RESILIENCE ANALYSIS IN CHAD 2014

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Table of Contents

Figures

Tables

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Acronyms

ABS	Access to Basic Services
AC	Adaptive Capacity
ASI	Agriculture Stress Index
AST	Assets
CAADP	The African Agriculture Development Programme
CEDAW	Convention on the Elimination of all Form of Discrimination against Women
COSOP	Country Strategic Opportunities Programme
CPDN	Contribution Prévue Déterminée au niveau National
DDI	Dietary Diversity Index
DOP	Direction de l'Organisation Pastorale.
ECPR	European Consortium for Political Research
ENSA	Enquête Nationale sur la sécurité alimentaire
FA	Factor Analysis
FCS	Food Consumption Score
GIS	Geographic Information System
GIWA	Global International Water Assessment
HDI	Human Development Index
HH	Household Head
IPCC	Intergovernmental Panel on Climate Change
MIMIC	Multiple Indicators Multiple Causes
NDVI	Normalized Difference Vegetation Index
ONS	Office National de la Statistique
PDDAA	Programme détaillé de développement de l'agriculture africaine
RAP	Resilience Analysis and Policies (team)
RCI	Resilience Capacity Index
RIMA	Resilience Index Measurement and Analysis
RM-TWG	Resilience Measurement Technical Working Group
RSM	Resilience Structure Matrix
SDSR	Stratégie de Développement du Secteur Rural
SEM	Structural Equation Model
SSN	Social Safety Nets
TLU	Tropical Livestock Units
UNDAF	United Nation Development Assistance Framework

UNDP	United Nations Development Programme
WB	World Bank
WFP	Word Food Programme
WHO	World Health Organization

Executive Summary

Climate change, the effect of population growth and unstable governance, have weakened the situation of the country and economic resources exacerbate tensions.

Since its independence, Chad has been afflicted with various conflicts. Yet, since 2010, Chad has the longest period of stability.

Important oil reserves were discovered in the early 2003, and this has led to new construction and infrastructure projects, including the building of many roads; also the exportation channels opened up and Chad began to export oil in 2004.

Nowadays oil and agriculture drive Chad's economy. Almost 80 per cent of Chad's population relies on subsistence farming and livestock and oil provides the almost totality of export revenues. Remittances have also been an important source vehicle of income generating activities, and Chad relies on foreign assistance and foreign capital for most public and private sector investment. Recently, the economy has been strained by the costs of repatriating Chadians fleeing the violence in South Sudan and the Central African Republic, so a lot of migrants returned to Chad, with consequently a reduction in remittances.

The great instability on the borders of the country and the high volatility of oil revenues continue to complicate the use of already limited resources for interventions in favour of the poorest.

Climate change in Chad is a serious threat for households (McSweeney,New and Lizcano, 2008).

The *Climate Change Vulnerability Index 2016*, which classifies the vulnerability of human populations in 186 countries to extreme climate related events over the next 30 years, said that changing in climate in Western Africa are already making water and food security unbalanced. Chad is the first in the list as the most vulnerable countries (Kreft,Eckstein,Dorsch et al., 2015). According to *Verisk Maplecroft*[1], climate change has contributed to reduce water and food security, and to increase migration and conflict in Niger, Nigeria, Chad and Cameroon, all of which border the Lake Chad.

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 (RM-TWG) as "the capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences" (RM-TWG, 2014).

RIMAII identifies and weighs four 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 RIMAII model are: Access to Basic Services (ABS), Assets (AST), Social Safety Nets (SSN) and Adaptive Capacity (AC). RIMAII provides

[1] For further information, visit: https://www.maplecroft.com/

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

KEY HIGHLIGHTS

1. **The resilience capacity of households is highly influenced by AST followed by ABS**. The analysis pointed out the importance of **agricultural wealth index**, the **general wealth index and the amount of land owned**. Additionally, **electricity for cooking, water source and sanitation** play a relevant role in the construction of **ABS**.
2. Disparities are found among self-reported livelihoods. Households involved in commerce, with average resilience scores of 23.4 are the more resilient, followed by households in the livestock & fish category (with an average resilience score of 22.7). Households reporting no activities are less resilient (with average resilience scores of 16.7) as in Table A 7 (Annex III). **AST is the most relevant pillars in terms of importance in determining RCI for all the livelihoods categories, except for those households reporting no activities**. The importance of **AC is quite different in each category**
3. Households with male household heads are more resilient than households with female heads, *de iure* female household heads are the less resilient. **AST is the most important pillar for male HH and *de jure* female HH**, the importance is higher among male headed households. Concerning female **HH *de facto,* AC is the pillars that has the major impact on RCI**. D***e iure*** **female headed households show a deficiency in the AST category, reporting the worst score in every variables**. Assets came out as a critical component of household resilience, being a support for productive activities in providing household nutrition.
4. Concerning the impact that shocks have on resilience and food security, **ASI** (Agriculture stress index) **coefficient of variations is negatively associated both with RCI and FCS** (here as a proxy of food indicator) as expected. Favourable events derived from ASI have positive impact, while the interaction terms ASI-fatalities (number of injured people from conflicts in the last 6 years) shows that **the combined effect of extreme climate events and conflicts worsened the situation**. Also NDVI (Normalized Vegetation Index) is positively correlated with both RCI and FCS. Having a situation of climatic stress has a negative impact, while the interaction terms NDVI-fatalities shows that the combined effect of extreme climate events and conflicts also worsened the situation as for ASI
5. Assets serve as a buffer that allows for smoothing when households experience shocks. Both theoretical and empirical evidence supports the notion that households with higher levels of assets demonstrate higher levels of resilience to shocks. Concerning the impact of consumptions smoothing strategies, diminishing food consumption seems to be the best strategies for both resilience and FCS: diminishing adult food consumption is significative only

for resilience, while diminishing numbers of meals doesn't affect not resilience neither FCS. Children out of school seems to be the better adaptive capacity together with buying low food.

POLICY IMPLICATIONS

The findings of the analysis are examined in relation to major policy initiatives programmed or implemented by the Government of Chad over the last decade.

According to the results of the resilience analysis, **intervention in infrastructure and policies to improve the level of income generated from agriculture and better use of land** would be beneficial. Food security, one of the key objectives of agricultural policy, is of major importance. The isolation of many settlements and the high cost of transporting food products to these areas because of the inadequacy of transport infrastructure are major constraints.

With regards to SSN, policy should focus also on social protection, especially for those who are more vulnerable (for example those who are in "no activities" in the livelihood categories).

The development of the rural sector is of major concern for the government; in fact, on June 2016 the Chad government adopted the *Programme détaillé de développement de l'agriculture africaine* (PDDAA), designed as part of the *Nouveau partenariat pour le development de l'Afrique* (NEPAD) to focus on investment trough three *piliers*: (i) expand and improving cultivated land trough reliable water control systems; (ii) improving rural infrastructure and trade capacity to improve market access; and (iii) increase food supply to reduce hunger. Moreover, the three *piliers* provide scientific support necessary for the production and long-term competitiveness, there is a fourth pillar, which is about agricultural extension and technology adoption.

The National Food Security Office (ONASA), created in 2001 with the task of improving food security[2] and maintaining food security stocks at a certain level, buys and sells food products on the local market, but also turns to imports if necessary. It is run by an equi-representational monitoring committee comprised, inter alia, of the ministries responsible for agriculture and finance, along with five representatives of donor countries and agencies involved in the building up of food security stocks[3].

Given the importance of the impact of geo-climatic variable on resilience and food security, policies aimed at reducing the impact of extreme weather conditions are recommended. In line with the results, Government attention is also projected to climate change consequences. Desertification caused reduction in agricultural and pastoral areas causing the displacement of pastoralists and farmers to more suitable areas for their activities and strengthening of general inequalities and discrimination of people; the reduction of Lake Chad reduces agricultural and fisheries production and strength the immigration of people to more wetlands. For this reason on September 2015, the government signed the *Contribution Prévue Déterminée au niveau National* (CPDN) in order to strengthen the capacity of actors (farmers, herders and fishermen) and income generating activities; improving production

[2] Law No. 002/PR/01 of 21 February 2001.
[3] See, in particular, FEWS NET (2006).

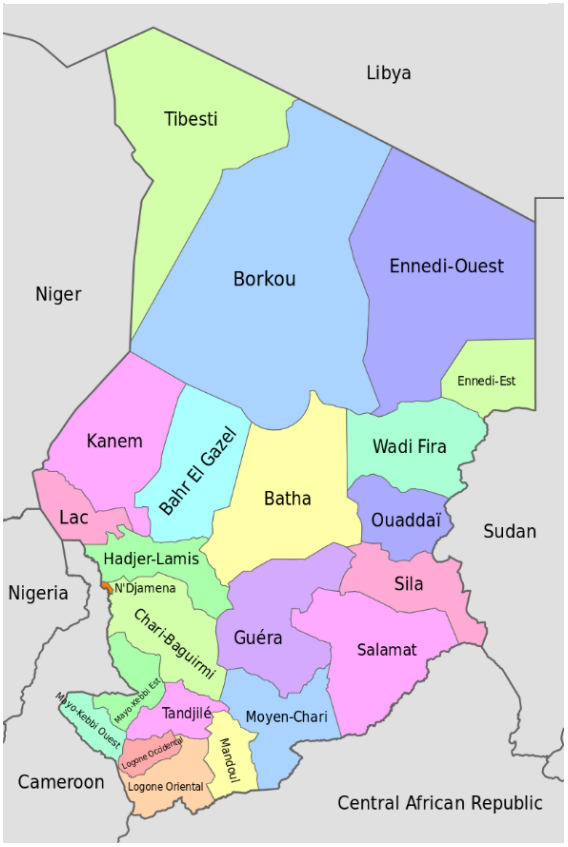
technologies with the development of water infrastructure, access to improved and adapted inputs (food, forage seed bank of animal genes, manure management, composting, etc.), developing units storage and conservation to reduce high post-harvest losses; inform, educate and communicate on climate risks (strengthening the observatory forecast weather events and developing people's capacities to prevent risks and to respond to disasters); create an observatory of adaptation policies to climate change; improve seasonal forecasting of rainfall and runoff; manage climate risk. Concerning AC, results suggests that **attention should go also to the educational sector**. This goes in line with the *Global Partnership for Education* part of Transitional Educational Plan (SIPEA), joined by Chad in 2012. Chad's education system faces several challenges. While access to primary education has improved from 85% in 2002 to 110% in 2010 (gross enrolment rate), completion rates remain low. In 2011, 2 out of 3 children of a given cohort either enrol or do not complete the primary education cycle, or they never enrol. The SIPEA priorities are that of delivering universal primary school; reduce geographical, socioeconomic, and gender disparities to promote access to education services for the most disadvantaged and vulnerable children; reduce education expenses to the community at the primary level. Resilience analysis over gender confirmed the **women condition in Chad**: **problem accessing property, less education with respect to men and a more general inequity**. On 8 March 2005 the President of Chad, Idriss Déby, announced his intention to promote the rapid adoption of a Family Code advocating gender equality, however this legislation is still at the draft stage. Early and forced marriages are especially widespread in Chad. In 2004, it was estimated that 49% of girls between 15 and 19 years of age were married, divorced or widowed. Polygamy, which is frequently practiced, affects more than one third of married women. According to tradition, only men have parental authority and, in case of divorce, mothers can only obtain custody of the children up to the age of 6 years.

Given the importance of selling livestock as one of the most important assets smoothing strategies in case of shocks, policy regarding livestock protection are suggested. In fact, the government and international donor community had contemplated considerable improvements for Chad's livestock management. The most successful programs have been animal vaccination campaigns, such as an emergency project carried to halt the spread of rinderpest. The campaign reached some 4.7 million head of cattle across the nation and demonstrated the capabilities of Chad's animal health service when given external support. As part of the economic reforms undertaken by the Government since 2000, and with the support of international agencies and IMF in particular, livestock policies have been implemented especially by the Direction de l'Organisation Pastorale (DOP).

1. Purpose of the analysis

This section introduces further background information on Chad, 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 Chad.

Figure 1: Administrative regions of Chad since 2012[4]



Chad is a landlocked country in the northern Central Africa. It is bordered on the north by Libya, on the south by the Central African Republic, on the east by the Republic of Sudan, on the southwest by Cameroon, and on the west by Nigeria and Niger. Chad is the fifth largest country in Africa in terms of area. N'Djamena is the capital and the largest city. It is located in the southwestern part of the country and, despite the many violent conflicts, the city continues to be the economic centre.

Chad has had a violent history of religious, ethnic conflicts and intermittent civil war in its 50 years of independence achieved from France in 1960 (Ploch, 2010). There are approximately 200 ethnic groups, and the population is divided into the majority of Muslim Arab and minority of non-Arab ethnic groups located in the north and east, there are also indigenous groups practicing Christian and various traditional credo located in the south (Sani and Desai, 2008). The country passed through a lot instable scenarios since 1965, when a tax protest drove the northern, Islamic tribes to rebel against the southern, Christian-dominated government. Authoritarian rules and civil war followed (Ploch, 2010). Chad's current president, Idriss Déby Itno, a former general, took power by force when he launched a rebellion against then President Hissein Habré from Sudan in 1989[5]. Déby's forces, together with the help of Libya and Sudan and largely unopposed by French troops stationed in Chad, occupied the capital, N'Djamena, in 1990, forcing Habré into exile. Habré has been sentenced to death *in absentia* in Chad and he is put down to be tried in Senegal for

[4] Image is taken from:
https://en.wikipedia.org/wiki/Regions_of_Chad#/media/File:Administrative_regions_of_Chad.svg
Jaldouseri-Own work, created: 2 December 2015. Public domain dedication,
https://creativecommons.org/publicdomain/zero/1.0/deed.en

[5] For further details visit: www.britannica.com/biography/Idriss-Deby

human rights abuses committed under his regime[6]. Déby, named president in 1991, pledged to create a democratic multi-party political system (May and Massey, 2001).

