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Health data in civil conflicts: South Sudan under scrutiny

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The Centre for Research on the Epidemiology of Disasters (CRED) is based at the Catholic University of Louvain (UCL), Brussels. CRED promotes research, training and information dissemination on natural disasters and conflicts, with a special focus on public health, epidemiology and socio-economic factors. It works closely with non-governmental organizations, multilateral agencies and academic institutions throughout the world.

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Introduction

The Centre for Research on the Epidemiology of Disasters (CRED) is a Brussels based academic research institution which has been undertaking epidemiological research into international disaster and conflict health for over 30 years. This analysis forms part of a loose series of country analyses produced by CRED staff. Former country analyses have been conducted on Ethiopia[1], Darfur[2], Somalia[3] and Zimbabwe[4].

The objective of this study is to summarize the knowledge and knowledge gaps on the public health situation in South Sudan and to give recommendations for programme planning in this region for the near future. We present a picture of the current public health situation in South Sudan and show trends over time, taking underlying factors into account where possible. Data from the Complex Emergency Database (CE-DAT) complements existing health data from conventional sources, enabling us to validate and compare different kinds of data sources.

We searched the Complex Emergency Database for small-scale surveys conducted by NGOs in the ten states of South Sudan between 2000 and 2010. This investigation was complemented by internet-based research and information from key contacts. We restricted our research to the most basic public health indicators in mortality, nutrition and measles vaccination coverage as these are widely accepted amongst epidemiologists and are common to all available data sources.

We begin with a brief overview of the current public health situation and point out some factors which have most recently contributed to hardship (Chapter 1). We then outline our data sources, which provided the primary information material on basic health indicators on South Sudan between the years 2000 and 2010, plus their characteristics and shortcomings. Data comparability issues and the specifics of the selected indicators are also discussed (Chapter 2). Chapter 3 shows how an extensive comparison of the data retrieved from the different sources per indicator provides the best possible compilation of information on basic public health indicators for South Sudan over time and space. Chapter 4 is based on CE-DAT data and tries to give insights into the impact of the 2005 CPA on the public health situation and show the patterns underlying these changes. Finally, we conclude by giving concrete recommendations for health policy planning and program planning in the ongoing state-building process in the newly emerging country of South Sudan (Chapter 5).

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[1] Workneh S. (2009). Ethiopia: Effects of civil war on nutrition, mortality and vaccination coverage using CE-DAT database from 2000-2008, CRED/UCL, Brussels [ID n°274].
[2] Guha-Sapir D., Degomme O., Phelan M. (2005). Darfur: Counting the deaths: Mortality estimates from multiple survey data. CRED: Brussels. [ID n°211].
[3] Ratnayake R. and Guha-Sapir D. (2008). Mortality rates in Somalia. For Global Nutrition Cluster, Interagency Standing Committee on Nutrition [ID n°248]
[4] Jönsson M. and Guha-Sapir D. (2009) Trends of health indicators in Zimbabwe. A CE-DAT technical brief. CRED Working paper. [ID n°247]

Chapter 1: Background on South Sudan

1.1 Public Health Situation

Decades of conflict, poverty and socio-economic marginalization in South Sudan have had a huge impact on the population´s health and dynamics, leaving the health system in a very poor state. Fifty percent of all South Sudanese live below the poverty line, especially in rural areas.[5] Half of the population is under 18 years of age[6] and on average, health accounts for only 3% of consumption per person per month.[7] Where available, indicators show a devastating picture of the public health situation with high rates of mortality and malnutrition.

According to the Sudan Country Analysis only one third of the population has access to adequate health services. The average population per functional health facility ranges from 4,000 to up to 34,000.[8] Facilities are generally very weak and in some areas have been non-existent for years. The problems are many and wide ranging, from a lack of funding, investment and poor infrastructure and services, to more specific problems such as scarcity of qualified staff and a high prevalence of communicable diseases. Community awareness of the importance of hygiene practices, sanitation and health issues is low, and there is no functioning health surveillance system. The maternal mortality rate is estimated to be 2,054 per 100,000 births[9], one of the highest in the world largely accounted for by the lack of emergency facilities and skilled birth attendants. Moreover, for every maternal death, 30 women are expected to develop severe morbidities. Thirty per cent of mothers give birth without any attendance from either skilled or traditional birth attendants, and only three in every five pregnancies result in a live birth. The UN has said that at present the Millennium Development Goals to reduce MMR by 75% by 2015 is unreachable.[10]

Barely one fifth of children aged 0-6 months receive exclusive breastfeeding as recommended by UNICEF[11]. Not surprisingly, in taking into account malnutrition rates, food scarcity and poverty rates, only around the same proportion of children of 0-11 months are deemed to be adequately fed. Coverage of Vitamin A supplementation in South Sudan is estimated at around 40% among 6-59 months-old children, significantly less than the national rate.[12] While immunization rates for Sudan as a whole show improving trends for nearly all vaccines, up-to-date data for South Sudan in particular is scarce and where present, suggests a considerable difference from national figures. Only around 40% of 12-23 month-olds are reported to have received measles vaccination, compared to 66% for the whole of Sudan. About the same percentage were found to have received no vaccinations at all. In North Sudan this figure is only 5%. According to WHO, 80% coverage is needed to achieve herd immunity to measles.[13]

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[5] 2009 National Baseline Household Survey.
[6] Southern Sudan Centre for Census, Statistics and Evaluation. Key Indicators for Southern Sudan. December 2010.
[7] Southern Sudan Centre for Census Statistics and Evaluation. Poverty in Southern Sudan, Estimates from NBHS 2009. March 2010.
[8] UN Workplan Sudan 2011.
[9] 2006 Sudan Household Health Survey.
[10] United Nations. Sudan Country Analysis. November 2007.
[11] 2006 Sudan Household Health Survey.
[12] 2006 Sudan Household Health Survey.
[13] 2006 Sudan Household Health Survey.

Communicable diseases are the primary cause of morbidity and mortality in South Sudan. Diarrhoea and respiratory tract infections are the most common diseases together with malaria,[14] the latter being the leading cause of mortality in under-fives in Sudan. Yet less than half of symptomatic children receive the appropriate anti-malarial treatment.[15] Usage of insecticide-treated bed nets is only around 10%. The high burden of diarrhoea and other waterborne diseases is mainly due to bad hygiene, with only 55% of the population having access to improved sources of drinking water and 80% having no access to a toilet.[16] Besides endemic diseases, South Sudan regularly experiences outbreaks of communicable disease such as cholera, hepatitis, shigellosis, measles, meningitis and kala-azar, claiming the lives of thousands each year. Data on HIV/AIDS prevalence is limited, but infection rates are thought be higher in South Sudan than in the North. Access to HIV related services is generally only found within the bigger towns. Awareness regarding AIDS amongst women is less than 50%, whilst comprehensive knowledge on prevention is as low 9.8%. Awareness of mother to child transmission is a little over 30%.[17]

1.2 Aggravating Factors

The 2005 Comprehensive Peace Agreement (CPA) was followed by a fragile interim process towards independence of South Sudan, culminating in the January 2011 referendum. However, neither the peace agreement nor formal succession put an end to instability and violence. This general insecurity has affected the health situation of people in South Sudan in various ways.

