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Undernourishment and critical food poverty:

Indicators at national and sub-national levels

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Indicators on undernourishment and critical food poverty at national and sub-national levels[1]

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Indicators to measure food poverty and undernourishment are useful for understanding food insecurity at national level and within countries. This paper discusses two indicators: proportion of undernourishment, and proportion of critical food poverty. Both indicators are based on nutritional underlying criteria and derived from food consumption and income data collected in national household surveys. Proportion of undernourishment is the Millennium Development Goals (MDG) indicator number 1.9, which is based on the distribution of dietary energy consumption (DEC); the proportion of critical food poverty is an indicator that links undernourishment to food poverty, based on the distribution of income (INC). The link is the concept of minimum dietary energy requirement (MDER) used in the FAO methodology as the cut-off value in the distribution of dietary energy consumption for estimating undernourishment. The critical food poverty line for estimating the proportion of critical food poverty is the critical income corresponding to the cost of the MDER, based on a balanced diet on energy-yielding nutrients accessible to low-income population groups. The macronutrient-balanced diet uses the recommendations of a Joint WHO/ FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases (2002, Geneva) as its point of reference. Examples illustrate the results of both indicators for a sample of countries in different continents.

Key words: Food deprivation, food poverty, income deprivation, food security indicators

Introduction

Traditionally undernourishment is measured as the proportion of population below the minimum level of dietary energy consumption, that is, the MDG indicator number 1.9, which uses the distribution of dietary energy consumption on per person per day as a base (FAO, 2003).

The World Bank measures poverty as the proportion of population below the *minimum* level of income (or proxy total expenditure), that is, the MDG indicator number 1.1 the proportion of population below $1 (Purchasing Power Parity) per day for international comparison, which uses the distribution of income (or proxy total expenditure) as a base (Deaton, 1997). The *minimum* level of income refers to the monetary value of the *average* dietary energy requirement of the population provided by a normative food basket using food prices of low income population groups.

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More recently, it has been proposed as a measure of poverty the proportion of *critical* food poverty, that is, the proportion of population below the *critical* level of income (or proxy total expenditure), based on the distribution of income (or proxy total expenditure) as a base The *critical* level of income refers to the monetary value of the *minimum* dietary energy requirement of the population provided by a balanced energy-yielding nutrients food basket using energy-yielding nutrient prices of low income population groups (Sibrian 2008, 2009; Sibrian, Mernies and Ramasawmy, 2009).

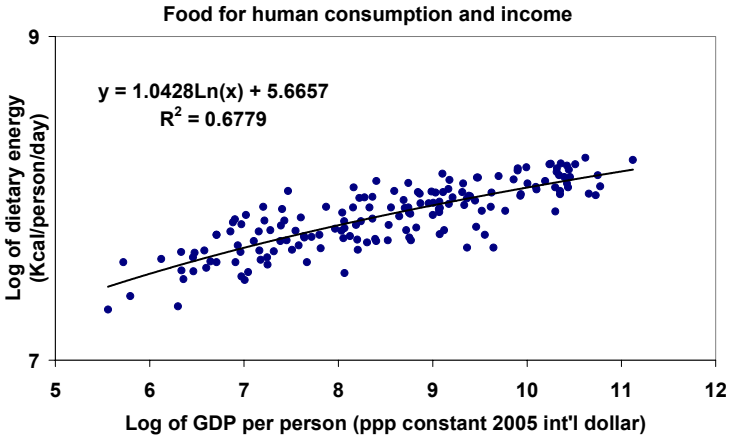
The main objective of this paper is to illustrate the indicators used for measuring undernourishment and critical food poverty national and subnational levels. Both indicators, undernourishment and critical food poverty, use the same nutritional underlying criteria; however, undernourishment is based on the distribution of dietary energy consumption while critical food poverty on the distribution of income (or total expenditure). As described elsewhere (Sibrian 2008) in estimating the proportion of food deprivation and critical food poverty, there are several methodological issues concerning the use of the underlying theoretical distribution for both dietary energy consumption (DEC) and income or proxy total expenditure.

The analysis of indicators on poverty and hunger requires understanding their contextual relationship. The paragraphs to follow illustrate these relationships.

Relationship between poverty and undernourishment

The relationship between poverty and undernourishment can be documented at several levels.

