FOOD AND NUTRITION SECURITY ASSESSMENT IN SUDAN

ANALYSIS OF 2009 NATIONAL BASELINE HOUSEHOLD SURVEY

SOUTHERN SUDAN COMMISSION FOR CENSUS STATISTICS AND EVALUATION | CENTRAL BUREAU OF STATISTICS

FOOD SECURITY TECHNICAL SECRETARIAT OF THE MINISTRY OF AGRICULTURE (FAO-SIFSIA/ SUDAN INTEGRATED FOOD SECURITY INFORMATION FOR ACTION)

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Executive Summary

One out of three Sudanese suffered from food deprivation in 2009, which is the Millennium Development Goal indicator 1.9 on hunger reduction, based on the 2009 Sudan NBHS data. The prevalence of undernourishment was 31 and 34 percent for urban and rural populations, respectively.

The prevalence of undernourishment for southern States fell in the category of very high severity of food deprivation (47 percent), while the figure for the northern States categorized high severity. The highest levels of food deprivation was observed in the States of Western Bahr Al Ghazal, Unity, Upper Nile, Warrap and Lakes, with more than half of their population, shown in brown in the map.

The average Sudan national had a daily dietary energy consumption (DEC) of 2180 Kcal per person in 2009. Rural and urban areas had similar daily DEC levels of 2140 and 2270 daily Kcal per person, respectively.

The depth of hunger, which refers to the amount of daily dietary energy consumption per person required by the undernourished population to reach the minimum dietary energy requirement (MDER), was 344 Kcal at the national level and 343 and 344 Kcal in urban and rural areas, respectively. This amount of DEC expressed in food quantity is about 100 grams of daily food grains per person which is equivalent to about 37 kg of yearly food grain consumption per person, ignoring possible food losses after food acquisition. The depth of hunger was however remarkably different in households by States, ranging from 249 Kcal in Al Gezira to 521 Kcal in Western Bahr Al Ghazal.

At national level, an average person spent 2.71 SDG to consume 2180 Kcal per day, more in urban areas (3.53 SDG) than in rural areas (2.32 SDG). Among States, food expenditures range from 1.32 SDG in Warrap to 3.63 SDG in Khartoum.

The percentage of food in total household consumption, food ratio (FR), was 61.4 percent at the national level, lower in urban areas, 56.4 percent, than in rural areas, 65.7 percent.

The contribution of macro-nutrients (carbohydrate, fat and protein) to DEC ranked carbohydrate as the highest source of energy (65.7 percent) followed by fat (21.9 percent) and then protein (12.4 percent). These contributions to total energy were in line with the WHO/FAO guidelines for a balanced diet by energy-yielding macro-nutrients.

The survey revealed that the percentage of DEC from purchases at the national level was 80.9 percent, 91.8 percent in urban areas and 75.2 percent in rural areas. In terms of food sources for DEC from own production was 7.6 percent nationwide, 1.4 percent in the urban areas and 10.7 percent in rural. The highest contributions to DEC from own production were in States Eastern Equatoria with 42.1 percent and Western Equatoria with 50 percent.

Inequality, as measured by the Coefficient of Variation (CV) of DEC due to income were similar for urban and rural populations, 31.2 and 32.2 percent respectively; however, it was higher in female than in male headed households, 35.1 and 29.6 percent, respectively.

Acronyms

ADER	Average Dietary Energy Requirement
BMI	Body Mass Index
BMR	Basal Metabolic Rate
CBS	Central Bureau of Statistics
COICOP	International Classification of Individual Consumption by Purpose
CPA	Comprehensive Peace Agreement
CPI	Consumer Price Index
CV	Coefficient of variation
DEI	Dietary Energy Intake
DES	Dietary Energy Supply
DEC	Dietary Energy Consumption
EC	European Community
FAO	Food and Agriculture Organization
FBS	Food Balance Sheet
FCT	Food Composition Tables
FNSA	Food and Nutrition Security Assessment
FSSM	Food Security Statistical Module
FPI	Food Price Index
IDC	International Demonstration Centre
HBS	Household Budget Survey
IMR	Infant Mortality Rate
NBHS	National Baseline Household Survey
NGO	Non-Governmental Organizations
MDER	Minimum Dietary Energy Requirement
MDG	Millennium Development Goals
PAL	Physical Activity Level
PRSP	Poverty Reduction Strategy Papers
SIFSIA	Sudan Institutional Capacity Programme: Food Security Information for Action
SOFI	State of Food Insecurity
SPSS	Statistical Package for the Social Sciences
SDG	Sudanese Pound
SSA	Sudan Statistical Agencies
SSCCSE	Southern Sudan Commission for Census Statistics and Evaluation
USDA	United States Department of Agriculture
WFS	World Food Summit
WHO	World Health Organization
UN	United Nations
UNU	United Nations University

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Foreword

The Sudan Statistical Agencies (SSA) were established as semi-autonomous agencies responsible for coordinating, monitoring and supervising the National Statistical System. The Central Bureau of Statistics (CBS) is responsible for the North of Sudan, while the Southern Sudan Centre for Census, Statistics and Evaluation (SSCCSE) is for the South. The agencies support the Government's evidence-based policymaking process by providing statistics needed for planning, monitoring, development, performance and progress in the implementation of major national development policies.

The SSA continued their commitment in collaboration with international agencies such as FAO and the European Commission to make statistics a "public good" through the support for the conduction and analysis of the food consumption and other data collected in the 2009 Sudan National Household Baseline Survey (NHBS). The food security statistics component of NHBS is supported by the Sudan Institutional Capacity Programme Food Security Information for Action (SIFSIA). This programme has as main objective to improve the statistical capacity of the SSA household experts in deriving and disseminating food security statistics and indicators from the NHBS.

This report provides a summary analysis of food and nutrition security assessment in Sudan and by States, area of residence and different functional groups in the country. It presents a suite of food security indicators including the Millennium Development Goal Indicator 1.9 on the prevalence of undernourishment at the national and sub national levels. This information is useful in locating and identifying food insecure population groups in Sudan for better targeted food policies, programmes and interventions. It also provides inputs for the design and planning of the Poverty Reduction Strategy Papers (PRSP) and serve as a baseline for the assessment and monitoring of food security indicators in Sudan. The report is open to debate and the SSA would be grateful to receive comments or suggestions concerning its contents and findings to improve the understanding of the food and nutrition security situation in Sudan.

Acknowledgement

This report was prepared by staff members from the CBS, SSCCSE and Secretariat of SIFSIA following their participation in the International Demonstration Centre (IDC) on food security and consumption statistics derived from household surveys held in Rome in April and May 2010.

The Sudanese Statistical Agencies (SSA) are grateful to FAO and SIFSIA for the technical and financial support to the NBHS process aiming to the release of this report. The "*Food and Nutrition Security Assessment in Sudan: Analysis of 2009 Sudan National Baseline Household Survey*" report resulted from a development process of technical assistance on statistical analysis of food consumption data provided by the FAO Statistics Division.

We wish to thank FAO-Statistics Division, in particular Ricardo Sibrian, without whom the production of this document would have been very difficult, if not impossible. Special thanks to Mr. Seevalingum Ramasawmy, statistician and Ms. Ana Moltedo, consultant and the Director of FAO Statistics Division for the continuous technical support provided during and after the IDC in Rome. The SSA would like to express thanks to Statistics Norway for the training provided on poverty and food security data analysis in January 2010 and their all long support during the NBHS process.

We are also grateful to national teams involved in the NBHS processes, especially those served as a technical group in evaluating the overall process. The NBHS would not have been possible without the financial support from various partners including African Development Bank (ADB), the United Nations Development Program (UNDP), and Statistics Norway. We also thank all other development partners and stakeholders who participated and contributed to the survey and this report. Finally, we would like to express our gratitude to the European Union for the financial support to various programs, including the FAO-SIFSIA project.

We also thank the user community whose contributions during the preliminary result dissemination forum had been extremely useful.

Differences between the Food and Nutrition Security Assessment in Sudan and the Poverty Estimate for Sudan

Readers should be aware that the food and nutrition security assessment results are different from the poverty estimate done by the Government of Sudan. The differences are predominantly methodological and some technical. This report provides a summary analysis of food and nutrition security assessment in Sudan and by States, area of residence and different functional groups in the country by using the food statistical procedures of the Food Security Statistics Module (FSSM)[1]. On the other hand, the poverty estimate focuses on consumption poverty – poverty measured in terms of total consumption of household by using various statistical methods (theoretical and practical applications).

The following differences should be noted between the two results:

- While the objective of the Poverty Estimate (PE) is providing input to the PRSP report and estimation of poverty incidence across States, the objective of the Food and Nutrition Security Assessment (FNSA) result will be mainly used for monitoring of prevalence of undernourishment and hunger under the umbrella of Millennium Development Goals (MDGs).

- As per PE, *incidence of poverty* is defined as people who do not have the necessary means to purchase the value of a minimum food and non-food bundle where as *food deprivation* in the FNSA refers to the condition of people whose food consumption in terms of energy is below a minimum dietary energy. Depth of hunger is the amount of calories the deprived population has missed to reach the daily Minimum Dietary Energy Requirement (MDER) per person.

- PE utilizes overall consumption poverty per person – food plus non-food poverty line. FNSA on the other hand focuses on food Dietary Energy Consumption (DEC). As per the

[1] The FSSM by using a parametric approach is a set of procedures implemented by national statistics offices in countries to produce a suite of standard indicators on food security at national and sub-national levels that are consistent and comparable over time and among countries.

FNSA estimation, the average Sudan national had a daily DEC of 2180 Kcal per person in 2009.

- Using internationally accepted KCAL categories, the PE considers an assumed *2400 kcal as a poverty line* - average dietary energy requirement by calculating an average calorific intake of food bundle. The FNSA takes *a daily MDER* - a weighted average of minimum requirement of the different age and sex groups of population. *Food deprivation of Sudan* refers to the proportion of the population whose dietary energy consumption is below the MDER.

- The PE, due to its sensitivity to methodological assumptions of poverty line, people are advised not to use it for across country comparisons where as the FNSA results are comparable across countries and regions.

1. Introduction

1.1 Background

The signing of the Comprehensive Peace Agreement (CPA) on January 9, 2005 marked the end of nearly four decades of civil war in Sudan and an optimistic beginning of reintegration into the international community. This peace, together with macroeconomic stability and considerable natural resources, has offered a tremendous opportunity to increase broad-based economic growth and access to social services by many people.

Following the CPA, Sudan Statistical Agencies have collaborated for the collection of a wide range of information for supporting the decision process at the national or state levels. In 2006, the Sudan Household Health Survey was undertaken with the international support to provide a comprehensive baseline health and nutrition data for the whole of Sudan. The fifth population census was carried out in 2008 after about fifteen years and provided useful disaggregated data on the population distribution and characteristics on the whole of Sudan critical to development planning and policies.

The 2009 Sudan National Household Baseline Survey (NHBS) was the third major nationwide conducted by the SSA since the CPA with the support of development partners. The 2009 NHBS was a comprehensive survey with the primary purpose of assessing the current living standards of the population and to provide the government with important data on poverty incidence needed for developing a Poverty Reduction Strategy Paper (PRSP). In addition the survey makes it possible to provide improved food security statistics and information that supports committed national decision making platforms in the fight against food deprivation crucial for monitoring selected indicators of Millennium Development Goals. In addition, the NHBS will update and generate comprehensive set weights for compiling the Consumer Price Indices (CPI) basket of goods and services.

A food consumption module was included in the 2009 NHBS questionnaire collecting detailed information on food consumption and expenditure, produced or acquired, over a recall period of one week for a list of 150 food items. The information on the food quantity and monetary values were useful in performing a separate comprehensive food security analysis under the

guidance of the FAO Statistics Division who is responsible for the monitoring of the MDG indicator 1.9 on hunger reduction. This report presents the findings of the food security statistics and indicators using the FAO food security statistics module (FSSM).

1.2 Economy

In recent years, Sudan has been experiencing an economic upturn, characterized by a long positive episode of growth and relatively low inflation. The growth of the Gross Domestic Product (GDP) was 8.4 per cent in 2008, but it is projected to slow down to about 5.0 per cent in 2009 reflecting the impact of the global financial crisis. The exploitation of oil reserves and "the peace dividend" were the main drivers of this economic success.

Direct foreign investment has stimulated the recent economic growth as well as a boom in the service sector, especially transportation and communication. Outside the oil sector, Sudan's economic growth is narrowly based and limited in reach. The rise of the oil economy also presents new challenges to macroeconomic stability. There were some warning signs of unfolding with the Sudanese Pound exchange rate linked to the decline of traditional exports, such as cotton and Arabic gum.

Despite the recent success at macroeconomic stabilization and the pro-market reforms under an IMF-monitored program, the governance of the oil sector and the management of windfalls present substantial risks. Most of the new employment opportunities are concentrated in the service sector, mainly the urban informal sub sector. Increased investment, however, in labour-intensive infrastructure and construction projects and trade in services (e.g. education, health, transportation and distribution) provide opportunities for employment generation and broad-based growth.

1.3 Agriculture

The agricultural sector is the core of Sudanese population and the primary source of livelihoods for a majority of its citizens. The Sudanese economy is predominately rural with 70 percent of the population deriving their livelihoods in rural areas. The agricultural sector contributes one third to GDP (32.6 percent) and more than one half (57 percent) to labour force (CIA, 2009).

There are three major farming systems, namely irrigated, rain-fed semi–mechanized and rain-fed traditional agriculture. Irrigated agriculture accounted for an average of 27.4 percent of the total value of agricultural production in 2005; rain-fed semi-mechanized and rain-fed traditional accounts for 18.8 percent. The livestock sector accounts for 49.0 percent (Dura in Sudan 2005).

Pastoralists predominantly for livestock production traditionally have been classified as a separate farming system, even though they are integrated with other farming systems, particularly with traditional rain-fed farming. Because of the diversity of agro–climatic environments under which the agricultural sector operates, the high seasonality of production and the separation of production and consumption centres by large distances, a wide range of policies, institutions and infrastructure to develop efficient marketing system will be needed to generate growth and achieve the poverty reduction objective.

1.4 Nutrition

Improving the health and nutritional status of the people of Sudan is one of the priorities for the Federal Government of Sudan (FMOH, 2005), and is vital to its development. While Sudan has enormous potential in terms of natural and human resources (FAO, 2005), it is not on track to meet the Millennium Goals by 2015 (UNICEF, 2006).

Nutritional indicators from recent studies (SHHS, 2006) in Sudan found that, as the MDG indicator 1.8 on hunger reduction, almost one in three (31 percent) children under the age of five years were underweight. Almost one half (48 percent) were stunted and 18.1 percent of children under five suffered from moderate or severe acute malnutrition.

2. National Baseline Household Survey 2009: A Brief Overview

2.1 Scope and purpose of the survey

The 2009 National Baseline Household Survey (NBHS) was the second major national sample survey conducted in Sudan after the CPA. The first was the Sudan Household Health Survey in 2006. NBHS is the first survey to use the sampling frame from the 5th Sudan Population and Housing Census of 2008. The survey followed an identical methodology across the twenty five states (15 states North and 10 states South) and fieldwork was carried out in the South in April-May 2009 and in the North in May-June 2009.

The primary purpose of the survey was to assess the current living standards of the population and to provide the government with important data on poverty incidence needed for developing a Poverty Reduction Strategy Paper (PRSP). In addition the survey makes it possible to provide food security statistics and information that supports committed national decision making platforms in the fight against food deprivation.

The survey will update and generate comprehensive weights for computation of the Consumer Price Indices (CPI) and make a major contribution to establish reliable statistics crucial for monitoring selected indicators of Millennium Development Goals.

2.2 Sample Design

The sample selected for the 2009 National Household Budget Survey (NBHS) was based on a stratified two-stage sampling design. The sampling frame for Sudan was based on the 2008 Sudan Population Census preliminary count of households by enumeration area (EA) and the census cartography. The primary sampling units (PSUs) were the EAs, which are census operational segments identified on maps. For the 2009 NBHS the census EAs were stratified by state, urban and rural areas. At the second sampling stage households were randomly selected from the listing of households in each sample EA.

The sample size was determined for obtaining reliable estimates for key survey indicators at the state level, and for the urban and rural domains at the national level. A sample of 44 EAs was selected at the first sampling stage for each of the 25 states in Sudan, and 12 households were

selected from each sample EA at the second stage. Therefore, the total households sample size was 528 per State, and a total of 13,200 households for Sudan.

At the first sampling stage the EAs within each stratum were selected systematically with probability proportional to size (PPS), where the measure of size was based on the number of households in each EA from the preliminary 2008 Sudan Population Census results. A few sample EAs could not be enumerated because of security or other problems of accessibility, in which case they were replaced by random EAs within the same geographic area. A listing of households was conducted in each sample EA to provide the second stage-sampling frame. Then 12 households were selected systematically with equal probability from the listing for each sample EA. There were some households, which could not be interviewed due to non-contact or refusal and were therefore substituted by pre-selected random replacement households in order to maintain the effective sample size. Estimates from the NBHS were self-weighted and derived using expansion factors for population-based estimates. Estimates of population-based standard errors were derived for the main variables (see Table 12 in the annex).

2.3 Questionnaire Design

The NBHS questionnaire was designed in consultation with data users to ensure their requirements could be incorporated. A Technical Working Group and a User Needs Group were set up, both in Khartoum and in Juba, to decide on user requirements and priorities for the survey. These groups included representatives from various ministries in northern and southern Sudan, UN agencies and international NGOs. Extensive and useful comments were received from the Living Standards Measurement Survey Unit at the World Bank.

Although the primary aim of the survey was to generate estimates of poverty incidence, it was agreed that the opportunity of this survey should also be used for collecting baseline information on a range of other indicators. The major purpose of including additional modules was to supplement the analysis of poverty by also looking at non-monetary deprivations, as well as to fill certain pressing data gaps in Sudan.

The questionnaire contains several modules: food, health, education, economic activity, housing, asset ownership, access to credit, economic shocks, household transfers, consumption and agriculture.

