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Exploring Food Gaps for Right-Sizing Food Assistance

Methods, Data Challenges, and Lessons Learned

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ABSTRACT

Accurate measurement of the depth of acute food insecurity remains a major gap in current global monitoring systems. While the Integrated Food Security Phase Classification (IPC) identifies the scale and geographic distribution of populations in crisis, it does not quantify the magnitude of food intake shortfalls faced by affected populations. This paper outlines an exploratory data exercise that tests three proxy approaches to estimating food gaps using available IPC and DIEM data. First, we derive back-of-envelope caloric deficit estimates by IPC phase using thresholds from the Household Economy Approach. Second, we assess whether widely used dietary diversity, experiential food insecurity, and coping capacity indicators can serve as proxies for calorie deficits by analyzing their cross-indicator correlations. Third, using microdata from FAO's DIEM surveys matched to IPC area phases, we estimate indicator-specific shortfalls using a Foster-Greer-Thorbecke gap framework and translate these into food assistance estimates. The results show that proxy indicators cannot be used interchangeably to estimate caloric shortfalls, reflecting weak cross-indicator correlations consistent with the existing literature. Within-phase heterogeneity is wide and data limitations are substantial. The paper documents these approaches and their limitations as an intermediate step. The paper provides several recommendations for improving data collection that would allow for more reliable food gap estimates using the framework presented in this paper, which in turn could then operationalized for humanitarian agencies to 'right size' and better target food assistance to populations facing acute food insecurity.

Keywords: Acute food insecurity; Food gap measurement; IPC; Humanitarian assistance targeting

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1. Introduction

Levels of acute food insecurity are high and increasing. According to the Global Report on Food Crises (GRFC) over 295 million people across 53 countries and territories faced crisis-level or worse acute hunger in 2024, an increase of almost 14 million people compared to 2023 and a tripling since 2016 (FSIN 2025). The enormity of this challenge comes at a time when budgets for humanitarian assistance are being reduced, adding even more urgency to the need to ensure that food assistance is appropriately targeted.

The GRFC and existing early warning systems monitor and report on the number of people facing food insecurity and classify them by degree of urgency. They do not provide a measure of the "depth" of the problem, that is, a measure of the gap between actual food intake and minimum food needs. Obtaining estimates on the "acute food security gap" could help better inform policy makers and development agencies about the severity of an existing 'food crisis' and the extent to which the crisis is worsening or lessening, as well as regarding the amounts of humanitarian food assistance needed for the affected populations and avoid famine.

Many consider the Integrated Food Security Phase Classification (IPC) as the leading framework for monitoring and analyzing the severity of acute food insecurity and malnutrition, and its methodology underlies the estimates of the Global Report on Food Crises (FSIN 2025) and is also central for early warning, early action systems for addressing acute food insecurity crises.[1] IPC classifies populations into five phases, from Phase 1 (minimal) to Phase 5 (catastrophe/famine), based on multiple sources of information including dietary diversity, nutritional status, mortality rates, and coping strategies, combined with expert judgment. Phases 3 and above indicate the requirement for urgent assistance. Classification is conducted at sub-national administrative levels, with frequency and geographic coverage varying by country.

There is a growing body of literature aimed at further refining the current approaches to identifying acute food insecurity and its underlying risk factors, including use of machine learning models (Busker et al., 2024; Constenla-Villoslada et al., 2024; Shi et al. 2025). Some of these approaches use area IPC classification as the outcome variable for model training. Several studies have also shown that the indicators used in IPC phase classification capture distinct dimensions of food insecurity and are complementary rather than interchangeable (Maxwell et al., 2014; Maxwell et al., 2023). This literature, along with the IPC system itself, has improved our understanding of the nature of acute food insecurity and the ability to anticipate acute food crises. Less well addressed in this literature, however, is how to identify actual shortfalls in food intake among affected populations to inform governments and humanitarian and development agencies about the amounts of assistance needed to address acute food insecurity.

We respond to this information gap by investigating the extent to which existing data and methods can support the estimation of acute food gaps at national and subnational levels, and what such estimates imply for the 'rightsizing' of humanitarian food assistance. Given the limited availability of household consumption surveys with sufficient geographic disaggregation, we recur to three proxy approaches. The first uses standardized calorie deficit thresholds per IPC phase drawn from the Household Economy Analysis (HEA) framework as a crude approximation to calculate food assistance requirements for populations facing crisis-level or worse acute food insecurity. This approach assumes all individuals

[1] In this regard, the IPC is often referred to as the "gold standard" for identifying acute food insecurity. See e.g., Group of 7 (2021).

within a specific IPC phase face the same caloric deficit.[2] The second investigates correlations between these indicators and the calorie deficit estimates from the first approach, to assess how well the proxy indicators capture the underlying calorie gap. The third calculates per-phase deficits in IPC-related food security and nutrition indicators, such as dietary diversity scores and categorical hunger measures.

The findings highlight significant data and methodological challenges that currently constrain the reliability of food gap estimates. In particular, we find mostly low and insignificant correlations between the proxy food insecurity indicators and calculated calorie deficits, suggesting that indicators cannot be used to substitute for direct caloric deficit measurement and that each captures a distinct dimension of food insecurity rather than a common underlying shortfall. The paper tests three proxy approaches to estimating food gaps using available IPC and DIEM data, illustrates how indicator-based deficits can be translated into food assistance estimates, and draws lessons for improving food insecurity measurement.

The remainder of the paper is structured as follows. Section 2 provides background on the IPC framework and the food gap measurement problem. Section 3 describes the data. Section 4 sets out the methods for each of the three approaches. Section 5 presents results. Section 6 discusses limitations, and Section 7 concludes with recommendations for further research.

2. Context: measuring acute food insecurity and the IPC framework

Acute food insecurity is faced by people who are unable to afford or access essential food needs, and presents imminent risks of malnutrition, starvation, or death (IPC 2021a). While the risk of food insecurity is greater for those in humanitarian crisis contexts, a humanitarian crisis does not have to be present for countries to experience high levels of food insecurity.

While there are various measures for identifying food security, the IPC is the commonly used global scale for classifying the severity of acute food insecurity and malnutrition and for estimating the number of people affected at each severity level. It is distinct from other standard measures of hunger or chronic food insecurity, like the prevalence of undernourishment (PoU) or the Food Insecurity Experience Scale (FIES), as monitored by the FAO. These measures focus on monitoring chronic undernourishment and food insecurity at the national level. Chronic and acute food insecurity differ in terms of the time dimension and urgency for action (see e.g., FSIN 2025). The former refers to a long-term or persistent inability of people to meet minimum food consumption requirements, often linked to structural poverty conditions. Acute food insecurity relates to immediate, acute hunger, often linked to specific shocks (conflict, weather, or economic) and requiring immediate humanitarian response to save lives and livelihoods.

The IPC classification has proven to be very effective in informing governments, humanitarian and development agencies, and other stakeholders engaged in addressing food crisis situations, as it provides a shared framework for classifying a wide range of contexts. However, this classification of populations is typically based on multiple sources of both quantitative and qualitative data. As a result, it does not provide a directly observed, quantitative indicator of the degree of food insecurity. Based on the multiple pieces of information, it only provides a categorical classification of populations along IPC's five phases of degrees of severity of acute food insecurity. Phases 1 or 2 (minimal or stressed) indicate no immediate unmet food needs, while Phases 3, 4, and 5 (crisis, emergency, and catastrophe/famine) indicate increasing severity of unmet food needs and the requirement for urgent humanitarian assistance (IPC 2021a).

[2] HEA is one of the approaches IPC uses to identify degrees of acute food insecurity.

There are two groups of other indicators deployed in IPC assessments, though not consistently available to all. These indicators identify food consumption deficiencies but without quantifying actual food-intake shortfalls. The two types are ***dietary diversity indicators*** and ***experiential indicators***. Surveys that help estimate diet diversity indicators ask respondents about the number of different food groups consumed over a reference period. The Food Consumption Score (FCS) and the Household Dietary Diversity Score (HDDS) are considered dietary diversity indicators.

Experiential indicators are based on survey data containing questions about experiences related to anxiety about household food access, satisfaction regarding food preferences, food availability, and diversity, signs of food shortages in daily life, or reduced coping capacity to access food in the event of shocks (Headey & Ecker, 2012). The Food Insecurity Experience Scale (FIES), the Coping Strategy Index (CSI), the reduced Coping Strategy Index (rCSI), and the Household Hunger Score (HHS) are considered experiential indicators,

Definitions of each of these indicators can be found in Appendix A.1. None of these indicators, however, quantify the actual food intake shortfall. They do, however, provide a sense of whether households miss out on certain foods, as reflected in the FCS and HDDS, or whether they skipped meals or ate less over a specific reference period (FIES, HHS) or faced other difficulties in accessing food (CSI, rCSI). While some of these indicators can be applied to both acute and chronic food insecurity depending on the reference period used, the DIEM survey data used in this analysis apply short recall periods (typically 7 days) consistent with the assessment of acute conditions.

IPC distinguishes between household-level and area-level phase classifications. The area=level classification used in this publication is publicly reported based in IPC's '20% rule', that is, when 20% or more of the population in an area is found to be facing a particular degree of severity of acute food insecurity, then the area is classified as belonging to that phase.

3. Data

The analysis draws on two main data sources: the IPC population tracker and FAO's Data in Emergencies Monitoring (DIEM) database.

