

# **Poverty in Northern Sudan, Estimates from the NBHS 2009**

(Draft version)

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## **Introduction**

The Central Bureau of Statistics of the Republic of the Sudan conducted the National Baseline Household Survey (NBHS) during May and June 2009 to assess the current living standards of the population. This nationwide effort provides detailed information on many welfare dimensions such as educational levels, access to health care, housing conditions, immunization and consumption-poverty. While this report focuses only on the consumption data, many other indicators and a few of the Millennium Development Goals can be estimated with the NBHS and that output will help the Government of National Unity to develop a Poverty Reduction Strategy and to enhance its planning and budgeting processes.

Poverty is a multidimensional phenomenon and it refers to a pronounced deprivation in one or more facets of the well-being of a person. This report focuses on consumption poverty, i.e. poverty is measured in terms of the total consumption of the household. While consumption is only one dimension of welfare, it is arguably an important one that shows whether an individual has enough monetary resources to meet his needs. However, further analytical work should be done based on the other non-consumption indicators to comprehensively assess the welfare of the people in Northern Sudan. The report will assess the consumption patterns of the population and present the current level of poverty in Northern Sudan. Section 1 presents the methodology for poverty analysis, Section 2 discusses the main findings and Section 3 concludes. In addition, Appendix A shows the detailed food bundle used in the poverty line and Appendix B presents the standard errors and confidence intervals associated with the poverty estimations.

## **Executive Summary**

### **Background**

- The Central Bureau of Statistics of the Republic of the Sudan conducted the National Baseline Household Survey (NBHS) during May and June 2009 to assess the current living standards of the population. The NBHS surveyed 7,920 households across all fifteen states and is representative of Northern Sudan.
- The survey provides detailed information on welfare dimensions such as educational levels, access to health care, housing conditions, immunization, consumption-poverty, etc.
- This report focuses on the consumption data that emerged from the NBHS and estimates consumption and poverty levels in Northern Sudan.

### **Poverty and methodology**

- Poverty is a multidimensional phenomenon and it refers to a pronounced deprivation in one or more facets of the well-being of a person.
- While there are a variety of potential welfare indicators that can be used to determine a population's poverty level, the most widely accepted one is based on consumption. Here, per capita consumption was chosen as the welfare indicator and a national poverty line was estimated based on current consumption patterns.
- The poverty line can be defined as the monetary cost to a given person, at a given place and time, of a reference level of welfare. If a person does not attain that minimum level of standard of living, she will be considered poor.
- The poverty line is calculated using 2,400 calories per person per day as the daily energy intake threshold, in addition to a minimal non food component.

### **Findings**

- **Consumption**
  - The monthly per capita consumption in Northern Sudan in 2009 was 148 SDG.
  - Urban areas display consumption levels significantly higher than rural areas, at SDG 197 and SDG 122 respectively.
  - Across regions, consumption is highest in Khartoum, followed by Northern, Eastern and Central, while Darfur and Kordofan show the lowest consumption.
  - Among states, average consumption is highest in Khartoum, followed by River Nile, Kassala and Northern. A second cluster of states is comprised by Al-Gezira, Sinnar, Western Darfur and Al-Gadarif. A third group of states includes White Nile, Blue Nile, Red Sea, Northern Kordofan, Southern Darfur and Southern Kordofan. Northern Darfur shows the lowest consumption.
  - Food is by far the main category and accounts for 62% of total consumption, with significant differences between urban and rural areas.

- **Poverty**

- The poverty line was calculated to be 113.8 SDG per person per month.
- 46.5% of the population of Northern Sudan is found to fall below the poverty line, with 26.5% of the urban population and 57.6% of the rural population falling below the poverty line.
- Khartoum is the region with the lowest poverty incidence, followed by Northern. Eastern and Central rank third, while Kordofan and Darfur are the poorest regions.
- Poverty levels vary greatly by state. The incidence of poverty ranges from one fourth in Khartoum to more than two thirds in Northern Darfur.

# **1 The methodology for poverty analysis**

Poverty refers to a pronounced deprivation in one or more dimensions of the welfare of an individual, such as limited access to health facilities, low human capital, inadequate housing infrastructure, malnutrition, lack of certain goods and services, inability to express political views or profess religious beliefs, etc. Each of them deserves separate attention as they concern different components of welfare, and indeed may help policy makers to focus attention on the various facets of poverty. Nonetheless, often there is a high degree of overlapping. For instance, in most contexts, a malnourished person is also poorly educated and without access to health care.

Research on poverty over the last years has reached some consensus on using economic measures of living standards and these are routinely employed on poverty analysis. Moreover, monetary-based poverty indicators are the basis to monitor the first of the Millennium Development Goals. This report focuses on consumption-poverty i.e. poverty will be measured in terms of total consumption per person. Although it captures a central component of any assessment of living standards, it does not cover all aspects of human welfare. Further analytical work should be done based on the other non-consumption indicators to comprehensively assess the welfare of the people in Northern Sudan.

Poverty analysis requires three main elements:

1. A welfare indicator, both measurable and acceptable, to rank all population accordingly.
2. An appropriate poverty line to be compared against the chosen welfare indicator in order to classify individuals as poor and non-poor.
3. A set of measures that combine the individual welfare indicators and the poverty line into aggregate poverty figures.

This section explains all the steps involved in the construction of the consumption aggregate, the derivation of the poverty line and the poverty measures. Subsection 1 reviews the arguments for choosing consumption as the preferred welfare indicator. Subsection 2 describes the estimation of the nominal household consumption. Subsections 3 and 4 explain how we arrive at an individual measure of real consumption by correcting for differences in location, interview dates and demographic composition of households. Subsection 3 is concerned with the spatial and temporal price adjustment, while subsection 4 deals with the household composition adjustment. Subsection 5 clarifies the derivation of the poverty line. Finally, Subsection 6 presents the poverty measures used in this report.

## **1.1 The choice of the monetary indicator**

The main decision in poverty estimation is to choose between income and consumption as the welfare indicator to determine poverty. Consumption is the preferred measure because it is likely to be a more useful and accurate measure of living standards than income. This preference of consumption over income is based on both theoretical and practical issues.<sup>1</sup>

The first theoretical consideration is that both consumption and income can be approximations to utility<sup>2</sup>, even though they are different concepts. Consumption measures what individuals have actually acquired, while income, together with assets, measures the potential claims of a person. Secondly, the time period over which living standards are to be measured is important: if one is using a long term perspective as in a lifetime period, both should be the same and the choice does not matter. In the short-run though, say a year, consumption is likely to be more stable than income. Households are often able to smooth out their consumption, which may reflect access to credit or savings as well as information on future streams of income. Consumption is also less affected by seasonal patterns than income: for example, in agricultural economies, income is more volatile and affected by growing and harvest seasons, hence relying on that indicator might under or overestimate significantly living standards.