Pilot surveys were carried by SSA during December 2008 and contributed to some useful inputs to the final questionnaire. Finally, after several rounds of SSA discussions in January and February 2009 and with support from other national and international stakeholders, the final questionnaire was approved in February 2009.

The questionnaire is identical for both southern and northern States, except in two modules, child-anthropometric module for nutritional status assessment in southern States and household income in northern States.

2.4 Challenges for future household surveys

The SSA encountered several challenges in the implementation of the NBHS:

1. **Insecurity for survey field staff**:
   The period of survey fieldwork in April-May 2009 coincided with a sharp spurt of insecurity in many parts of southern States. The upsurge in conflict denied access to some areas and required SSA, on occasion, to evacuate SSA field staff. Replacement EAs from a pre-drawn random set of replacements were assigned in case of inaccessibility due to insecurity. Up to five replacement EAs were anticipated per state; this number was sufficient with the exception of Jonglei and Western Equatoria where additional replacement EAs were required.

2. **Local languages:**
   Due to a profusion of tribal languages in Sudan, it was not possible to translate the questionnaire into all local languages. Questionnaires were printed in English and Arabic, and translations of key terms local languages were discussed during training of interviewers.

3. **Lack of standardized measures:**
   The collection of food consumption data was hard by the lack of standardized units of quantity measurement in Sudan. Because much food consumption is sourced in non-

standardized units (such as heaps, cups and bundles), it is hard to calculate consumption in standardized comparable units (such as kilograms and litres). Accordingly, the questionnaire allowed respondents to report consumption in non-standard units. Parallel market surveys by State provided commodity specific conversion factors for these units, for example, 1 heap of potatoes on average had 450 grams. While this was the only feasible solution, it may still be prone to non-trivial measurement error.

4. **Logistics and poor infrastructure:**
   As in all large-scale field activities in Sudan, logistics and constraints of poor infrastructure absorbed a significant proportion of the survey implementation efforts.

5. **Incomplete household survey reference period:**
   The period of survey fieldwork in April-June 2009 represented a short span period of the year. Results on food security will represent the situation during this particular period. The SSA will need to extend the national budget surveys to cover agricultural and other economic activities using a sampling design that allocates households randomly over a twelve-month period.

2.5 Food component of the NBHS

The NBHS recorded data on food consumption at the household level using a recall period for the last seven days. It collected data on 135 items, which were organized in 19 broad categories of food items:

- *cereals;*
- *roots and tubers;*
- *sugar, jam and sweets;*
- *pulses;*
- *nuts;*
- *vegetables;*
- *fruits;*
- *stimulants (coffee, tea and cocoa);*

- *spices;*
- *alcoholic beverages;*
- *meat;*
- *eggs;*
- *fish and seafood;*
- *milk and cheese;*
- *oils and fats;*
- *non alcoholic drinks; and*
- *miscellaneous food including food consumed away from home such as restaurants, cafes and food from street vendors*.

The food consumption and security analysis makes use of all food details in terms of quantity and values reported for each food item at the household over the reporting period. The sources of household and household's members food acquisition such as purchases, meals bought and eaten away from home, food from previous stocks, own production or received as a gift. Non-purchased food items were valued using the collected food prices. The survey collected 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.

2.6 Limitations to the consumption data

1) The survey was conducted during a short period of the year, so it accounts for food acquisition during a particular season and does not consider food variations due to seasons and income over a longer period of one year.
2) Lack of standardization of local units of quantity measurement, like heap, cup, bag, etc, provided challenges in data collection.
3) Some food items in questionnaire were not specific enough in description to find better correspondence of nutrients conversion factors.
4) Updated height data for the population by age and sex groups were not available for better estimating the minimum dietary energy requirements.

2.7 Methodology of measuring food deprivation

The prevalence of undernourishment is the hunger indicator 1.9 measuring food deprivation falling with the MDG "Eradicate extreme poverty and hunger" by 2015.

MDG Target 1C - Halve, between 1990 and 2015, the proportion of people who suffer from hunger.

Indicator 1.9: Proportion of population below minimum level of dietary energy consumption

FAO is the UN organization responsible for the estimation of the MDG 1.9 indicator for the global monitoring progress hunger reduction, which is directly related to the World Food Summit target of reducing the number of food-deprived population by half by 1025.

The methodological details for measuring food deprivation are presented in Annex 1. The FAO measure of food deprivation is based on a comparison of usual food consumption expressed in terms of dietary energy (kcal) with minimum energy requirement norms. The part of the population with food consumption below the minimum energy requirement is considered underfed or food deprived. The prevalence of undernourishment may be estimated for any population groupings (national or sub national levels) and required three fundamental parameters:

1) the average daily dietary energy consumed per person (DEC);

2) the daily minimum dietary energy requirement (MDER) per person[2], which refers to the energy needed for the lowest acceptable weight for attained-height as well as for the lowest light physical activity level (PAL) by age-sex structure of the population; and

3) the Coefficient of Variation (CV) of DEC, which is a non-linear function of variance of the distribution of DEC under the lognormal assumption as indicated in the footnote.

All three parameters are derived from the food and household data collected from national household surveys at the national and sub national levels for identifying and locate the food-deprived people.

[2] MDER does not refer to the average dietary energy requirement as used for estimating the extreme poverty line used in the poverty assessment methodology.

2.8 Minimum dietary energy requirement (MDER)

Different people need different amounts of energy and some physical activities use more energy than others. The energy requirement of an individual is the level of energy intake from food that will balance energy expenditure when an individual has a body size and composition and level of activity, consistent with the long term good health; and that will allow for the maintenance of economically necessary and socially desirable physical activity. The human body requires dietary energy intake for its expenditure of energy, which is dependent on the basal metabolic rate (BMR), i.e. energy expended for the functioning of an individual in a state of complete rest, for digesting food, metabolizing food and storing an increased intake and for performing physical activities. The actual amount of energy needed will vary from person to person and depends on their basal metabolic rate (BMR) and their physical activity level (PAL). Additional energy for growth in the case of children and for pregnancy and lactation for women has also to be taken into account.

MINIMUM DIETARY ENERGY REQUIREMENT (MDER)

In a specified age and sex group, the amount of dietary energy per person that is considered adequate to meet the energy needs for the minimum acceptable weight for attained-height maintaining a healthy life and carrying out a light physical activity level. In the entire population, the minimum energy requirement is the weighted average of the minimum energy requirements of the different age and sex groups in the population.

The key parameters for estimating the energy requirement for each sex-age group are body weight and physical activity level (PAL) index. However, the Expert Consultation has recognized that for a given height, there is a range of body weight that is consistent with good health. Similarly, there is a range of PALs that is consistent with performance of economically necessary and socially desirable activity.

The standards of energy requirement are specified for populations by sex and age groups and the norms or standards as defined by nutritional experts from international organizations, particularly, the FAO/WHO/UN Expert Consultation on Energy and Protein Requirement and Consultations. These norms are regularly reviewed and updated in the light of new development and research. The last update was adopted following the 2004 Report of a Joint FAO/WHO/UNU Expert Consultation held in Rome from 17-24 October 2001.

Estimates of MDER for all national and sub-national population groupings were calculated using the age sex population structure of the household members of the survey round itself and the reference value of height from the James & Schofield tables (1990). Since body weight has a larger variation for attained height, the latter is used to derive the body weight for the estimate of energy requirement. The NBHS did not collect height data for individuals in sampled households, nor was such data made available from any other anthropometric surveys, at the time of analysis and the heights data for Sudan from James & Schofield tables were used on the assumption that these heights hold for individuals in Sudan.

Figure 1 shows that the daily minimum dietary energy requirement per person in Sudan was 1751 Kcals in 2009. The main factor that influences the MDER is the age sex distribution of the group. In 2009, the population has a high proportion of about 41 percent of children less than 15 years and predominantly by boys.

Figure 1: MDER in Sudan and by Income Quintile, Area and Region (2009 NBHS)

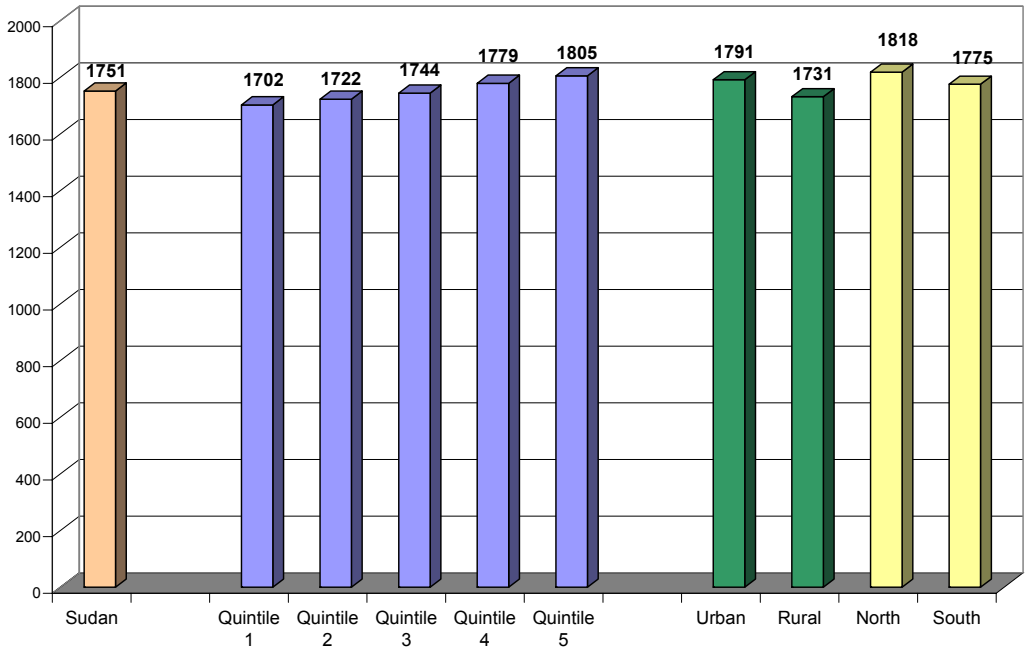


Figure 2 shows the population pyramid of Sudan with population estimates data and it clearly shows the outnumber of males to females in most age groups and the predominance of young age population groups given that the median age was 19 years in 2009.

The differences in MDER values among the population by States, areas of residence and functional groups of income were within a range of 116 Kcals. The lowest MDER of the population in the lowest quintile was due to a higher number of children and the highest MDER in urban regions was due to a higher number of adults, which attract rural male adults to urban labour markets.

Figure 2: Sudan Population Distribution by sex and age for 2009

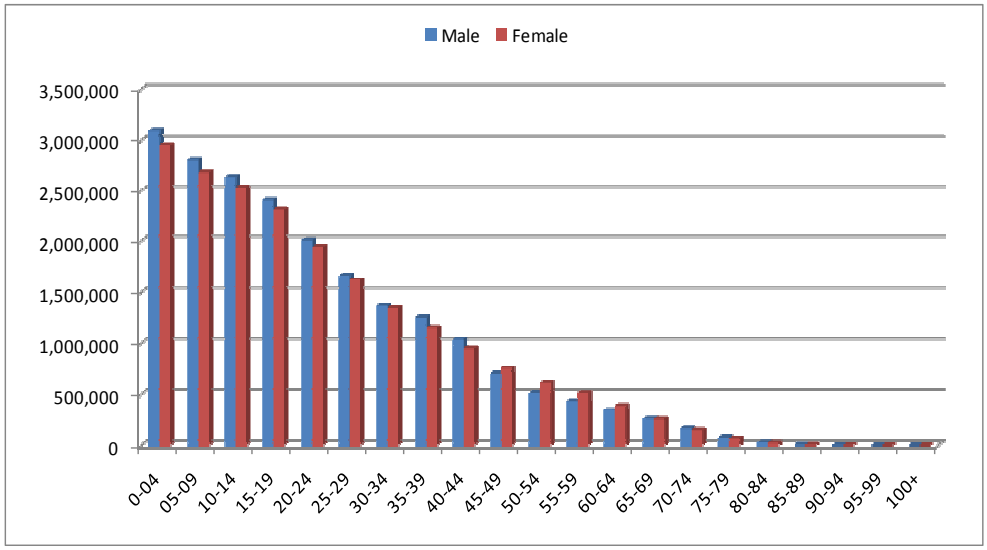
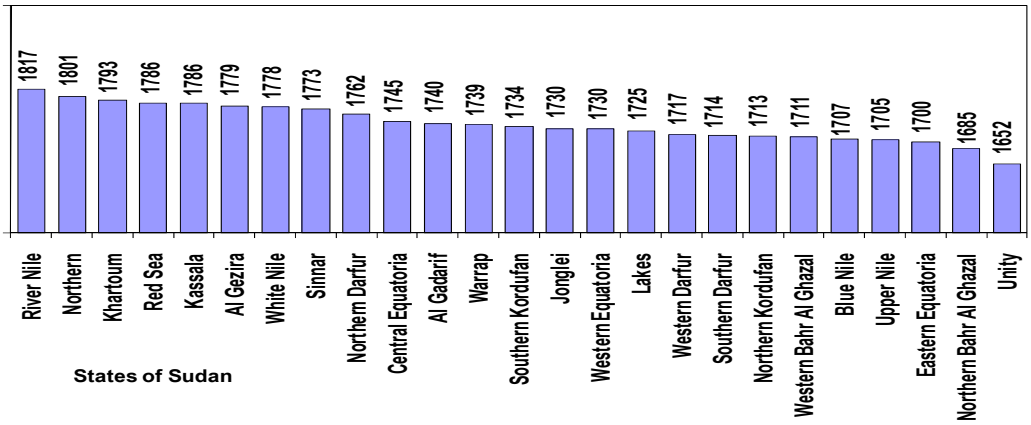


Figure 3 shows MDER values by States. The MDER values were quite different among States; River Nile had the highest MDER of 1817 Kcals and Unity the lowest of 1652 Kcals. This difference of 165 kcals was attributed to diverse age-sex population structures of these States.

Figure 3: MDER by States of Sudan (2009 NBHS)



3. Results and Findings

The analysis of food consumption data of the 2009 Sudan NBHS was performed using statistical procedures of the Food Security Statistics Module (FSSM). Food and household data together with data on household members were used as inputs for the analysis. The Sudan 2009 NBHS food items quantity data were converted to nutrients values using the corresponding nutrients factors obtained from the Tanzania Food Composition Table (FCT) as the Sudan FCT was not available. The food security statistics were derived at the national and sub national levels, which relates to demographic population groupings and functional socio economic groupings. This section gives estimates for food security statistics of food consumption, access to food measures, food diet and the prevalence of undernourishment, which is the MDG huger indicator 1.9 for the different population groupings useful to define the profile and location of the food insecure population.

3.1 Food deprivation

***Food deprivation** refers to the condition of people whose food consumption in terms of energy is continuously below a minimum dietary energy requirement. This is based on assumption that the distribution of food consumption expressed in terms of daily dietary energy per person.*

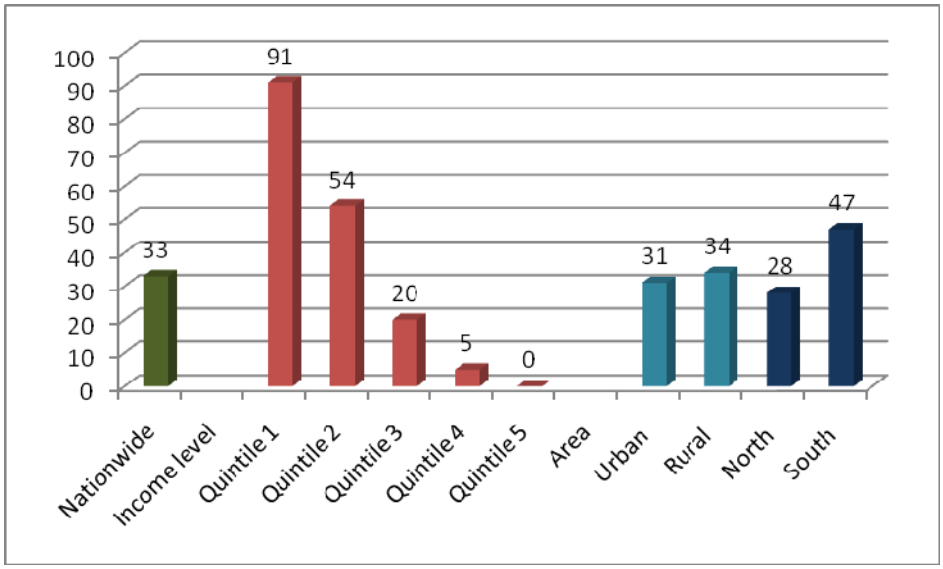
According to FAO methodological framework for the global monitoring of prevalence of undernourishment, the severity of food insecurity depends on the level of food deprivation. Table 1 below gives the different degrees of the severity of undernourishment.

Table 1: Severity of undernourishment (FAO)

Level of food deprivation (%)	Severity of undernourishment
<2.5	Negligible
2.5 - 4	Very Low
5-9	Low
10-19	Moderate
20-34	High
>35	Very High

The food deprivation of Sudan refers to the proportion of the population whose dietary energy consumption is below the Minimum Dietary Energy Requirement (MDER) of 1751 kcals. The 2009 NBHS food data yielded an average national dietary energy consumption was 2180 kcal per person per day and a CV of DEC of around 31.5 percent, hence a value of 33 percent for the prevalence of undernourishment for 2009 as shown in Figure 4.

