MEASUREMENT OF FOOD DEPRIVATION

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1. INTRODUCTION

The FAO measure of food deprivation, which is referred to as the prevalence of undernourishment, is based on a comparison of usual food consumption expressed in terms of dietary energy (kcal) with minimum energy requirement norms. The part of the population with food consumption below the minimum energy requirement is considered underfed.

For the purpose of monitoring progress towards the target of halving the number of undernourished, the need had arisen to regularly up-date such estimates at the global as well as country level. FAO has been undertaking this task in its annual report on "The State of Food Insecurity in the World" (SOFI), which was first issued in 1999. SOFI 2003, which is the latest report, was issued in October 2003. The estimates cover 45 developing countries in Africa, 30 in Asia, 19 in Latin America and 5 in the Caribbean; the 12 Eastern European countries, the 12 CIS countries and the 3 Baltic States

In the following sections the basic methodological framework, the data sources and the procedures used by FAO for deriving the country estimates are described. Then, the alternatives to the FAO's approach and the need for complementary indicators are discussed. The last section examines the relationship between food deprivation, child malnutrition and income poverty indicators.

2. METHODOLOGICAL FRAMEWORK

The estimate of the proportion of the population below minimum level of dietary energy consumption has been defined within a probability distribution framework:

$$P(U) = P(x < r_L) = \int_{x<r_L} f(x)\,dx = F_x(r_L) \quad \text{..... (1)}$$

where

P (U) is the proportion of undernourished in total population

(x) refers to the dietary energy consumption

r_L is a cut-off point reflecting the *minimum energy requirement*

f(x) is the density function of dietary energy consumption. and

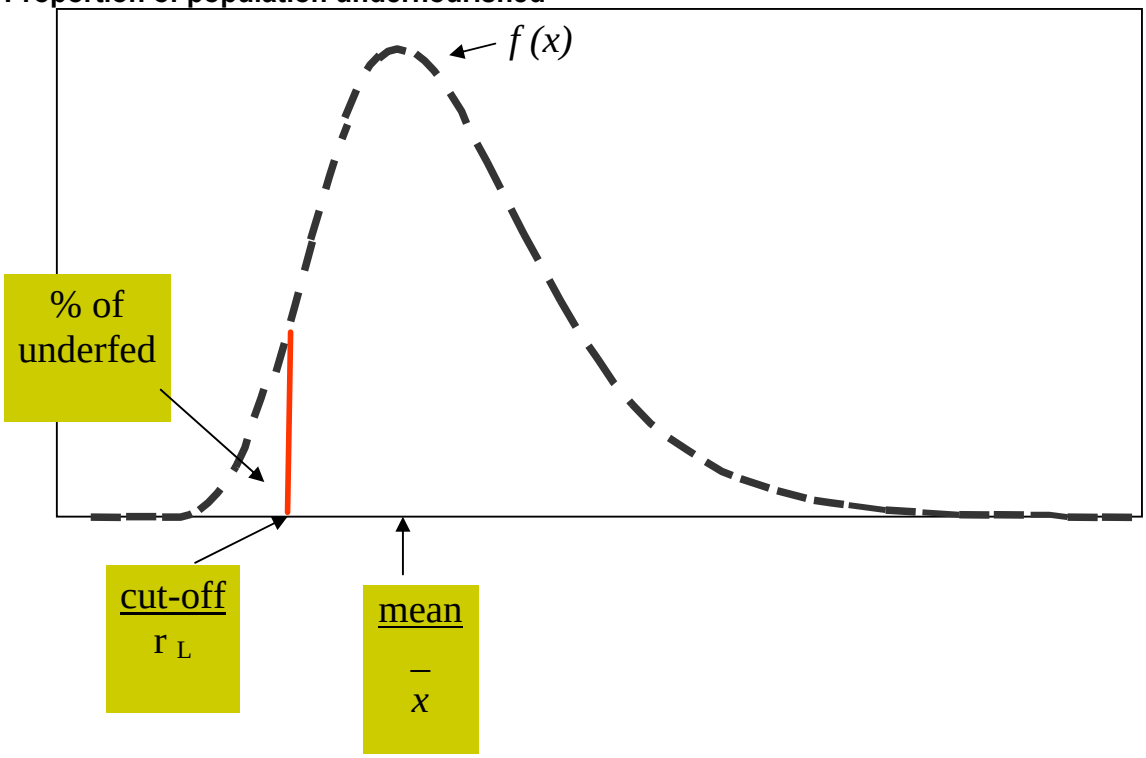
Fx is the cumulative distribution function

The next two sections discuss the estimation of *f(x)* and r_L .

