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The U.S. Government's Global Hunger & Food Security Initiative

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Measuring Resilience in the Horn of Africa

REPORT 3

Development of a **pilot composite index** using data from the IGAD region

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technical consortium
Building Resilience in the Horn of Africa

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1 Introduction

The Technical Consortium for Building Resilience in the Horn of Africa (TC) is a project of the CGIAR, which was formed in 2011 following the effects of the 2011-2012 drought. The main aim of the Technical Consortium initially was to provide financial and technical support to the Intergovernmental Authority on Development (IGAD) and its member states (Djibouti, Ethiopia, Kenya, Somalia, South Sudan, Sudan and Uganda) to formulate regional and national investment programmes for the long-term development of ASALS and to follow this with technical support, with particular focus on monitoring and evaluation and the targeting of investments within these plans. These investment plans became the Country Programme Papers (CPPs) for drylands projects for the Member States and the Regional Programming Framework (now the IGAD Drought Disaster Resilience Sustainability Initiative - IDDRSI), which focused on investment plans to address regional issues for IGAD.

The focus of the TC's work at present is to collaborate with different partners, specifically including the governments in the region as their plans develop, to provide tools for measuring the impact of investments on enhanced resilience and to develop decision support tools for better targeting and prioritization of investments or projects. These tools will not only be useful for monitoring the impact of interventions within the national drylands investment plans and provide evidence for rational decision-making and prioritization, but will be applicable for donors, developments, NGOs and civil society when measuring or targeting their projects.

It has been noted that there is a gap between the strategies that decision makers use to allocate policy-related investments for ASALs and the analytical techniques that researchers use to model the conditions of ASALs and assess the impact of related interventions. To help bridge this gap, the TC has been working to develop and apply approaches to support evidence-based decision-making and investment prioritization to enhance resilient development trajectories in Horn of Africa (HoA). The result will be a toolbox of methodologies and application processes that facilitate the capacities of the IGAD member states to identify the investments with greatest potential for the highest impact to build resilience to shocks and stressors, in particular to drought, in the HoA. The toolbox will be tailored to elucidate the implications of more focused interventions, for a more specific sub-population of interest, as those details are specified by IGAD or the member states. It will also be able to test how well investments perform under different conditions (climatic and otherwise) and over varied time horizons.

The toolbox will be of use to multiple audiences, but the primary focus for application will be to provide tools for the Government of Kenya (GoK) National Drought Management Authority (NDMA), to assist with decision analysis and prioritization for investment proposed in the Kenya Ending Drought Emergencies Common Programme Framework (EDE CPF) drylands investment plan. It is also assumed, however, that the conceptual analysis and knowledge gained in the

provision of tools to the GoK NDMA will also be of use to other clients such as NGOs, donors and development partners to assist with their decision making processes and that these tools will also have potential for replication in the remaining IGAD member states.

As aid strategies shift from short-term solutions to more sustainable, longer-term interventions that build development and capacity to overcome environmental and social shocks, the term 'resilience' has gained significant traction across the development and humanitarian realm. Defined as the capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences, resilience remains an elusive concept to record and monitor. This report details one methodology that the TC has piloted to try to respond to this challenge. The TC has formulated composite indices from weighted resilience indicators and this brief summarises process of development of the pilot composite index as a potential approach to monitoring and evaluating resilience in the Horn of Africa.

2

Establishing a central concept as a first step in composite index construction

JOSHUA BUSBY, TODD SMITH
University of Texas, Austin

In order to ensure that a composite index remains coherent and credibly weighted, the central concept behind the index needs to be well defined. For a composite index with intended applications in resilience M&E, the varied definitions of resilience therefore need to be addressed.

Most definitions of resilience in development scenarios hinge upon the response of social, ecological and economic systems to shocks and stressors. It is, however, extremely difficult to quantify this response, as it is impossible to observe the full range of possible disturbances, hence assessments of system resilience normally fall short of providing comprehensive evaluations. In addition, as building resilience is rarely a linear, cumulative process that increases as each system component improves, the current linear and causal socio-ecological models used to measure resilience are inadequate to understand these micro, meso and macro interactions. For example, an overall loss of resilience may be caused by an increase in one variable but may produce or result in a drastic reduction in another. Furthermore, resilience can be viewed over varying spatial scales such as individuals, households and communities, and over varying temporal scales such as seasons, annually or across a program lifespan, from immediate to long-term. This variance may make it necessary to continually update panel datasets.

The Resilience Measurement Technical Working Group[1] defines resilience as follows: “Resilience is the capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences.”

One of the key features of this definition is that resilience is understood and measured according to the instrumental effects it exerts on targeted development outcomes[2] that may be affected by stressors and shocks. Defining resilience as a capacity means that resilience is comprised of a set of ex ante attributes and supports that should positively shift the likelihood function that describes the relationship between shocks and development outcomes, such as food security[3]. In keeping with their goal of being able to measure changes in outcomes, particular with respect to investments and projects for IGAD member state countries, the Technical Consortium carried out an initial data inventory of the Horn of Africa region to form baseline datasets for the IGAD member states (Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan, Former Sudan and Uganda). From this catalogue of baseline datasets, 165 indicators were selected that are

[1] WFP. (2013). Resilience Measurement Principles: Toward an agenda for measurement design. Resilience Measurement Technical Working Group. Technical Series No. 1. FSIN. Rome.

[2] The Technical Consortium portrays these outcomes as standard sustainable development indicators such as health, nutrition, education, living standards, and in terms of asset accumulation and income levels. These are just examples; the point of articulating outcomes in these terms is because the IGAD member states already report on progress in development towards improvements in these outcomes, hence we can harness a process already underway, and do not add a new layer of data collection.

[3] Barrett, C. & Constas, M. (2013). Resilience to avoid and escape chronic poverty: Theoretical Foundations and Measurement Principles. Paper presented at IFPRI, August 2013

generally agreed to represent resilience and can be used to monitor and evaluate the relative progress of each member states towards its resilience outcomes.

The indicators were then divided amongst the three systems: social (51), economic (73) and ecological (41). Within each category, indicators were grouped to form a series of sub-composite indicators before aggregating them again into a single composite indicator at the systems level. There were initially six key processes in the ecological system, six in the social system, and seven in the economic system.[4] This is explained in further detail below.

[4] Several of the putative system composite indices lack spatial data including Land use support, Community Support, and Information, reducing the social system to four main composites. Economic shocks was dropped from the economic system.

3

Weighting and assimilation of composite indicators

ROB DAVIES, TIM WROBLEWSKI
habitatINFO

An ESRI Model Builder was used to assimilate: six composite indicators for ecological/environmental (water resources, land use, ecosystem services, per capita resources, climate and natural resource shocks); four composite indicators for social (health, education, governance and social shocks); and seven composite indicators for economic (infrastructure, trade access, financial services, wealth, financial conditions, livelihood/income diversification and economic shocks).

Assessing ecological/environmental sensitivity

For the generation of ecological indices, it was assumed that people are more resilient to shocks where they have more accessible water resources; where their land use practices have caused least environmental degradation; where ecosystem services are healthy; where people live within balance of natural resources; and where the climate is naturally favourable.

On this assumption, each environmental composite indicator was reclassified on a scale of 1-30 and combined by addition with the following weightings:

- water resources 2
- land use 3
- ecosystem services 3
- population / per capita resources 3
- climate 1

As with inputs, these weights are chosen on the basis of three criteria (in descending order of importance):