There are also practical arguments to take into account. First, consumption is generally an easier concept than income for the respondents to grasp, especially if the latter is from self-employment or family-owned businesses. For instance, workers in formal sectors of the economy will have no problem in reporting accurately their main source of income, i.e., their wage or salary. But self-employed persons in informal sectors, or engaged in agriculture, will have a harder time coming up with a precise measure of their income. Often in these cases, household and business transactions are intertwined. Besides, as was mentioned before, seasonal considerations are to be included to estimate an annual income figure. Finally, we also need to consider the degree of reliability of the information. Households are less reluctant to share information on consumption than on income. They may be afraid that income information will be used for different purposes, say taxes, or they may just consider income questions as too intrusive. It is also likely that household members know more about the household consumption than the level and sources of household income.

## **1.2 The construction of the consumption aggregate**

Creating the consumption aggregate is also guided by theoretical and practical considerations. In the case of the NBHS, the focus will be on the consumption aggregate of the household in the last year. First, it must be as comprehensive as possible given the available information. Omitting some components assumes that they do not contribute to

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<sup>1</sup> See Deaton and Zaidi (2002), Haughton and Khandker (2009) and Hentschel and Lanjouw (1996).

<sup>2</sup> “Utility” in economics refers, loosely speaking, to the satisfaction attained from the consumption of a basket of goods and services.

people's welfare or that they do not affect the rankings of individuals. Second, market and non-market transactions are to be included, which means that purchases are not the sole component of the indicator. Third, expenditure is not consumption. For perishable goods, mostly food, it is usual to assume that all purchases are consumed. But for other goods and services, such as housing or durable goods, corrections have to be made. Lastly, the consumption aggregate comprises five main components: food, non-food, durable goods, housing and energy. The specific items included in each component and the methodology used to assign a consumption value to each of these items is outlined below.

### **Food component**

The food component can be constructed by simply adding up the consumption of all food items in the household, previously normalized to a uniform reference period. The NBHS records information on food consumption at the household level using a recall period for the last seven days. It collects data on 150 items, which are organized in 14 categories: bread and cereals; meat; fish and seafood; milk, cheese and eggs; oils and fats; fruits; pulses; sugar, jam and sweets; other food items; coffee, tea and cocoa; water and drinks; tobacco; restaurants and cafes; and food from street vendors.

A few general principles are applied in the construction of this component. First, all possible sources of consumption are included, which means that the food component comprises not only consumption out of purchases, or from meals eaten away from home, but also food from previous stocks, that was produced within the household or received as a gift. Second, only food that was actually consumed, as opposed to total food purchases or total home-produced food, enters in the consumption aggregate. Third, non-purchased food items need to be valued and included in the welfare measure. The survey collects information on food purchases, thus it is possible to estimate a unit value for each food item by dividing the amount paid by the quantity purchased. Ideally food items will be disaggregated enough to be regarded as relatively homogeneous within each category, however these unit values will also reflect differences in the quality of the good. To minimize this effect and to consider spatial differences, median unit values were computed at several levels: urban and rural areas within states, state, urban and rural areas, and for the entire Northern Sudan. Hence if a household consumed a food item not purchased in the last week, the median unit value from the urban or rural area from that state would be used to value that consumption. If no other household consumed the same item in that area or if there were not enough observations to obtain a reliable unit value, the median unit value from the immediate upper level was used to estimate the value of that consumption.

A critical issue that had to be dealt with was the variety of quantity unit codes in which households could report their purchases and consumption. The questionnaire explicitly recognizes 18 different quantity unit codes, ranging from standard units as kilograms and litres to less standard units as heaps, bundles, cups, *rubus*, bottles and sacks. The way to address this matter was to conduct a supplementary survey in all 15 states in Northern Sudan and weight all these non-standard units for the 83 most consumed items. Even when the dispersion within each non-standard unit could be non-negligible (for instance, heaps could be small, medium or big), this allowed the conversion of all purchases and



consumption into kilograms and litres and simplified the estimation of unit values to impute a monetary value to all food consumption that was not purchased.

### **Non-food component**

As in the case of food, non-food consumption is a simple and straightforward calculation. Again, all possible sources of consumption must be included and normalized to a common reference period. Data on an extensive range of non-food items are available, 133 items arranged in groups such as clothing and footwear, education, health, beauty and toilet articles, recreational expenses, household goods, durable goods, housing expenditures, transportation, communication and insurance. The survey does not gather information on quantities consumed because most non-food items are too heterogeneous to try to calculate unit values. This subsection covers the consumption of most non-food items while durable goods, housing and energy will be dealt with later.

Practical difficulties arise often for two reasons: the choice of items to include and the selection of the recall period. Regarding the first issue, the rule of thumb is that only items that contribute to the consumption of the household are to be included. For instance, clothing, footwear, beauty articles and recreation are included. Others such as taxes are commonly excluded because they are not linked to higher levels of consumption, that is, households paying more taxes are not likely to receive better public services than, say, houses which paid lower taxes in the same community. Capital transactions like purchases of financial assets, debt and interest payments should also be excluded. The case for lumpy or infrequent expenditures like marriages, dowries, births and funerals is more difficult. Given their sporadic nature, the ideal approach would be to spread these expenses over the years and thus smooth them out, otherwise the true level of welfare of the household will probably be overestimated. Lack of information prevents us from doing that, and so they are left out from the estimation. Finally, remittances given to other households are also excluded. The rationale for this is to avoid double counting because these transfers almost certainly are already reflected in the consumption of the recipients. Hence including them would increase artificially living standards.

Two non-food categories deserve special attention: education and health. In the case of education there are three issues to consider. First, some argue that if education is an investment, it should be treated as savings and not as consumption. Benefits from attending school are distributed not simply during the school period but during all years after. Second, there are life-cycle considerations as educational expenses are concentrated in a particular time of a person's life. Say that we compare two individuals that will pay the same for their education but one is still studying while the other finished several years ago. The current student might seem better-off due to higher reported spending on education but that result is just related to age and not to true differences in welfare levels. One way out would be to smooth these expenses over the whole life period but that option is not available for our data since we only observe the individuals at one point in time. Third, we must consider the coverage in the supply of public education. If all of the population can benefit from free or heavily subsidized education (as it is the case in many parts of Northern Sudan) and the decision of studying in private schools is driven by quality factors, differences in expenditures can be associated with differences in welfare

levels and the case for their inclusion is stronger. Standard practice was followed and educational expenses were included in the consumption aggregate. Excluding them would make no distinction between two households with children in school age, but only one being able to send them to school.

Health expenses share some of the features of education. Expenditures on preventive health care could be considered as investments. Differences in access to publicly provided services may distort comparisons across households. If some sectors of the population have access to free or significantly subsidized health services, whereas others have to rely on private services, differences in expenditures do not correspond to differences in welfare. But there are other factors to take into account. First, health expenditures are habitually infrequent and lumpy over the reference period. Second, health may be seen as a “regrettable necessity”, i.e. the inclusion of health expenditures incurred due to the illness of a household member in the welfare indicator implies that the welfare of that household has increased when in fact the opposite has happened. Third, health insurance can also distort comparisons. Insured households may register small expenditures when some member has fallen sick, while uninsured ones bigger amounts; this is less of a concern in Northern Sudan due to low penetration of health insurance. It was decided to include health expenses because, as in the case of education, their exclusion would imply making no distinction between two households, both facing the same health problems, but only one paying for treatment.