The sharp increase in violence during 2009 continued in 2010. Armed inter-ethnic clashes were reported in all ten Southern states, resulting in high levels of displacement within South Sudan. By the end of October 2010, over 900 people had reportedly been killed in inter- and intra-tribal violence, or in fighting between civilians and security forces.[18] According to reports by local authorities and assessment teams, some 212,000 people were newly uprooted from their homes at some point in 2010, causing major interruptions of health care services in South Sudan. Civilian mortality due to conflict is mostly due to indirect causes related to disruption in essential health care and loss of livelihood assets. Combat related deaths (direct mortality), such as the one referred to above, constitute a small proportion of the conflict related deaths.[19]

Years of civil war in the South has led to large population displacement towards the northern states of Sudan. However, the signature of the peace agreement was followed by an important return movement of Southern Sudanese to their places of origin. Since 2005, the number of returnees is estimated to have exceeded two million, with a significant increase towards the end of 2010. Return initiatives promoted by the Government of South Sudan and fears about insecurity due to the referendum in February 2011 are thought to have precipitated this increase. The total number of returnees coming from northern Sudan to southern Sudan between October 2010 and 8 March 2011 is estimated at

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[14] UN Workplan Sudan 2011.
[15] United Nations. Sudan Country Analysis. November 2007.
[16] Southern Sudan Centre for Census, Statistics and Evaluation. Key Indicators for Southern Sudan. December 2010.
[17] 2006 Sudan Household Health Survey.
[18] OCHA. Sudan Humanitarian Update. 4th Quarter 2010.
[19] Guha-Sapir, D. and O. D'Aoust (2010). Demographic and Health Consequences of Conflict. Background Paper for the World Development Report 2011 on Conflict, Security and Development. CRED 2011.

253,682.[20] However, the latest figures suggest that there is no end in sight to this process. These largely uncontrolled influxes of people, many of whom are in a vulnerable state of health, are putting the already fragile health situation in South Sudan under additional stress. Local health authorities are often overwhelmed and it is difficult for returnees in transit to receive temporary assistance while they await onward transport.

Since 2000, Sudan has suffered from 15 major floods affecting more than 1.5 million people, and flooding has been a major challenge to public health in South Sudan ever since. In 2010, exceptionally high rainfall led to recurrent flooding in all ten Southern states throughout the year. Recovery assistance and medical care for the estimated 140,000 affected people in dispersed rural settings who lost assets and livelihoods remains scarce.[21]

A severe outbreak of kala-azar occurred in South Sudan in 2010. Over 8,300 cases were confirmed[22] with children being the most affected, their susceptibility often aggravated by poor nutritional status. According to WHO, case numbers are likely to remain high and may increase until mid-2011, mainly as a result of population movements and difficulties in vector control. Kala-azar is the visceral form of leishmaniosis, an infectious disease caused by *Leishmania* parasites. Almost all infections result in the death of the patient if left without proper treatment. The burden is estimated at 500,000 deaths worldwide each year.[23]

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[20] OCHA. Sudan weekly humanitarian bulletin. 4-10 March 2011.
[21] UN Workplan Sudan 2011.
[22] OCHA. Sudan Humanitarian Update. 4th Quarter 2010.
[23] Desjeux P. (2001). The increase of risk factors for leishmaniasis worldwide. Transactions of the Royal Society of Tropical Medicine and Hygiene 95 (3): 239–43.

Chapter 2: Characteristics and Limitations of Different Data Sources

2.1 Data Sources

There is a number of different sources of health data on South Sudan, each of which with its particular limitations and methodologies.

2.1.2 MICS-2, 2000

MICS-2 was a joint exercise between the Sudanese Federal Ministry of Health (FMoH) and the Central Bureau of Statistics (CBS).[24] Technical assistance and training were provided by UNICEF's Sudan Country Office. The World Bank contributed towards costs. The objectives were to provide up-to-date information for assessing the situation of children and women, to monitor the progress toward goals established at the World Summit for Children, to contribute to the improvement of data and monitoring systems in Sudan and to strengthen technical expertise in the design, implementation, and analysis of systems.

The 1993 national census was used to create separate sampling frames for rural and urban areas within each state. The sample design was chosen to provide estimates for indicators at the national level, by state, by urban/rural setting and by gender. The primary level of stratification was the 16 states in the north and the three main towns and surrounding accessible rural areas in the South (Juba, Malakal and Wau) which were added to form one unit (referred to as one "state"). In total 25,200 households in the north were selected and 1,610 households in the south, with a reported response rate of 99.9%. Due to restricted access to rural South Sudan, it was not possible to obtain a representative sample for the southern states. Only safe urban areas in the three southern towns were included. Difficulties in estimating ages made it impossible to calculate how many individuals were underweight and suffering from chronic malnutrition. As a result, the main report is only able to give a marginal discussion and analysis of data for South Sudan.

2.1.3 SHHS (MICS-3), 2006

The 2006 Sudan Household Health Survey (SHHS) was undertaken by the Federal Ministry of Health, the Federal Central Bureau of Statistics (CBS) and the Ministry of Health, and provided data of better quality than MICS 2. This survey was historic in the sense that it was the first joint activity conducted across the Sudan's 25 states following the Comprehensive Peace Agreement.[25] Its main objectives were to collect baseline social indicators to aid public policy formulation and planning and measure progress towards Millennium Development Goals (MDG) and other quality of life indicators. The survey was also intended to provide up-to-date information to assess the situation of women and children and to strengthen the institutional capacity needed to carry out future surveys and censuses.

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[24] Multiple Indicator Cluster Survey Sudan 2000.
[25] 2006 Sudan Household Health Survey.

