Food and Agriculture Organization of the United Nations

FAO RESILIENCE ANALYSIS No. 5

RESILIENCE
ANALYSIS
IN
SUDAN

2009

RESILIENCE ANALYSIS IN

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ACRONYMS

ABS	Access to Basic Services
AC	Adaptive Capacity
ADB	African Development Bank
AICD	Africa Infrastructure Country Diagnostic
ARP	Agricultural Revival Programme
AST	Assets
CBS	Sudan Central Bureau of Statistics
CIA	Central Intelligence Agency
CPA	Comprehensive Peace Agreement
DJAM	Darfur Joint Assessment Mission
DTIS	Sudan Diagnostic Trade Integration Study
EA	Enumeration Area
FAO	Food and Agriculture Organization of the United Nations
FHH	Female-Headed Household
FMoH	Federal Ministry of Health
FSIN	Food Security Information Network
GoNU	Government of National Unity
HH	Household Head
IDP	Internally Displaced Person
IFA	Income and Food Access
IFAD	International Fund for Agricultural Development
IMF	International Monetary Fund
INC	Interim National Constitution
IPCC	Intergovernmental Panel on Climate Change
MDG	Millennium Development Goals
MHH	Male-Headed Household
MoFNE	Ministry of Finance and National Economy
NBHS	National Baseline Household Survey
NGO	Non-Governmental Organization
NSP	National Strategic Plan

Acronyms

PPS	Probability Proportional to Size
PRSP	Poverty Reduction Strategy Paper
PSU	Primary Sampling Units
RAP	Resilience Analysis and Policies team, FAO
RCI	Resilience Capacity Index
RIMA	Resilience Index Measurement and Analysis
RSM	Resilience Structure Matrix
RMTWG	Resilience Measurement Technical Working Group
S	Sensitivity
SAC	Strategic Advisory Council
SIFSIA	Sudan Institutional Capacity Programme: Food Security Information for Action
SOED	Sudanese Organization for Education Development
SPLM	Sudan People's Liberation Movement
SSN	Social Safety Nets
SUNA	Sudan Now News Agency
TLU	Tropical Livestock Units
UCLA	University of California, Los Angeles
UNEP	United Nations Environment Programme
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNOPS	United Nations Office for Project Services
USAID	United States Agency for International Development
WFP	Word Food Programme
WHO	World Health Organization

EXECUTIVE SUMMARY

The Republic of Sudan (referred to hereafter as 'Sudan') is the third largest country in Africa, situated in the Nile Valley of North Africa. Although its geographical position features fertile lands and thus an abundance of livestock, the country has been devastated by civil wars intermittently for four decades. Crises in Darfur in western Sudan have led to a major humanitarian disaster, with an estimated 3 million people displaced (Norwegian Refugee Council and Internal Displacement Monitoring Centre, 2015).

While these conflicts are often layered with religious, linguistic and ethnic factors, at their core lays the issue of imbalanced development between the central area of the nation and peripheral regions. Together, the latter are far larger in size (The Joint Outreach Tripartite Committee, 2015). According to the *African Economic Outlook* report (ADB *et al.*, 2015), the poverty rate in Sudan is 46.5 percent nationwide and varies considerably between rural and urban areas (57.6 percent versus 26.5 percent, respectively), and between those who are self-employed (mostly farmers) and wage earners (62 percent versus 41 percent, respectively).

A large part of the country experiences a lack of basic infrastructure, coupled with reliance by much of the population on subsistence agriculture. This keeps close to half of the population at or below the poverty line (UCLA African Studies Center, 2008).

During the past decade, growth was driven mainly by the oil industry, but was accompanied by growing unemployment due to limited investment in non-oil industries and the poor economic environment for private enterprises and self-employed workers (ADB *et al.*, 2015).

The Comprehensive Peace Agreement (CPA) – signed in 2005 between the Government of Sudan and the Sudan People's Liberation Movement (SPLM) – put an end to the civil war and paved the way for unprecedented opportunities for peace, development and prosperity. Together with macroeconomic stability and considerable natural resources, the CPA has offered a tremendous opportunity to increase broad-based economic growth and access to social services for many people (FAO-SIFSIA, 2010).

Taking all this into consideration, reinforcing household resilience for dealing with recurrent and often complex shocks is a key element in poverty reduction interventions. Resilience is defined according to the definition by the Resilience Measurement Technical Working Group (RMTWG):[1] "the capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences" (FSIN RMTWG, 2014).

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[1] The RMTWG has been established under the Food Security Information Network (FSIN): www.fsincop.net/topics/resilience-measurement/technical-working-group/en/

The Food and Agriculture Organization of the United Nations (FAO) has been on the front line of resilience measurement since 2008. Together with other key partners, FAO has been pioneering resilience measurement and analysis with respect to food insecurity through the Resilience Index Measurement and Analysis (RIMA) (FAO, 2015) model. This model has been employed to undertake this analysis of Sudan. RIMA identifies and weighs six pillars of resilience and relating factors that contribute to making households resilient to shocks that affect their food security. It also allows for tracing the stability of these factors over time. The pillars that constitute the RIMA model are: Income and Food Access (IFA), Access to Basic Services (ABS), Assets (AST), Social Safety Nets (SSN), Sensitivity (S) and Adaptive Capacity (AC). RIMA provides evidence in favour of designing, delivering, monitoring and evaluating assistance for populations in need, in a more effective way based on what they need most.

This household resilience analysis of Sudan is based on the National Baseline Household Survey 2009 (NBHS 2009), developed and implemented by the Government of Sudan from May to June 2009. At the time that that survey was designed and carried out, South Sudan had not yet gained independence as a sovereign nation. Thus, the survey was originally intended to collect data from across the regions that are currently officially referred to as the nations of Sudan and South Sudan. However, ongoing conflicts in the regions that now comprise South Sudan meant that no data was collected there during the survey. Given this, and that South Sudan gained independence in 2011 after the NBHS 2009 had concluded, this resilience analysis refers only to present-day Sudan, and does not include any analysis for South Sudan.

This household resilience analysis examines differences in resilience capacity and resilience structure between female- and male-headed households, and between regions. This analysis can be adopted as a baseline to critically review the different policies implemented by the Government of Sudan, in order to suggest targeted policy improvements.

KEY HIGHLIGHTS

1. **Household resilience has been found to be highly influenced by IFA, ABS and AST.** IFA is mainly influenced by household monthly per capita income; ABS is highly correlated to access to electricity, improved toilet facilities and cooking facilities. Concerning AST, agricultural wealth index (agricultural tools, etc.) is by far the most important variable. These three pillars showed the strongest relationship to household resilience, followed by AC and SSN, while S is the least covariated pillar.

2. **There are apparent disparities in resilience capacity between regions.** Households in Khartoum and northern regions, with average resilience scores of 0.37 and 0.33 respectively, are the more resilient areas, followed by households in central and eastern regions (with an average resilience score of 0.25 and 0.23, respectively). Households in Kordofan and Darfur are less resilient (with average resilience scores of 0.19 and 0.18) as in Table A8 (Annex II). Households in Khartoum, northern and eastern regions have better access to basic public services as well as IFA, compared with households in Kordofan and Darfur, where lower indexes for agricultural wealth and wealth are also found.

3. **Minor differences in the resilience score of female- and male-headed household have been found.** However, these differences increase when examining the results for specific factors. Female-headed households are more efficient at allocating budgets for food consumption, while they are less likely to have access to basic services such as electricity.

POLICY IMPLICATIONS

The findings of the analysis are examined in relation to major policy initiatives implemented over the last decade by the Government of Sudan together with other stakeholders.

In 2006, a Strategic Advisory Council (SAC) was established to develop a 25-year development plan for Sudan. The resulting National Long-term Strategic Plan, which will span the period from 2007 to 2031, includes strong references and commitments to the Millennium Development Goals (MDG). Sudan has also launched its Five Year Development Plan (which will span from 2012 to 2016) to serve as a growth-oriented strategy with a primary focus on sustainable development and poverty reduction in the medium term.

In July 2015, the World Food Programme (WFP) launched a new two-year plan in Sudan to provide 5.2 million people by mid-2017 with lifesaving food assistance and nutrition support, as well as recovery and resilience-building activities to help communities become self-reliant. 1.8 million displaced people in Darfur are included in this group receiving assistance (WFP, 2015).

The results of this resilience analysis show the need to focus on developing basic infrastructure and agricultural sectors. The most pressing infrastructure challenges lie in the water and transport sectors. Evidence suggests that considerable effort should be given to the development of rural areas, specifically to improve rural households' access to quality facilities, such as potable water and public electricity. Agricultural land is used very lightly in Sudan, in part because of the inadequacy of roads. Sizeable parts of economically productive areas in Sudan are isolated from the markets. The development of roads is a necessary precondition to realize the agricultural potential of Sudan. Road density in Sudan is among the lowest in Africa and the world, and power infrastructure is developed only in urban centres. Improvements in infrastructure in all parts of Sudan in recent years have had a strong impact on per capita growth, contributing 1.7 percentage points. In the last five years, the Government of Sudan has invested heavily in infrastructure, with some notable achievements (AICD, 2011).

