The 2015-2016 Drought in South Africa

National Outcome Forecast Analysis

Analysis of Fourteen Livelihood Zones in Limpopo, KwaZulu-Natal and Free State Provinces, with a Synthesis for the Remainder of the Country

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- Statistics South Africa
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Glossary, Terms and Abbreviations

ARC	Agricultural Research Council
ARC-ISCW	Agricultural Research Council – Institute for Soil, Climate and Water
ASI	Agricultural stress index
CEC	Crop Estimates Committee
CRS	Coordinate reference system (same as SRS)
DAFF	Department of Agriculture, Forestry and Fisheries
FAO	United Nations Food and Agriculture Organization
FAO-GIEWS	United Nations Food and Agriculture Organization – Global Information and Early Warning System
GIS	Geographic information system
LZ	Livelihood zone
NAMC	National Agriculture Marketing Council
NOFA	National outcome forecast analysis
RFA	Rainfall anomaly
SPI	Standard precipitation index
SRS	Spatial reference system (same as CRS)
VCI	Vegetation condition index
VHI	Vegetation health index

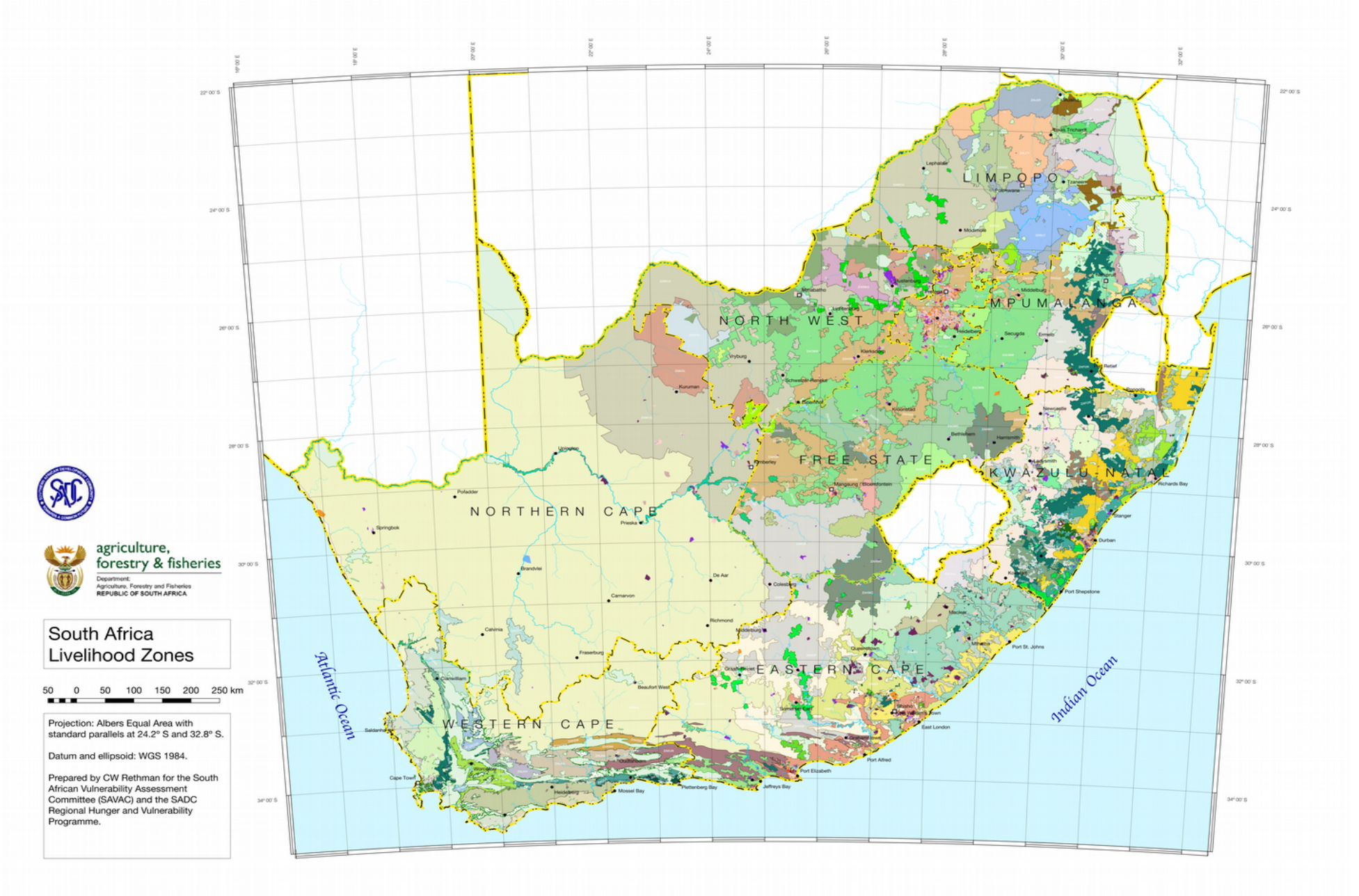

Figure 1: National Livelihood Zone Map of South Africa

South Africa - Livelihood Zones - Legend

Executive Summary

Introduction

The Department of Agriculture, Forestry and Fisheries (DAFF), in collaboration with the Southern African Development Community (SADC) Regional Vulnerability Assessment and Analysis (RVAA) Programme, is working towards strengthening food insecurity and vulnerability assessment in South Africa. Through this partnership, a number of activities have been conducted towards institutionalisation of the South African Vulnerability Assessment Committee (SAVAC). The activities include:

- A scoping study, a strategic plan and the formation of Provincial VACs in three provinces;
- Baselines assessments in Limpopo province;
- An outcome forecast assessment in Limpopo, and;
- Baselines assessments in Free State and KwaZulu-Natal provinces.

However, during 2015 and 2016 two events have had enormous impact on the lives of the country's poorest people: the occurrence of a severe drought resulting from an extreme El Niño event and the progressive devaluation of the Rand, the country's local currency. The former has impacted on farmers' ability to produce food locally, and the latter has substantially pushed up the price of imports.

In order to understand how these factors impact down stream on households access to quality food, we need to first understand how those households make a living. This necessitates understanding *the sum* of the different strategies they use to obtain enough food, to acquire the services and other goods they need to achieve the acceptable standard of living.

