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Food Insecurity Projections for Anticipatory Action: Comparative Spatiotemporal Analysis of FEWS NET and the IPC in Somalia

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Abstract. Anticipatory Action (AA) has become a central pillar of contemporary humanitarian action, aiming to reduce the impacts of climate-related hazards by enabling preventive interventions before crises fully materialize. Food insecurity projections play a critical role in AA, particularly in the context of droughts. Two internationally operating systems, FEWS NET and the Integrated Food Security Phase Classification (IPC), provide widely used assessments and projections of food insecurity. Practitioners are often required to choose between these frameworks when designing AA trigger systems, a challenge that was recently amplified by USAID funding disruptions and the temporary outage of FEWS NET, highlighting the vulnerability of critical humanitarian data streams and the need for informed substitution. This study presents a systematic spatiotemporal comparison and projection skill assessment of FEWS NET and IPC food insecurity data for Somalia between 2017 and 2025. Using harmonized geospatial time series, we evaluate differences in historical assessments and projections, the frequency of projected crisis conditions, and projection accuracy relative to subsequent current assessments. Results indicate strong agreement between the two systems in their assessments of current conditions, but notable divergence in projections: FEWS NET consistently projects slightly higher levels of food insecurity and substantially more frequent Emergency and Famine conditions than the IPC. Projection accuracy is moderate for both systems and characterized by a predominance of positive bias, particularly for higher food insecurity classes. This reflects a precautionary forecasting approach that is appropriate in humanitarian contexts but must be explicitly considered when defining trigger sensitivity and resource allocation in anticipatory action. Overall, the findings demonstrate that FEWS NET and IPC projections are not directly interchangeable despite their shared classification scale, underscoring the need for dataset-specific trigger calibration.

Submission Type. analysis, case study

BoK Concepts. [GS3] Use of geospatial information

Keywords. Anticipatory Action, Food Insecurity, Geoinformation for Humanitarian Action

1 Introduction

Climate change is increasingly exacerbating the frequency and intensity of climate-related hazards such as droughts, heatwaves, and floods, placing growing pressure on vulnerable regions (IPCC (2022)). In response to these challenges, the humanitarian sector has undergone a substantial paradigm shift over recent decades, moving from predominantly reactive disaster response towards more proactive and anticipatory approaches (Coughlan De Perez et al. (2015)). Anticipatory Action (AA), also known as forecast-based financing, aims to mitigate humanitarian impacts by triggering preventive interventions based on monitored indicators and predefined thresholds prior to the full manifestation of a crisis (Coughlan De Perez et al. (2015)).

Food insecurity projections are a central component of anticipatory action (AA) frameworks, as they enable the identification of emerging crises several months in advance (Hillbruner and Moloney (2012)). This is particularly relevant for drought-related AA systems, since droughts are slow-onset and multifactorial hazards whose complex impacts on livelihoods are difficult to predict or monitor using a limited set of meteorological, hydrological, or agricultural indicators alone (Srivastava et al. (2025)). Consequently, food insecurity indicators play a critical role as proxies for anticipating some of the most severe impacts of prolonged droughts on livelihoods and household vulnerability. At the same time, assessing food insecurity remains a complex and multidimensional challenge (Machefer et al. (2025)). As a result, multiple food insecurity classification systems have been developed, which can create challenges for practitioners when projections diverge.

Two of the primary global frameworks providing regular current assessments and multi-month projections of food insecurity are FEWS NET (https://fews.net) and the Integrated Food Security Phase Classification (IPC) (https://www.ipcinfo.org). While both systems employ a compatible five-class scale (cf. Table 1), they differ substantially in their methodological approaches, release frequencies, spatial units, and the structure of their assessment and projection cycles. These differences complicate direct comparison and pose practical challenges for practitioners tasked with selecting appropriate datasets for operational AA implementation.

Recent funding disruptions that affected USAID-supported FEWS NET operations further revealed the vulnerability of critical humanitarian data streams (Harter (2025), Njeru (2025)). The temporary shutdown of FEWS NET demonstrated how practitioners may be forced to substitute one dataset for another with little warning, immediately introducing uncertainty into established AA trigger systems. This underscores the importance of a systematic understanding of the similarities and differences between FEWS NET and the IPC, particularly in contexts where projections are directly linked to high-stakes operational decisions. Differences in predictive accuracy, bias, or the frequency of high-severity classifications can fundamentally alter the behavior of implemented trigger systems, potentially leading to premature or unnecessary interventions or, more critically, to missed crises resulting in delayed or insufficient humanitarian action. Despite the widespread use of FEWS NET and IPC projections in anticipatory action protocols, empirical evidence comparing their predictive performance and operational implications remains limited, complicating evidence-based trigger design and increasing uncertainty for practitioners.

To address this gap, this study presents a comparative analysis of FEWS NET and IPC food insecurity assessments and projections using Somalia as a case study for the period 2017–2025. The analysis is based on time series of geospatial food insecurity classifications and examines differences across both spatial and temporal dimensions. A comparative skill assessment is conducted to evaluate projection accuracy and systematic bias in each dataset. The primary focus is on projected classifications, as these are the component of food insecurity data that are frequently utilized within anticipatory action trigger systems.

Somalia was selected as the study region due to its recurrent and severe droughts over the past decade, often compounded by conflict and economic vulnerability, which make anticipatory action both necessary and operationally relevant (Ahmed Dirie et al. (2024), Weingärtner et al. (2022)). These repeated crises also provide a suitable context for evaluating the behavior and performance of the two approaches under both stable and crisis conditions, including periods of increased uncertainty and constrained data collection.

2 State of the art

2.1 Food Insecurity Data in Anticipatory Action and Early Warning Systems

Anticipatory Action methodologies are being developed and practically implemented by major humanitarian actors in the humanitarian space, including the Food and Agriculture Organization (FAO), the International Federation of Red Cross and Red Crescent Societies (IFRC) and the World Food Programme (WFP). Over the past decade, these organizations have implemented pilot programmes, operational guidelines, and evaluation studies demonstrating how food insecurity projections can be integrated into anticipatory action trigger systems (Anticipation Hub (2024)).