1 PURPOSE OF THE ANALYSIS

This section introduces further background information on Sudan,
in the context of which this resilience analysis was carried out.
This section briefly details the most important periods and events that
have had the strongest impact on the daily life of households in Sudan.

Sudan, geographically the third largest country in Africa, has faced periodic civil wars in various regions since its independence in 1956 (Peace Direct, 2015). Conflicts largely originated from the political, economic, religious and cultural marginalisation of peripheral regions by the central government, given that the offices of regional authorities are located far from the central national government. The 2005 CPA gave a period of apparent peace, and also marked the beginning of the South Sudan independence process. South Sudan then became independent in 2011.[2] However, many tensions attributable to the oil sector remained unresolved between Sudan and South Sudan (DTIS, 2008).

Unfortunately, the CPA remained largely unimplemented in the regions that were most critical, where violent conflicts persisted (CPA Monitor, 2005; Grawert, 2010). Unresolved issues (such as property rights, ethnic conflicts and land tenure) led to serious human rights violations in the southern part of the country, especially in Darfur, south Kordofan and the Blue Nile regions. The most significant violence took place in Darfur, where in 2014 more than half a million people were displaced. Currently, almost 3 million people are displaced (Norwegian Refugee Council and Internal Displacement Monitoring Centre, 2015), and more than half a million of them are living in refugee camps in the region. According to the United Nations High Commissioner for Refugees (UNHCR), about 6.9 million people need civilian assistance in Sudan (UNHCR, 2015).

In addition to these persistent conflicts, Sudan has also experienced severe droughts over the past thirty years. Meanwhile, food production has decreased, accompanied by a more than proportional increase in the population (UNEP, 2007). The effects of the war, together with food insecurity, have further increased the number of both internally and internationally displaced people needing international food aid (UN, 2006, and UN, 2007).

This background, along with the lack of basic infrastructure across a significant part of the country and reliance by much of the population on subsistence agriculture, all contribute significantly to the increased level of poverty in the country (Abdel Gadir Ali, Undated; Faki and Taha, 2007;

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[2]   From 9 to 15 January 2011, there was a referendum to determine whether South Sudan should become an independent country and separate from Sudan. 98.83% of the population voted for independence.

Faki *et al.*, 2010). According to the *African Economic Outlook* report (ADB *et al.*, 2015), the poverty rate in Sudan is 46.5 percent nationwide and varies considerably between rural and urban areas (57.6 percent versus 26.5 percent respectively), and between the self-employed (mostly farmers) and wage earners (62 percent versus 41 percent respectively).

Subsequently, the Government of National Unity (GoNU) (formed in accordance with the CPA), signed an agreement with the African Development Bank (ADB) on 17 April 2007 concerning a project for capacity building for poverty reduction and good governance (CBS, 2010). It was acknowledged that a national baseline household survey should be conducted for all the 25 states in Sudan (at the time of the NBHS 2009, Sudan included present-day South Sudan, which encompassed 10 of these states; South Sudan gained independence in 2011).

The NBHS 2009, the third of such surveys undertaken by the Sudan Central Bureau of Statistics (CBS),[3] was designed to provide information on many aspects of welfare such as educational levels, access to health care, housing conditions, immunization and consumption poverty. The NBHS 2009 was the first to use the sampling framework from the 5th Sudan Population and Housing Census of 2008. It followed an identical methodology across the 25 states (15 states in Sudan,[4] and 10 states in South Sudan) and interviews were carried out in the south from April to May 2009 and in the north from May to June 2009.

The policies implemented in recent years have been aimed at increasing income (especially in order to reduce disparities among regions) and above all at poverty reduction, in particular for those areas where long-running conflicts undermined human development and increased poverty levels (IFAD, 2007; Castro, 2010)

Sudan has been working with the International Monetary Fund (IMF) (IMF, 2010) to implement macroeconomic reforms, including a managed float of the exchange rate (CIA, 2009). Productivity growth is the driver of economic growth, diversification, the creation of productive employment and income growth. Sudan has rich agricultural resources but productivity is very low in the farming and livestock subsectors (Government of Sudan, 2011).

In 2005, the CPA and the adoption of the Interim National Constitution (INC) provided the frameworks for the alignment of resources towards broad-based, sustained development and poverty reduction. The INC and the CPA recognized that the realization of the MDG was a prerequisite for achieving socio-economic stability in Sudan. Since the adoption of the CPA, there has been progress in building the foundation for sustained development with rapid improvements in education, decentralization of government, and improvements in infrastructure. The rapid increase in school enrolments in recent years, particularly in conflict affected regions, is a sign that the people of Sudan are eager to move on and to improve their lives.

Considering this background, households in Sudan faced and continue to face an interaction of multiple stressors including endemic poverty, ecosystem degradation, complex disasters and conflicts, alongside limited access to capital, markets, infrastructure and technology (IPCC, 2007). The degree to which households or individuals can recover from such shocks without compromising their long-term livelihood security is determined by the varying circumstances of each household and their ability to handle these risks. Reinforcing resilience among people to deal with recurrent shocks is a key element to be taken into account in poverty reduction interventions.

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[3]   The first was in 1967 and the second was in 1978.

[4]   The 15 states in Sudan have been aggregated into six geographical zones: northern, eastern, Khartoum, central, Kordofan and Darfur.

As mentioned above, the NBHS 2009 had intended to collect data from states in both Sudan and South Sudan – at the time of the survey being conducted, South Sudan was officially still a part of Sudan. However, ongoing conflicts in South Sudan prevented the successful collection of data from regions in that area, and as such NBHS 2009 does not include comprehensive data for South Sudan. Because of this, this analysis examines resilience in Sudan only, and not in South Sudan.

2 RESILIENCE MEASUREMENT

*This section introduces the FAO resilience measurement framework.
It briefly describes the econometric framework underlying Resilience
Index Measurement and Analysis (RIMA) estimation approach and provides
substantive detail on the construction of particular resilience components
and variables used in the analysis.*

Resilience is a dynamic multidimensional concept that incorporates bidirectional interaction between households and their environments. When data in relation to long periods of time are unavailable, it is possible to conduct a static analysis using a cross-section dataset (see next paragraph for details). This compiles important information about how people actually cope with upheavals instead of focusing only on their vulnerability to the adverse impacts of such upheavals (Almedom *et al.*, 2007).

FAO, through the Resilience Analysis and Policies (RAP) team, defines resilience according to the Resilience Measurement Technical Working Group's definition (FSIN RMTWG, 2014): "the capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences".

RIMA consists of two parts: Resilience Capacity Index (RCI) and Resilience Structure Matrix (RSM). RCI employs the estimated resilience index in order to target and rank the studied population; RSM uses the pillar weights in order to assess which pillars are the most relevant in determining resilience, and the weights of the variables in order to assess which observed variables are the most relevant in determining the related pillars.

The RIMA model estimates the RCI as a latent variable depending on predetermined dimensions, as per Figure 1, the so-called 'pillars'. Resilience, being unobservable (Alinovi *et al.*, 2008), is estimated through a range of pillars: Income and Food Access (IFA), Access to Basic Services (ABS), Assets (AST), Social Safety Nets (SSN), Sensitivity (S) and Adaptive Capacity (AC), see Table 1 for pillars' details.

The estimation procedure consists of two steps. In the first step, the estimation of the pillars takes place. In the second step, the pillars obtained are then employed in the estimation of the household RCI.

Table 1. **Resilience pillars**

	Pillars of resilience	Definition
Physical pillars	**Income and Food Access (IFA)**	These are aspects of a livelihood, showing a household's capacity to earn a living. Examples of indicators include income, Food Consumption Score (FCS) and total expenditure.
	Access to Basic Services (ABS)	Access to Basic Services shows the ability of a household to meet its needs, such as sending children to school, accessing health care, selling products at the market, accessing toilets, water and electricity, and other minimum requirements.
	Assets (AST)	Assets are the key elements of a livelihood, enabling households to produce consumable or tradable goods. Examples of indicators include the Assets index (e.g. agricultural tools), Agricultural Wealth index (e.g. agricultural equipment), Wealth index (e.g. non-agricultural equipment – e.g. car, phone). The indicator is an aggregated measure obtained through principal component analysis used as a proxy for access to productive assets and non-productive assets.
	Social Safety Nets (SSN)	The Social Safety Nets pillar measures the ability of households to access timely and reliable assistance provided by international agencies, charities and non-governmental organizations, as well as help from friends and relatives.[5]
Capacity pillars	**Sensitivity (S)**	Sensitivity measures: (i) the degree to which a household is affected by a shock (i.e. a household deriving a large part of its total income from shock-affected activities has higher sensitivity than others do) and (ii) the degree to which a household has been affected by shocks in the recent past.
	Adaptive Capacity (AC)	Adaptive Capacity is the ability of a household to adapt to a new situation and develop new sources of livelihood. For instance, having multiple sources of income may decrease the negative effects of a shock on a household. The observable variables included in this dimension are education, diversification of income and food ratio.

The pillars, much like the concept of resilience itself, are not directly measurable and are themselves considered latent variables. RIMA employs factor analysis for estimating resilience pillars. Factor analysis allows expressing a set of observed variables, used as proxy for a pillar, as a single variable, the component of interest. A sufficient number of factors have been retained in order to make sure they account for at least 95 percent of the explained variance. Table 2 lays out the number of factors used to construct each pillar during the two-step analyses.

