First things first: food to live well[1]: A new method to estimate undernourishment and food insecurity

Rob Vos
Director Rural Poverty Reduction Programme
Food and Agriculture Organization - FAO
United Nations

Introduction

Living well, "vivir bien", starts of course with eating well. First things first. We have many improved measures of wellbeing and even happiness. We also have a longstanding tradition as to how we measure food sufficiency and good nutrition. But, timely and accurate measurement across whole population remains difficult. FAO measures food insecurity and undernourishment on a regular basis for all countries. It is a key reference. But, the measure is also strongly criticized. We think it is still the best we can do with available data, but we also think it can be done better.

The Food Insecurity Experience Scale is a new measure and FAO is developing. This short note provides a brief explanation of this new measure and some first preliminary results from a worldwide survey, which if it works will provide a direct, easy to measure new standard for monitoring the first of all elements of wellbeing: having enough to eat to live a healthy life.

Falling undernourishment

We produce enough food in the world to feed everyone. Much progress has been made in reducing hunger. The conventional FAO measure identifies undernourishment as a lack of caloric intake or food energy deficiency. By this measure,

the world has made enormous progress in reducing hunger.

The 2015 MDG 1 target of halving the prevalence of undernourishment has been met. Latin America stands out as the region with most progress and has more than halved the prevalence of undernourishment and almost halved the number of people living in food insecurity between 1990 and today.
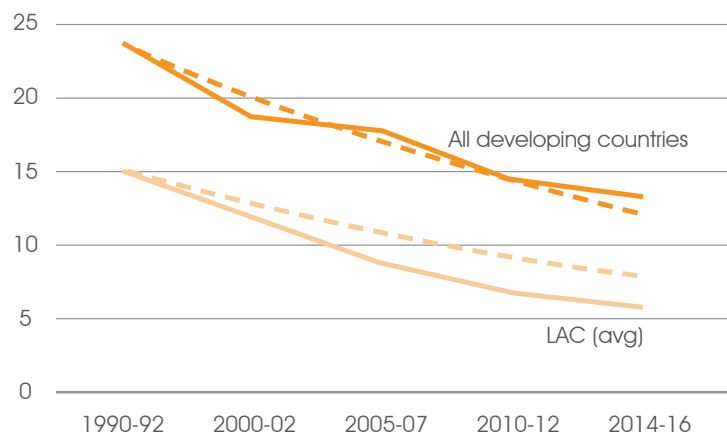
Yet, more than 800 million people in the world and more than 30 million Latin Americans suffer from undernourishment. Almost, two million of them live in Ecuador which also has made significant progress, as can be seen from Figures 1a and 1b, but progress over the past 25 years has been slower than in the rest of the region. Over the past ten years, though, Ecuador's progress has been faster.

What are we measuring?

But how solid is our measure? What is it what we are trying to measure?

In the simplest terms, this is how FAO attains its measure of the prevalence of undernourishment[2] : First, we determine the range of caloric needs in the population taking into consideration the distribution of people by gender, age, body masses (proxied by attained height) and physical activity levels.

Figure 1a.
**Prevalence of undernourishment (%) in Latin America and Caribbean and average for all developing countries, 1990-2015**

All developing countries

LAC (avg)

1990-92   2000-02   2005-07   2010-12   2014-16

Source: (FAO, IFAD, & WFP, 2015)

[2] For a more technical explanation, see (FAO, IFAD, & WFP, 2015) (http://www.fao.org/publications/card/en/c/c2cda20d-ebeb-4467-8a94-038087fe0f6e/) .

Figure 1b.
Prevalence of undernourishment (%) in Ecuador and average for Latin America and Caribbean, 1990-2015
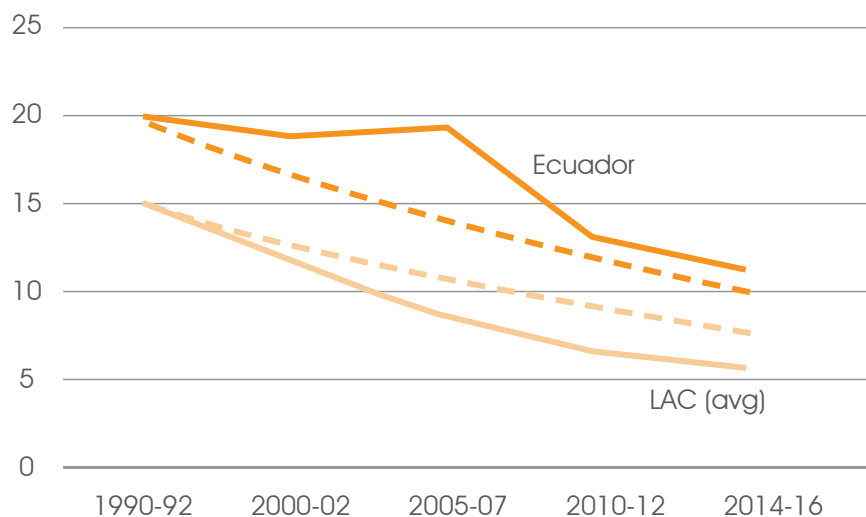
Source: (FAO, IFAD, & WFP, 2015)