Between 1998 and 2010, Chad has faced growing rebellions of defectors and dissidents, which aimed to topple Idriss Déby (Ploughshares, 2009). The involvement of foreign powers to sustain the rebellion (i.e. Sudan) or the regime, like France, was explicit. In fact, between the 2010 agreement with the Sudanese authorities[7] and 2015, Chad was the only country in the region not affected by conflict and terrorism (OECD, 2014). However, the country has had to face the repercussion of the various crises in the region. First, the refugees/displacement crisis has dramatically affected Chad as 550 000 currently live in situation of displacement, among whom 395 875 are refugees fleeing the conflicts in Sudan (i.e. Darfur), Central African Republic and Nigeria, (OCHA, 2016). This crisis has constituted the rationale for establishing the two peacekeeping mission, EUFOR-Chad/RCA and MINURCAT, respectively in 2008 and 2009. While the first mission was actually 'bridging' the security situation before the implementation of the second mission, the MINURCAT which was put to an end in 2010 as the Chadian government asked for it not to be renewed (Ploch, 2010). Second, the Libyan and the Malian crisis have had similar effects on the security situation in Chad, meaning that they both led to the dissemination of weapons and to the lack of border control. These two elements also contributed to raising the level of threat related to terrorism. Actually, tackling the threat of terrorism was one of the aims of the costly military intervention in Mali in January 2013 (Maoundonodji, 2013). Third, since 2009, attacks and counterattacks related to the terrorist group have caused the death of more than 20,000 people in the Lake Chad area, and the crisis has caused the displacement of 117,000 people in Chad alone (DDC, 2016). In February 2015 Boko Haram launched several attacks on both Niger and the south-western states of Chad, triggering counter-offensives from both states as well as the implementation of administrative measures such as state of emergency, for instance, in the Lake Chad state since November 2015. Finally, one can argue that the most crucial crisis that Chad face on the long-term rests on internal issue. In fact, "the mismanagement of national resources, the systemic corruption which erodes every economic sector, the impunity with which allies of the regime benefit, the illicit and violent practices of some militaries, as well as the deterioration of most of the population's purchasing power who now lives with less than one dollar per day, constitute sources of insecurity as well as potential factors of destabilisation" (Maoundonodji, 2013).

Armed conflicts and continuing tensions between ethnic, religious, and regional groups have severely damaged the economy. Almost 30 years of violence and political instability have ruined Chad's infrastructure and seriously shut off its economic development. Economic progress has also been impeded by several other constraints. Chad is seriously damaged by its landlocked position; exports and imports pass through Cameroon where widespread corruption inflates transport costs; high level of

[6] For further details, visit: www.hrw.org/news/2012/07/20/world-court-important-victory-habre-victims

[7] In January 2010, the Chadian and Sudanese authorities came to an agreement to stop providing support to rebel groups which led to significant reduction and improved bilateral relations (Ploch, 2010).

taxation and corruption, have discouraged foreign investments. Not only that, energy prices in Chad are among the highest in the world, and variable rainfall causes frequent deficits in food production. Due to its desert climate, Chad is also known as "The Dead Heart of Africa" (Botha, 1992). Remoteness, inadequate infrastructure, drought, famine, and the dependency on a single cash crop (that is cotton) for export earnings made Chad one of the poorest nations of the world (Decalo, 1987). Therefore, 87 percent of the rural population lives below the poverty line and has limited access to basic education; 63 percent of the population is enrolled in school, as a results adult literacy rates is around 34 percent (WFP, 2015). Chad is ranked 184 out of 187 countries on the UNDP Human Development Index (United Nations Development Programme, 2015).

Economy saw a growing period in 2014, and this trend continued in 2015 thanks to the start of production at new oil fields. In fact, in 2003, significant oil reserves were discovered and oil began pumping, and this made of Chad the second world's exporter of oil after Sudan. Oil wealth has led to new construction and infrastructure projects, including the building of many roads. By the mid-1980s, the only paved roads linking the capital to the interior, some 250 kilometres of hardtop, had disappeared because of insufficient maintenance and there were no railroads (African Development Bank & African Development Funds, 2009).

While a small portion of the society benefits from the new oil market, poverty continues to affects every region of Chad. The majority of Chadians live in the central and southern parts of the country, those area are the most vulnerable to climatic variations and the most exposed to food insecurity. Climatic conditions are extreme, from drought to torrential rain and flooding[8]. Most of Chad's population continue to rely on agriculture for subsistence farming and livestock. The effects of climate change are making it increasingly difficult for people in certain areas to produce enough food.

The country is divided into three major climatic zones (S*aharan*, *Sahelian*, and *Soudanian*) (Ministère de l'Agriculture & l'Irrigation and Ministère de la Santé Publique, 1997) which are distinguished by the level of annual average rainfall. There are only two productive zones, the *Soudanian* cotton-producing zone of the south, sometime called *Le Tchad Utile* (Useful Chad) (Abderhaman, 1992), and the central *Sahelian* cattle-herding region. The northern *Saharan* region is limitedly involved in crop production.

Chad is characterized by extreme climate episodes which, according to the season and the climatic zones, may take the form of very severe droughts or devastating floods[9]. Vulnerability to these it's amplified by the administrative structures (ministries, government agencies and local government), lack of human and financial resources, and lack of effective households' adaptive capacities. Climate change impacts are felt in agriculture, livestock breeding, fisheries, health, housing and more areas[10].

[8] For further details visit: www.ruralpovertyportal.org/country/home/tags/chad
[9] For further details visit: www.gcca.eu/national-programmes/africa/gcca-chad
[10] Ibidem.

The one paying more from the climate change is the Lake Chad. Lake Chad is situated at the borders of Chad, Niger, Nigeria and Cameroon (see Figure 11 Annex IV). It is the most important source of freshwater for irrigation especially for Chad, but due to dramatic climate change, in the last 30 years the size of the lake has seriously decreased (Drake and Bristow, 2006). Between 1960 and 2000, the region where the lake is located experienced one of the most substantial and sustained reduction in rainfall events recorded anywhere in the world (IPCC, 2001).

The impact of this on human systems has triggered large-scale social disruptions at various times in the past (Odada *et al.*, 2006). A growing numbers of agencies and policy makers started to have concerns over the security implications of the drying lake (FAO, 2009).

The changes in the lake size have contributed not only to the lack of water, crop failures, livestock deaths, fisheries failure, soil salinity, but also to increase poverty and tensions throughout the region. Household living around the lake do not have access to safe drinking water and proper sanitation because the necessary infrastructure is lacking. As a consequence, a new phenomenon is growing, households are moving not only for greener pastures but also for life safety[11], these lead to politically destabilisation in the destination states or cities (Carius *et al*., 2004).

A framework like this is often a fertile field for conflicts, also among different ethnic groups. As in Okpara *et al.* (2015), "*Water – its quantity, quality and distribution - has several potential consequences for human well-being in a way that its connection with security and conflict has become a subject of growing concern globally*". From the broad water conflict literature, it is possible to find that increasing water scarcity can activate e regional tension and conflicts, drive border frictions, tribal violence and crossborder terrorism (Kreamer, 2012). Since 2005, conflicts for the use of resources within the Lake have create security problems at the south part of the Lake pool where the largest population of resource users live (GIWA, 2004).

The rising of violent jihadist militants in the southern portion of the Lake, has been linked to loss of livelihoods and joblessness created by environmental degradation around the Lake (Ifabiyi, 2013).

Nowadays, in Chad the main issues are represented by malnutrition and stunting, erratic climate and refugees. Given the emergency in northern Nigeria, the delicate conditions of households in the Lake Chad basin have been deteriorating, and a lots of people have been displaced. All the refugees, the displaced people and in this area are now completely dependent on humanitarian aid for their survival in Cameroon, Chad, and Niger.

Considering this background, households in Chad faced and continue to face an interaction of multiple stresses, such as poverty, ecosystem degradation, conflicts, and limited access to basic infrastructure. The degree to which households or individuals can recover from such shocks without compromising their long-term livelihood security is determined by the option available to the

[11] For further details visit: www.afdb.org/en/news-and-events/article/lake-chad-a-living-example-of-the-devastation-climate-change-is-wreaking-on-africa-15129/

households and its ability to handle these risks. Reinforcing people resilience to deal with recurrent shocks is a key element to be taken into account in poverty reduction interventions.

This report aims at identify the key pillars of resilience and related contributing factors at the household level using the FAO RIMA-II methodology.

The report is structured as follows: Section 2 presents the methodology employed to estimate the resilience capacity (RIMAII first part); Section 3 gives details on the data employed; Section 4 shows the analysis of resilience structure at the rural level, at the agro-ecological zones, by livelihood and gender of household head. Section 5 discusses the causal part of RIMA-II, focusing on the effects of shocks on resilience capacity and on the analysis of food security. Section 6 is the conclusion with some policy indications.

2. Resilience Measurement

Resilience could be defined as "the capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences" (RM-TWG, 2014).

The RIMA-II methodology is composed of two parts (FAO, 2016a): a **descriptive** analysis providing household resilience capacity, and a **causal** analysis providing the determinants of the resilience capacity.

The *descriptive analysis* produces the Resilience Capacity Index (RCI), and the resilience structure matrix (from now on RSM). The RCI can be employed for ranking and targeting households.

The casual analysis provides the determinants of the resilience capacity. RIMA-II takes into account negative events that affect households (so-called idiosyncratic shocks) as well as communities, regions or even entire countries (covariate shocks). While the former are self-reported by the household in the survey, the latter, for example, geo-climatic, are detected though secondary data. These include both additional datasets and Geographic Information System (GIS) data.

With the *descriptive analysis* it is possible to establish which profiles of households (by region, urban status, gender of HH, livelihood) are the most resilient. By focusing on the most relevant pillars, according to the RSM, it is possible to rate which specific profiles of households are the most resilient. Consequently, policy recommendations can be formulated, with a particular focus on those households who need to be target for relevant policies.

The estimation of the RCI is based on a two-stage procedure. In the first step, the resilience pillars are estimated from observed variables through Factor Analysis (FA). In the second step, the RCI is estimated from the pillars, taking also into account the indicators of food security using the Multiple Indicators Multiple Causes (MIMIC) model. The latter are considered outcomes of resilience..

The pillars employed in the analysis are: Access to Basic Services (ABS), Assets (AST), Social Safety Nets (SSN), and Adaptive Capacity (AC). The definitions of each pillar and the related variables are reported in Table 1.

Table 1: Resilience pillars

ABS	Asset to basic services shows the ability of a household to meet basic needs, by accessing and effectively using basic services, such as sending children to school; accessing water, electricity and sanitation; selling products at the market.	Electricity; sanitation; water sources; water consumption (daily *per capita* amount in liters); distance to cities (more than 100k inhabitants.)
AST	Assets, both productive and non-productive, are the key elements of a livelihood, since they enable households to produce and consume goods. Examples of (e.g. agricultural equipment), while non-agricultural assets take into account the monetary value of the house where the household is located, and its appliances.	Wealth index; agricultural wealth index; tropical livestock units (TLU); land owned (Ha); amount of cereals harvested.

SSN	Social safety nets proxies the ability of the household to access formal and informal assistance from institutions, as well as from relatives and friends.	Transfers received, assistance index[12], access to credit
AC	Adaptive capacity is the ability to adapt toa new situation and develop new livelihood strategies. For instance, proxies of the AC are the average years of education of household members and the household perception on the decision-making process of their community.	Head literacy, dependency ratio, participation index[13], food stress index[14]

For the analysis of food insecurity usually a wide range of food security indicators (see for example Carletto et al., 2013) is employed. Unfortunately in this case, given the lack of information, the indicators employed in this analysis are per capita food expenditure, and Food Consumption Score (from now on FCS). The purpose of the two indicators is to capture different aspects of food security; food consumption represents the monetary value of consumption, while FCS represents the number of food groups (FCS) eaten on a seven days recall base. Table 2 offers details on the indicators employed in the analysis. Table 2 below, gives detailed information on the food indicators employed in the analysis.

Table 2: Food security indicators

Per capita food expenditure	Monetary value, expressed in US dollars, of monthly per capita food consumption, including bought, auto-produced, received for free (as gifts or part of a conditional project) and stored food.
FCS	Calculated summing the weighted frequency of consumption of different food groups consumed by the household during the 7 days before the survey. The standard food groups and weights (in parentheses) are the following: main staples (2), pulses (3), vegetables (1), fruit (1), meat and fish (4), milk (4), sugar (0.5), oil (0.5) and condiments (0) (WFP, 2008).

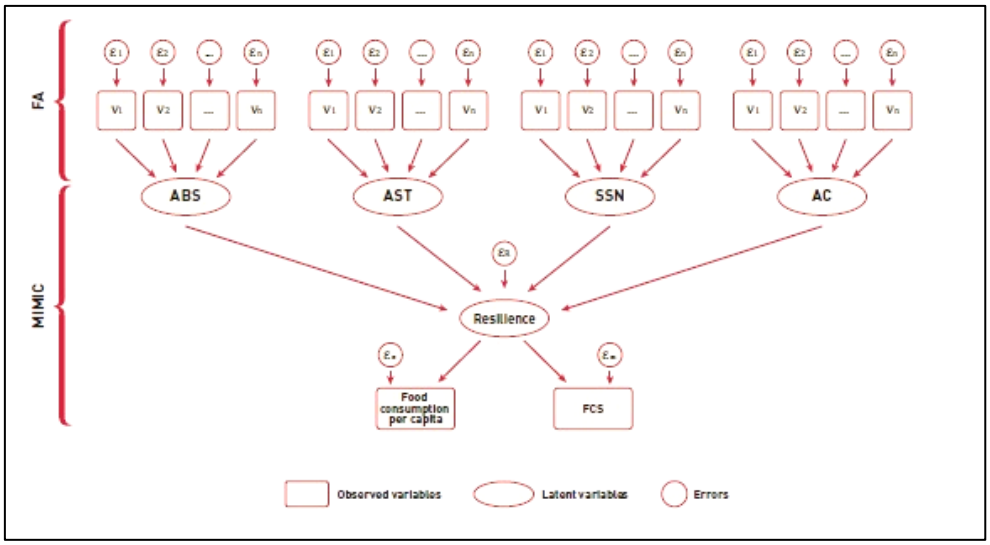
[12] Assistance index has been constructed taking information from Section 8 of the ENSA. The index has been calculated trough polychoric correlation analysis using the different types of external assistance received in the previous 12 months.

[13] Participation index: has been constructed using information collected in Section 3 of the questionnaire. The index has been calculated through polychoric correlation using participation in different type of livelihood. Higher numbers means that a households is diversifying its income; lower numbers means that the household is more specialized in one activity.

[14] Food stress index: has been constructed based on the information coming from Section 7 of the questionnaire, Food Strategies module. It is the total of all the day (on a past 7 days recall) a household had to adapt to food shortage. The total has been rescaled to come out with an index in a 0-1 range.

Figure 2 above, goes through the two-step process that allows for the estimation of the RCI. After estimating the pillars, the RCI is jointly estimated through its pillars, by taking into account food security indicators.

Figure 2: Resilience index building structure



Resilience is a dynamic multidimensional concept that incorporates bidirectional interaction between households and their environments, to conduct this kind of analysis panel data (FAO, 2016b) or pseudo panel data (FAO, 2016b) are required. When this data are unavailable, it is possible to conduct a static analysis using a cross-section dataset. 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).