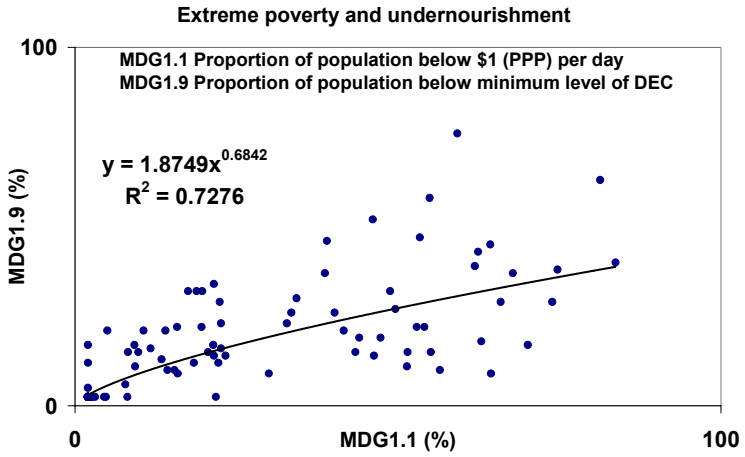
Figure 1



Sources: WDI, 2009 from World Bank Database and FAO, 2008a.

Figure 1 shows a strong non-linear relationship between income and food as measured by Gross Domestic Product valued at purchasing power parity (GDPppp) and dietary energy available for food consumption in selected countries, both expressed in terms of natural logarithm scale. However the relationship depicted by these indicators in Figure 1 ignores the distributions of income and dietary energy consumption within the population in countries.

Figure 2

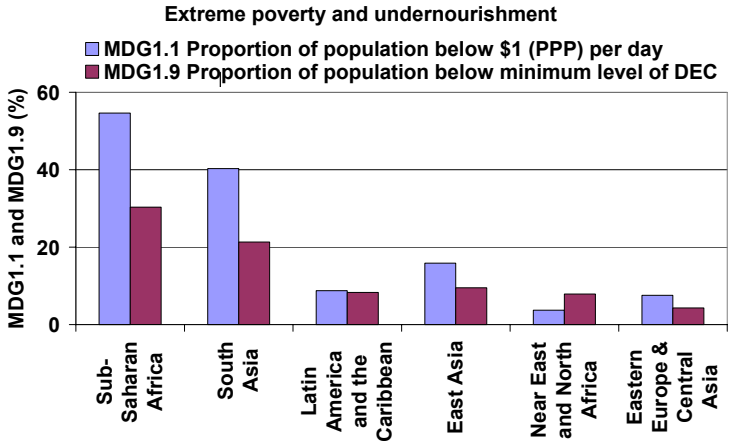


Sources: MDG 1.1 and 1.9 from UNSD-MDG Database 2009.

Figure 2 shows the non-linear relationship between poverty and undernourishment as measured by the proportion of extreme poverty (MDG 1.1 indicator) and the proportion of undernourishment (MDG 1.9 indicator). The nature of the relationship is stronger than that shown in Figure 1.

At regional level the relationship between the proportion of extreme poverty and the proportion of undernourishment is shown in Figure 3. Regions show higher levels of extreme poverty than undernourishment, except the Near East region where extreme poverty is lower than undernourishment.

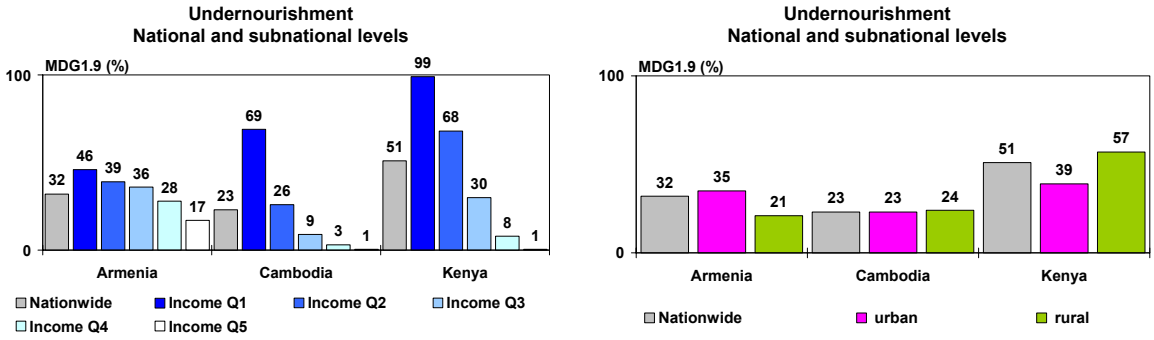
Figure 3



Sources: Aggregated estimates based on MDG 1.1 and 1.9 from UNSD-MDG Database 2009

At subnational levels the relationship between poverty and undernourishment is shown in Figure 4. Undernourishment estimates are higher in low income groups than in high income groups.