The second difficulty regarding non-food consumption is related with the selection of the recall period. The key aspect to consider is the relationship between recall periods and frequency of purchases. Most non-food items are not purchased frequently enough to justify a weekly recall period, hence generally recall periods refer to the last month, the last quarter or the last year. The NBHS collects information with two reference periods: last 30 days and last 365 days. Those non-food items that are purchased or paid more frequently will fall into the last month recall period (toilet and personal care items, transportation, household utilities), whereas those less common will go into the last year reference period (clothing and footwear, purchase and repair of household appliances, educational expenses). It was not necessary to choose one recall period over the other because each item was asked only for one recall period. Thus non-food consumption involved adding up all non-food expenditures, previously normalized to a common reference period.

### **Durable goods**

Ownership of durable goods could be an important component of the welfare of the households. Given that these goods last typically for many years, the expenditure on purchases is not the proper indicator to consider. The right measure to estimate, for consumption purposes, is the stream of services that households derive from all durable goods in their possession over the relevant reference period. This flow of utility is unobservable but it can be assumed to be proportional to the value of the good. The NBHS provides information on eight durable goods: televisions, radios, telephones, computers, refrigerators, fans, air conditioners and mosquito nets. The survey asks about the number of items owned by the household and their current market value, but

unfortunately it does not ask about their age. Calculating this consumption component would have involved making assumptions about not only the depreciation rates for these eight durable goods but also the average age of each durable good owned by the household. This may result in an extremely imprecise estimation, thus it was decided to exclude this component from the consumption aggregate.

### **Housing**

Housing conditions are considered an essential part of people's living standards. Nonetheless, in most developing countries limited or non-existent housing rental markets pose a difficult challenge for the estimation and inclusion of this component in the consumption aggregate. As in the case of durable goods, the objective is to try to measure the flow of services received by the household from occupying its dwelling. When a household rents its dwelling, and provided rental markets function well, that value would be the actual rent paid. If enough people rent their dwellings, that information could be used to impute rents for those that own their dwellings. On the other hand, if the household does not rent its dwelling, the survey asked how much they would be willing to pay if they had to rent it. Data on self-reported imputed rent can also be used as an alternative to data on actual rents. Unfortunately estimating a housing component in Northern Sudan may be particularly difficult for two reasons. First, barely 5% of households rent their dwellings, which means that rental markets are developed at all and more likely they are concentrated in a few cities. Second, even when the NBHS provides information on imputed rent, these data may not be that credible considering that renting a dwelling is not common in most of the country. This will be particularly more serious in rural areas, which account for 64% of the population. It was decided to exclude this component from the consumption aggregate because its estimation may be quite imprecise. The exclusion of the imputed value of housing is not expected to significantly change the relative ranking of the population in terms of total consumption.

### **Energy**

The final non-food component that justified special attention was energy consumption, that is, expenditures on energy sources for lighting and cooking such as electricity, gas, generator fuel, kerosene, charcoal and firewood. The NBHS collects information about the last 30 days on purchases, consumption out of these purchases, and consumption out of previous stocks, own-production, gifts and other sources. Almost all households reported some energy consumption, with the exception of around 4% of the sample. In order to overcome this lack of information, a regression was run to impute energy expenditures to those households that did not report anything. Consumption on all energy sources was taken from households reporting expenditures and correlated with the type of dwelling, the number of household members, the per capita number of rooms in the dwelling, whether the area was urban or rural, the state and the main source for lighting and cooking. The predicted energy consumption was imputed for households not reporting any energy consumption.

## **1.3 Price adjustment**

Nominal consumption of the household must be adjusted for cost-of-living differences. A temporal and a spatial price adjustment are required to adjust consumption to real terms. In the case of the NBHS, it was decided not to adjust nominal consumption over time because the fieldwork took place over 6 weeks, thus the inflation during that period was considered negligible. In other words, the amount of goods and services a person could buy in week 1 of the fieldwork with, say, 100 Sudanese Pounds was assumed to be the same as in week 7. On the other hand, prices are expected to differ markedly across geographical domains. It was considered that that a spatial price index by urban and rural areas would capture properly the spatial price differences in Northern Sudan. In other words, the initial assumption is that the purchasing power of 100 Sudanese Pounds in cities and towns is different from that in the countryside.

A Laspeyres price index for urban and rural areas was constructed using information from the survey and employing the following formula:

$$L_i = \sum_{k=1}^n w_{0k} \left( \frac{p_{ik}}{p_{0k}} \right)$$

where  $w_{0k}$  is the national budget share of item  $k$ ,  $p_{ik}$  is the median price of item  $k$  in urban or rural areas, and  $p_{0k}$  is the national median price of item  $k$ .

This price index compares the cost of a national bundle of goods and services using national prices with the cost of the same bundle in urban and in rural areas. Given that the bundle will be the same for both areas, it follows that this price index can vary only because of differences in prices.

The NBHS provides information on budget shares for all items. In the case of food, it is possible to estimate unit values for most food items and match them with their respective budget shares. However, in the case of non-food, it is not possible to calculate any sort of prices. Two assumptions were required to circumvent this problem. First, all non-food items were bundled together, that is, they were treated as a single good. Second, the price of this sole non-food item was the same in urban and rural areas.

These two assumptions are not expected to have significant consequences. On the one hand, the share of food at the national level is 62%, hence differences in food prices will likely drive any differences in prices between urban and rural areas. On the other hand, the alternative of ignoring the non-food component and using only a food price index will make rural areas relatively better-off compared to urban areas because food prices are typically lower in the former. Given that non-food is generally cheaper in urban areas, at least assuming no differences in non-food prices will partially offset the food price differences and provide a better estimate of a full price index.

The Laspeyres price index by urban and rural areas is reported in Table 1.1. The index suggests that there are practically no differences in the cost of living between urban and

rural areas, that is, on average the reference bundle costs the same in cities and towns than in the countryside. It is worth mentioning a few issues that may influence this result. First, the reference bundle is the same in both areas. This means that while some food items may be more expensive in urban areas, other food items will be cheaper. The data show that these opposite effects cancel each other out for the whole bundle. This finding should not be understood as that every single food item costs on average the same in urban and rural areas. Second, aggregation plays a role. Had the price index been defined by region or by state, different results would have been obtained. Yet those results (not shown here) suggest that the price differences are not as large as people may suspect. Finally, seasonality may have affected the result. The survey was fielded in May and June, so one should be cautious about extending this finding for any period of the year.

Table 1.1: Laspeyres price index by urban and rural areas

## 1.4 Household composition adjustment

The final step in constructing the welfare indicator involves going from a measure of standard of living defined at the household level to another at the individual level. Ultimately, the concern is to make comparisons across individuals and not across households. Consumption data are collected typically at the household, so computing an individual welfare measure generally is done by adjusting total household consumption by the number of people in the household, and assigning that value to each household member. Common practice when doing this is to assume that all members share an equal fraction of household consumption. However, as will be explained later, that is a very particular case.