Using household survey data for food consumption, we then estimate the proportion of individuals whose average caloric intake over the year falls below their specific caloric requirement. Subsequently, we multiply the estimated proportion by the total population size to obtain an estimate of the total number of individuals who are "undernourished" in the specific sense of likely having insufficient caloric intake to fulfill the needs for a normal and healthy life. Are we measuring this correctly?

The deficiencies and limitations of the existing methods are well-known. Yet, for now, it is probably still the best what can be done with existing data. We have to make inferences from levels of food consumption or, in most cases, of levels of food expenditures. This may not be a good measure of whether people "eat enough and adequately" on a regular basis.

However, there are no regular data on habitual food consumption, let alone of food absorption for each individual. So, even assessing the sufficiency of food energy intake for each individual is difficult and can only be done indirectly with available data for most countries.

Some alternative methods, such as food consumption score or household dietary diversity

scores are interesting but lack robustness and adequate standardization to come to comparable measures across countries and population groups. Yet, the High-Level Panel of Experts (HLPE) on Food Security and Nutrition, not the least of bodies, thinks FAO should do a better job. In a report to the Committee on World Food Security of a few years ago, the HLPE said that our estimates "give no sense of the severity of hunger". The Panel also criticized FAO for not providing a direct estimate of food insecurity (HLPE, 2012).

Bill Gates made a similar comment in 2013 and suggested we should implement a survey asking people directly about their food and nutrition situation (Gates, 2013). FAO is listening! It has led to the Voices of the Hungry project.

The Food Insecurity Experience Scale

FAO has now started to experiment with a new measure which tries to measure food insecurity as an experienced condition. It is an experience-based metric of severity of food insecurity calculated from people's direct responses to

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[3] This theoretical construct of food insecurity formed the basis for the U.S. Household Food Security Survey Module (US HFSSM), which has been applied annually in the United States since 1995 and has served as a model for the FIES. Numerous other experience-based food insecurity scales emerged from the same theoretical basis in diverse countries around the world. The FIES builds on these tools by providing an analytic framework that ensures comparability across countries.

questions regarding their access to adequate food. The construct it measures is consistent with the view that the key defining characteristic of food security at the household level is "secure access at all times to sufficient food" (Maxwell & Frankenberger, 1992, pág. 8).

We should be able to measure such a condition as a recurrent and comparable state across individuals. We then try to rank these experiences in terms of severity according to a Food Insecurity Experience Scale (FIES) which could be interpreted as situations when:

- people have felt anxiety about getting enough to eat or have had to compromise the quality and variety of food they eat (e.g. because of a lack of money), then we classify them as being mild to moderately food insecure; and
- people are reducing quantities or skipping meals all together or indicate they have experience actual hunger, we would classify them as moderately to severely food insecure.

These experiences may be identified along the following scale:

Compared to other indicators of food security at the household level, experience-based indicators stand out because of their analytic soundness, ease of administration and timeliness of reporting. Those based on the FIES, in particular, will be distinct because of the cross country comparability.

The Voices of the Hungry project

Estimation of the Food Insecurity Experience Scale is at the heart of FAO's Voices of the Hungry Project. The project has developed a simple questionnaire with 8 questions about the food insecurity condition of households and individuals. The questionnaire was implemented in over 150 countries as part of the 2014 Gallup World Poll - WGP. FAO is currently processing the results.

The results should provide a benchmark for estimating the prevalence of moderate and severe food insecurity for global monitoring purposes. The low costs and ease of implementation should allow us to get more timely and direct estimates of the hunger situation in the world. We subsequently hope statistical offices to include the

Mild food insecurity	Moderate food insecurity		Severe food insecurity
Anxiety about ability to procure adequate food	Compromising quality and variety of food	Reducing quantities, skipping meals	Experiencing hunger

The analytical idea behind the concept is based on a long established psychometric model (the Rasch measurement model) and it has been tested successfully in a range of countries over the past decades, including the United States.