The sampling frame was produced according to the availability of information. In the Northern States (except the Darfur states) population data was available from the Central Bureau of Statistics on the basis of the Census enumeration area. This was not possible for the southern states so a sampling frame was based on the World Health Organization's list of villages and estimated population developed for the National Immunization Days (NIDs) campaign. These had provided a rough demographic estimate based upon the calculated number of under-five children identified by the WHO Extended Programme of Immunization. Areas in South Sudan with security or accessibility problems had once again been excluded from the framework. However, nomadic tribes camping at a location at the time of survey were included. At this time, despite its weaknesses, the SHHS is possibly the most complete and reliable data source for South Sudan. Today it still provides the most recent census-type data at the national level.

2.1.4 World Health Organization

The World Health Organization offers a large quantity of publicly available data, most of which is contained in various reports from regional or head offices. Definitions or methodologies used to obtain these data are often not presented systematically, making a coherent data collection process difficult and long winded, and leading to discrepancies. Data on indicators of interest to this report was available only for the country as a whole. Mortality rates which are regularly reported in the annual World Health Statistics reports are a useful source for national level monitoring, but suffer from unexplained significant discrepancies between reports from different years. The annual World Health Statistics reports were also used to provide additional information on malnutrition rates. Malnutrition rates were taken from the Global Database on Child Growth and Malnutrition Sudan data table. Immunization rates were WHO/UNICEF estimates obtained from the immunization profile on Sudan, linked directly to the WHO Sudan country homepage.

2.1.5 CE-DAT

The Complex Emergency Database (CE-DAT) developed and run by the Centre for Research on the Epidemiology of Disasters (CRED), is an international initiative to monitor and evaluate the health status of populations affected by complex emergencies. This aims to develop a database of mortality and malnutrition rates - the most commonly used public health indicators of the severity of a humanitarian crisis. CE-DAT currently compiles more than 2,700 epidemiological surveys from 51 countries. Field agencies use mortality and nutrition indicators to identify and measure the severity of needs. The main objectives of CE-DAT are to provide key mortality, nutritional and health indicators for rational humanitarian aid decision-making; to promote the effectiveness of international policies on conflict prevention and response through evidence-based trend analyses and impact briefings; to strengthen the capacity of national and international field operators in data collection and analysis; and to improve standardization and help establish standards to enable the comparability of complex emergency data across time and space. The project works closely with the Standardized Monitoring and Assessment in Relief and Transition (SMART) initiative, which provides support for the methodology of conducting such surveys, and with the SPHERE project, which provides a humanitarian charter and minimum standards in disaster responses.[26] These surveys consist of two major components, a cross-sectional nutrition survey and a retrospective mortality survey, typically using a cluster sampling method. Most of them follow the internationally accepted 30x30 scheme, whereby 30 households are chosen out of 30 clusters selected according to size. In order to assess the completeness of reports, the CE-DAT team has developed guidelines for consistent reporting, which

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[26] CEDAT Database Report. December 2010.

are available for field agencies as a practical checklist of the key elements that should be included in a survey report. The quality of a survey's results can be assessed once a report's completeness has been appraised.

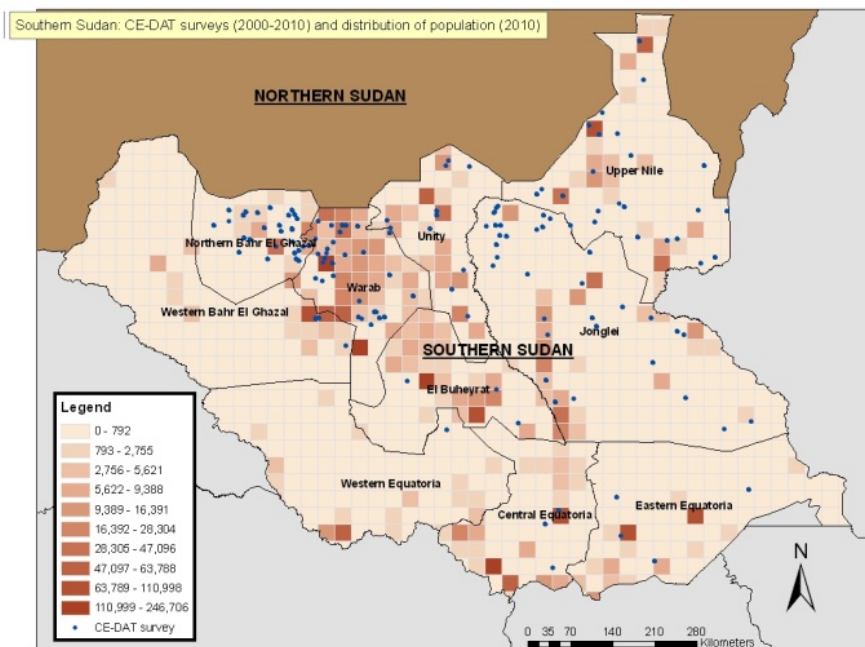**Figure 1: CE-DAT surveys and distribution of population**

Figure 1 shows the geographical distribution of CE-DAT surveys within South Sudan. The blue points are the center points of the surveyed areas. CE-DAT coverage is consistently good in North Bahr El Ghazal (the scene of many hostilities in past conflicts) as well as in the Northern states of Warab, Unity, Jonglei and Upper Nile, regions where the majority of the population resides. In contrast, there are fewer surveys from the Western states which are also sparsely populated. Finally, despite over 250 surveys, there are some regions in the country where there is practically no data at all but where the population density is also the lowest. Lakes (El Buheyrat) is an exception where few surveys have been conducted despite a relatively high population density.

Table 1 adds a time dimension to the geographic distribution of surveys reported in CE-DAT. Most surveys were conducted in the period between 2001 and 2007 with a peak in 2004 (45 surveys). While several states like North Bahr El Ghazal, Jonglei, Upper Nile or Unity are well covered, many others saw barely a handful of surveys over a ten year period.

Table 1: Number of CE-DAT surveys by year and state (2000-2010)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
North Bahr El Ghazal	1	10	3	5	17	9	3	4	3	3	0	58
Jonglei	1	7	11	8	8	5	5	6	1	0	3	55
Upper Nile	0	0	5	9	5	7	2	6	3	1	0	38
Unity	3	9	7	3	2	4	6	3	1	0	0	38
Warab	0	2	2	9	4	1	1	3	3	2	1	28
West Bahr El Ghazal	4	2	3	5	7	5	0	0	0	0	0	26
Central Equatoria	3	4	2	0	0	2	2	0	0	0	0	13
East Equatoria	0	0	0	1	2	1	0	0	0	1	0	5
Lakes (El Buheyrat)	2	0	0	0	0	1	0	0	0	0	0	3
West Equatoria	0	0	0	0	0	1	0	0	0	0	0	1
Total	14	34	33	40	45	36	19	22	11	7	4	265

2.2 Indicators and Data Comparability

2.2.1 Mortality Rates

Mortality is the most widely used indicator for evaluating the severity of a humanitarian crisis. Needs assessments, intervention planning and priority setting are often based on mortality indicators. At this time, there is widespread confusion regarding the different expressions and concepts related to mortality indicators.