The RCI is estimated through the measurement part of the structural equation models, in order to check for any correlation between the residual errors of the pillars.

In accordance with the above-mentioned procedures, the following model has been estimated to perfectly fit the observed variables.

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[5] See Annex I for details – Background to Social Safety Nets (SSN).

Table 2. **Resilience variables and factors**

Pillars of resilience		Variables	Factors
Physical pillars	**Income and Food Access (IFA)**	Per capita income Per capita expenditure Per capita calories consumption	2 factors
	Access to Basic Services (ABS)	Household Facilities Index[6] Distance to water	2 factors
	Assets (AST)	Tropical Livestock Units (TLU) Land Agricultural assets Wealth index[7]	2 factors
	Social Safety Nets (SSN)	Transfers from the government, transfers from NGOs, transfers from other sources (private or public)	1 factor
Capacity pillars	**Sensitivity (S)**	Losses due to crop shocks Livestock shocks Other shocks	1 factor
	Adaptive Capacity (AC)	Dependency ratio Education Income diversity source	1 factor

Figure 1. **Resilience Index and pillars**
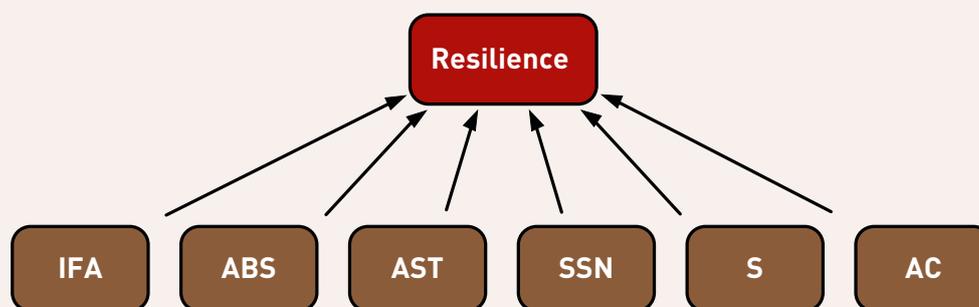
This model satisfies every goodness of fit test and perfectly represents the underlying structure of the observed variables.

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[6] Household Facilities Index is created through factor analysis. A list of variables is used assuming value 1 or 0 depending on whether or not a household has a certain facility. Examples include electricity, toilets, etc.

[7] Wealth index is created through factor analysis. A list of variable is assuming value 1 or 0 is used, depending on whether or not a household has a certain non-agricultural asset. Examples of assets include owning a car, a telephone or a moto.

2.1 SHORT-TERM VS LONG-TERM DATA

The availability of short-term or long-term data influences the analytical capacity of RIMA (as well as any other measurement tool). The basic difference between the short-term and long-term data is in the structure of the data itself.

Cross-sectional data are short-term data, meaning they involve multiple individuals or households with multiple sets of information at the same time. With cross-sectional data, it is not possible to analyse the dynamic of an event along a specific timeframe. Resilience analysis using cross-sectional data provides information on a specific period of time and helps with classifying households within different resilience classes. It is also possible to compare the RCI with the resilience index matrices among different household categories (e.g. female household head vs male household head, household living in urban area vs household living in rural area) or even regional differences. When comparing the RCI among different categories it is also possible to analyse the relationship between resilience and the level of food security in such regions.

Panel data or longitudinal data are long-term data, meaning the same individuals/households are interviewed with a complex questionnaire at different moments in time. Through a panel dataset it is possible to study the dynamic of resilience over time and the dynamic relationships between resilience and shocks, food deprivation and poverty. It would also be possible to investigate how households choose between consumption and asset smoothing strategies. The main difference between cross-section analysis of resilience and dynamic analysis of resilience is that in the first case there is a **static** assessment, while in the second case the analysis is **continuous** and it is possible to study how the data relationships evolve over time.

This report is focused on a static analysis of Sudan, exploring resilience capacity and structure in 2009. In order to carry out further analysis (such as a dynamic analysis) it would be necessary to employ panel data. If a new survey could take place, it could be employed in studying changes in resilience capacity. Although it would be highly unlikely that the same households could be interviewed again to create a new dataset, it would be still possible to compare the two datasets by adopting synthetic panel (Lanjouw and Dang, 2013) techniques.

3 DATA

*This section describes the data included in the analysis for the
National Baseline Household Survey 2009 (NBHS 2009), and the reasons
why these data were suitable to be incorporated into this study.
The limitations of these data are also explored.*

Following the CPA, Sudan Statistical Agencies[8] collaborated on the collection of a wide range of information for supporting the decision-making process for policy creation at the national or state levels.

The NBHS 2009 was the first survey to use the sampling framework from the 5th Sudan Population and Housing Census of 2008, following an identical methodology across 25 states (15 states in Sudan and 10 states in South Sudan). Fieldwork was carried out in the south in from April to May 2009 and in the north from May to 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. That data was 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 national decision-making platforms dedicated to the fight against food deprivation in Sudan.

The survey was conducted by the CBS and the Ministry of Finance and National Economy (MoFNE), in collaboration with the ADB and FAO.[9]

> *"The NBHS 2009 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)."*
>
> (FAO-SIFSIA, 2010)

The sample selected for the NBHS 2009 was based on a stratified two-stage sampling design using the 5th Sudan Population and Housing Census of 2008. The sampling framework was based

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[8] The Sudan Statistical Agencies were established as semi-autonomous agencies responsible for coordinating, monitoring and supervising the National Statistical System. The CBS is responsible for Sudan, while the Southern Sudan Centre for Census, Statistics and Evaluation (SSCCSE) is responsible for South Sudan.

[9] The survey was conducted through SIFSIA, funded by the European Commission and Statistics Norway.

on the preliminary count of households by enumeration area (EA) and the census cartography of the 5th Sudan Population and Housing Census of 2008. The primary sampling units (PSUs) were the EAs, which are census operational segments identified on maps. For the NBHS 2009, 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 selected in order to obtain 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 sample size is 528 households 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 5th Sudan Population and Housing Census of 2008 results. A few sample EAs could not be enumerated because of security issues or other problems of accessibility, in which case they were replaced by random EAs within the same geographic area. A new listing of households was conducted in each sample EA to provide the sampling frame for the second stage. Then 12 households were selected systematically with equal probability from the listing for each sample EA. Each of the non-interviewed households was substituted by a pre-selected, random replacement household in order to maintain the effective sample size (SIFSIA, 2009). The survey has detailed information on household demographics and livelihoods strategies, asset ownership, health, education and credit facilities, household transfers, housing, shocks, consumption and agriculture. Food consumption, derived from their own production and stock, purchase, gift or other sources, was recorded based on a recall period for "the last seven days" prior to the survey period.

For the analysis, quantities of food consumption reported in local units are converted into standard units (kilograms) and imputed values are calculated using the price data collected in parallel with survey periods. The quantity of consumption is also converted to calorie consumption based on calorie conversion factors and estimates defined by the World Health Organisation (WHO) and FAO. The total size of land cultivated and livestock owned by households are converted to hectares (abbreviated as 'ha') and Tropical Livestock Units (TLU), respectively. The survey also reported estimated values of total size of land cultivated and livestock owned, as well as for durable assets. Annual income is calculated as the sum of imputed production values, income from wage employment, salaries, gift and remittance, among others. All data were aggregated at the household level for the analysis.

3.1 LIMITATIONS OF THE ANALYSIS

The period of survey fieldwork during April to May 2009 coincided with a sharp rise in instability in many parts of the southern states. The upsurge in conflict prevented access to some areas and required the Sudan Statistical Agencies, on occasion, to evacuate their field staff. Replacement EAs from a pre-drawn, random set of replacements were assigned in case of inaccessibility due to these conflicts. 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.

The survey was conducted over a relatively short period of time, so it does not consider variations due to seasons or to income over a longer period of one full year. Thus, results represent the situation during this particular period. As in all large-scale field activities in Sudan, the necessary logistics and the constraints associated with poor infrastructure accounted for a significant

proportion of the effort required to carry out the survey. The lack of standardization of local units made measurements difficult at times, for example for food consumption. A market survey, conducted at the state level, provided specific conversion factors for the non-standardized measurement units.

The analysis featured in this report captures the contribution made to resilience by different dimensions and variables at that specific moment. Additionally, because data collected during the NBHS 2009 was insufficient for regions in South Sudan (which at the time was a part of Sudan; South Sudan gained independence in 2011), this analysis explores resilience in Sudan only.

4 RESILIENCE ANALYSIS

This section provides the resilience analysis results.
It first describes the resilience capacity and structure
of Sudan at the national level, spelling out the relevance of each pillar
in explaining the RCI. Then, it presents the results, disaggregated
by location of household, region and gender of the household head,
identifying existing differences in resilience capacity and
structure between various social groups.

This section presents the results of the resilience analysis. First, it analyses the pillar and variable contribution in determining, respectively, the RCI and the RSM at the national level. Then, it presents the analysis of resilience capacity disaggregated by gender of household heads and regional location in order to detect and explain potential differences in resilience between different household profiles (by looking at the average pillars scores and the mean values of observed variables).