IPC data: Totals of people living in acute food insecurity are taken from IPC's population tracker at national and sub-national levels and at the frequency by which IPC assessments are available. This dataset is available from IPC. IPC phase classification is conducted at either administrative (admin) level 1 or level 2, depending on the country. We use the lowest admin level available in the IPC data for the time period of the analysis.

DIEM data. FAO's Data in Emergencies Monitoring (DIEM) database brings together indicators on food insecurity, dietary diversity, resilience of livelihoods, and coping mechanisms for food crisis countries, with data disaggregated at sub-national levels and at the household level. The indicators drawn from DIEM for this analysis are the Food Consumption Score (FCS), the Household Dietary Diversity Score (HDDS), the Household Hunger Score (HHS), the Food Insecurity Experience Scale (FIES), and the Reduced Coping Strategy Index (rCSI). Definitions and thresholds for each of these indicators are provided in Appendix A.1.

The DIEM database does not include information on how populations are classified by IPC phase. We therefore merged the IPC data with the DIEM indicator set by matching each DIEM observation to the IPC phase classification for the corresponding area and time period. We allowed for a window of three months before and after the survey and IPC assessment dates. Where multiple IPC analyses fell within this window for a given household and survey round, we retained the closest one in time. Thus, country inclusion in the analysis is based on the overlapping DIEM and IPC analysis data availability. Table 1 summarizes the coverage of the matched dataset by country. The matched sample covers 20 countries for the period 2020–2025. No areas classified as IPC Phase 5 are present in the matched dataset, reflecting the absence of DIEM survey coverage in areas of the most extreme food insecurity, itself an important limitation when assessing the depth of crisis at the most severe end of the scale.

To assess whether the matching procedure introduces any systematic bias in indicator values, Appendix A.2 compares the distribution of indicator scores in the full DIEM sample against the matched subsample by country. While this comparison cannot confirm representativeness of either sample relative to the broader population, it provides some reassurance that the matching does not systematically select areas or households with atypical indicator values.

Table 1 Number of districts with matched IPC and DIEM data by country and IPC Phase

Country	IPC1	IPC2	IPC3	IPC4
Afghanistan	0	4	43	3
Bangladesh	0	36	37	0
Burkina Faso	6	13	19	1
Cameroon	16	70	38	0
Central African Republic	0	1	128	32
Chad	3	27	22	0
Democratic Republic of the Congo	0	29	133	0
Guatemala	0	19	16	0
Honduras	0	9	9	0
Mali	134	35	7	0
Mozambique	1	145	103	0
Niger	25	22	2	0
Nigeria	14	246	145	1
Pakistan	0	17	127	1
Sierra Leone	10	77	13	0
Somalia	15	66	146	30
South Sudan	1	13	114	29
Sudan	0	14	31	2
Yemen	0	0	115	54
Total	225	855	1267	154

Source: Authors' estimates based on DIEM database.

4. Methods

To estimate acute food gaps, we explore three approaches of increasing complexity. The first uses assumed calorie deficit thresholds by IPC phase; the second assesses whether proxy food insecurity indicators can serve as substitutes for calorie deficit estimates; and the third redefines the food gap concept in terms of each indicator's own scale. Each approach is described in turn below.

4.1 Approach 1: Hypothetical average calorie-intake shortfalls by IPC phase

The first approach assumes an average shortfall in caloric intake vis-à-vis minimum requirements for populations in each IPC phase, applied uniformly across the population for each phase. We do so uniformly as we have no information about the distribution of calorie gaps among the population in each

IPC phase per area of residence. The shortfall is expected to increase with the severity of acute food insecurity from IPC Phase 1 to Phase 5.

We derive key assumptions for caloric and other dietary deficiencies and livelihoods deprivation from the thresholds established in IPC Protocols, as summarized in Table 2. Focusing on minimum daily calorie intake, we set the threshold at 2,100 Kcal per person per day, as used in WFP's Basic Food Basket. Using the correspondence between HEA thresholds and IPC phases established by Save the Children (2008) and Lawrence (2017), we define the following assumed average shortfalls per phase (Table 2, last row):

- 0% for food secure households (IPC 1)
- 0% for households with stressed food security (IPC 2), reflecting that these are able to satisfy minimum food requirements, albeit in some cases by depleting livelihood protection assets
- <20% for households in crisis-level acute food insecurity (IPC 3)
- 20%-50% for households in humanitarian emergency (IPC 4)
- >50% for households facing catastrophe/famine (IPC 5)

Table 2 Indicator Thresholds for the Food Consumption Component of the Acute IPC Household Reference Table

Indicator	1 – None	2 – Stressed	3 – Crisis	4 – Emergency	5 – Catastrophe
Phase description	Household group is able to meet essential food and non-food needs without engaging in atypical, unsustainable strategies to access food and income.	Even with any humanitarian assistance, household group has minimally adequate food consumption but is unable to afford some essential nonfood expenditures without engaging in irreversible coping strategies.	Even with any assistance, household group has food consumption gaps with high or above usual acute malnutrition OR Household group is marginally able to meet minimum food needs only with accelerated depletion of livelihood assets that will lead to food consumption gaps.	Even with any humanitarian assistance, household group has large food consumption gaps resulting in very high acute malnutrition and excess mortality OR Household group has extreme loss of livelihood assets that will lead to large food consumption gaps in the short term.	Even with any humanitarian assistance, household group has an extreme lack of food and/or other basic needs even with full employment of coping strategies. Starvation, death, and destitution are evident.
HHS	0	1 to 2	3	4	5 to 6
CSI	Reference, stable	Reference, but unstable	> Reference and increasing	Significantly > reference	Far > reference
rCSI	0 to 4	5 to 18	≥ 19		
HDDS	> 12	5 to 12	3 to 4	0 to 2	0 to 2
FCS	35 to 112+		13 to 34.5+	0 to 12.5	
FIES**	<-0.58	-0.58 - 0.36	>0.36	>0.36	>0.36
HEA	No livelihood protection deficit	Small or moderate livelihood protection deficit and no survival deficit (i.e., food intake shortfall)	Livelihood protection deficit ≥80% or survival deficit <20%	Survival deficit ≥20% but <50%	Survival deficit ≥50%

Source: IPC (2015, 2021b); Vaitla et al. (2015); and Cafiero (2024).
Note: *The standard FCS-based food consumption categories are: < 21 = "Poor," 21–35 = "Borderline," and > 35 = "Acceptable." In areas where oil and sugar are regularly consumed, the thresholds are adjusted as follows: < 28 = "Poor," 28–42 = "Borderline," and > 42 = "Acceptable."
† 42 to 112 for populations consuming oil and sugar daily. ‡ 13 to 41.5 for populations consuming oil and sugar daily.
** Please note that the FIES thresholds for IPC4 and IPC5 refer to median values with rather large variability across estimates for different contexts (see Cafiero et al. 2024).

While the indicator thresholds are not defined in academic peer-reviewed publications, they have been confirmed as part of expert consensus within the IPC protocol. Based on these assumed phase-specific deficits, food assistance requirements are estimated by multiplying the assumed caloric deficit by the size of the population in each phase. Total caloric needs are then converted to amounts of cereals and other staple foods using food balance sheet conversion factors from FAOSTAT (see Appendix A.3). Because the assumed average shortfalls are not based on direct empirical observations and in practice may vary from context to context, the approach allows for adjustment thresholds defining the shortfalls and instant re-estimate required food assistance by phase, country, area, and year, as applicable when context-specific evidence is available.

In addition to expressing the deficit in terms of calories and cereal equivalents, we summarize the aggregate food gap using a modified Foster-Greer-Thorbecke (FGT) index (Foster, Greer & Thorbecke, 1984), a well-established measure widely used in poverty analysis. With the inequality aversion parameter set to one (α=1), it is analogous to the standard poverty gap measure, applied here to food intake rather than income. The calorie gap index is estimated as the average distance of the population from the minimum caloric threshold of 2,100 Kcal per person per day, based on the assumed, phase-specific deficits and the share of the population classified in each IPC phase. This yields a single summary figure, ranging from 0 to 1, representing the average shortfall across the entire assessed population. A value of 0.05, for instance, means that on average, the population faces a caloric shortfall equivalent to 5% of the minimum daily requirement. We use this index to allow comparison of food gap severity across countries and over time, and to facilitate the cost calculations in Approach 3. Formally,

$$P_1 = \frac{1}{N}\sum_{i=0}^{q}\left(\frac{z - y_i}{z}\right)$$

where N is the total population, q is the number of individuals below the threshold z, and y_i is the assumed average caloric intake for the IPC phase of the i-th household. Note that in this approach y_i takes a single assumed value for all people classified in a given phase, in contrast to Approach 3 where y_i is observed at the household level.

4.2 Approach 2: Using correlated food insecurity indicators to derive caloric deficit estimates by IPC phase

The second approach assesses whether the dietary diversity and experiential food insecurity indicators available in the DIEM database can serve as proxies for caloric deficits by IPC phase. The relationship between these indicators and actual caloric intake has been examined before but only for a number of country-case studies. Marivoet et al. (2019), for instance, find a significant correlation between caloric intake and food consumption scores but conclude that a geographically disaggregated approach is needed to account for regional diversity in food systems. Wiesmann et al. (2009) find that the degree of correlation between the FCS and caloric intake varies widely across countries. Lovon and Mathiassen (2014) find a statistically significant but only moderately strong relationship, with correlation coefficients of around 0.2 in Honduras and 0.36 in Guatemala, reflecting the nature of the indicator as capturing dietary diversity rather than food quantities consumed, while Hussain et al. (2014) find that household dietary diversity scores show strong positive correlation with caloric intake but with substantial seasonal variation and a non-linear relationship.