Two types of adjustments have to be made to correct for differences in composition and size. The first relates to demographic composition. Household members have different needs based mainly on their age and gender, although other characteristics can also be considered. Equivalence scales are the factors that reflect those differences and are used to convert all household members into “adult equivalents”. For instance, children are thought to need a fraction of what adults require, thus if a comparison is made between two households with the same total consumption and equal number of members, but one of them has children while the other is comprised entirely by adults, it would be expected that the former will have a higher individual welfare than the latter. Unfortunately there is no agreement on a consistent methodology to calculate these scales. Some are based on nutritional grounds, a child may need only 50% of the food requirements of an adult, but is not clear why the same scale should be carried over non-food items. It may very well be the case that the same child requires more in education expenses or clothing. Others are based on empirical studies of household consumption behavior, although with more analytical grounds, they do not command complete support either.<sup>3</sup>

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<sup>3</sup> See Deaton and Muellbauer (1986) or Deaton (1997).

The second adjustment focuses on the economies of scale in consumption within the household. The motivation for this is the fact that some of the goods and services consumed by the household have characteristics of “public goods”. A good is said to be “public” when its consumption by a member of the household does not necessarily prevent another member from consuming it too. Examples of these goods could be housing and durable goods. For example, a new household member can join the dwelling and this does not preclude the existing household members from living there as well. Larger households may spend less to be as well-off as smaller ones. Hence, the bigger the share of public goods in total consumption is, the larger the scope for economies of scale is. On the other hand, private goods cannot be shared among members; once one member has consumed them, no other can. Food is the classic example of a private good. It is often pointed out that in poor economies, food represents a sizeable share of the household budget and therefore in those cases there is little room for economies of scale.

Both adjustments can be implemented using the following scale from the Organisation for Economic Co-operation and Development (OECD):

$$AE = 1 + 0.7(N_{\text{adults}} - 1) + 0.5N_{\text{children}}$$

where AE is the number of adult equivalents of the household. The 0.7 and 0.5 coefficients reflect also economies of scale, hence the smaller these parameters, the more significant the economies of scale are.<sup>4</sup> It was mentioned that standard practice is to use a per capita adjustment for household composition and that is also followed here. This is a special case of the above formulation, it happens when both 0.7 and 0.5 are set equal to 1, so all adults and children consume as much as the first adult and there is no room for economies of scale. In other words, all members within the household consume equal shares of the total consumption and costs increase in proportion to the number of people in the household. In general, per capita measures will underestimate the welfare of households with children as well as larger households with respect to families with no kids or with a small number of members respectively.

It is important then to conduct sensitivity analysis to see how robust the poverty measures and poverty rankings are to different assumptions regarding child costs and economies of scale.<sup>5</sup> The previously mentioned scale from the OECD was implemented along with another where the impact of economies of scale is more important (0.5 rather than 0.7 and 0.3 rather than 0.5). On the one hand, the level of poverty went down drastically, which is unsurprising given the significant proportion of children in Northern Sudan. On the other hand, the rankings across greater regions and states were barely altered, which is positive news if the objective of the analysis is to rank regions and states in terms of poverty.<sup>6</sup>

## 1.5 The poverty line

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<sup>4</sup> See Deaton and Zaidi (2002) and Haughton and Khandker (2009) for other adult equivalent scales and for a more detailed discussion.

<sup>5</sup> Lanjouw et al (1998).

<sup>6</sup> These findings are not shown in this report.

The poverty line can be defined as the monetary cost to a given person, at a given place and time, of a reference level of welfare.<sup>7</sup> If a person does not attain that minimum level of standard of living, she will be considered poor. Implementing this definition is, however, not straight-forward because considerable disagreement could be encountered at determining both the minimum level of welfare and the estimated cost of achieving that level. In addition, setting poverty lines could be a very controversial issue because of its potential effects on monitoring poverty and policy-making decisions.

It will be assumed that the level of welfare implied by the poverty line should enable the individual to achieve certain capabilities, which include a healthy and active life and a full participation in society. The poverty line will be absolute because it fixes this given welfare level, or standard of living, over the domain of analysis. This guarantees that comparisons across individuals will be consistent, for instance, two persons with the same welfare level will be treated the same way regardless of the location where they live. Second, the reference utility level has been anchored to certain attainments, in this particular case to the attainment of the necessary calories to have a healthy and active life. Finally, the poverty line will be set as the minimum cost of achieving that requirement.

The Cost of Basic Needs method was employed to estimate the nutrition-based poverty line. This approach calculates the cost of obtaining a consumption bundle believed to be adequate for basic consumption needs. If a person cannot afford the cost of the basket, this person will be considered to be poor. First, it shall be kept in mind that the poverty status focuses on whether the person has the means to acquire the consumption bundle and not on whether its actual consumption met those requirements. Second, nutritional references are used to set the utility level but nutritional status is not the welfare indicator. Otherwise, it will suffice to calculate caloric intakes and compare them against the nutritional threshold. Third, the consumption basket can be set normatively or to reflect prevailing consumption patterns. The latter is undoubtedly a better alternative. Lastly, the poverty line comprises two main components: food and non-food.

### **Food component**

The first step in setting this component is to determine the nutritional requirements deemed to be appropriate for being healthy and able to participate in society. Clearly, it is rather difficult to arrive to a consensus on what could be considered as a healthy and active life, and hence to assign caloric requirements. Besides, these requirements vary by person, by his/her level of activity, the climate, etc.<sup>8</sup> Common practice is to establish thresholds of around 2,100 to 3,000 calories per person per day. The majority of the population lives in rural areas, thus it was decided to set the daily energy intake at 2,400 calories per person per day, which is not an uncommon threshold for the countryside.

Second, a food bundle must be chosen. In theory, infinite food bundles can provide that amount of calories. One way out of this is to take into consideration the existing food

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<sup>7</sup> Ravallion (1998) and Ravallion (1996).

<sup>8</sup> Food and Agriculture Organization of the United Nations (2001, 2003).

consumption patterns of a reference group in the country. It was decided to use the bottom 60% of the population, ranked in terms of real per capita consumption, and obtain its average consumed food bundle. It is better to try to capture the consumption pattern of the population located in the low end of the welfare distribution because it will probably reflect better the preferences of the poor. Hence the reference group can be seen as a first guess of the poverty incidence<sup>9</sup>. Third, calorific conversion factors were used to transform the food bundle into calories. Tobacco, residual categories and meals eaten outside the household were excluded from this calculation: the first because is not really a food item and the other two because it is very difficult to approximate calorific intakes for them. For all of the remaining food items, it was possible to assign a calorific factor. Fourth, median unit values were derived in order to price the food bundle. Unit values were computed using only market transactions from the reference group. Again, this will capture more accurately the prices faced by the poor. Fifth, the average calorific intake of the food bundle was estimated, so the value of the food bundle could be scaled proportionately to achieve 2,400 calories per person per day. For instance, the average daily caloric intake of the bottom 60% of the population in Northern Sudan was around 2,000 calories per person and the daily value of the food bundle was SDG 1.89 per person. Hence the value of the daily poverty line is SDG 2.27 ( = SDG 1.89 x 2,400 / 2,000 ) per person. Table 1.2 shows the caloric contribution of the main food categories as well as their respective share in the cost of the food poverty line.<sup>10</sup>

Table 1.2: Food bundle per person per day by main food groups

### **Non-food component**

Setting this component of the poverty line is far from being a straightforward procedure. There is considerable disagreement on what sort of items should be included in the non-food share of the poverty line. However, it is possible to link this component with the normative judgment involved when choosing the food component. Being healthy and able to participate in society requires spending on shelter, clothing, health care, recreation, etc. The advantage of using the NBHS is that the non-food allowance can also be based on prevailing consumption patterns of a reference group and no pre-determined non-food bundle is required.