Crude Mortality Rate (CMR) describes the number of deaths over a given time period for a known size of at risk population. It is generally expressed as "deaths/10 000/day". In demographic contexts, CMR is sometimes referred to as Crude Death Rate (CDR) and expressed as "deaths/1 000/year" or "deaths/1 000/month".

A second source of confusion comes from the terminology of Under Five Mortality Rate (U5MR), another indicator used in crisis situations. U5MR is widely considered as an indicator of the health status of a population as a whole. It is therefore even more widely established than CMR. Humanitarian professionals understand it as the number of deaths among children under five years of age over a given period – usually expressed as "deaths/10 000/day" but sometimes also as "deaths/1 000/year" or "deaths/1 000/month". However, demographers prefer the term "Zero-to-Five Death Rate" (0-5DR) instead of U5MR in order to remain consistent with their use of CDR.

Another important indicator is Infant Mortality Rate, which is the probability of a child dying before its first birthday, expressed per 1 000 live births. If the time should be extend and cover the period until the fifth birthday, the term Under Five Mortality Rate is often used, even though in this case it is strictly speaking not a rate but a probability. This indicator requires complex calculations since it needs the determination of a birth rate and assumes no change in mortality rate over time. U5MR (defined as death rate) and Under Five Mortality Rate (defined as a probability) cannot be converted into each other. Standard retrospective mortality surveys do not allow the calculation of the probabilities of dying, which is why small scale-surveys do not provide this information.

As mentioned, definitions and units of these indicators often differ between disciplinary groups such as epidemiologists, demographers and economists, introducing confusion and sometimes misleading conclusions when analysed. Although attempts have been made for standardization of definitions and units of measure, notably by the SMART initiative, these have not so far proven successful. In our report, we apply the most commonly used definitions, i.e. CMR as total deaths/10 000/day, U5MR as a mortality rate (deaths under five years per 10 000/day) and Infant Mortality Rate as the probability during the first year of life.

The severity of a given situation requires the comparison of the current mortality rates with a reference value, for example the rate prior to the onset of the crisis. This "non-crisis" mortality rate can then serve as a baseline for estimating the so-called excess mortality, i.e. the share of mortality which can be attributed to the crisis itself. Calculations undertaken in the 1990´s suggested a reference CMR of 0.44/10 000/day for Sub-Saharan Africa. Based on this, a crisis in Sub-Saharan Africa would be declared if mortality exceeds 0.88/10 000/day. For operational ease, this rate has been adjusted to 1/10 000/day. This threshold is now widely used for defining a humanitarian emergency in Sub-Saharan Africa. As U5MRs are usually estimated to be around double the CMR, 2/10 000/day is taken as the threshold for U5MR.

2.2.2 Malnutrition Rates

The nutritional status provides critical information for assessing the effects of humanitarian crises on the population in developing countries. Malnutrition among children aged 6-59 months is used as an indicator for the general health and welfare of a community. Anthropometric data collection of nutritional surveys therefore normally only targets children of below five years of age. However, nutrition science has developed several indicators to distinguish between different forms and levels of nutritional deficiency. Acute malnutrition reflects short-term nutritional deficiencies in a population, e.g. hunger gaps before harvest time, sudden interruption of livestock etc. It is often used for intervention decisions. The chronic malnutrition indicator reflects the long-term effects of poor nutrition and is more useful for long sighted project planning and development policies. Both acute and chronic malnutrition indicators require the same kind of anthropometric information on children under five years of age, namely age, sex, weight, height and presence of any oedema.

Rapid loss of body tissue, as happens in situations of acute malnutrition, leads to wasting and is expressed as "weight for height". Chronic malnutrition, on the other hand, results in growth failure, which leads to stunting. The chronic malnutrition indicator is expressed as "height for aged. Acute and chronic malnutrition combined is calculated by assessing underweight rates and is expressed as "weight for age". The Mid-Upper Arm Circumference (MUAC) is also sometimes used when screening the malnourished community and, as a valuable indicator for mortality risk, is often used as an admission criterion for feeding centers.

A system to classify different levels of severity for the three categories, acute malnutrition, chronic malnutrition and underweight has been developed. This uses either the standard deviation from the Z-score or the percentage of the median defined by a reference population (according to either NHCS or WHO standards).

Global Acute Malnutrition (GAM) is defined as either: 1) a weight-for-height index less than -2 standard deviations, 2) a weight-for-height index of less than 80%, or 3) presence of bilateral oedema. Moderate Acute Malnutrition (MAM) is defined as either 1) a weight-for-height index between -2 and

-3 standard deviations or 2) a weight-for-height index between 80% and 70%. Severe Acute Malnutrition (SAM) is defined as 1) a weight-for-height index below -3 standard deviations or 2) presence of bilateral oedema. These definitions set the cut-offs for Global, Moderate and Severe Chronic Malnutrition and for Global, Moderate and Severe Underweight.

Certain thresholds have also been developed for acute malnutrition: malnutrition rates of 5% are usually considered acceptable, 5-10% indicates the poor nutritional status of a population, 10-15% indicates a serious situation and >15% is a critical situation. No percentage cut-offs have so far been defined for chronic forms of malnutrition.

2.2.3 Immunization Rates

Vaccination coverage is regarded as another valuable indicator for assessing the basic functioning of a health care system and service disruption in a crisis situation. This indicator is also important since measles outbreaks are amongst the major concerns in disasters, especially where population density is high, such as in refugee camps. Case fatality rates can reach up to 20% in susceptible populations. The proportion of children having received Measles-Containing-Vaccination (MCV) is therefore often assessed in surveys. The WHO recommends that 80% of children should be vaccinated against measles in order to achieve what is known as 'herd immunity', when enough individuals in a population have been vaccinated for all individuals to be reasonably protected against a disease. SPHERE goes even further and recommends that measles vaccination coverage should be 90%, especially in areas of high population density, such as refugee camps.

There is no standard definition for "being vaccinated". Different criteria might be considered, such as maximum age (e.g. below 23 months), age range (e.g. between 12-23 months) or the number of vaccinations received.

Chapter 3: Data on Key Health Indicators

3.1 MCV Coverage

The MCV coverage shows wide variation between different data sources within South Sudan. In this section we compare coverage rates reported by small scale surveys and national figures.