While we do not have observed estimates of caloric deficits by IPC Phase in the DIEM database, we use the findings from Approach 1 to test the degree of correlation between the hypothesized caloric deficits and the other indicators used in acute food insecurity assessments, as well as amongst those other indicators. We test these across contexts at the district and household level. Specifically, we proceed in two steps.

First, we assess the degree of correlation between the prevalence and intensity of acute food insecurity by IPC phase and scores on the alternative indicators, using district/area level means from the matched IPC-DIEM dataset. For the food gap related indicators, we use both the prevalence (population share) of people in IPC 3+ and the average intensity (calorie gap) for people in IPC 3+, reflecting the assumed uniform deficits from Approach 1. We estimate Spearman rank correlation coefficients across districts and areas, which identify the degree to which the ranking of areas coincides across indicators. A value of 1 (or -1) indicates perfect correlation; a value of 0 indicates no association.

Second, we repeat the correlation analysis using the underlying household-level DIEM survey data, to assess whether results obtained from area-level means hold at the household level.[3] If sufficiently strong correlations are found, there could be a basis to use indicator values to proxy the food gap.

4.3 Approach 3: Estimating food gaps in terms of each indicator

The third approach redefines the food gap concept. Rather than measuring gaps in terms of caloric deficiency, it estimates the degree of deficit in terms of each indicator's own scale (i.e., dietary diversity, hunger experience, or coping capacity) and relates these to the cost of a minimum consumption basket to estimate required food assistance.

For each of the indicators, we apply the modified Foster-Greer-Thorbecke (FGT) gap index described in approach 1. The gap for each indicator is estimated as the average distance of households below (or above) the critical threshold defined for that indicator in the IPC technical manual (Table 2), calculated across the full matched household-level dataset.

We first estimate FGT indices across all matched countries and years to obtain average deficits by IPC phase (FGT0, the prevalence of households below the threshold; and FGT1, the average gap across the entire population). We then repeat this calculation by country and phase to obtain country-specific deficit estimates, which better account for the large cross-country variation in food insecurity conditions.

Finally, country-phase FGT1 values are multiplied by the total population in each IPC phase from the unmatched IPC assessments, and by the approximate cost of a basic WFP food assistance ration (USD 0.50 per person per day, multiplied by 365 days), to generate annual cost estimates of the food assistance required to fill the gap in each country and phase.

5. Results

5.1 Approach 1 results: Hypothetical average calorie-intake shortfalls by IPC phase

Using the assumed phase-specific caloric deficit thresholds described in Section 4.1, we calculate ranges of food assistance requirements for all food crisis countries with available IPC assessments. Table 3 summarizes the underlying assumptions, while Table 4 presents illustrative results for a number of selected countries for the latest available period.

Assuming a uniform caloric deficit across all households within each IPC phase, the required daily food assistance for Afghanistan would be approximately 1,029 MT of cereals in 2025, and around 928 MT for Bangladesh. These figures are illustrative of how food assistance needs can be derived from this framework, rather than operational estimates; the uniform per-phase deficit assumption is a strong

[3] The estimates of the proxy indicators per households are derived in principle form the same sample of households in each context and period of the IPC assessment.

simplification that, as shown in Section 5.3, is not supported by the within-phase distributions of the indicator data.

Table 3: Theoretical daily caloric deficits by IPC Phase

IPC Phase	Assumed caloric deficit (%)[a]	Assumed caloric deficit in KCal pp/pd	Assumed average consumption in KCal pp/pd	Assumed average deficit in cereals[b,c] kg/pp/pd
IPC1	0%	0	2,100.0	0.00
IPC2	0%	0	2,100.0	0.00
IPC3	10.5%	220.5	1,879.5	0.06
IPC4	35.5%	745.5	1,354.5	0.20
IPC5	50.0%	1,050.0	1,050.0	0.28

Source: Authors own estimations.
Note: a. Assumed caloric deficits are derived from the HEA survival deficit thresholds referenced in the IPC technical manual. For IPC Phases 3 and 4, the midpoint of the respective deficit range is used (10.5% for Phase 3; 35.5% for Phase 4). For IPC Phase 5, the lower bound of the range (50%) is used given the open-ended nature of the threshold. These are illustrative assumptions to show the application of assumed calorie gaps per phase.
b. Total calories are converted to metric tons of cereals using conversion factors identified in FAO's Food Balance Sheet methodology, i.e. 100g of cereals = 379 KCal. We note that for an adequate diet the minimum intake of Kcal must come from a more balanced food basket than just one based on cereals. With the assumption made here, the minimum food energy intake of 2,100 Kcal pp/pd would translate to about 0.55 kg of cereals pp/pd.
c. While the specific composition of this composite cereal equivalent will vary across countries, this approach provides a comparable global measure that can be adapted to any specific national context by respecifying assistance needs in terms of a local minimum food basket.

Table 4 Estimated food assistance requirements[a] (in MT of cereals)

Name of IPC analysis	No. people	Total gap mill. kcal	Calorie gap (FGT index)	Total gap MT cereal
Afghanistan - March 2025	14,687,175	3,802.5	0.03835	1,029.1
Bangladesh - Analysis: AFI April 2025	48,592,438	3,409.7	0.0168	927.8
Burkina Faso - Analysis March 2024	17,064,478	425.7	0.00735	115.6
Cameroon - Analysis November 2024	19,507,779	818.5	0.01405	222.0
Central African Republic - April 2025	1,863,845	742.9	0.0532	200.8
Chad - Analysis March 2025	11,218,359	595.0	0.01615	161.5
Guatemala - May 2025	7,933,489	931.2	0.02495	252.4
Honduras - Analisis CIF IAA Febrero 2025	4,539,379	454.2	0.0214	123.3
Mali - Analysis November 2024	19,690,848	209.0	0.0042	56.8
Mozambique - November 2022	16,119,683	894.6	0.013	242.3
Niger - Analysis November 2024	21,314,393	369.6	0.00525	100.4
Nigeria - Analysis November 2024	99,282,181	6,050.6	0.0126	1,643.6
Pakistan - November 2024	23,164,746	3,319.0	0.0306	898.2
Sierra Leone - Analysis March 2025	5,728,666	231.0	0.01405	62.7
Somalia - July 2025	9,576,841	1,082.2	0.0264	292.7
South Sudan - September 2024	2,635,000	2,322.0	0.08185	626.7
Sudan - May 2022	21,336,498	3,346.5	0.0335	904.0

Name of IPC analysis	No. people	Total gap mill. kcal	Calorie gap (FGT index)	Total gap MT cereal
Yemen - Analysis May 2025	7,270,040	6,521.1	0.08895	1,759.5

Note: a. Total caloric deficits and gaps in terms of MT of cereal equivalent are estimated based on single-point midpoint estimates, in accordance with the assumptions summarized in Table 3 and further explained in the text

b. FGT1 refers to the "food gap" equivalent of the "poverty gap as defined by the Foster-Greer-Thorbecke index, expressing the share of the population in IPC3+ times the average caloric food gap (as a share of minimum requirements). See Section 4.1 for further details.

5.2 Approach 2 results: correlates between food insecurity indicators

We studied the association between IPC acute food insecurity estimates (population and prevalence) and the scores for the following alternative indicators: the food consumption score (FCS), the Reduced Coping Strategies Index (rCSI), the Food Insecurity Experience Scale (FIES), the Household Hunger Score (HHS), and the Household Dietary Diversity Score (HDDS). A value of 1 (or -1) for the Spearman rank correlation coefficient means a perfect correlation and a value of 0 when there is no association at all. Given the way they are defined, the indicators FCS, rCSI, and HDDS (lower values mean higher food insecurity risk) are expected to show a negative correlation with the other indicators.

Using district/area level means, we find that while all signs are as expected rank correlations across the acute food insecurity indicators across areas/districts in food crisis countries are generally weak (see Table 5a). Unsurprisingly, we do obtain a very high correlation coefficient (0.98) between the *prevalence* (FGT0) and *intensity* (FGT1) of acute food insecurity of people in IPC Phases 3 and above. The next strongest association is between the FIES and rCSI (0.73). All other indicators show weaker rank correlation. Even the two dietary diversity indicators, the food consumption score (FCS) and the household diversity score (HDDS), show moderate to weak correlation (0.55) when compared through the means at the district/area level. Correlations between the calorie gap and other indicators are all low at less than |0.42|.

Table 5a Spearman rank correlation coefficients between acute food insecurity indicators (based on district/area means)

variable	FIES raw score	Food consumption score	RCSI score	HDDS score	HHS 3+ Population Share	Population share in phase 3+	Kcal gap index
FIES raw score	1						
Food consumption score	-0.48	1					
RCSI score	0.73	-0.23	1				
HDDS score	-0.4	0.55	-0.25	1			
HHS 3+ Population Share	0.68	-0.24	0.62	-0.31	1		
Population share in phase 3+	0.43	-0.3	0.27	-0.18	0.25	1	
Kcal gap index	0.42	-0.29	0.27	-0.17	0.25	0.98	1

Source: Authors' calculations based on DIEM database (district level data)
Note: Indicators in table are as defined in the text. Correlation coefficients higher than |0.6| are shaded in green, while moderate correlations of between |0.4| and |0.6| are shaded in yellow. Light red shaded cells are considered to reflect low (less than |0.4|) or insignificant correlation.