This section aims to identify the differences in resilience capacity between social groups and to isolate the more relevant pillars, as well as to identify variables determining such disparities. Knowing the socio-economic profiles of the least and the most resilient households is of crucial importance for shaping proper policies aiming to increase resilience capacity.

4.1 ANALYSIS AT THE NATIONAL LEVEL

The RCI[10] presents two major peaks,[11] meaning that there exist two large concentrations around two different values of the RCI itself (Figure 2). This means that the households' RCIs are not concentrated around one area, but instead in two specific areas on the graph.

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[10] For detailed information about RCI estimates and test, see Table 3: Resilience regional distribution.

[11] The distribution of data in statistics can have one peak or several peaks. The most common distribution is the normal distribution, which has one peak. A less familiar type of distribution is bimodal distribution, which has two peaks. The peaks that are present in any distribution are the recurring number. The two peaks in a bimodal distribution also represent the two most recurring numbers (e.g. two local maximums); these are those values where the data stop increasing and start decreasing. Usually, having two peaks means there are two different groups (Behboodian, 1970).

Figure 2. **Resilience distribution in Sudan (2009)**
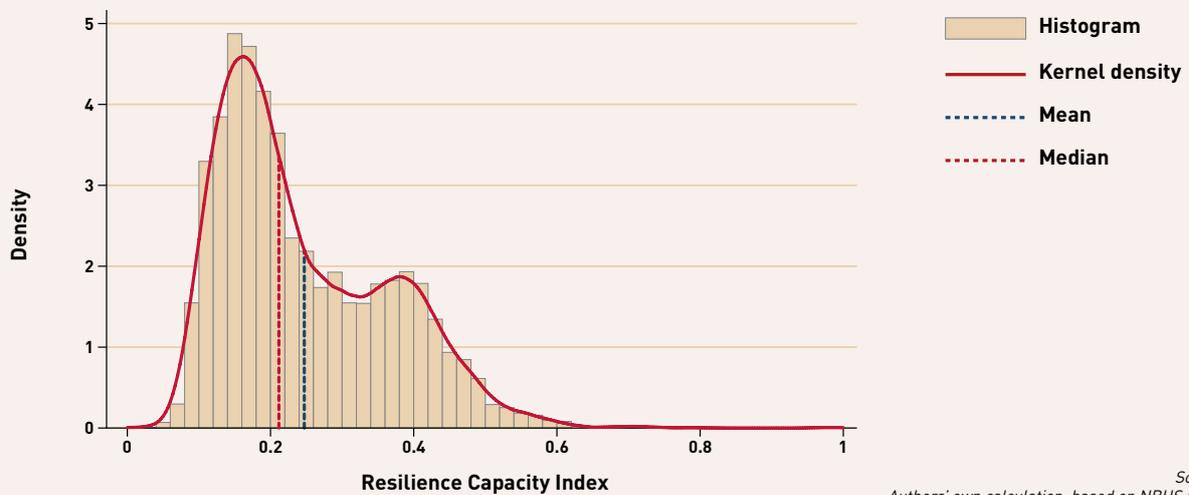
A specific group of households is concentrated on a very low RCI, while the other one is concentrated around a higher value. From the analysis of this distribution, it is apparent that the households around a lower RCI are those concentrated in the Darfur and Kordofan areas, while those households around the higher RCI are those residing in the central area. A detailed description of the findings can be found in paragraph 4.2 Resilience at the region.

Looking at figure 3, pillars that appear to be most closely associated with the RCI are AST and ABS, followed by IFA. S and SSN appear to be of minor importance, while AC is the least important.[12]

Figure 4 shows the variable weights in determining each pillar.

In terms of AST, agricultural wealth index (agricultural tools, etc.) is by far the most important variable.

Looking at ABS, having access to electricity, improved toilet facilities and cooking facilities play the major role.

For IFA, per capita monthly expenditure is the most relevant variable, followed by monthly per capita income and daily caloric intake.

With regards to the other pillars, which nevertheless show a minor importance, two factors contribute the most to the importance of AC: having a diversified income portfolio, and having more workers than dependants residing within the households. The role of public transfers is of major importance for SSN. Finally, the loss of money due to shocks affecting livestock and crops are the most relevant determinants of S. Drought, flood, crop diseases, pests, and the death or theft of livestock are among the most common shocks reported by households. Individuals living in rural areas are much more likely to experience all three of these shocks.

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[12] The interpretation of factor loadings is not straightforward; it can be certainly said that higher factor loading means greater impact on the actual value of the RCI. The typical weakness of latent variable models is that it is not possible to draw strict conclusions, like under a regression framework. While the Betas estimated from a regression can be employed to say that every unit of increase in regressors translates in Beta increase/decrease of the outcome, the same does not apply to latent variable models. What can be concluded from SEM coefficients is the actual contribution of components to the RCI. This means that the estimated coefficients explain which components contribute more than the others to the index.

Figure 3.   **Resilience structure - Loading of factor (SEM) in Sudan (2009)**
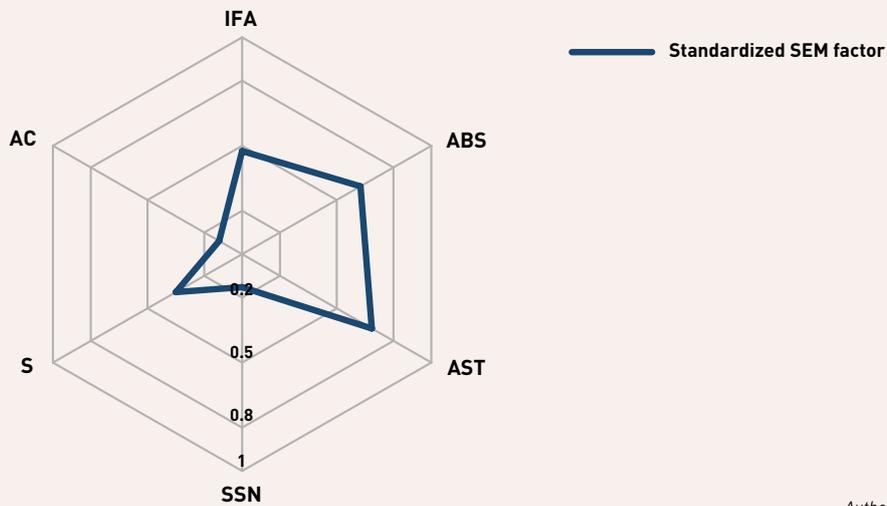
Source:
Author's own calculation, based on NBHS (2009)

Figure 4.   **Resilience structure - Variable weights by pillar in Sudan (2009)**
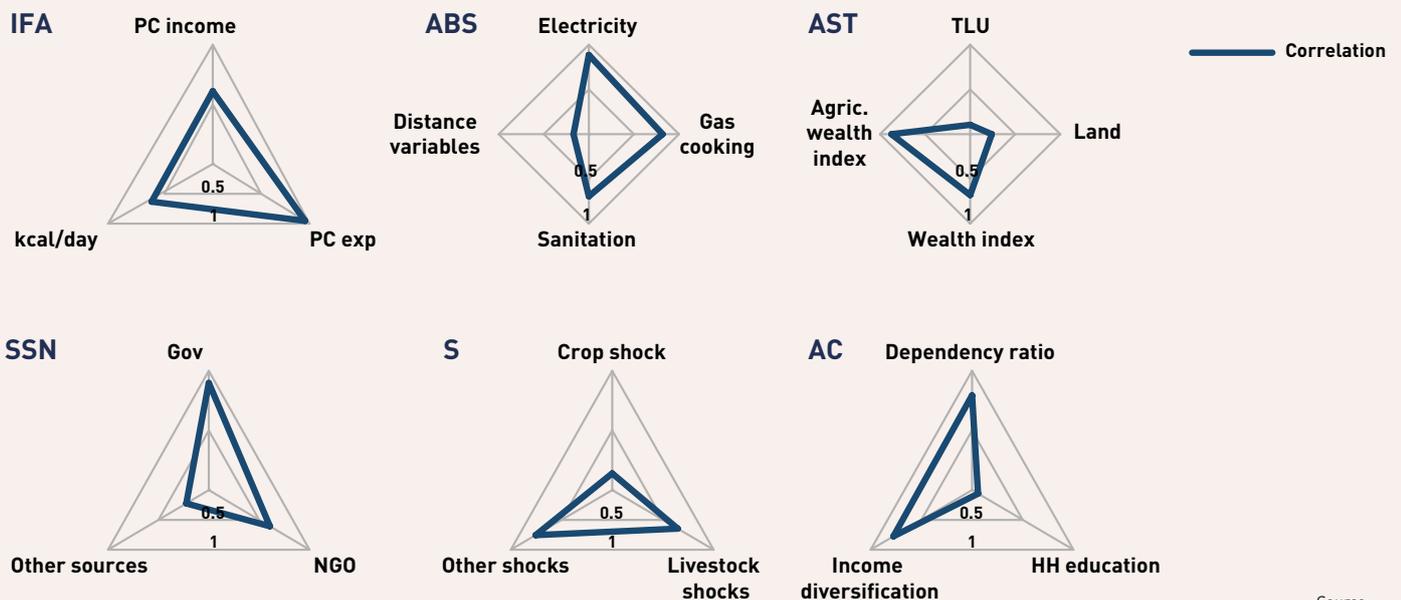
Source:
Author's own calculation, based on NBHS (2009)

In conclusion, the most relevant variables for the RCI are: agricultural wealth index, access to electricity, access to toilet facilities, access to cooking facilities and per capita expenditure. The importance of these variables suggests that interventions in infrastructure and policy to improve the level of income generated from agriculture would be beneficial. In fact, the most important policies that have been adopted by the Sudanese Government are pursuing such outcomes (AICD, 2011).