To get to a robust measure we look at the consistency across all questions asked for any representative sample of the population. To get to a comparable standard across countries, a global reference standard for the degree of food insecurity is developed by equalizing measures for degrees of food insecurity in different countries.[4]

questionnaire as a regular part of their household surveys, and Ecuador could be one of the first to do so. The questionnaire consists, as said, of 8 yes/no questions, and it takes on average less than 4 minutes to complete.

Table 1 below shows the 8 questions as asked to individuals in the Gallup World Poll with representative samples of 1,000 individuals in 150+ countries. The questions are asked directly to adults to reveal food-related behaviours and experiences associated with increasing difficulties in accessing food. They are asked in a sequence going from less likely to highly likely food insecurity and from low to severe food insecurity. It allows us to measure actual food access for each individual for which we currently lack proper indicators.

The severity of the food insecurity condition of each respondent is measured based on the

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[4] The FIES global standard scale is a set of item parameters based on data from all countries in the survey. By adjusting each country's scale to the global standard, the respondent severity parameters are adjusted to a common metric, producing a comparable measure of severity for respondents in all countries and comparable national prevalence rates at specified thresholds of severity for all countries. Both the calculation of the global standard and the adjustment of each country's scale to the global standard take into account that in any given country one or more items may differ in severity from the severity level common in most countries. For further technical details, see (FAO, 2015).

combination of responses to the 8 questions[5]. The fundamental assumptions behind the measurement model are that (a) a higher severity of food insecurity will increase the probability of reporting any of those experiences and (b) experiences can be meaningfully ranked in terms of severity. This probabilistic link forms the basis for measuring the severity of food insecurity (considered as a latent trait) through the responses to the 8 FIES items. Under the assumptions of the model, the severity associated with each

experience can be inferred from the frequency with which it is reported: more severe experiences will be reported by fewer respondents, and vice versa. Also, while it is expected that respondents reporting more severe food insecurity experiences also report the less severe ones, the statistical measure of a respondent's food insecurity level is based only on the number of affirmative answers to the 8 questions irrespective of which specific experiences were affirmed.

Tabla 1

Gallup World Poll – Voices of the Hungry questionnaire

Now I would like to ask you some questions about your food consumption in the last 12 months. During the last 12 MONTHS, was there a time when:		
Q1. You were worried you would run out of food because of a lack of money or other resources?	0	No
	1	Yes
	98	Don't Know
	99	Refused
Q2. You were unable to eat healthy and nutritious food because of a lack of money or other resources?	0	No
	1	Yes
	98	Don't Know
	99	Refused
Q3. You ate only a few kind of foods because of a lack of money or other resources to get food?	0	No
	1	Yes
	98	Don't Know
	99	Refused
Q4. You hand ti skip a meal because there was not enough money or other resources to get food?	0	No
	1	Yes
	98	Don't Know
	99	Refused
Q5. You ate less than you thought you should because of a lack of money or ather resources?	0	No
	1	Yes
	98	Don't Know
	99	Refused
Q6. your household ran out of food because of a lack of money or other resources?	0	No
	1	Yes
	98	Don't Know
	99	Refused
Q7. You were hungry but did not eat because there was not enough money or other resources for food?	0	No
	1	Yes
	98	Don't Know
	99	Refused
Q8. You went without eating for a whole day because of a lack of money or other resources?	0	No
	1	Yes
	98	Don't Know
	99	Refused

Source: (FAO, 2015)

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[5]   The single-parameter logistic IRT (Rasch) model is estimated from the responses to the 8 dichotomous FIES items using conditional maximum likelihood (CML) methods. The analysis sample is limited to respondents with complete and non-extreme responses, but all complete responses are used to estimate prevalence rates. Respondent parameters and errors for each raw score are calculated as the maximum likelihood estimates given estimated item parameters. The Rasch-model assumption of equal discrimination is assessed by examining standardized item infit statistics.

These statistics have quite large sampling errors for sample sizes typical in the GWP data. These errors are taken into account and infit statistics in the range of 0.8 to 1.2 are considered excellent. Those in the range of 0.7 to 1.3 are considered to be acceptable. Finally, overall model fit is assessed by Rasch reliability statistics—the proportion of total variation in true severity in the sample that is accounted for by the model. For a further technical description of the application of the Rasch model for the FIES estimates, see (Ballard, Kepple, & Cafiero, 2013)http://www.fao.org/3/a-as583e.pdf.

In principle, a prevalence rate can be calculated for any specified threshold. The Voices of the Hungry project sets thresholds as to estimate two prevalence rates:

- the Prevalence of Experienced Food Insecurity at moderate or severe levels (FImod+);
- the Prevalence of Experienced Food Insecurity at severe levels (FIsev).