The size and complexity of South Africa as a country requires the vulnerability assessment system to be decentralised to provincial level or through the establishment of Provincial Vulnerability Assessment Committees (PVACs). The first provincial vulnerability assessment committee (PVAC) formed was the Limpopo VAC (LimVAC) and further PVACs have been formed in KwaZulu-Natal and Free State. As result of these efforts, full baselines with livelihoods and food security indicators' assessments have been carried out in *fourteen livelihood zones* by 29 April 2016.

The SAVAC uses a system that combines the Household Economy Approach (HEA), which provides a longitudinal or temporal picture of the *depth* of changing household food access and living standards, with the Food Security Continuum (the 'Continuum'), which provides a detailed cross-sectional 'snapshot' description of people and household under different food security indicators. The basic principle underlying the Household Economy Approach is that the understanding of local livelihoods is essential for analysing the impact (at household level), of shocks such as drought, conflict or market changes. The Household economy analysis establishes a picture of typical, normal livelihood patterns for households in different geographical areas, in order to understand a range of conditions that local communities must cope with in a normal year as its baseline assessment.

Obviously, it is not practical to analyse in detail the various components of each and every household's livelihood in the country, so a level of aggregation needs to be applied.

The baseline assessment also focuses on understanding the various household sources of food, income and expenditure patterns among the four wealth groups ('Very Poor', 'Poor', 'Middle' and 'Better Off') defined by community key informants. It also explores issues related to household vulnerability as well as the coping strategies and options they undertake during bad years.

The baseline information is then used as a reference point for modelling the likely effects of shocks such as drought, floods and market failure. These shocks may affect people's ability to maintain their livelihoods or in extreme cases, they could be life-threatening. Any external response to these shocks needs to be based on the provision information and analysis, which gives solid guidance for short, medium and long term relief, recovery and development initiatives.

The purpose of the forecast scenario analysis exercise was to establish whether livelihoods of the household in the area covered by the zones have been affected, compared with the baseline outcomes. This will be used to demonstrate the approach and provide recommendations for appropriate policy action.

A team of twenty eight personnel, trained in vulnerability assessment and analysis methodologies, was engaged in defining problem specifications and modelling the possible effects on households. Crop

failure may, for example, leave one group of households without anything to eat if crop production is their main source of food but another group may be able to cope because they have alternative sources of food and income that can make up for lost crop production.