4.2 RESILIENCE AT THE REGIONAL LEVEL

The analysis at the national level showed that the RCI was apparently divided into two major groups (see Figure 2). Almost the majority of households are concentrated around a low value of the RCI (see the last row of Table 3).

It seems like the RCI distribution may be attributable to regional differences (when examining only statistics around the two peaks).

Table 3. **Resilience regional distribution in Sudan (2009)**

Region	First peak		Second peak	
	Mean	# Obs	Mean	# Obs
Northern	0.25	158	0.43	449
Eastern	0.20	879	0.44	269
Khartoum	0.26	50	0.44	219
Central	0.20	936	0.41	513
Kordofan	0.18	727	0.41	81
Darfur	0.17	1098	0.40	128
Total	0.20	3848	0.51	1659

While the most resilient households are more concentrated in the central (with the Khartoum area) and northern regions, the least resilient regions are not surprisingly Darfur (northern Darfur, western Darfur and southern Darfur) and Kordofan (northern Kordofan and southern Kordofan) (see Table 4 below).

Table 4. **Darfur - Kordofan mean Resilience Index in Sudan (2009)**

Sub region	Resilience
Northern Darfur	0.17
Western Darfur	0.19
Southern Darfur	0.20
Northern Kordofan	0.20
Southern Kordofan	0.19

Figure 5 supports the above-mentioned, i.e. that the most resilient households are those situated in the Khartoum region, followed by the central region (which comprises the Al-Gezira, White Nile, Sinnar and Blue Nile state) and the northern region (which comprises the northern and River Nile states) (see Table A7 for regional pilars' statistics).

This finding is in line with World Bank Sudan Overview (2009), which reported that poverty incidence in north Darfur is approximately three times that of Khartoum and more than twice that of the River Nile region (World Bank, 2009). In showing these regional disparities, the RCI reflects poverty distribution; the poorer a household is, the less resilient it is, as in Figure 5.

Figure 5.   Capturing regional effects in Sudan (2009)
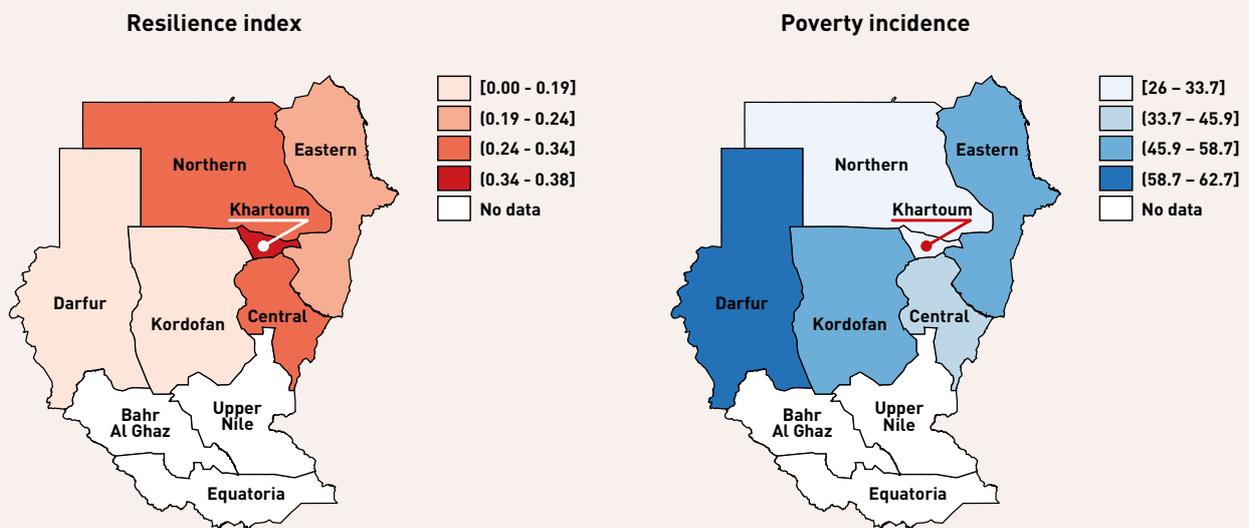
Source:
Authors' own calculation, based on NBHS (2009)

The RSM shows different patterns in each region (Figure 6).

Figure 6.   Regional disparities in the resilience structure in Sudan (2009)
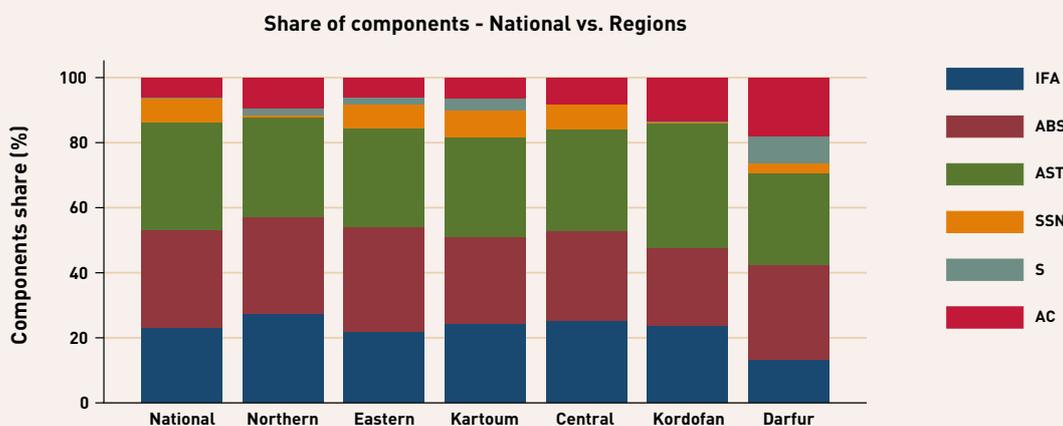
Source:
Authors' own calculation, based on NBHS (2009)

The most important pillars common to each region are AST, ABS and IFA. The relevance is not exactly the same in each region, but it's always high.

The relevance of AST is almost homogeneously important in each region (Figure 6). However, when looking at Table A5 (in Annex II) it is possible to disentangle the different assets owned by households, which explain why the RCI is lower in Darfur and Kordofan. The wealthiest regions have a higher agricultural wealth index and wealth index. Even if Darfur and Kordofan possess more animals (in terms of TLU)[13] and more hectares of land, indeed possessing few agricultural tools reduces their productivity and actually makes them more sensitive to shocks. Looking at the average loss from shocks, Kordofan and Darfur are the two that recorded the most significant loss of money.

Being situated close to the capital, Khartoum, and having access to electricity or toilet facilities help households to be more resilient (especially in the central region and Khartoum). Conversely, being situated far from Khartoum and having limited access to any kind of facilities together result in a low RCI score (such as in Darfur and Kordofan).

Kordofan and Darfur are the two regions with higher food insecurity, showing also a lower per capita income and a lower per capita expenditure. This can explain why the importance of IFA is relatively high in those regions (it contributes to creating a lower RCI). Meanwhile, the opposite scenario takes place in the relatively wealthier regions, where the consumption of daily calories is relatively high and the per capita income is higher in comparison to critical regions. This helps to make households in those regions more resilient than others.

The role of AC is marginal, suggesting the need for intervention is this area. One of the main problems in Sudan, especially in the critical areas, is that not everybody has access to school. Over the last few years, many Sudanese non-governmental organizations (NGOs) are working towards improving access to education in Sudan. The most important of these organizations is the Sudanese Organization for Education Development (SOED), which places its major focus on basic education.

In conclusion, the most relevant variables for the RCI at the regional level are the agricultural wealth index, access to electricity, access to toilet facilities, cooking facilities and per capita expenditure (those variables that make AST, ABS and IFA the most important pillars). The importance of these variables suggests interventions are required not only at the national level, but also at the regional level, especially in areas where the situation is exacerbated because of years of conflict. In addition to the aforementioned policy about infrastructure, United Nations agencies and NGOs, together with the Sudanese Government, are coordinating the implementation of the UN and Partners Work Plan for 2013 for Sudan (UN, 2012). The main goals of this project are to promote and facilitate durable solutions, to empower people and communities by reducing aid dependence, and to build the capacity of national actors to address humanitarian needs in Sudan.

FAO is also on the front line of addressing these issues in Sudan, with projects dealing with sustainable agriculture, food security and nutrition. This is especially so in West Kordofan State, where technical assistance to support food security and livelihoods is being provided, and in the Darfur region to support the recovery of livelihoods of vulnerable pastoralist and agropastoralist households.

The most important policies adopted jointly by the Sudanese Government and other stakeholders, also at the regional level, are aimed at achieving objectives in the same vein of these findings.