Table 5b Spearman rank correlation coefficients[a] between acute food insecurity indicators (based on household level-data)

Variable	FIES raw score	FCS	rCSI score	HDDS score	HHS score
FIES raw score	1				
FCS	-0.38	1			
rCSI score	0.67	-0.3	1		
HDDS score	-0.25	0.46	-0.21	1	
HHS score	0.84	-0.32	0.54	-0.24	1

Source: Authors' calculations based on DIEM database (household level data)
Note: Indicators in table are as defined in the text. Correlation coefficients higher than |0.6| are shaded in green, while moderate correlations of between |0.4| and |0.6| are shaded in yellow. Light red shaded cells are considered to reflect low (less than |0.4|) or insignificant correlation.
a. The Spearman rank correlation coefficient is calculated across all matched household-survey observations that have non-missing values across all indicators. See Table A6 for a full breakdown of indicator completeness (at the household level) by country.

Performing the correlation analysis with household level data yields similar findings to those based on district level means (Table 5b). Since we do not have household level identification of Kcal gaps, we only have findings for the other food insecurity indicators. Furthermore, the DIEM database includes household-level estimates for the FIES raw scores for a limited number of cases for the years 2022 and beyond only. Bearing this limitation in mind, the rank correlation between FIES, on the one hand, and rCSI and HHS, appears somewhat stronger with the household level data. Rank correlations between the other variables, however, are even somewhat weaker when using the household level estimates.

These findings suggest there is no obvious way to use these indicators as proxies for estimating calorie gaps. The FIES and Hunger Score (HHS) are conceptually related as these indicators try to measure experiences with shortfalls in quantities of food intake. This similarity is confirmed to a certain degree only by the data as we find relatively high rank correlations larger than |0.6|, though far from perfect (1) correlations. The FCS and HDDS indicators are also conceptually similar, as these measure shortfalls in dietary diversity. Nonetheless, we do not find any strong correlation between the two, neither at the district nor at the household level. The reduced coping strategy index (rCSI) is also weakly correlated with the other indicators, suggesting reduced coping is complementary rather than a substitute for the other acute food insecurity related measures.

These results are broadly consistent with the existing country-case literature on indicator interchangeability. Marivoet et al. (2019), Wiesmann et al. (2009), and Lovon and Mathiassen (2014) all find that correlations between dietary diversity indicators and caloric intake are moderate at best and highly context-specific, reflecting the fact that indicators like the FCS capture dietary quality rather than food quantities consumed. Hussain et al. (2014) similarly find that while household dietary diversity scores correlate with caloric intake, the relationship is non-linear and subject to substantial seasonal variation. Our findings, while more limited in scope and rigor, point in the same direction: cross-indicator correlations are weak, and substitution across indicators for the purposes of food gap estimation is difficult to justify.

5.3 Approach 3 results: estimating "food gaps" in terms of each indicator

Lacking a solid basis for estimating caloric food gaps, we define the gap specifically for each food security indicator. We first assess the distributions around the means for each IPC phase of the five food insecurity indicators that are part of the suite of indicators used in IPC assessments. We subsequently use the household-level data to estimate “gaps” measured as the difference between the observed indicator score for each household and the critical threshold as defined for each indicator (see Table 2 above).

5.3.1 Household distributions of proxy indicators

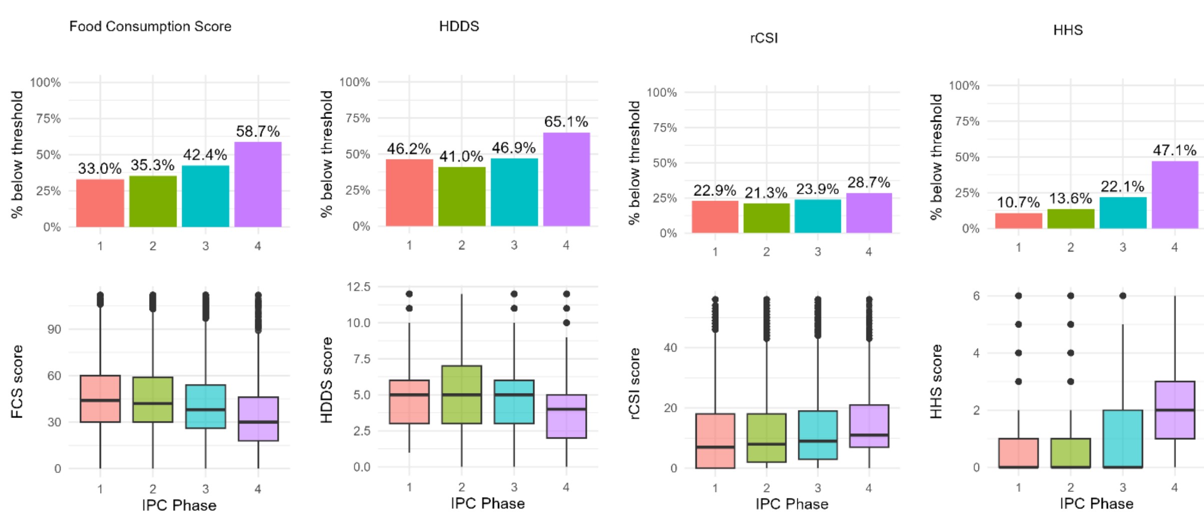
For the matched data, we further analyzed the distributions of district- and household-level mean scores by IPC phase. We do not report findings for IPC5 because of a lack of observations. Both district- and household-level assessments yield similar results, so we confine the presentation of results to the household level data. Summary indicators for each indicator are presented in Table 6, and distributions are shown as box plots in Figure 1. After excluding implausible observations at the extremes (i.e. exceeding theoretically possible values), we calculate the distributions and means using all observations by country and available years.

Table 6 Means of proxy food insecurity indicators by IPC phase (household level data)

IPC Phase	FCS	HDDS	rCSI	FIES (raw score)	HHS
IPC 1	46.4 (21.8)	4.7 (2.3)	11.0 (13.5)	2.9 (3.1)	0.6 (1.2)
IPC 2	45.2 (21.4)	5.2 (2.4)	11.6 (11.6)	4.0 (3.3)	0.8 (1.2)
IPC 3	42.4 (20.7)	4.9 (2.3)	12.4 (11.5)	4.8 (3.3)	1.1 (1.4)
IPC 4	36.4 (20.4)	4.1 (2.3)	14.5 (12.0)	5.9 (2.8)	1.7 (1.5)
Overall	43.3 (21.0)	5.0 (2.4)	12.1 (11.7)	4.5 (3.3)	1.0 (1.3)
Threshold	35	3	19	n.a.	3

Note: mean (SD). FIES available for 2023+ data only
Source: Authors’ calculations based on DIEM database.

Figure 1. Distribution of food insecurity indicators around medians by IPC Phase (household level data)



Source: Authors’ calculations based on DIEM database.

Several key features stand out that further complicate finding proxies for food gaps across the IPC analyzed data:

a. Since we could only match households to IPC phases identified at the district level, we find **overlapping distributions across phases**. That is to say, one can find households with critically poor scores on the proxy food insecurity indicators in districts labelled as IPC Phase 1 or 2 (no food insecurity) and one may find households with satisfactory scores (above critical thresholds) in districts identified as IPC 3 and 4. It implies that to estimate "food gaps" as accurate as possible, one would need to (i) estimate food gaps for all households across all IPC phases and (ii) avoid geographic targeting by district because of potentially large inclusion and exclusion errors.

b. **Means by IPC Phase generally follow the expected pattern**, that is, depending on the definition of the indicator, decreasing (FCS and HDDS) or increasing (rCSI, HHS, FIES) by worsening acute food insecurity according to the IPC phases (Table 6).

c. Even for the most severe phase with data (IPC Phase 4), **no indicator mean crosses its critical threshold**. The dispersion is particularly high for the rCSI and HHS, both showing implied coefficients of variation larger than 1.[4]

Overall, these findings suggest that using means by IPC phase would be a poor guide for approximating food gaps and showing the need to use household level data.

5.3.2 Food gap estimates for each proxy indicator

Bearing the caveats and limitations indicated in the previous section in mind, we proceeded with estimating the FGT indices for each of the proxy indicators to provide alternative food gap estimates in the terms of each of those indicators. While we do not attribute any immediate operational meaning to these estimates, our objective is to show how this could be done such that governments and humanitarian and development agencies could identify needs for assistance to food insecure populations in different dimensions.

Using the IPC area phase classifications matched to DIEM household survey data, we identify the share of the population (prevalence) in deficit and the average degree of shortfall to calculate the "food gaps" consistent with the FGT index as defined in Section 4.1 in the same way as applied for the first, naïve approach. Using this matched data, our objective is to calculate FGT1 values that can be associated with IPC phases in order to better understand the shortfalls and associated resources required when an area is classified in a certain IPC phase. Thus, we make this calculation by phase (across the entire matched data) and by country and phase for country specific deficits. Table 7 summarizes the first, i.e. estimates for the prevalence and "gap" for each indicator by IPC Phase (across all food crisis countries in the DIEM database and across all available years (2021-2025).

As already noted in the previous sub-section, the findings show that there are people in need in all IPC Phases (as classified at the district level). For the dietary diversity indicators, more than one third of households in IPC Phases 1 and 2 have scores below the minimum threshold for dietary diversity, and the average shortfalls across households that are in districts classified in Phases 1 and 2 are in the range of about 10-20% (Table 7). For IPC Phases 3 and 4, the average shares of the population with dietary diversity shortfalls increase to between 42-59% with average shortfalls in the population ranging from 15-35%. The household hunger score and reduced coping strategies index shares and average deficits are in similar ranges as the dietary diversity indicators.