The lower threshold is specified at the level of severity associated to the item "Ate less than should" in the global reference scale (at about -0.3 units), while the higher threshold is specified at the severity level of the item "Did not eat a whole day" (a value of about 2.0 on the global reference scale).

Some preliminary findings

The data in Table 2 show how countries are distributed across possible classes of food insecurity prevalence. In 2014, 31 of the 143 countries covered in this analysis more than 50% of the population have experienced moderate or severe food insecurity, a rather worrisome result. On the other side, in 10 of the 143 countries the incidence of food insecurity is quite small, that is affecting less than 5% of the population. In terms of the most severe condition, prevalence rates are worryingly high in 33 countries and very small in 18 countries.

Tabla 2

Distribution of countries for different classes of moderate (FImod+) and severe food insecurity (FIsev)

FI_{mod+}			FI_{sev}		
Range	N. of countries	% of countries	Range	N. of countries	% of countries
0-5	10	7.0	0-1	18	12.6
5-15	45	31.5	1-5	47	32.9
15-25	25	17.5	5-10	20	14.0
25-50	32	22.4	10-20	25	17.5
>50	31	21.7	>20	33	23.1

Source: (FAO, 2015)

To test the validity and robustness of the FIES: some simple correlations with key development indicators for the 143 countries with valid results. Table 3 presents the values of rank correlation between moderate and severe food insecurity as measured by the FIES and a number of internationally recognized indicators of development. The data reveal that the indicators for both moderate and severe food insecurity show significant and high correlation with the expected sign and all statistically significant.

Looking at some specific indicators, figures 2 and 3 shows the strong positive correlations between the prevalence of severe food insecurity and, respectively, child mortality rates and the poverty incidence (using a $2 per person per day international poverty line).

Tabla 3

Spearman's rank correlation between Food Insecurity indicators and development indicators at the country level1

Indicator	Period	N	FI$_{mod+}$	FI$_{sev}$
Under-5 mortality rate	2013	138	0.846**	0.781**
Human Development Index	2013	138	-0.831**	-0.741**
Prevalence of undernourishment	2014	137	0.759**	0.684**
Poverty headcount ratio al $1.25 a day	2011	96	0.766**	0.725**
Poverty headcount ratio al $1.25 a day	2010-2013	80	0.792**	0.762**
Multidimensional Poverty Index	2009-2013	47	0.712**	0.601**
GINI index	2009-2013	96	0.468**	0.499**
Gross National Income per capita	2011-2013	139	-0.800**	-0.700**
Children aged 0-59 months Underweight	2009-2013	105	0.602**	0.570**
Children aged 0-59 months Stunting	2009-2013	105	0.669**	0.632**
Children aged 0-59 months Wasting	2009-2013	104	0.363**	0.354**
Children aged 0-59 months Overweight	2009-2013	92	-0.355**	-0.334**
Rural population (%)	2011-2013	140	0.614**	0.517**
Adult literacy rate (%) projection	2015	115	-0.732**	-0.733**
Youth (15-24 years) literacy rate (%)	2015	115	-0.749**	-0.720**
Life expectancy at birth	2013	138	-0.783**	-0.695**
Fertility rate	2012	141	0.815**	0.795**
Adolescent fertility rate (women ages 15-19)	2012	140	0.817**	0.759**
Sanitation facilities (%with acces)	2012	132	-0.840**	-0.765**
Water source (% with access)	2012	135	-0.806**	-0.718**
Gender-relates development index (GDI)	2013	123	-0.619**	-0.655**

1 See Annex 1 for a description of the indicators and sources of data
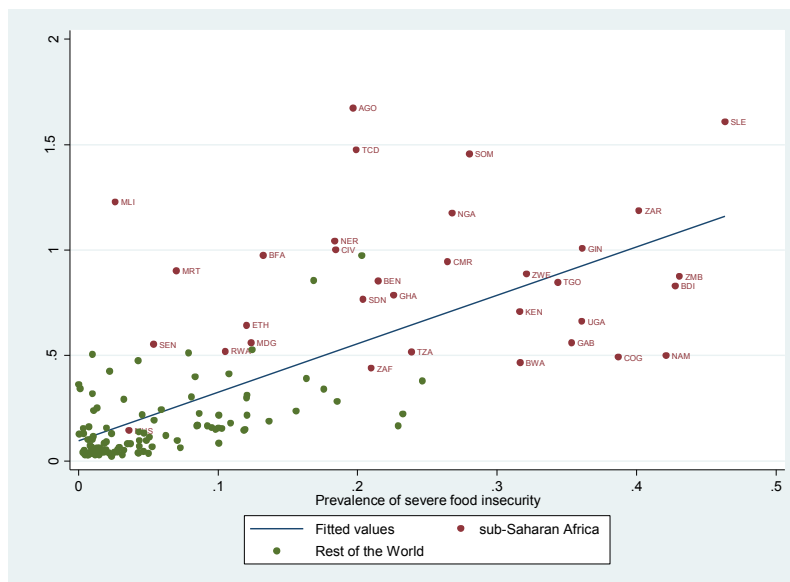* Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed).
N = Number of valid cases.
Periods 2009 to 2013: last value available.