The specification of RCI estimation is presented in Annex I.

3. Data

3.1 Household Level Data

Data used for the analysis came from the *Evaluation Post-récoltes de la Sécurité Alimentaire des Ménages Ruraux du Tchad* (October 2014, also known as *Enquête Nationale sur la sécurité alimentaire*, ENSA).

Every year, the Ministry of Agriculture and Irrigation (MAI), through the SISAAP[15] (Système d'Information durable sur la Sécurité Alimentaire et d'Alerte Précoce), together with its technical partners (FAO, WFP, FEWS NET, CARE) lead the national survey on food security aimed to determine the prevalence of household food insecurity .

The overall objective envisaged by the survey is to collect information to assess the food security of households, their level of vulnerability and to identify the beneficiaries targeting criteria for interventions. The full ENSA sample is composed of 8.921 households living in 61 departments. The present work is based on a sample of 6946 households located in the rural area only. Specifically, the sample is composed of those households interviewed just after the rainy season in October 2014. Sample is representative at regional level. For the ENSA three different type of data collection have been applied:

- A focus group with opinion leaders, traditional leaders, local officials, resource persons, NGOs to discuss the main priority to add into the questionnaire;
- Household level interviews with heads of households or their representatives getting all the possible information about household life; and food security.
- Community levels interviews to assess price developments and market supply systems.

Information coming from the focus groups were helpful to address the specific problems of people in different areas. Specifically, they identified sources of income, source of foods, strategies to mitigate the impacts of shocks, and to some extent, an indication on the most vulnerable groups to food security.

Households were selected in each village randomly. Interviews were done directly with the head of the households or other adult person in the household capable of providing the requested information. The

[15] It's a 48 months project (from March 2013 to March 2017) carried out by the Ministry of Agriculture and Irrigation together with FAO, WFP and EU. FAO has contributed to the realization of a concept note, a road map and a project proposal, including encouraging the strengthening and harmonization of institutions that provide Information at centralized and decentralized levels. The project allows both to guide development actions and to have an essential early warning to anticipate and mitigate the negative effects of shocks. The overall objective is to provide Chad of a functional and sustainable information system for dealing with food insecurity involving the State, its regional representative / departmental and technical and financial partners. For more information visit: www.fao.org/fileadmin/user_upload/faoweb/chad/docs/Fiche_projet_SISAAP.pdf.

interviews provide information about: human capital, agriculture, income sources, food stock levels, food consumption, expenditures, and shocks to households, and household coping mechanisms.

Unfortunately, community level data were not available, so the analysis was carried out only taking into account household level data.

3.1.1 Data limitation

Usually to better analyse the resilience of a specific country, data coming from LSMS survey typology are used. The reason is that these type of questionnaires are multi-topic household surveys, collecting information at the household and individual levels, including anthropometric measurements, health status, fertility, and education in addition to employment, income and household expenditure sections. Given the nature of the ENSA questionnaire, more focused on food security, it has been difficult to extrapolate variables typically used for resilience analysis. Given the lack of some information, ENSA questions have been adapted for the resilience purpose. However, not all of the variables that are normally present in the construction of the pillars reflect the standards, this is the case of distance variables. Normally this type of information is taken directly from specific questions in the questionnaire, unfortunately in ENSA there were no questions about distance, so external source was necessary (harvestchoice.org).

3.2 Covariates shocks data

For the causal analysis, geo variable and conflict variables have been used. Geo-climatic variables are at district level and have been provided by the GIEWS (Global Information and Early Warning System) and reports data for the last 20 years[16] on the NDVI (Normalized Difference Vegetation Index)[17], the ASI (Agricultural Stress Index)[18] and the rainfall variation[19]. The response of vegetation to environmental stresses can be identified through the analysis of satellite imagery in certain spectral bands. To evaluate the photosynthetic activity, one of the most used indicators is the normalized vegetation index (NDVI), which is calculated as the ratio between the sum and difference of the near-infrared bands (fraction reflected by the leaves) and red (absorbed fraction from chlorophyll). For the present analysis the NDVI growth rate is employed, calculated taking into account the difference

[16] Geo-climatic dataset goes from 1995 to 2015.

[17] The normalized difference vegetation index (NDVI) is a graphical indicator that can be used to assess whether the target being observed contains live green vegetation or not. Further information are available at: http://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/vh_browse.php

[18] The Agriculture Stress Index (ASI) helps show how 'stressed' crop areas are by combining vegetation condition and temperature variables. More info http://www.fao.org/geonetwork/srv/en/metadata.show?id=12691

[19] Rainfall variability at a time scale from years to days is as much a characteristic of climate as the total amounts recorded. Low values, however, do not necessarily lead to drought, nor is drought necessarily associated with low rainfall. Agricultural drought occurs when water supply is insufficient to cover crop or livestock water requirements. In addition to reduced rainfall, a number of factors may lead to agricultural drought, some of them not always obvious. More info http://mars.jrc.ec.europa.eu/mars/About-us/FOODSEC/Data-Distribution

between the first five years average and the last five years average of the entire sample. The rescaled NDVI gives the Vegetation Condition Index (VCI). It is a proxy indicator of moisture conditions of vegetation (Kogan, 1995), compared to the minimum and maximum limits of vigour of ecosystems; it is defined by the NDVI. VCI is divided into categories of conditions. (See Table 1 in Annex I). Stress condition is the worse category and it is synonym of extreme drought. To take into account of extreme weather conditions, two dummy variables have been contracted based on the NDVI. The vegetation stress dummy based on the Vegetation Condition Index (VCI) takes value 1 if for the first years and the last years a household lies in the stress conditions (between 0 and 35.99, as for Table1, Annex I). This means a households experienced severe drought. The flood dummy is based on the rescaled NDVI growth rate, the hypothesis here is that if rescaled the NDVI is close to one it means that the household experienced weather events similar to flooding. NDVI_flood takes value 1 if the rescaled growth rate is in the range of 0.7 – 1.

ASIS, instead, highlights anomalous vegetation growth and potential drought in arable land during a given cropping season. It integrates the Vegetation Health Index[20] (VHI): temporally and spatially. ASI assesses the temporal intensity and duration of a dry periods and calculates the percentage of arable land affected by drought (a VHI value below 35 percent, which identifies a critical level). For the present analysis the coefficient of variation of ASI has been utilized, which represents the coefficient of variations between first five and last five of the data in the sample. It could be considered as "relative" Euclidean distance. The hypothesis is that big variation in the index means that extreme climate events happens (either drought or flood), so the effect should be negative. The Coefficient is constructed as follow:

$$\sqrt{\frac{(Distance^2(\ last\ years - \ first\ years))}{(Average\ last\ years + Average\ first\ years)}} \qquad (3)$$

To take into account extreme weather condition, a dummy variable has been created (ASI favourable) taking value 1 if the average value of the distance (as growth rate) is greater than its standard deviation. Geo-climatic variables do not cover the entire ENSA sample, for three regions data are not available: Tibesti, Borkou and Ennedi.

Alongside the geo variables, conflicts data have been used to check the interaction impact of climate and fatalities related to conflicts.

[20] VHI is a proxy indicator of the overall health of the vegetation; is a combined estimate the thermal state and moisture content (Kogan, 1995) of the vegetation, which is given the same weight. It derives from the coupling of the two indices VCI and the temperature condition index (TCI)

VHI = a * VCI + b * TCI

a and *b* (*b = 1 – a*) are coefficients that quantify the contribution of the two indices VCI and TCI (temperatures). Normally the two coefficients have an equal weight (0.5), since the contribution of different humidity and temperature during the vegetative cycle is not known (Kogan, 2001). Conditions of increasing drought correspond to decreasing values of the index below 40.

Data at the district level, come from ACLEDDATA[21] and go from 1997 to 2014. Together with the type/number of conflict also fatalities are reported; number of conflicts and fatalities has been divided into two groups, first six years total events (from 1997 to 2005) and last six years total events (from 1996 to 2014), finally two aggregate variables have been created: total conflicts and total fatalities, which cover all the years. A dummy variable has been created, named EXTREME, which takes value 1 if the average number of fatalities in the last six year exceed the standard deviation of the total number of fatalities (from 1997 to 2014).

Figure 3: Extreme fatalities location, Chad (2014)

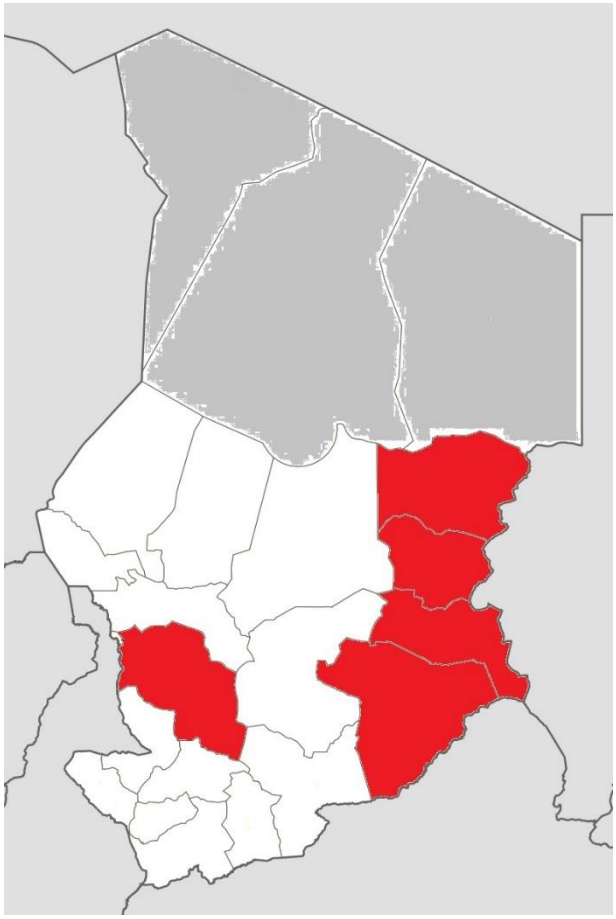


Figure *3*, above shows the extreme fatalities map, in red are highlighted those regions who reports a high number of fatalities in the last 6 years: Wadi Fra, Ouddai, Sila Salamat on the Sudan border in the Darfur area, and Char-Baguirmi, where the capital city is, right on the Cameroon border. (***we need to explore this in terms of conflicts, maybe Aurelien could help me***)

[21] ACLED (Armed Conflict Location & Event Data Project) is the most comprehensive public collection of political violence and protest data for developing states. This data and analysis project produces information on the specific dates and locations of political violence and protest, the types of event, the groups involved, fatalities, and changes in territorial control. Information is recorded on the battles, killings, riots, and recruitment activities of rebels, governments, militias, armed groups, protesters and civilians. For more information, visit: http://www.acleddata.com/.

4. Descriptive resilience analysis

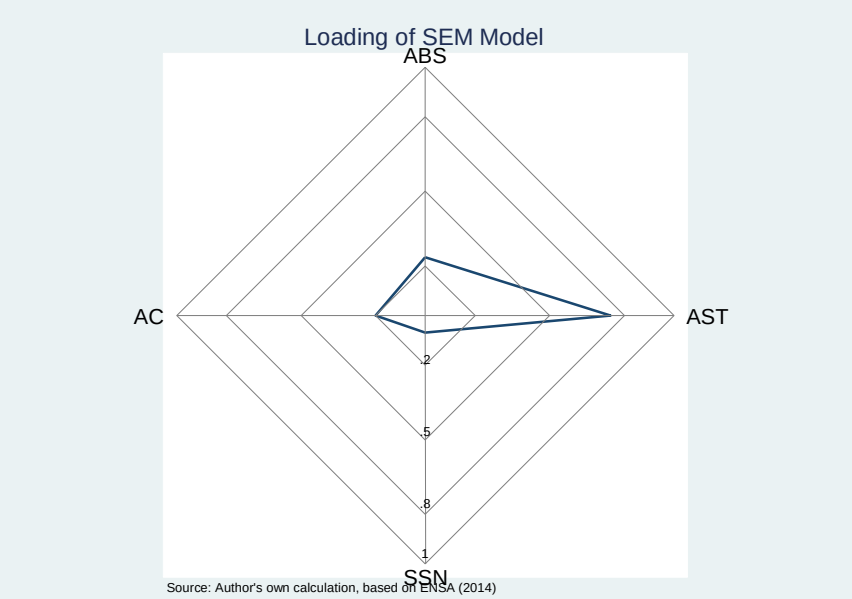
This section presents the results of the resilience analysis. First, it analyses the pillar and variable contribution in determining, respectively, the RCI and the RSM at the national level. Then, it presents the analysis of resilience capacity disaggregated by gender of household heads and regional 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[22].

4.1 Analysis at the national level

At the national level (see Figure 4) **AST is the pillar that has the major relevance on the resilience capacity index**, followed by ABS, AC and SSN.

Figure 4: RSM – Loading of factor (SEM), Chad (2014)

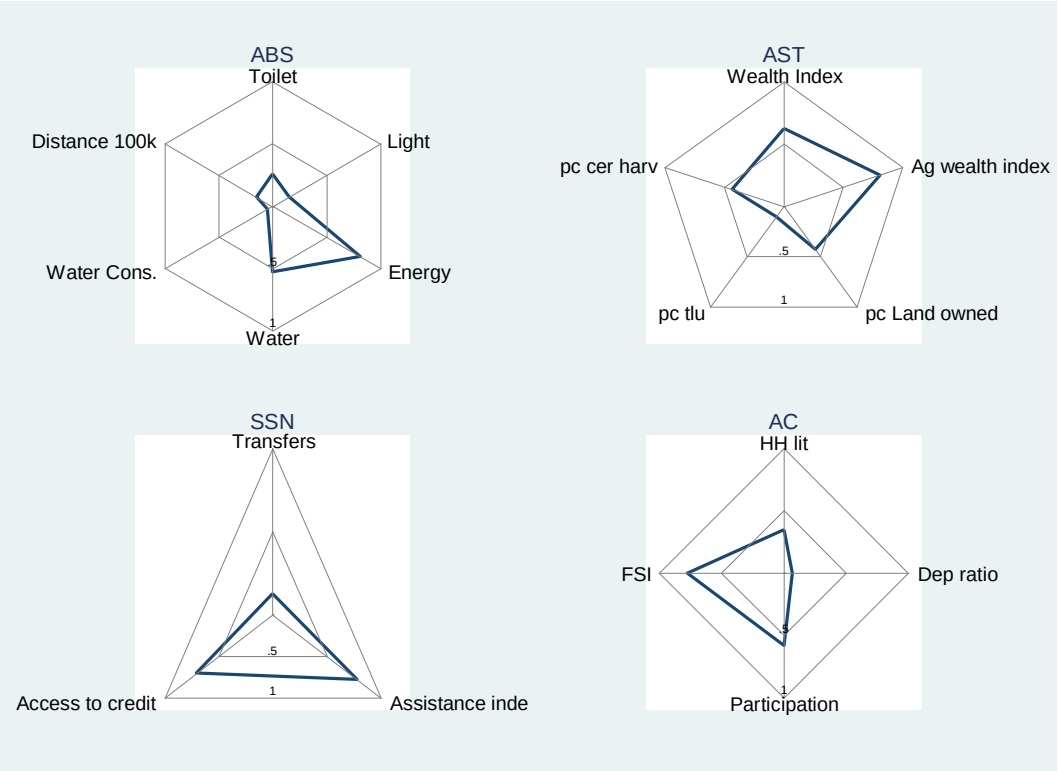


Source: Author's own calculation, based on ENSA (2014)

The RSM provides further details on the most relevant variables contributing to each specific pillar (see Figure 5).