We follow the same procedure to estimate the dietary and coping capacity deficits at the country level, and not surprisingly, the estimates suggest very large differences in need across countries (Table 8). To improve upon Approach 1 where we did not take into account country heterogeneity, we calculate deficits for the various indicators by country and phase, so that each country is associated with an average deficit,

[4] The coefficient of variation is defined as the standard deviation divided by the mean.

which we then use with unmatched IPC data to calculate response requirements. These results are shown in Table 8. For simplicity, we include only the food consumption score deficits, but calculations for all indicators are available in the appendix (A.4 and A.5).

Table 7 Dietary and coping capacity FGT indices by IPC Phase

IPC Phase	FCS			HDDS			HHS			rCSI		
	FGT0	Avg Gap	FGT1	FGT0	Avg Gap	FGT1	FGT0	Avg Gap	FGT1	FGT0	Avg Gap	FGT1
IPC 1	0.33	0.3	0.1	0.46	0.46	0.21	0.11	0.67	0.07	0.23	0.65	0.15
IPC 2	0.35	0.32	0.11	0.41	0.44	0.18	0.14	0.62	0.08	0.21	0.55	0.12
IPC 3	0.42	0.34	0.15	0.47	0.44	0.21	0.22	0.62	0.14	0.24	0.57	0.13
IPC 4	0.59	0.44	0.26	0.65	0.53	0.34	0.47	0.7	0.33	0.29	0.57	0.16
Overall	0.4	0.34	0.14	0.46	0.45	0.2	0.2	0.63	0.12	0.23	0.57	0.13

Source: Authors' calculations based on DIEM database
Note: FGT0 = prevalence or share of population in need (below or above critical threshold defined for each indicator); the average gap is the average gap among households under the threshold; FGT1 = the prevalence (FGT0) times the average shortfall ("gap") for people in need against the threshold for each indicator.

Table 8 FCS FGT indices by country and IPC Phase

Country	FCS gap IPC 3		FCS gap IPC 4	
	FGT0	FGT1	FGT0	FGT1
Afghanistan	0.6	0.2	0.8	0.4
Bangladesh	0.6	0.5		
Burkina Faso	0.6	0.2	0.6	0.2
Cameroon	0.4	0.2		
Central African Republic	0.4	0.2	0.4	0.1
Chad	0.3	0.1		
Democratic Republic of the Congo	0.3	0.1		
Guatemala	0.1	0		
Honduras	0.1	0		
Mali	0.5	0.2		
Mozambique	0.4	0.1		
Niger	0.6	0.3		
Nigeria	0.6	0.2	0.2	0
Pakistan	0.3	0.1	0.8	0.4
Sierra Leone	0.4	0.1		
Somalia	0.5	0.2	0.6	0.2
South Sudan	0.7	0.3	0.8	0.4
Sudan	0.3	0.1	0.7	0.2
Yemen	0.3	0.1	0.4	0.1

Source: Authors' calculations based on DIEM database
Note: FGT0 = prevalence or share of population in need (below critical threshold of 35 defined for the FCS indicator): FGT1 = the prevalence times the average shortfall for people in need against the threshold for the FCS indicator. The table only shows the FGT measures for the Food Consumption Score. The "gap" estimates for all indicators can be found in Appendix A.4 and A.5.

We then use the "food gaps" (i.e., the FGT1 deficit measures shown in Tables 7 and 8) to calculate the possible cost of certain interventions based on IPC phase classifications and the population in those phases. We use the IPC data (to clarify, not the IPC data matched to household survey data but the IPC data covering all analyses, which includes by area the total population, the overall phase classification, and the share of the population classified into IPC 1-5). The average gaps by phase can then be multiplied by whatever unit is considered relevant in a particular response context. For example, one stopgap "solution" would be to cover the gap either through food distribution, cash transfers or asset protection. For example, for a crude approximation of the cost to fill the gap, we use the average cost of a basic WFP balanced food aid package, with an approximate value in today's prices of $0.50 per person per day, which we multiply by 365 days.[5] We then multiply this value by the FGT1 value for that country and phase (previously calculated from the matched data), and the total population in that phase. This total value per phase in millions of USD is then summed across phases 3 and 4 to output a total cost of action to fill the gap. Table 9 shows total costs associated with the gaps using the FCS, and Table 10 shows the same for each indicator.

Table 9 Annual cost estimates per country based on average FCS gaps.

Country	Year	FCS gap IPC 3			FCS gap IPC 4			Total cost
		Population	FGT1	Cost*	Population	FGT1	Cost*	Total cost*
Afghanistan	2025	10635326	0.18	349.4	1954959	0.45	160.6	509.9
Bangladesh	2025	15463347	0.5	1411.0	0			1411.0
Burkina Faso	2024	1673313	0.22	67.2	76124	0.2	2.8	70.0
Cameroon	2024	2814832	0.16	82.2	265314			82.2
Central African Republic	2025	1743894	0.16	50.9	480660	0.14	12.3	63.2
Chad	2025	2186341	0.08	31.9	151432			31.9
Congo - Kinshasa	2024	22436761	0.09	368.5	3115990			368.5
Guatemala	2025	3106988	0.03	17.0	330145			17.0
Honduras	2025	1669230	0.04	12.2	115602			12.2
Mali	2024	882670	0.19	30.6	19239			30.6
Mozambique	2025	1946717	0.11	39.1	142893			39.1
Niger	2024	1475127	0.26	70.0	59421			70.0
Nigeria	2025	24216127	0.2	883.9	679974	0	0.0	883.9
Pakistan	2024	9283376	0.1	169.4	1706195	0.36	112.1	281.5
Sierra Leone	2025	854530	0.11	17.2	57075			17.2
Somalia	2025	2799645	0.21	107.3	623610	0.24	27.3	134.6
South Sudan	2024	4564000	0.34	283.2	1707000	0.41	127.7	410.9
Sudan	2024	14603918	0.07	186.6	6554877	0.18	215.3	401.9
Yemen	2025	11925426	0.08	174.1	5220058	0.11	104.8	278.9

Source: Authors' calculations based on DIEM database
Note: Using the DIEM household data, FCS gaps were calculated per household, with 0 gap for those over the threshold of 35. These gaps were averaged across all households per phase. The average gap was then multiplied by the population in that phase and by the associated cost of a full ration (.5 USD * 365). ** Cost in millions USD (annual)*

It is important to note that the population values in each phase are taken from the IPC analysis for the given year with the greatest population coverage, since many countries have more than one analysis per

[5] In 2021, the World Food Program's average daily cost per direct beneficiary was USD 0.38 (USD 0.33 for food transfers, USD 0.50 for cash-based transfers and USD 0.35 for commodity vouchers).

year. We provide the cost estimates in Tables 9 and 10 to illustrate how under this approach the food assistance needs can be identified in each context, as well as adjusted if further information is available about actual dietary deficits by IPC Phase and the local costs of the basic food ration. Table A.7 in the appendix presents these gap indices (FGT1) over time, illustrating how the specific years selected for Tables 9 and 10 compared to other years.

Table 10 Annual cost estimates per country for all indicators

Country	Year	Cost using FCS gaps (mill. USD)	Cost using RCSI gaps (mill. USD)	Cost using HDDS gaps (mill. USD)	Cost using HHS gaps (mill. USD)
Afghanistan	2025	509.9	360.2	653.4	311.4
Bangladesh	2025	1411.0	0.0	112.9	56.4
Burkina Faso	2024	70.0	100.6	115.9	29.2
Cameroon	2024	82.2	128.4	82.2	87.3
Central African Republic	2025	63.2	73.6	120.4	131.1
Chad	2025	31.9	12.0	35.9	27.9
Congo - Kinshasa	2024	368.5	859.9	737.0	859.9
Guatemala	2025	17.0	73.7	73.7	28.4
Honduras	2025	12.2	60.9	48.7	24.4
Mali	2024	30.6	66.0	24.2	46.7
Mozambique	2025	39.1	53.3	78.2	49.7
Niger	2024	70.0	140.0	70.0	24.2
Nigeria	2025	883.9	883.9	715.8	618.7
Pakistan	2024	281.5	245.9	585.8	129.7
Sierra Leone	2025	17.2	12.5	45.2	9.4
Somalia	2025	134.6	239.7	174.3	173.8
South Sudan	2024	410.9	41.6	471.2	478.4
Sudan	2024	401.9	516.7	368.7	273.0
Yemen	2025	278.9	391.8	341.5	144.2

Source: Authors' calculations based on DIEM database

6. Limitations

This paper is best understood as a data exploration exercise of possible approaches for approximating food gaps, rather than as a definitive estimation exercise. Motivated by a real gap in humanitarian information systems, we tested three approaches to approximate food gaps using available data, each with known shortcomings that preclude treating the resulting estimates as operationally reliable. We document what we did and what we found to inform future work on addressing this gap.

Approach 1 is explicitly back-of-envelope. The assumed caloric deficits per IPC phase are derived from HEA thresholds that represent expert consensus rather than empirically validated estimates, and the assumption that all households within a phase share the same deficit is a strong simplification, one that is directly contradicted by the wide overlapping distributions of indicator values across phases documented in Section 5.3.1. The 2,100 Kcal per person per day threshold is also a simplification; the appropriate minimum varies by country depending on the age and sex composition of the population, and using a uniform threshold likely overstates the share of the population in deficit relative to more context-specific approach.