The initial step is to choose a reference group that will represent the poor and calculate how much they spend on non-food goods and services. This reference group will be the population whose food consumption is similar to the food poverty line. The rationale behind this reference group is that if an individual spends in food what was considered the minimum for being healthy and maintaining certain activity levels, it will be assumed

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<sup>9</sup> More precisely, using the consumption pattern of the bottom 60% of the population to calculate the food bundle implies that both the composition of consumption, i.e. the proportion of various items in total food consumption, and the food prices faced by the poor and the bottom 60% of the population are not significantly different.

<sup>10</sup> A more detailed table by food item is provided in appendix A.



that this person has also acquired the minimum non-food goods and services to support this lifestyle.

Different ways are suggested in the literature to determine the average non-food consumption of those with a food spending similar to the food poverty line. One option is to rely on econometric techniques to estimate the Engel curve, that is, the relationship between food spending and total expenditures. However, a simple non-parametric calculation as suggested in Ravallion (1998) was followed. The procedure starts by estimating the average non-food consumption of the population whose food expenditures lie within plus and minus 1% of the food poverty line. The same exercise is then repeated for the population lying plus and minus 2%, 3%, and up to 10%. Second, these ten mean non-food allowances are averaged and that will be the final non-food poverty line. Finally, the total poverty line can be easily estimated by adding the food poverty line with the non-food poverty line.<sup>11</sup> The advantage of this method is that no assumptions are made on the functional form of the Engel curve and that weights decline linearly around the food poverty line; this means that the closer a household is to the food poverty line, the higher is its assigned weight. Table 1.3 displays the food and non-food component of the poverty line.

Table 1.3: Poverty line per person per month

The various assumptions explicitly made in this section should caution the reader against potentially erroneous comparisons of poverty measures across countries. Poverty estimates are sensitive to the specific methodological assumptions which are made, especially with regard to the calorific threshold, the adjustment for household size, the economies of scale and proportion of population chosen for selecting the food bundle. Additionally, because food bundles are different across countries, and may therefore imply a different cost to acquiring even the same number of calories, it is erroneous to immediately compare poverty incidence across countries. These considerations make comparison of poverty estimates, even with neighbouring countries, hazardous. For example, it may be cheaper to acquire 2,400 kcal if the main staple is sorghum as in Northern Sudan, in comparison to “matooke” as in parts of Uganda. Similarly, Uganda uses 3,000 kcal as the calorific threshold instead of the 2,400 kcal applied here – clearly, estimates of poverty would increase with an increase in the calorific threshold. The major purpose of poverty estimation using the above methodology is to rank the various geographical and/or administrative domains, in this case states, according to the estimated incidence of poverty and to track the trends in poverty over time. While our analysis is suitable for the first purpose, and can be used as a basis for comparisons over time after successive rounds are completed, it may not be suitable for comparisons across countries.

## 1.6 Poverty measures

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<sup>11</sup> An equivalent way of estimating the total poverty line requires calculating the food share of the reference group. The total poverty line will be the ratio between the food poverty line and the food share of the reference group.

The literature on poverty measurement is extensive, but attention will focus on the class of poverty measures proposed by Foster, Greer and Thorbecke (1984). This family of measures can be summarized by the following equation:

$$P_{\alpha} = (1/n) \sum_{i=1}^q \left( \frac{z - y_i}{z} \right)^{\alpha}$$

where  $\alpha$  is some non-negative parameter,  $z$  is the poverty line,  $y$  denotes consumption,  $i$  represents individuals,  $n$  is the total number of individuals in the population, and  $q$  is the number of individuals with consumption below the poverty line.

The headcount index ( $\alpha=0$ ) gives the share of the poor in the total population, that is, it measures the percentage of population whose consumption is below the poverty line. This is the most widely used poverty measure mainly because it is very simple to understand and easy to interpret. However, it has some limitations. It takes into account neither how close or far the consumption levels of the poor are with respect to the poverty line, nor the distribution of consumption among the poor. The poverty gap ( $\alpha=1$ ) is the average consumption shortfall of the population relative to the poverty line. Since the greater the shortfall, the higher the gap, this measure overcomes the first limitation of the headcount. Finally, the severity of poverty ( $\alpha=2$ ) is sensitive to the distribution of consumption among the poor, a transfer from a poor person to somebody less poor may leave unaffected the headcount or the poverty gap but will increase this measure. The larger the poverty gap is, the higher the weight it carries.

These measures satisfy some convenient properties. First, they are able to combine individual indicators of welfare into aggregate measures of poverty. Second, they are additive in the sense that the aggregate poverty level is equal to the population-weighted sum of the poverty levels of all subgroups of the population. Third, the poverty gap and the severity of poverty satisfy the monotonicity axiom, which states that even if the number of the poor is the same, but there is a welfare reduction in a poor household, the measure of poverty should increase. And fourth, the severity of poverty will also comply with the transfer axiom: it is not only the average welfare of the poor that influences the level of poverty, but also its distribution. In particular, if there is a transfer from one poor household to a richer household, the degree of poverty should increase.<sup>12</sup>

Finally, Appendix B shows the poverty measures with their respective standard errors and confidence intervals. Since these estimations are based on surveys and not on census data, standard errors will take into account the elements of the sample design, that is, stratification, clustering and sampling weights.<sup>13</sup> Ignoring them will risk, when carrying

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<sup>12</sup> Sen (1976) formulated the monotonicity and the transfer axioms.

<sup>13</sup> See Howes and Lanjouw (1997) for a detailed explanation.

out poverty comparisons, mixing up true population differences with differences in sampling procedures.

## 2 Main findings

This section presents the main findings of the poverty analysis. The first subsection examines the level and composition of the consumption aggregate, while the second subsection assesses the current extent of poverty and the robustness of these results.

### 2.1 Consumption

According to the household survey, the monthly per capita consumption in Northern Sudan in 2009 was SDG 148. Tables 2.1, 2.2 and 2.3 display the average consumption by main expenditure groups and across three different partitions of the country: urban and rural areas, regions and states. Urban areas display consumption levels significantly higher than rural areas (SDG 197 and 122 respectively). Across regions, consumption is highest in Khartoum, followed by Northern, Eastern and Central, while Darfur and Kordofan show the lowest consumption. Among states, average consumption is highest in Khartoum, followed by River Nile, Kassala and Northern. A second cluster of states is comprised by Al-Gezira, Sinnar, Western Darfur and Al-Gadarif. A third group of states includes White Nile, Blue Nile, Red Sea, Northern Kordofan, Southern Darfur and Southern Kordofan. Northern Darfur shows the lowest consumption.