Figure 4

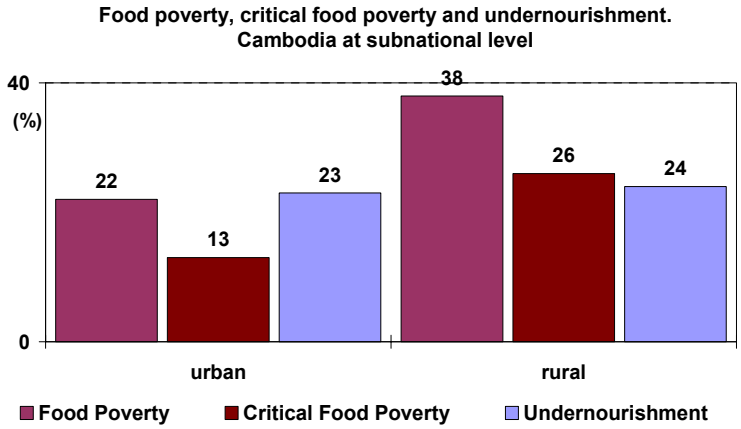


Source: Armenia, Cambodia and Kenya Lao Food Insecurity Assessments from Households Surveys

It has been argued that poverty in general is higher in rural areas; however undernourishment in households living in rural areas do not necessarily show higher undernourishment than in urban areas as shown in Figure 4; Armenia, for example, shows lower undernourishment in rural areas, in contrast Kenya the opposite situation, while Cambodia shows no difference between rural and urban.

In spite of this seemingly equality between urban and rural populations in Cambodia, the relationship between the proportions of food poverty, critical food poverty[2] and undernourishment are quite different as depicted in Figure 5. Food poverty and critical food poverty were higher in rural than in urban areas. Food poverty was higher than undernourishment in rural and not different in urban areas. Critical food poverty was lower than undernourishment in urban and not different in rural areas.

Figure 5

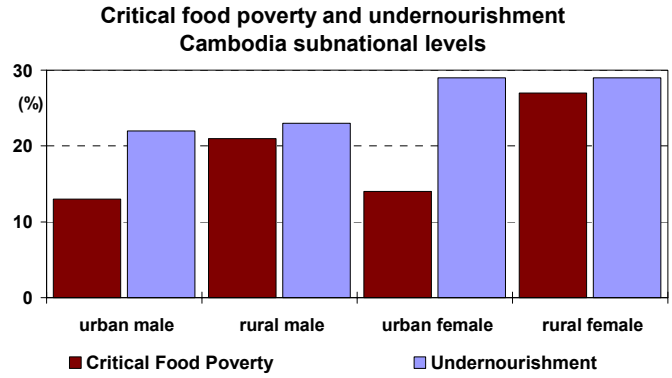


Sources: Cambodia, 2007

[2] ***Definitions of food poverty and critical food poverty presented in this paper are given in the section of "Discussion and conclusion" below.***

Figure 6 depicts the proportions of critical food poverty and undernourishment taking into account gender at subnational levels by area of residence in Cambodia. Female headed households showed higher critical food poverty as well as undernourishment than male headed households in both urban and rural areas.

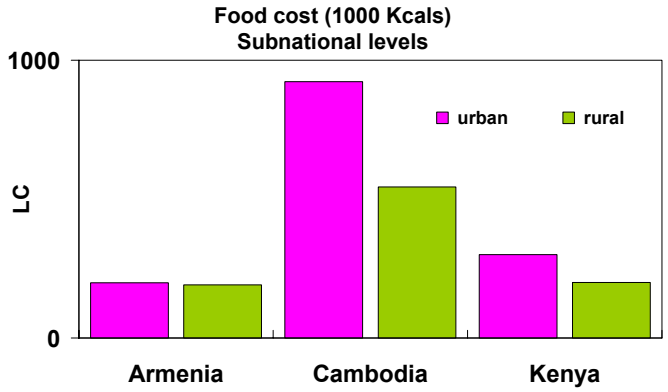
Figure 6



Sources: Pothy P. *et al*, 2008

Figure 7 shows dietary energy cost of food consumed in local currency (LC) for Armenia, Cambodia and Kenya (multiplied by 10). The monetary value of food consumed is expressed for 1000 kilo-calories as purchased or acquired from other sources, regardless of the edibility status of food, that is, ready to eat or uncooked. The difference between costs in urban and rural areas in Cambodia is quite high compared to Kenya or Armenia. The cost, as expected, is higher in urban areas than in rural areas and reflects different food consumption patterns. The cost of food produced in rural areas is higher in urban areas due to transport costs, middle-person profits in the marketing chain from production to consumption as well as food losses. The cost of processed food, for example sugar and oil, is lower in urban areas than in rural areas.