Food insecurity data have been incorporated into operational anticipatory action frameworks in real-world humanitarian applications. Notably, the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) leveraged forecast-based financing through the Famine Action Mechanism (FAM), launched by the World Bank, the United Nations, and the International Committee of the Red Cross (ICRC). In June 2020, OCHA triggered the release of anticipatory action funds in Somalia based on projected food insecurity thresholds driven by the combined impacts of COVID-19, desert locust infestations, and flooding (FAO and WFP (2023); Gettliffe (2021); Wolski et al. (2024). In Ethiopia, a forecast-based trigger mechanism was developed for the drought Anticipatory Action Plan, integrating projected food insecurity classifications with seasonal rainfall forecasts. The mechanism relies on FEWS NET and IPC projections and is activated only when predefined food insecurity thresholds are exceeded and drought is identified as a contributing driver. (UN OCHA (2020)). In Zimbabwe, the IFRC implemented anticipatory early actions for drought using a two-stage trigger system that combines forecasts of the ENSO with food insecurity projections. FEWS NET IPC forecasts serve as a second trigger, activating food security–related early actions when IPC class 4 (Emergency) conditions are projected (IFRC (2022)).

More recently, in 2024, the IFRC approved a drought Early Action Protocol (EAP) for Somalia that explicitly integrates projected food insecurity into its trigger mechanism. The protocol applies a dual-trigger approach combining a merged SPI-12 drought forecast with a population-weighted index derived from FEWS NET food insecurity projections, thereby linking climatic drought conditions with anticipated impacts on livelihoods. Anticipatory actions are activated only when both drought severity thresholds and projected food insecurity conditions are exceeded (IFRC (2024)).

2.2 The FEWS NET and IPC Acute Food Insecurity Classification Frameworks

Table 1. Acute food insecurity class classification as used by both FEWS NET and IPC.

Class	Description
Class 1: Minimal	Essential food and non-food needs are met
Class 2: Stressed	Minimally adequate food consumption, unable to afford some non-food needs
Class 3: Crisis	Food consumption gaps and/or high levels of acute malnutrition
Class 4: Emergency	Large food consumption gaps, very high acute malnutrition, and excess mortality
Class 5: Famine	Extreme food consumption gaps, starvation, and very high mortality

2.3 The Famine Early Warning Network (FEWS NET)

The Famine Early Warning Systems Network (FEWS NET) is a USAID-funded initiative established in 1985 in response to the 1983-1985 famines in East and West Africa, with the mandate to provide early warning of food insecurity and famine risk. FEWS NET has operated in Somalia since 1995 (FEWS NET).

FEWS NET assesses acute food insecurity at the subnational level using the Integrated Food Security Phase Classification (IPC) scale, which they adapted from the IPC so the both systems are compatible. Assessments of current conditions and forward-looking projections are produced through an internal scenario development process that integrates quantitative inputs such as satellite-derived indicators, climate data, market and price models, and production and harvest forecasts with qualitative information, including field assessments, local informants, and NGO and UN reports. Analyses are conducted at the level of livelihood zones, defined as geographic areas characterized by similar patterns of food and income access. (FEWS NET) FEWS NET publishes three to four Food Security Outlook reports per year. Between 2009 and 2016, reports were released quarterly; since 2016, releases have typically occurred in February, June, and October. Currently each outlook covers an eight-month analysis period, comprising a current situation assessment and two four-month projection periods aligned with seasonal dynamics (FEWS NET):

- Current Situation (CS): Assessment of current conditions at the time of publication.
- Near-term Projection (ML1): Outlook for the subsequent 3-4 months following the reports publication.
- Mid-term Projection (ML2): Outlook for months 5-8 following publication.

2.4 The Integrated Food Security Phase Classification (IPC)

The Integrated Food Security Phase Classification (IPC) is a multi-partner initiative comprising 16 organizations that applies internationally recognized scientific standards to deliver evidence-based and consensus-driven analyses of acute food insecurity and malnutrition. Classifications are generated through a *Convergence of Evidence* framework, in which diverse quantitative and qualitative data sources - including household food security and nutrition surveys capturing core IPC indicators, market price data, climate forecasts, focus group discussions, key informant interviews, and field observations - are systematically synthesized by multi-partner technical working groups to produce a unified classification. (IPC (2021)).

The standard spatial unit for IPC analyses is typically the second administrative level. Somalia marks a special case, where classifications are first conducted at the livelihood zone level, and subsequently represented at the intersection of livelihood zones and districts. As a result, IPC geometries share district boundaries that are further subdivided by livelihood zones (IPC (2021)). In contrast to FEWS NET, IPC analysis periods are not defined by a fixed offset from the publication date but are instead aligned with the country-specific seasonal calendar. For Somalia, IPC typically publishes two analyses per year: One following the Gu rainy season (approximately January), with projections for the Xagaa dry/lean season, and a second following the Deyr rainy season (approximately July), with projections for the Jilaal dry/lean season. While each analysis generally spans a six-month period comprising a current situation assessment and a forward-looking projection, the exact duration and structure of these periods have varied over time and were adaptively adjusted, for example during drought related crises (IPC (2021)).

- Current Situation (C): Assessment of the most recent conditions, typically following a major seasonal event such as a harvest, and valid for one to three months.

- Projection (P1): Projected food insecurity conditions for the upcoming seasonal period, typically three to five months.
- Extended Projection (P2): Outlook for subsequent periods beyond the primary projection, produced inconsistently and therefore not always available

Table 2. Comparison of FEWS NET and IPC acute food insecurity assessments and projections

	FEWS NET	**IPC**
Mandate	Early warning	Global standard
Primary funder	USAID (US Gov.)	Global partnership (UN, NGOs)
Release frequency	3–4 reports/year	2–3 reports/year
Time horizon	Current situation, short- and mid-term projection	Current situation, projection up to 6 months
Methodology	Scenario development	Convergence of evidence
Decision process	Analyst-driven	Multi-partner consensus
Quantitative data	Satellite data, market and price models, livelihood models, production and harvest forecasts	Climate data, household surveys, anthropometry, production and livestock counts
Qualitative data	Local informants, field trips by analysts, NGO/UN reports, expert judgment	FGD, KII, field observations, consensus of technical working groups
Spatial unit (Somalia)	Intersection of livelihood zones and administrative units	Intersection of livelihood zones and administrative units

Although both food insecurity frameworks are compatible through their shared five-phase Acute Food Insecurity (AFI) classification scheme (see Table 1), they differ in several important aspects, including the spatial units used for analysis, the methodological approaches utilized to integrate diverse data sources and expert judgment, and the definition and timing of both current situation assessments and projections. (cf. Table 2). Most importantly the two frameworks differ in the underlying methods and concept: The IPC focuses on assessing the current state of acute food insecurity and projecting whether conditions are likely to improve or deteriorate, drawing on available evidence and the collective judgment of experts from governments, the United Nations, and non-governmental organizations. In contrast, FEWS NET emphasizes forecasting key risk factors such as rainfall patterns, market price dynamics, conflict, and harvest outcomes, that are expected to influence the severity and scale of acute food insecurity over the coming months. Unlike the IPC, FEWS NET's analysis is not based on a formal multi-partner consensus classification process ((Vos et al., 2023)).