Figure 2 compares MCV coverage from various sources. The green lines are national estimates (Sudan) of average MCV coverage for a given year from WHO/UNICEF (light green) and the Sudanese Government (dark green). Values extracted from surveys reported in CE-DAT are shown as grey points. The yellow and red squares in 2006 represent values taken from the 2006 Sudan Household Health Survey.

**Figure 2: MCV coverage over time (various sources)**
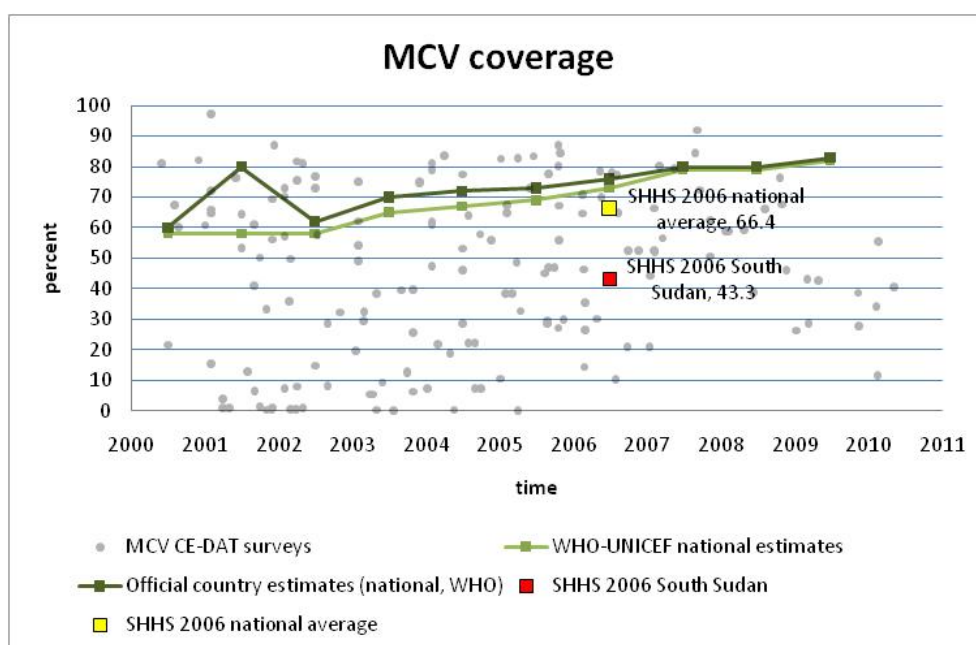
The WHO/UNICEF figures indicate a slow but steady increase in MCV coverage during the last decade, starting at about 60% and finally crossing the critical (herd immunity) value of 80%. However, these figures refer to the whole country. The 2006 SHHS reports a separate value for South Sudan and reveals a substantial gap between the South and the rest of the country. This observation is also supported by CE-DAT: a large proportion of CE-DAT values clearly lie below the WHO/UNICEF national estimates. The large-scale SHHS 2006 includes the whole area of interest (South Sudan) in the sampling and is thus – at least technically – more representative than the mosaic of small-scale surveys reported in CE-DAT. However, since this is an estimate of a South Sudan *average*, spatial disparities are not reflected.

Large-scale surveys such as SHHS 2006, often initiated by national authorities or international organizations, and small-scale surveys, conducted by NGOs and reported in CE-DAT, should be seen as complementary information rather than alternative. Large-scale surveys are spatially comprehensive (usually representative) but only provide a snapshot in time; small-scale surveys provide

geographically limited snapshots but once compiled such as in CE-DAT, can add substantially to the larger picture, both over space and time. Indeed, the numerous small scale surveys reveal important regional disparities and thus add a further dimension to the averages estimated in SHHS 2006. Furthermore, instead of just giving a snapshot in time, CE-DAT provides data spanning several years. Although these surveys do not allow for any easy trend analysis, advanced statistical techniques could be applied to extract patterns and trends from this database.

Figure 3: MCV coverage from CE-DAT surveys in South Sudan
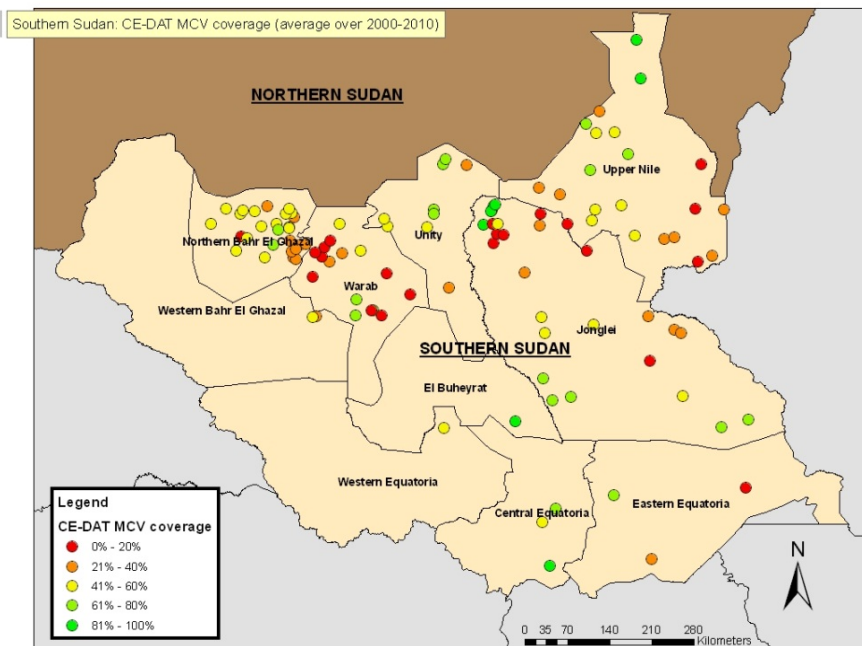
The map in Figure 3 highlights the spatial disparities mentioned above. Both spatial disparities and some clustering of MCV coverage can be observed in South Sudan, especially in the states of North Bar El Ghazal, Warab, Upper Nile and Jonglei. The map lacks the time dimension as it presents all reported MCV coverage values from small scale surveys for the last ten years from South Sudan. While this is a limitation it nevertheless provides insights in areas where children are likely to be under vaccinated.