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[13] Tropical Livestock Units is a universally adopted uniformed measure of livestock ownership.

4.3 RESILIENCE INDEX BY GENDER WITHIN REGIONAL DIFFERENCES

Female-headed households (FHHs) are more concentrated in the regions of Darfur and Kordofan, with a presence of 20.47 percent and 13.76 percent respectively (see Table 5 below for details).

Table 5. **Percentage of female household heads in Sudan (2009)**

Region	FHH (%)
Northern	8.62
Eastern	4.86
Khartoum	8.92
Central	6.87
Kordofan	13.76
Darfur	20.47
Total	10.47

Although FHHs at the national level are only 10.5 percent of the sample, they still statistically suffice to draw reliable inferences about resilience patterns (see Annex I for details).

RCI, at the national level, is on average higher for male-headed households (MHHs) than for FHHs (see Figure 7 below for RCI average and Table A6 for gender pilars' statistics).

Figure 7. **Resilience Capacity Index over HH gender in Sudan (2009)**
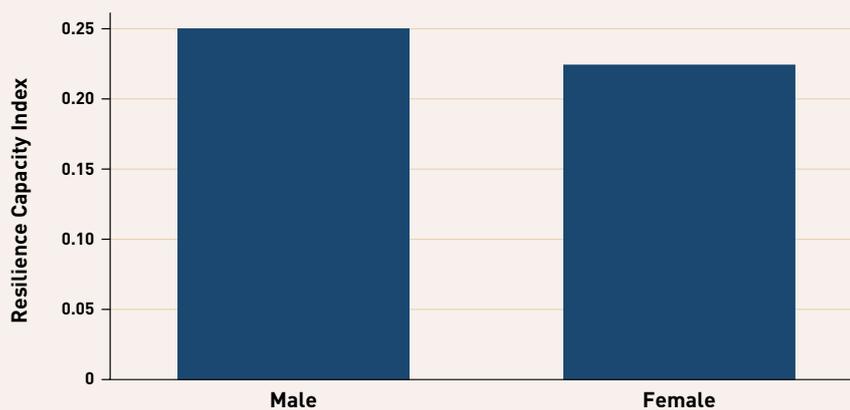
Source:
Authors' own calculation, based on NBHS (2009)

Almost the same pattern exists at the regional level. Figure 8 below shows regional differences in the RCI by household head gender. Despite the difference in resilience, FHHs are almost less resilient all the time, except in the eastern region. The worse situation is in the Darfur area, where FHHs registered the lowest RCI.

Figure 8. **Resilience Capacity Index over HH gender, by region in Sudan (2009)**

Resilience over HH gender by region
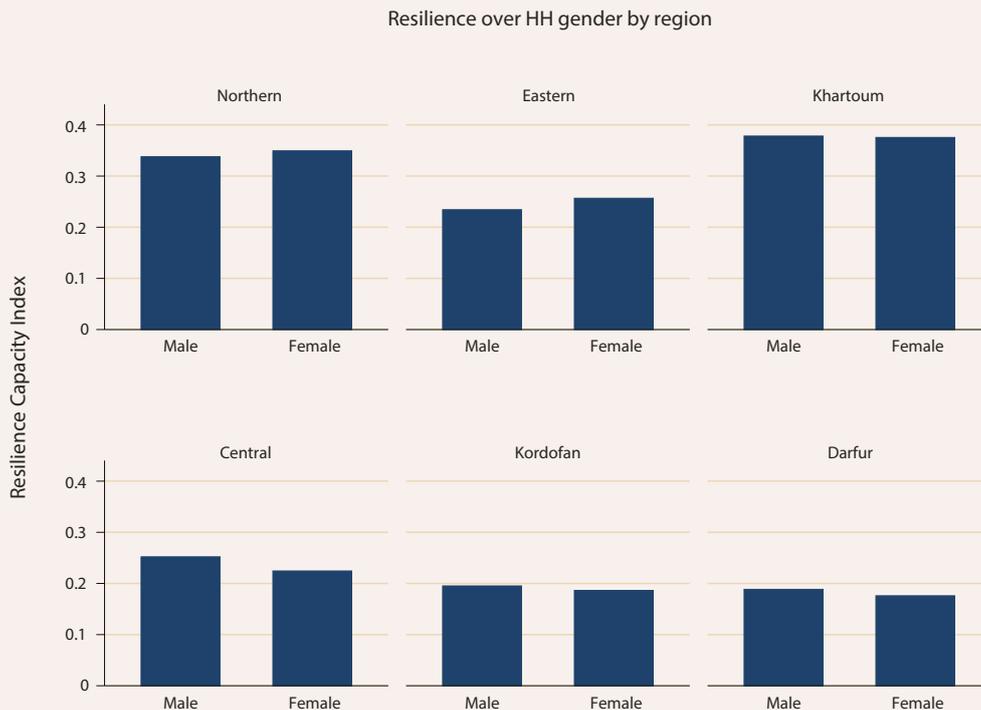
Source:
Authors' own calculation, based on NBHS (2009)

Differences are also present in the RSM – see Figure 9.

As for the national level analysis, when considering gender differentiation the most important pillars are AST, ABS and IFA.

While MHHs follow the national structure, major differences are found in the FHH structure matrix.

AST constantly plays a relevant role for both FHHs and MHHs. However, FHHs report lower average values in all components (TLU, land owned, wealth index and agricultural wealth index). This means that the lack of assets (agricultural and non-agricultural) has contributed most significantly to the final low resilience score.

ABS is also constantly relevant for both FHHs and MHHs (with the exception of Khartoum and the eastern region) and FHHs report significantly lower access to every basic service, especially as there are greater distances involved to access water and much lower access to improved sanitation and electricity (see Table A4).

Concerning IFA, the importance for FHHs is lower compared with MHHs and at the national level in general. Even if FHHs report better scores in daily per capita caloric consumption and total per capita expenditure, the situation is the opposite for per capita income. Indeed, the income registered is lower. Given the results in Table A4, it could be said that FHHs are more efficient than MHHs in overcoming their lower income for the sake of budget allocation for food consumption, especially given that they experience a greater monetary loss due to shocks. Similar conclusions can be found in Ibnouf (2009).

Figure 9. **Resilience Structure Matrix - Share of components at gender and national level in Sudan (2009)**
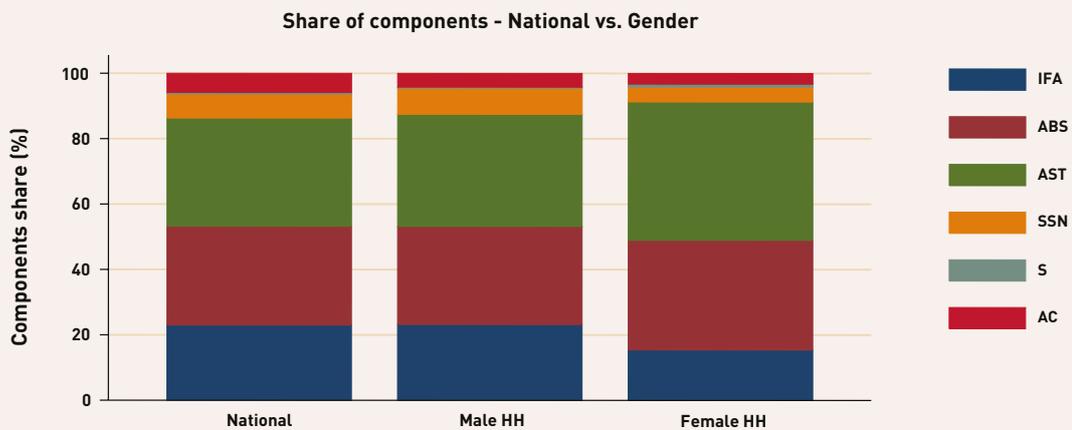
Source:
Authors' own calculation, based on NBHS (2009)

Figure 10. **Resilience Structure Matrix - Gender differences over regions in Sudan (2009)**
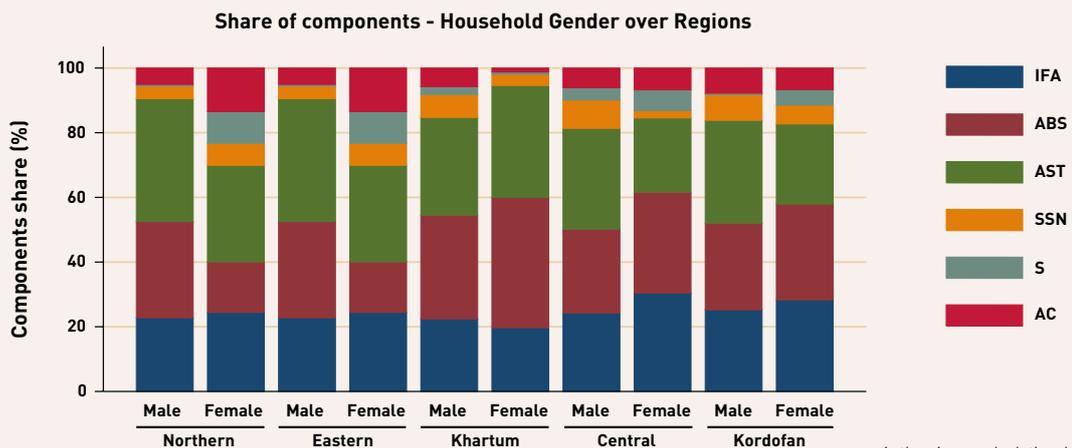
Source:
Authors' own calculation, based on NBHS (2009)

Also at the regional level, the most important pillars for both MHHs and FHHs are AST, ABS, then IFA. As the analysis moves from central to peripheral regions (such as Darfur and Kordofan), distance variables and access to basic infrastructure become more important, especially for FHHs (see Figure 10).

