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Estimating household and institutional food wastage and losses in the context of measuring food deprivation and food excess in the total population (*)

Sibrián, Ricardo¹ Komorowska, Joanna² Mernies, Jorge³

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Senior Statistician, ESSA, Statistics Division, FAO
Volunteer, ESSA, Statistics Division, FAO
Chief, ESSA, Statistics Division, FAO

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SUMMARY

The FAO's measure of food deprivation, the prevalence of undernourishment, is conceptually based on a comparison of dietary energy intake (DEI) with a normed minimum energy requirement which is compatible with a healthy life while performing light physical activity, taking into account the inequality in access to food. The inequality is expressed in terms of the biological variation and non-biological variation among individuals in the population.

Data sources for deriving dietary energy intake used in estimating the prevalence of undernourishment, the national food balance –NFB- and the household surveys - HHS, aim to measure food consumption as proxy of food intake. However, neither of them takes into account the amount of household or institutional food wastage and losses after food has been acquired by the population, that is, household (for private consumption) or institutional (for public consumption) food wastage and losses.

This paper describes a statistical procedure for estimating DEI based on dietary energy consumption (DEC) adjusted for household food wastage. It also proposes an estimating function of household and institutional food wastage and losses to better approximate food intake for the purpose of measuring food deprivation and food excess. The paper concludes that more empirical data is needed to improve the methodological development and the assessment world food wastage in the effort of measuring food deprivation and food excess; however it recommends, for the time being, using the proposed approach for estimating food wastage based on dietary energy consumption.

I. Introduction

The FAO's measure of food deprivation, also called the prevalence of undernourishment, is conceptually based on a comparison of dietary energy intake (DEI) with a normatively specified minimum dietary energy requirement (MDER) taking into account the inequality in access to food in terms of the biological variation due to sex-age and physical activity variations among individuals and the socioeconomic variation due to different levels of income and other income related factors within the population. The proportion of the population with dietary energy consumption below the MDER is taken as the prevalence of undernourishment (FAO 1996 – The 6th World Food Survey).

According to this approach DEI, expressed in terms of per person per day, follows a log-normal probability distribution with parameters μ and σ . These parameters are yearly estimated on the basis of data from national food balances (NFB) or less frequently from household surveys (HHS) collecting food consumption and expenditure data, in terms of food quantities, that are then converted into dietary energy, called dietary energy consumption (DEC) as proxy of DEI.

The MDER used in estimating the prevalence of undernourishment is a population based weighted average of MDER for different age and sex, which is compatible with a healthy life while performing light physical activity.

Both data sources on food consumption, NFB and HHS, aim to measure food consumption as proxy of the dietary energy intake using different data collection procedures. However, neither of them takes into account the amount of food wastage or losses after food has been acquired by the population. Thus the actual food intake may be lower than the food consumption measured by HHS or by NFB. Food wastage refers to all foods appropriate for human consumption that has not being consumed by the population. It includes plate waste, spoiled foods, unrecorded food given to pets (unrecorded feed), composted and put in garbage disposals or lost in preparation.

Evidently, food wastage may be a major source of bias of final DEI estimates (FAO Statistics Division, 1983). It is therefore important to account for wastage in

calculating food intake, for the non-food use and food losses incurred between food acquisition and intake cannot be ignored; this occurs even when food supplies fall short of needs (Harrison, Rathje and Hughes, 1975; and Mercado-Villavieja, 1976).

The aim of this document is to describe a statistical procedure for adjusting DEC for food wastage so as to arrive at a closer approximation of DEI. The DEI, i.e. DEC after adjusting for food wastage and losses, would be used in the estimation of under-nourishment and over-nourishment.

The document is structured as follows. First, the background reports on a literature review related to household food wastage based on a preliminary report (FAO, 2004); second, a description of the statistical framework for estimating the distribution of dietary energy intake based on dietary energy consumption and food wastage; third, an illustration of parameter estimation applied to a limited dataset from Philippines; lastly, a proposal of a provisional function for adjusting the food consumption data in the context of estimating the prevalence of food deprivation and food excess.