[22] Please be careful with the interpretation of results. When a pillar and/or a variable are found to be less relevant to the actual resilience capacity level, it does not mean that they may not be relevant in the future and/or are not relevant for resilience in general. When the RIMA analysis is run employing a cross-section dataset, it provides no evidence of resilience dynamics; therefore it only can assess and describe a status quo. The descriptive part of RIMA is not intended to be a causal analysis that assesses the determinants of the increase or decrease of resilience and food security. This is provided by a causal analysis (i.e. causal analysis), which seeks panel or pseudo panel data. The factor loadings of the MIMIC model are reported in Figure 3. Their interpretation is not straightforward. The Betas estimated from the latent variable model cannot be employed for causal inference in the same way as those estimated from a regression model. On the contrary, higher factor loadings explain more than the other the estimated RCI.

Figure 5: RSM – Variable weights by pillar, Chad (2014)



Agricultural wealth index, **wealth index**, followed in equal measure by **per capita land owned (Ha) and per capita amount of cereal harvested are the most important variable for AST**, the role of per TLU is marginal.

Access to electric energy for cooking food, safe source of water are the most relevant variables for **ABS**, the second pillars in terms of impact on the RCI. Considering AC, the most relevant variables are **food stress index** (from now on **FSI**), followed by **participation index in income generating activities**, and literate household head.

Looking at **SSN**, which although, shows a limited impact, the variables contributing most are **assistance index**, followed equally by the possibility to have **access to credit** and the received transfers.

The relevance that each variable has in term of importance on each corresponding pillar suggests that interventions in infrastructure and policy to improve the level of income generated from agriculture would be beneficial. In fact, on June 2016 the Chad government adopted the *Programme détaillé de développement de l'agriculture africaine* (PDDAA), designed as part of the *Nouveau partenariat pour le development de l'Afrique* (NEPAD) to focus on investment trough three *piliers*: (i) expand and improving cultivated land trough reliable water control systems; (ii) improving rural infrastructure and trade capacity to improve market access; and (iii) increase food supply to reduce hunger. Moreover, the three *piliers* provide scientific support necessary for the production and long-term competitiveness, there is a fourth pillar, which is about agricultural extension and technology adoption. Indeed, within agricultural policy it is important to mention the *Tchad Schema directeur agricole (2006 – 2015) et*

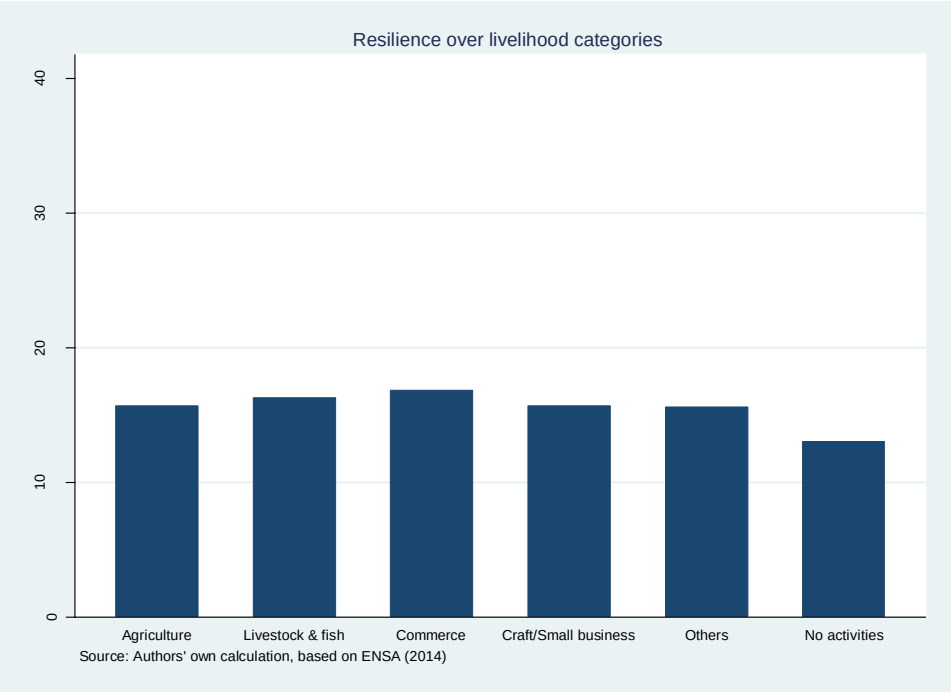
Plan d'Action (2015). The central objective of the CSDR is a sustainable policy to increase the agricultural volume production in preserved environment and to strength the rural sector capacity to raise the standard of living in order to promote the rural areas. Concerning international organization policies, one of the most important policy in Chad put in place by IFAD is the Country Strategic Opportunities Programme (COSOP) for the period 2010-2015 is the *Improvement access to and sustainable management of water resources* (IFAD, 2009).

4.2 Analysis at the livelihood level

According to the International Federation of Red Cross[23], livelihood "*is a means of making a living. It encompasses people's capabilities, assets, income and activities required to secure the necessities of life. A livelihood is sustainable when it enables people to cope with and recover from shocks and stresses (such as natural disasters and economic or social upheavals) and enhance their well-being and that of future generations without undermining the natural environment or resource base*". In line with this definition, livelihood classes have been created based on self-reported activities taken from the revenue module[24], and those are: agriculture, livestock & fish, commerce, craft/small business, others, the last one is for those households who didn't report any activities. Figure 6 below, shows the average RCI among livelihood categories. The **most resilient households are those involved in the commerce**, followed by those involved in livestock and fish activities, craft and small business, agriculture and others (see Figure 6)

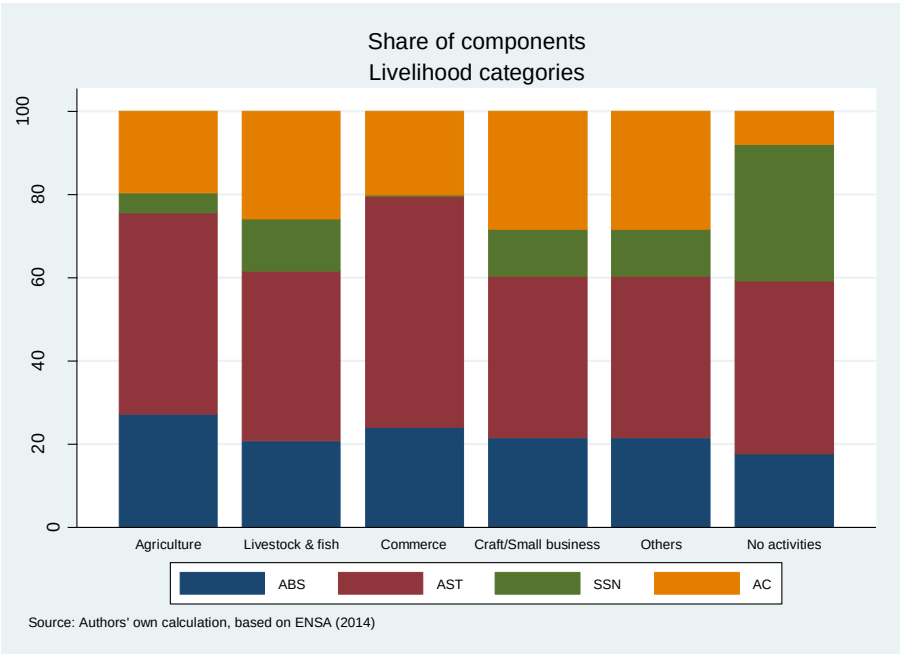
[23] See: www.ifrc.org/en/what-we-do/disaster-management/from-crisis-to-recovery/what-is-a-livelihood/
[24] Specifically self-reported livelihood are taken from Module 3, question 3.1: *primary source of revenue*.

Figure 6: RCI over livelihood categories, Chad (2014)



Looking at the RSM (Figure 7), it catches the eye as the impact of the pillars within each category is very different. **AST is the most relevant pillars in terms of impact on RCI for all the livelihoods categories, except for those households reporting no activities**, where the role of AST, ABS and SSN is equally weighted. For livestock and craft/small business categories, the second more important pillars is AC, while for the remaining categories is ABS. The importance of **AC is quite different in each category**.

Figure 7: RSM - Correlation pillars – RCI over livelihood categories



What will follow is an attempt to explain what contributed more, in terms of pillars' variables and their relevance, to the final households' RCI score. Going through variables' statistics (see Annex III, Table A 10) and according to the different livelihood categories, this is what emerged:

1. **Agriculture category**: **AST is the pillar that impact more the final RCI score**, the category has the best score in almost all the variable with respect to other categories. Though wealth index has the lowest score. Second pillar in terms of importance is ABS. Here, it emerges a lack of basic services especially for electricity and water source. Adaptive Capacity (AC), third in term of importance shows difficulties, participation in income generating activities is among the lowest. For the SSN there is a general lack of safety nets, no transfers are reported and access to credit together with assistance index have the lower average compare to other livelihood categories. What emerges is that those households involved in agriculture have in general a lack of basic services, with low diversified income (mainly from agriculture) and with family largely composed by active population (i.e. in the 15-64 age category).
2. **Livestock & fish category**: in line with the previous category and with the national tendency, **AST is the pillar playing the major on the RCI final score,** with per capita TLU being the most important variable. Wealth index and agricultural wealth index are among the lowest. **ABS is the second pillar in term of importance**, also here there is an evident **lack of basic services,** energy for cooking is absent, and electricity as source of lightning has one of the lowest score. AC, the third in term of importance, shows a relative low participation index and higher dependency ratio compared to the previous category. In terms of SSN, the situation it's better than the agriculture one, but also here there are no transfers reported, though households can count here on assistance, in fact assistance index and access to credit have the highest average. Picture that came out from this category is a household with lack of basic services, not having the right inputs/tools for being involved in agriculture, with an almost specialized source of income, with quite high humanitarian assistance being those who suffered more for food shortage, large family, living on remote place.
3. **Commerce category**. **AST, also here is the most relevant pillar in terms of impact of RCI.** Being the one with the highest RCI, **there is a relative better situation for basic services**, in fact the percentage of household with sanitation facilities, save water, electricity as source of light is among the highest compared to the other categories. Wealth index and agricultural wealth index have the higher average score with respect to the other livelihood categories. The reason why agricultural wealth index is higher here than in the agricultural categories is because the commerce category refers here to those category largely composed of households involved in the sale of food and livestock, meaning that they are farm owner. In terms of SSN, no transfers are reported, but **assistance index and access to credit are among the highest**. Concerning **AC,** participation index is on the average the higher and 35% of household head

can read and write. Household belonging to this categories are those who are wealthier, with a relative small family, quite diversified income portfolio, not stumbled in food insecurity period.

4. **Craft\small business**. **AST, as in the previous category, is the most important pillar,** variables in this pillars follow the national average, except for per capita harvested cereals which is above the national level. This means that households are involved also in agriculture (presumably for own consumption). **AC is the second pillar in term of importance**, all the variables follow the national average, except for participation in different income generating activities, which is above the average. **ABS and SSN have almost the same impact**, with a relative better access to basic services with respect to the other livelihood categories. For SSN, almost 60 percent of the household has access to credit (the highest percentage).
5. **Others. AST is still the pillars with the major impact**. Agricultural wealth index and per capita land owned are below the national level, while wealth index, per capita tlu, and per capita harvested cereal are slightly above the average. **AC, as in the previous category is the second pillar impacting more RCI**. Variables here are all slightly above the national level. Concerning ABS, it seems that the access to basic services is quite better that others categories, as a matter of fact electricity as source of cooking has the highest percentage. In terms of SSN, this category is the well-off one, household have remittances (the only one category), but also a good assistance index and access to credit services.
6. Those households reporting **no activities**, have the worst situation: **lack of basic services**, **lack of assets** even if involved in agriculture (the amount of cereal harvested is the second best), **lack of safety nets** and **low adaptive capacity;** presumably in this category there are the most vulnerable households.

In summing up the results, **variables in the asset (AST) pillar are those having the major relevance for the final RCI score**. Again, recommendations go to those policies having as final objective improvement of the agricultural sector (being one of the major sector contributing to GDP) and a better use of land. From ABS came out the need to work on infrastructure, especially in the water access improvement. The fact that only one livelihood category has remittances means that policies should focus also on social protection, especially for those households who are more vulnerable (see for example the "no activities" category).