The analysis shows that the situation for FHHs is worse than that for MHHs. Indeed, gender inequality issues emerge, especially in critical regions like Darfur and Kordofan. In fact, according to the United Nations Development Programme (UNDP) (UNDP, 2013), Sudan ranks 128 out of 146 countries for gender equality, with extreme disparities across the country.

The constant conflicts and displacement, especially in the Darfur area, have exacerbated socio-economic indicators and increased gender disparities by cutting off livelihood opportunities and access to basic services. According to *Forced Migration Review* (Adam, 2009), women comprise the majority of Sudanese international displaced persons (IDPs) and refugees, mostly settled in the Darfur area. In several refugee camps, women make up about 90 percent of the adult population (USAID, 2004). As a result, women and children are among the most vulnerable groups in Darfur and protection concerns, particularly for female IDPs, are huge.

Looking at Table 6, the majority of FHHs in the Kordofan area are headed by a widow, while FHHs in the Darfur area are headed by a married woman. The percentage of FHHs that are headed by a divorced woman, together with those headed by a woman who has never been married, is very low.

Table 6. **Female household heads marital status at regional level in Sudan (2009)**

Region	Never Married (%)	Married (%)	Widowed (%)	Divorced (%)
Northern	11.00	27.50	52.70	8.80
Eastern	5.20	24.70	55.80	14.30
Khartoum	0.00	42.60	36.20	21.30
Central	3.40	33.80	43.40	19.30
Kordofan	4.80	40.70	44.80	9.70
Darfur	1.50	52.30	32.20	13.90

Considering only the FHHs in Kordofan and Darfur, Table 7 shows the percentage of male spouses who have been far from the household in the last twelve months.

Table 7. **Female household heads status in Sudan (2009)**

Region	Male spouse outside the households (%)
Kordofan	6.15
Darfur	30.77

This presumably means that the husbands of women who head FHHs are away from the household for employment reasons.[14] This is an important distinction in order to observe the differences between households that can still rely on remittances from abroad and those that cannot. It is also interesting to check the total number of children living in the FHHs, taking into account regional differences.

Table 8.   **Total number of children less than fourteen in female headed households in Sudan (2009)**

Region	Obs	Mean	Min	Max
Northern	91	1.30	0	7
Eastern	77	1.21	0	6
Khartoum	47	1.45	0	6
Central	145	2.00	0	8
Kordofan	145	2.19	0	8
Darfur	324	2.29	0	9

Figure 11 shows the predicted RCI related to the number of children in the households at the national, Kordofan and Darfur levels. This takes into consideration the gender of household heads and the differences in poverty status between the households.[15] Having more children decreases the index, especially for FHHs.

Figure 11. **Relation Resilience Capacity Index/Number of children in a household, controlling for poverty status in Sudan (2009)**
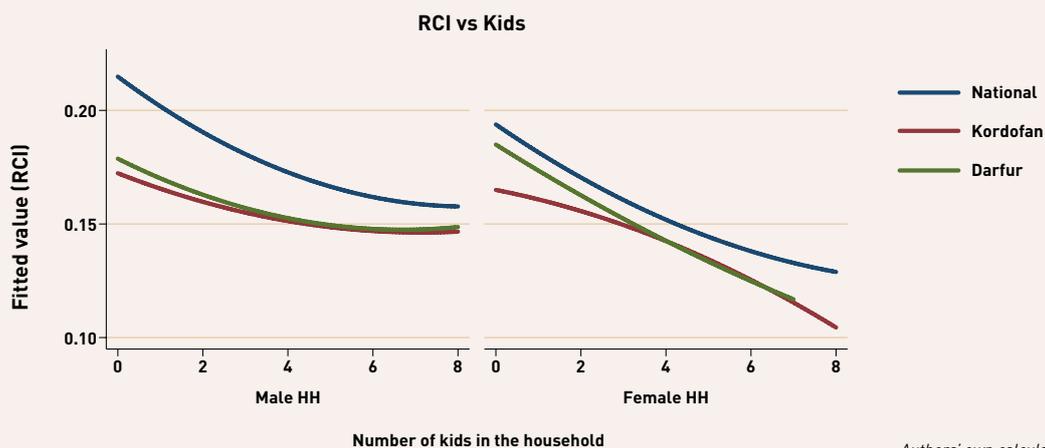
Source: Authors' own calculation, based on NBHS (2009)

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[14] Unfortunately, data limitation means it is not possible to establish if husbands are outside the country, or still within the country but in other regions.

[15] Poverty is a dummy variable, having value 1 if the household is below the third decile of per capita income and zero otherwise.

Looking at the Figure 11, having more children causes an almost exponential drop in the RCI, especially in the Kordofan and Darfur areas.

This piece of information is important in the targeting process for policy interventions. In fact, it is highly recommended to address FHHs with a large number of children, supporting them with interventions on infrastructure, and broadening their employment opportunities and income sources.

In particular, young people and FHHs of a bigger size should be targeted with social protection projects in order to help them with recovery in the long term.

Furthermore, in January 2012 the Federal Ministry of Health (FMoH) and WHO started to develop the program, the Darfur health profile, within the Darfur Joint Assessment Mission (DJAM). They also began to establish the financial resources required for development needs in social areas and infrastructure.

Since 2011, the United Nations Children's Fund (UNICEF) is promoting primary health care systems, leading water, sanitation and hygiene improvement initiatives, and supporting access to education and community based management.

5 MAIN CONCLUSIONS FROM THE ANALYSIS AND POLICY IMPLICATIONS

This section summarizes the main findings of the resilience analysis, provides final assessments and delivers relevant implications for policy design and implementation.

Household resilience to food insecurity in Sudan was examined based on the NBHS 2009, covering a nationally representative 7,918 households drawn from 15 states in 6 regions. The RCI has been calculated using six pillars: IFA, ABS, AST, SSN, S and AC.

The rationale for this analysis is to provide stakeholders with a good understanding of the situation in that year, and to serve as a basis for a possible future analysis that employs more recent data.

The relevant pillars of resilience are IFA, ABS and AST.

There is a significant divide in the resilience capacity of households among regions. In particular, Khartoum and the northern region show the most resilient households, while Darfur and Kordofan score the lowest in terms of resilience capacity.

The major differences in resilience capacity between MHHs and FHHs can be attributed to a different ABS, AST, and lower income.

Resilience related policy indications could be drawn from this report. Households in Khartoum, and the northern, central and eastern regions are better off in terms of access to basic facilities as well as income and food access.

The difference in the resilience scores between MHHs and FHHs is statistically significant. FHHs are more efficient in allocating budgets for food consumption than MHHs; FHHs have a lower income and experience more significant losses, but they maintain a better food consumption. However, FHHs are less likely to have access to basic services such as electricity, among others. These services may be costly for FHHs as their average monthly income is less than that of MHHs.

Because the household RCI is mainly influenced by household income and food access – which in turn are the consequances of household expenditure, calorie consumption and income – the promotion of income-generating activities is the most important policy instrument in the effort to improve household resilience.

In rural areas, where more than 70 percent of the Sudanese population is located, policy should be geared towards agricultural intensification that will enhance production and the productivity of

households. This includes the use of improved technologies and investment in irrigation schemes (infrastructure).

Sudan's growth process has been imbalanced, with the majority of its businesses and irrigated land concentrated in the area around the capital and with a huge disparity in development indicators between the best and worst performing regions. Outcomes from the NBHS 2009 confirm that the major challenge facing Sudan's progress towards the MDG is the massive inequality in outcomes and access to services (Table A4 and Table A5).

Better irrigation systems could help to diversify income sources from high value crops and increase the household RCI. Moreover, the provision of credit incentives with the aim of increasing agricultural productivity of local farmers could help to improve the average household income, and thus have a positive effect on resilience and food insecurity.

The communities in rural areas and in the Kordofan and Darfur regions have less access to basic services; the provision of education and health, electricity and solid waste disposal services, among others, are important in those areas as these services represent both an ends and a means of economic development (UNEP, 2002).

In general, broad-based development strategies are important for per capita income growth. These strategies can help to achieve sustainable growth, because they imply diversification of the economy as well as participation of the broadest range of Sudanese households in the development process.

These strategies could initiate agricultural development and raise rural income by increasing agricultural productivity. The use of new technologies, like fertilizers, can result in high agricultural output, while introducing a better storage system for harvested crops could help to increase agricultural production.