2.5 Emerging Approaches for the Assessment of Food Insecurity

While humanitarian operations continue to rely primarily on standardized food insecurity frameworks such as FEWS NET and the IPC, a growing body of academic research proposes alternative methods that may become relevant for operational use in the future. These approaches aim to complement or extend existing systems by leveraging novel data sources, machine learning methods, or the integration of multiple food insecurity classifications into composite indices:

Lentz et al. (2019) present a replicable, near–real-time statistical machine learning framework that integrates granular, publicly available data to predict food security crises more rapidly and, in some cases, more accurately than consensus-based approaches. Busker et al. (2024) developed an machine-learning model that predicts IPC food insecurity classes up to 12 months ahead using multi-source geospatial hazard and socio-economic data, showing performance comparable to FEWS NET in pastoral and agro-pastoral regions. More recently Machefer et al. (2025) introduced the Harmonized Food Insecurity Dataset (HFID), an open-source resource that consolidates multiple complementary indicators, including IPC and FEWS NET classifications, the World Food Programme's Food Consumption Score (FCS), and the reduced Coping Strategies Index (rCSI).

2.6 Previous Evaluations of Food Insecurity Frameworks

Only a limited number of studies have systematically assessed the predictive skill of large-scale food insecurity classification systems. Hillbruner and Moloney (2012) conducted one of the earliest evaluations of FEWS NET projections preceding the 2011 Somalia famine, using a qualitative timeline analysis to examine factors contributing to the failed humanitarian action. Their findings indicate that FEWS NET provided timely and accurate early warnings, which were not acted upon by decision-makers.

Subsequent quantitative evaluations focused on comparing FEWS NET projections with later current assessments. Choularton and Krishnamurthy (2019) evaluated FEWS NET projections by comparing them with subsequent current assessments for Ethiopia at a fine spatial resolution (district or *woreda* level), finding generally high projection accuracy. This assessment framework was later extended to multiple countries across the Greater Horn of Africa by Krishnamurthy et al. (2020). A large-scale validation of FEWS NET food security assessments and projections across 25 countries in East, West, and Southern Africa from 2009 to 2020 was conducted by Backer and Billing (2021), using grid-cell–level data to evaluate the accuracy and bias of projections against subsequent current assessments. Building on this work, Bertetti et al. (2024) evaluated FEWS NET's near-term projections by comparing them to subsequent current assessments. In addition to common statistical metrics to assess prediction skill, their study benchmarked FEWS NET projections against simple heuristic models to further contextualize forecast skill.

Notably, existing studies have exclusively evaluated the performance of a single framework, namely FEWS NET. To our knowledge, no comparative skill assessment of FEWS NET and IPC projections has been conducted to date. This study addresses this gap by systematically comparing both frameworks, thereby providing new insights into how methodological differences translate into divergent projection behavior and skill. Such insights are particularly relevant for humanitarian decision-making in Somalia, a region recurrently affected by severe drought and high levels of acute food insecurity (Ahmed Dirie et al. (2024), Weingärtner et al. (2022)).

3 Data and Methods

3.1 Used Data

Data used for the analysis consist of the *acute food insecurity* classification products of both FEWS NET and the IPC, provided in geospatial formats (IPC) and tabular CSV formats, supplemented by additional polygon datasets defining the analysis units for FEWS NET. For both systems, classifications are reported at the spatial level defined by the intersection of Somalia's second-level administrative boundaries (districts) and livelihood zones, which vary over the study period.

From the full set of available acute food insecurity products, the analysis includes current assessment data for both datasets, IPC Projection 1, and FEWS NET's mid-term projection (ML2). IPC Projection 2 was excluded due to very limited temporal coverage for Somalia, while FEWS NET ML2 was selected as it most closely matches IPC Projection 1 in terms of projection horizon.

Data was acquired through the FEWS NET and IPC APIs as well as directly from the IPC website, as the IPC API did not consistently provide data at the required spatial resolution. Consequently, for selected assessment periods, IPC data were manually downloaded via the IPC web interface. In particular, IPC assessments for the period from June 2021 to July 2022 could not be included, as these datasets were not available at the district (administrative level 2) scale through the IPC API or web interface, but only at coarser spatial resolutions. This gap corresponds to three IPC assessment periods and was considered acceptable for the analysis, as a total of 32 IPC assessment periods remained available for the 2017–2025 study period. To ensure consistent coverage across datasets, the analysis period was restricted to 2017 through the end of 2025, reflecting the temporal availability of IPC data in geospatial format, while FEWS NET data were available from 2010 onward.

3.2 Preprocessing

Initial preprocessing steps included the removal of non-relevant geometries, the assignment of time-consistent livelihood zone geometries for FEWS NET across the study period, the standardization of analysis period definitions including start and end dates, and the harmonization of attribute tables into a consistent schema across both datasets. The resulting FEWS NET and IPC datasets, each containing all current assessments and projections, were then transformed into two parallel time series representations: One retaining the original analysis period structure (e.g. a single value for January–March), and a second converted into a monthly format, assigning current and projected food insecurity class values to each covered month.

Subsequently, the time series datasets were rasterized at a fine spatial resolution (0.01°) to enable consistent spatial aggregation across temporally varying geometries. At the latitude of Somalia, this corresponds to an approximate ground resolution of $\tilde{1}.1$ km, which is sufficient to capture the comparatively large spatial units of FEWS NET and IPC analyses without introducing excessive loss of detail from rasterization. Variation in grid cell size across the north–south extent of Somalia is minimal and considered negligible for the purposes of this study. Zonal statistics were then calculated at the district (administrative level 2) scale, which also corresponds to the spatial unit most commonly used in anticipatory action systems. These statistics were derived using the exactextractr package, applying area-weighted extraction to account for partial pixel overlaps and ensure maximal accuracy in the aggregation process. For each district and time step, two summary statistics were calculated: the area-weighted mean food insecurity class (calculated as the sum of class values weighted by pixel area within each district) and the majority class classification, defined as the class covering the largest area within each district.

3.3 Analysis

The analysis was comprised of two main steps. The first step focused on a comparative assessment of historical temporal trends and spatial patterns in the food insecurity time series derived from FEWS NET and IPC: Descriptive statistics were calculated based on the monthly time series, including mean class values for current assessments and projections over time and at the district level. In addition, spatial difference metrics, specifically the mean signed difference and the root mean squared difference (RMSD), were computed to quantify systematic differences between the two datasets. Complementary analyses were conducted for the highest food insecurity classes, Emergency and Famine (classes 4 and 5), which are particularly relevant for operational use in anticipatory action frameworks. The key results of this descriptive analysis were visualized using time series plots and thematic maps.