Table 3: Households distribution among RCI terciles according to livelihood categories, Chad (2004)

RCI Categories	Pastoral	Livestock & fish	Commerce	Craft\small business	Others	No activities
Low	35.62	23.73	24.60	29.39	41.31	53.85
Medium	33.77	35.22	33.87	37.06	28.68	26.92
High	30.60	41.05	41.53	33.55	30.01	19.23

Source: Author's own calculation based on ENSA (2014)

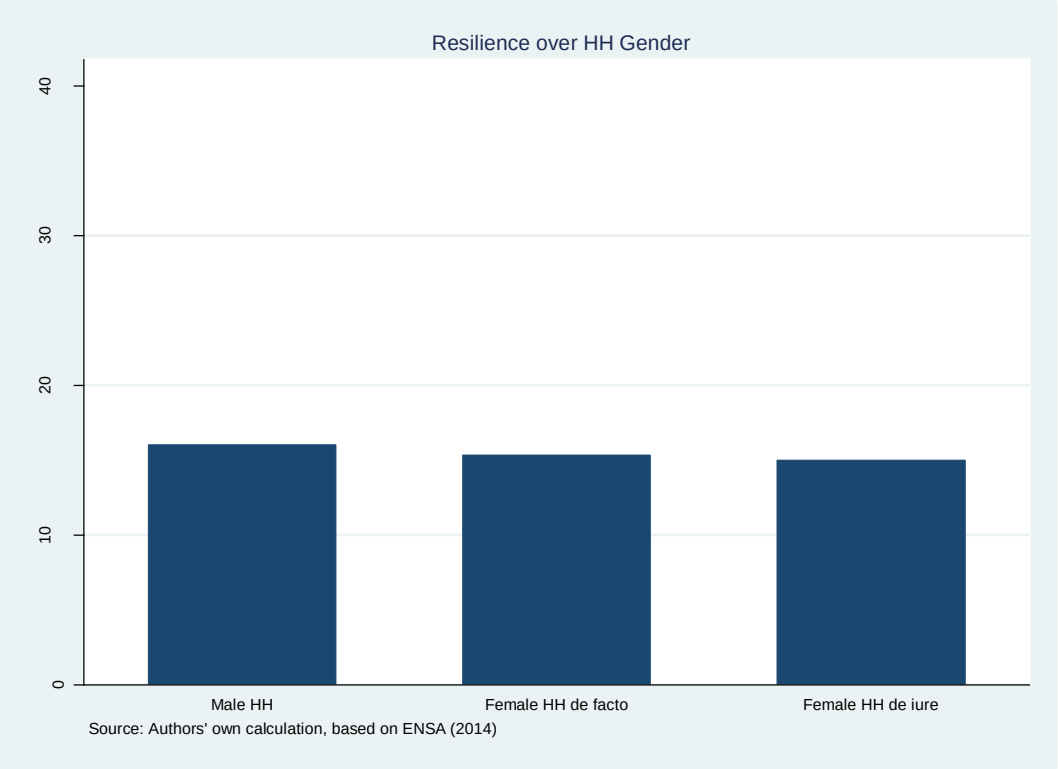
Table 3 above shows how households are distributed among resilience terciles[25]. Households involved in the commerce (41 percent) have a high RCI score, same thing for those in the livestock category and craft\small business. While households being agricultural oriented are more concentrated around a lower RCI (35% of this category are in the first terciles of RCI distribution). Concerning other and no activity also here the vast majority of the households in these two category are more around the first terciles showing a very low RCI. (For the total numbers of households in each category and in each terciles see Annex III, Table A 12).

4.3 Analysis by gender of household heads

Recently literature it is increasingly refrained from superficial comparisons between male and female headed households and switched to the analysis of different types of the latter (Chant, 2008). On a rather aggregated level it is useful to distinguish between *de iure* and *de facto* female headed households. In case of the former women are the legal and customary heads. Examples are households headed by widows and unmarried, separated or divorced women. The latter have either a self-reported female head whose husband is present or, more typically, a self-reported male head who is absent for most of the time (Quisumbing and Pena, 2001). In the present work, the sampled households are mainly composed by male household heads. In fact female household head are only the 18 per cent, of those 62% are female headed household *de facto* and 38% are *de iure.*

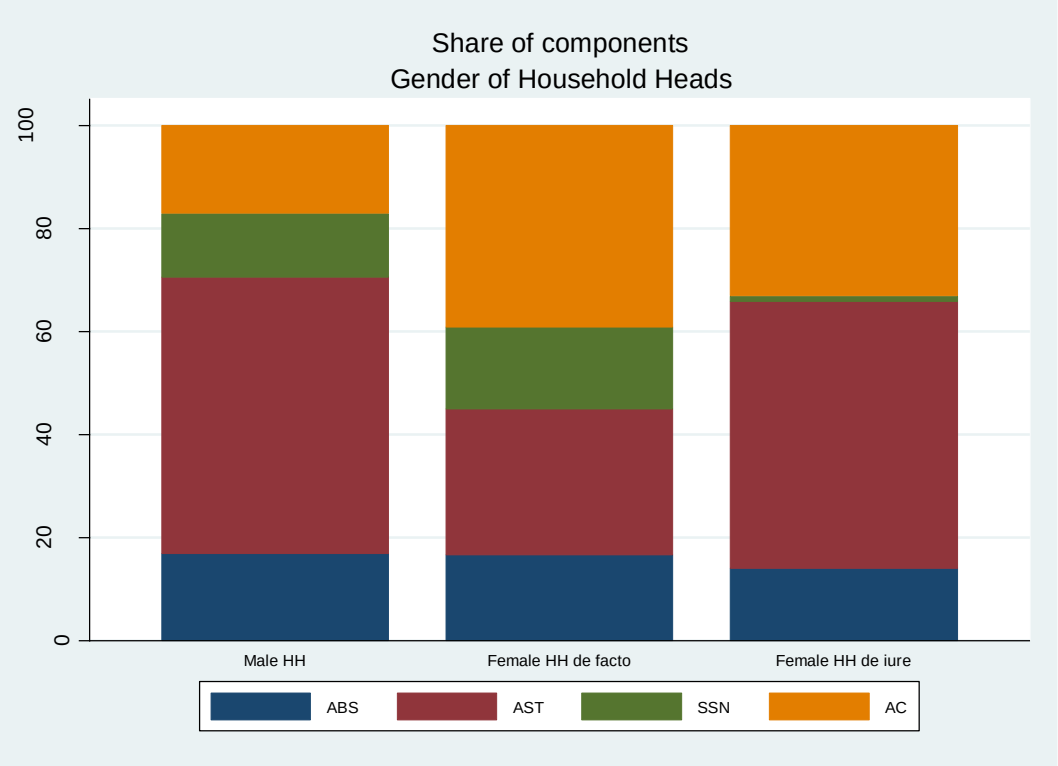
[25] Resilience Capacity index has been divided into terciles, low correspond to the first terciles, medium tot the second and high to the third.

Figure 8: RCI over HH gender, Chad (2014)



Households with male household heads are more resilient than households with female heads (Figure 8 above).The difference between the mean value of the RCI of male headed households and female HH *de* facto and between male HH and female HH *de* jure are statistically significant (see Annex II, Table A1 and Table A2), difference between female HH *de iure* and *de facto* is not significant (see Annex III, Table A3), but is still important to analyse RCI at gender level because of the important findings that are coming out from the RSM figure. The weights that each pillar has within the three RSM are very different from each other (Figure 9). **AST is the most important pillar for male HH and female HH *de jure***, the importance is higher among male headed households. Concerning female **HH *de facto*, AC is the pillars that has the major impact on RCI**.

Figure 9: RSM – Correlation pillars – RCI over Gender, Chad (2014)



Looking at Table A 9 Annex III, ***de iure* female headed households show a deficiency in the AST category, reporting the worst score in every variables**. On the contrary, male headed households have the best scores. Assets are a critical component of household resilience. In some cases, they support productive activities or directly provide for household nutrition. In others, they serve as a buffer that allows for consumption smoothing when households experience shocks. Both theoretical and empirical evidence supports the notion that households with higher levels of assets demonstrate higher levels of resilience to shocks.

Test statistics have been run for each variables used in the pillars construction, to check the significance of the difference between de iure female households head and de facto household heads (see Annex II, Table A 4). Less than the half (7) of all the variables employed (18) are statistically different between de iure and de facto female headed households. (*if we want to add this in the report we should go deep reporting the results for all the variables*).

Going through variables' statistics what came out is:

- **Male Headed Households**: **AST is the pillar that highest relevance on RCI score**, they have the best score in all the variable with respect to other categories. The impact of ABS and AC is the same. Concerning ABS sanitation and water facilities are in line with the national level, they live closer to big cities (more than 100k inhabitants) with respect to female headed households. The literacy rate is the highest among all, almost 40% of headed households are able to read and write, they are more specialized in agriculture showing the lowest participation index, together with the highest per capita amount of cereal harvested. SSN has the lower

impact on the final RCI score. In fact, they have the lowest assistance index, access to credit is quite limited and the transfers they received is way lower than the national average.

- ***De facto* Female Headed Households: AC is the pillar having the major relevance in determining RCI.** Dependency ratio is among the lowest accompanied by a high food stress index. Presumably, households with large number of children could be those who suffer more for food deprivation. AST is the second pillar in term of importance, showing here a relative deficiency in the assets. Though, those are the one who diversify more their income, and have the greater access to credit (53%). Also here there is a deficiency is basic services.
- ***De iure* Female Headed Households: AST is the most relevant pillar**. All the variables show the lowest score. AC is the second pillar in term of impact, they have the lower literacy rate, but dependency ratio is among the highest. The impact of SSN is of minor importance, but the category is the one showing the highest transfers, the higher assistance index, though the access to credit has the lower score (47% compared t0 53% of the de facto female headed households).

The results reflect partially the women condition in Chad. Despite the ratified Convention on the Elimination of all Form of Discrimination against Women (CEDAW) in 1995, obstacles to the parity are still present. In 2012, the World Economic Forum ranked Chad among the worst regions in their Global Gender Gap Report. Women in Chad have problems in accessing property, education, 50 percent of women are in primary education, and only 5 percent in secondary (200-2007)[26]. Obstacles to access to health are also of major concerns.

UNICEF[27] statistics on women situation are very concerning. Maternal mortality rate is one of the highest in the world at 1,200 per 100,000 live births. In addition to that, the lack of supportive policies, institutional mechanisms, and legal frameworks to protect women is very striking in Chad. Three out of ten women are married before the age of 15, and 2 out of 5 women have undergone some form of female genital mutilation. In addition to that, only 1 out of 10 young women aged 15 to 25 has a comprehensive knowledge of HIV prevention. In 2012 a country programme has been approved with joint work of UNICEF and the government. The programme is a contribution to the achievement of the Millennium Development Goals and the priorities of the UNICEF medium-term strategic plan, the Chad poverty reduction strategy paper (PRSP) and the United Nation Development Assistance Framework (UNDAF). By the end of 2016, the programme aims at reducing the prevalence of global and severe acute malnutrition to below 12% and 3%; increasing access to potable water to 60 per cent, the percentage of the population using appropriate sanitation to 25% and the adoption of proper hygiene practices to 30%; increasing the net school enrolment rate to 70%, the completion rate to 60%, the gender parity index to 0.95.

[26] See: www.wikigender.org/wiki/africa-for-womens-rights-chad/
[27] Unicef country overview, available at: http://www.unicef.org/chad/overview_7120.html

5. Causal resilience analysis

RIMA II methodology considers food security as its specific well-being indicator. Well-being and resilience are closely linked, in a way that resilience could highlights the positive capacity to respond to shocks defending households from long-term sufferance (RM-TWG, 2015). In fact, one of the main focus of resilience is the *ex-ante* link between well-being (for example food security, or livelihood) and shocks, and *ex-post* capacity to preserve the well- being after a shocks.

Shocks and stressors may be of different nature, interrelated and or occur together, one shock can lead to another one: for example high food prices can lead to social and political instability (Lagi,Bertrand and Bar-Yam, 2011). Food insecurity and drought can be cause and consequence of conflict (Breisinger,Ecker,Maystadt et al., 2014).

According to their nature shocks could be idiosyncratic (affecting a household, like illness, injury, death, job loss, crop failure, loss of transfers) and covariant (affecting group of households, communities, regions or even entire countries, like armed conflicts, financial crisis, changes in food prices, drought, flood, social unrest).

Household living in developing countries are for the most part dependent on the production and consumption of crop and livestock, and considering the environment in which they live, the probability to face emergencies is high, and these can threaten access to food at the local, regional and national level.

Achieving food security requires a combination of food availability, food access, and food utilization that can be stable over the time. The stability of food security depends on food systems that are resilient (Holling, 1973). The role of resilience is that of maintaining the level of food security in the presence of shocks. If food system is indeed secure (that is, a household can handle a shock), than this will result in resilience. As a results, in the short run resilience is the ability of households, whose livelihoods and agricultural production are highly dependent on natural resource based, to recover their food consumption and production to the original condition against environmental variability (such as climatic shocks, disasters and socio-economic shocks). In the long –run, resilience can be defined as the adaptive capacity of a household to (Walker,Abel,Anderies et al., 2011):

- absorb shocks: resists a shock by reducing risks;
- adapt to changing conditions: respond to change by making *ad-hoc* choices;
- learn, innovate and transform: improve choices leading to positive changes.

Households' food security generally depends not only on the resilience capacity but also on the degree of exposure to shocks and on the heaviness of the shocks themselves (Venton and Majumder, 2013). Shocks could dramatically decrease the resilience capacity of a household, hitting the level of food security. *Shocks is an event that can trigger decline in well-being, which can affect in individuals, households (illness, death), a community, a region, or even a nation (natural disaster, macroeconomic*

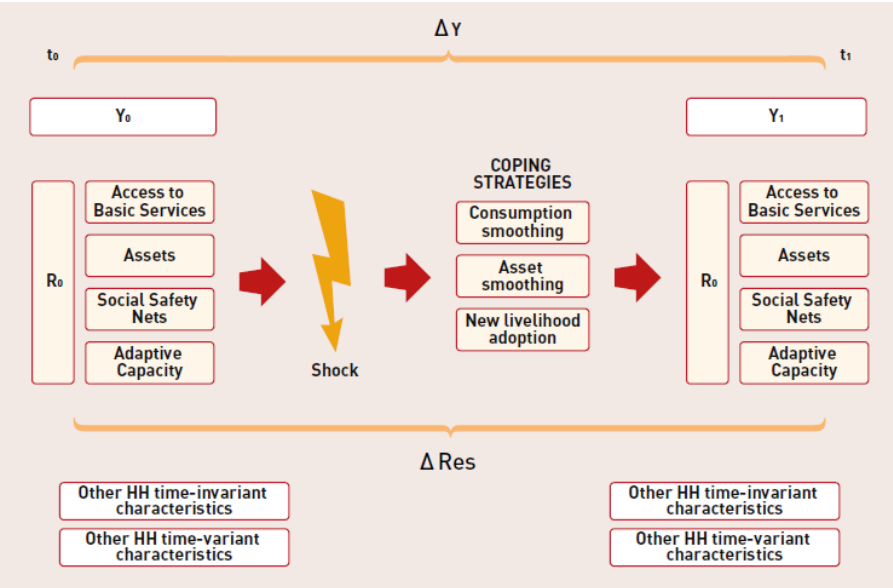
crisis). (World Bank, 2000). Food production has been changing significantly in recent years because of climate change and of growing demand for food.

There is a growing literature examining the relationship between climate change and food, food security and conflict, conflict and security, and there is a consensus on the fact that climate change can cause humanitarian crises hitting the households' resilience (IPCC, 2007).