Baseline data was used to determine the key parameters that needed to be analysed and these included crop and livestock production, prices, and government assistance programmes among others. The SAVAC also consulted Department of Agriculture Officers in the municipalities within the livelihood zones and villages to seek their technical input and participation in the forecast analysis data collection.

This report focuses on the current agricultural season in terms of general rainfall and weather conditions, crop and Livestock production and household sources of food and cash income.

The analysis combines current year monitoring data with baseline data to project the most likely scenario in the quarter of the 2015/16 consumption year.

A Summary of the Assessment Process

The process of baseline livelihood profiling started in 2014 with a livelihood zoning exercise, given the significance of geography as a determinant of livelihood patterns. A livelihood zone was visited and the next step was to define the wealth groups in the livelihood zone as wealth determines options available to the household for access to food and income.

Having patterned households according to where they live and their wealth[1], the next step was to generate baseline livelihood profiles for typical households in each wealth group for a defined baseline or reference consumption year. An understanding of food access is gained by investigating the sum of ways households obtain food; that is, how much food they get from their own direct food crop production, their livestock, gifts from others, exchanges or barters and from purchases. To understand the latter, information is also collected on how much cash income is earned in a year and what essential needs are met with the earned income.

Once the baseline is established, analysis can be made on the likely impact of a shock or hazard in the current year. This involves assessing how food access will be affected by the shock, what other food sources can be added or expanded to make up for the initial shortfall, given households' asset holdings and capacity to earn more. After all these factors are considered, final deficits emerge once households have exhausting all their coping strategies. The SAVAC used the period April 2013 to March 2014 as the baseline or reference consumption year and therefore the current analysis reflects the impact of current problems for the forecast period of 2013 to 2014.

The key parameters evaluated in April 2016

Using the baseline profiles, key parameters of change in each livelihood were identified. Each parameters affects a particular source of food, source of income or expenditure by changing either the amount of that source or its price. Examples of key parameters are the crops grown by households, their livestock, their labour, the social grants they receive from government and the food and non-food items that they purchase. With consumption, foodstuffs are grouped into staple and non-staple, and are combined with non-food expenditure to be compared with accepted standards, such as the Food Poverty Line (FPL), the Lower Bound and Upper Bound Poverty Lines (LBPL and UBPL).

Key parameters *always* compare the consumption year under review (in this case the period from April 2016 to March 2017) with the baseline consumption years (in all livelihoods it is the period from April 2013 to March 2014). An important characteristic of key parameters is whether they are *known* or *unknown*: known parameters are those which impact on livelihoods early in the consumption year and thus have already occurred, allowing their measurement, while unknown parameters have yet to occur during the consumption year and so cannot be measured. Of course, with the consumption year under review only just having started, there remain a lot of unknown parameters, which can only be included by constructing *scenarios*.

The key parameters assessed included:

- Household own-production and how this year it compares with that in the baseline year March 2013;
- Household access to food from agricultural labour exchange and how this compares with the baseline year;
- Access to food from livestock products and how this compares with the baseline year;
- Quantities of income-activities in the current year from crop sales, livestock sales, agricultural labour, other casual labour, petty trading, access to social grants and other income activities that vary across wealth groups, compared with the baseline;
- The prices of maize and livestock in the current year compared with baseline year prices;

1 Wealth is defined in terms of asset holdings and incomes

- The price of items in the minimum non staple basket (soap, paraffin, matches, sugar, Tea and salt), and the essential expenditure basket (education, medical, ploughing, seed, livestock treatment, cooking oil, clothing and grinding costs).

Comparison of key parameters data for 2013 with 2014 was done and the findings from this analysis formed the current year problem specification for scenario modelling.

Methodology

Household Economy Approach

The South Africa Vulnerability Assessment Committee (SAVAC), conducts assessments and analysis using a livelihoods based analytical framework, called the Household Economy Approach (HEA), for modelling its forecasts. There are four steps in a household or food economy analysis. The first two are concerned with dividing the population into groups of households that share similar characteristics in terms of their access to food and income. The assumption underlying these two steps is that access to food and income is determined by two factors; geography and economic status (i.e. relative wealth). While geography (where a household lives) determines the options for obtaining food and income, wealth generally determines a household's ability to exploit those options. The third step involves developing a baseline picture of food access, income and expenditure for each wealth group. The fourth and final step is to combine information on baseline access with that on hazard and response in order to generate projections of future food and income access; the process can be summarised thus: Baseline + Hazard + Response = Outcome. The HEA methodology provides an opportunity for field officers to probe during discussions while at the same time observing the surrounding and non-verbal communication signs.