3. ESTIMATION PROCEDURES

The graph below illustrates the framework for the estimation procedures.

Proportion of population undernourished



In the graph the curve *f(x)* depicts the proportion of the population corresponding to different per caput dietary energy consumption levels *(x)* represented by the horizontal line. The area under the curve up to the cut-off point, r_L, represents the proportion of the population undernourished.

The density function, *f(x)*, is assumed to be lognormal so that the parameters μ and σ^2 can be estimated on the basis of the mean, $\bar{x}$, and the coefficient of variation, *CV(x)*. A summarised description of the procedure for calculating the prevalence of undernourishment on the basis of $\bar{x}$, *CV(x)* and rL is given below.

3.1 Estimation *of the mean and CV of f(x)*

3.1.1 Estimation of the mean, $\bar{x}$

There are two options for estimating the mean: using Food Balance Sheet (FBS) data or Household Budget Survey (HBS) data. The first can be used to prepare annual estimates for monitoring progress in food security for the country as a whole. The second one allows the derivation of sub-national estimates. The latter estimates can not be prepared on a yearly basis, as they depend on the survey frequency, in general ranging from 5 to 10 years.

3.1.1.1 Dietary energy consumption from the Food Balance Sheet

The mean is represented by the *per caput* Dietary Energy Supply (**DES**) which refers to the food available for human consumption during the course of the reference period, expressed in terms of energy (kcal/person/day). The estimate is derived from the Food Balance Sheets compiled on the basis of data on the production and trade and of food commodities. Using these data and the available information on stock changes, losses between the level at which production is recorded and the household gate, and types of utilization a supply/utilization account is prepared for each commodity in weight terms. The food component, which is usually derived as a balancing item, refers to the total amount of the commodity available for human consumption during the year. The total DES is obtained by aggregating the food component of all commodities after conversion into energy values.

The procedure of using the *per caput* DES derived from the food balance has some advantages as indicated below.

- The FAO *per caput* DES database, which covers practically all countries of the world, is regularly revised and up-dated in connection with FAO's continuous work programme on supply/utilization accounts and food balance sheets. As a result the database represents a readily available source of information for the assessment and monitoring of the prevalence of food deprivation at the global, regional and country levels.

- The linkage of the *per caput* DES with a measure of inequality within a probability framework provides a mechanism for assessing the effect of short-term changes in food supply as well as its components (production, import, etc.) on the distribution of dietary energy consumption and hence the prevalence of food deprivation. In addition, the use of a probability model – such as the log-normal function – facilitates the assessment of expected changes in the prevalence of food deprivation as a result of the combined effect of food supply increase and inequality reduction.

3.1.1.2 Dietary energy consumption from Household Budget Survey

This option requires converting quantities of the different food items consumed by the household into energy values. These data are usually collected through budget surveys using large scale samples which may allow mean estimates not only at the national level but also at sub-national levels such as geographic areas and socio-economic population groups.

3.1.2 Estimation of the coefficient of variation, CV(x)

The **CV** of the household *per caput* dietary energy consumption is formulated as follows:

$$CV(x) = \sqrt{CV^2(x \mid v) + CV^2(x \mid r)},$$

where **CV(*x*)** is the total CV of the household *per caput* dietary energy consumption, **CV (*x*|*v*)** is the component due to household *per caput* income **(*v*)** and **CV (*x*|*r*)** is the component due to energy requirement **(*r*)**. **CV (*x*|*r*)** is considered to be a fixed component and is estimated to correspond to about 0.20. **CV (x|v)** is however estimated on the basis of household survey data.