Across all three approaches, a more fundamental limitation remains unresolved: none of the available indicators directly measure actual food intake. Until representative food consumption survey data, collected at sufficient geographic disaggregation to be matched to IPC phase classifications, become available for food crisis countries, any food gap estimate will rest on assumptions or proxies that carry substantial uncertainty. This is not a limitation that can be resolved through methodological refinement alone; it requires investment in data collection.

7. Conclusions and recommendations for further research

While there are well-established approaches for classifying areas and populations by the severity of acute food insecurity, there are no adequate data for measuring the depth of food-intake shortfalls. This leaves governments and aid agencies with estimates of the number of people who may need food assistance, but not how much assistance is needed to cover those shortfalls. This paper is an exploratory data exercise, an intermediate step that tests what can and cannot be done with currently available data and methods to approximate food gaps associated with IPC phase classifications. We are candid about the limitations of each approach, and the paper is not intended to provide operational estimates at this stage.

The first approach provides a back-of-envelope estimation of caloric deficits by IPC phase based on HEA thresholds. Its main limitation is the reliance on uniform assumed deficits across all households within a phase. That said, by making the approach and its assumptions fully transparent, it could prove useful in country contexts where practitioners have access to context-specific information on the depth of need by phase and wish to adjust the assumptions accordingly. Used in that way, it provides an adjustable starting point for food assistance planning rather than a definitive estimate.

The second approach finds, broadly in line with the existing literature on food security indicators, that the available proxy indicators cannot be substituted for one another and cannot be used interchangeably to proxy caloric shortfalls. The weak cross-indicator correlations we document confirm that each indicator captures a distinct dimension of food insecurity. Had we found strong correlations, it might have been possible to use the distribution of indicator gaps by phase as a reliable proxy for caloric deficits. We do not find this and therefore conclude that there is no solid empirical basis for using any of the available proxy indicators as a substitute for direct caloric deficit measurement.

The third approach estimates food gaps in the terms of each indicator's own scale using the FGT framework. By calculating the distance of individual households from the IPC technical manual thresholds for each indicator and scaling these up to population-level cost estimates, we illustrate how such a framework could inform, in principle, food and other humanitarian assistance that is targeted on the basis of different dimensions of food insecurity. We present this as a first exploratory step in that direction rather than a ready-made tool. Moving towards any practical application would require at minimum two things: a review and empirical validation of the indicator thresholds currently specified in the IPC technical manual and further empirical work associating caloric deficits with specific indicator values across food crisis contexts, which would allow the indicator-based gaps to be grounded in actual food intake shortfalls.

More broadly, the findings point to a clear research and data agenda comprising at least four elements:

- The first involves the validation of the surveys and survey methods for each indicator. While the FAO DIEM data has large coverage, we cannot say with certainty that after matching IPC and DIEM data, the households in areas classified by IPC phase are representative at that area level. This means it is not possible to estimate confidence intervals for the gap estimates for each indicator. More country and round specific information about sample design is needed from the DIEM database.

- Second, in this paper we identified gaps against the threshold values for the various food insecurity indicators as specified in the IPC technical manual. These thresholds are currently under review by IPC partners and any change to those thresholds would require re-estimating the food gaps. A "food gap" monitoring system could be set up such that users would be able to adjust the thresholds and get updated gap estimates instantaneously.

- Third, clearly more research is needed to better understand and better measure the degree of (caloric) food shortfalls associated with each IPC Phase of acute food insecurity. Such research could initiate with analyzing the relationship between acute and chronic food insecurity and malnutrition. This will require using actual food consumption data from household expenditure surveys (or alike) which are representative at the sub-national level to allow matching households with IPC Phases and include differential reference periods for food consumption to identify both acute and chronic undernourishment. Not many food-crisis countries will have household surveys available with such characteristics, so this research may need to commence with a limited set of country cases.

- Fourth, further analysis with the DIEM database itself is needed to identify context-specific factors that determine food security outcomes across each of the indicators to understand better why we find low correlations between them. Such assessment could make use of the machine-learning techniques applied for the estimation of predictive models of acute food insecurity (e.g., Busker et al., 2024; Constenla-Villoslada et al., 2024; Shi et al. 2025). By incorporating the DIEM database into the datasets used for those models it may be possible to better understand the extent to which different food crisis risk factors determine not only the extent but also the severity and depth of acute food insecurity.

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Appendix A.1 Description of key acute food security indicators and thresholds

A.1.1 Thresholds for key acute food insecurity outcomes by IPC Phase, according to the IPC Protocol

	IPC1 Food secure	**IPC2 Stressed**	**IPC3 Crisis-level acute food insecurity**	**IPC4 Emergency**	**IPC5 Catastrophe/ Famine**
Mortality rate Crude (per 10,000/day) Under 5 (per 10,000/day)	<0,5	<0.5 <1.0	0.5 – 1.0 1.0 – 2.0	1.0 – 2.0 >2.0	>2
Nutritional status (0-5) Wasting Stunting	<3% <20%	3%-10% >20%	10%-15% and increasing	>15% and increasing	>30%
Food access/availability Kcal per person per day	>2,100 Stable	~2,100 unstable	~2,100 via asset depletion or <2,100	Significantly <2,100	Severely <2,100
Dietary diversity	Adequate	Chronic deficit	Acute deficit	<= 3 food groups consumed	-
Asset use/coping strategy	Sustainable	Unsustainable	Accelerated and critical depletion/loss	Near complete and irreversible loss	Complete loss/livelihood collapse

Source: Adapted from Lawrence (2017)

A.1.2 HDDS (Household Dietary Diversity Score)

The HDDS is an indicator developed by Food and Nutrition Technical Assistance (FANTA) and promoted by FAO. It aims to reflect the economic ability of a household to access a variety of foods and is based on households' self-reporting of the number of food groups consumed in the previous 24 hours. IPC cut-offs have been prepared for HDDS with 12 food groups, based on FANTA/FEWS NET Household Food Consumption Indicator Study. The HDDS sums the total number of food groups (out of 12 possible groups) that any member in the household has consumed over the previous 24 hours. Only foods consumed in the home are counted in this indicator, and each food group is equally weighted for a total possible score ranging from 0 to 12.

The 12 food groups HDDS captures are: cereals, root and tubers, vegetables, fruits, meat and poultry, eggs, fish and seafood, pulses and legumes, milk/dairy products, fat and oil, sugar, and other miscellaneous foods.

The HDDS guidelines state that normative data on ideal/target scores for the indicator are usually not available, but that context-specific thresholds can be developed.

The "new" *acute IPC indicator thresholds for HDDS* are:

- HDDS of 5-12 with no recent deterioration (Phase 1)
- HDDS of 5-12 with recent deterioration/loss of one food group from a typical HDDS (Phase 2)
- HDDS of 3-4 (Phase 3)
- HDDS of 1–2 (Phase 4 and 5)

A.1.3 FCS: Food consumption score

The FCS is an indicator adopted by WFP and collected in all assessments and monitoring activities of WFP. The FCS is a composite score based on the number of food groups (out of 8 possible food groups) that any household member has consumed over the previous 7 days, multiplied by the number of days that the food group was consumed, weighted by the nutritional importance of the food group, for a total possible score ranging from 0 to 112.

Based on standard thresholds, households are classified into one of three food consumption groups: poor, borderline, or acceptable, with scores of ≤21, 28 and 35, respectively, except in situations of high oil and sugar consumption, for which the cut-offs used for the same groups are ≤28, 35 and 42, respectively. These same groupings are used as cut-offs for different phases in the IPC Acute Food Insecurity Reference Table.

Only foods consumed in the home are counted in this indicator. Broad food groups and associated FCS weights are: main staples—weighted at 2, pulses—weighted at 3, vegetables—weighted at 1, fruit—weighted at 1, meat and fish—weighted at 4, milk—weighted at 4, sugar—weighted at 0.5, and oil—weighted at 0.5. (Condiments can also be captured but are weighted at 0).

Thresholds are imposed on the continuous score to differentiate households into one of three categories:

- FCS > 35 (or 35-112) "acceptable" in areas where oil and sugar are consumed regularly (Phase 1 and 2)
- FCS 13 - 34.5 "poor" (IPC 3)
- FCS 0 - 12.5 "severe" (IPC 4 and 5)

A.1.4 HHS: Household Hunger Score

The HHS is based on three questions capturing experiences that proved to be the most universal in terms of interpretation but also the most severe. These experiences include: having no food of any kind in the household, going to sleep hungry because there was not enough food, and going a whole day and night without eating.

The response frequencies for HHS include "never," "rarely," "sometimes," and "often" with corresponding values of 0, 1, 1, and 2, respectively.

The frequency of these experiences are summed for each question to produce a scale with a range of 0–6.

Questions for the HHS cover a 30-day recall period.

The acute IPC indicator thresholds for the HHS are:

- HHS of 0 (Phase 1)
- HHS of 1 (Phase 2)
- HHS of 2–3 (Phase 3)
- HHS of 4–6 (Phase 4)
- HHS of 6 (Phase 5)

A.1.5 Coping Strategies Index (CSI)

The CSI was originally developed as an alternative to a food consumption survey questionnaire. The CSI enumerates context-specific coping behaviors that household members rely on when they do not have adequate food to consume and weighs these behaviors according to their locally perceived severity.

The measure then counts the frequency of identified behaviors through a survey and multiplies the frequency by the determined severity weight, summing the results of each item to produce an index score.