The shares of all consumption groups are displayed in the bottom panel of each table. Food is by far the main category and accounts for 62% of total consumption, with significant differences between urban and rural areas. It is expected that food consumption rises less quickly as total consumption rises, that is, the food share falls as total consumption rises. Indeed that is the case between urban and rural areas: in the former, food accounts for 60% of total consumption, while in the latter for 64%. However, the pattern holds neither by region nor by state. Across regions and states, food shares are fairly similar despite the significant differences in consumption. For instance, Kassala ranks third in average consumption but shows the second highest food share across states. On the other hand, Northern Darfur, the state with the lowest consumption, has a comparable food share with Northern and River Nile, two of the states with the highest consumption.

What could explain this puzzling finding? Further descriptive and econometric analysis provided additional insights and an explanatory hypothesis. In urban areas the share of food decreases significantly as total consumption rises, whereas in rural domains the association is positive but not significant. Thus the negative relationship between food share and total consumption found across urban and rural areas when looking at their average values also holds when examining the entire consumption distribution in urban areas, but it does not hold within rural areas. This would suggest that access to non-food goods and services may be quite limited in rural areas, hence when consumption increases, the food share will rise too. This hypothesis seems rather likely for Northern Sudan given that market penetration in rural areas remains low. Supplementary support for this hypothesis is provided by the fact that the number of food goods and services consumed per household in rural areas rises more markedly with total consumption than in urban areas. Overall, additional consumption in rural areas is channelled towards not only more food spending but also more food items.

Returning to the discussion on the different components of consumption, among non-food categories, spending on utilities is the most important component. Expenditure on water and energy sources for cooking and lighting accounts for 8% of total consumption, with urban areas having a similar share than rural areas. Transportation and communication represent 7% of total consumption and it displays noticeable differences in cities and towns compared to the countryside: 9% and 6% respectively. Health account for 6% of consumption and both urban and rural areas show similar shares. Maintenance of the dwelling, repair of household appliances and purchases of household utensils and cleaning articles represent 5% of total consumption, while clothing stands at 4%. Education only account for 2% and personal care, recreational expenses and other consumption represent the remaining 6%. Overall, with the exception of transportation and communication, all non-food components display similar shares between urban and rural areas.

More striking differences are observed when looking at consumption patterns by poverty status (Tables 2.4, 2.5, 2.6, 2.7 and 2.8). First, the average consumption of the poor is a third of that of the non-poor. Second, the negative association between food share and total consumption does not hold by poverty status either. The food share of the poor is virtually the same than the food share of the non-poor. More precisely, the difference in the average food share between the poor and the non-poor is not statistically significant in any of the regions or states. As discussed before, this finding most likely is caused by the lack of availability of non-food goods and services in rural areas, which account for more than three fifths of the population. Third, average spending on education and health is quite different by poverty status, but the shares are similar between the poor and the non-poor. Fourth, consumption of water and energy is significantly higher among the non-poor, but the poor consume significantly more in relative terms<sup>14</sup>. Fifth, the share of expenditures regarding the maintenance of the dwelling is the same by poverty status, although the non-poor spend noticeably more than the poor. Lastly, the non-poor spend significantly more on transportation and communication than the poor, both in absolute and relative terms.

Table 2.4: Consumption per person per month by urban and rural areas and poverty status

Table 2.5: Consumption per person per month by region and poverty status

Table 2.6: Consumption per person per month in the Northern and Eastern regions by state and poverty status

Table 2.7: Consumption per person per month in the Khartoum and Central regions by state and poverty status

Table 2.8: Consumption per person per month in the Kordofan and Darfur regions by state and poverty status

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<sup>14</sup> It is important to recall that the consumption of energy sources, as with the consumption of other goods here, reflects not just the actual spending on energy resources but also the imputed value of the own-produced energy consumption by households. So, self-collected firewood or own-produced charcoal could account for much of the spending of poor households on energy, even though no market transaction has taken place.

## 2.2 Poverty estimates

The incidence of poverty in Northern Sudan is 46.5% (Table 2.9), which means that almost one out of two Northern Sudanese does not have the necessary means to purchase the value of a minimum food and non-food bundle. Although the poverty headcount is very easy to understand, it does not provide information on how close or far the poor are from being able to satisfy their basic needs or how consumption is distributed among the poor. This could be a serious limitation when evaluating alternative policy options, for example, the implementation of a particular policy could improve the welfare of the poor leaving unchanged the poverty incidence. In order to obtain a more complete description of the poverty situation, two other measures are also considered: the poverty gap and the severity of poverty.

Table 2.9: National poverty rates

The poverty gap estimates the average shortfall in consumption relative to the poverty line and thus overcomes the first limitation of the headcount. It stands at 16%, which implies that the average deficit in consumption of each person in the country is 16 percent below the poverty line, if the non-poor are considered to have a zero shortfall. On the other hand, the poverty gap among the poor is 35%, that is, the average consumption of the poor falls short of the poverty line by 35 percent or around SDG 40 per person per month.

Lastly, the severity of poverty is 8%. Unlike the headcount or the poverty gap, this measure is sensitive to the distribution of consumption among the poor.<sup>15</sup> For instance, if a transfer occurs from one poor household to a richer household, the level of poverty should increase. Even when the poverty incidence and the poverty gap may be unaffected, the severity indicator will increase. Unfortunately, there is no easy or intuitive interpretation of this indicator. However, it may help to compare and rank poverty across different groups when similar incidences and poverty gaps are found.

### **Sensitivity of the poverty estimates to the level of the poverty line**

A natural concern that arises is to find out how sensitive the poverty measures are to the level of the poverty line. Yet considerable effort has been put in deriving a poverty line following a fairly established methodology and trying to be as transparent and objective as possible, an unavoidable degree of arbitrariness is involved in the process. Many explicit and implicit assumptions have been made along the way and not everybody may agree with them. Other poverty lines might be equally appealing and justified.

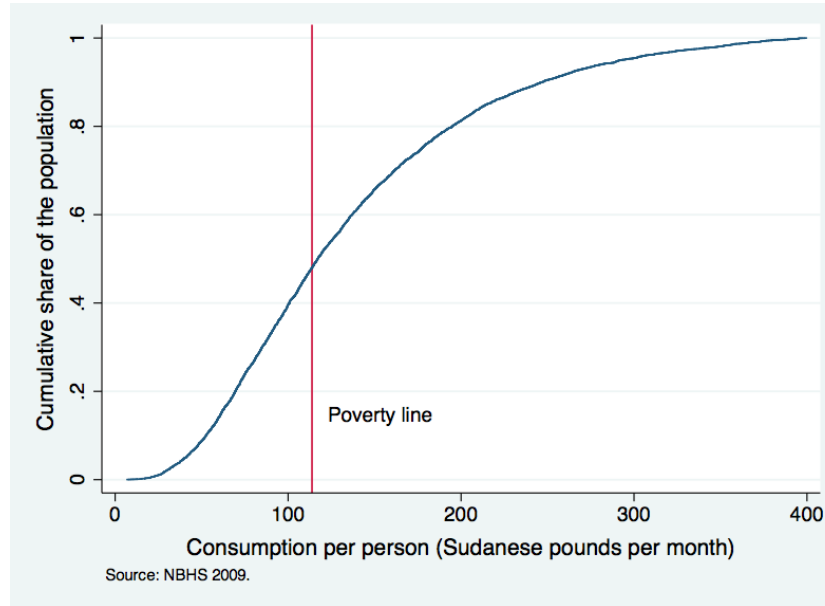
A first way to assess how much the incidence of poverty will change when the poverty line is shifted upwards or downwards is by plotting the cumulative distribution function of per capita consumption (Figure 2.1). For a given consumption level on the horizontal axis, the curve indicates on the vertical axis the percentage of the population with an equal or lesser level of consumption. If one thinks of the chosen consumption level as the