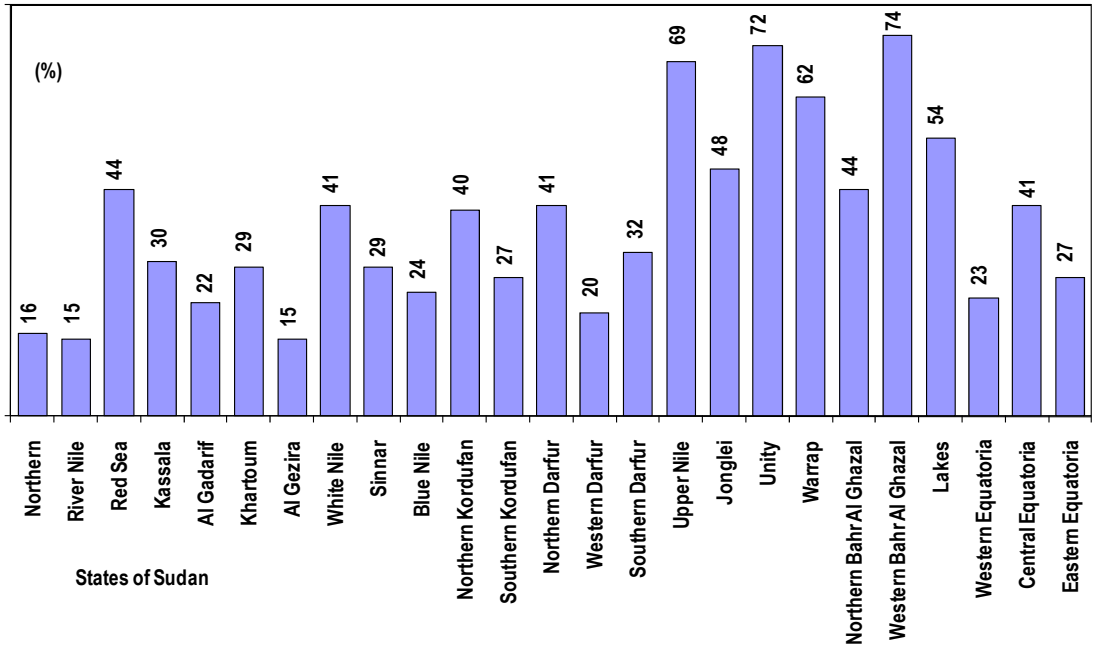
Figure 4: Prevalence of undernourishment in Sudan and by Income Quintile, Area and Region



Around 13 million people are food deprived in Sudan. Food deprivation was almost similar in urban (31 percent) and rural (34 percent) areas; urban areas may be marginally more food secure due to higher levels of consumption and better access to food markets. It was higher in southern States (47 percent) than in northern States (28 percent). The prevalence of undernourishment was very high in southern States as well as in households in the two lowest income quintiles.

Levels of food deprivation varied significantly across States as shown in Figure 5. The highest food deprivation was observed in Western Bahr Al-Ghazal State (74 percent), followed by Unity State (72 percent), while the lowest levels were recorded in Al Gezeera and River Nile States (15 percent each) and Northern State.

Figure 5: Prevalence of undernourishment by States of Sudan



The high level of food deprivation among the states of the South were due to either to high level of inequality of access to food or low level of dietary energy consumption (Table 2).

Table 2: Summary statistics for states of South Sudan

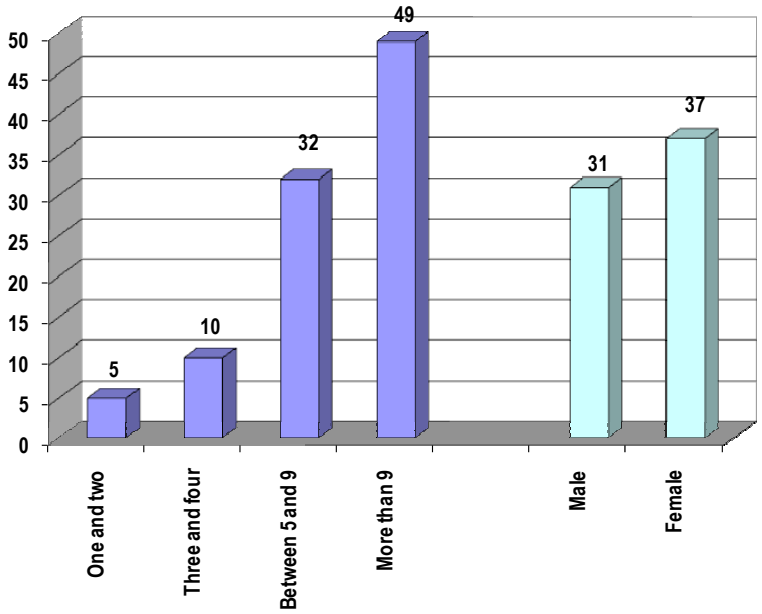
	Western Equatoria	Eastern Equatoria	Central Equatoria	Jonglei	Northern Bahr Al Ghazal	Lakes	Warrap	Upper Nile	Western Bahr Al Ghazal	Unity
DEC (kcal/p/d)	2490	2400	2070	1960	1830	1810	1520	1520	1440	1430
MDER (kcal/p/d)	1730	1701	1744	1730	1686	1724	1745	1705	1711	1652
CV (x) - %	40.6	44.4	41.0	47.2	29.9	48.9	37.9	40.9	37.7	37.4
Prevalence of Undernourishment (%)	**23**	**27**	**41**	**48**	**45**	**55**	**71**	**69**	**74**	**72**
Unit Calories cost (SDG /1000 kcal)	0.96	1.07	1.10	0.98	0.76	1.16	0.87	1.69	1.51	0.96
Average Total Consumption (SDG)	2.97	3.14	3.92	2.25	1.73	2.71	1.63	3.95	2.99	1.92

Western Equatoria had the highest DEC of 2,490 kcal well ahead from its average minimum requirement of 1730 kcal. However, its high inequality of food access of 40.6 percent indicated large disparities of food consumption in that State, in spite of having a high daily average per person total consumption of 2.97 SDG. The 23 percent of food-deprived population in the State was high

and was the better off state among the other states of South Sudan. Upper Nile showed some particular characteristics with its high level of food deprivation of 69 percent. It had the highest daily average per person total consumption of SDG 3.95, which indicated that its population had resources for the purchase of good and services, but its population had average food consumption less than their average requirement. Nearly three quarter of that amount went for food as food prices were high in that state as it had the highest average unit calories cost of 1.69 SDG among the states of South Sudan. In Upper Nile, there could be problems of availability of food items, which caused the high food prices and could be the reasons of high food insecurity in that State.

Figure 6 shows that food deprivation was higher in female-headed households (37 percent) than in male-headed households (31 percent). This may be explained by the better food access of male-headed households to education and secure jobs with higher incomes. Female-headed households are usually those missing the male head and are involved in low income jobs.

Figure 6: Prevalence of undernourishment in Sudan by household size and gender of household-head



The prevalence of undernourishment by household size, ranged from 5 percent for households of one or two members to 49 percent for households with more than 9 members. While there are usually economies of scale in large households, it seems that access to food diminishes greatly with increased members.

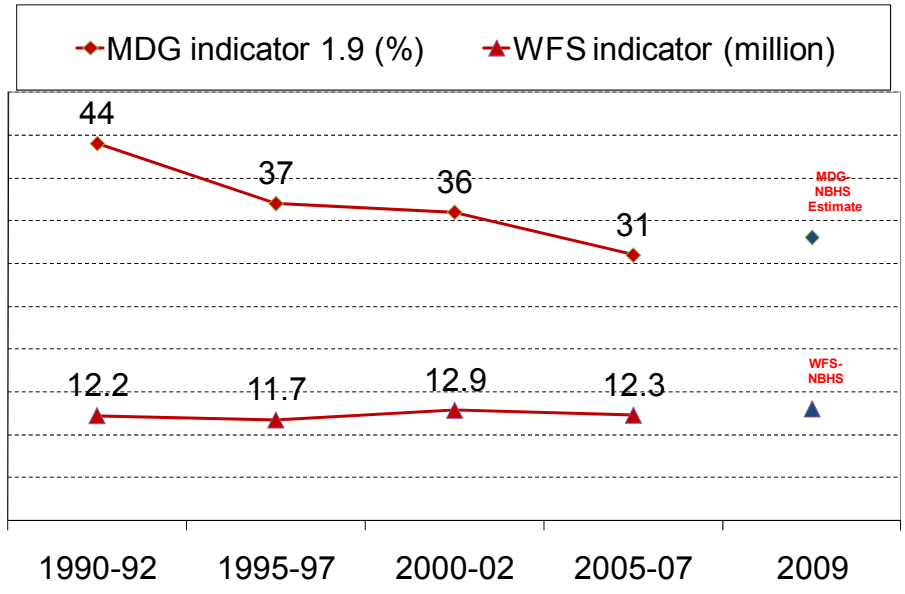
In summary, the most important factor correlated with high levels of undernourishment seems to be income. The level of undernourishment in the poorest 20 percent of the population was alarmingly high at 91 percent in comparison to almost nil in the highest income 20 percent of the population.

The targets of the World Food Summit (WFS) of 1996 and the Millennium Development Goals (MDG) of 2000, called for halving, respectively, the number and proportion of population suffering from hunger by 2015 compared to 1990 levels. In spite of the high rates of undernourishment in Sudan, the country can still achieve the MDG target of 22 percent in 2015, based on updated estimates of CV of DEC due to income from the 2009 NBHS (see Figure 7).

Millennium Development Goal on hunger targets to halve, between 1990 and 2015, the proportion of people who suffer from hunger and is specified as Indicator 1.9:

"Proportion of population below minimum level of dietary energy consumption "

Figure 7: Trend of MDG and WFS Global Estimates (SOFI 2009) and 2009 NBHS Estimates in Sudan



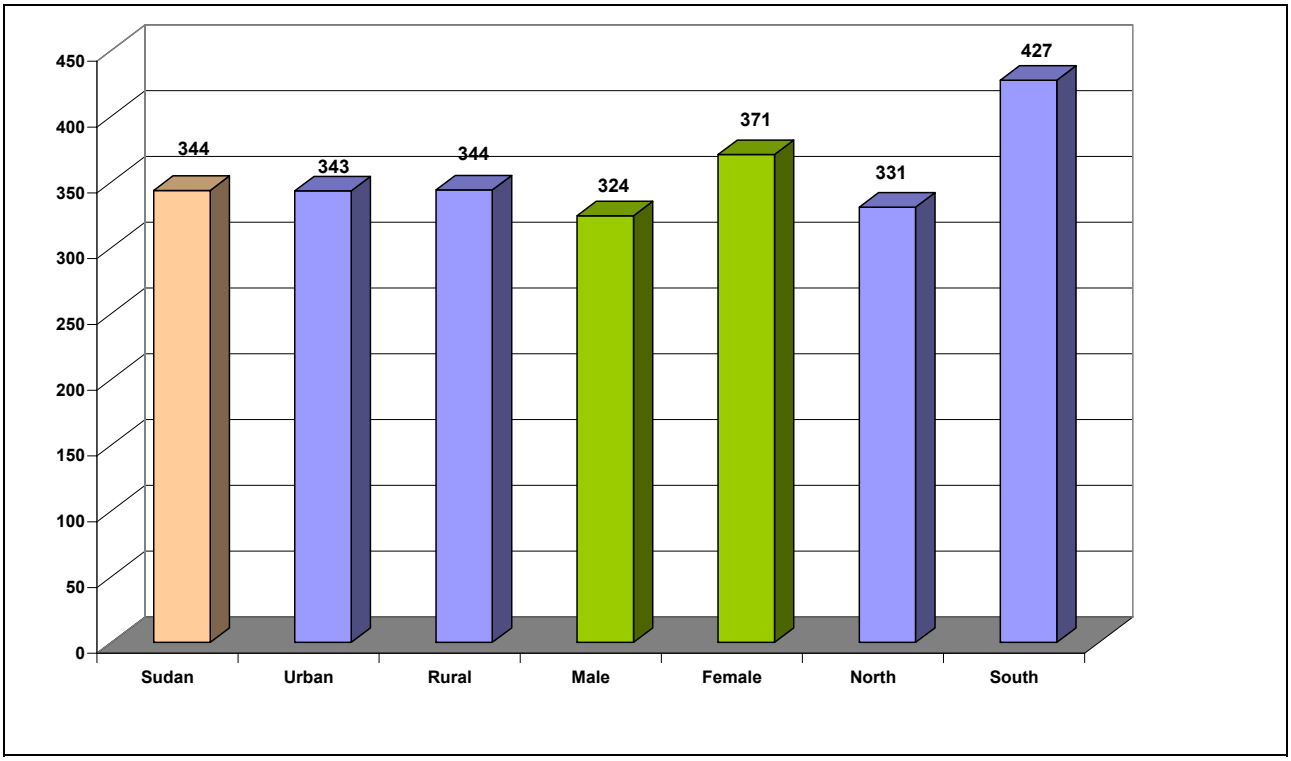
It should be noted that the global estimates of FAO as published in the 2009 State of Food Insecurity in the World (SOFI 2009) were derived using the country food dietary energy supply derived from production and trade date in preparing the Sudan food balance sheets by FAO. These estimates refer to dietary energy supply for human consumption for entire Sudan including private

and public food consumption, while the 2009 NBHS estimates refer to dietary energy consumption for households, which is private consumption in Sudan.

3.2 Depth of hunger

Depth of hunger is the amount of calories the deprived population have missed to reach the daily MDER per person level. Figure 8 shows that on average, a Sudanese deprived person missed daily around 100 grams of cereal-equivalent in food (344 Kcal) to reach the MDER.

Figure 8: Depth of hunger (Kcal/person/day) in Sudan and by Area and Region

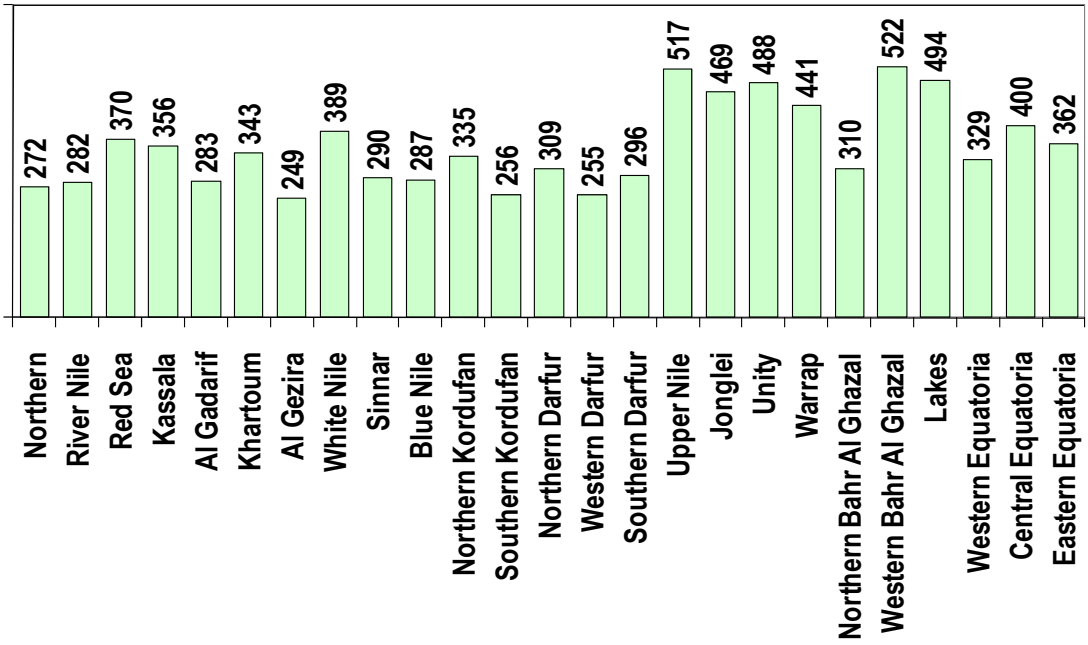


The depth of hunger differed marginally between 343 Kcal for urban areas and 344 Kcal in rural areas. There is a sizeable difference between northern States (331 kcal) and southern States (427 Kcal), followed by the difference between male and female headed households, 324 kcal and 371 Kcal, respectively.

Across the 25 States of Sudan, there were large variations in the depth of hunger (See Table 2). This can be explained by the fact that different States have different policies on food security

management and agriculture policies as well as different levels of security and stability. The highest depth of hunger was in Upper Nile State (517 Kcal) and the lowest in Al Gezira State (249 Kcal).

Figure 9: Depth of hunger (Kcal/person/day) in Sudan and by Area and Region



3.3 Food consumption and expenditure patterns

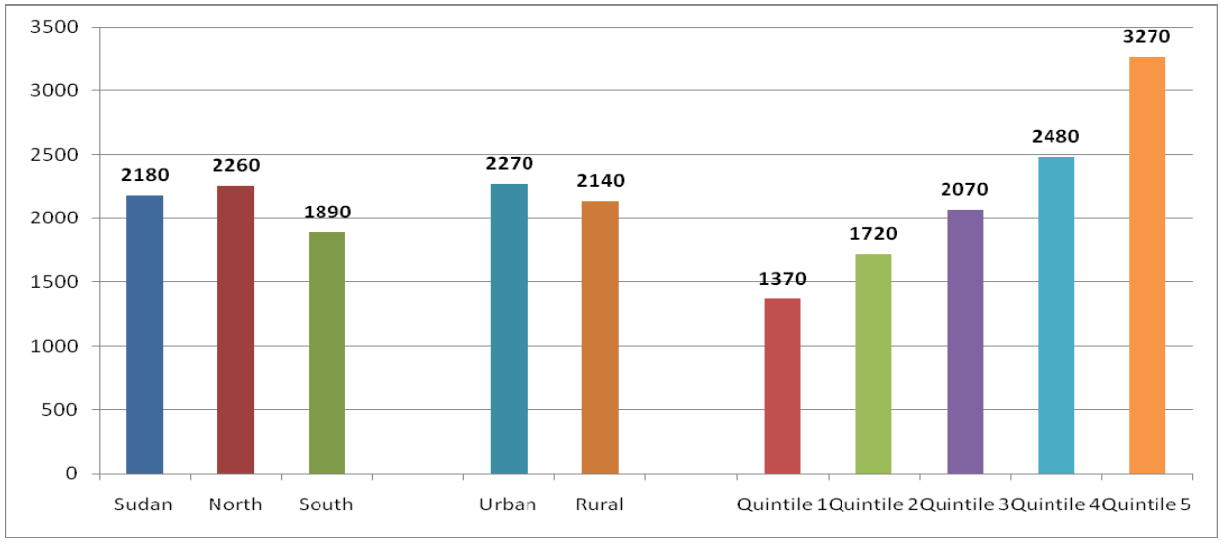
The food consumption data were analysed in terms of quantity, nutrient and monetary values. All food quantities were converted to nutrients using the appropriate conversion nutrients values from the Tanzania FCT supplemented with those from the USDA nutrition database. In addition, analysis by main food sources such as purchases, own production, away from home consumption and other sources including from stocks and gifts, etc. All values were standardized on per person[3] per day basis for comparison purposes among the different population groupings and countries.