Climate change will produce more threats (like hurricane, floods, and droughts) and the resulting crises will affect individual/households resilience (migration, food insecurity, conflicts) (Hsiang,Meng and Cane, 2011); (Tol and Wagner, 2010); (Hendrix and Salehyan, 2012); (Zhang,Lee,Wang et al., 2011). The costs of disasters related to climate change are rising, lately there are more severe weather related events that together with population growth, urbanisation, land and eco-systems degradation and scarcity of natural resources, will create more fragility and will improve the probability of new complex conflicts (European Commission, 2013).

In order to cope with all these concatenated shocks, people, communities and society need to be able to recover from such shocks and stresses, and have coping strategies to deal with them. Coping is a reactive response over a short-time frame, performed to interact with shocks. Next figure (Figure 10) describes what happens to an household well-being when a shock occurs and resilience mechanisms are activated. Y0 (e.g. food security at time 0) is obtained through a set of time-variant and time-invariant characteristics, a number of pillars contributing to household resilience capacity. When a shock occurs, a series of coping strategies is activated, principally consumption smoothing, assets smoothing and adoption of new livelihood strategies. Household resilience contributes to these absorptive, coping and transformative capacities in an attempt to bounce back to the previous state of well-being. This can result (over the long-term) in an increase or decrease in Y. Any change in Y has an effect on resilience capacity and, consequently, can limit future capacity to react to shocks.

Figure 10: Resilience conceptual framework



The present section will present the analysis of the impact of covariates shock on RCI and food security indicators (paragraph 5.1); while to test the reactivity of households to shocks an analysis is run to measure the importance of different coping strategies available in the household in reducing the impact of shocks and stressors (paragraph 5.2)

5.1 Effects of shocks on RCI and food security indicators.

This section aims at testing the associations of RCI and food indicators with covariant shocks, the focus of the analysis is on climate related shocks and their interaction with fatalities related to conflict shocks. Normally these kind of analysis are made using panel data, to take into account the dynamics of the events; unfortunately, working on a cross-sectional environment, this is just an attempt to measure the immediate impact of geo-variables both on resilience and food security indicators, controlling for livelihood categories. Two different models have been run

To this end, the following empirical model is employed:

$$Y_i = \alpha + \beta GEO_j + \gamma \text{GEO} * \text{FATALITIES}_j + \vartheta X_i + \varepsilon_i \quad (2)$$

Where:

- GEO_j represents the climatic shocks in the *j-th* region;
- $\text{GEO} * \text{FATALITIES}_j$ represents the interaction term climatic shocks and conflicts in the *j-th* region.
- X_i represents household control characteristics and household demographics.

The summary statistics of all variables used are in Table A14 of Annex III, while Table 4 shows the results of the effects of shocks on the RCI and FCS.

Table 4: Effects of ASI on RCI and Food security indicators.

VARIABLES	(1) RCI	(2) FCS
ASI Coefficient of variation	-10.44***	-48.05***
	(1.959)	*(5.699)*
Favorable event	1.618***	5.757***
	(0.427)	*(1.243)*
Extreme fatalities#ASI 1	-0.194**	-0.835***
	(0.0766)	*(0.223)*
De facto Female HH	-0.623**	0.460
	(0.288)	*(0.838)*
De iure Female HH	-0.844**	0.939
	(0.359)	*(1.043)*
Age of HH	-0.117***	-0.401***
	(0.0353)	*(0.103)*
Age squared	0.000849**	0.00301***
	(0.000371)	*(0.00108)*
Children Share	0.421	3.386**
	(0.481)	*(1.399)*
# of adults	0.200***	1.185***
	(0.0506)	*(0.147)*

Livestock & fish	2.552***	9.166***
	(0.274)	(0.798)
Commerce	2.579***	7.070***
	(0.299)	*(0.869)*
Craft/Small business	1.128***	3.053**
	(0.423)	*(1.231)*
Others	0.193	-0.914
	(0.256)	*(0.746)*
No activities	-3.549***	-8.424***
	(1.036)	*(3.014)*
Constant	28.29***	82.27***
	(1.482)	*(4.311)*
Observations	6,605	6,605
R-squared	0.065	0.077

*Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)*
Source: Authors' own calculation, based on ENSA (2014)

ASI coefficient of variations is negatively associated both with RCI and FCS (here as a proxy of food indicator) as expected. Favourable events derived from ASI have positive impact, while the interaction terms (ASI-fatalities) shows that the combined effect of extreme climate events and conflicts worsened the situation.

Table 5: Effects of NDVI on RCI and Food security indicators

VARIABLES	(1) RCI	(2) FCS
NDVI (long AVG)	52.25***	165.0***
	(12.30)	(35.90)
Stress conditions	-3.842***	-8.177***
	(0.434)	(1.267)
Favourable condition	0.263	2.169
	(0.504)	(1.470)
Extreme#NDVI	-53.45***	-149.4***
	(12.37)	(36.11)
De facto Female HH	-0.684**	0.131
	(0.290)	(0.846)
De iure Female HH	-0.718**	1.047
	(0.358)	(1.046)
Age of HH	-0.112***	-0.385***
	(0.0353)	(0.103)
Age squared	0.000822**	0.00297***
	(0.000371)	(0.00108)
Children Share	0.432	3.057**
	(0.482)	(1.408)
# of adults	0.207***	1.189***
	(0.0506)	(0.148)
Livestock & fish	2.981***	10.67***
	(0.287)	(0.837)
Commerce	2.668***	7.064***
	(0.298)	(0.870)
Craft/Small business	1.341***	3.671***
	(0.424)	(1.237)
Others	0.386	-0.379
	(0.261)	(0.762)
No activities	-3.701***	-8.926***
	(1.035)	(3.020)

Constant	26.62***	57.26***
	(1.299)	(3.792)
Observations	6,605	6,605
R-squared	0.068	0.073

*Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)*
Source: Authors' own calculation, based on ENSA (2014)

NDVI is positively correlated with both RCI and FCS. Having a situation of climatic stress has a negative impact, while the interaction terms (NDVI-fatalities) shows that the combined effect of extreme climate events and conflicts worsened the situation as in the previous output

5.2 Coping strategies

When households or communities are constantly hit by shocks and sometimes lack the means to respond, having difficulty in accumulating the human, physical, and natural capital, needed to bounce back to the previous well-being. In response, households cope by utilizing a complex set of strategies to smooth consumption and/or asset. *Coping means the managing of resources in means the managing of resources in difficult situations. It includes finding ways to solve problems, to handle stress or to solve problems, to handle stress or to develop defence mechanisms* (Brahmi and Poumphone, 2002).

This sub-section aims at testing the associations of RCI and food indicators with the coping strategies adopted by the sampled household in case of adverse situations. A set of coping strategies derived directly form the questionnaire are used as covariates, together with households control variables and demographics.

To this end, the following empirical model is employed:

$$Y_i = \alpha + \beta CS_i + \gamma AP_i \vartheta X_i + \varepsilon_i \quad (4)$$

Where:

- CS_i represents of comping strategies put in place by the *i-th* households:
- AP_i represents the adaptive capacity of the *i-th* household:
- X_i represents household control characteristics and household demographics.

In order to avoid endogeneity problems caused by reverse causality and due to simultaneity bias IV model is employed[28]. The hypothesis here is

(see Annex III, Table A15, for the statistics of the variable in the model).

Table 6: Effects of coping strategies on RCI and food consumption score.

VARIABLES	(1) RCI	(2) fcs
Female HH *de facto*	-0.763***	-0.418
	(0.285)	*(0.795)*

[28] Instrumented variables (smoothing strategies and adaptive capacity) are obtained from maximum likelihood estimation, trough equation-level score with the coefficient of variation of ASI employed as instrument.

Female HH *de iure*	-0.726*	0.381
	(0.408)	*(1.102)*
Age of HH	-0.126***	-0.405***
	(0.0371)	*(0.0997)*
Age of HH squared	0.000879**	0.00294***
	(0.000391)	*(0.00105)*
Children share	0.322	2.805*
	(0.643)	*(1.494)*
# of adults	0.238***	1.263***
	(0.0594)	*(0.148)*
Coping Strategies		
Asset smoothing		
Sell unproductive inputs	0.915***	1.689*
	(0.339)	*(1.019)*
Sell livestock	1.796***	4.773***
	(0.353)	*(1.017)*
Sell harvest unripe products	0.956***	5.400***
	(0.368)	*(1.117)*
Sell part of land	0.135	3.346*
	(0.558)	*(1.892)*
Consumption smoothing		
Diminishing food consumption	0.287***	1.000***
	(0.0761)	*(0.235)*
Diminishing adults food consumption	0.249**	-0.0564
	(0.105)	*(0.308)*
Diminishing numbers of meals	-0.0432	0.368
	(0.0991)	*(0.301)*
Non consumption smoothing		
Lower exp for ag. inputs	-1.006**	-2.999**
	(0.500)	(1.391)
Lower exp. for medication	-0.610	-2.244
	(0.614)	(1.781)
Lower exp. for health and education	-1.888***	-5.282***
	(0.543)	(1.706)
Adaptive capacity		
Borrow food from relative	-2.570***	-6.333***
	(0.341)	(0.952)
Buying food credit	0.850**	4.616***
	(0.344)	(1.044)
Ask for money (loan)	-2.185***	-7.734***
	(0.309)	(0.920)
Consumption of seeds in stock	-2.001*	-5.443*
	(1.090)	(3.014)
Take out children from school	1.022*	5.185***
	(0.535)	(1.595)
Send household members to beg	0.880	3.890**
	(0.618)	(1.973)
Low quality food strategy	2.395**	5.169*
	(1.135)	(3.104)
Constant	23.91***	56.15***
	(0.820)	(2.175)
Observations	6,605	6,605
R-squared	0.050	0.055

*Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)*
Source: Authors' own calculation, based on ENSA (2014)

Form Table 6, it emerges that among the asset smoothing strategies, those having the major impacts on both the indexes are sell livestock followed by selling harvested unripe product and unproductive inputs;

while selling land has a positive outcome only of food consumption score. Concerning the impact of consumptions smoothing strategies, diminishing food consumption seems to be the best strategies for both resilience and FCS: diminishing adult food consumption is significative only for resilience, while diminishing numbers of meals doesn't affect not resilience neither FCS. Non-food consumption strategies are surprisingly negative, diminishing the expenses for health and school have a negative impacts on both the indexes, the possible explanation is that giving up part of the expenditure in medication or health in general, can lead to problems in case of illness. That is the sick person who cannot be cured, cannot work and consequently brings economic losses to the households. Among the household adaptive strategies, taking out children from school has a positive impact on food consumption score, slightly less of resilience. Among adaptive capacity, children out of school can help households to improve home production to meet food basic needs, which could lead to an increase in food consumption score. Among the credits strategies asking for money loan or borrow food have a negative impact on both the indexes. The possible explanation is that asking for money loan can give an immediate relief to the household but in the long period creates debits, which can impact the household income. Buying low food quality in case of adverse situations seems to be the best solution both for resilience index and food consumption score.

6. Main conclusion from the analysis and policy implications.

The present analysis has employed the RIMA-II methodology in order to measure the resilience capacity of households in Chad, and to understand how food security and resilience are influenced by shocks and geo-climatic scenarios. The dataset used in this analysis comes from *Enquête Nationale sur la sécurité alimentaire* (ENSA) collected in 2014. This report looks at the resilience in order to design a comparison between different livelihoods and between genders of household heads to provide an adequate foundation for policy implication.

The main result is that household are mainly influenced by AST and ABS. In terms of **AST, agricultural wealth index, the general wealth index and the total land owned are the most important variables**. For **ABS the variables that influence the pillar the most are electricity for cooking and access to safe water, followed by sanitation facilities**. The results suggest that **intervention in infrastructure and policy to improve the level of income generated from agriculture and better use of land** would be beneficial.

Chad's electricity capacity is negligible, and the absence of importation is one of the major stumbling blocks to economic development.[29] Only 2 per cent of households have electricity, and in 2004, the Government announced its intention to privatize the management of electric power, to overhaul and increase the production capacity of the Chadian Electricity and Water Company (STEE[30]), and to overhaul and expand the distribution infrastructure. Access to water resources, as well as sanitation, are a vital prerequisite for the social and economic advancement of Chad. Access to water is central to pastoral activities, which constitute one of the country's principal economic and commercial occupations. Water is no less essential to agricultural activity, especially food production. In July 1998, the Chadian Government initiated a reform of the public water production and distribution services. Under the new 1999 Water Code, public supplies of drinking water must be provided in such a manner as to encourage private initiative as well as competition, and the provision of water is to be outsourced by the Government to one or several independent operators[31]. **With regards to SSN, policy should focus also on social protection**, especially for those who are more vulnerable (for example those who are in "no activities" in the livelihood categories). During 2014 and 2015, the World Bank's Social Protection and Labor (SPL) Global Practice undertook extensive analytical work in Chad to assess the country's poverty and vulnerability profile, and the characteristics of its social safety nets system. This report, Republic of Chad – Shaping Adaptive Safety Nets to Address Vulnerability, is the result of such

[29] World Bank (2004).
[30] STEE is a State enterprise, still holds the monopoly on the supply of water and electricity to certain towns in Chad, including N'Djamena.
[31] Law No. 016/PR/99 of 18 August 1999 enacting the Water Code.

work and was prepared in the context of the renewed relationship between the Government of Chad and the World Bank. Such partnership includes the reengagement of the World Bank on the SPL agenda, and programming of World Bank support to Chad as part of the Systematic Country Diagnostic and the Country Partnership Framework[32].

The analysis follows on looking more deeply into the self-reported livelihoods categories and at the gender of the household heads. Concerning the self-reported livelihoods (agriculture, livestock & fish, commerce, craft/small business, others, the last one is for those households who didn't report any activities), **households involved in commerce are those reporting the highest level of RCI**, **while those reporting no activities scored the lowest**. What came out from the analysis is that AST is still the most important pillar for all the livelihood categories, though the importance of the others is quite different in each category. ABS and AC vie for the second pace, while SSN is the less important. As regards to gender of households heads, analysis went deeper in considering differences in gender, next to male households heads, the analysis also differentiates between *de facto* and *de iure* female household heads. From the analysis it emerges that male households head are slightly more resilient than female household heads (*de iure* and *de facto*), there is quite no difference in the RCI between *de iure* and *de facto* household heads. Differences come out in the RSM, where the importance played by each pillars is very different. In this case AST is the most important pillar only for male HH and *de iure* female HH, while for the *de facto* female HH the most important pillars is AC.