The second analysis step consisted of a comparative skill assessment to evaluate and contrast the projection performance of FEWS NET and IPC at the analysis-period level. For this purpose, a paired dataset was built linking individual projections with subsequent current assessments, representing predicted and observed conditions, respectively. Projection–current assessment pairs were created under the following conditions:

- **FEWS NET:** A projection period and a current assessment period were paired if their validity periods showed any temporal overlap. This resulted in a total of 24 projection–assessment pairs. Due to the FEWS NET reporting structure, pairings consistently followed the pattern that a one-month current assessment overlapped with the first month of the projected period (e.g. a projection from February 2022 to May 2022 paired with a current assessment for February 2022).
- **IPC:** A projection period and a current assessment period were paired only if they were directly adjacent in time and the current assessment period began after the projection period. This alternative rule was required because, due to the IPC reporting schedule, projections and current assessments rarely overlap temporally, with current assessments typically covering the final month of the preceding projection period. This resulted in a total of 12 projection–assessment pairs, where the one-month current assessment consistently followed directly after the final month of the projection period (e.g. a projection from February 2022 to May 2022 paired with a current assessment for June 2022).

In both systems, projections and current assessments were restricted to one-to-one pairings, ensuring that each projection and each current assessment was used in only a single comparison.

The effective lead time of projections differs between the two systems and should be considered when interpreting the comparative skill assessment. FEWS NET ML2 projections represent a medium-term outlook with a typical lead time of approximately 4–8 months (e.g. a February release projecting June–September), with one exception in February–May 2019 showing a shorter lead time of 2–6 months. In contrast, IPC projection lead times are more variable due to seasonally defined reporting periods, ranging from approximately 1 to 6 months, with most between 2 and 5 months (e.g. February release projecting April–June).

Based on the paired projection–assessment dataset, a set of accuracy and difference metrics was calculated for each pair to evaluate projection skill. These included: (i) a binary *hit* indicator, defined as true when the majority class of the projection exactly matched the paired current assessment and false otherwise; (ii) the *majority class difference*, calculated as the difference between the projected and observed majority class; and (iii) the *mean class difference*, defined as the difference between the area-weighted mean projected and current class values. Projection bias was subsequently characterized by the sign of the class differences, distinguishing between positive and negative bias, where positive values indicate overestimation and negative values indicate underestimation of the projected food insecurity class relative to the observed assessment.

Although area-weighted mean class values more closely preserve the underlying spatial distribution of food insecurity prior to aggregation at the district level, majority class values were used for hit-rate and majority-difference calculations to maintain the discrete, ordinal nature of the acute food insecurity class scale. This ensures that accuracy metrics reflect whole-class agreement and deviation, consistent with how food insecurity classifications are interpreted and operationalized. Mean-based differences were retained to capture more gradual food insecurity shifts within districts that may not be reflected in majority classifications alone. In practice, aggregation effects were minimal: the average absolute difference between area-mean and area-majority classes is 0.155 for FEWS NET ML2 projections and 0.131 for CS assessments, and 0.067 for IPC projections and 0.058 for IPC current assessments, indicating that the choice of aggregation method does not significantly affect the calculated metrics

The calculated accuracy and projection bias metrics are subsequently visualized using confusion matrices that differentiate bias across projected classes, a projection-error time series, and thematic maps showing district-level projection bias over the full study period.

3.4 Data and Software Availability

All acute food insecurity data used in this study are publicly available. FEWS NET classifications were accessed via the FEWS NET API (https://help.fews.net/fdw/fews-net-api). IPC classifications were obtained via the IPC API (https://docs.api.ipcinfo.org/) and, for selected periods with incomplete API coverage, directly from the IPC data portal (https://www.ipcinfo.org/ipc-country-analysis/en/?maptype=77106). All data preprocessing and analyses were conducted in the R programming environment, while map production and visualization were performed using R and QGIS. The complete analysis workflow, including all preprocessing scripts, analysis code, and QGIS project files, is publicly available at https://github.com/GIScience/agile2026_food_insecurity_anticipatory_action. No restrictions apply to the reuse of the data beyond the original licensing terms of the respective providers.

4 Results

4.1 Comparison of past assessments and projections

Figure 1 presents a comparative timeline of the mean FEWS NET and IPC acute food insecurity classifications across Somalia from 2017 through the end of 2025. As noted in the data section, the IPC time series contains a data gap of three assessment periods between June 2021 and July 2022. Both frameworks exhibited substantial temporal variability in both current assessments and forward-looking projections. Despite this variability, the two frameworks displayed broadly consistent temporal patterns, indicating general agreement in the timing and direction of major changes in food insecurity conditions. The time series, nonetheless, revealed distinct periods of divergence, with the largest discrepancies observed in 2018, particularly between the projections. Over the full study period, mean food insecurity values for current assessments were nearly identical for FEWS NET (2.26) and IPC (2.28). In contrast, projected values were systematically higher than current assessments for both systems, with FEWS NET projections averaging approximately 2.43 compared to 2.30 for IPC. This consistent elevation of projected class values relative to observed assessments suggests a slight positive bias in the projected food insecurity when compared to the current assessments.

The spatial distribution of mean projected food insecurity was relatively consistent between FEWS NET and IPC (see Figure 2), reflecting the agreement observed in the temporal analysis. Both datasets showed elevated mean class values across central Somalia and parts of Somaliland, while southern regions generally exhibit lower averages, with the notable exception of large parts of the Bay region in south-central Somalia, which displayed some of the highest mean values overall. FEWS NET's projections produce slightly higher mean class levels across central and northern areas, whereas spatial patterns in the south closely match those of the IPC. For current assessments (not shown), no substantial differences in spatial patterns were observed between the two systems. Similar to the projections, the current assessments also showed a general pattern of higher class values in the central and northern regions.

The comparison of projected months falling into *emergency* (class 4) or *famine* (class 5) revealed substantially greater divergence between FEWS NET and IPC than observed for mean projected class values (see Figure 3). These high-severity classes are particularly relevant for anticipatory action and humanitarian decision-making, as they frequently underpin trigger mechanisms and response planning. FEWS NET projections indicate markedly higher frequencies of class 4 and class 5 classifications than IPC, particularly across some regions in central and south Somalia, where many districts exceed 20 % of projected months in these high-severity categories. In contrast, IPC projections identify few districts with comparably high frequencies of emergency or famine conditions. However, it is important to note that class 5 (Famine) accounts for less than 3 % of all projections classified as class $\geq$4 in both datasets. Notably, in some districts across the southern and central regions where FEWS NET classified 20-30 % of projected months as class $\geq$4, IPC did so for only 0–10 % of months. This pronounced discrepancy indicates that the two systems differ not only in average projected food insecurity levels but, more importantly, in their expectations regarding the recurrence and persistence of crisis conditions.