Figure 7



Source: Armenia, Cambodia and Kenya Lao Food Insecurity Assessments from Households Surveys

Discussion and conclusion

Undernourishment

The proportion of the population consuming less food to meet the minimum dietary energy requirement (MDER) is the proportion of undernourishment P(U). The proportion of undernourishment in total population is based on the probability distribution of DEC with density function determined by the mean and the variance of DEC, under the assumption of lognormal distribution (FAO 2008b). The mean is estimated as DEC for global monitoring of undernourishment from food balance accounts converted to dietary energy and for subnational monitoring from household surveys collecting food consumption in physical quantities. In both cases physical quantities of food are converted to dietary energy.

The variance is estimated from the CV of DEC. The CV of DEC involves two main components, thus ignoring non-relevant sources of variation. The first component CV of dietary energy consumption due to income, and the second component is CV of DEC due to energy requirements. The latter reflects differences in biological features of individuals such as sex, age and physical activity within the population and the former reflects the effect of income.

The CV of DEC due to income for global and for subnational monitoring of undernourishment is derived from income and food consumption data collected in national household surveys. It is estimated based on the variation of dietary energy consumption reflected by the averages of household dietary energy consumption on per person per day basis among income deciles.

The CV of DEC due to dietary energy requirements is derived using the variation of dietary energy requirements among sex and age groups, based on the minimum and maximum dietary energy requirements derived from standards of dietary energy requirements and the corresponding minimum and maximum body weight for attained-heights collected in anthropometric surveys and minimum and maximum physical activity levels. The standards of dietary energy requirements for minimum and maximum physical activity levels are obtained from the FAO/WHO/UNU Expert Consultation on Human Energy Requirements (FAO, 2004) and the minimum and maximum body weight for attained-heights are obtained from the BMI standards from WHO (WHO 2006, 2007).

The MDER used as cut-off point in the distribution of DEC is the population-based MDER that is derived from the FAO/WHO/UNU standards of dietary energy requirements for ***minimum*** physical activity level compatible with a ***sedentary*** lifestyle (FAO, 2004) and the ***minimum*** acceptable body weight for attained-heights (the fifth percentile of the WHO growth standards) as in the BMI standards from WHO (WHO 2006, 2007).

It is clear that in estimating the parameters mean of DEC and variance of DEC (function of the CV) at global level, the mean of DEC depends on the amount of dietary energy available for human consumption in the study population. DEC estimated for global monitoring from national food accounts covers household and non-household consumption, while DEC estimated for subnational monitoring at

national and subnational levels from national household surveys covers food available for consumption at household level only.

If the non-household food consumption is high, for example food for tourists in hotels, soldiers in military compounds, prisoners in jails, patients in hospitals, and residents in residential compounds and so on, the DEC estimated using national food accounts may be quite different than that using household survey data. The DEC from household survey data assumes that food consumed away from home, purchased and received at workplace or school canteens as well as food given away to other families or institutions are taken into account.

The DEC estimated using household survey data depends on the food acquisition capacity of households as it was illustrated in the cases of Armenia, Cambodia and Kenya. This acquisition capacity of households may be quite different among population groups as it was shown for Cambodia between urban and rural households due to the role of food from own-consumption. The size of the effect may be different from region to region within countries and also across countries; hence the distributions of DEC are shifted to the left or to the right of the DEC at national level.

The acquisition of food by households in different income levels is due to the different capacity of purchasing or producing and consuming (own-production or own-consumption). At subnational level, for example between urban and rural areas, income plays an important role in the specification of the distribution of DEC, in particular the component of variation of DEC induced by income (economical capacity for food acquisition) captured by the CV of DEC due to income. For example CV of DEC due to income in Kenya and Cambodia were higher than in Armenia. The CV of DEC due to requirements varies among subnational population groups; however the effect of this source of variation on the spread of the distribution of DEC is lower than the effect of DEC.