The HEA methodology has been widely adopted in most Member States in the SADC Region. The methodology saves on resources and time, making it affordable and sustainable under small budgets. The methodology also attempts to maximise the use of existing information and survey data. Besides data generated using HEA, SAVAC also uses a range of secondary sources of data such as the crop estimates from the Department of Agriculture, population projections from the Stats SA, inflation rates from Stats SA and price data from NAMC. The field exercise therefore provides an opportunity to verify secondary data with that obtained from the province, district and municipalities as well as the villagers.

The Entire Process

In order to achieve the objectives laid out, this exercise was broken down into thirty-one steps:

Preparation of the Baselines

1. Prepare a synthesis-baseline for farm workers;
2. Prepare a synthesis baseline for the urban poor;

Preparation of the analysis spreadsheets;

3. Prepare analysis spreadsheets for all assessed and completed livelihood zones;
4. Prepare synthesis analysis spreadsheets for the remaining open access livelihood zones in the country;
5. Prepare analysis spreadsheets for farm workers and for the urban poor;

Collecting data from secondary sources

6. Collect secondary source data for crop production, largely from the Crop Estimates Committee (CEC) for each harvest from 2013 onwards;
7. Collect secondary source satellite imagery and climatic spatial data (for example, the Standard Precipitation index);
8. Collect secondary source data for price problem specifications;

9. Collect secondary economic forecasts such as inflation, gross domestic product (GDP) and gross national product (GNP) growth rates;

Defining the hazard area and getting crop production problem specifications

10. To define the "hazard-affected" spatial area in the country, review and choose from the various rainfall and vegetation maps and remote sensing raster images;
11. Use a desktop Geographic Information System (GIS) to geo-reference the raster image or convert the origin rainfall vector feature set to the map coordinate reference system (CRS);
12. For raster images, in the desktop GIS, convert the colour remote sensing images to greyscale if the image contains more then one colour (for example, from red to yellow to green) by applying different weightings on each primary colour (red, blue and green) to ensure that each colours does not overlap with another colour's grey shade value (e.g. dark green must be a different grey value from dark red);
13. Remove the any lines or borders within the image by filtering out all-black or dark grey pixels (which should be beyond the darkest colour shade);
14. Convert the raster image to vector polygons ('polygonise' or 'vectorise'), with an attribute in the polygon table holding the greyscale value.
15. Import the vector feature set into a geo-spatially enabled database (such as PostGIS) for further operations;
16. Switch the greyscale values to text values representing the range of covered by each colour in the original raster image. This should result in an ordinal text value that traverses the remote sensing image from its lowest value range to its highest range;
17. Filter out all polygons smaller than nine pixels;
18. Buffer the resultant polygons to make sure that they overlap one another that polygons separated by only one pixel will be combined;
19. Union ("dissolve" in ESRI parlance) the resultant filtered polygons in single multi-polygon for the remaining "hazard-affected" areas (which can be dumped to obtain separate single-polygon features, if needed);
20. Select an appropriate cut-off for the vector layer on the new ordinal value column, so only the "hazard-affected" (in the current case, "drought-affected") areas are shown;
21. Remove any edge boundaries or other image paraphernalia by cropping the image to a polygon that defines the area of interest.
22. Compile the crop estimate data to obtain provincial commercial crop problem specifications and national 'subsistence' crop problem specifications;
23. Overlay ("intersect" and "union", in ESRI parlance) the "hazard-affected" area polygons onto the crop national crop areas
24. Assuming the unaffected areas are at or close to normal crop production (100%), calculate the problem specification for the affected areas using the crop estimates problem specs from (21) above.

Run the outcome analysis on the spreadsheets

25. Enter all the problem specifications in all the outcome analysis spreadsheets (this can be done strategically to save time, by entering basic problem specifications that are the same and then copying file with variants on them;
26. Collect all the outcomes (food deficit, food poverty line deficit, lower bound poverty line deficit and upper bound poverty line deficit) for each wealth group in each scenario in each livelihood zone into a single large table.