4.2 Comparative Skill Assessment

Overall projection accuracy was moderate, with FEWS NET achieving 61.8% and IPC 64.5% agreement between projected and subsequent current assessments. Discrepant cases can be classified as either positive bias, where projected food insecurity exceeds the observed current class, or negative bias, where it is underestimated. Across all projection–assessment pairs, positive bias occurred in 26.6% of cases for FEWS NET and in 22.0% of cases for the IPC, while negative bias accounted for 11.6% and 13.6%, respectively. For both systems, the vast majority of mismatches involved deviations of no more than one food insecurity class (93.3% for FEWS NET and 96.9% for IPC), indicating that while overall accuracy was limited, projections more frequently erred toward overestimation rather than underestimation, and large forecasting errors were rare.

The bias matrices for FEWS NET and IPC revealed similar class-dependent error structures (See Figure 4). Prediction accuracy was highest for lower food insecurity classes (classes 1 and 2) and declined for classes 3 and 4, where agreement dropped below 50%; class 5 results were not robust due to the small number of cases. For both systems, the highest accuracy was observed when class 2 was predicted. In predicted classes of low food insecurity risk (1 and 2), errors were predominantly characterized by negative bias, indicating slight underestimation of food insecurity severity in subsequent assessments. This pattern was reversed for predicted classes of higher food insecurity risk, where negative bias became rare and positive bias which was often exceeding one class, became increasingly prevalent. In particular, predictions of class 4 were more frequently followed by lower current assessments than by matching outcomes in both datasets. This asymmetry suggests a systematic tendency toward

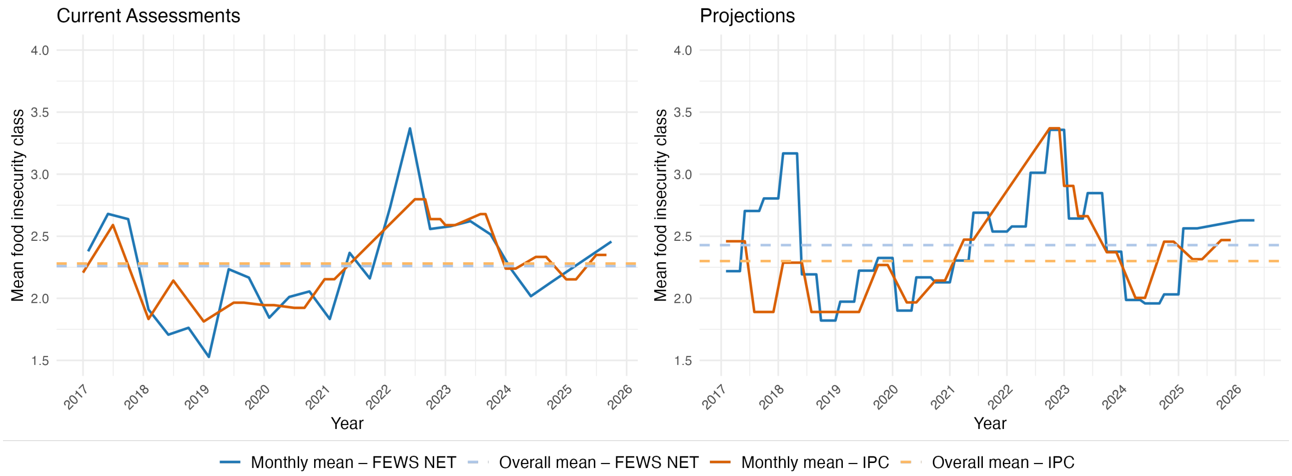

Figure 1. Timeline of mean current assessments and projections of acute food insecurity classes for FEWS NET (left) and the IPC (right). Mean values for each reported month are calculated across all districts of Somalia. The overall mean across all districts and the full study period is indicated by the light-colored dashed lines. The figure illustrates similarities in current assessments and some differences in projected severity between the two systems.

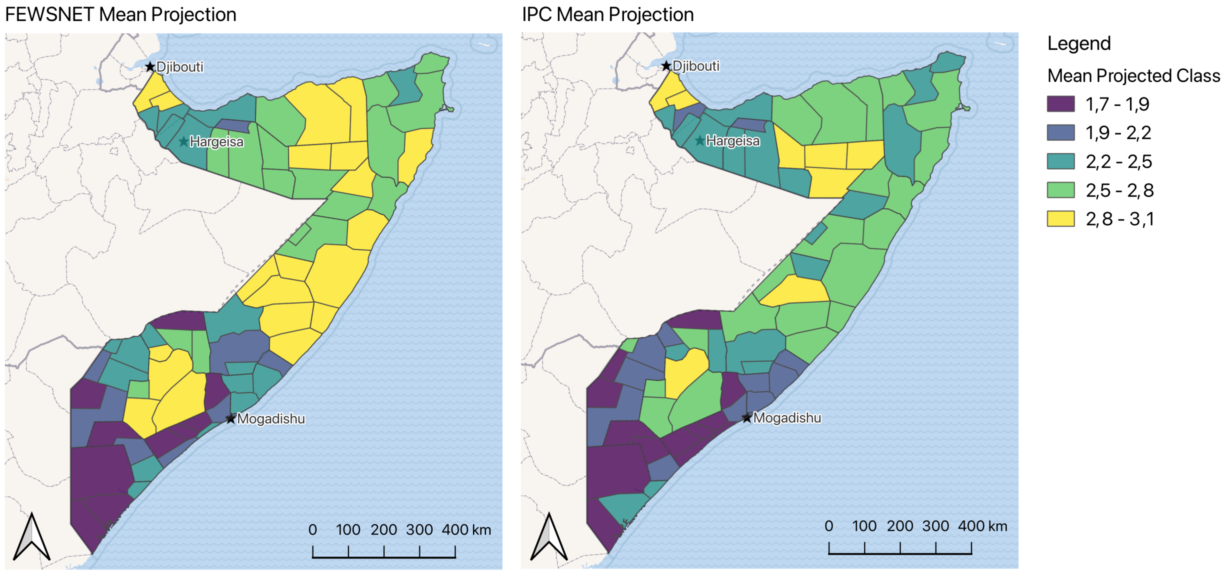

Figure 2. Spatial distribution of mean projected acute food insecurity classes across Somalia based on FEWS NET (left) and IPC (right) projections for the period 2017–2025. Mean values represent area-weighted averages of projected food insecurity classes aggregated at the district level. Differences highlight systematic variation in projected food insecurity between the two systems, particularly in central and northern Somalia. Basemap source: OpenStreetMap.

pessimistic forecasting when higher food insecurity levels are anticipated - a behavior that is consistent with the intended use of such projections in anticipatory action contexts, where underestimation of crises may carry substantial humanitarian risks.