For the purpose of estimation, **CV (x|v)** is formulated as follows:

$$CV(x|v) = \sigma(x|v) / \mu(x) .$$

The numerator of the ratio is derived as

$$\sigma(x \mid v) = \sqrt{\left[\sum_{j=1}^{k} f_j (x \mid v)_j^2 - (\sum_{j=1}^{k} f_j (x \mid v)_j)^2 / n\right] / (n-1)}$$

and the denominator, which is the overall average household *per caput* dietary energy consumption, is derived as

$$\mu(x) = \sum(x) / n$$

where ***k*** is the number of income classes and f_j is the number of sampled households and $(x|v)_j$ is the average household *per caput* dietary energy consumption of the ***jth*** income or expenditure class.

Thus, the data required for estimating **CV (x|v)** are the averages of household *per caput* dietary energy consumption by household *per caput* income or expenditure classes from **n** households and the number of households in each class.

According to the sample size and design, the CV estimates can be broken-down by geographic areas and socio-economic groups.

3.2 Estimation of the minimum energy requirement (cut-off point), r_L

The procedure for estimating the minimum energy requirement by sex and age group begins with the specification of the reference body weight. After specifying the reference body weight the procedure for arriving at the corresponding energy requirement differs between children below age 10 on the one hand and adolescents and adults on the other. Therefore the procedure for deriving the reference body weight is handled first, followed by two separate subsections dealing with the derivation of minimum energy requirements for children and adolescents and adults and lastly a fourth subsection dealing with the derivation of the overall minimum *per caput* energy requirement. Minimum energy requirements can be estimated for geographic and socioeconomic groups, using survey data on heights and demographic structure.

3.2.1 Reference body- weight

The reference body weights by sex and age groups are based on the available weight-for-height reference tables. Thus given an estimate of the actual height the acceptable weight corresponding to this height is derived from these tables.

For **children below age 10 the** reference body weight is fixed at the median of the range of weight-for-height given by the WHO reference tables (WHO, 1983).

For **adolescents and adults** of age 10 and above, the reference body weight is estimated on the basis of the fifth percentile of the distribution of the Body Mass Index [1] (WHO, 1995).

The actual heights by sex and age used are those estimated by national anthropometric studies.

3.2.2 Minimum energy requirements for children below 10

The minimum energy requirement per person for children is obtained by multiplying the reference body weight by the recommended energy requirement per kilogram of body weight for each sex/age group. The energy requirements per kilogram of body weight are based on the recommendations of the report of the FAO/WHO/UNU Expert Consultation on Energy and Protein Requirements (FAO/WHO/UNU, 1985).

3.2.3 Minimum energy requirements for adults and adolescents aged 10 and above

The minimum energy requirements per person for adults and adolescents are derived by first estimating the Basic Metabolic Rate (**BMR)** on the basis of the reference body weight and using the sex and age specific regression parameters of the Schofield equations (James and Schofield, 1990).

Then, the minimum energy requirements are derived by multiplying BMR by sex specific Physical Activity Level factors.

3.2.4 The overall minimum per caput energy requirement

The overall minimum *per caput* dietary energy requirement, which is used as the cut-off point, $\mathbf{r}_L$, for estimating the prevalence of undernourishment, is derived by aggregating the sex-age requirements weighted by the proportion of each sex and age group in the total population.

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[1] The BMI refers to weight (kg) divided by height² (m).

Finally a pregnancy allowance (**PA**) in *per caput* terms for the whole population is added to the overall requirement. The PA is estimated by multiplying the birth rate by 75 kcal (assuming an estimated daily requirement of 100 kcal during pregnancy over 75 per cent of the year).

Thus, the overall minimum *per caput* energy requirement is derived as

$$r_L = \Sigma_{ij} (MER_{ij} * P_{ij}) + PA$$

where

MER = minimum energy requirement per person
P_{ij} = proportion of each sex and age group in the total population
PA = pregnancy allowance
i = age group
j = sex

3.3. Estimation of the proportion and number of undernourished

The density function of dietary energy consumption, **f(x),** is assumed to be lognormal with parameters **μ** and **σ ².** These are estimated on the basis of $\bar{x}$ and *CV*(*x*) as follows:

$$\sigma = [\log_e (CV^2(x) + 1)]^{0.5}$$

and

$$\mu = \log_e \bar{x} - \sigma^2 / 2$$

The proportion of population below r_L is then evaluated as follows:

$$\Phi [(\log_e r_L - \mu) / \sigma)]$$

Where **Φ =** standard normal cumulative distribution.