Attribute the analysis to populations and calculate the totals

27. Overlay ("intersect" and "union", in ESRI parlance) the "hazard-affected" area polygons onto the enumeration small areas (SAs), and assign an attribute "hazard affected" as well as the month and date to a new table of small areas;
28. Review the nature of the problem specifications for the livelihood zones analysis. In the case of the current NOFA there are *four scenarios* for each livelihood zone: *drought-affected* versus *normal* and *grant-receiving* versus *non-grant-receiving;*
29. Compute other problem specifications that are general or the same for all livelihood zones, such as general rates of inflation, price changes, etc.;
30. Create pivot tables for each outcome;
31. Map the numbers of people (or percentages of people) affected for each outcome;
32. Map the amounts of deficit for each outcome.

This involved a considerable amount of processing. To get the job done quicker, scripts were written and applied to many of the processes. Fortunately, this can be done given modern software and database tools such as Postgres, PostGIS, NodeJS and the QGIS desktop mapping application (with its many plugins).

The outcomes are presented as maps and as tables in pages….

Findings

The following draws on the steps outlined above.

The Baselines

Farm Workers (Step 1)

Urban Poor (Step 2)

The Analysis Spreadsheets

Existing baselines (Step 3)

Other Open Access Livelihood Zones, Farm Workers and the Urban Poor (Step 3 to 5)

Secondary Source Data (Step 6 to 9)

This analysis was completed entirely with data from secondary sources. Normally, when an assessment of this nature is undertaken, some primary data will still be captured and used alongside that from the secondary indicators. This helps to 'ground truth' the analysis, as well as filling in the indicator gaps that monitoring systems often leave out in livelihoods, such as: casual labour opportunities, informal or petty trading, crafts and self-employment.

Hazard Definition and Problem Specification

The hazards people face can be broken into two types: spatial and non-spatial. Spatial hazards are those that are confined to particular geographical areas (such as crop failures resulting from drought or floods), whereas non-spatial hazards are those that afflict people (but not necessarily all people) in all areas (such as a general rise in prices or changes to social development policies).

With both hazard types, a determination needs to be made for those that experience the hazard versus those that do not.

Usually, a combination of approaches are applied to arrive at a spatial definition of the hazard. The first approach is to use some sort of spatial hazard data, such as remote sensing images, while the second approach is to look at the production factors of interest (for example, crops or livestock).

Climatic Spatial Data and Remote Sensing (Step 10)

The author looked at several types of remote sensing data sets and these include:

- Rainfall deviation from satellite images (source: FAO);
- Rainfall deviation from local sources (source: ARC-ISCW);
- Standard precipitation index (SPI) (source: ARC-ISCW);
- Normalised differential vegetation index (NDVI) (source: FAO-GIEWS);
- Vegetation condition index (VCI) (source: FAO-GIEWS);
- Vegetation health index (VHI) (source: FAO-GIEWS); and
- Agriculture stress index (ASI) (source: FAO-GIEWS).

At first glance, the agricultural stress index (ASI) appeared to be the simplest and most attractive set to use to determine hazard areas, with a historical set of images for each dekad that shows how, where and when the drought developed to it most devastating. **Figure 2** the development of the drought over the months from November 2015 to February 2016. The ASI has the advantage that it is a combination of a range of factors that affect crop performance, so in many ways it is good for establishing a problem specification. However, it also suffers some disadvantages:

- The ASI focusses only on crops, while in many affected parts of the country livestock are the key productive components; and
- The ASI only shows results for the current cropping season, so areas with different seasonal priorities (such as winter rainfall) have to come from a different set of images.