Figure 5 shows the number of administrative districts exhibiting projection errors for each current assessment period, disaggregated by the magnitude and direction of the error. Both FEWS NET and the IPC displayed substantial temporal variability in projection errors, with no clear trend toward increasing or decreasing error magnitude or a persistent bias direction over time. FEWS NET exhibited a higher frequency of larger errors compared to the IPC, most notably in 2018, where a episode of strong positive bias affected more than 30 districts. While some assessment periods were dominated by errors in a single direction, other periods showed substantial numbers of both positive and negative deviations, indicating spatially heterogeneous bias patterns across Somalia within the same time step. Overall, positive bias was more prevalent than negative

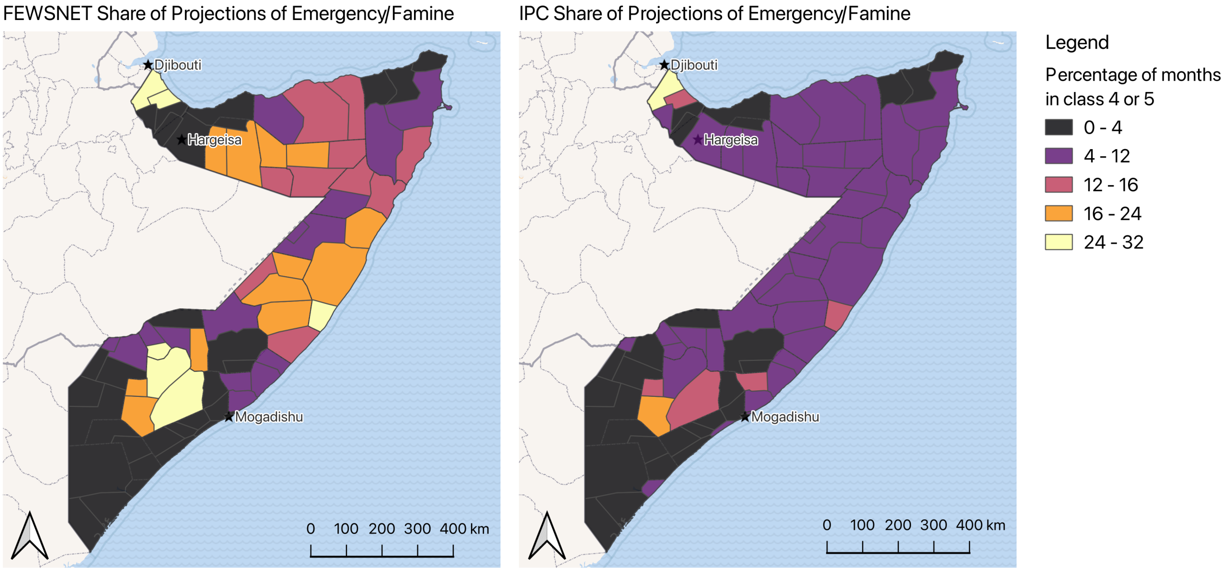

Figure 3. Spatial distribution of the percentage of months projected in Emergency or Famine conditions (IPC classes 4 or 5) across Somalia based on FEWS NET (left) and IPC (right) projections for the period 2017–2025. Percentages represent the share of all projected months in which a district was classified as class 4 or 5. The maps highlight pronounced differences between the two systems, with FEWS NET projecting substantially more high-severity conditions, particularly in central and north-eastern Somalia. Basemap source: OpenStreetMap.

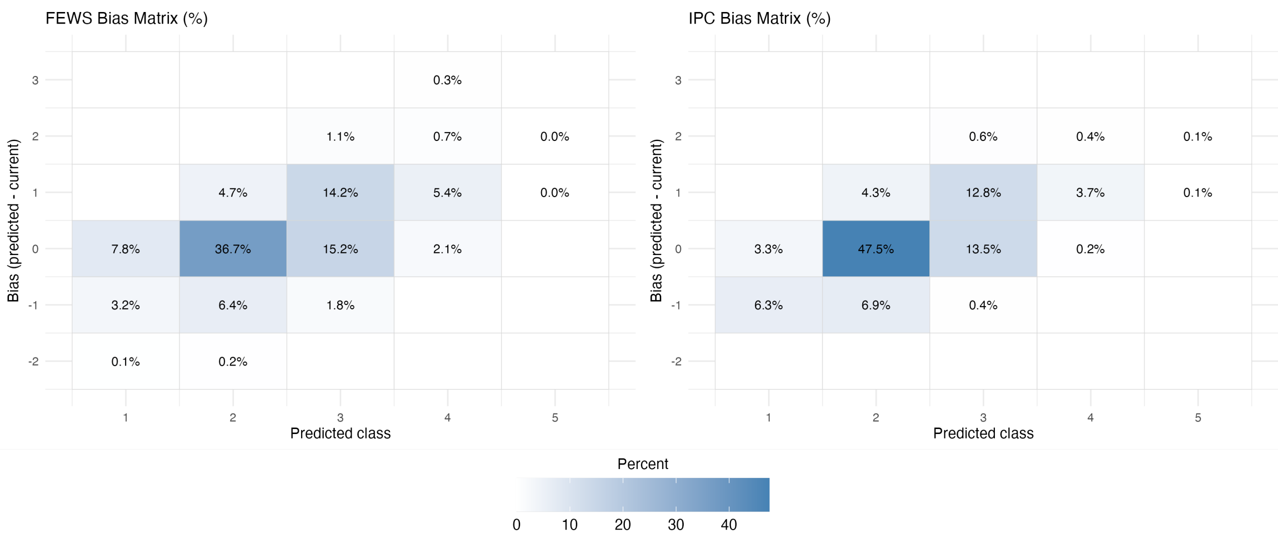

Figure 4. Bias matrices for FEWS NET (left) and IPC (right) projections comparing projected and subsequent current acute food insecurity classes across Somalia. The x-axis shows the projected class, while the y-axis shows the class difference between the projection and the subsequent current assessment (projected minus observed). Values indicate the percentage of all projection–assessment pairs falling into each category. Positive values indicate overestimation of food insecurity, negative values indicate underestimation, and zero indicates exact agreement between projected and observed class.

bias in both systems, with this tendency being more pronounced for FEWS NET.