3.2   Under Five Mortality

Child Mortality provides a mixed picture as well. Figure 4 and Figure 5 compare Under Five Mortality data reported by sources already referred to in the previous section. Due to the different definitions and more importantly, the different scales used, the presentation of the data is separated into two graphs as a single graph with two axes would have created more confusion than illumination. WHO and SHHS 2006 data are comparable as they use the same definition of Under Five Mortality (Figure 5).
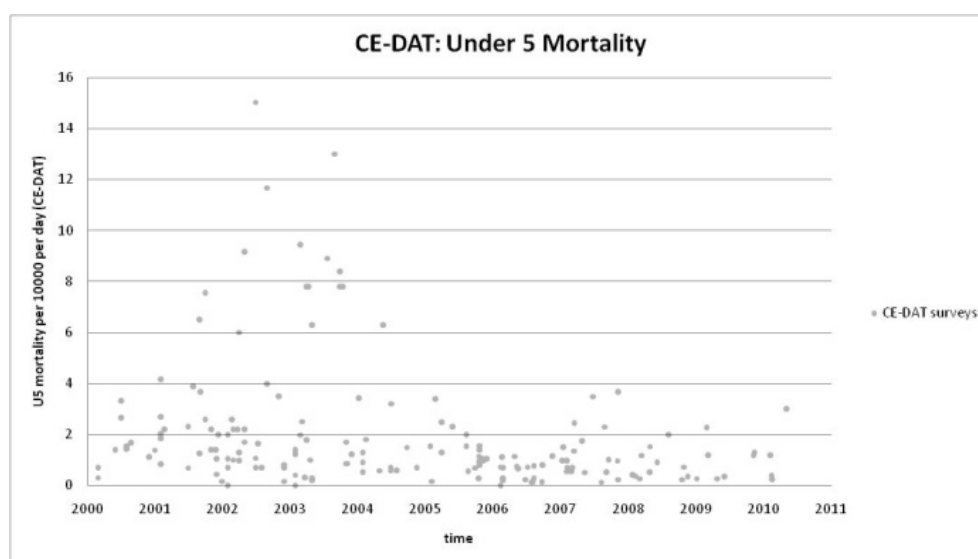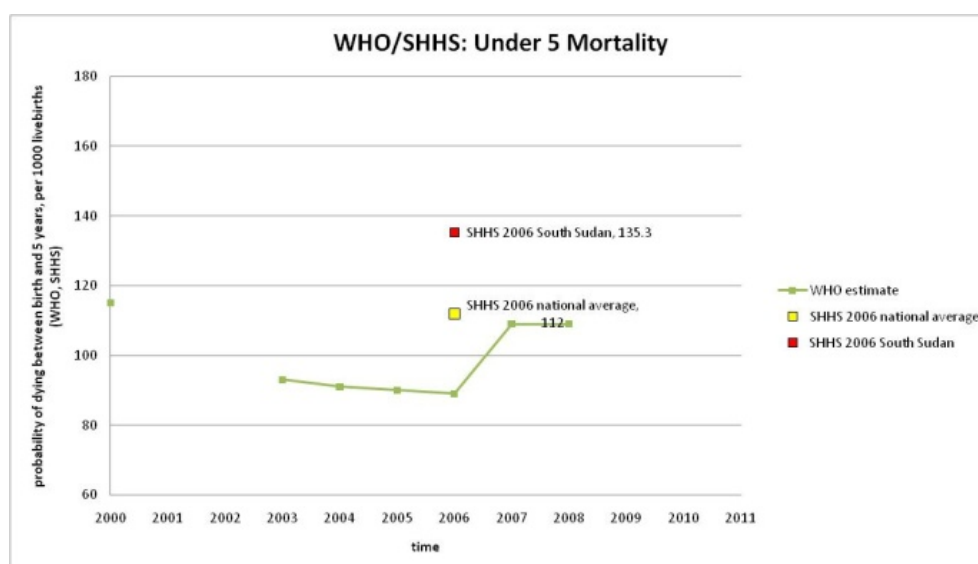
In Figure 5, we present the WHO estimates for Under Five Mortality which increase dramatically in 2007 after having been nearly constant from 2003 to 2006. According to their methodology, WHO base their estimates on a wide range of data sources, ranging from national estimates, estimates by head office staff, national and international surveys – with the side-effect of decreasing transparency. This makes it difficult to clarify the increase in Under Five Mortality in 2007. This increase may be speculatively explained by the inclusion of new information provided by SHHS 2006. Although much effort and resources have been invested in these statistics, the lack of transparency and regional detail makes it challenging to derive useful operation and policy conclusions from them.

The small scale surveys conducted by NGOs in South Sudan (figure 4) reveal a more detailed picture than the point estimates presented in figure 5. In the first half of the decade, the surveys showed alarmingly high values for child mortality until 2005 after which it decreased. This is not necessarily a

reflection of an improvement of the situation or the effectiveness of humanitarian aid but could equally be the consequence of previously high mortality rates that decreased the number of vulnerable children.

The critical threshold for a humanitarian emergency is a value of between about 1 to 2 deaths per 10 000 population per day, based on varying definitions from different humanitarian organizations. The small-scale CE-DAT survey data shows extremely high values obtained from certain surveys between 2002 and 2004 but no incidence of such high mortality has been observed in recent years. However, bearing in mind the U5MR baseline of 1/10 000/day and the threshold for an emergency situation as 2/10 000/day, it should be noted that many recent surveys show numbers beyond these levels.

Figure 6: Under 5 Mortality from CE-DAT surveys in South Sudan
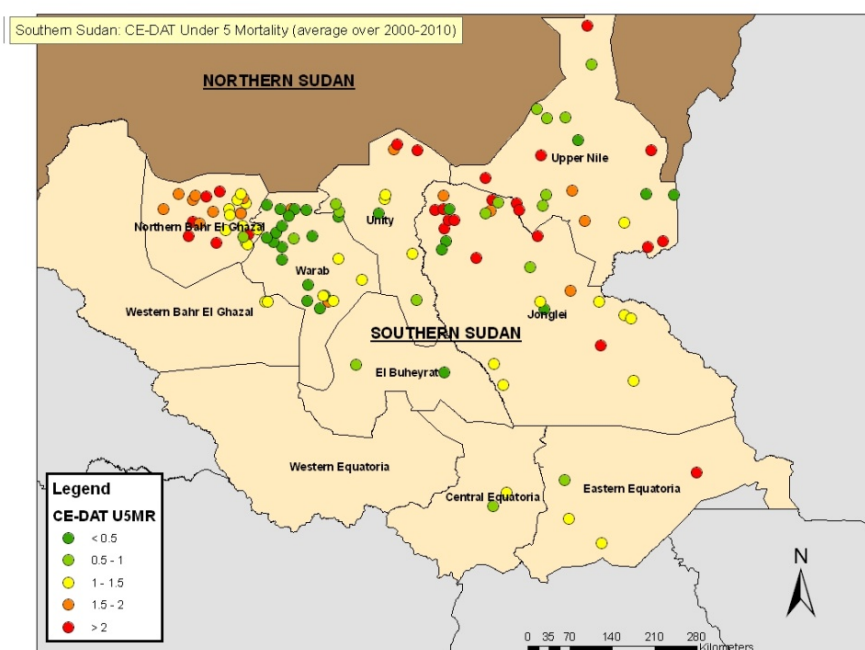