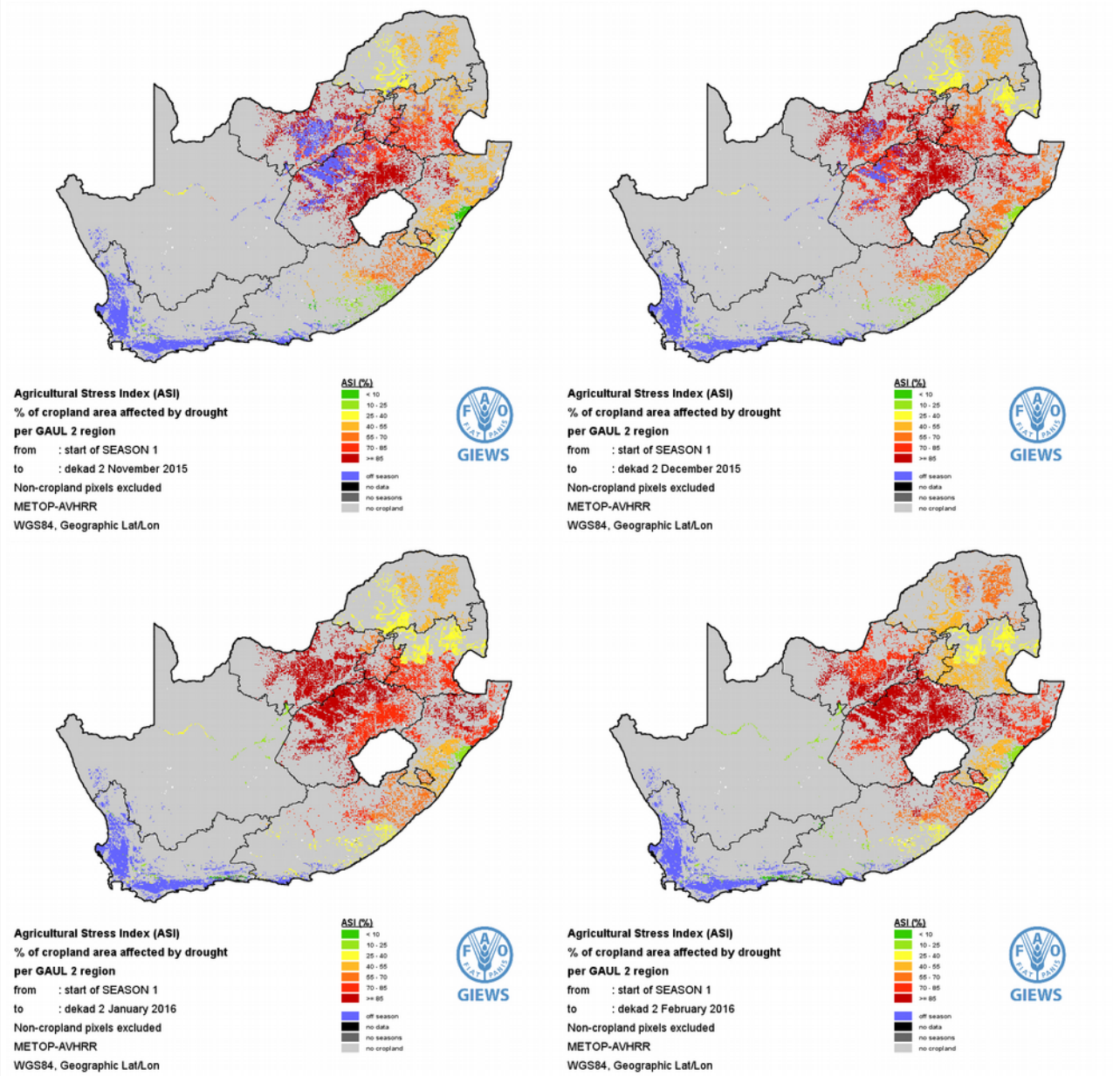

Figure 2: Agricultural stress index (ASI) remote sensing maps for the second dekad of November 2015, December 2015, January 2016 and February 2016 (source: GIEWS, FAO http://www.fao.org/giews/earthobservation/country/index.jsp?lang=en&code=ZAF#). The images are reproduced as provided by the source, with longitudes and latitudes mapped to a cartesian plane, based on the World Geodetic Survey 1984 origin and ellipsoid.

Nevertheless, the images in **Figure 2** do show the extent of crop failure: the dark red areas of North West, Free State and northern KwaZulu-Natal, as well as the red or orange parts of KwaZulu-Natal, Eastern Cape and Limpopo. Note, the winter rainfall Western Cape and the vast area under livestock grazing in North West, Northern Cape and Free State do not show up.