Because of context specificity, the original CSI scores were not comparable across different contexts, and the CSI does not have universal thresholds for different categories of food insecurity but rather suggested measures against a location-specific baseline.

The current (and old) acute IPC household reference table suggests local baseline references for CSI, mapping subsequent CSI measures against the reference as follows:

- subsequent measures showing stability similar to the reference CSI (Phase 1)
- subsequent measures similar to the reference CSI but showing instability (Phase 2)
- subsequent CSI greater than the reference and increasing (Phase 3)
- subsequent CSI significantly greater than the reference (Phase 4), and subsequent CSI far greater than the reference (Phase 5).

The CSI can be asked for either a 7-day or 30-day recall period.

A.1.6 rCSI: Reduced coping strategy index

To address the issue of the CSI's context specificity, Maxwell et al. (2008) identified a subset of coping behaviors and their related severity levels that were similar across all empirical contexts in which the CSI had been measured. From this analysis, they suggested a "reduced" CSI (rCSI) that was more universally applicable and included only five behaviors and associated (standard) weights.

In particular, this indicator captures how many times in the past 7 days any household member engaged in the following behaviors:

- eating less preferred but less expensive foods—weighted at 1,
- reducing the number of meals per day—weighted at 1,
- limiting portion size at mealtime—weighted at 1,
- prioritizing consumption for certain household members (e.g., limiting adult intake)—weighted at 3, and
- borrowing food/money from friends and relatives—weighted at 2,

This could add to a total possible index score ranging from 0 to 56.

Reanalyzing the data based on an index consisting of only these five indicators produced results that correlated with other indicators as well as or better than the "full" CSI (Maxwell and Caldwell 2008). The rCSI has been widely adopted, though it has not been integrated into the acute IPC household reference table and so does not have thresholds for acute IPC analysis.

A.1.7 Food Insecurity Experience Scale (FIES)

The FIES is a metric of severity of food insecurity at the household or individual level that relies on people's direct yes/no responses to eight brief questions regarding their access to adequate food. It is a statistical measurement scale similar to other widely accepted statistical scales designed to measure unobservable traits such as aptitude/intelligence, personality, and a broad range of social, psychological and health-related conditions.

FIES cut-offs are common, normalized thresholds developed specifically for use with the FIES 30 day-recall in the IPC Acute Food Insecurity Reference Table. These thresholds do not correspond to those defined for use of FIES in the context of SDG monitoring and in the IPC Chronic Food Insecurity

Reference Table, which are different and based on a 12-months recall period. The threshold that identifies "moderate" food insecurity in the context of SDG monitoring is less severe than the one that identifies IPC Acute Phase 3 or worse. While the standard FIES includes 8 questions (i.e. 8 items), the related scores do not allow differentiating between IPC Phases 3, 4 and 5, an extended version of the FIES has been created and preliminary findings indicate that this extended version might be able to better differentiate between Phase 3, Phase 4 and Phase 5.

Appendix A.2 Comparing distributions of indicators from the DIEM database before and after matching to the IPC data

Country	FCS		HDDS		HHS		rCSI	
	FCS (DIEM)	FCS (matched)	HDDS (DIEM)	HDDS (matched)	HHS (DIEM)	HHS (matched)	rCSI (DIEM)	rCSI (matched)
Afghanistan	33.4 (15.0)	32.0 (12.7)	4.5 (2.3)	4.4 (2.3)	1.3 (1.3)	1.2 (1.3)	16.6 (11.1)	14.0 (9.5)
Bangladesh	31.1 (31.7)	28.9 (30.8)	6.5 (2.0)	6.6 (1.8)	0.3 (0.7)	0.2 (0.7)	4.2 (8.3)	0.6 (3.0)
Burkina Faso	35.9 (17.9)	35.2 (17.9)	4.2 (2.0)	4.0 (2.2)	0.5 (1.0)	0.6 (1.1)	8.9 (13.1)	11.9 (14.3)
Cameroon	44.4 (21.6)	44.8 (22.0)	4.8 (2.0)	4.9 (2.0)	1.2 (1.4)	1.2 (1.4)	16.2 (13.6)	16.2 (13.6)
Central African Republic	40.3 (20.0)	39.6 (19.5)	4.3 (2.5)	4.2 (2.5)	2.1 (1.4)	2.1 (1.4)	18.8 (9.2)	19.0 (9.1)
Chad	45.3 (16.6)	43.9 (16.7)	5.8 (2.2)	5.9 (2.2)	0.8 (1.0)	0.9 (1.1)	8.5 (7.6)	9.5 (7.9)
Democratic Republic of the Congo	47.3 (20.8)	46.7 (20.9)	5.0 (2.3)	5.0 (2.3)	1.5 (1.4)	1.5 (1.4)	15.8 (12.4)	16.0 (12.3)
Guatemala	59.0 (23.1)	62.8 (22.6)	5.6 (2.6)	5.9 (2.6)	0.6 (1.1)	0.5 (1.1)	10.7 (12.5)	9.7 (12.4)
Honduras	62.8 (22.8)	65.6 (24.8)	5.4 (2.5)	5.4 (2.6)	0.8 (1.3)	0.8 (1.3)	12.0 (13.3)	11.6 (13.6)
Mali	50.1 (23.8)	50.8 (23.4)	5.2 (2.4)	5.3 (2.5)	0.7 (1.2)	0.6 (1.2)	12.5 (14.1)	11.8 (14.0)
Mozambique	44.0 (18.7)	42.5 (18.1)	5.0 (2.1)	4.6 (2.0)	1.0 (1.3)	1.1 (1.3)	11.6 (12.0)	12.0 (12.1)
Niger	21.5 (25.9)	37.7 (23.8)	3.5 (2.1)	3.6 (2.0)	0.7 (1.3)	0.7 (1.2)	18.9 (16.6)	18.9 (16.7)
Nigeria	45.3 (23.0)	45.0 (22.6)	5.6 (2.6)	5.5 (2.5)	0.7 (1.2)	0.7 (1.2)	13.0 (11.8)	13.0 (11.6)
Pakistan	43.9 (18.5)	44.4 (18.2)	4.4 (2.1)	4.5 (2.1)	0.5 (1.0)	0.5 (1.0)	8.9 (10.6)	9.0 (10.7)
Sierra Leone	42.4 (18.2)	42.2 (18.3)	4.3 (2.4)	4.3 (2.4)	0.9 (1.1)	0.9 (1.1)	11.3 (10.2)	11.4 (10.1)
Somalia	37.4 (21.1)	37.5 (21.1)	3.8 (2.0)	4.0 (2.0)	1.8 (1.4)	2.0 (1.4)	23.5 (11.9)	23.5 (11.9)
South Sudan	25.7 (15.0)	25.6 (15.0)	3.6 (2.4)	3.5 (2.5)	2.4 (1.3)	2.3 (1.3)	8.8 (7.0)	8.5 (6.7)
Sudan	51.6 (21.7)	52.3 (21.1)	5.6 (2.2)	5.9 (2.2)	0.8 (1.2)	0.7 (1.2)	11.6 (11.0)	11.9 (11.4)
Yemen	48.2 (20.9)	48.2 (21.3)	5.3 (1.9)	5.4 (1.8)	0.8 (1.1)	0.7 (1.0)	13.8 (11.7)	11.9 (10.9)
Overall	43.2 (21.3)	42.5 (20.8)	5.0 (2.4)	4.9 (2.4)	0.9 (1.3)	1.0 (1.3)	12.6 (11.7)	12.1 (11.7)

Appendix A.3 FAO Conversion Table for calories to kilograms of cereals

The table is a selection of conversions for cereals taken from the FAO Conversion Table.

ITEM	CALORIES	PROTEIN	FAT
	kcal	Grams	Grams
CEREALS AND PRODUCTS			
WHEAT	334	12.2	2.3
FLOUR OF WHEAT	364	10.9	1.1
BRAN OF WHEAT	213	12.1	3.1
MACARONI	367	11.0	1.1
GERM OF WHEAT	382	29.1	10.7
BREAD	249	8.2	1.2

ITEM	CALORIES	PROTEIN	FAT
BULGUR WHOLEMEAL	345	12.3	2.0
PASTRY	369	7.4	17.0
WHEAT STARCH	362	0.5	0.3
WHEAT GLUTEN	380	95.0	0.0
RICE PADDY	280	6.0	1.4
RICE HUSKED	357	7.5	1.8
RICE MILLED	360	6.7	0.7
RICE BROKEN	360	6.7	0.7
RICE FLOUR	366	6.4	0.8
RICE GLUTEN	380	95.0	0.0
RICE STARCH	362	0.5	0.3
BRAN OF RICE	276	13.3	15.8
BARLEY	332	11.0	1.8
POT BARLEY	348	9.6	1.1
BARLEY PEARLED	346	9.0	1.4
BARLEY FLOUR AND GRITS	343	9.2	1.7
MALT OF BARLEY	368	13.1	1.9
MALT EXTRACTS	367	6.0	0.0
MAIZE	356	9.5	4.3
GERM OF MAIZE	373	11.1	38.5
FLOUR OF MAIZE	363	8.4	1.2
MAIZE GLUTEN	380	95.0	0.0
STARCH OF MAIZE	362	0.5	0.3
POP CORN	356	9.5	4.3
RYE	319	11.0	1.9
FLOUR OF RYE	341	9.0	1.8
OATS	385	13.0	7.5
OATS ROLLED	384	16.0	6.3
MILLET	340	9.7	3.0
FLOUR OF MILLET	340	9.7	3.0
SORGHUM	343	10.1	3.3
FLOUR OF SORGHM	343	10.1	3.3
BUCKWHEAT	330	11.0	2.0
FLOUR OF BUCKWHEAT	344	6.4	1.2