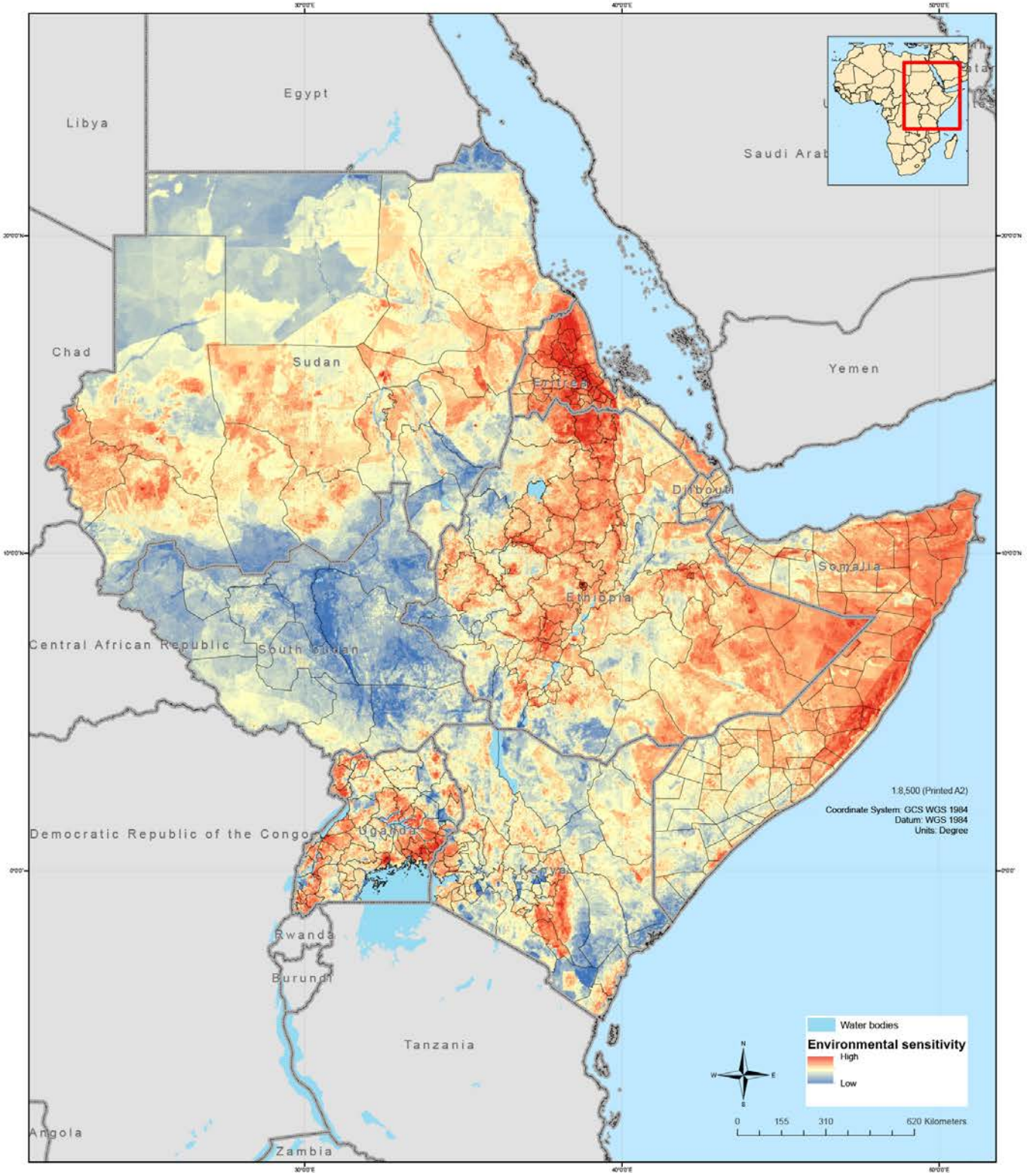
1. how important the composite indicator is considered to be with regard environmental resilience
2. a confidence that the data in the layer truly represent the indicator
3. geographic resolution

All weightings are readily changed in prepared models within the ArcGIS geodatabase hosting the data. Future sensitivity analysis can include altering these weightings and analysing the effect on the outputs.

The following map[5] in Figure 1 shows the overall system indicator for environmental sensitivity, Most of these indicators represent predisposing conditions which may be expected to amplify or mitigate the impact of a shock. Shocks are expected to have high impact if they occur in red areas due to low environmental resilience, and relatively low impact if they occur in blue areas due to high environmental resilience. The map has an overlay of administration district level 2 for all countries except for Uganda which shows level 3.

[5] Sourced from www.gadm.org

Environmental sensitivity



The following composite indicators were used to produce this map (weightings in brackets):

Ecological:
Water resources (2), land use (3), ecosystem services (2), population and per capita resources (3), climate (1)

map produced by habitat INFO, UK, 11/13

Ecological composite indicators

ENVIRONMENTAL 1: WATER RESOURCES

(CPP Sub-component 1.1: Water Resources Development)

This composite collates best available data pertaining to above and below ground freshwater. It includes the following four equally weighted indicators:

- dam capacity
- groundwater storage
- groundwater production
- distance to water source