[3] *The per person standard has been adopted throughout the food security analysis instead of adult equivalent notion as the sampling was based on households and population of Sudan rather than on age and sex of the population. In addition, there is lack of information on the intra household food consumption distribution for a reliable application of those adult equivalent conversion factors whose estimates differ by an overall fixed scalar factor over the per person estimates.*

3.3.1 Dietary energy consumption (DEC)

Dietary energy consumption (DEC) refers to food consumption expressed in terms or kilocalories per person per day basis. The dietary energy consumption, based on food consumption was estimated at 2180 Kcal/person/day in Sudan.

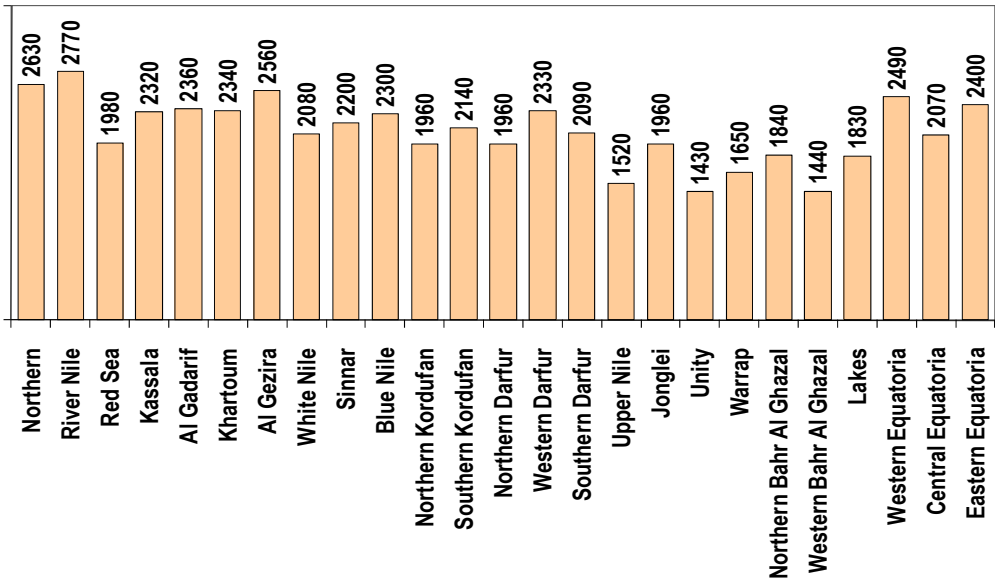
Figure 10: Dietary Energy Consumption (kcal/person/day) Sudan, Area, Income Quintile and Region



The increasing DEC trend with income levels was clear; the highest income group had a DEC of 3270 Kcal, over twice that of the lowest income group of 1370 Kcal as shown in Figure 10. Urban households consumed marginally more calories than rural households. The DEC in southern States was lowest (1890 Kcal) compared to northern States (2260 Kcal).

The DEC varied among States, the highest DEC in Northern and River Nile States and the lowest DEC in Unity State as shown in Figure 11.

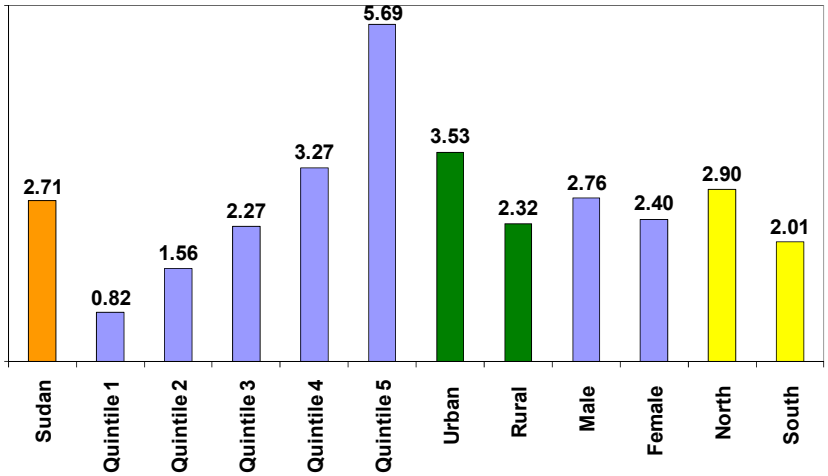
Figure 11: Dietary Energy Consumption (kcal/person/day) by State



3.3.2 Food expenditure

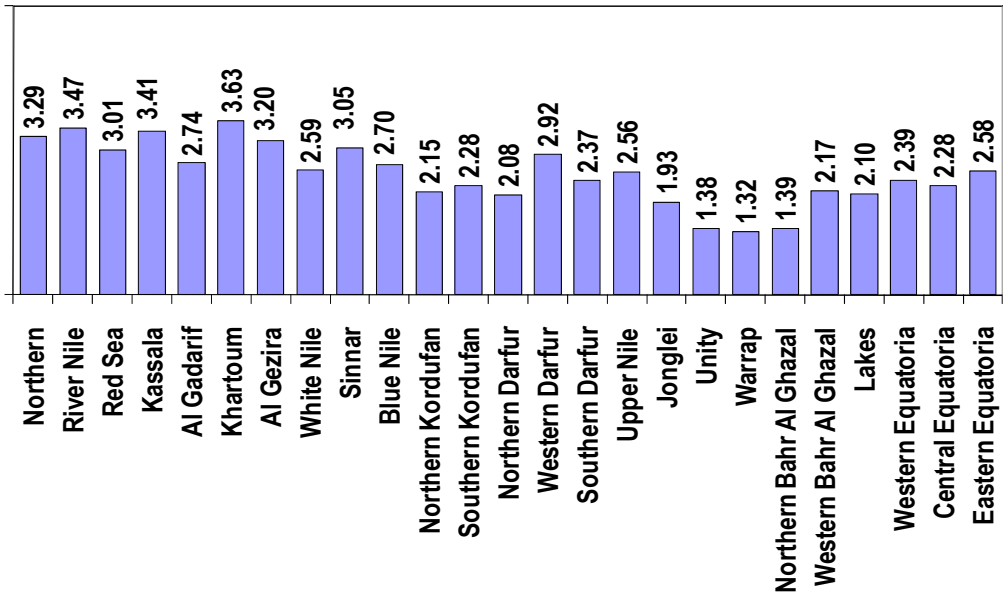
At national level, on average, daily one person spent 2.71 SDG to consume 2180 Kcal per day. Food expenditure increased with income quintile. Households in the fifth quintile spent daily almost seven times that of the first quintile, 5.69 and 0.82 SDG per person, respectively. Urban households spent daily more money in food than rural households, 3.53 SDG and 2.32 SDG per person, respectively.

Figure 12: Food consumption in monetary value (SDG) Sudan and by Area, Income Quintile and Region



Among States, it ranged from 1.32 SDG in Warrap to 3.63 SDG in Khartoum as shown in Figure 13.

Figure 13: Food consumption in monetary value (SDG) by State



3.3.3 Share of food in monetary value to total consumption (Food Ratio)

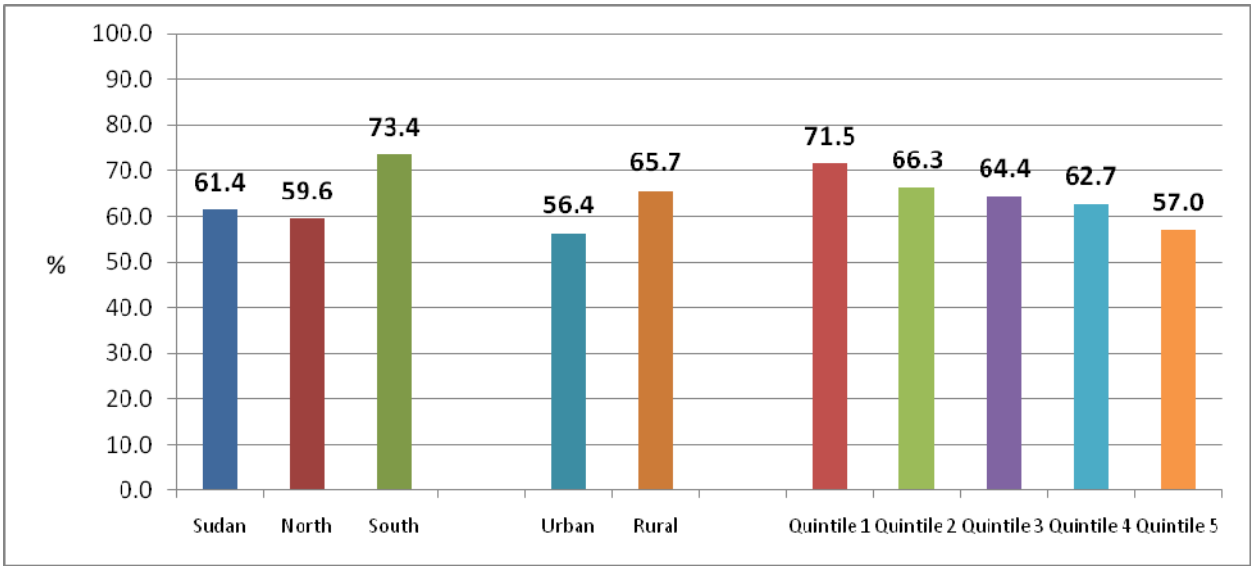
Expenditures on food constitute a large share of household consumption in Sudan. The food expenditure ratio (FR), also known as the 'Engel ratio', was 61.4 percent for Sudan. This means that on average a household spent on food items more than three fifths of its total expenditure.

The food ratio decreased with income, the lowest income quintile spent 71.5 percent compared to 57 percent for the highest income quintile. This is consistent with a priori expectations and is in line with Engel's Law[4].Given that urban areas have on average higher incomes than rural areas, it is not surprising that the food ratio was lower in urban than in rural areas.

There was a wide gap in FR between the northern States (59.6 percent) and the southern States (73.4 percent) as shown in Figure 14. This may be explained by the fact that southern States are primarily rural, while the northern States in comparison are more urban areas.

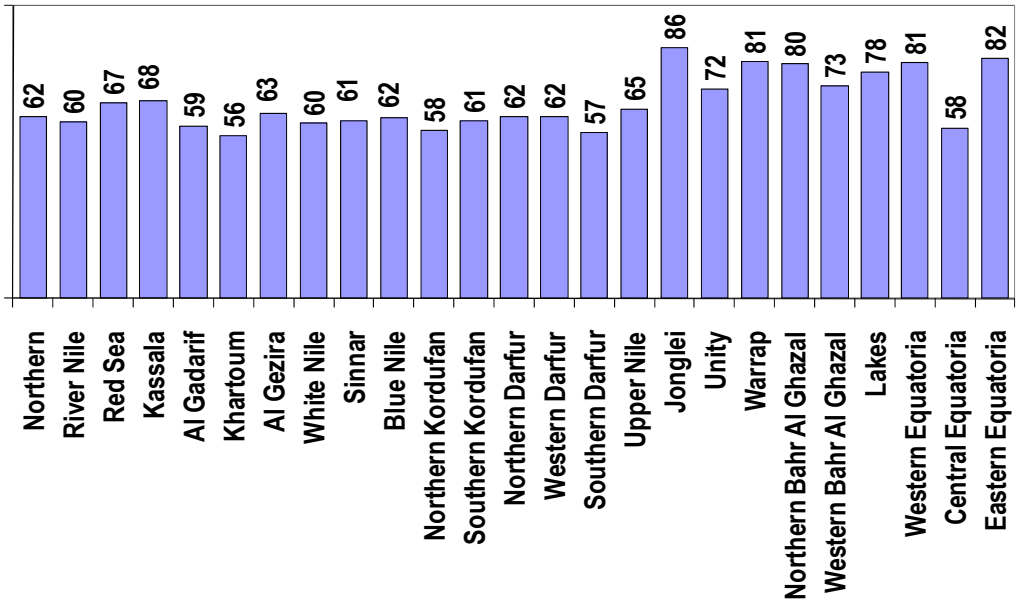
[4] Engel's law states, that for a given set of tastes and preferences, with higher income, expenditure on food (monetary value) gets higher but at a slower rate than income. Hence, the share of food in total expenditure (Engel ratio) is lower as income is higher.

Figure 14: Share of food consumption expenditure to total consumption expenditure (FR)



Households in the States of Eastern Equatoria, Western Equatoria, Northern Bahr Al Ghazal, Warrap, and Jonglei spent on food more than 80 percent of their total consumption expenditure depicted by Figure 15.

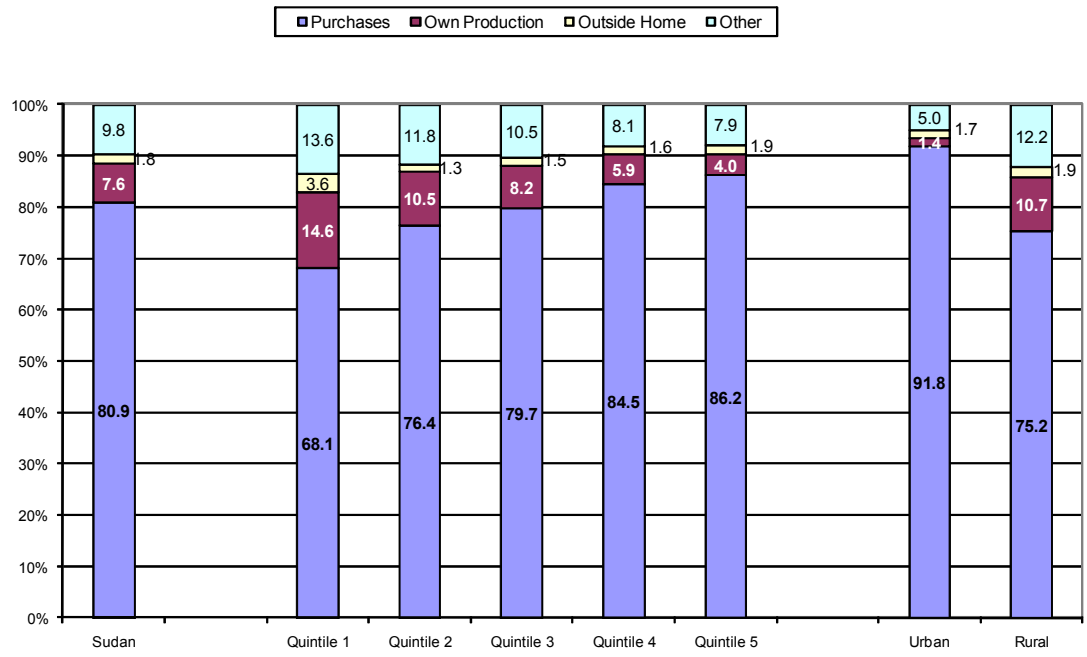
Figure 15: Share of food consumption expenditure to total consumption expenditure (FR)



3.3.4 Dietary energy consumption (DEC) by food sources

Households in Sudan acquired their food mostly from purchases (80.9 percent), followed by other sources (9.8 percent), which include gifts, food aid, and payment in kind and so on. In addition, households in the highest income quintile (86.2 percent) acquired food more from purchase compared to the lowest income quintile (68.1 percent) as shown in Figure 16. Purchased food items were the primary source for northern States (86.1 percent) compared to southern States (57.6 percent) (Table 4 in Annex).

Figure 16: Share of DEC by Food Sources Sudan, Income Quintile, Area and Region

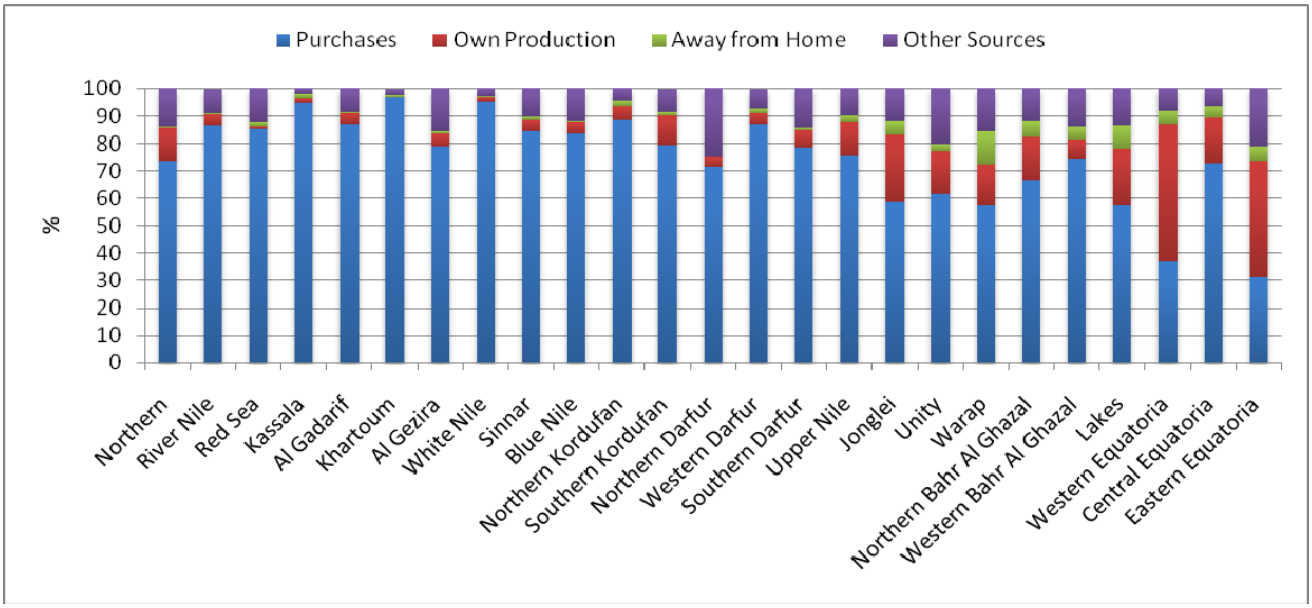


Own production was not a major source of calories in the entire country since on average it accounted for only 7.6 percent of dietary consumption. However, this share was fairly high in southern States (23.9 percent) (Table 4 in Annex). As expected, own production was negligible in urban areas (1.4 percent), while more important in rural areas (10.7 percent). The lowest income quintile (14.6 percent) also had an important share from own production.