Appendix A.4 Dietary and coping capacity FGT indices by country (across households in matched IPC and DIEM data)

Country	FCS		HDDS		rCSI		HHS	
	FGT0	FGT1	FGT0	FGT1	FGT0	FGT1	FGT0	FGT1
Afghanistan	0.64	0.19	0.48	0.24	0.25	0.11	0.26	0.14
Bangladesh	0.55	0.49	0.09	0.04	0.01	0	0.02	0.01
Burkina Faso	0.57	0.2	0.61	0.3	0.26	0.19	0.12	0.07
Cameroon	0.37	0.13	0.44	0.16	0.38	0.24	0.2	0.15
Central African Republic	0.43	0.15	0.62	0.29	0.44	0.19	0.49	0.32
Chad	0.32	0.08	0.24	0.09	0.11	0.04	0.12	0.06
Democratic Republic of the Congo	0.33	0.09	0.47	0.18	0.36	0.2	0.3	0.2
Guatemala	0.11	0.03	0.31	0.12	0.19	0.13	0.07	0.06
Honduras	0.11	0.04	0.41	0.17	0.25	0.17	0.11	0.09
Mali	0.29	0.09	0.36	0.17	0.27	0.18	0.13	0.08
Mozambique	0.36	0.1	0.53	0.21	0.24	0.14	0.17	0.12
Niger	0.55	0.24	0.7	0.34	0.44	0.38	0.12	0.09
Nigeria	0.4	0.13	0.41	0.14	0.28	0.14	0.12	0.08
Pakistan	0.34	0.1	0.48	0.22	0.13	0.09	0.09	0.05
Sierra Leone	0.38	0.11	0.56	0.26	0.19	0.09	0.13	0.07
Somalia	0.5	0.21	0.63	0.28	0.61	0.39	0.42	0.28
South Sudan	0.75	0.35	0.71	0.38	0.07	0.03	0.62	0.37
Sudan	0.24	0.06	0.25	0.1	0.22	0.12	0.11	0.08
Yemen	0.31	0.09	0.31	0.1	0.21	0.12	0.06	0.04

Source: Authors' calculations based on DIEM database
Note: This is across all phases. FGT0 = prevalence or share of population in need (below or above critical threshold defined for each indicator): FGT1 = the prevalence times the average shortfall for people in need against the threshold for each indicator.

Appendix A.5 Dietary and coping capacity FGT indices by country and phase (across households in matched IPC and DIEM data)

Country	FCS				HDDS				rCSI				HHS			
	FCS gap IPC3		FCS gap IPC4		HDDS gap IPC3		HDDS gap IPC4		rCSI gap IPC3		rCSI gap IPC4		HHS gap IPC3		HHS gap IPC4	
	FGT0	FGT1	FGT0	FGT1	FGT0	FGT1	FGT0	FGT1	FGT0	FGT1	FGT0	FGT1	FGT0	FGT1	FGT0	FGT1
Afghanistan	0.6	0.2	0.8	0.4	0.5	0.2	0.9	0.6	0.2	0.1	0.6	0.5	0.2	0.1	0.4	0.2
Bangladesh	0.6	0.5			0.1	0			0	0			0	0		
Burkina Faso	0.6	0.2	0.6	0.2	0.7	0.4	0.8	0.4	0.4	0.3	0.4	0.2	0.1	0.1	0.2	0.1
Cameroon	0.4	0.2			0.4	0.2			0.4	0.2			0.2	0.2		
Central African Republic	0.4	0.2	0.4	0.1	0.6	0.3	0.7	0.3	0.4	0.2	0.4	0.1	0.5	0.3	0.5	0.4
Chad	0.3	0.1			0.2	0.1			0.1	0			0.1	0.1		
Democratic Republic of the Congo	0.3	0.1			0.5	0.2			0.4	0.2			0.3	0.2		
Guatemala	0.1	0			0.3	0.1			0.2	0.1			0.1	0		
Honduras	0.1	0			0.4	0.2			0.3	0.2			0.1	0.1		
Mali	0.5	0.2			0.4	0.1			0.5	0.4			0.3	0.3		
Mozambique	0.4	0.1			0.6	0.2			0.2	0.1			0.2	0.1		
Niger	0.6	0.3			0.6	0.3			0.6	0.5			0.1	0.1		
Nigeria	0.6	0.2	0.2	0	0.5	0.2	0.2	0.1	0.4	0.2	0	0	0.2	0.1	0	0
Pakistan	0.3	0.1	0.8	0.4	0.5	0.2	0.8	0.6	0.1	0.1	0.3	0.3	0.1	0.1	0.1	0.1
Sierra Leone	0.4	0.1			0.6	0.3			0.2	0.1			0.1	0.1		
Somalia	0.5	0.2	0.6	0.2	0.7	0.3	0.6	0.2	0.6	0.4	0.6	0.4	0.4	0.3	0.4	0.3
South Sudan	0.7	0.3	0.8	0.4	0.7	0.4	0.9	0.6	0.1	0	0.1	0.1	0.6	0.3	0.8	0.6
Sudan	0.3	0.1	0.7	0.2	0.2	0.1	0.5	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0
Yemen	0.3	0.1	0.4	0.1	0.3	0.1	0.4	0.1	0.2	0.1	0.3	0.2	0	0	0.1	0.1

Source: Authors' calculations based on DIEM database

Appendix A.6 Share of matched households with complete data across all indicators, by country
Matched IPC-DIEM household data, 2021–2025

Country	HH with complete data, all 4 indicators (%)	HH with complete data, all 5 indicators incl. FIES (%)
Afghanistan	97.1	69.1
Bangladesh	8.6	0
Burkina Faso	100	50.5
Cameroon	70.7	69.3
Central African Republic	49	48.1
Chad	85.1	44.2
Democratic Republic of the Congo	90.6	77.5
Guatemala	61.1	59.5
Honduras	59.1	57.1
Mali	100	80.2
Mozambique	100	65.9
Niger	34.6	32.5
Nigeria	39.2	29.8
Pakistan	87.2	67.6
Sierra Leone	86.5	54.9
Somalia	64.3	63.4
South Sudan	57.2	43
Sudan	100	0
Yemen	100	99.9
Overall	72	54.3

Source: Authors' calculations based on DIEM database

Appendix A.7 Average gaps by indicator and country over time

Country	FCS					HDDS					rCSI					HHS				
	2021	2022	2023	2024	2025	2021	2022	2023	2024	2025	2021	2022	2023	2024	2025	2021	2022	2023	2024	2025
Afghanistan		0.3	0.29	0.12	0.1		0.34	0.29	0.18	0.1		0.39	0.24	0.09	0.04	0.22	0.23	0.23	0.08	0.05
Bangladesh		1	0.02			0.25	0.18	0.03	0.01	0		0		0.05		0.09	0.06	0.02	0.01	0
Burkina Faso		0.23	0.17		0.16		0.37	0.23		0.18		0.21	0.13		0.07		0.09	0.06		0.02
Cameroon		0.13	0.1	0.13	0.13		0.2	0.14	0.19	0.11				0.24	0.21		0.17	0.12	0.16	0.15
Central African Republic			0.08	0.19			0.28	0.36	0.23					0.19			0.3	0.35	0.31	
Chad		0.06	0.05	0.06	0.08	0.04	0.11	0.11	0.09	0.07		0.03	0.03	0.05	0.02	0.03	0.07	0.05	0.06	0.03
Democratic Republic of the Congo		0.06	0.09	0.1	0.08		0.17	0.27	0.2	0.13		0.13	0.19	0.18	0.25		0.14	0.18	0.23	0.19
Guatemala		0.02	0.06	0.05			0.17	0.15	0.14				0.14	0.14			0.03	0.07	0.1	
Honduras				0.03	0.04		0.11		0.19	0.31				0.17	0.1		0.09		0.1	0.25
Mali		0.08	0.09	0.14			0.22	0.16	0.1			0.23	0.15	0.24			0.06	0.08	0.14	
Mozambique		0.06	0.12	0.1		0.07	0.1	0.27	0.17			0.11	0.16	0.12		0.16	0.07	0.12	0.11	
Niger			1	0.24			0.28	0.47	0.35					0.38			0.05	0.14	0.09	
Nigeria		0.06	0.02	0.21			0.28	0.05	0.14			0.12	0.03	0.21			0.07	0.01	0.18	
Pakistan	0.06	0.12	0.12	0.05		0.2	0.2	0.26	0.17		0	0.06	0.09	0.07		0.08	0.03	0.06	0.03	
Sierra Leone		0.09	0.1	0.17	0.07	0.27	0.28	0.3	0.25	0.2		0.1	0.11	0.06	0.05	0.14	0.07	0.08	0.05	0.05
Somalia		0.24	0.19			0.37	0.24	0.34				0.4	0.39			0.12	0.28	0.28		
South Sudan		0.31	0.36	0.35			0.52	0.29	0.39			0.14	0				0.42	0.37	0.38	
Sudan		0.07			0.07		0.11					0.11					0.06			0.13
Yemen		0.08	0.09	0.09	0.08	0.21	0.24	0.12	0.11	0.1		0.22	0.18	0.14	0.12	0.04	0.06	0.07	0.05	0.05

Source: Authors' calculations based on DIEM database (household level data)

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