The predominance of positive bias is also evident in the spatial distribution of mean district-level bias shown in Figure 6, although clear spatial variability exists. Most districts exhibit slight to moderate positive bias, with higher values concentrated in northern Somalia and Somaliland. In contrast, southern regions showed lower bias levels, with many districts clustered around zero. Both systems produced for very few districts a negative mean bias (one for FEWS NET and two for the IPC), and none displayed pronounced negative deviations. Overall, no region exhibited a strongly pronounced bias, as mean deviations did not exceed ± 0.5 IPC classes, indicating that projection bias remained moderate and showed no substantial spatial differentiation.

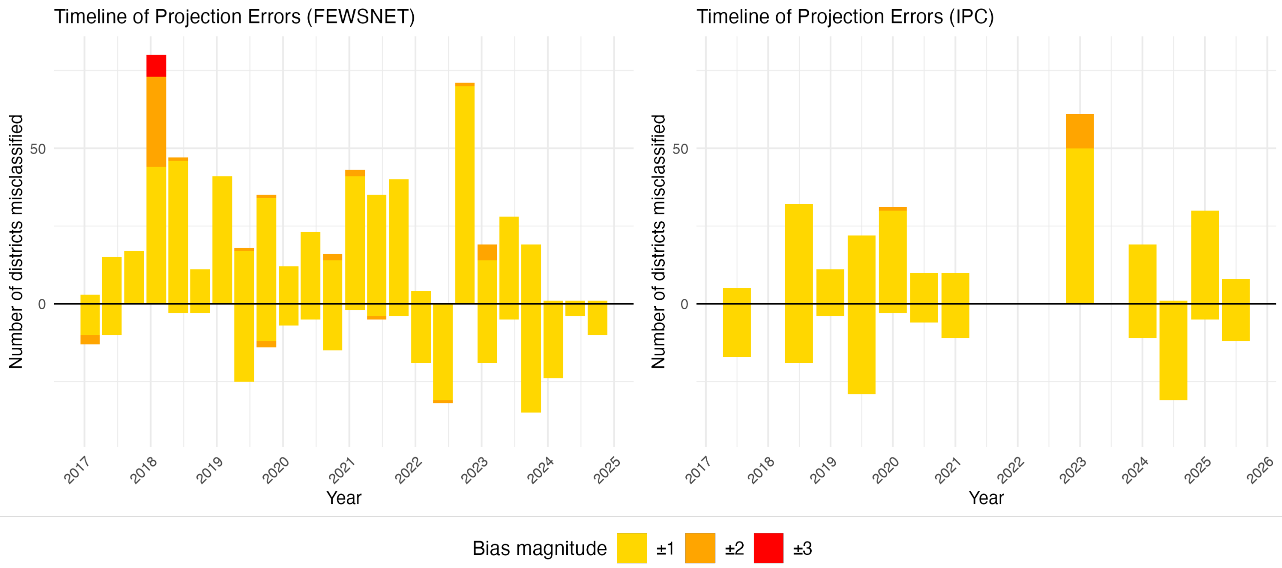

Figure 5. Temporal evolution of projection errors for FEWS NET (left) and the IPC (right), showing the number of districts with mismatches between projected and subsequent current acute food insecurity classes for each reporting period. Positive values indicate overestimation of food insecurity (projected class higher than observed), while negative values indicate underestimation.

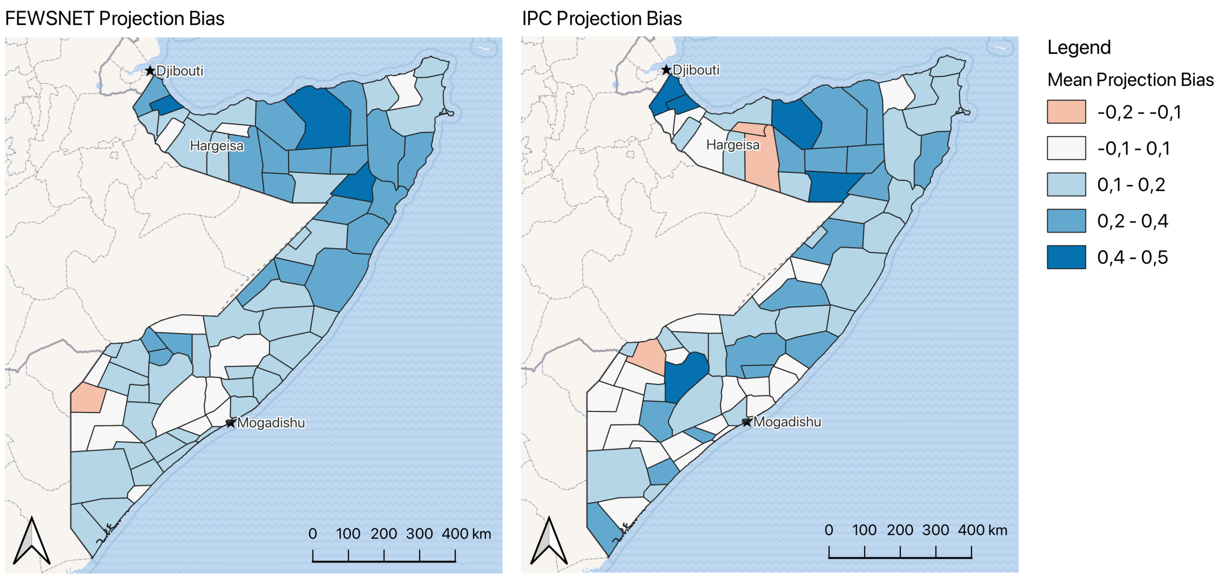

Figure 6. Spatial distribution of mean projection bias for FEWS NET (left) and IPC (right) across Somalia over the full study period. Bias is calculated as the mean difference between projected and subsequent current acute food insecurity classes (projected minus observed) across all paired projection–assessment periods. Positive values indicate systematic overestimation and negative values indicate underestimation. Basemap source: OpenStreetMap.

5 Discussion

Food insecurity data is a central component of anticipatory action frameworks, particularly in drought- contexts where they are frequently implemented as part of trigger systems. While their inclusion is essential for capturing impacts on livelihoods and resulting vulnerability, food insecurity indicators have inherent limitations when compared to more directly observable and forecastable parameters such as climatic indices like e.g. the SPI-12. Due to the multifactorial nature of food insecurity and the absence of a simple, fully quantitative measurement approach applicable across large populations and spatial extents, elevated uncertainty is to be expected. This uncertainty is reflected in the observed spatiotemporal differences between the analyzed FEWS NET and IPC classifications for Somalia. Nevertheless, despite identifiable discrepancies, the overall similarity in temporal trajectories, spatial patterns, and projection bias indicates that the multi-method approaches underpinning both systems capture food insecurity dynamics in a consistent way, supporting their application in anticipatory action frameworks.