In Figure 6 we have added the spatial dimension to our analysis. We have observed both high spatial disparities and some clustering, similar to MCV coverage. Almost all of the worst values for Under Five Mortality (red points) are found in the rural areas of Unity, Jonglei and Upper Nile, indicating high vulnerability of these populations. In contrast, the comparably densely populated state of Warab displays a better health status of its children.
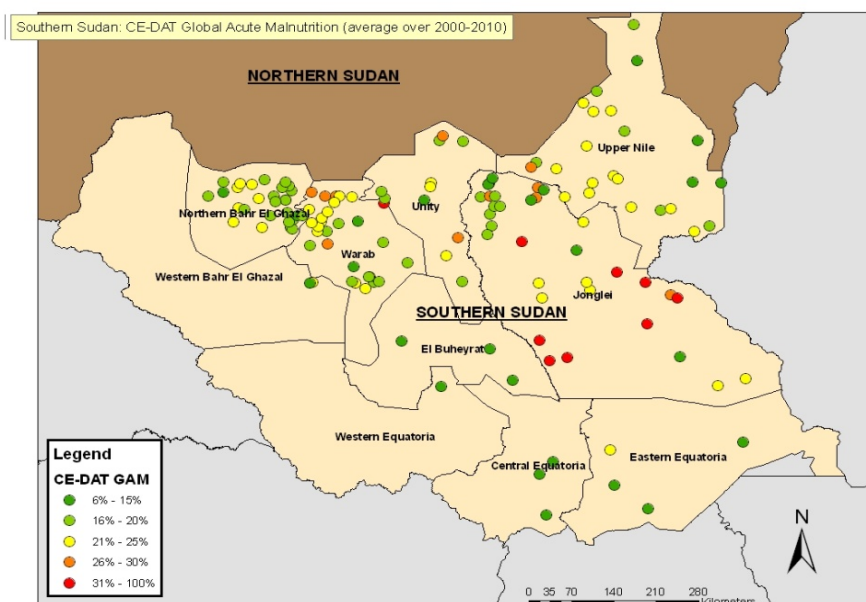
3.3 Global Acute Malnutrition

Global Acute Malnutrition (see section 2.2 for general discussion) is one of the most widely employed indicators in humanitarian crises. It has the advantage also of a standard methodology for measurement that allows comparison over time and across populations.

Figure 7: Global Acute Malnutrition data from CE-DAT and SHHS 2006
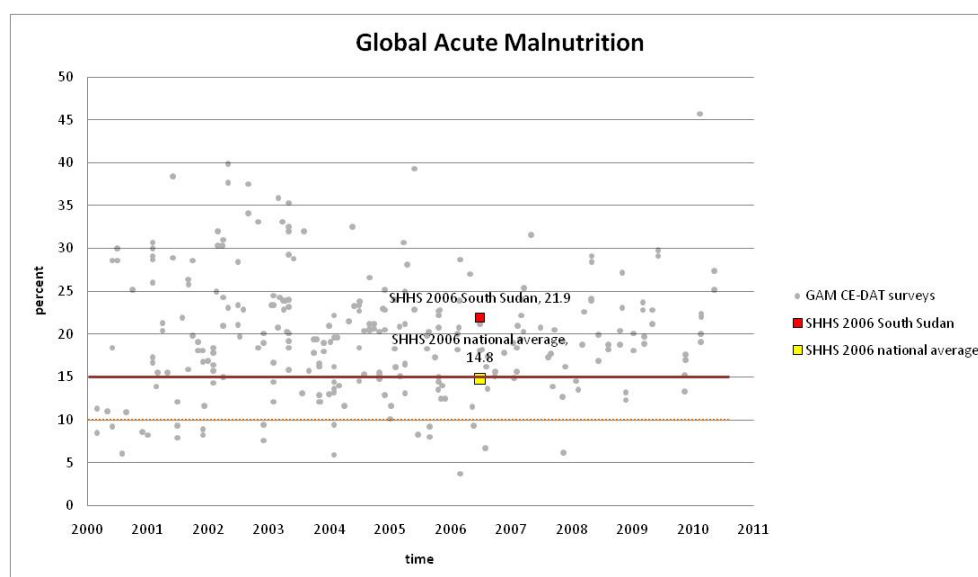
Almost all of the CE-DAT surveys in Figure 7 report malnutrition levels above the 10% threshold reflection of a serious nutrition crisis. More notably, the majority of these report levels which are above the 15% threshold which is recognized as a critical and life-threatening situation. These findings from small-scale surveys are in line with the two point estimates from the SHHS 2006. The scatter plot of the CE-DAT survey results show a narrowing of the spread after 2004.

Figure 8: Geographic distribution of GAM from CE-DAT surveys

As Figure 8 shows, small-scale surveys can provide more refined insights into intra-state disparities than state-wide averages. Our data shows that Global Acute Malnutrition values in the whole country are alarmingly high. The highest values (30% or more) are to be found in Jonglei although some areas in the north of the state show lower values that are comparable to the other states.

Chapter 4: Health Development since the 2005 Peace Agreement

Peace agreements after violent conflicts should in theory bring with it tangible improvements for civilians. These improvements should be reflected in their ability to ensure their livelihood, receive essential healthcare for their children and themselves as well as basic education. Civil violence is also expected to come to an end following such agreements. In this context, this chapter we explore whether there was indeed an improvement of key health indicators in South Sudan following the comprehensive peace agreement in January 2005.

4.1 Methodology

Using standard data sources such as WHO statistics allow straightforward interpretation, trend and cross-country analyses. These statistics systematically provide a single estimate per year for each country, therefore offering a complete data set. On the other hand, interpretation of a collection of small-scale surveys such as CE-DAT is less straightforward. Although these surveys provide better resolution in time and space, their analysis needs to account for the heterogeneity of different survey characteristics such as locations or reference populations.

We classify our survey sites as urban or rural depending on the levels of population density. For each survey location, we calculated the population density (based on AfriPop estimates) in a 50km radius around the geographic coordinates reported in CE-DAT (these coordinates usually represent the center point of the geographic unit covered by the survey). We classify every survey location with a population density above median as being urban and all locations below the median as rural (Figure 10).