Food eaten away-from home was a small component of DEC, with only 1.8 percent coming from this source in Sudan. One surprising trend is that the lower income group had a larger share of their DEC from this source (3.6 percent) than higher income groups (1.9 percent). One explanation

for this could be that low income households did not have the resources to acquire food and relied on food provided from other family members and friends.

Figure 17: Share of food sources by State



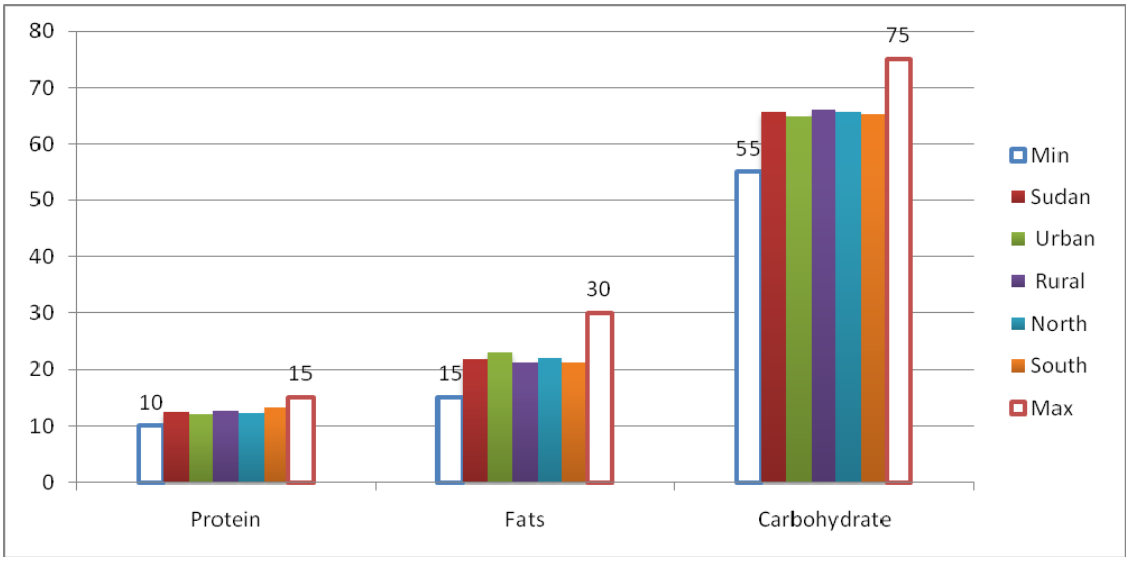
The food sources reflect the agricultural possibilities in specific States in terms of subsistence food. As expected Khartoum had the lowest share of own production (0.2 percent) and the highest share of purchases (96.7 percent). Other more agrarian States like Western and Eastern Equatoria had a much higher share of own production at 50 percent and 42.1 percent, respectively, meaning that their population depend heavily on subsistence food depicted by Figure 17.

3.3.5 Diet composition

About 65.7 percent of average DEC of the Sudanese was derived from carbohydrate which was the highest energy source, followed by fat that contributed 21.9 percent and then protein at 12.4 percent. These macro-nutrient contribution pattern of total energy falls within the range of recommendations of WHO/FAO for macro-nutrient balanced diets consisting of 10-15 percent from protein, 15-30 percent from fat and 55-75 percent from carbohydrate. This macro-nutrient balanced diet was equally observed among households headed by females and males as well as urban and rural, northern and southern States (see Figure 18). Amongst all States, Western Equatoria in southern States registered the lowest percentage share of protein at 9.8 percent which falls below the WHO/FAO recommendation of 10 percent while Bahr Al Ghazal in northern States the share of fat

was 14.7 percent, which is also slightly less than the minimum recommended of 15 percent as described in Table 7 in the Annex.

Figure 18: Percentage share of macro-nutrients in DEC: Sudan and by Area and Region

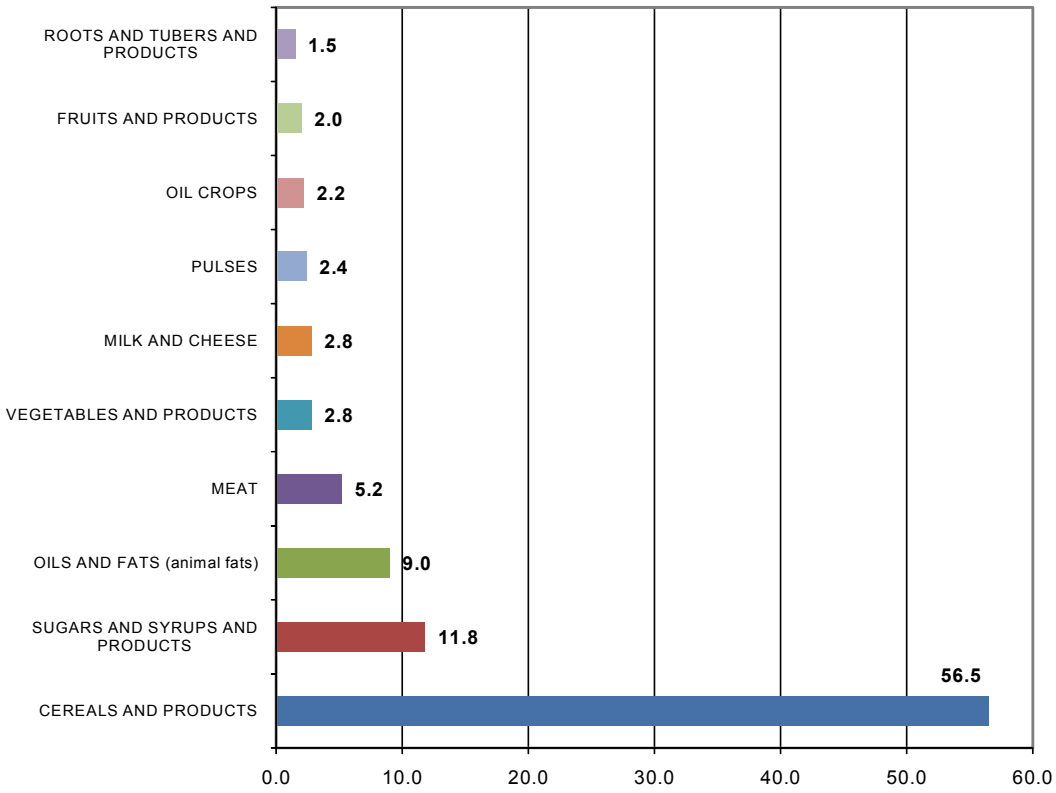


3.3.6 Food consumption by main commodity groups

The contribution of each food commodity group as a share of total DEC, it was clear that the cereals and their products provided a high share of 56.5 percent of total DEC, followed by sugar and products at 11.8 percent, then oil and fat (animal fat) at 9 percent, meat with 5.2 percent and finally vegetables, milk & cheese, and pulses which provided 2.8, 2.8 and 2.4 respectively (Figure 19).

The main source of energy by food commodity in all States was mainly Dura, except Northern Darfur and Western Darfur States with millet, Northern State with wheat, Khartoum, Red Sea and River Nile States with bread, and Western Equatoria State with Cassava Flour.

Figure 19: Percentage share of food commodity group in total DEC in Sudan



3.3.7 Protein consumption

The average daily consumption of protein in the Sudanese diet was 67.6 gram derived from a variety of food items such as milk and cheese, meat and fish, eggs, etc. consumed as shown in Figure 20. Dura was the main food item contributing a high quantity of protein. Proteins are derived from animal products and from vegetable products and their biological effects are different. The quality of protein consumption will be analysed in-depth in a complementary report. The share of animal protein in total protein consumption in Sudan was 24.3 percent. There is a significant variation among States; the highest share was recorded in Upper Nile Sate at 53 percent followed by Western Bahr Al Ghazal State at 45.5 percent while the lowest in the Northern State with 13.8 percent (Fig 21).

Figure 20: Consumption of food items (gram) contributing to protein

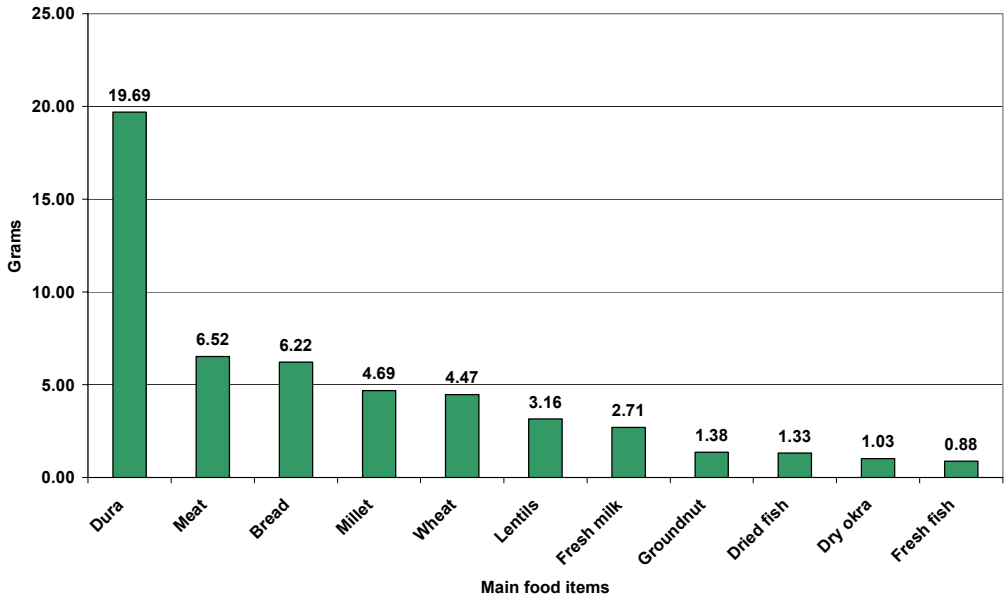
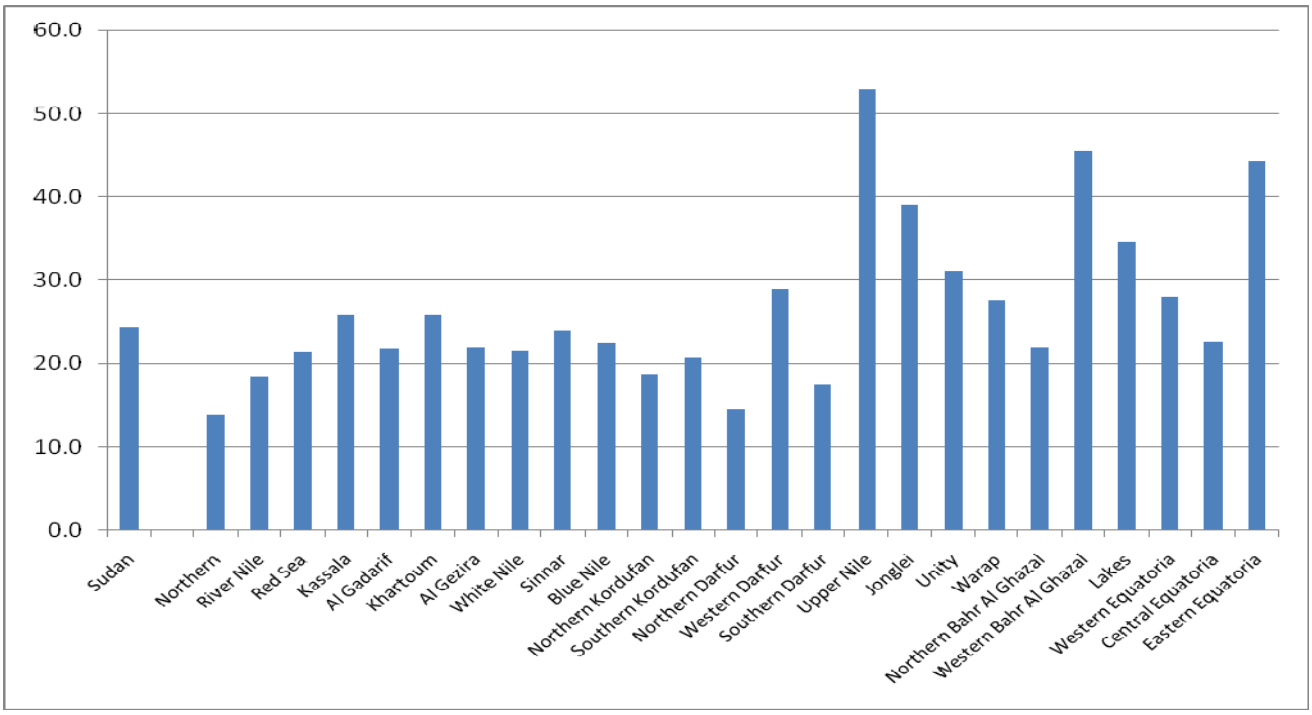


Figure 21: Percentage share of animal protein in total protein consumption in Sudan



The lower share of animal protein in Northern State can be explained by the fact that it depends is primarily on agricultural produce. In general the southern states seem to have a higher share of animal protein which is a reflection of the prevalence of cattle, and thus meat, in the region.

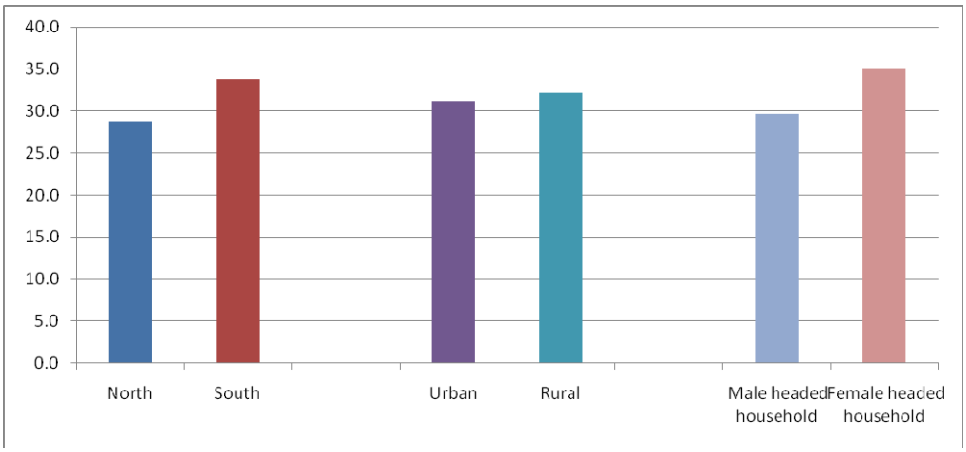
3.4 Inequality in food consumption due to income

Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food, which meets their dietary needs and food preferences for an active and healthy life. Inequality in access to food, measured by the coefficient of variation (CV) of the dietary energy consumption, is then one of the key parameters in the FAO determination of food deprivation.

Coefficient of variation of dietary energy consumption has two components, one is the variation of DEC due to income and the second is the variation of DEC due to energy requirement of individuals. The latter is usually very close to 20 percent and depends on the age-sex structure of the population, body weight and activity level of the household members. Inequality of DEC due to income is measured at sub-national levels in rural and urban areas so no value of CV at national level is provided in Table 5 in the Annex. The analysis mainly focuses on CV at sub-national level and for other population groups. The FAO manual gives a detailed discussion on computation of these indicators.

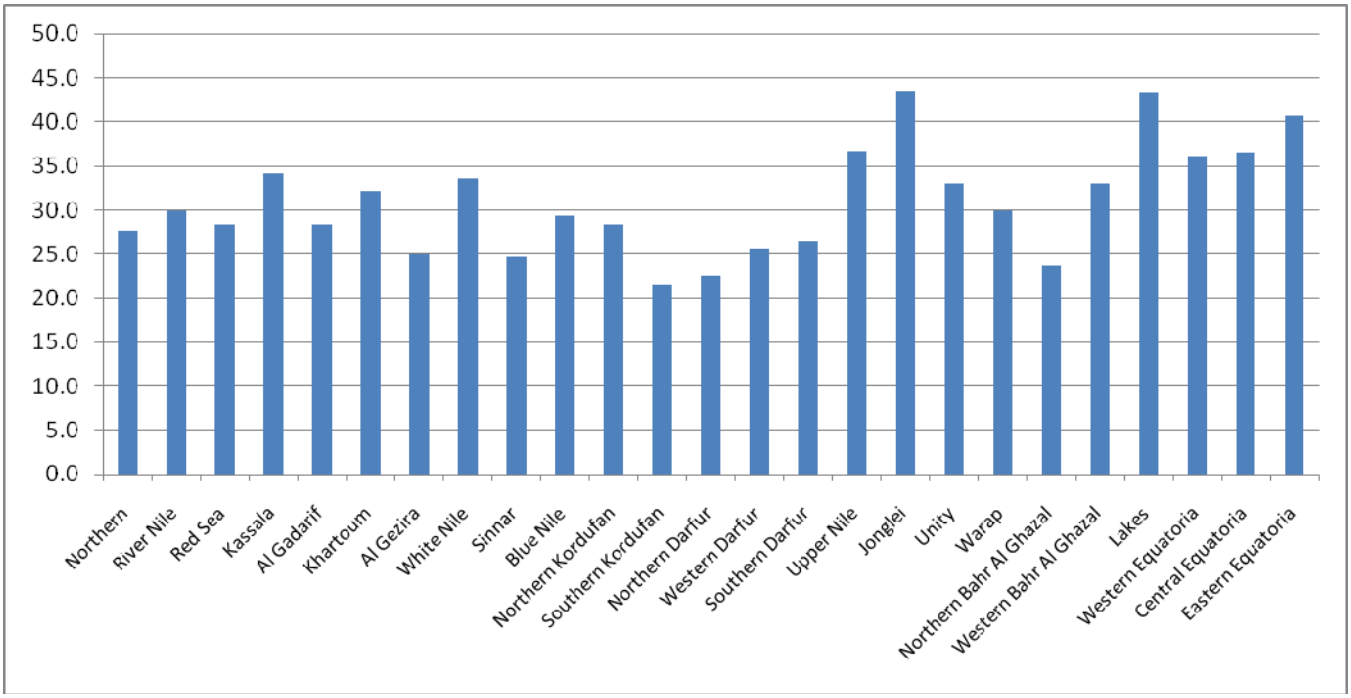
The inequality in food access as measured by the CV of DEC due to income, was fairly high across all population groups. The CV of DEC due to income in urban and rural areas were 31.2 and 32.2 percent respectively. The inequality in southern States was 33.8 percent, higher than in northern States (28.8 percent) and in female headed families higher than in male headed families as shown in Figure 22.