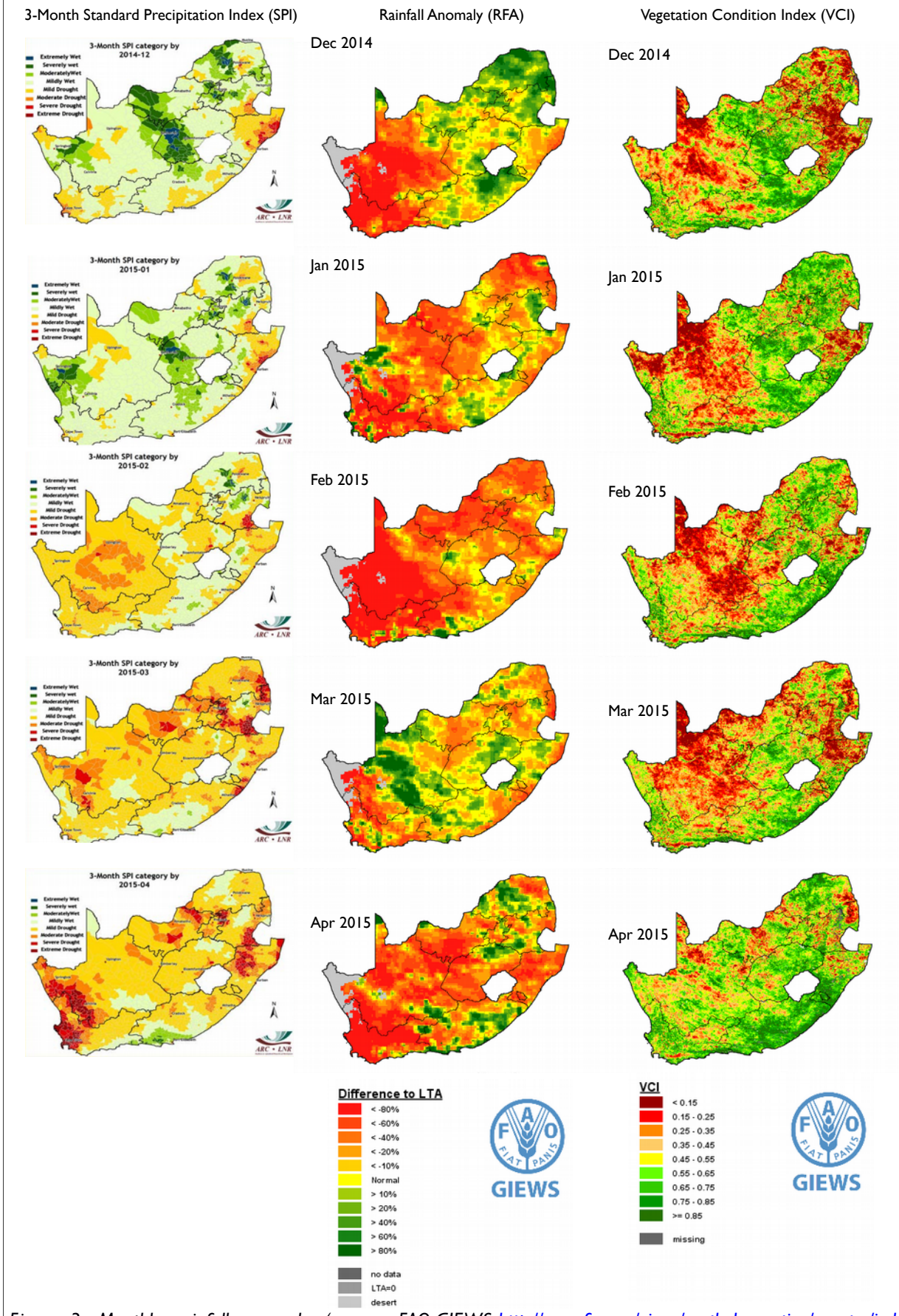

Figure 3: Monthly rainfall anomaly (source: FAO-GIEWS http://www.fao.org/giews/earthobservation/country/index.jsp?lang=en&code=ZAF#), vegetation condition index (Source: FAO-GIEWS) and standard precipitation index (Source: ARC-ISCW http://www.arc.agric.za/Pages/Newsletters.aspx#k=UMLINDI) from December 2014 to April 2015. The images are reproduced as provided by the source, with longitudes and latitudes mapped to a cartesian plane, based on the World Geodetic Survey 1984 origin and ellipsoid.