We further classify our surveys by the time in which they were undertaken through a binary variable reflecting whether it was the pre peace agreement or the post peace agreement period. Surveys that were conducted after the peace agreement received a value of 1. We regress the four CE-DAT indicators on pre and post peace agreement period and the urban/rural classification. We did the regression both with and without introducing an interaction term (*peace*urban*).

4.2 Quantifying the Peace Dividend

Our analysis shows that the peace agreement in South Sudan has brought variable benefits to its population. Table 2 presents a summarize result of the regression analysis.

We observed significant improvement for all indicators since January 2005 except for MCV coverage in urban survey locations. The "peace dividend" is generally higher in rural than in urban survey locations. We rejected the GAM regression with interaction term because adding it did not improve

the goodness of fit. However, using the simple model without interaction term, we have observed a fairly small but statistically significant decrease of around 1.6 percentage points on average in the post- peace agreement period, independent of whether the survey location is classified as urban or rural.

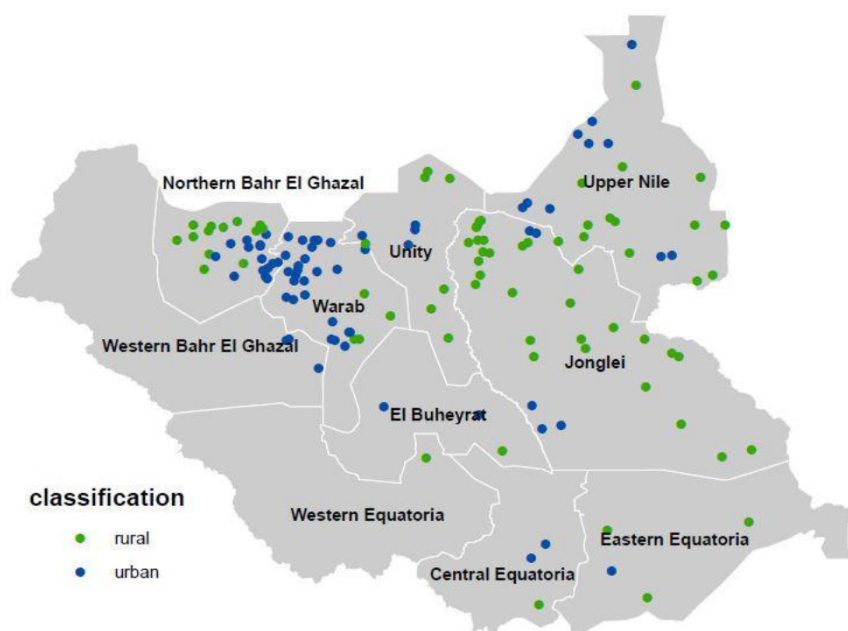**Figure 9: Classification of survey locations**

Table 2: "Peace dividend" (by population density)

		Peace dividend	improvement?
MCV coverage	rural	20.345	Yes
	urban	(insignificant)	-
Under Five Mortality	rural	-3.271	Yes
	urban	-0.143	Yes
Crude Mortality Rate	rural	-1.343	Yes
	urban	-0.096	Yes
Global Acute Malnutrition	global (regression without interaction)	-1.608	Yes

The reduction of GAM is one of the most important objectives of all humanitarian workers. Therefore a 1.6 percentage point decrease in the post peace agreement period is disappointing, especially in a country where malnutrition ranges around an unacceptable 20% in most areas of the country.

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Other indicators such as mortality rates and MCV coverage improved noticeably since January 2005, this mainly in rural areas. Nonetheless, the progress leaves a bitter taste since the situation simply moves from a critical level to a better but still unacceptable one. In fact, given that indicators in urban survey locations only improved slightly, stagnate or sometimes even deteriorated, the catch-up of rural areas seems to be an adjustment to poor urban standards rather than a true improvement.

All that can be said is that after the peace agreement, public authorities and the international community succeeded in avoiding further humanitarian disasters such as those that people in South Sudan experienced in the pre peace agreement period.

Chapter 5: Recommended Priorities for Action

This report presents and analyses data from small- and large-scale surveys undertaken by national, UN or non-governmental organizations. It examines a period of ten years covering the 2005 peace agreement and continuing until 2010. The report also discusses the strengths and limitations of these data sources and the contradictions between them. It explores in depth the three principle human survival indicators – Measles Containing Vaccine Coverage, Global Acute Malnutrition and Under Five Mortality. According to our analysis, we present the main health priorities for action in South Sudan today:

1. Vaccine-preventable diseases - in particular measles - are the top global killers of children living in poverty and are undoubtedly the top killers of children in South Sudan. The MCV coverage in South Sudan, despite national statistics, is most likely to be well below the minimum required WHO threshold of 80%. Our analysis indicates that vaccination policy in South Sudan should not be based on the national statistics on coverage but rather on those reported by local small-scale surveys, which present a more localized and differentiated picture. Furthermore, we note that certain states of South Sudan have performed significantly better than others in the provision of health services and in particular in vaccination delivery. In-depth studies to determine the causes of this variation would be useful for effective policy and resource allocation in the health sector.

2. Global Acute Malnutrition levels have shown some improvement over the last years but only through the elimination of some of the extraordinarily high levels of malnutrition observed between 2000 and 2005. This could be due to either concurrent high child mortality leading to a drop in the prevalence of extreme malnutrition, or due to humanitarian action in those areas with severe food shortages. Humanitarian aid tends to target only those with extreme malnutrition, essentially guaranteeing temporary survival of the children. The food security situation in South Sudan, in our opinion, is structural although it has been persistently addressed through humanitarian aid for several years. We recognize that the country needs on one hand long-term interventions to address the fundamental causes of food shortage and malnutrition. We also recognize that the population needs emergency food aid to contain widespread nutritional crises. Therefore, innovative approaches that combine both strategies into a hybrid humanitarian-development food policy are needed.

3. Child mortality in South Sudan continues to be of serious concern. Mortality levels have not fallen in the last few years and CE-DAT surveys indicate no signs of positive evolution in most regions of the country. Poor understanding of the causes of death is an important barrier to the reduction of mortality in children. Risk factors such as maternal mortality and birth complications would provide invaluable guidance for setting policy for child health programming.

4. Finally, in South Sudan as in many other fragile states, the availability of data is one of the principle obstacles to effective policy setting. National statistics in most cases do not accurately represent the reality and can mislead programming of scarce resources. In South Sudan we have found serious contradictions between national statistics and small-scale surveys, which will need further investigation. The potential for an integrated approach, which combines small- and large-scale health surveys, is significant for data poor situations and should not be overlooked.

This is the time for South Sudan to set the right health priorities for its population and it should do so using all the evidence it can gather.