Indeed, the development of physical infrastructure has begun in recent years. The Dams Rehabilitation Construction project is being implemented by the United Nations Office for Project Services (UNOPS). By the end of 2011, the United Nations Environment Programme (UNEP) had provided project brokering and environmental screening for 11 dam repair projects. The project was also implemented by the Agricultural Revival Programme (ARP) 2008-2011, a plan to achieve this implemented by the Sudanese Government, which aimed to improve water harvesting through the:

➤ construction of 1000 dams;
➤ construction of 5000 hafirs;[16]
➤ installation of 750 filters.

The area of intervention also involved improvements to agricultural production. For the Agricultural Development Strategy, as part of the Agricultural Revival Programme, achieving growth and rural poverty alleviation was centred on enabling and assisting small-scale producers to move out of subsistence agriculture towards market-oriented agriculture. The objectives of the strategy include higher agricultural exports, increased productivity, improved food security and agricultural incomes, reduced rural poverty, and redressed regional imbalances.

Concurrently with the policies for agricultural development, the Interim Poverty Reduction Strategy Paper (IMF, 2013) initiative was conceived as one instrument to elaborate a new direction for governance, socio-economic development and poverty reduction strategies in Sudan. Concerning socio-economic development, progress has been made in rehabilitating infrastructures damaged by conflicts.

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[16] Earth excavation that is seasonally filled with water for domestic use and as drinking water for livestock.

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All links were checked on February 19th 2016.

ANNEX I

BACKGROUND TO SOCIAL SAFETY NETS (SSN)

The SSN pillar measures the ability of households to access timely and reliable assistance provided by international agencies, charities and NGOs, as well as to access help from friends and relatives. Normally the government or NGO transfers are given to those households that need help the most. To reinforce this, the following table shows the correlation matrix between income and transfers.

Table A1. **Anti-image correlation matrix income vs transfers in Sudan (2009)**

	Per capita income	Governmental transfers	NGO transfers	Other transfers
Per capita income	1			
Governmental transfers	-0.035	1		
Ngo transfers	-0.027	0.157	1	
Other transfers	0.044	0.024	-0.009	1

The correlation matrix is normally used to check the adequacy of the variables to include in factor analysis.

From Table A1, it's clear that those households receiving public transfers are those that register low income. As a result, correlation is negative between per capita income and governmental transfers, and between per capita income and NGO transfers.

Examining the next table (Table A2), it is clear that households in the first income quintile are those that receive more public than private transfers, while for those in the fifth quintile the situation is exactly the opposite.

Table A2. **Transfers vs income quintiles in Sudan (2009)**

	Income	
	I quintile	V quintile
Per capita gov. trans. (US $)	3.148	1.609
Per capita NGO trans. (US $)	2.284	1.170
Per capita other trans. (US $)	0.411	1.811

According to the logic of the latent variable models, all the variables used in the construction of an index require a positive relation. Namely, it is possible through the correlation matrix to find all those variables that are a manifestation of the same underlying variable. Thus in order to calculate a proper RCI for the SSN index construction, the inverse of public transfers (governmental and NGO transfers) was necessary in order to create coherence in the correlation matrix.

TESTING THE RCI OF FHHS

In the following test, a mean comparison RCI is run between the group of FHHs and the group of MHHs. The test assumes that variances for the two populations are the same.

The t-statistic is 5.603 with 7916 degrees of freedom. The corresponding two-tailed p-value is 0.0000, which is less than 0.05. The conclusion is that the difference of means in RCI between males and females is statistically different from 0 (see Table A3 below for details).

Table A3. **T-test results for resilience index by household head gender in Sudan (2009)**

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]		T-stat
Male	7088	0.119	0.005	0.393	0.110	0.128	
Female	830	0.039	0.013	0.372	0.014	0.064	
Combined	7918	0.111	0.004	0.391	0.102	0.119	
Difference		0.080	0.014		0.052	0.108	5.60***

* α<0.1, ** α<0.05, *** α<0.01.

ANNEX II

Table A4. **Observed variables - Descriptive statistics at national and gender of household head in Sudan (2009)**

Pillars of resilience	Variables in each pillar	National	Male HH	Female HH
IFA	Monthly per capita income	70.540	71.940	57.300
	Monthly per capita expenditure	133.200	132.900	135.700
	Daily caloric intake	2474.400	2458.500	2625.000
ABS	Access to public electricity network	0.140	0.150	0.048
	Sources of energy for cooking (1 if gas/electricity)	0.155	0.167	0.041
	Access to toilet facility	0.545	0.556	0.435
	Distance to water access	20.650	19.820	28.500
AST	Tropical Livestock Unit	2.025	2.039	1.895
	Land owned	3.836	3.955	2.702
	Wealth index	-0.142	-0.121	-0.336
	Agricultural wealth index	-0.241	-0.240	-0.321
SSN	Governmental transfers	2.737	2.419	5.748
	Ngo transfers	1.660	1.442	3.726
	Other transfers	0.925	0.764	2.448
S	Loss due to crop shock (per capita)	150.900	154.000	121.300
	Loss due to livestock shock (per capita)	153.500	148.900	196.500
	Loss due to other shock (per capita)	204.400	188.400	355.900
AC	Household Dependency Ratio	1.235	1.207	1.503
	Household head years of education	3.485	3.792	0.575
	Number of sectors hh members are employed	1.962	1.979	1.799

Table A5. **Observed variables – Descriptive statistics at national and regional level in Sudan (2009)**

	Variables in each pillars	National	Northern	Eastern	Khartoum	Central	Kordofan	Darfur
					REGION			
IFA	Monthly per capita income	70.540	92.190	86.510	136.600	80.800	66.510	45.490
	Monthly per capita expenditure	133.200	180.500	142.000	242.100	137.600	119.800	113.900
	Daily caloric intake	2474.400	3099.000	2488.600	3211.900	2536.600	2321.300	2260.200
ABS	Access to public electricity network	14.00%	42.40%	11.70%	38.50%	22.90%	3.00%	1.70%
	Sources of energy for cooking (1 if gas/electricity)	15.50%	67.50%	9.80%	38.50%	22.90%	1.10%	10.8%
	Access to toilet facility	54.50%	91.00%	36.10%	92.30%	50.60%	47%%	50%
	Distance to water access	20.650	4.450	21.810	23.920	16.470	27.910	29.480
AST	Tropical Livestock Unit	2.025	1.995	1.563	0.991	1.391	2.903	2.413
	Land owned	3.836	1.851	6.313	2.457	3.863	4.890	2.687
	Wealth index	-0.142	0.303	-0.164	0.326	-0.119	-0.174	-0.303
	Agricultural wealth index	0.000	1.213	0.187	0.723	-0.082	-0.278	-0.276
SSN	Governmental transfers	2.737	1.704	0.544	0.070	1.234	1.163	6.811
	Ngo transfers	1.660	0.606	0.191	0.844	0.268	1.046	4.658
	Other transfers	0.925	1.373	0.895	0.468	1.044	1.112	0.547
S	Loss due to crop shock (per capita)	150.900	237.000	109.200	6.838	154.000	145.900	141.800
	Loss due to livestock shock (per capita)	153.500	61.220	97.800	43.230	96.050	177.800	262.000
	Loss due to other shock (per capita)	204.400	206.400	171.300	111.600	125.700	234.000	287.600
AC	Household Dependency Ratio	1.235	0.800	1.248	0.654	1.169	1.359	1.388
	Household head years of education	3.485	4.833	1.828	5.231	3.774	2.698	3.955
	Number of sectors hh members are employed	1.962	1.852	1.462	1.462	1.899	2.321	2.095
	Observations	7 915	1 056	1 584	527	2 111	1 054	1 583

Table A6. **Pillars statistics in Sudan (2009)**

Pillars of resilience	National	Male	Female
Income and Food Access (IFA)	-0.078	-0.092	0.038
Access to Basic Services (ABS)	-0.133	-0.109	-0.340
Assets (AST)	0.029	0.057	-0.232
Social Safety Nets (SSN)	-0.085	-0.029	-0.561
Sensitivity (S)	0.066	0.035	0.331
Adaptive Capacity (AC)	-0.028	0.022	-0.451

Table A7. **Pillars statistics at regional level in Sudan (2009)**

Pillars of resilience	Region					
	Northern	Eastern	Khartoum	Central	Kordofan	Darfur
Income and Food Access (IFA)	0.274	-0.042	0.679	-0.114	-0.319	-0.078
Access to Basic Services (ABS)	0.635	-0.344	0.977	-0.038	-0.662	-0.133
Assets (AST)	0.764	0.144	0.565	-0.003	-0.070	0.029
Social Safety Nets (SSN)	-0.003	0.132	0.179	0.130	0.127	-0.085
Sensitivity (S)	-0.080	-0.225	-0.586	-0.072	0.348	0.066
Adaptive Capacity (AC)	-0.034	-0.275	0.091	-0.001	0.234	-0.029

Table A8. **Resilience Capacity Index over regions in Sudan (2009)**

Region	Obs	Mean	Std. Dev.	Min	Max
Northern	1056	0.339	0.111	0.090	0.731
Eastern	1584	0.235	0.122	0.055	1.000
Khartoum	527	0.378	0.108	0.098	0.714
Central	2111	0.250	0.110	0.058	0.651
Kordofan	1054	0.194	0.078	0.059	0.692
Darfur	1583	0.186	0.077	0.000	0.528

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