According to the results, FEWS NET exhibited a systematic tendency to project higher food insecurity levels than the IPC, despite the two systems producing nearly identical mean values for current assessments. This divergence was most pronounced in the substantially higher frequency of *emergency* and *famine* projections produced by FEWS NET, a finding with direct implications for the operational use of these datasets in anticipatory action. In practice, FEWS NET's projections may offer greater sensitivity to emerging crises, potentially enabling earlier trigger activation, but this also potentially comes at the cost of a higher likelihood of acting in vain if predictions are overly pessimistic. This trade-off is particularly relevant in the design of AA systems, where premature or unnecessary interventions can carry significant financial and operational costs as resources for intervention are sparse. When employed within the same AA trigger framework, FEWS NET-based thresholds would have triggered substantially more frequently than IPC-based thresholds during the 2017–2025 period, particularly across central and northern Somalia. Consequently, any switch between classification systems must be carefully evaluated prior to operational implementation, as such substitutions can fundamentally alter trigger behavior, which is an issue underscored by recent scenarios in which practitioners were forced to rely on IPC data following temporary shutdown of FEWS NET operations due to USAID funding cuts.

Overall projection accuracy was moderate for both FEWS NET and IPC, consistent with findings reported by Bertetti et al. (2024), where FEWS NET´s projection accuracy for Somalia was among the lowest across all countries covered by FEWS NET acute food insecurity reports. The skill assessment showed higher accuracy for both systems in lower food insecurity classes (classes 1-2), indicating strong reliability for monitoring stable conditions and early deterioration. In contrast, accuracy declined and bias increased for classes 3-4, precisely where anticipatory action trigger decisions become most critical. The largest projection errors, which were predominantly positive, occurred towards the end or following major drought episodes such as the 2017 drought and the prolonged 2021–2023 drought (Ahmed Dirie et al. (2024), REACH (2023)), suggesting elevated uncertainty under crisis conditions and a tendency to overestimate persistence of drought impacts beyond the current crisis conditions. The predominance of positive bias, particularly for higher predicted classes, aligns with a precautionary early warning approach, where overestimation may be preferable to underestimation in humanitarian contexts. However, this tendency must be explicitly considered in trigger design, especially where limited resources make acting in vain costly. At the same time, mean district-level biases remained below ± 0.5 classes, indicating moderate deviations that rarely translated into systematic misclassification and supporting the continued operational use of both systems. Overall, the pronounced differences in projected *emergency* and *famine* frequencies, combined with the coexistence of positive and negative bias across districts within the same period, highlight the limitations of uniform national triggers and strongly support the need for spatially granular food insecurity assessments and trigger activation in anticipatory action frameworks.

Several methodological limitations should be considered when interpreting the results. In theory, a degree of self-referentiality between projections and subsequent assessments could contribute to the observed positive bias, as projections of severe food insecurity may trigger interventions that mitigate conditions by the time current assessments are conducted, an effect that aligns with the core principle of anticipatory action. However, given the still limited implementation of such measures in Somalia during the study period, a substantial influence of this mechanism is considered unlikely. The analysis is further constrained by limited data availability and the absence of a truly independent ground truth for validation beyond subsequent current assessments. It is therefore important to note that the skill assessment does not constitute an independent validation of predictive performance, but rather an assessment of internal consistency between projections and subsequent assessments, which may share underlying data sources, assumptions, and expert judgment. Differences in reporting schedules and data structures necessitate distinct pairing rules for FEWS NET and the IPC and prevent exact temporal alignment between projections and current assessment periods for the IPC data. This introduces an additional limitation that should be considered when interpreting the skill assessment, especially with regard to accuracy metrics. While this reduces strict comparability between the systems, the primary focus of the analysis was not prediction accuracy, which was broadly similar between the two systems, but rather the investigation of differences in projection bias across food insecurity classes and between the systems. These differences are more pronounced and more relevant for anticipatory action applications than accuracy alone. Similarly, differences in projection lead times between FEWS NET and the IPC represent a limitation. A fully standardized comparison would ideally require harmonized lead times; however, the analysis necessarily reflects the operational characteristics of the available data, and these differences should be considered when interpreting the results.

6 Conclusion

Food insecurity projections are an integral component of humanitarian decision-making and play a central role in the design of trigger frameworks for anticipatory action, particularly in drought contexts. This study compared acute food insecurity assessments from FEWS NET and the IPC, two of the most widely used systems for food insecurity assessment and projection, using Somalia as a case study for the period 2017–2025. Although both frameworks rely on a compatible five-class scale, they differ in their underlying methodological approaches, assessment cycles, and spatial representations. Through a spatiotemporal comparison and a projection skill assessment, this study evaluated the implications that differences in past assessments and projections have for the potential practical implementation of these systems in anticipatory action.

The analysis revealed a high degree of consistency between FEWS NET and IPC current assessments, both temporally and spatially, indicating broad agreement in the characterization of observed food insecurity conditions. Projections, however, showed greater divergence: FEWS NET projections displayed a tendency toward higher food insecurity levels than those of the IPC, most notably in the substantially higher frequency of projected Emergency and Famine conditions. This finding is highly relevant for the practical use of projections in anticipatory action, as FEWS NET–based thresholds would have potentially triggered considerably more often than IPC-based thresholds during the study period if, for example, the reaching of "Emergency" status was implemented as a threshold within a trigger system.

Projection accuracy was moderate for both systems and slightly higher for the IPC. For both frameworks, accuracy was highest for lower food insecurity classes and decreased toward higher classes, where anticipatory action decisions become most critical. Projection errors were dominated by positive bias, particularly for higher projected classes, reflecting a conservative forecasting tendency that reduces the risk of missed crises but increases the likelihood of premature or unnecessary action. Nevertheless, large errors were rare, and mean district-level biases generally remained below 0.5 classes, supporting the continued operational use of both datasets. Overall, the results demonstrate that FEWS NET and IPC projections are not directly interchangeable despite their shared classification scale. Dataset choice can substantially influence trigger behavior and response frequency, underscoring the need for careful, dataset-specific trigger calibration.

Declaration of Generative AI in writing

AI tools were only utilized for language editing, improving grammar, and sentence structure, but not for generating scientific content, research data, or substantive conclusions. All intellectual and creative work, including the analysis and interpretation of data, is original and has been conducted by the authors without AI assistance.

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Competing Interests

The authors declare no competing interests.

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