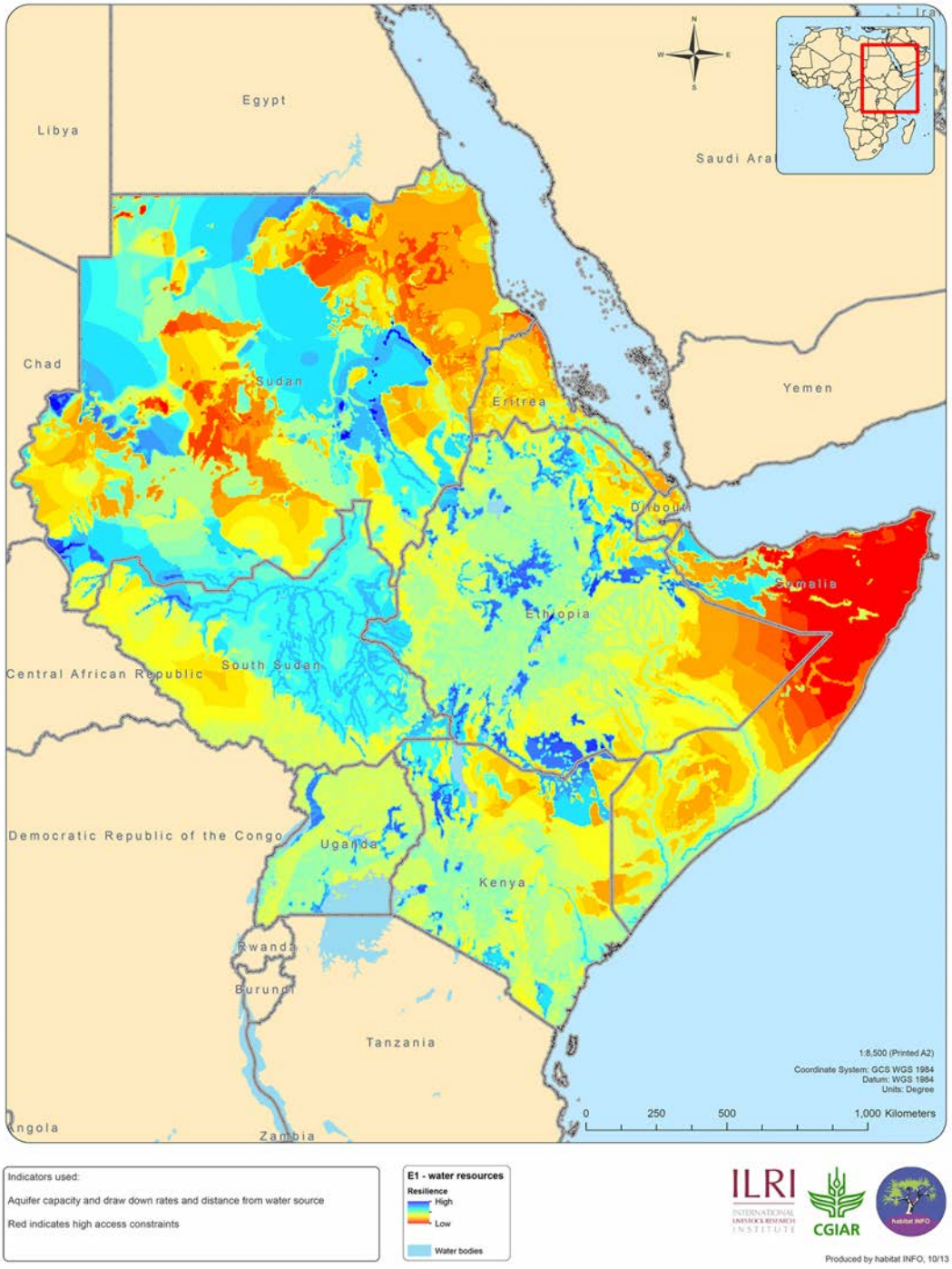
water stress

high resilience

Composite indicator - health of natural resources

MAP E1

E1 - access to water resources



ENVIRONMENTAL 2: LAND USE

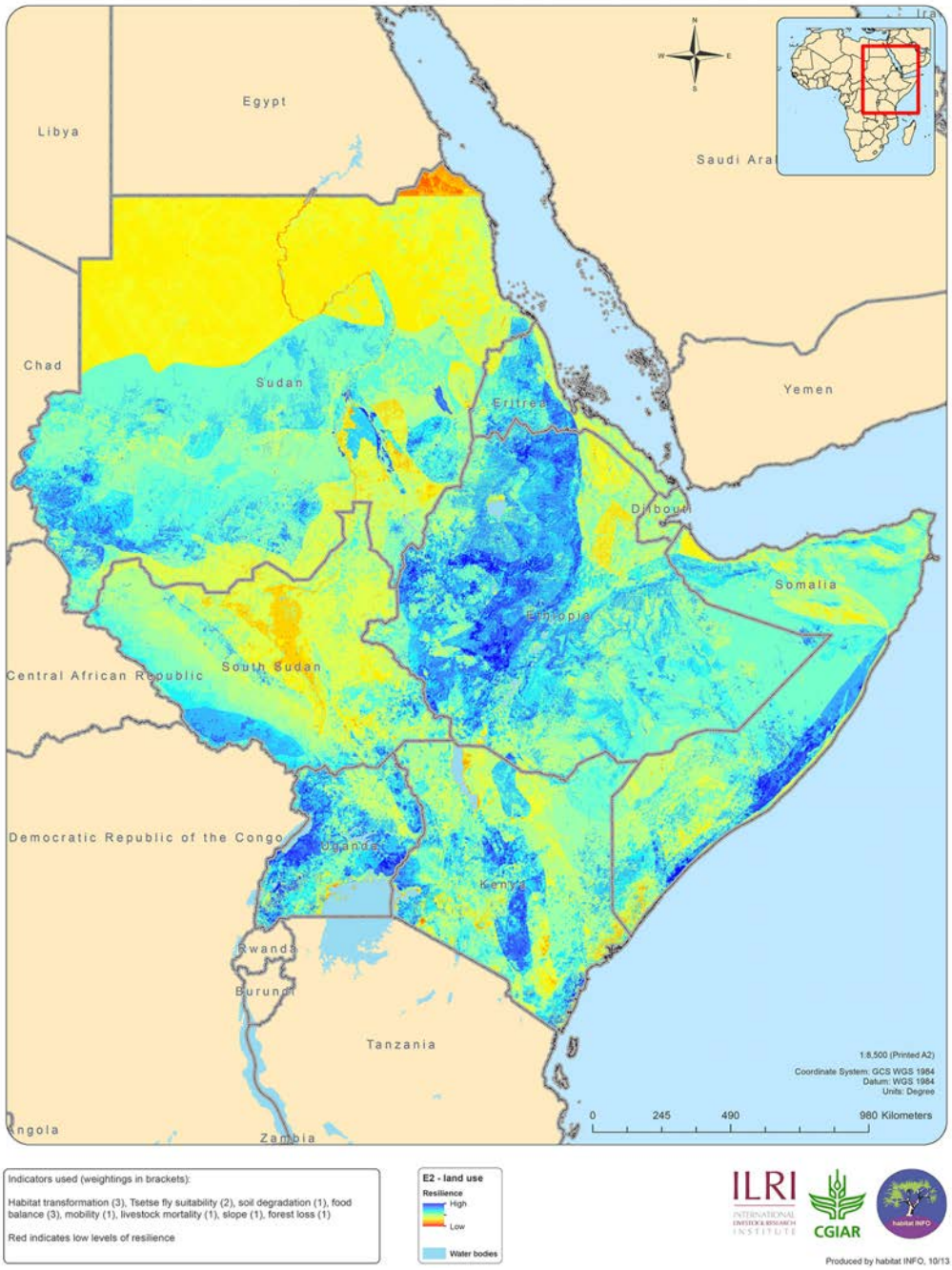
(CPP Sub-component 1.2: Pasture, Land & Environmental Management)

This composite collates best available data pertaining to land use impact. It includes the following indicators and weightings:

- forestloss * 1
- slope * 1
- model mortalities c.v. * 2
- model expected mortality rate 2014 * 2
- model livestock excess 2014 * 3
- mortality rate (Kenya) * 1
- soil degradation * 1
- habitat transformation * 3
- tsetse fly occurrence * 2
- livestock mobility *1

Composite indicator - health of natural resources
E2 - land use

MAP E2



high impact
high resilience

ENVIRONMENTAL 3: ECOSYSTEM SERVICES

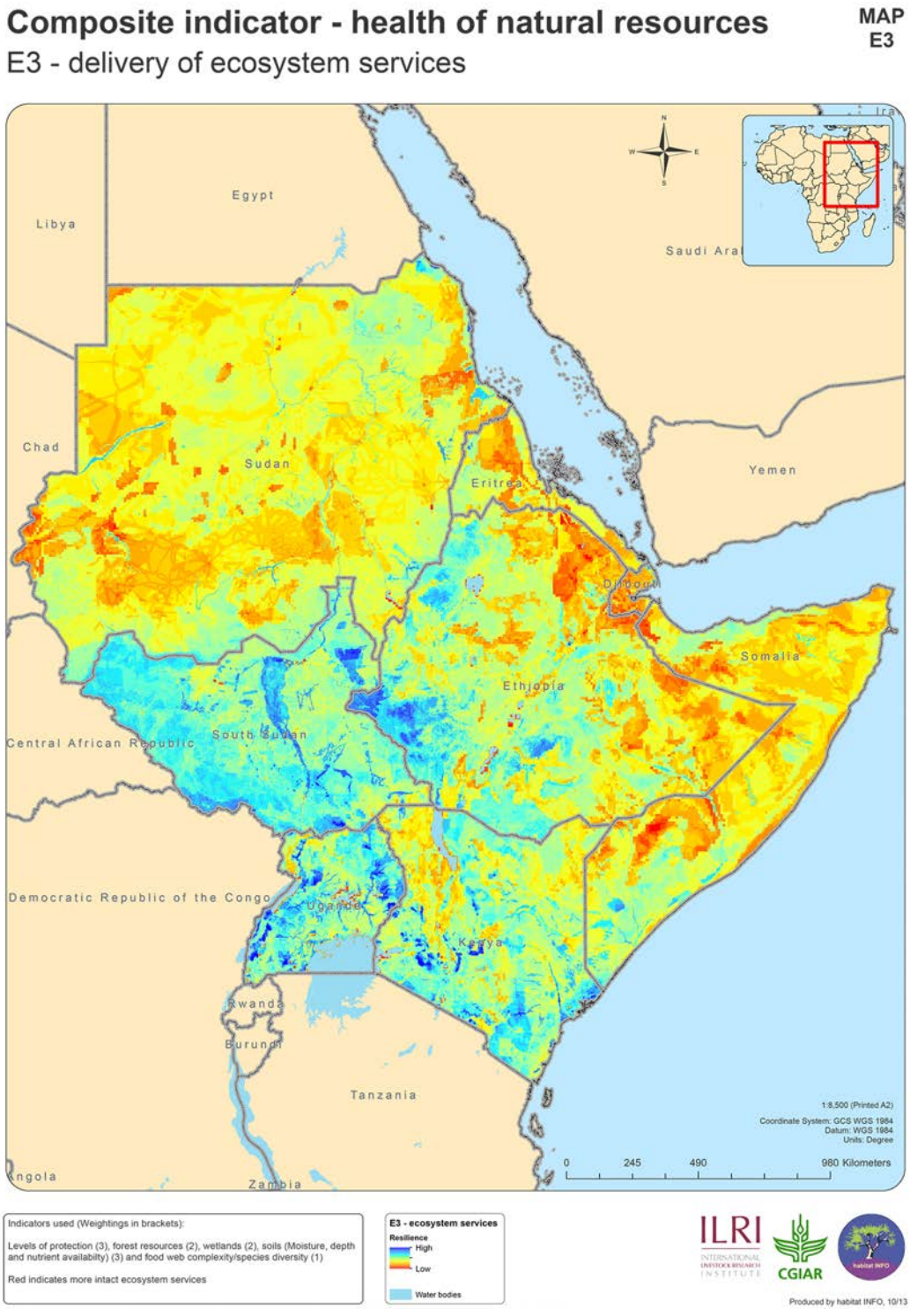
(CPP Sub-component 1.3: Biodiversity)

This composite collates best available data pertaining to ecosystem services. It includes the following indicator layers and weightings:

- levels of protection * 3
- forest resources *2
- wetlands * 2
- soil qualities *3
- vertebrate taxa richness (as an indicator of food web complexity) * 1

low services

high resilience

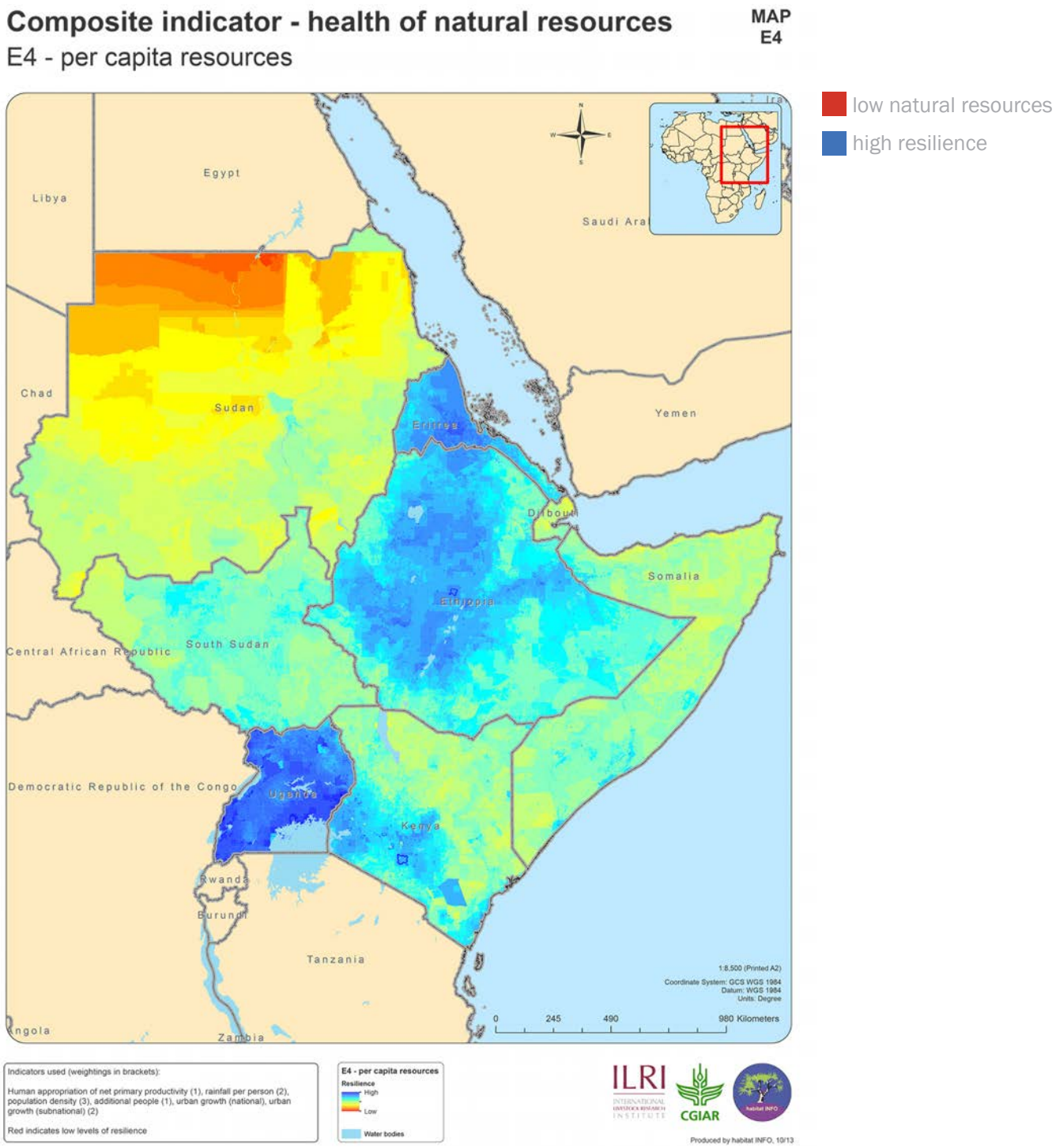


ENVIRONMENTAL 4: POPULATION & PER CAPITA RESOURCES

(CPP Sub-component: n/a)

This composite collates best available data pertaining to population density and per capita natural resources. The following layers are combined with the following weightings:

- rainfall per person * 2
- people living in water stress * 2
- human appropriation NPP * 1
- population density (AfriPOP) * 3
- urban population growth (national) * 1
- additional people to be accommodated (UNDP projection) * 1
- measure of agglomeration zones * 2



ENVIRONMENTAL 5: CLIMATE

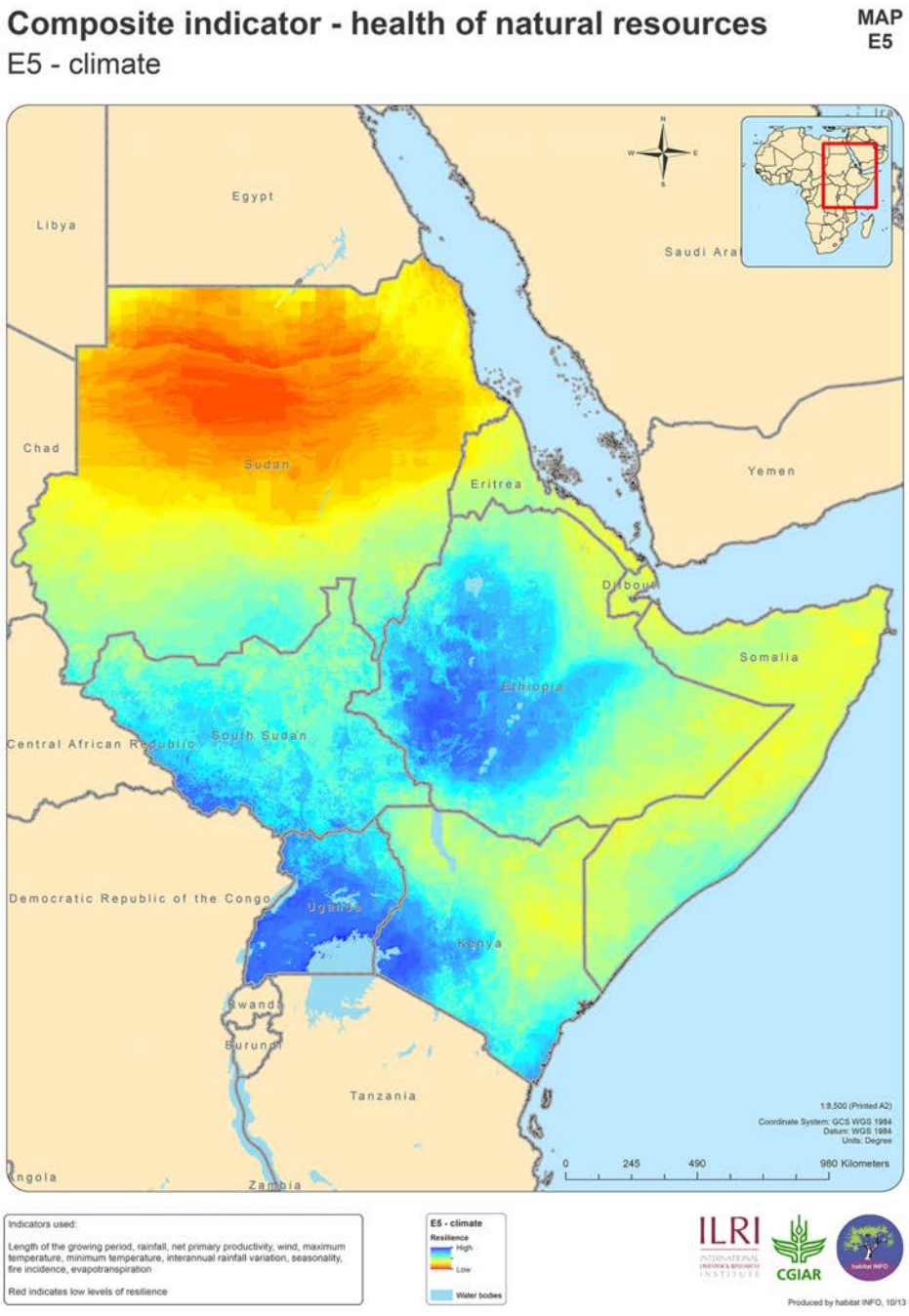
(CPP Sub-components 1.4 / 1.5: Renewable Energy / Climate Change / Adaptation / Mitigation)

This composite collates best available data pertaining to climate. The following layers are combined with the following weightings:

- rainfall * 1
- length growing period * 1
- net primary productivity * 1
- wind speed * 1
- maximum temperature extremes * 1
- minimum temperature extremes * 1
- inter-annual rainfall variation (IWMI) * 1
- inter-annual rainfall C.V. (TAMSAT) * 1
- standardised precipitation index * 1
- incidence of fire * 1
- evapotranspiration * 1

harsh climate

high resilience



ENVIRONMENTAL 6: NATURAL SHOCKS

During this project, reasonable datasets were collated for assessing the geographic likelihood of droughts and floods (including sea level rise and storm surges), earthquakes and fires. There are also limited data available on locust outbreaks. There is a data need to assess the geographic likelihood of pest (rodent and other insect) outbreaks, and disease epidemics relevant to livestock and wild animals (anthrax, rabies, further information on trypanosomiasis incidence etc). A worthwhile exercise would be the collation and analysis of information on the distribution and allocation of resources during interventions aimed at responding to emergencies associated with natural shocks ('dashboard tool').

