine learning and artificial intelligence in improving our understanding of developments in FNS.

Box 4 Recommendations at a glance

Policy recommendations

We recommend the following

1. Promote and build data literacy across relevant stakeholders at all levels.
2. Programme to local contexts and realities
3. Shift from reactive intervention to preventive actions
4. Encourage awareness of monitoring and legitimacy effects.

Analytics recommendations

We recommend the following.

1. Enhance use of data analytics and foresight to build food system resilience
 2. Explore interface dynamics from IPC Phase 2 (stressed food security) to IPC Phase 3 (food crisis (in addition to interface dynamics for IPC Phase 3 and above - crisis/emergency/famine) to support the development of a strategic response framework
 3. Correlate hazard occurrence with FNS dynamics
 4. Publish time series of underlying IPC indicators
 5. Localize and contextualise data analytics
 6. Explore use of predictive analytics to identify critical tipping points to spark anticipatory action
 7. Validate /apply recent advances in data analytics to inform FNS modelling and response
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Appendix 1 FNS indicators

Availability Indicators	Dimension	Term	Level
Frequency of vegetable consumption	availability	short	individual
Frequency of meat and fish consumption	availability	short	individual
Frequency of dairy consumption	availability	short	individual
Numbers of meals eaten a day	availability	short	individual
Dietary diversity of 8 major food groups: cereals, milk, meat, sugar, vegetable oils, oils, fruits, starchy roots	availability	short	individual
Frequency of vegetable consumption	availability	short	household
Frequency of meat and fish consumption	availability	short	household
Frequency of dairy consumption	availability	short	household
Numbers of meals eaten a day	availability	short	household
Dietary diversity of 8 major food groups: cereals, milk, meat, sugar, vegetable oils, oils, fruits, starchy roots	availability	short	household
Cereal yields	availability	short	macro
Food production index	availability	short	macro
Livestock production index	availability	short	macro
Ratio of total export to food imports	availability	short	macro
Food expenditure budget share of total household expenditure	accessibility	short	individual
Food expenditure budget share of total household expenditure	accessibility	short	household
BMI	utilization	short	individual
Height for age (stunting)	utilization	short	individual
Weight for age (underweight)	utilization	short	individual
Weight for height (wasting)	utilization	short	individual
Mid-upper arm circumference	utilization	short	individual
Night blindness	utilization	short	individual
Low birth weight	utilization	short	individual
Anaemia	utilization	short	individual
Crude death rate of a crisis or disaster	utilization	short	macro
% of wasted children age under five	utilization	short	macro
% of thin women at reproductive age	utilization	short	macro
% of stunted children age under five	utilization	short	macro
% of children age under five with iron deficiency	utilization	short	macro
% of children age under five with vitamin A deficiency	utilization	short	macro
% of women at reproductive age with iron deficiency	utilization	short	macro
% of women at reproductive age with vitamin A deficiency	utilization	short	macro
Height for age (stunting)	utilization	long	individual
Low birth weight	utilization	long	individual
Infant mortality	utilization	long	individual
Maternal mortality	utilization	long	individual
Height for age (stunting)	utilization	long	household
Low birth weight	utilization	long	household
Infant mortality	utilization	long	household
Maternal mortality	utilization	long	household
% of stunted children age under five	utilization	long	macro
% of infant mortality	utilization	long	macro
% of maternal mortality	utilization	long	macro
Number of days of permanent or temporary disability	stability	short	individual
Duration of household food stocks	stability	short	household
Index of variability of food production	stability	short	macro
Variability of food prices	stability	short	macro
Number of storage sites and storage capacity	stability	short	macro

Adapted from (Pangaribowo, et al., 2013)

Appendix 2 Disaster classification

Group	Subgroup	Type	Sub- Type
Natural	Geophysical	Earthquake	Ground movement
			Tsunami
		Volcanic activity	Ash fall
			Lahar
			Pyroclastic flow
			Lava flow
		Mass movement (dry)	Landslide
	Rockfall		
	Hydrological	Flood	Flash flood
			Riverine flood
			Coastal flood
		Landslide	Avalanche
		Wave action	Rogue wave
	Meteorological	Extreme temperature	Heat wave
			Cold wave
			Severe winter conditions
		Fog	-
		Storm	Extra-tropical storm
			Tropical storm
	Climatological	Drought	-
		Wildfire	Forest fire
			Land fire
		Glacial lake outburst	-
	Biological	Epidemic	Viral disease
Bacterial disease			
Parasitic disease			
Fungal disease			
Prion disease			
Insect infestation		Grasshopper	
		Locust	
Animal accident	-		
Technological	Industrial		
	Transport		
	Miscellaneous		

Adapted from (EM-DAT , 2021)

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Wageningen Centre for Development Innovation supports value creation by strengthening capacities for sustainable development. As the international expertise and capacity building institute of Wageningen University & Research we bring knowledge into action, with the aim to explore the potential of nature to improve the quality of life. With approximately 30 locations, 7,200 members (6,400 fte) of staff and 13,200 students, Wageningen University & Research is a world leader in its domain. An integral way of working, and cooperation between the exact sciences and the technological and social disciplines are key to its approach.

Report WCDI-22-217



To explore
the potential
of nature to
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quality of life



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The mission of Wageningen University & Research is "To explore the potential of nature to improve the quality of life". Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 7,200 employees (6,400 fte) and 13,200 students and over 150,000 participants to WUR's Life Long Learning, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.