II. Background

The need to consider food wastage for estimating food consumption was identified as early as 1939 (Chatfield, 1956). Since then, there have been many attempts to estimate household food wastage. However, due to its complexity, it has been very difficult to obtain acceptable estimates.

Most of the work has been done in developed countries, namely in the United Kingdom and in the United States of America. Other studies have been carried out in developing countries such as Philippines, Korea, Tunisia, Guatemala, Honduras, Costa Rica, Cuba, El Salvador, Panama, Peru and Paraguay (Chun *et al*, 1986; Chatfield, 1956; and, Mercado-Villavieja, 1976).

Some studies have measured household food wastage as a percentage of total consumed calories, others as a percentage of total weight of consumed food or as percentage of each of the consumed food-items. Furthermore, the estimated food wastage in terms dietary energy varied considerably, ranging from 0 to 29 percent, regardless the definition used; however, the majority of food wastage estimates fall within a range from 10 to 15 percent.

Some studies have estimated lower food loss in low-income households than in high-income households (Fung and Rathje, 1982; Chun, 1986; and, Jones, 2003). However, Wenlock *et al* (1980) did not find differences by household income levels, even after taking into account household size and geographical region. Dowler (1977) found similar results of no correlation between income and food wastage. Van De Reit (1985) concluded that household income is related to food wastage but in a nonlinear manner. Moreover, it has been noted that high income households with adequate storage facilities e.g. refrigeration and enclosed cabinets, produced greater edible food wastage (Mercado-Villavieja, 1976).

Some studies found a tendency for large-size families to waste more food than small-size families (Dowler, 1977; Wenlock and Buss, 1977; and, Wenlock *et al*, 1980), while others argued that in large-size families or families with small children, food wastage is not a concern (Fung and Rathje, 1982).

Among household characteristics, the knowledge respondents on food safety and quality issues had the strongest negative correlation with overall quantity of food wastage (Harrison, Rathje and Hughes, 1975; Fung and Rathje, 1982).

The wide range of estimates and findings in the literature can be explained by the differences in the way food wastage is defined and measured, methodological differences, sample sizes, geographical location and household characteristics (Kantor, 1998).

Methodologies vary considerably, from weighing edible food waste to using 7-day diaries completed by household members and from calculating caloric content of food to physically sorting garbage. In some cases, estimates were derived indirectly from loss coefficients based upon existing research. Some of the studies used very small sample sizes while others were performed at a more aggregate level than households (regional or national). In many studies domestic animals and garbage disposals were not accounted for in estimating household food wastage, thus yielding inaccurate estimates (Harrison, Rathje and Hughes, 1975; Wenlock and Buss, 1977; and, Jones, 2003). In some cases the wastage due to food used as feed to pets reached 30% of total food wastage in dietary energy terms (Wenlock *et al*, 1980; and, Mercado-Villavieja, 1976).

Studies in the United States show that food eaten outside of home is another important part of household consumption. During 1994-1996, meals eaten outside the household provided 32% of total energy consumption (USDA, 2003). Even though this percentage may be lower in developing countries, the data collected should account for meals eaten outside to give more accurate estimates of actual food consumption and hence of food wastage (FAO Statistics Division, 1983) and the institutional food wastage in restaurants, hospitals, schools, army barracks, religious residences, street vendors and other establishments needs to be accounted for.

An interesting finding emerging from the literature is that many researchers believe that the estimates obtained are too low, suggesting that better methods should be used (Adelson, Asp and Noble, 1961; Adelson *et al*, 1963; Dowler, 1977, Wenlock and Buss, 1977; Wenlock *et al*, 1980; Fung and Rathje, 1982; Rathje, 1984, Van De Reit, 1985; Kantor *et al*, 1997; and, Jones *et al*, 2003).

Because of the lack of standardization in estimating food wastage, it is



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