Version 2 of the spatial tool can include likelihood of exposure layers for shocks with a specific geographic focus and a measure of this can be included in the output table by administration district. In using these measures however it should be borne in mind that shocks may have the greatest impact in areas where they are least expected and where people are least prepared for dealing with them.

Social and economic composite indicators

It is assumed that people are more resilient to shocks where they have access to good healthcare; where education levels are high; where governance is good; where they are supported by extensive material infrastructure; where they have good trade access; where financial services and conditions are favourable; where they are wealthy; and where they enjoy access to a diversity of livelihoods in rural areas.

Based on this assumption, each socio-economic composite indicator was reclassified on a scale of 1-30 and combined by addition with the following weightings:

- health 2
- education 2
- governance 3
- infrastructure 2
- trade access 1
- financial services 1
- wealth 3
- financial conditions 1
- income diversification 1

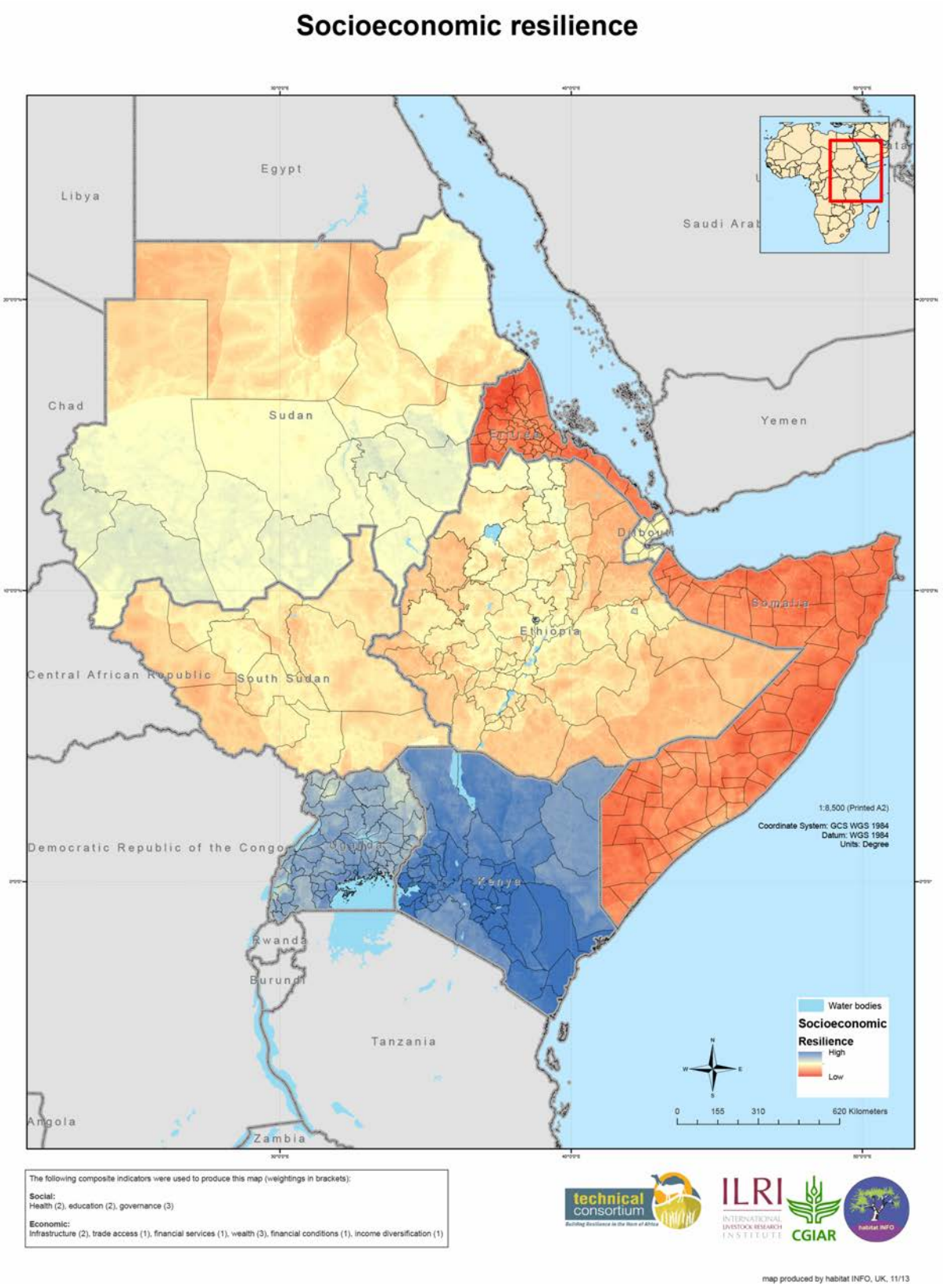
As with inputs, these weights are chosen on the basis of three criteria (in descending order of importance):

1. how important the composite indicator is considered to be with regard to socio-economic resilience
2. a confidence that the data in the layer truly represent the indicator
3. geographic resolution

The following map shows the overall system indicator for socio-economic resilience. Most of these indicators represent adaptive capacity conditions which may be expected to help or hinder populations in their recovery after a shock. People are expected to take a longer time to recover following a shock in red

areas due to low socio-economic resilience, and relatively short times to recover from a similar shock in blue areas due to high socio-economic resilience.

The map has an overlay of administration district level 2 for all countries except for Uganda which shows level 3. These are sourced from www.gadm.org. These are used for query by the spatial tool.



Social composite indicators

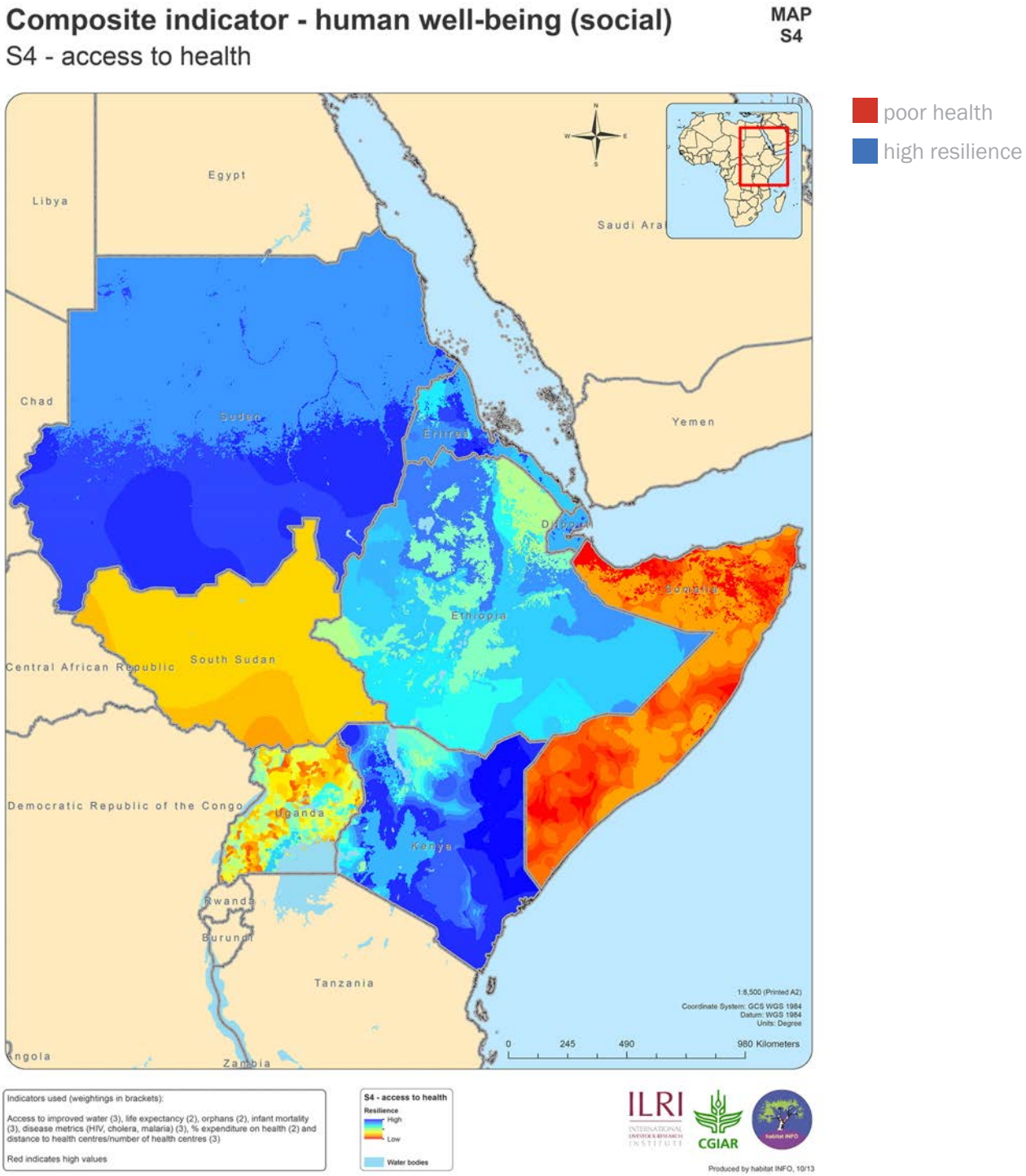
This system collates information on social infrastructure and support.