Figure 22: CV of DEC due to income by Region and Gender of Household-Head



The CV of DEC due to income varies greatly among States, from 21.5 percent in South Kordofan State to 43.5 percent in Jonglei State and 43.3 percent in Lakes State, depicted in Figure 23.

Figure 23: Coefficient of Variation (CV) of DEC due to income by state



4. Conclusion

Food security statistics are essential as inputs for planning, coordinating and monitoring food insecurity, in particular the prevalence of undernourishment. They provide decision-makers and stakeholders with reliable, relevant information for carrying out more effectively targeted activities. Although the NBHS has some limitations mentioned above, it has generated the first nationwide food consumption data, which were used to derive a suite of food security indicators including the MDG hunger indicator 1.9 and the WFS target at national and sub national levels, and other indicators of food access and food utilization in terms of micro nutrients consumption. These food security statistics serve as the first comprehensive baseline information for Sudan for the identification and location of the food insecure population for more focused food policies and programmes. Further work can still be done in the future taking into account the recommendations mentioned in this report with the help of FAO and other stakeholders.

Sudan as a nation has numerous advantages and opportunities with vast areas of agricultural lands, extensive water resources, wealth of livestock of all kinds, mineral and other underground resources including oil. It also faces numerous challenges in the form of inequality in allocation of resources between urban and rural areas, conflicts in different parts of the country, poor infrastructure among others, which must be overcome before it can take full advantage of its natural endowments. Sudan is currently ranked 147th among 177 countries on Human Development Index compared to 141st in 2006 (UNDP's Human Development Index report 2008). This is despite high economic growth during the period, and is a reflection of Sudan's inability to harness its growth potential for the benefit of all its citizens.

The approach mapped out by FAO, IFAD and WFP suggest a 'twin-track approach' to achieving the target of reducing the number and proportion of undernourished people in the world by half;

1. Strengthen the productivity and incomes of the hungry and poor, targeting the rural areas where the vast majority of them live and the agricultural sector on which their livelihoods depend on and

2. Provide direct access to food and create safety nets for the hungry (FAO. 2009)

Glossary

ANTHROPOMETRY

Use of human body measurements to obtain information about nutritional status.

AVERAGE ENERGY REQUIREMENT

It refers to the amount of energy considered adequate to meet the energy needs for normative average acceptable weight for attained height while performing moderate physical activity in good health.

BALANCED DIET

The diet is balanced when it is judged consistent with the maintenance of health in a population. The balance can be examined in terms of the contribution of the various energy-yielding macronutrients and other nutrients. A macronutrient-based balance food consumption pattern should contribute to total energy from proteins, fats and carbohydrates within recommended ranges as follows: proteins from ten to 15 percent, fats from 15 to 30 percent and carbohydrates from 55 to 75 percent, as from a technical report of a 2002 Joint WHO/FAO Expert Consultation (WHO 2003).

DEGREE OF FOOD DEPRIVATION

A measure of the overall food insecurity situation in a country, based on a classification system that combines prevalence of undernourishment, i.e. the proportion of the total population suffering from a dietary energy deficit, and depth of undernourishment, i.e. the magnitude of the undernourished population's dietary energy deficit.

DEPTH OF FOOD DEPRIVATION

It refers to the difference between the average dietary energy intake of an undernourished population and its average minimum energy requirement (MDER).

DIETARY ENERGY UNIT COST

The dietary energy unit cost is the monetary value in local currency of 1000 kilo-calories of food consumed.

DIETARY ENERGY CONSUMPTION

Food consumption expressed in energy terms. At national level, it can be calculated from the FBS (see below); the FBS estimate refers to both private (households) and public (hospitals, prisons, military compounds, hotels, residences, etc) food consumption. At sub-national levels it is estimated using food consumption data, with quantities collected in national household surveys (NHS); these estimates refer to private food consumption.

DIETARY ENERGY DEFICIT

Same as Depth of Food deprivation.

DIETARY ENERGY INTAKE

The energy content of food consumed.

DIETARY ENERGY REQUIREMENT

It refers to the amount of energy required by individuals to maintain body functions, health and normal physical activity.

DIETARY ENERGY SUPPLY

Food available for human consumption are expressed in kilocalories per person per day (kcal/person/day). At country level, it is calculated as the food remaining for human use after deduction of all non-food consumption (exports, animal feed, industrial use, seed and wastage)

FOOD BALANCE SHEET

Food Balance Sheets\ (FBS) is compiled every year by FAO, mainly with country-level data on the production and trade of food commodities. Using these data and the available information on seed rates, waste coefficients, stock changes and types of utilization (feed, food, processing and other utilization), a supply/utilization account is prepared for each commodity in weight terms. The food component of the commodity account, which is usually derived as a balancing item, refers to the total amount of the commodity available for human consumption during the year.

FOOD CONSUMPTION DISTRIBUTION

Food consumption distribution refers to the variation of consumption within a population. It reflects both the disparities due to socio-economic factors and differences due to biological factors, such as sex, age, body-weight and physical-activity levels.

FOOD DEPRIVATION

Food deprivation refers to the condition of people whose food consumption is continuously below its requirements. FAO's measure of food deprivation refers to the proportion of the population whose dietary energy consumption is below the minimum energy requirement (see below).

FOOD INSECURITY

Food insecurity is a situation that exists when people lacks secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life. It may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate use of food at the household level. Food insecurity, poor conditions of health and sanitation, and inappropriate care and feeding practices are the major causes of poor nutritional status. Food insecurity may be chronic, seasonal or transitory.

FOOD SECURITY

A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

GINI COEFFICIENT

The Gini coefficient measures the extent to which the distribution of income (or, in some cases, consumption expenditure, food dietary energy consumption) among individuals or households within an economy deviates from a perfectly equal distribution. A Lorenz curve plots the cumulative percentages of total income received against the cumulative number of recipients, starting with the poorest individual or

household. The Gini coefficient measures the area between the Lorenz curve and a hypothetical line of absolute equality, expressed as a percentage of the maximum area under the line. Thus, a Gini coefficient index of 0 represents perfect equality, while an index of 100 implies perfect inequality.

GINI COEFFICIENT DUE TO INCOME

The Gini coefficient is a measure of inequality in food consumption when income is used as the grouping variable and ranges from 0 (when income has no effect on food consumption) to one (when food consumption depends only on income). It can refer to inequality in food consumption due to income in monetary or in energy terms.

HOUSEHOLD CONSUMPTION EXPENDITURE

Household consumption expenditure refers to all monetary expenditure by the household and individual members on goods intended for consumption and expenditure on services, plus the value of goods and services received as income in kind and consumed by the household or individual members of the household. Thus the value of items produced by the household and utilised for own consumption, as well as the net rental value of owner-occupied housing and the gross rental value of free housing occupied by the household, each represent part of household consumption expenditure.

HOUSEHOLD FOOD CONSUMPTION EXPENDITURE

This refers to food consumed by household members during a specified period, at home and away from home, for example, at restaurants, bars, the work place, school, and so on. It includes food from all sources, purchased or from garden or farm. Further deductions should be made to allow for food given away to other households or non-household members and visitors as well as for wastage and losses occurring after acquisition.

HOUSEHOLD EXPENDITURE

Consumption plus non-consumption expenditure made by the household, both including food.

HOUSEHOLD NON CONSUMPTION EXPENDITURE

It refers to income taxes, other direct taxes, pension and social security contributions, remittances, gifts and similar transfers made by the household in monetary terms or in kind, including food such as given away, raw or ready to eat.

HOUSEHOLD INCOME

Income is the sum of all receipts, in money or in kind, which as a rule are received regularly and are of recurring nature, including food.

INCOME ELASTICITY OF FOOD DEMAND

The income elasticity of food demand measures the responsiveness of the quantity, monetary or nutrient value demanded of a good, to the change in the income of the people demanding the good. It is calculated as the ratio of the percent change in quantity demanded to the percent change in income.

INCOME INEQUALITY

Income inequality refers to disparities in the distribution of income.

INEQUALITY IN FOOD CONSUMPTION DUE TO INCOME

The inequality refers to the variation of the food consumption level within a population due to disparities in income distribution.

KILOCALORIE (Kcal)

The kilocalorie is a unit of measurement of dietary energy. In the International System of Units (ISU), the universal unit of dietary energy is the joule (J) but Kcal is still commonly used. One kilocalorie = 4.184 kilo-joules (KJ).

MACRONUTRIENTS

Used in this document to refer to the proteins, carbohydrates and fats that are required by the body in large amounts and that are available to be used for energy. They are measured in grams.

MICRONUTRIENTS

Refer to the vitamins, minerals and certain other substances that are required by the body in small amounts. They are measured in milligrams or micrograms.

MINIMUM DIETARY ENERGY REQUIREMENT

In a specific age and sex group, the amount of dietary energy per person is that considered adequate to meet the energy needs for minimum acceptable weight for attained-height maintaining a healthy life and carrying out a light physical activity. The minimum dietary energy requirement is the weighted average of the MDER of the different age and sex groups in the population.

NUTRITIONAL STATUS

The physiological status of an individual that results from the relationship between nutrient intake and requirement and from the body's ability to digest, absorb and use these nutrients. Lack of food as well as poor health and sanitation and inappropriate care and feeding practices are the major causes of poor nutritional status.

SHARE OF FOOD EXPENDITURE

The proportion of household consumption expenditure allocated to food; it is also known as the Engel ratio.

UNDERNOURISHMENT

Undernourishment refers to the condition of people whose dietary energy consumption is continuously below a minimum dietary energy requirement for minimum acceptable body weight and carrying out a light physical activity for maintaining a healthy life. The number of undernourished people refers to those in this condition.

UNDERNUTRITION

The result of undernourishment, poor absorption and/or poor biological use of nutrients consumed.

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Annex I - Methodology of Measuring Food Deprivation

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

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

where:

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

(x) refers to the dietary energy consumption

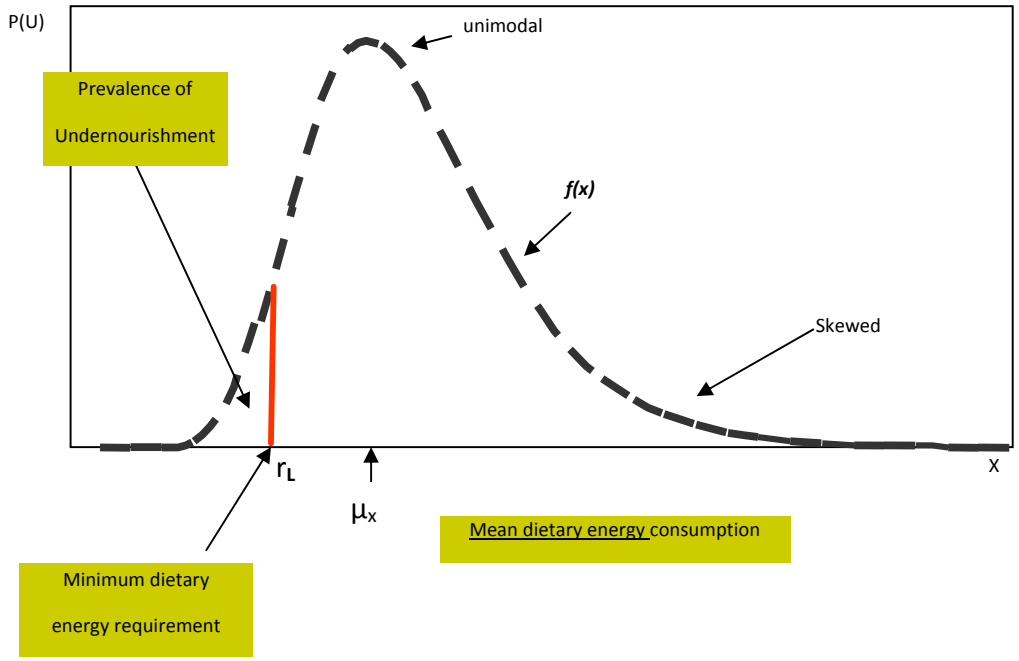
$\mathbf{r_L}$ is a cut-off point reflecting the minimum energy requirement

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

$\mathbf{F_x}$ is the cumulative distribution function of dietary energy consumption

The graph below illustrates the methodological framework for the estimation procedures of the proportion of population undernourished, i.e. prevalence of undernourishment.

Theoretical distribution of dietary energy consumption



In the graph the curve **f(x)** depicts the proportion of the population corresponding to different per caput dietary energy consumption levels **(x)** represented by the horizontal line. The area under the curve up to the minimum energy requirement which is a cut-off point in the curve, $\mathbf{r_L}$, represents the proportion of the population undernourished, i.e. prevalence of undernourishment.

The density function, **f(x)**, **of dietary energy consumption** is assumed to be lognormal so that the parameters $\boldsymbol{\mu_x}$ and $\boldsymbol{\sigma_x^2}$ can be estimated on the basis of the mean, $\bar{x}$, and the coefficient of variation, **CV(x)**.

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

There are two options for estimating the mean $\bar{x}$: using Food Balance Sheet (FBS) data or Household Budget Survey (HBS) data. The first is used to prepare annual estimates for monitoring progress in food security for the country as a whole. FAO is using this FBS estimate for its global monitoring of MDG 1.9. The second one allows the derivation of both national and sub-national estimates. The latter estimates cannot be prepared on a yearly basis, as they depend on the survey frequency, in general ranging from 5 to 10 years.

Note that Prevalence of undernourishment estimated using FBS mean food consumption is always less than using the HBS mean as the former represents food supply for both private (household) and public consumption. The HBS gives private household food consumption estimates, which are more realistic and consistent in capturing food deprivation.

The National Mean computed from the Sudan 2009 NHBS is 2180 kcal/person/day.

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

The **CV(*x*)** is the coefficient of variation of the daily per person dietary energy consumption and is formulated as follows:

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

Where

CV(*x*/*v*) is the coefficient of variation of the daily per person dietary energy consumption due to per person daily income **(*v*)** and **estimated** on the basis of food consumption data collected in the HBS**;**

CV(*x*/*r*) is the coefficient of variation of the daily per person dietary energy consumption due to energy requirement **(*r*)** and is considered a fixed component corresponding to about 0.20.

CV(x|v) is estimated using the following formula:

CV(x|v) = σ (x|v) / μ(x) .

Where

σ (x|v) is the standard deviation of the weighted daily per person dietary energy consumption by income deciles distribution and is derived from the formula:

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

μ(x) is the weighted average daily per person dietary energy consumption by income deciles distribution and is derived from the formula:

$$\mu(x) = \sum_{j=1}^{k} f_j (x \mid v)_j / n$$

k is 10 - the number of income deciles;

f_j is the number of persons in the sampled households of the *j*th income class;

$(x|v)_j$ is the average daily per person dietary energy consumption of the *j*th income class; and ***n*** is number of persons in the household income and expenditure survey.

In many cases, total expenditure data are used as a proxy of income data because the latter is not available or wrongly reported at the collection stage.

Thus, the data required for estimating **CV(x|v)** are the averages daily per person dietary energy consumption and the number of persons of the population in each household income deciles. Note that the number of persons in the sampled households has to be expanded to the total population using the sampling and expansion weights.

The Coefficient of Variation of the daily per person dietary energy consumption computed from the Sudan 2009 NHBS is 37.5 .

Sudan daily per person minimum dietary energy requirement

The overall daily minimum dietary energy requirement per person, which is used as the cut-off point, r_L, for estimating the prevalence of undernourishment, is derived by aggregating the sex-age requirements weighted by the proportion of each sex and age group in the total population.

Finally, a pregnancy allowance (**PA**) in per person terms for the whole population is added to the overall requirement. The PA is estimated by multiplying the birth rate by 210 kilo-calories, assuming an estimated daily requirement of 280 kilo-calories during pregnancy over 75 per cent of the year.

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

Where :

MER = daily minimum dietary energy requirement per person

P_{ij} = proportion of each sex and age group in the total population

PA = pregnancy allowance

i = age group

j = sex

The Minimum Dietary Energy Consumption per person per day computed using demographic data from the Sudan 2009 NHBS is 1751 kcal/person/day .

Estimation of the proportion and number of undernourished using HBS data

The density function of dietary energy consumption, **f(x)**, as indicated previously, is assumed to be lognormal with parameters μ_x and σ_x^2. These parameters are estimated using the derived values of the mean $\bar{x}$ and the coefficient of variation ***CV(x)*** of the dietary energy consumption, both estimated from HBS data as follows:

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

$$[\log_e (0.375^2 + 1)]^{0.5} = 0.362386$$

and

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

$$\log_e 2180 - 0.362386^2 / 2 = 7.621418.$$

The proportion of population below r_L is then evaluated using the standard normal cumulative distribution as follows:

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

$$\Phi [(\log_e 1751 - 7.621418) / 0.362386)] = \Phi [- 0.42351] = 0.33596$$

Where:

Φ = standard normal cumulative distribution.

Thus,

the percentage of the population undernourished = 33.6 .

As the total population of Sudan in 2009 was 39.15 million, the number of undernourished is obtained as follows:

Number of undernourished = 39.15 * 0.336 = 13.0 million.