4. ARE THERE OTHER VALID OPTIONS TO THE FAO'S APPROACH?

The need for finding alternatives to FAO's parametric approach for estimating food deprivation, was widely discussed during the International Scientific Symposium (ISS) held in Rome in June 2002. As mentioned in previous sections, the mean of the food consumption distribution can be estimated using data from national food accounts or national household budget surveys, as both allows for the measurement of a similar concept of food consumption, but using different procedures. The use of one or the other source depends on the purpose and scope of the measurement. As regards the second parameter of the distribution, the situation is different: the inequality in access to food can be derived from national household budget survey data only. For the scope of global monitoring of WFS and MDG hunger reduction targets, the FAO estimates are based on food consumption levels derived from food accounts. The current national household survey programmes do not provide an adequate global and regional coverage on a regular basis. However, for the purpose of targeting sub-national areas and population groups, FAO approach allows for the

estimation of both parameters of the food consumption distribution from household survey data.

During the last two years, several efforts for finding better alternatives for estimating the prevalence of undernourishment have been fruitless. For example, some authors have proposed a non-parametric approach based on the classification of each sampled household as undernourished / not undernourished. This procedure is methodologically incorrect because it is not possible – for reasons already explained in the document describing the FAO measurement of undernourishment presented at the ISS - to derive adequate estimates of food consumption and needs *for each individual household*. Therefore, it cannot be considered as a valid alternative. In view of the above, FAO's approach, in spite of signalled limitations, is still the best available way for measuring undernourishment. However, as a follow-up of the ISS discussions, FAO is actively working on the integration of a suite of complementary indicators reflecting not only the food situation (nourishment) but also other key dimensions such as income, health, environment and nutritional status. Furthermore, FAO is undertaking case studies using qualitative measures of food insecurity as complementary approaches to enhance the assessment of the food situation.

5. FOOD DEPRIVATION, CHILD MALNUTRITION AND POVERTY INDICATORS

The World Food Summit (WFS) in 1996 set the goal - to reduce the number of hungry people in the world by half before the year 2015. Four years later, that goal was echoed in the first of the Millennium Development Goals (MDGs), which set targets of reducing by half both the proportion of people who suffer from hunger and the proportion living on less than US$1 per day. These targets are closely related; neither can be achieved without the other, and achieving both is essential to success in reaching the rest of the MDGs.

While poverty is undoubtedly a cause of hunger, hunger can also be a cause of poverty. Hunger often deprives impoverished people of the one valuable resource they can call their own: the strength and skill to work productively. Hunger seriously impairs the ability of the poor to develop their skills and reduces the productivity of their labour.

Hunger in childhood impairs mental and physical growth, crippling the capacity to learn and earn. Evidence from household food surveys in developing countries shows that adults with smaller and slighter body frames caused by undernourishment earn lower wages in jobs involving physical labour. And they are frequently unable to work as many hours or years as well-nourished people, as they fall sick more often and have shorter life spans.

Therefore, any effort to achieve sustainable development demands a concerted effort to reduce poverty, including finding solutions to hunger and malnutrition. Alleviating hunger is a prerequisite for sustainable poverty reduction since better nourishment improves labour productivity and the earning capacity of individuals. In order to make poverty reduction strategies work, they must address adequate food access. However, this is not a sufficient condition to ensure a good nutritional status. Malnutrition can be the outcome of a range of circumstances such as bad health and environmental conditions.

The assessment of progress made to halve between 1990 and 2015 the proportion of people who suffer from hunger, is based on two related aspects: food deprivation or "undernourishment" and child malnutrition. The analysis on undernourishment is based on the FAO estimates. These figures are estimates of the proportion of the population below the minimum level of dietary energy consumption. The data on child malnutrition are based on the estimates of underweight prevalence (low weight-for-age) prepared by UNICEF. Both indicators are related but they are not measuring the same thing and are not referring to the same population. The first indicator refers to the prevalence of food deprivation in the whole population. The second indicator refers to the prevalence of underweight in the child

population and, as mentioned before, is related not only to food deprivation but also to other factors such as infections, adequate family care and environmental conditions.

In view of the above, there is a clear need to assess separately each one of the three dimensions: income poverty, food deprivation and child malnutrition. This would allow for the analysis of their relationship and the differences in trends at the global, regional and country levels.

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