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<sup>15</sup> It weights the shortfall in consumption relative to the poverty line more heavily the poorer the person is.

poverty line, the curve will show the associated poverty headcount and hence it can be seen as a “poverty incidence curve”. Thus at a poverty line of SDG 114 per person per month, around 46.5% of the population are poor. Nonetheless, given that the slope of the distribution is relatively steep around that level, it is likely that small changes in the poverty line will have large impacts on the poverty incidence.

Figure 2.1: Cumulative distribution of consumption per person



The concentration of the population around the poverty line can also be illustrated with the related concept of the density function.<sup>16</sup> Figure 2.2 depicts the kernel density estimate of per capita consumption. It shows that a significant clustering occurs below the poverty line, which suggests that poverty measures will be more sensitive to scaling down the poverty line than to scaling it up. Table 2.10 confirms this by estimating all three poverty indices when the poverty line is scaled up and down. On the one hand, it reveals that 13 percent of the population lies within plus or minus 10 percent of the poverty line and 25 percent within plus or minus 20 percent. On the other hand, all poverty indices change more when the poverty line is scaled down than when it is scaled up.

Figure 2.2: Density function of consumption per person

<sup>16</sup> The notion of the density function is very similar to that of histograms. Traditional histograms divide a range of the variable of interest into certain number of intervals of equal width and draw a vertical bar for each interval with height proportional to the relative frequency of observations within each interval. A kernel density function can be thought of as a “smoothed” histogram. It estimates the density, or relative frequency, at every point rather than at every interval. Hence, say in the case of consumption, the area between two consumption levels is the proportion of the population with consumption within that range (it follows that the total area under the curve is 1 or 100 percent of the population).

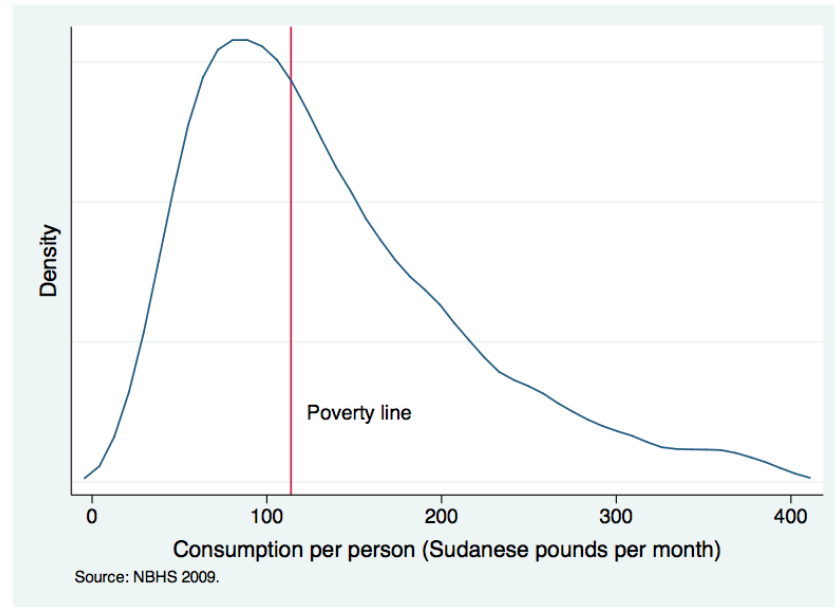


Table 2.10: Impact of scaling the poverty line on poverty

### A poverty profile

How does poverty vary across Northern Sudan? Table 2.11 displays poverty measures according to three partitions: by urban and rural areas, by region and by state. A few findings are worth noticing. First, poverty is significantly lower in urban areas. Only one out of four urban dwellers is poor, whereas this proportion reaches three out of five people in the countryside. The poverty gap and the severity of poverty show similar patterns. Second, Khartoum is the region with the lowest poverty incidence, followed by Northern. Eastern and Central rank third, while Kordofan and Darfur are the poorest regions. Third, the distribution of the population by region is not closely aligned with the distribution of the poor by region. Khartoum represents roughly one fifth of the population, but only one tenth of the poor. On the other hand, Kordofan and Darfur account for 34% of the population but 45% of the poor.

Fourth, poverty levels vary greatly by state. The incidence of poverty ranges from a quarter of the population in the capital to more than two thirds of the population in Northern Darfur. The remaining states can be combined into three groups according to their poverty incidence. River Nile, Northern, Kassala and Al-Gezira have poverty rates between one third and two fifths of their population. A second group may comprise Sinnar and Al-Gadarif, where the proportion of the population that is poor is 44% and 55% respectively. The third group includes White Nile, Western Darfur, Blue Nile, Red Sea, Northern Kordofan, Southern Kordofan and Southern Darfur. In these states poverty is between 55% and 61%. Fifth, it is not clear that urbanization is a factor associated with poverty when looking across states (figures not shown in Table 2.11). For instance, Red Sea and Northern Kordofan have basically the same poverty incidence, around 57%, but their levels of urbanization are quite different (55% and 20% respectively). Conversely,



Blue Nile and River Nile have similar levels of urbanization, around 27%, but their poverty incidence is rather dissimilar (56% and 32% respectively).

Sixth, the distribution of the poor across states fairly resembles the distribution of the population, with the exception of Khartoum (where its share among the poor is significantly lower than among the population) and almost all states in the Kordofan and Darfur regions (where their share among the poor is higher than their share among the population). Lastly, the poverty gap among the poor shows significantly less dispersion than the poverty gap. This reflects the fact that the latter is an average among all population, whereas the former only among the poor. For instance, even though the Eastern region has a clearly lower poverty incidence than Kordofan and Darfur, their average shortfall in consumption relative to the poverty line are not significantly different. In other words, the consumption of the poor is fairly similar across these regions. Another case is Kassala, which shows almost half the poverty incidence than Northern Darfur, but whose poverty gaps among the poor are basically the same.

Table 2.11: Poverty profile

What is the sensitivity of these findings to the level of the poverty line? Stochastic dominance analysis allows us to find the range of poverty lines over which poverty comparisons are robust. It relies on graphical tools and its main advantage is that it focuses on the entire distribution of consumption.<sup>17</sup> The main previous findings are corroborated (Figures 2.3, 2.4 and 2.5). Urban areas are unambiguously better-off than rural areas. Across regions, Khartoum displays the highest level of consumption followed by Northern. Eastern and Central rank third and it is not possible to assert which is better-off because their curves are quite close and crossed each other. Kordofan and Darfur rank last and their curves overlap each other for most part of the distribution, which means they have similar levels of consumption and thus of poverty.