In short, the distributions of DEC by subnational populations are different because the two parameters, DEC and CV of DEC are different.

In addition to this, the population-based MDER used as cut-off point in the distribution of DEC also varies among subnational population groups. One example is that low income households have lower MDER per person than high income households. This is due to low dietary energy requirements of more young members in low income household. A second example is that rural households have lower MDER per person per day than urban households. This is due to low dietary energy requirements of more young members in rural households compared to urban households. A third example is that households with female heads have lower MDER per person than male-headed households. This is due to less dietary energy requirements of missing male members in households headed by females.

The distributions of DEC among subnational population groups with different means and variances and their different MDERs call for all three inputs in estimating the proportion of undernourishment at subnational levels. This is against the common practice of using a common standard of dietary energy requirements, for example, MDER or the average dietary energy requirements use for estimating the proportion of extreme poverty as recommended by the World Bank.

Food poverty and critical food poverty

The proportions of food poverty and critical food poverty in total population are based on the probability distribution of INC with density function determined by parameters mean and variance of INC, under the assumption of lognormal distribution. The proportion of the population living on less income (or proxy total expenditure) than that required to obtain the food to meet the ***average*** dietary energy requirements -ADER (food-poverty line), is the proportion of food poverty P(FP) while the proportion of the population living on less income (or proxy total expenditure) than that required to obtain the food to meet the ***MDER*** (critical-food-poverty line), is the proportion of critical food poverty P(CFP).

The variance of INC is estimated by the CV of INC which one-to-one corresponding to the Gini's coefficient under the lognormal assumption. The CV of INC is derived from national income and expenditure household surveys collecting income or proxy total expenditure. It is estimated based on the variation of averages of income among income deciles on per person per day basis. The CV of INC is in general over-estimated due to the inclusion of sampling-design variation and other instrumental sources of variation. The actual distribution of INC may be flatter than the actual distribution of INC. This limitation applies to all poverty indicators, including the proportion of critical food poverty; however it is still useful for the identification of food poor and insecure population groups.

The population-based critical-food-poverty line is derived by costing the balanced MDER. This balanced MDER provides dietary energy from energy-yielding nutrients as follows: 65%, 22.5% and 12.5% of dietary energy from carbohydrate, fat and protein respectively, based on FAO and WHO recommendations. It does not take into account micronutrients and amino-acid patterns. The prices of these energy-yielding nutrients are accessible to households in the first income quintile. Usually (not always) the DEC of the first income quintile is NOT balanced and the balanced DEC is higher than that paid by these households. The concept of the MDER is the link between these two indicators, the proportion of undernourishment and the proportion of critical food poverty.

In short, the distributions of INC by subnational populations are different because the two parameters, INC and CV of INC are different. Furthermore, the critical-food-poverty line based on the cost of the balanced MDER which differs among population groups, as described in the previous paragraphs, call for specific subnational estimations of the proportion of critical food poverty.

Critical food poverty and undernourishment

Food costs are useful to explain differences in proportions of critical food poverty and undernourishment. In Cambodia, for example, critical food poverty and undernourishment in urban and rural areas are determined by income and food cost. The lower critical food poverty in urban areas is determined by a higher income, even if the dietary energy per unit costs more in urban areas than in rural areas. In contrast, the higher critical food poverty in rural areas is determined by a lower income, even if dietary energy per unit costs less in rural areas than in urban areas. The quality of the diet consumed in rural areas in general is lower than in urban

areas. Any action aiming to poverty and undernourishment reduction needs to address income in rural areas and food costs in urban areas taking in consideration the nutritional quality of food consumed, in particular households headed by females.

Conclusion

The indicators on poverty and hunger illustrated at global and subnational levels are useful for assessing and monitoring food security. The increasing demand for indicators on poverty and undernourishment in developing countries can be met by using already collected data on food consumption in physical quantities in addition to monetary values in household income and expenditure surveys. Household surveys that for any reason have limited the data collection to monetary values can include in future surveys physical quantities for the purpose of food security analysis. These are elements useful for decision-makers in the national as well as in the international platforms engaged in the country's national food security. Hence decision-makers and stakeholders in national food security are encouraged to commission food security indicators and food insecurity assessments from national statistics offices; and, national statistics offices are encouraged to strengthen their statistical capacity to offer and users to include food security indicators derived from already collected data on food consumption (physical and monetary values) in national budget surveys.

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