Annex II-Tables

Table 1 - Food deprivation and parameters by population Groupings

Population Groupings	Number of sampled households	CV (%) of DEC (FULL) as defined by FAO	MDER (kcal/person/day)	Average DEC (kcal/person/day)	Proportion of food deprivation in total population (%) MDG 1.9	DEC of food deprived population (kcal/person/day)	Depth of hunger (kcal/person/day)
Sudan	12805		1751	2180	33	1407	344
Income level							
Quintile 1	2561		1702	1370	91	1319	383
Quintile 2	2561		1722	1720	54	1492	230
Quintile 3	2561		1744	2070	20	1581	163
Quintile 4	2561		1779	2480	5	1648	131
Quintile 5	2561		1805	3270	0	*	*
Area							
Urban	3999	36.7	1791	2270	31	1448	343
Rural	8806	37.0	1731	2140	34	1387	344
Household size							
One and two	911	37.2	1937	3430	8	1661	276
Three and four	2675	33.2	1742	2780	10	1507	235
Between 5 and 9	7456	33.6	1743	2150	32	1429	314
More than 9	1763	29.8	1762	1850	49	1418	344
Gender of head of household							
Male	10396	35.0	1755	2200	31	1431	324
Female	2409	39.7	1718	2100	37	1347	371
Age of head of household							
Less than 35	3227	38.6	1654	2330	23	1352	302
35 to 44	4113	35.2	1696	2160	30	1385	310
45 to 60	3789	34.2	1827	2100	40	1464	363
More than 60	1676	35.3	1830	2260	33	1484	346
Education of head of household							
Not finished primary	1155	35.2	1725	2160	31	1405	321
Primary	2301	34.3	1759	2290	27	1455	304
Secondary	1135	34.4	1740	2430	20	1460	281
Post secondary	499	32.5	1808	2590	16	1544	264
Khalwa	686	33.6	1782	2220	30	1466	316
No education	7029	37.0	1743	2040	40	1377	365
State							
Northern	528	33.8	1801	2630	16	1529	272
River Nile	528	35.8	1817	2770	15	1536	282
Red Sea	528	34.3	1786	1980	44	1416	370
Kassala	528	39.0	1786	2320	30	1430	356
Al Gadarif	528	33.8	1740	2360	22	1456	283
Khartoum	527	37.6	1793	2340	29	1450	343
Al Gezira	528	31.4	1779	2560	15	1530	249
White Nile	528	38.5	1778	2080	41	1389	389
Sinnar	526	31.1	1773	2200	29	1483	290
Blue Nile	528	34.5	1707	2300	24	1420	287
Northern Kordufan	526	33.6	1713	1960	40	1378	335
Southern Kordufan	528	28.2	1734	2140	27	1478	256
Northern Darfur	526	29.1	1762	1960	41	1454	309
Western Darfur	528	31.3	1717	2330	20	1462	255
Southern Darfur	527	32.1	1714	2090	32	1418	296
Upper Nile	527	40.9	1705	1520	69	1189	517
Jonglei	457	47.2	1730	1960	48	1261	469
Unity	511	37.4	1652	1430	72	1165	487
Warap	427	35.2	1745	1650	63	1301	444
Northern Bahr Al Ghazal	515	29.7	1686	1840	44	1375	311
Western Bahr Al Ghazal	512	37.7	1711	1440	74	1190	521
Lakes	469	47.0	1724	1830	54	1231	493
Western Equatoria	522	40.6	1730	2490	23	1401	329
Central Equatoria	477	41.0	1744	2070	41	1345	399
Eastern Equatoria	476	44.4	1701	2400	27	1338	363
Regions							
North	7912	34.3	1760	2260	28	1451	309
South	4893	38.4	1717	1890	47	1318	399

Table 2 - Selective Food consumption statistics

Population Groupings	Average number of people in household	Average DEC (kcal/person/day)	Average food consumption in monetary value (SDG/person/day)	Average dietary energy unit value (SDG/1000kcals)	Average total consumption (SDG/person/day)
Sudan	6.3	2180	2.71	1.24	4.42
Income level					
Quintile 1	7.2	1370	0.82	0.60	1.15
Quintile 2	7.2	1720	1.56	0.91	2.35
Quintile 3	6.7	2070	2.27	1.10	3.53
Quintile 4	6.0	2480	3.27	1.32	5.22
Quintile 5	4.9	3270	5.69	1.74	9.99
Area					
Urban	6.4	2270	3.53	1.55	6.25
Rural	6.2	2140	2.32	1.09	3.54
Household size					
One and two	1.8	3430	5.34	1.56	8.96
Three and four	3.6	2780	3.80	1.36	6.18
Between 5 and 9	6.7	2150	2.62	1.22	4.25
More than 9	11.5	1850	2.14	1.16	3.52
Gender of head of household					
Male	6.5	2200	2.76	1.26	4.51
Female	5.3	2100	2.40	1.14	3.82
Age of head of household					
Less than 35	5.0	2330	2.90	1.24	4.55
35 to 44	6.5	2160	2.67	1.24	4.34
45 to 60	7.0	2100	2.56	1.22	4.21
More than 60	6.2	2260	2.93	1.29	4.93
Education of head of household					
Not finished primary	6.1	2160	2.66	1.23	4.36
Primary	6.6	2290	3.02	1.32	4.98
Secondary	6.1	2430	3.63	1.49	6.45
Post secondary	6.2	2590	4.37	1.68	8.54
Khalwa	6.9	2220	2.67	1.20	4.28
No education	6.2	2040	2.24	1.10	3.37
State					
Northern	6.2	2630	3.29	1.25	5.30
River Nile	6.0	2770	3.47	1.25	5.75
Red Sea	5.2	1980	3.01	1.52	4.50
Kassala	6.0	2320	3.41	1.47	5.04
Al Gadarif	6.0	2360	2.74	1.16	4.65
Khartoum	6.3	2340	3.63	1.55	6.53
Al Gezira	6.1	2560	3.20	1.25	5.05
White Nile	6.4	2080	2.59	1.25	4.33
Sinnar	6.1	2200	3.05	1.39	5.03
Blue Nile	6.4	2300	2.70	1.18	4.39
Northern Kordufan	5.5	1960	2.15	1.10	3.75
Southern Kordufan	7.6	2140	2.28	1.07	3.76
Northern Darfur	6.6	1960	2.08	1.06	3.36
Western Darfur	5.4	2330	2.92	1.25	4.69
Southern Darfur	6.7	2090	2.37	1.14	4.18
Upper Nile	7.6	1520	2.56	1.69	3.95
Jonglei	6.4	1960	1.93	0.98	2.25
Unity	7.8	1430	1.38	0.96	1.92
Warap	7.1	1650	1.32	0.80	1.63
Northern Bahr Al Ghazal	6.2	1840	1.39	0.75	1.73
Western Bahr Al Ghazal	5.4	1440	2.17	1.51	2.99
Lakes	7.6	1830	2.10	1.15	2.71
Western Equatoria	5.5	2490	2.39	0.96	2.97
Central Equatoria	6.2	2070	2.28	1.10	3.92
Eastern Equatoria	5.7	2400	2.58	1.07	3.14
Regions					
North	6.2	2260	2.90	1.28	4.87
South	6.5	1890	2.01	1.06	2.73

Table 3 - Share of food consumption to total consumption in monetary value and by food sources

Population Groupings	Share of food consumption in monetary value to total consumption (%)	Share of food consumption in monetary value purchased to total food value (%)	Share of food consumption in monetary value from own production to total food value (%)	Share of food consumption in monetary value eaten away from home to total food value (%)	Share of food consumption in monetary value from other sources to total food value (%)
Sudan	61.4	80.2	7.5	6.7	5.7
Income level					
Quintile 1	71.5	67.2	16.7	4.2	11.9
Quintile 2	66.3	77.2	10.3	4.6	7.9
Quintile 3	64.4	79.7	8.9	5.7	5.7
Quintile 4	62.7	82.4	6.8	6.3	4.6
Quintile 5	57.0	81.6	5.1	8.3	4.9
Area					
Urban	56.4	87.5	1.5	7.9	3.1
Rural	65.7	74.8	11.9	5.7	7.6
Household size					
One and two	59.6	81.1	6.1	7.3	5.5
Three and four	61.4	82.0	6.3	6.8	4.8
Between 5 and 9	61.7	79.7	7.9	6.5	5.8
More than 9	60.7	79.6	7.4	6.8	6.1
Gender of head of household					
Male	61.3	81.0	7.0	6.6	5.4
Female	62.7	73.8	11.5	6.8	7.9
Age of head of household					
Less than 35	63.8	77.4	9.0	7.7	6.0
35 to 44	61.7	80.7	7.3	6.6	5.4
45 to 60	60.7	80.2	7.3	6.6	5.9
More than 60	59.4	82.6	6.3	5.4	5.6
Education of head of household					
Not finished primary	61.0	83.1	6.1	5.9	4.9
Primary	60.7	83.4	5.4	7.0	4.2
Secondary	56.3	84.1	3.6	7.5	4.8
Post secondary	51.1	88.4	1.3	6.2	4.1
Khalwa	62.5	82.9	4.4	6.9	5.7
No education	66.6	74.1	12.1	6.4	7.3
State					
Northern	62.2	77.2	9.6	4.3	8.9
River Nile	60.3	80.1	8.7	4.7	6.6
Red Sea	66.9	84.8	2.1	6.7	6.4
Kassala	67.6	90.5	2.8	5.3	1.3
Al Gadarif	59.0	88.1	3.2	4.8	3.8
Khartoum	55.6	90.6	0.7	6.7	2.1
Al Gezira	63.4	83.9	6.3	4.2	5.7
White Nile	59.8	95.1	2.5	1.4	1.0
Sinnar	60.7	82.2	4.2	7.2	6.3
Blue Nile	61.6	82.7	5.4	6.7	5.3
Northern Kordufan	57.5	82.8	6.0	7.2	4.0
Southern Kordufan	60.6	81.4	7.9	6.4	4.4
Northern Darfur	62.0	79.3	3.7	4.1	12.9
Western Darfur	62.2	86.7	1.8	7.3	4.2
Southern Darfur	56.8	77.7	4.5	10.8	7.0
Upper Nile	64.8	66.3	21.9	4.8	6.9
Jonglei	85.8	49.3	24.2	10.4	16.1
Unity	71.7	50.6	25.5	6.9	17.1
Warap	81.1	53.1	18.3	9.4	19.1
Northern Bahr Al Ghazal	80.1	63.3	18.4	8.3	10.0
Western Bahr Al Ghazal	72.6	68.7	6.8	11.5	13.0
Lakes	77.5	44.6	32.3	10.1	12.9
Western Equatoria	80.5	39.4	45.6	7.2	7.8
Central Equatoria	58.3	66.5	19.0	8.4	6.1
Eastern Equatoria	82.0	23.7	43.1	16.9	16.4
Regions					
North	59.6	85.4	3.9	6.1	4.5
South	73.4	52.0	26.7	9.4	11.9

Table 4 - Share of food dietary energy to total food dietary energy consumption by food sources

Population Groupings	Share of dietary energy purchased to total food consumption (%)	Share of dietary energy from own production to total food consumption (%)	Share of dietary energy eaten away from home to total food consumption (%)	Share of dietary energy from other sources to total food consumption (%)
Sudan	80.9	7.6	1.8	9.8
Income level				
Quintile 1	68.1	14.6	3.6	13.6
Quintile 2	76.4	10.5	1.3	11.8
Quintile 3	79.7	8.2	1.5	10.5
Quintile 4	84.5	5.9	1.6	8.1
Quintile 5	86.2	4.0	1.9	7.9
Area				
Urban	91.8	1.4	1.7	5.0
Rural	75.2	10.7	1.9	12.2
Household size				
One and two	82.6	6.3	2.1	8.9
Three and four	81.2	6.9	3.0	8.8
Between 5 and 9	80.3	7.9	1.6	10.2
More than 9	82.0	7.3	1.6	9.1
Gender of head of household				
Male	81.8	7.0	1.7	9.5
Female	74.1	12.0	2.4	11.5
Age of head of household				
Less than 35	78.0	9.4	2.3	10.3
35 to 44	82.6	6.7	1.6	9.1
45 to 60	80.2	8.0	1.5	10.3
More than 60	82.3	6.0	2.4	9.4
Education of head of household				
Not finished primary	84.1	6.4	1.1	8.4
Primary	84.4	5.7	2.4	7.5
Secondary	86.2	3.8	1.6	8.4
Post secondary	88.7	1.9	1.2	8.2
Khalwa	80.1	5.6	1.0	13.4
No education	76.3	10.7	2.0	11.0
State				
Northern	73.4	12.0	0.5	14.1
River Nile	86.3	4.2	0.6	8.8
Red Sea	85.2	0.9	1.5	12.4
Kassala	94.9	1.3	1.7	2.1
Al Gadarif	86.9	3.9	0.5	8.7
Khartoum	96.7	0.2	0.7	2.3
Al Gezira	78.9	4.6	0.7	15.9
White Nile	95.0	2.0	0.2	2.8
Sinnar	84.3	4.3	1.2	10.2
Blue Nile	83.4	4.2	0.6	11.8
Northern Kordufan	88.4	5.0	2.1	4.5
Southern Kordufan	79.4	10.6	1.5	8.4
Northern Darfur	71.6	3.5	0.3	24.6
Western Darfur	86.9	4.2	1.5	7.3
Southern Darfur	78.5	6.2	1.1	14.2
Upper Nile	75.8	11.8	2.7	9.8
Jonglei	58.5	24.7	4.7	12.1
Unity	61.7	15.5	2.7	20.2
Warap	57.5	15.0	11.7	15.8
Northern Bahr Al Ghazal	66.6	15.5	5.9	12.0
Western Bahr Al Ghazal	74.3	7.1	4.8	13.8
Lakes	57.4	20.8	8.4	13.4
Western Equatoria	37.0	50.0	4.8	8.2
Central Equatoria	72.6	16.9	4.0	6.5
Eastern Equatoria	31.4	42.1	5.3	21.2
Regions				
North	86.1	3.9	1.0	9.1
South	57.6	23.9	5.6	12.9

Table 5 - Inequality Measures (CV – Coefficient of variation) of food consumption, total consumption and income by population groupings

Population Groupings	CV of DEC due to income (%)	CV of food consumption in monetary value DUE TO income (%)	CV of total consumption DUE TO income (%)	CV of Income - FULL (%)	CV of DEC-FULL (%)	CV of food consumption in monetary value FULL (%)	CV of DEC - FULL as defined by FAO (%)
Area							
Urban	31.2	53.2	63.7	63.7	44.4	59.3	36.7
Rural	32.2	66.1	69.4	69.4	48.0	71.9	37.0
Household size							
One and two	29.7	54.0	64.6	64.6	43.9	61.2	37.2
Three and four	26.8	59.2	68.7	68.7	45.6	64.3	33.2
Between 5 and 9	28.2	59.5	68.4	68.4	44.3	65.4	33.6
More than 9	23.4	57.3	63.6	63.6	42.4	63.2	29.8
Gender of head of household							
Male	29.6	62.3	70.5	70.5	46.1	68.1	35.0
Female	35.1	76.8	91.0	91.0	52.2	82.7	39.7
Age of head of household							
Less than 35	34.1	68.2	75.2	75.2	49.9	73.8	38.6
35 to 44	30.5	65.7	74.3	74.3	45.8	70.9	35.2
45 to 60	28.1	59.3	69.7	69.7	44.2	65.4	34.2
More than 60	29.4	62.6	71.1	71.1	49.1	68.9	35.3
Education of head of household							
Not finished primary	30.0	58.9	62.7	62.7	45.3	63.6	35.2
Primary	28.7	58.4	63.0	63.0	46.2	64.5	34.3
Secondary	29.0	55.2	68.1	68.1	44.1	61.4	34.4
Post secondary	25.8	44.8	61.1	61.1	41.2	52.9	32.5
Khalwa	27.8	53.0	54.6	54.6	41.8	59.3	33.6
No education	32.0	67.8	72.3	72.3	48.7	74.0	37.0
State							
Northern	27.6	47.1	56.5	56.5	38.9	51.8	33.8
River Nile	29.9	54.1	61.5	61.5	37.6	58.2	35.8
Red Sea	28.4	59.5	64.2	64.2	45.8	62.6	34.3
Kassala	34.1	66.1	69.9	69.9	44.5	70.0	39.0
Al Gadarif	28.4	56.4	59.4	59.4	39.8	62.2	33.8
Khartoum	32.2	50.4	63.7	63.7	44.3	55.7	37.6
Al Gezira	24.9	46.2	51.1	51.1	37.4	50.8	31.4
White Nile	33.6	55.2	61.1	61.1	45.1	61.3	38.5
Sinnar	24.7	51.9	57.9	57.9	39.7	58.5	31.1
Blue Nile	29.3	66.1	69.6	69.6	42.1	69.3	34.5
Northern Kordufan	28.3	66.5	75.1	75.1	44.4	72.8	33.6
Southern Kordufan	21.5	53.6	56.8	56.8	37.6	58.3	28.2
Northern Darfur	22.5	59.4	63.4	63.4	38.0	67.5	29.1
Western Darfur	25.6	60.8	72.2	72.2	43.6	67.4	31.3
Southern Darfur	26.5	64.0	71.6	71.6	42.9	70.0	32.1
Upper Nile	36.7	59.2	67.1	67.1	57.7	67.5	40.9
Jonglei	43.5	101.2	93.1	93.1	59.2	102.0	47.2
Unity	33.1	67.0	85.4	85.4	56.7	75.5	37.4
Warap	29.9	100.5	97.2	97.2	70.4	105.9	35.2
Northern Bahr Al Ghazal	23.7	76.4	87.0	87.0	41.1	80.4	29.7
Western Bahr Al Ghazal	33.1	82.5	94.4	94.4	55.7	86.6	37.7
Lakes	43.3	143.0	128.8	128.8	71.6	149.2	47.0
Western Equatoria	36.2	64.8	65.2	65.2	50.9	68.0	40.6
Central Equatoria	36.5	78.2	97.3	97.3	59.1	89.0	41.0
Eastern Equatoria	40.7	87.8	93.0	93.0	54.2	91.6	44.4
Regions							
North	28.8	58.4	66.6	66.6	42.9	63.9	34.3
South	33.8	88.4	96.5	96.5	61.5	95.2	38.4