SOCIAL 4: HEALTH

(CPP Sub-component: n/a)

This composite collates best available data pertaining to health. It includes the following indicator layers and weightings:

- health expenditure * 1
- access to health care * 3
- access to improved water * 1
- life expectancy * 3
- orphans * 2
- infant mortality * 2
- disease impact * 3 (as a collation of malaria, cholera and HIV)



SOCIAL 5: EDUCATION

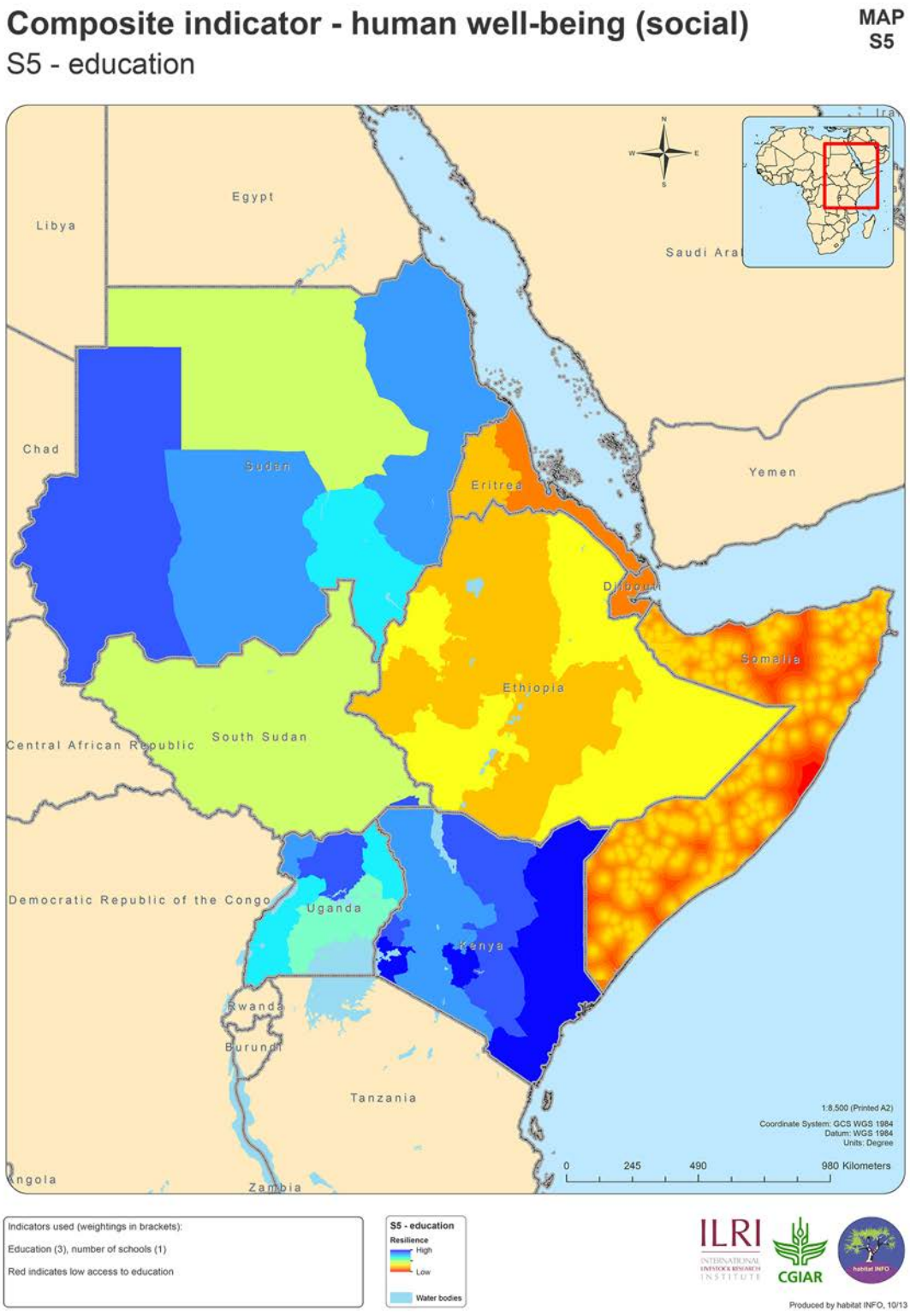
(CPP Sub-component: n/a)

This composite collates best available data pertaining to education services. It includes the following indicator layers and weightings:

- education level analysis *1
- distance to schools * 1

low services

high resilience



SOCIAL 6: GOVERNANCE

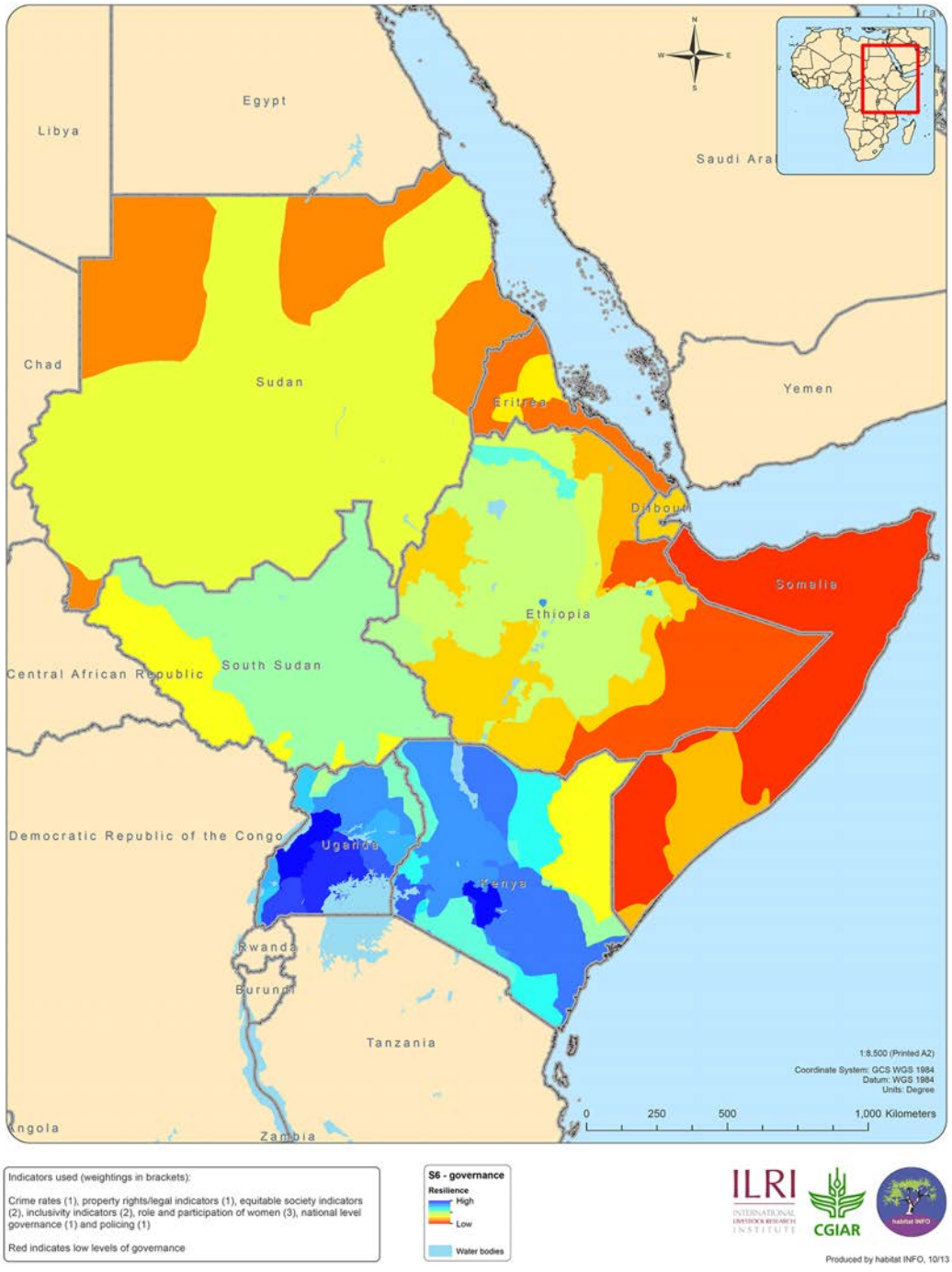
(CPP Sub-components 6.1 / 6.2: Conflict Resolution, Peace Building)