At the state level, with the exception of Khartoum and Northern Darfur, the best and worst state in terms of consumption, the previous partition into three groups stands, although with minor changes. Northern, River Nile and Al-Gezira follow Khartoum in having the highest levels of consumption. Kassala shows very low consumption at the bottom of the distribution (consistent with its high poverty among the poor) but then reaches consumption levels comparable to the other three states. A second cluster of states includes Sinnar and Al-Gadarif. Lastly, the third group of states comprises Red Sea, White Nile, Blue Nile, Western and Southern Darfur, and Northern and Southern Kordofan. They display the lowest consumption levels and nothing conclusive can be said about their ranking because their curves keep overlapping and crossing each other.

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<sup>17</sup> By plotting two or more cumulative density functions of per capita consumption in the same graph, it is possible to infer first-order stochastic dominance. Distribution A first-order stochastically dominates distribution B if for any given level of per capita consumption, the share of the population with a lesser or equal level of consumption will always be lower in distribution B. In other words, if curve A always lies above curve B, distribution B will have a higher level of welfare and hence lower poverty. However, if the curves intersect each other, the criteria do not apply and it is not possible to infer which distribution has a higher level of welfare.

Figure 2.3: First order dominance results: Cumulative distribution of consumption per person by urban and rural areas

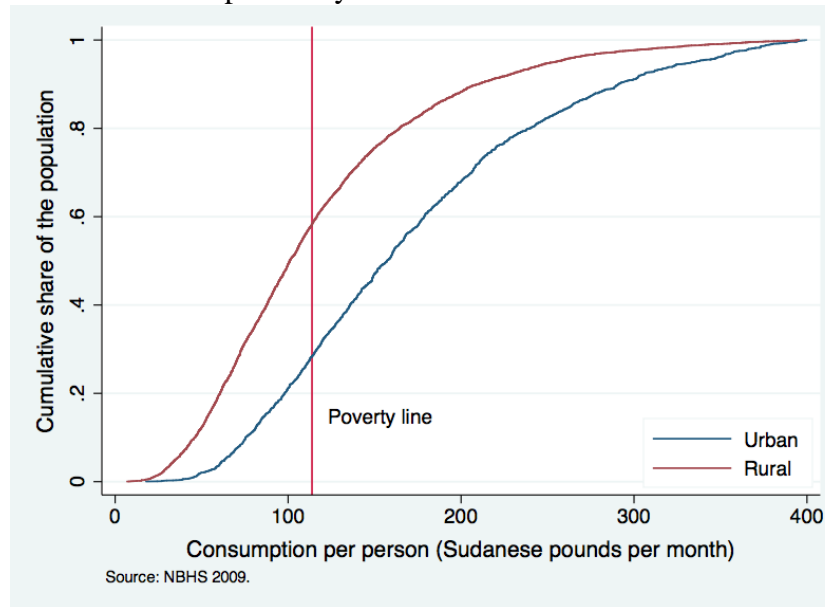


Figure 2.4: First order dominance results: Cumulative distribution of consumption per person by region

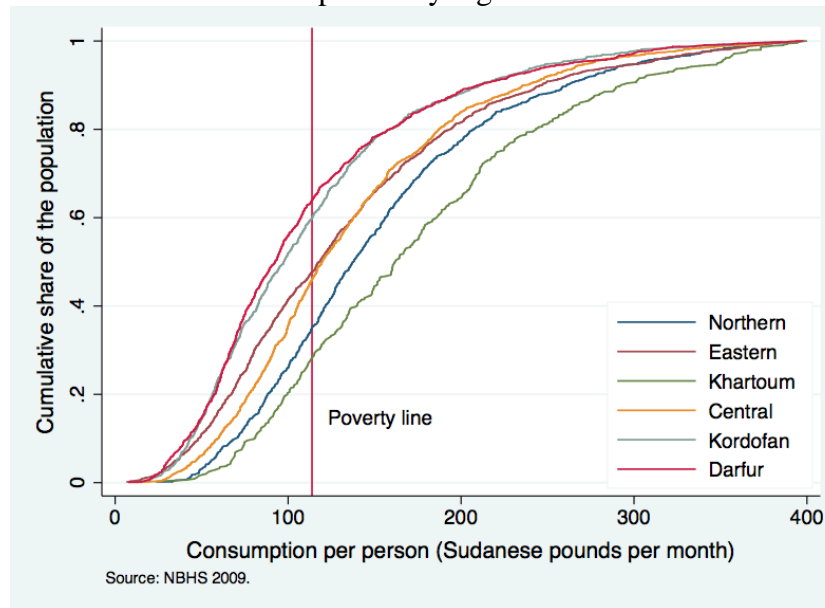
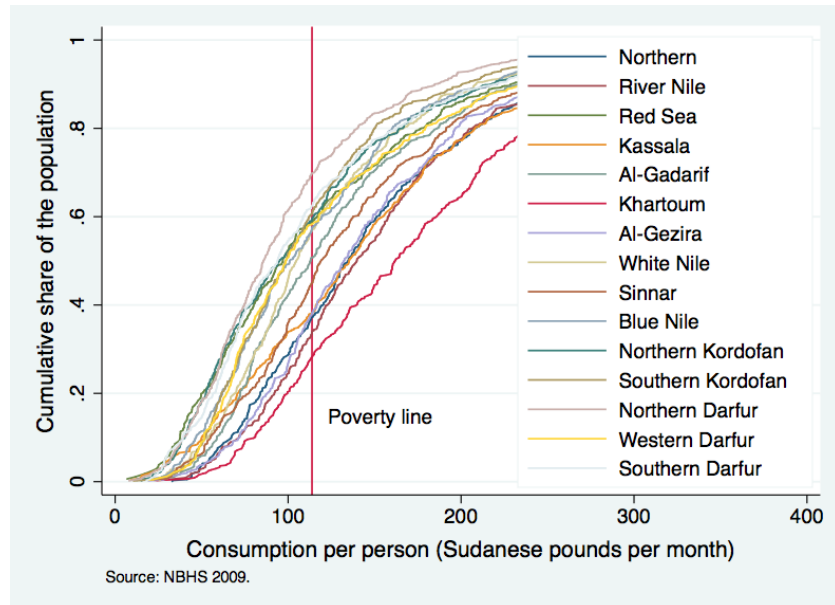


Figure 2.5: First order dominance results: Cumulative distribution of consumption per person by state



### 3 Final remarks

This report provides poverty estimations based on the National Baseline Household Survey 2009. Per capita consumption was chosen as the welfare indicator and a national poverty line was estimated based on current consumption patterns. Poverty is a common occurrence in Northern Sudan and affects almost half of its population. Urban areas are significantly less poor than rural domains. The distribution of the poor reflects largely the distribution of the population, with the exceptions of the capital and the Kordofan and Darfur regions. Comparisons across states could be quite ambiguous, while Khartoum is the least poor and Northern Darfur is the poorest, the ranking among the other states is not robust because some of them display similar consumption and thus broadly the same poverty levels.

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## **APPENDIX A**

Table A.1: Food bundle per person per day