Table 6 - Food consumption in monetary and nutrient values by national, sub national and population groupings

Population Groupings	Average DEC (kcal/person/day)	Average food consumption in monetary value of food consumed (SDG/person/day)	Average food PROTEIN consumption (g/person/day)	Average CARDOHYDRATES consumption (g/person/day)	Average FAT consumption (g/person/day)
Sudan	2180	2.71	67.6	335.2	53.1
Income level					
Quintile 1	1370	0.82	41.4	220.4	28.3
Quintile 2	1720	1.56	51.9	267.1	39.6
Quintile 3	2070	2.27	63.8	321.8	48.3
Quintile 4	2480	3.27	76.6	378.8	62.1
Quintile 5	3270	5.69	104.6	487.0	87.4
Area					
Urban	2270	3.53	68.2	350.2	58.0
Rural	2140	2.32	67.4	328.0	50.8
Household size					
One and two	3430	5.34	107.7	508.4	93.0
Three and four	2780	3.80	85.8	412.8	75.0
Between 5 and 9	2150	2.62	66.5	331.3	51.4
More than 9	1850	2.14	57.3	288.4	42.3
Gender of head of household					
Male	2200	2.76	67.8	337.2	53.6
Female	2100	2.40	66.4	321.2	50.0
Age of head of household					
Less than 35	2330	2.90	72.5	353.5	58.7
35 to 44	2160	2.67	66.4	331.2	52.3
45 to 60	2100	2.56	65.2	324.8	49.6
More than 60	2260	2.93	70.1	345.7	56.3
Education of head of household					
Not finished primary	2160	2.66	65.0	336.2	51.0
Primary	2290	3.02	69.4	353.0	56.9
Secondary	2430	3.63	73.3	374.1	61.5
Post secondary	2590	4.37	77.5	394.5	69.3
Khalwa	2220	2.67	70.8	332.7	55.1
No education	2040	2.24	64.8	313.9	48.2
State					
Northern	2630	3.29	90.5	397.0	61.5
River Nile	2770	3.47	81.1	452.2	60.1
Red Sea	1980	3.01	58.0	317.3	45.9
Kassala	2320	3.41	74.8	349.2	60.2
Al Gadarif	2360	2.74	73.3	376.6	51.5
Khartoum	2340	3.63	65.2	372.7	59.2
Al Gezira	2560	3.20	78.9	409.3	56.0
White Nile	2080	2.59	63.1	323.1	49.9
Sinnar	2200	3.05	78.6	322.4	54.5
Blue Nile	2300	2.70	72.1	360.8	50.9
Northern Kordufan	1960	2.15	55.7	305.0	46.6
Southern Kordufan	2140	2.28	66.5	321.6	53.4
Northern Darfur	1960	2.08	60.1	276.4	53.8
Western Darfur	2330	2.92	74.1	326.8	62.6
Southern Darfur	2090	2.37	65.6	299.4	56.7
Upper Nile	1520	2.56	62.9	209.9	41.1
Jonglei	1960	1.93	70.0	283.3	52.8
Unity	1430	1.38	47.2	224.9	31.3
Warap	1650	1.32	56.7	247.8	40.9
Northern Bahr Al Ghazal	1840	1.39	60.6	309.2	30.1
Western Bahr Al Ghazal	1440	2.17	51.7	211.9	37.5
Lakes	1830	2.10	63.2	270.7	46.7
Western Equatoria	2490	2.39	61.0	425.3	50.6
Central Equatoria	2070	2.28	54.9	351.1	40.1
Eastern Equatoria	2400	2.58	88.1	326.3	66.9
Regions					
North	2260	2.90	68.9	347.9	55.4
South	1890	2.01	62.9	288.1	44.7

Table 7 - Nutrient's contribution to dietary energy consumption

Population Groupings	Share of DEC in total DEC coming from proteins (%)	Share of DEC in total DEC coming from fats (%)	Share of DEC in total DEC coming from carbohydrates, fiber and alcohol (%)
Sudan	12.4	21.9	65.7
Income level			
Quintile 1	12.1	18.6	69.3
Quintile 2	12.1	20.7	67.2
Quintile 3	12.3	21.0	66.7
Quintile 4	12.3	22.5	65.1
Quintile 5	12.8	24.0	63.2
Area			
Urban	12.0	23.0	65.0
Rural	12.6	21.3	66.1
Household size			
One and two	12.5	24.4	63.1
Three and four	12.3	24.3	63.4
Between 5 and 9	12.4	21.6	66.1
More than 9	12.4	20.6	66.9
Gender of head of household			
Male	12.4	22.0	65.7
Female	12.7	21.5	65.9
Age of head of household			
Less than 35	12.4	22.6	65.0
35 to 44	12.3	21.8	65.8
45 to 60	12.4	21.3	66.3
More than 60	12.4	22.4	65.2
Education of head of household			
Not finished primary	12.0	21.3	66.7
Primary	12.1	22.3	65.6
Secondary	12.1	22.8	65.2
Post secondary	12.0	24.1	64.0
Khalwa	12.7	22.3	64.9
No education	12.7	21.2	66.1
State			
Northern	13.8	21.1	65.2
River Nile	11.7	19.5	68.8
Red Sea	11.7	20.9	67.4
Kassala	12.9	23.3	63.8
Al Gadarif	12.4	19.6	68.0
Khartoum	11.1	22.7	66.1
Al Gezira	12.3	19.7	68.0
White Nile	12.1	21.6	66.2
Sinnar	14.3	22.3	63.4
Blue Nile	12.6	20.0	67.5
Northern Kordufan	11.3	21.4	67.3
Southern Kordufan	12.4	22.5	65.1
Northern Darfur	12.2	24.7	63.1
Western Darfur	12.7	24.2	63.1
Southern Darfur	12.5	24.4	63.0
Upper Nile	16.6	24.4	59.0
Jonglei	14.3	24.2	61.5
Unity	13.2	19.7	67.0
Warap	13.7	22.3	64.0
Northern Bahr Al Ghazal	13.2	14.7	72.1
Western Bahr Al Ghazal	14.3	23.4	62.2
Lakes	13.8	23.0	63.1
Western Equatoria	9.8	18.3	71.9
Central Equatoria	10.6	17.4	71.9
Eastern Equatoria	14.7	25.1	60.2
Regions			
North	12.2	22.0	65.8
South	13.3	21.3	65.3

Table 8 – Share of animal protein in total protein consumption (%) by national, sub national and population groupings

Population Groupings	Share of animal protein in total protein consumption (%)
Sudan	24.3
Income level	
Income quintile 1	16.7
Income quintile 2	18.9
Income quintile 3	21.7
Income quintile 4	24.9
Income quintile 5	31.3
Area	
Urban	26.3
Rural	23.3
State	
Northern	13.8
River Nile	18.4
Red Sea	21.4
Kassala	25.8
Al Gadarif	21.8
Khartoum	25.8
Al Gezira	21.9
White Nile	21.6
Sinnar	23.9
Blue Nile	22.4
Northern Kordufan	18.7
Southern Kordufan	20.7
Northern Darfur	14.5
Western Darfur	29.0
Southern Darfur	17.5
Upper Nile	53.0
Jonglei	39.1
Unity	31.1
Warap	27.6
Northern Bahr Al Ghazal	21.9
Western Bahr Al Ghazal	45.5
Lakes	34.5
Western Equatoria	28.0
Central Equatoria	22.6
Eastern Equatoria	44.3

Table 9 - Food consumption in monetary and nutrient values by food commodity groups (Sudan)

Food commodity group	Average food consumption in monetary value (SDG/person/day)	Average DEC (kcal/person/day)	Average PROTEIN (gm/person/day)	Average CARDOHYDRATES (gm/person/day)	Average FATS (gm/person/day)
CEREALS AND PRODUCTS	0.63	1237	39.4	224.3	12.7
ROOTS AND TUBERS AND PRODUCTS	0.05	34	0.5	7.5	0.1
SUGARS AND SYRUPS AND PRODUCTS	0.21	259	0.2	62.2	1.0
PULSES	0.07	53	4.5	6.2	0.3
TREE NUTS	0.00	0	0.0	0.0	0.0
OIL CROPS	0.03	49	2.0	1.5	3.7
VEGETABLES AND PRODUCTS	0.27	61	2.6	10.5	0.3
FRUITS AND PRODUCTS	0.13	44	0.5	9.5	0.2
STIMULANTS	0.11	7	0.1	1.5	0.0
SPICES	0.08	17	0.7	2.6	0.2
ALCOHOLIC BEVERAGES	0.01	6	0.0	0.6	0.0
MEAT	0.51	113	10.3	1.4	7.6
EGGS	0.02	7	0.5	0.1	0.5
FISH AND FISH PRODUCTS	0.09	20	2.8	1.1	0.5
MILK AND CHEESE	0.24	62	3.3	4.6	3.3
OILS AND FATS (vegetable oils)	0.01	6	0.0	0.0	0.7
OILS AND FATS (animal fats)	0.13	196	0.0	0.0	21.8
NON ALCOHOLIC BEVERAGES	0.02	3	0.0	0.8	0.0
MISCELLANEOUS AND PREPARED FOOD	0.10	15	2.1	10.2	1.7

Table 10 - Nutrient share in total dietary energy consumption by food commodity group (Sudan)

Food commodity group	Share of DEC in Total Energy Consumption (%)	Share of PROTEIN in Total Protein Consumption (%)	Share of CARBOHYDRATE in Total Carbohydrates Consumption (%)	Share of FATS in Total Fats Consumption (%)
CEREALS AND PRODUCTS	56.5	56.7	65.1	23.2
ROOTS AND TUBERS AND PRODUCTS	1.5	0.7	2.2	0.1
SUGARS AND SYRUPS AND PRODUCTS	11.8	0.3	18.0	1.9
PULSES	2.4	6.5	1.8	0.5
TREE NUTS	0.0	0.0	0.0	0.0
OIL CROPS	2.2	2.9	0.4	6.8
VEGETABLES AND PRODUCTS	2.8	3.7	3.0	0.6
FRUITS AND PRODUCTS	2.0	0.7	2.7	0.3
STIMULANTS	0.3	0.1	0.4	0.1
SPICES	0.8	1.0	0.8	0.3
ALCOHOLIC BEVERAGES	0.3	0.0	0.2	0.0
MEAT	5.2	14.8	0.4	13.9
EGGS	0.3	0.8	0.0	0.9
FISH AND FISH PRODUCTS	0.9	4.0	0.3	1.0
MILK AND CHEESE	2.8	4.7	1.3	6.1
OILS AND FATS (vegetable oils)	0.3	0.0	0.0	1.3
OILS AND FATS (animal fats)	9.0	0.0	0.0	39.8
NON ALCOHOLIC BEVERAGES	0.1	0.0	0.2	0.0
MISCELLANEOUS AND PREPARED FOOD	0.7	3.1	2.9	3.2

Table 11 - Food consumption in monetary and nutrient values by main food items (Sudan)

Food Item	Quantity Consumed (g/person/day)	Monetary Value (SDG/person/day)	Dietary Energy Consumption (Kcal/person/day)	Dietary Energy Consumption Unit Value (SDG/1000 Kcal)	Protein Consumption (g/person/day)	Protein Consumption Unit Value (SDG/100g)
Dura	147.70	0.17	525	0.32	16.69	1.01
Sugar	55.60	0.14	222	0.62	0.00	*
Cooking oil	21.50	0.13	194	0.67	0.00	*
Bread	70.70	0.16	187	0.85	6.22	2.54
Millet (Dukhn)	40.50	0.05	128	0.39	4.69	1.08
Dura flour	27.30	0.04	93	0.45	3.00	1.41
Wheat	22.30	0.03	76	0.34	3.06	0.83
Fresh milk	84.70	0.19	51	3.66	2.71	6.91
Wheat flour	11.80	0.03	41	0.67	1.41	1.94
Local biscuit	8.70	0.03	37	0.88	0.80	4.06
Groundnut (Roasted)	5.80	0.01	36	0.36	1.38	0.93
Rice (imported)	9.80	0.04	34	1.09	0.64	5.84
Fresh beef	15.90	0.16	33	4.75	2.15	7.37
Dry okra (dry Alweka)	9.60	0.06	28	2.22	1.03	6.03
Sheep meat	12.90	0.15	27	5.34	2.61	5.61
Macaroni- spaghetti-noodles	7.20	0.03	26	1.33	0.75	4.53
Maize flour	6.50	0.01	23	0.39	0.53	1.72
Onions	54.90	0.06	21	2.92	0.66	9.27
Lentils	6.80	0.04	19	2.04	1.64	2.37
Cassava flour	6.00	0.01	19	0.37	0.16	4.42
Yellow maize (Dura Shami)	5.10	0.00	18	0.26	0.41	1.13
Lentils (Adasia)	5.90	0.01	17	0.67	1.52	0.76
Candy	3.90	0.01	16	0.70	0.18	6.04
Dates	6.40	0.02	15	1.25	0.15	12.57
Groundnut flour	2.40	0.01	13	1.06	0.62	2.23
Tahnieh Halawa	2.40	0.02	12	1.26	0.04	38.43
Tripes	3.80	0.00	12	0.55	0.56	0.59
Kisra & asida	5.80	0.01	12	0.88	0.29	3.50
Goat meat	5.70	0.05	11	4.69	1.07	4.93
Local banana	15.30	0.02	10	2.20	0.12	18.61
Dry Egyptian beans	2.90	0.01	10	0.48	0.76	1.08
Other flour	2.90	0.00	9	0.93	0.28	1.70
Breakfast cereals	2.10	0.00	8	0.55	0.17	2.63
Dried fish	3.30	0.04	7	3.04	1.33	2.87
Other spices	3.30	0.02	7	5.28	0.27	8.31
White beans	2.20	0.01	7	1.13	0.51	1.57
Chicken & poultry	4.60	0.05	7	6.63	0.69	6.84
Mangoes	12.80	0.02	6	3.65	0.04	50.41
Eggs	4.20	0.02	6	4.04	0.46	4.82
Milokhia	12.00	0.02	5	4.87	0.52	4.43
Cassava tubers	3.90	0.00	5	0.31	0.04	3.52
Fresh fish	8.10	0.04	5	7.81	0.88	4.05
Other roots- tubers	2.50	0.01	4	2.11	0.04	19.59
Potato	7.70	0.02	4	6.83	0.17	14.68
Sugar cane	13.00	0.03	4	9.15	0.00	*
Oranges	9.90	0.03	3	7.93	0.07	39.67
Fresh tomatoes	14.30	0.05	3	14.73	0.12	36.82
Millet flour	3.80	0.01	3	1.08	0.25	2.62
Mango incl. Indian	8.90	0.01	3	22.29	0.03	74.95
Fanta / Sprite	7.30	0.02	3	14.78	0.00	817.18
Sweet potato	4.20	0.01	3	3.17	0.04	18.85
Green okra	5.10	0.03	2	2.94	0.09	30.20
Milk products	3.70	0.02	2	8.21	0.15	12.93
Traditional beer	4.20	0.01	2	4.57	0.01	62.20
Cucumber	12.70	0.01	1	11.34	0.06	21.23
Maize (in the cob)	2.40	0.00	1	4.53	0.02	16.52
Pumpkin (GaraÕa)	2.70	0.00	0	12.86	0.01	50.16
Khazalten tea & other	2.70	0.03	0	*	0.00	*
Coffee	4.70	0.04	0	*	0.01	690.36
Salt	6.70	0.01	0	*	0.00	*

Table 12 - Population Based Standard Error

Population Groupings	Standard error of DEC	Standard error of food monetary value	Standard error of total consumption	Standard error of income
Area				
Urban	64	0.11	0.21	0.21
Rural	35	0.04	0.07	0.07
Household size				
One and two	163	0.28	0.50	0.50
Three and four	85	0.12	0.22	0.22
Between 5 and 9	37	0.05	0.09	0.09
More than 9	64	0.09	0.15	0.15
Gender of head of household				
Male	35	0.05	0.09	0.09
Female	72	0.11	0.20	0.20
Age of head of household				
Less than 35	67	0.10	0.18	0.18
35 to 44	52	0.08	0.14	0.14
45 to 60	52	0.08	0.13	0.13
More than 60	102	0.14	0.25	0.25
Education of head of household				
Not finished primary	95	0.14	0.23	0.23
Primary	87	0.12	0.20	0.20
Secondary	118	0.20	0.40	0.40
Post secondary	189	0.35	0.72	0.72
Khalwa	116	0.15	0.25	0.25
No education	37	0.05	0.08	0.08
State				
Northern	135	0.20	0.32	0.32
River Nile	139	0.20	0.34	0.34
Red Sea	102	0.17	0.26	0.26
Kassala	124	0.21	0.32	0.32
Al Gadarif	122	0.17	0.27	0.27
Khartoum	123	0.21	0.39	0.39
Al Gezira	128	0.18	0.28	0.28
White Nile	110	0.15	0.26	0.26
Sinnar	114	0.18	0.29	0.29
Blue Nile	117	0.17	0.28	0.28
Northern Kordufan	104	0.14	0.26	0.26
Southern Kordufan	107	0.13	0.22	0.22
Northern Darfur	99	0.13	0.22	0.22
Western Darfur	119	0.17	0.28	0.28
Southern Darfur	109	0.15	0.29	0.29
Upper Nile	89	0.16	0.24	0.24
Jonglei	121	0.14	0.16	0.16
Unity	78	0.09	0.15	0.15
Warap	325	0.11	0.12	0.12
Northern Bahr Al Ghazal	98	0.10	0.11	0.11
Western Bahr Al Ghazal	81	0.15	0.22	0.22
Lakes	123	0.43	0.44	0.44
Western Equatoria	145	0.16	0.20	0.20
Central Equatoria	128	0.16	0.27	0.27
Eastern Equatoria	143	0.19	0.23	0.23
Regions				
North	37	0.06	0.10	0.10
South	55	0.06	0.07	0.07

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