Source:(FAO, 2015)

Figure 2

Correlation between prevalence of severe food insecurity (FIES) and income poverty (at $2 poverty line)

Note: Pairwise correlation coefficient = 0.6575, significant at 1 % level.
Source: (FAO, 2015)

Figure 3

Correlation between prevalence of severe food insecurity (FIES) and income poverty (at $2 poverty line)
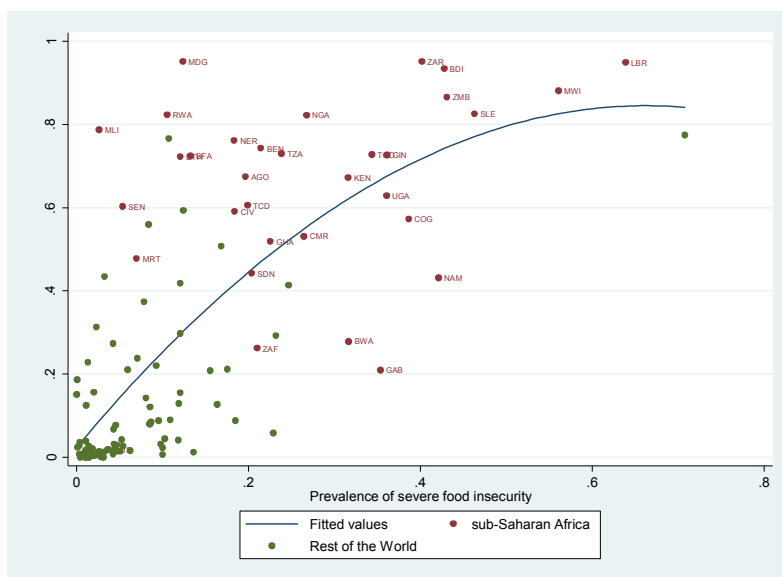
Note: Pairwise correlation coefficient = 0.7255, significant at 1 % level.
Source: (FAO, 2015)

Concluding remarks

This note described in detail the activities and preliminary results of the Voices of the Hungry project, the latest FAO initiative in the field of food security measurement. The project aims to fill an important gap in the suite of tools available to measure household or individual food insecurity. The methodology described here produces estimates of the prevalence of food insecurity at various levels of severity that are valid, reliable and properly comparable across countries.

Moreover, the simplicity of the questionnaire and the availability of the necessary software for data analysis make it possible to obtain results much more quickly and at a fraction of the costs of obtaining analogous measures using other approaches. All of this makes an approach based on the FIES particularly attractive for monitoring of food insecurity at global level.

The methodological innovations presented in this paper led to the definition of two indicators: the percentage of individuals in a population that have experienced moderate-or-severe (FImod+) and severe levels of food insecurity (FIsev).

Further validation is underway, but if it holds up we expect many benefits from using the FIES.First, it will produces timely, reliable and meaningful information on the depth of food insecurity for both individuals and households. Second, it can be easily applied. It is rapid and comes at low cost. Remember the questionnaire takes less than 4 minutes. It can be included as part of virtually any survey and so to link it to other measures of well-being. Third, the measures are worldwide comparable as they are expressed on a global reference scale. Fourth, it allows assessment of food insecurity experiences at the individual level, thus permitting proper analysis of gender-related food insecurity disparities or any other key socio-demographic characteristic.

Is FIES ready to become the new standard? Not yet. As said, further validation of method and the results from the global world poll is needed. For policy purposes more detailed data may be needed. The data that have been collected through the GWP is good enough to estimate national level prevalence rates to serve global monitoring purposes. More detailed analyses will require more data from larger samples and linking the questionnaire to household surveys that measure wellbeing on more dimensions. This would also ease research on the determinants of the degree of food insecurity is needed.

Ecuador and INEC more in particular could well offer to be a front-runner. As said, linking the VoH questionnaire to any household survey is easy and not costly at all. Its work on measuring the "Buen Vivir" in the country could be enriched through the Food Insecurity Experience Scale. As I suggested in the beginning, first things first – this is where you may wish to start!

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