The development of the rural sector is of major concern for the government; in fact, on June 2016 the Chad government adopted the *Programme détaillé de développement de l'agriculture africaine* (PDDAA), designed as part of the *Nouveau partenariat pour le development de l'Afrique* (NEPAD) to focus on investment trough three *piliers*: (i) expand and improving cultivated land trough reliable water control systems; (ii) improving rural infrastructure and trade capacity to improve market access; and (iii) increase food supply to reduce hunger. Moreover, the three *piliers* provide scientific support necessary for the production and long-term competitiveness, there is a fourth pillar, which is about agricultural extension and technology adoption. Government attention is also projected to climate change consequences. Desertification caused reduction in agricultural and pastoral areas causing the displacement of pastoralists and farmers to more suitable areas for their activities and strengthening of general inequalities and discrimination of people; the reduction of Lake Chad reduces agricultural and fisheries production and strength the immigration of people to more wetlands. For this reason on September 2015, the government signed the *Contribution Prévue Déterminée au niveau National* (CPDN) in order to strengthen the capacity of actors (farmers, herders and fishermen) and income generating activities; improving production technologies with the development of water infrastructure, access to improved and adapted inputs (food, forage seed bank of animal genes, manure management, composting, etc.), developing units storage and conservation to reduce high post-harvest losses; inform,

[32] https://openknowledge.worldbank.org/handle/10986/24586?show=full

educate and communicate on climate risks (strengthening the observatory forecast weather events and developing people's capacities to prevent risks and to respond to disasters); create an observatory of adaptation policies to climate change; improve seasonal forecasting of rainfall and runoff; manage climate risk. Concerning AC, results suggests that **attention should go also to the educational sector**. This goes in line with the *Global Partnership for Education* part of Transitional Educational Plan (SIPEA), joined by Chad in 2012. Chad's education system faces several challenges. While access to primary education has improved from 85% in 2002 to 110% in 2010 (gross enrolment rate), completion rates remain low. In 2011, 2 out of 3 children of a given cohort either enrol or do not complete the primary education cycle, or they never enrol. The SIPEA priorities are that of delivering universal primary school; reduce geographical, socioeconomic, and gender disparities to promote access to education services for the most disadvantaged and vulnerable children; reduce education expenses to the community at the primary level.

Resilience analysis over gender underlines the **women condition in Chad**: **problem accessing property, less education with respect to men and a more general inequity**.

On 8 March 2005 the President of Chad, Idriss Déby, announced his intention to promote the rapid adoption of a Family Code advocating gender equality, however this legislation is still at the draft stage. Early and forced marriages are especially widespread in Chad. In 2004, it was estimated that 49% of girls between 15 and 19 years of age were married, divorced or widowed. Polygamy, which is frequently practiced, affects more than one third of married women. According to tradition, only men have parental authority and, in case of divorce, mothers can only obtain custody of the children up to the age of 6 years.

Given the importance of selling livestock as one of the most important assets smoothing strategies in case of shocks, policy regarding livestock protection are suggested. In fact, the government and international donor community had contemplated considerable improvements for Chad's livestock management. The most successful programs have been animal vaccination campaigns, such as an emergency project carried to halt the spread of rinderpest. The campaign reached some 4.7 million head of cattle across the nation and demonstrated the capabilities of Chad's animal health service when given external support. As part of the economic reforms undertaken by the Government since 2000, and with the support of international agencies and IMF in particular, livestock policies have been implemented especially by the Direction de l'Organisation Pastorale (DOP).

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Annex I

THE ESTIMATION OF THE RCI

In the first step, FA is used to identify the pillars that contribute to household resilience, starting from observed variables. This variable reduction mechanism relies on finding cross-correlations between the observed variables, identifying number of (unobservable) factors reflected in correlations, and predicting the latent outcome (pillar) as a linear combination of underlying factors. The factors considered for each attribute are those capable of explaining at least 95 percent of the variance of the model itself. In further detail, four factors are retained for the ABS pillar, 3 factors for AST, 1 factor for SSN and 2 factors for AC. In the second step, a mixed-modelling technique termed multiple indicators and multiple causes (MIMIC) is used to estimate the RCI. MIMIC model belongs to the class of Structural Equation Model (SEM), and it is characterized by one underlying latent variable that has multiple indicators as well as multiple causes. In more detail, a system of equations is constructed, specifying the relationships between an unobservable latent variable (RCI), a set of outcome indicators (food security indicators), and a set of covariates (pillars). The MIMIC model is made up of two components, the measurement equation (i), reflecting the observed indicators of food security, and the structural equation (ii), which correlates the estimated attributes to resilience capacity.

$$\begin{bmatrix} Food\ expenditure \\ FCS \end{bmatrix} = [\Lambda_1, \Lambda_2] \times [\eta] + [\varepsilon_2, \varepsilon_3] \quad (5)$$

$$[\eta] = [\beta_1, \beta_2] \times \begin{bmatrix} ABS \\ AST \\ SSN \\ AC \end{bmatrix} + [\varepsilon_1] \quad (6)$$

In the formative model, the hypothesis is that resilience (RCI) is influenced by the pillars. Formative indicators are assumed to be correlated and to be measured. In the reflective part, the model's reflective indicator errors (ε) are correlated and assumed to contain measurement errors. The MIMIC model allows for simultaneous estimation of the measurement model and the incorporation of causal variables in the structural model for the latent variable RCI. RCI is linearly determined (apart from random errors, ε1) by formative indicators or pillars, and RCI determines the observed reflective indicators (apart from random errors, ε2 ε3 ε4)[33] (Lester, 2008).

[33] For reflective indicators, it is also necessary to ensure that indicators are measured on the same scale (Lester 2008). MIMIC model is applied for cross sectional data and panel data, the difference is in the way the model is constructed. For panel data it's better to run a pooled MIMIC in order to have a unique average value to better compare the resilience among the years.

Since the latent variable (RCI) is unobserved by construction, there is no natural scale or unit of measurement reference. However, in order to represent it, a reference unit scale must be defined. Therefore, the coefficient (loading Λ1) of food consumption is not estimated, but it is restricted to unity, meaning that one standard deviation increase in RCI results in a single unit increase in the standard deviations of food consumption. This defines the unit of measure for the other lambda (Λ2) and for the variance of food consumption and FCS. Given the model above:

$$Food_{exp} = \Lambda_1 RES + \varepsilon_2 \quad (7)$$

$$FCS = \Lambda_2 RES + \varepsilon_3 \quad (8)$$

After estimating the RCI, a rescaling method range *minimum value t*o *maximum value* is employed. Accordingly, the index value range between 0 and 100. The adopted transformation is the following:

$$Rescaled\_RCI_i = \frac{(RCI_i - RCI_{min})}{(RCI_{max} - RCI_{min})} * 100 \quad (9)$$

where RCI_i is the estimated index for the *i-th* household.

Annex II

T-TEST STATISTICS

Table A 1: T-test for difference in RCI Male HH and Female HH *de facto*, Chad (2014)

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Male HH	5,702	21.64	0.10	7.36	21.45	21.83
Female HH *de facto*	775	20.80	0.26	7.21	20.29	21.31
combined	6,477	21.54	0.09	7.35	21.36	21.72
Difference		0.84	0.28		0.29	1.39
diff = mean(Male HH) - mean(Female HH *de facto*)					t =	2.9758
Ho: diff = 0					degrees of freedom =	6475
Ha: diff < 0		Ha: diff != 0				Ha: diff > 0
Pr(T < t) = 0.9985		Pr(|T| > |t|) = 0.0029				Pr(T > t) = 0.0015

Source: Authors' own calculation, based on ENSA (2014)

Table A 2: T-test for difference in RCI – Male HH and Female HH *de iure*, Chad (2014)

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Male HH	5,702	21.64	0.10	7.36	21.45	21.83
Female HH *de iure*	472	20.47	0.38	8.28	19.72	21.22
combined	6,174	21.55	0.09	7.44	21.36	21.73
Difference		1.17	0.36		0.47	1.86
diff = mean(Male HH) - mean(Female HH *de iure*)					t =	3.2731
Ho: diff = 0					degrees of freedom =	6172
Ha: diff < 0		Ha: diff != 0				Ha: diff > 0
Pr(T < t) = 0.9995		Pr(T > t)= 0.0011				Pr(T > t) = 0.0005

Source: Authors' own calculation, based on ENSA (2014)

Table A 3: T-test for difference in RCI – Female HH *de facto* – Female HH *de iure*, Chad (2014)

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Female HH *de facto*	775	20.80	0.26	7.21	20.29	21.31
Female HH *de iure*	472	20.47	0.38	8.28	19.72	21.22
combined	1,247	20.68	0.22	7.63	20.25	21.10
Difference		0.33	0.45		-0.55	1.20
diff = mean(Female HH *de facto*) - mean(Female HH *de iure*)					t =	0.738
Ho: diff = 0					degrees of freedom =	1245
Ha: diff < 0		Ha: diff != 0				Ha: diff > 0
Pr(T < t) = 0.7697		Pr(T > t) = 0.4606				Pr(T > t) = 0.2303

Source: Authors' own calculation, based on ENSA (2014)

Table A 4: T-test for difference in pillars' variables Female HH *de iure* and Female HH *de facto*, Chad (2014)

TOILET

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    .4202703    .0181575    .4939361    .3846239    .4559166
 De jure |     447    .3355705    .0223588    .4727186    .2916287    .3795122
---------+--------------------------------------------------------------------
combined |   1,187    .3883741    .0141523    .4875858    .3606078    .4161403
---------+--------------------------------------------------------------------
    diff |            .0846998    .0291169                .0275734    .1418262
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =   2.9090
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9982         Pr(|T| > |t|) = 0.0037          Pr(T > t) = 0.0018
```

LIGHT

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    .0013514    .0013514    .0367607   -.0013016    .0040043
 De jure |     447    .0246085    .0073361    .1551024    .0101909    .0390261
---------+--------------------------------------------------------------------
combined |   1,187    .0101095    .0029048    .1000787    .0044104    .0158086
---------+--------------------------------------------------------------------
    diff |           -.0232571    .0059595               -.0349494   -.0115649
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =  -3.9026
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0001         Pr(|T| > |t|) = 0.0001          Pr(T > t) = 0.9999
```

ENERGY

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    .0013514    .0013514    .0367607   -.0013016    .0040043
 De jure |     447    .0089485    .0044592    .0942781    .0001849    .0177122
---------+--------------------------------------------------------------------
combined |   1,187    .0042123    .0018806    .0647927    .0005226     .007902
---------+--------------------------------------------------------------------
    diff |           -.0075972    .0038767               -.0152032    8.77e-06
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =  -1.9597
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0251         Pr(|T| > |t|) = 0.0503          Pr(T > t) = 0.9749
```

WATER

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    .5337838    .0183508    .4991948    .4977579    .5698096
 De jure |     447    .5100671    .0236709    .5004588    .4635468    .5565874
---------+--------------------------------------------------------------------
combined |   1,187    .5248526    .0145008    .4995925    .4964026    .5533026
---------+--------------------------------------------------------------------
    diff |            .0237167    .0299323               -.0350095    .0824428
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =   0.7923
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.7858         Pr(|T| > |t|) = 0.4283          Pr(T > t) = 0.2142
```

WATER CONSUMPTION

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    1.038838    .0295261    .8031973    .9808728    1.096803
 De jure |     447     1.01868    .0380428    .8043141    .9439148    1.093445
---------+--------------------------------------------------------------------
combined |   1,187    1.031247     .023317    .8033384    .9854996    1.076994
---------+--------------------------------------------------------------------
    diff |            .0201577    .0481399               -.0742912    .1146067
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =   0.4187
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.6623         Pr(|T| > |t|) = 0.6755          Pr(T > t) = 0.3377
```

INV DISTANCE

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    .1431395    .0031824    .0865696     .136892     .149387
 De jure |     447      .17992    .0050682    .1071535    .1699595    .1898805
---------+--------------------------------------------------------------------
combined |   1,187    .1569903    .0027999    .0964644     .151497    .1624836
---------+--------------------------------------------------------------------
    diff |           -.0367805    .0056814               -.0479273   -.0256337
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =  -6.4738
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

WEALTH INDEX

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740   -.0673297    .0073015    .1986214   -.0816638   -.0529956
 De jure |     447   -.1108391    .0128015    .2706537   -.1359978   -.0856804
---------+--------------------------------------------------------------------
combined |   1,187   -.0837144    .0066552    .2292897   -.0967717   -.0706572
---------+--------------------------------------------------------------------
    diff |            .0435094    .0136829                .0166639    .0703548
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =   3.1798
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9992         Pr(|T| > |t|) = 0.0015          Pr(T > t) = 0.0008
```

AG WEALTH INDEX

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740   -.0721359    .0101625    .2764493   -.0920867   -.0521851
 De jure |     447   -.0805168    .0212576    .4494363   -.1222943   -.0387393
---------+--------------------------------------------------------------------
combined |   1,187    -.075292    .0102042    .3515635   -.0953123   -.0552717
---------+--------------------------------------------------------------------
    diff |            .0083809    .0210675               -.0329529    .0497147
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =   0.3978
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.6546         Pr(|T| > |t|) = 0.6908          Pr(T > t) = 0.3454
```

PC LANDOWN

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    .3663158    .0240909    .6553443     .319021    .4136106
 De jure |     447    .3489014    .0337044    .7125906    .2826623    .4151406
---------+--------------------------------------------------------------------
combined |   1,187    .3597579    .0196566     .677225    .3211924    .3983234
---------+--------------------------------------------------------------------
    diff |            .0174144    .0405824               -.0622071    .0970358
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =   0.4291
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.6660         Pr(|T| > |t|) = 0.6679          Pr(T > t) = 0.3340
```

PC TLU

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    .3172225    .0265485    .7221979    .2651029     .369342
 De jure |     447    .2925785    .0357651    .7561586    .2222895    .3628675
---------+--------------------------------------------------------------------
combined |   1,187    .3079421    .0213321     .734951    .2660893    .3497949
---------+--------------------------------------------------------------------
    diff |            .0246439    .0440392               -.0617597    .1110475
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =   0.5596
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
```

```
 Pr(T < t) = 0.7121         Pr(|T| > |t|) = 0.5759          Pr(T > t) = 0.2879
```

PC CEREAL HARVESTED

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    8.332603    1.292072    35.14815    5.796035    10.86917
 De jure |     447    4.417087    1.204658    25.46933    2.049577    6.784598
---------+--------------------------------------------------------------------
combined |   1,187      6.8581    .9257707    31.89546    5.041769    8.674431
---------+--------------------------------------------------------------------
    diff |            3.915516    1.908084                .1719167    7.659115
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =   2.0521
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9798         Pr(|T| > |t|) = 0.0404          Pr(T > t) = 0.0202
```