This composite collates best available data pertaining to governance. It includes the following indicator layers:

- crime rates * 1
- property rights / legal * 1
- proportions in upper and lower income brackets * 3
- transboundary communities * 2
- gender composite * 3
- Mo Ibrahim index * 1
- number of police * 1

Composite indicator - human well-being (social) **MAP S7**

S6 - level of governance

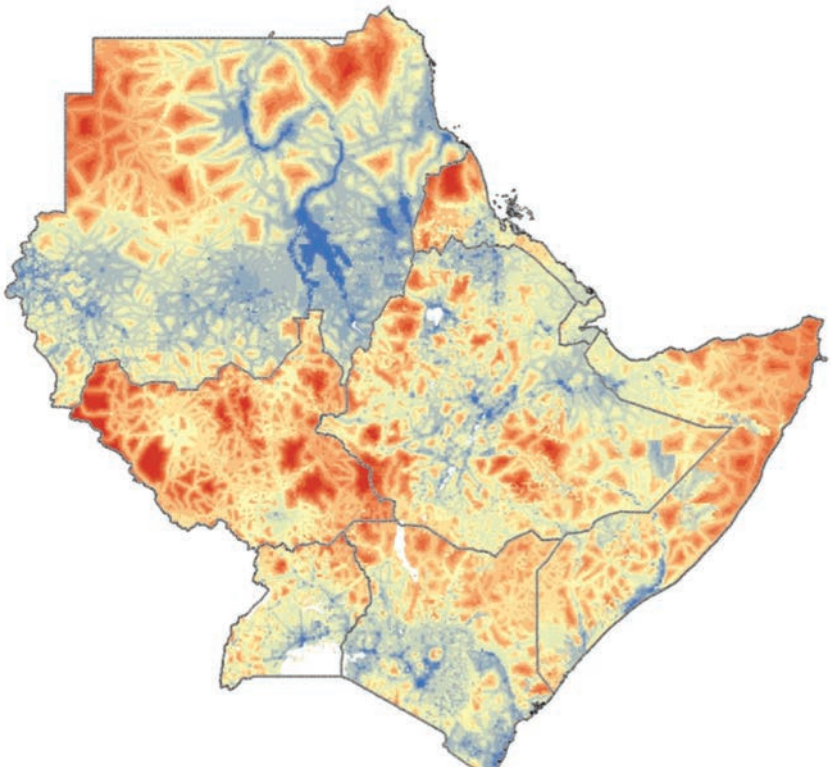


poor governance

high resilience

Economic composite indicators

This system collates information on material assets.



ECONOMIC 1: INFRASTRUCTURE

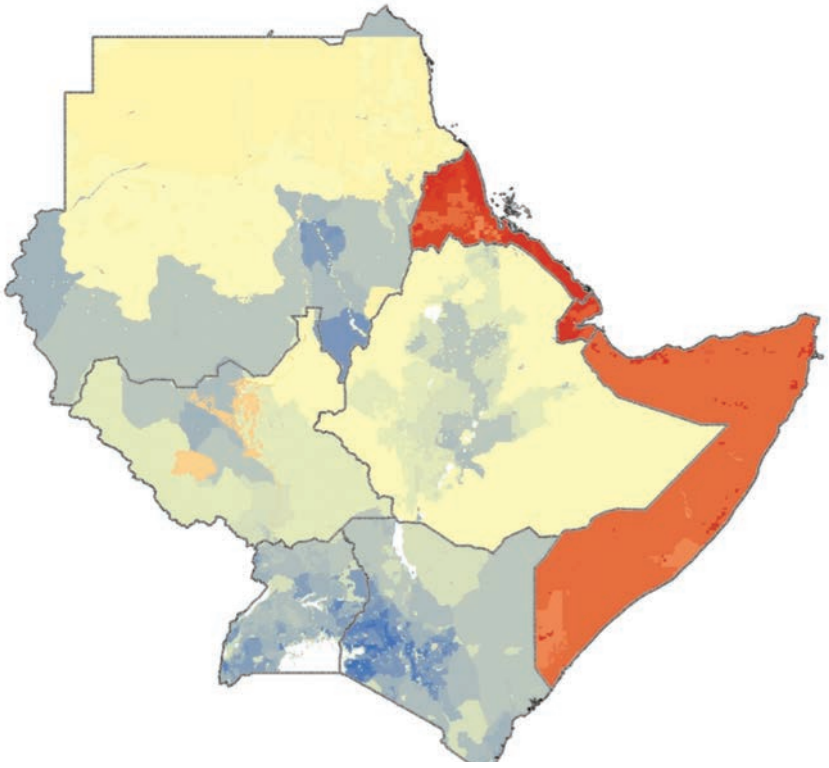
(CPP Sub-component 2.1: Transport & Market Development)

This composite collates best available data pertaining to infrastructure. It includes the following indicator layers and weightings:

- Lights at night * 2;
- Travel-time to nearest city (50k) * 3;
- Distance to nearest port * 1;
- Communication infrastructure * 1;
- Percent land under irrigation * 1;
- Irrigation potential * 1;
- Electricity infrastructure * 1;
- Distance to nearest airport * 1;
- Travel-time nearest market (20k) * 1;

poor infrastructure

high resilience



ECONOMIC 2: TRADE ACCESS

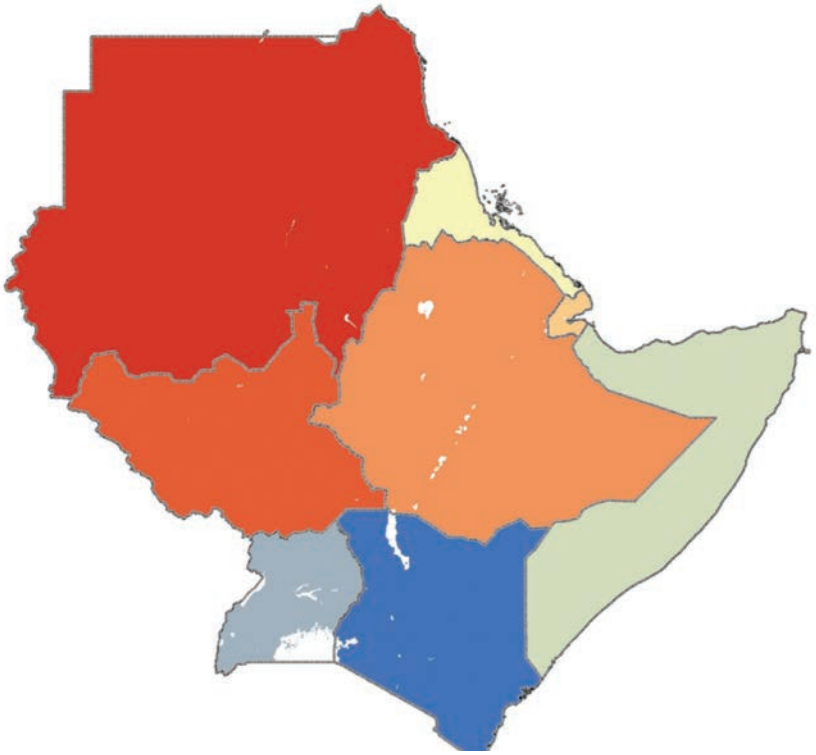
(CPP Sub-component 2.2: Securing Pastoral Mobility for Trade)

This composite collates best available data pertaining to education services. It includes the following indicator layers and weightings:

- ease of doing business * 1;
- livestock trade volumes * 1;
- exchange rate policy * 1;

low trade access

high resilience



ECONOMIC 3: FINANCIAL SERVICES

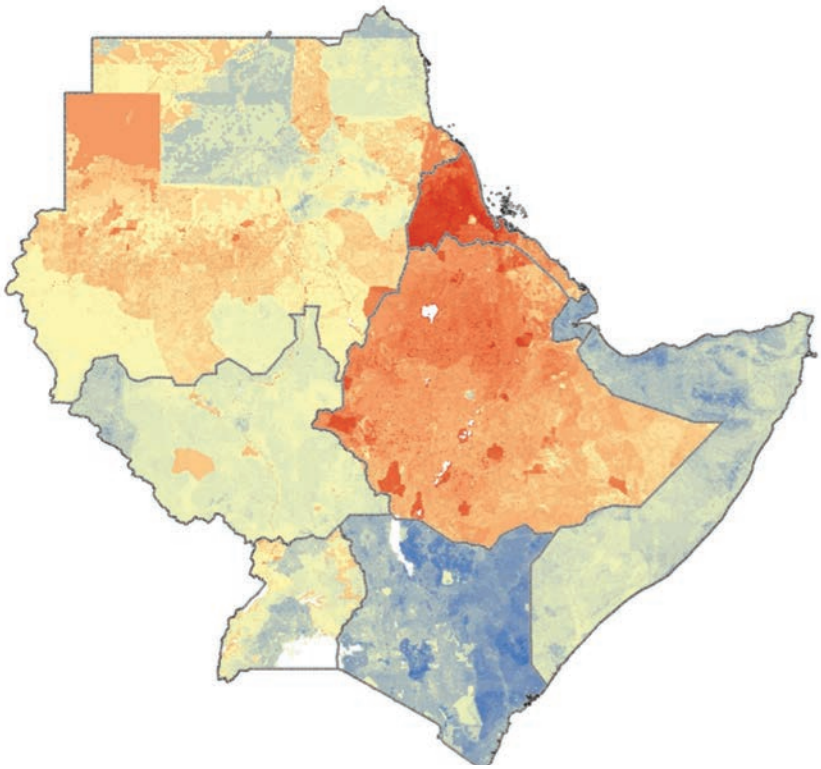
(CPP Sub-component 2.3: Securing Financial Transaction)

This composite collates best available data pertaining to education services. It includes the following indicator layer and weighting:

- Access to financial services * 1 (a collation of information on bank branches, ATMs, loans and savings);

low services

high resilience



ECONOMIC 4: WEALTH

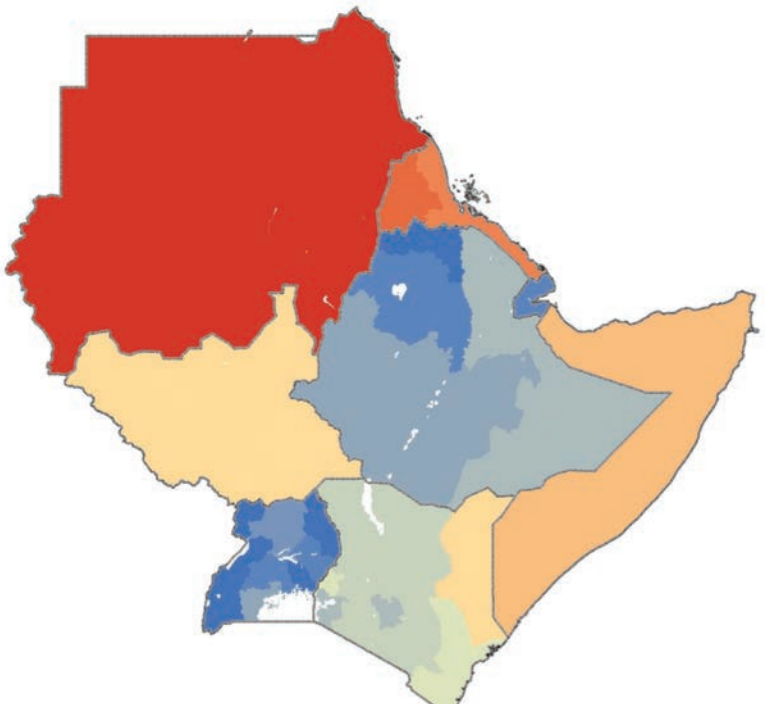
(CPP Sub-component: n/a)

This composite collates best available data pertaining to wealth. It includes the following indicator layers and weightings:

- tourism * 1;
- national GDP * 1;
- subnational GDP/km2 * 3;
- household assets * 1;
- agricultural assets * 1;
- diet statistics * 1;
- poverty infrastructure * 2;
- malnourishment children under five * 3;
- aid activity * 1;
- livestock per capita * 2

poverty

high material resilience



ECONOMIC 5: FINANCIAL CONDITIONS

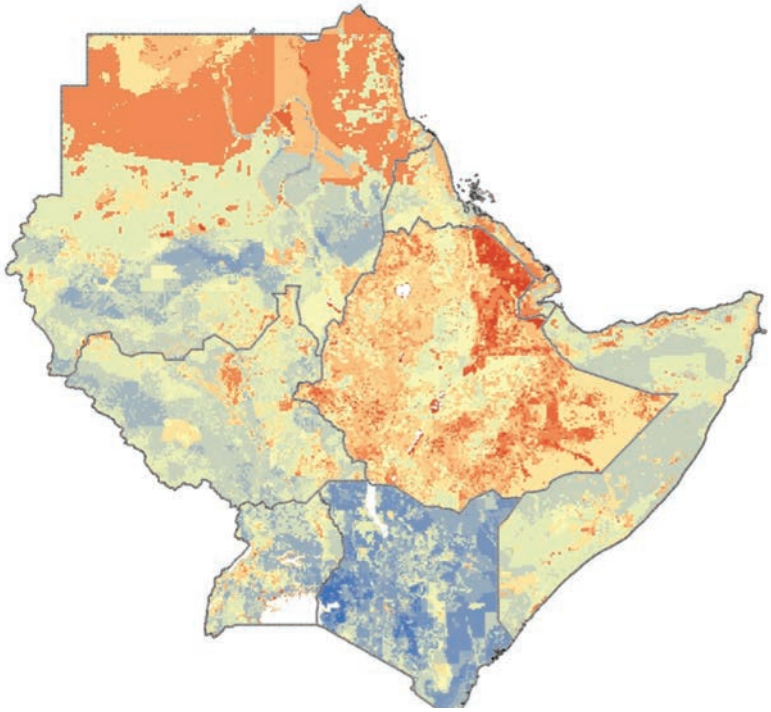
(CPP Sub-component: n/a)

This composite collates best available data pertaining to financial conditions. It includes the following indicator layers and weightings:

- Price stability *1;
- Interest rates * 1;
- Inflation rates * 1;
- Employment rates * 1

poor financial conditions

high resilience



ECONOMIC 6: INCOME / LIVELIHOOD DIVERSIFICATION

(CPP Sub-component 3.5: Income Diversification)

This composite collates best available data pertaining to income or livelihood diversity. It includes the following indicator layers and weightings:

- Livelihood diversity * 1;
- Livestock diversity * 1;
- Crop diversity * 1;

low diversification

high resilience

4

Challenges to the utility of a composite index in measuring changes in resilience composite indicators

JOSH BUSBY, TODD SMITH

While a more inclusive resilience measure, such as a composite index, may be better suited to represent the various pillars and indicators of resilience, its complexity limits its ability to be continually updated – as required by the variance of resilience scenarios. A model that relies on data that is irregularly updated or that has too many moving parts may provide an initial baseline snapshot but mat be too difficult to refresh on a regular basis. The sheer number of indicators in a composite index may prove difficult to replicate on a regular basis, given problems of data availability.

In any project level information, there needs to be an appreciation of baseline conditions in an area and a clear sense of what the project is trying to achieve. Composite indices are useful for baseline assessments of general conditions in an area, but they are only minimally informative for project-level monitoring and evaluation. While a resilience index could inform deliberations about baseline conditions in an area and changes over time, one could not use the index to evaluate whether or not a given project contributed to changes in an index over time. The geographic scale for which many resilience indicators are collected is simply at a higher level of aggregation with limited temporal coverage.

The International Livestock Research Institute (ILRI) works to improve food security and reduce poverty in developing countries through research for better and more sustainable use of livestock. ILRI is a member of the CGIAR Consortium, a global research partnership of 15 centres working with many partners for a food-secure future. ILRI has two main campuses in East Africa and other hubs in East, West and Southern Africa and South, Southeast and East Asia. www.ilri.org

CGIAR is a global agricultural research partnership for a food-secure future. Its science is carried out by 15 research centres that are members of the CGIAR Consortium in collaboration with hundreds of partner organizations. www.cgiar.org

The Technical Consortium for Building Resilience in the Horn of Africa provides technical support to IGAD and member states in the Horn of Africa on evidence-based planning and regional and national investment programs, for the long-term resilience of communities living in arid and semi-arid lands. It harnesses CGIAR research and other knowledge on interventions in order to inform sustainable development in the Horn of Africa. www.technicalconsortium.org