TRANSFERS

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    .7935601    .1537735    4.183093    .4916751    1.095445
 De jure |     447    1.572671    .3242936    6.856337    .9353382    2.210005
---------+--------------------------------------------------------------------
combined |   1,187    1.086958    .1555594    5.359468    .7817552     1.39216
---------+--------------------------------------------------------------------
    diff |           -.7791113    .3203905               -1.407707   -.1505154
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =  -2.4318
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0076         Pr(|T| > |t|) = 0.0152          Pr(T > t) = 0.9924
```

ASSISTANCE INDEX

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    .1914238    .0025246    .0686753    .1864676    .1963799
 De jure |     447    .1925118     .004092    .0865147    .1844698    .2005539
---------+--------------------------------------------------------------------
combined |   1,187    .1918335    .0022016    .0758532     .187514    .1961531
---------+--------------------------------------------------------------------
    diff |           -.0010881    .0045457               -.0100066    .0078305
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =  -0.2394
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.4054         Pr(|T| > |t|) = 0.8109          Pr(T > t) = 0.5946
```

ACCESS TO CREDIT

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    .5351351    .0183473    .4991013     .499116    .5711542
 De jure |     447    .4720358    .0236386    .4997767    .4255789    .5184927
---------+--------------------------------------------------------------------
combined |   1,187    .5113732    .0145149    .5000813    .4828954     .539851
---------+--------------------------------------------------------------------
    diff |            .0630993    .0299134                .0044102    .1217885
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =   2.1094
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9824         Pr(|T| > |t|) = 0.0351          Pr(T > t) = 0.0176
```

HEAD LITERATE

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    .1310811    .0124147    .3377173    .1067087    .1554534
 De jure |     447    .0917226    .0136672    .2889574    .0648625    .1185827
---------+--------------------------------------------------------------------
combined |   1,187    .1162595    .0093075    .3206709    .0979984    .1345205
---------+--------------------------------------------------------------------
    diff |            .0393585    .0191835                .001721     .076996
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =   2.0517
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9798         Pr(|T| > |t|) = 0.0404          Pr(T > t) = 0.0202
```

DEPENDENCY RATIO INVERTED

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    1.155084    .0350005     .952117    1.086371    1.223796
 De jure |     447    1.484382      .06914    1.461784    1.348501    1.620262
---------+--------------------------------------------------------------------
combined |   1,187    1.279091    .0342681    1.180634    1.211858    1.346323
---------+--------------------------------------------------------------------
    diff |            -.329298    .0701049               -.4668415   -.1917545
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =  -4.6972
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

PARTICIPATION

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740     .446246    .0048115    .1308864    .4368002    .4556918
 De jure |     447    .4438535    .0064136    .1355987    .4312489    .4564581
---------+--------------------------------------------------------------------
combined |   1,187     .445345    .0038496    .1326288    .4377923    .4528977
---------+--------------------------------------------------------------------
    diff |            .0023925     .007948               -.0132013    .0179863
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =   0.3010
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.6183         Pr(|T| > |t|) = 0.7635          Pr(T > t) = 0.3817
```

FOOD STRESS INDEX

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
De facto |     740    3.073671    .1719978    4.678846    2.736009    3.411334
 De jure |     447    2.960684    .2499805    5.285181    2.469398     3.45197
---------+--------------------------------------------------------------------
combined |   1,187    3.031123    .1426317     4.91407    2.751284    3.310961
---------+--------------------------------------------------------------------
    diff |             .112987    .2944783                -.46477     .690744
------------------------------------------------------------------------------
    diff = mean(De facto) - mean(De jure)                         t =   0.3837
Ho: diff = 0                                     degrees of freedom =     1185

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.6494         Pr(|T| > |t|) = 0.7013          Pr(T > t) = 0.3506
```

Annex III

MIMIC Variables Statistics

Table A 5: RCI and pillars statistics- National level, Chad (2014)

	National	Std. Dev.	Min	Max
Resilience	21.46	7.41	0	100
ABS	8.08	6.02	0	100
AST	13.57	3.15	0	100
SSN	21.13	7.83	0	100
AC	70.11	9.84	0	100

Table A 6: RCI and pillars statistics- Gender of HH level, Chad (2014)

	Male HH	Female HH *de facto*	Female HH *de iure*
Resilience	21.63	20.80	20.47
ABS	8.12	7.56	8.40
AST	13.73	12.98	12.57
SSN	20.87	22.39	22.21
AC	70.40	69.08	68.38

Table A 7: RCI and pillars statistics- Livelihood level, Chad (2014)

	Agriculture	Livestock & fish	Commerce	Craft\small business	Other	No Activity
Resilience	20.89	22.73	23.40	21.82	20.95	16.72
ABS	8.17	6.91	8.65	8.52	8.47	7.21
AST	13.78	13.18	13.90	13.00	13.21	12.34
SSN	20.19	23.13	21.38	22.32	22.00	18.68
AC	68.51	70.12	71.63	76.41	73.00	67.40

Table A 8: MIMIC variables - National level, Chad (2014)

	Mean	SD	Min	Max
ABS				
Toilet	0.404	0.491	0	1
Light	0.015	0.122	0	1
Energy	0.003	0.058	0	1
Water	0.511	0.500	0	1
Average quantity of water used per person in HH, liter/person/day	1.166	0.895	0	6
Travel time to nearest town (>100k)	7.367	4.666	0	20
AST				
Wealth Index	-0.023	1.107	-1	15
Ag wealth Index	0.025	2.045	-1	37
Land owned (Ha)	0.418	0.779	0	20
TLU	0.354	0.703	0	8
Pc amount of cereal arvested	12.300	210.400	0	13333
SSN				
Transfers received	0.418	5.697	0	385
Assistance index	0.181	0.061	0	1
Access to credit	0.492	0.500	0	1
AC				
HHH literate	0.348	0.476	0	1
Dependency ratio	1.171	0.987	0	12
Participation Index	0.428	0.133	0	1
Food stress index	2.622	4.534	1	35
FOOD INDECES				
Monthly Household food expenditure	18.710	27.780	0	776.80
Food Consumption Score	51.120	21.470	0	112
Observations	**6949**			

Table A 9: MIMIC variables - Gender level, Chad (2014)

	Male HH	Female HH de facto	Female HH de iure
ABS			
Toilet	0.407	0.420	0.336
Light	0.016	0.001	0.025
Energy	0.003	0.001	0.009
Water	0.508	0.534	0.510
Average quantity of water used per person in HH, liter/person/day	1.196	1.039	1.019
Travel time tonearest town (>100k)	7.042	9.359	8.020
AST			
Wealth Index	0.053	-0.067	-0.111
Ag wealth Index	0.101	-0.072	-0.081
pc Land owned (Ha)	0.430	0.366	0.349
pc TLU	0.366	0.317	0.293
Pc amount of cereal harvested	13.490	8.333	4.417
SSN			
Transfers received	0.271	0.794	1.573
Assistance index	0.178	0.191	0.193
Access to credit	0.488	0.535	0.472
AC			
HHH literate	0.399	0.131	0.092
Dependency ratio	1.140	1.434	1.108
Participation Index	0.424	0.446	0.444
Food stress index	2.532	3.074	2.961
FOOD INicatorsD			
Monthly Household food expenditure	18.440	19.920	20.020
Food Consumption Score	51.320	50.290	50.090
Observations	**5702**	**740**	**447**

Table A 10: MIMIC variables – Livelihood level, Chad (2014)

	Pastoral	Livestock & fish	Commerce	Craft/Small business	Others	No activities
ABS						
Toilet	0.390	0.371	0.490	0.380	0.436	0.313
Light	0.011	0.013	0.025	0.013	0.028	0.021
Energy	0.004	0.000	0.003	0.000	0.005	0.000
Water	0.461	0.574	0.625	0.604	0.539	0.375
Average quantity of water used per person in HH, liter/person/day	1.179	1.097	1.324	1.213	1.074	0.811
Travel time to nearest town (>500k)	6.292	11.160	8.101	7.517	7.594	6.050
AST						
Wealth Index	-0.025	-0.074	0.212	-0.088	-0.096	-0.428
Ag wealth Index	0.159	-0.369	0.182	-0.157	-0.159	-0.473
pc Land owned (Ha)	0.517	0.284	0.399	0.255	0.232	0.349
pc TLU	0.283	0.882	0.277	0.180	0.277	0.128
Pc amount of cereal harvested	16.480	4.101	4.348	5.469	11.510	10.210
SSN						
Transfers received	0.000	0.000	0.000	0.000	2.767	0.000
Assistance index	0.175	0.198	0.185	0.183	0.184	0.166
Access to credit	0.454	0.592	0.509	0.591	0.511	0.375
AC						
HHH literate	0.356	0.284	0.350	0.386	0.365	0.271
Dependency ratio	1.117	1.247	1.077	1.309	1.303	1.596
Participation Index	0.385	0.459	0.467	0.553	0.494	0.374
Food stress index	2.624	2.659	2.645	2.262	2.664	2.892
FOOD INDECES						
Monthly Household food expenditure	18.230	20.490	18.360	18.130	19.450	17.170
Food Consumption Score	49.890	56.780	55.950	52.050	47.720	39.670
Observations	**3725**	**1062**	**744**	**313**	**1053**	**52**

Table A 11: MIMIC variables – Agro – ecological zone level, Chad (2014)

	Soudanian	Sahelian	Saharan
ABS			
Toilet	0.497	0.318	0.555
Light	0.020	0.011	0.067
Energy	0.006	0.001	0.003
Water	0.409	0.629	0.320
Average quantity of water used per person in HH, liter/person/day	1.396	0.955	1.075
Travel time tonearest town (>100k)	5.070	10.000	0
AST			
Wealth Index	0.111	-0.110	0.444
Ag wealth Index	0.354	-0.297	-0.483
pc Land owned (Ha)	0.545	0.271	0.045
pc TLU	0.204	0.525	4.752
Pc amount of cereal harvested	20.400	3.006	0.483
SSN			
Transfers received	0.263	0.611	1.745
Assistance index	0.168	0.194	0.176
Access to credit	0.380	0.596	0.471
AC			
HHH literate	0.438	0.262	0.233
Dependency ratio	1.037	1.247	1.089
Participation Index	0.416	0.443	0.399
Food stress index	2.196	2.923	2.775
FOOD INDECES			
Monthly Household food expenditure	16.490	21.160	58.610
Food Consumption Score	52.570	50.380	58.040
Observations	**3528**	**3077**	**344**

Table A 12: Total number of households in each RCI terciles by livelihood categories, Chad (2014)

RCI Terciles	Pastoral	Livestock & fish	Commerce	Craft\small business	Others	No activities
1	1327	252	183	92	435	28
2	1258	374	252	116	302	14
3	1140	436	309	105	316	10
Total	3725	1062	744	313	1053	52

Table A 13: Geo variables statistics, Chad (2014)

Climatic Geo Data	Rainfall	ASI	NDVI
Last year average	22.392	9.289	0.381
Last 3 years average	23.056	4.737	0.389
Last 5 years average	22.393	5.027	0.389
Last 10 years average	21.240	6.009	0.380
Last 15 years average	20.372	8.422	0.373
Last 30 years average	20.197	12.972	0.364
Distance between last year average and last 3 years average	-0.664	4.552	-0.008
Distance between last year average and last 5 years average	0.000	4.262	-0.008
Distance between last year average and last 10 years average	1.152	3.279	0.001
Distance between last year average and last 15 years average	2.021	0.867	0.008
Distance between last year average and last 30 years average	2.196	-3.683	0.017
Standard deviation of last year	4.524	2.231	0.005
Coefficient of variation between last year and last 3 years average	0.046	0.287	0.011
Coefficient of variation between last year and last 5 years average	0.044	0.291	0.011
Coefficient of variation between last year and last 10 years average	0.051	0.293	0.008
Coefficient of variation between last year and last 15 years average	0.059	0.284	0.013
Coefficient of variation between last year and last 30 years average	0.063	0.390	0.027
number of decades in which ASI is higher than average	1.600		
number of decades in which NDVI is lower than average	1.722		

Table A 14: Coping strategies variables' statistics, Chad (2014)

	Mean	Standard Deviations	Min	Max
Sell unproductive inputs_dummy	0.113	0.317	0	1
Use household savings	0.157	0.364	0	1
Sell livestock	0.126	0.332	0	1
Harvest unripe products	0.104	0.305	0	1
Sell productive inputs	0.077	0.267	0	1
Sale part of land	0.0301	0.171	0	1
asset_smoothing	0.911	1.753	0	6
Lower expenses for agricultural inputs	0.0974	0.297	0	1
Lower expenses for medication	0.101	0.302	0	1
Lower expenses for health and education	0.096	0.295	0	1
Non food consumption smoothing strategies	0.335	0.911	0	3
Times in last week you diminished food consumed	0.625	1.485	0	7
Times in last week adults diminished food consumed in favor of youngster	0.433	1.191	0	7

Times in last week you diminished the number of meals per day	0.451	1.235	0	7
Food consumption smoothing strategies	0.674	1.209	0	3
Consumption smoothing strategies	1.101	1.994	0	6
Buying food at credit	0.213	0.409	0	1
Ask for money loan_dummy	0.255	0.436	0	1
Borrow food from relatives	0.164	0.37	0	1
Borrowing credits	0.738	1.187	0	3
Consumption of seeds	0.08	0.271	0	1
Take out kids from school	0.0508	0.22	0	1
Send household members to beg	0.0364	0.187	0	1
Household Adaptive strategies	0.266	0.832	0	3
Low quallity food strategy (interaction dummy)	0.0735	0.261	0	1
Borrow food strategy (interaction dummy)	0.139	0.346	0	1
First Priority and Need now	3.447	3.603	1	15
priority1==Food for the houselhold	0.537	0.499	0	1
priority1==Cash transfers	0.0239	0.153	0	1
priority1==Credit	0.138	0.345	0	1
priority1==Job	0.0309	0.173	0	1
priority1==Activity that generate revenues	0.0681	0.252	0	1
priority1==Seeds	0.0153	0.123	0	1
priority1==Fertilizer	0.0119	0.109	0	1
priority1==Pesticides	0.00403	0.0634	0	1
priority1==Agricultural tools	0.117	0.321	0	1
priority1==Clothes	0.00403	0.0634	0	1
priority1==Carburant	0.000863	0.0294	0	1
priority1==Food for livestock	0.00676	0.082	0	1
priority1==Veterinary products	0.00979	0.0984	0	1
priority1==Other	0.013	0.113	0	1
Observations	6949			

Annex IV

Figure 11: Lake Chad

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