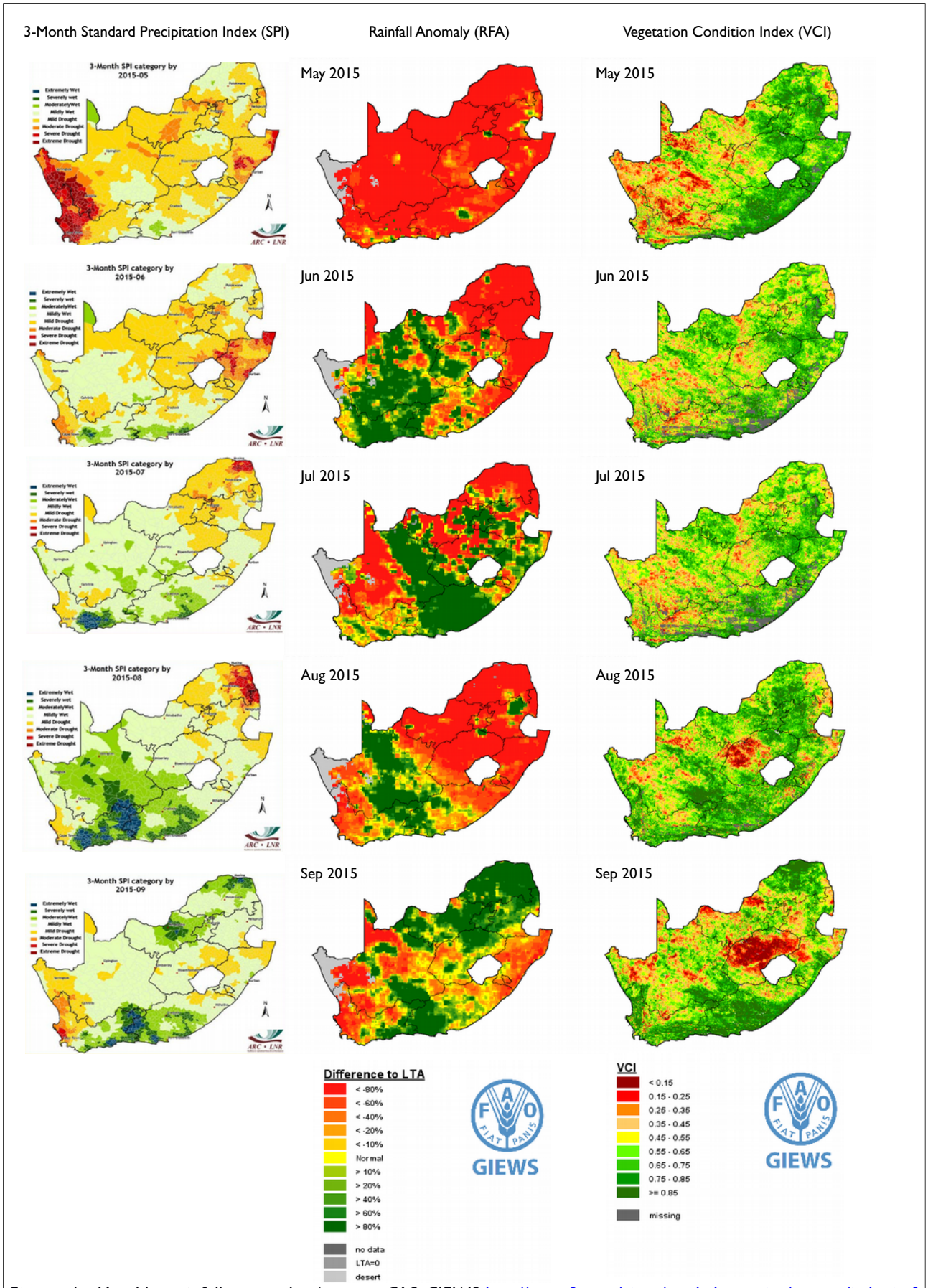

Figure 4: Monthly rainfall anomaly (source: GAO-GIEWS http://www.fao.org/giews/earthobservation/country/index.jsp?lang=en&code=ZAF#), vegetation condition index (Source: FAO-GIEWS) and standard precipitation index (Source: ARC-ISCW http://www.arc.agric.za/Pages/Newsletters.aspx#k=UMLINDI) from May to September 2015. The images are reproduced as provided by the source, with longitudes and latitudes mapped to a cartesian plane, based on the World Geodetic Survey 1984 origin and ellipsoid.

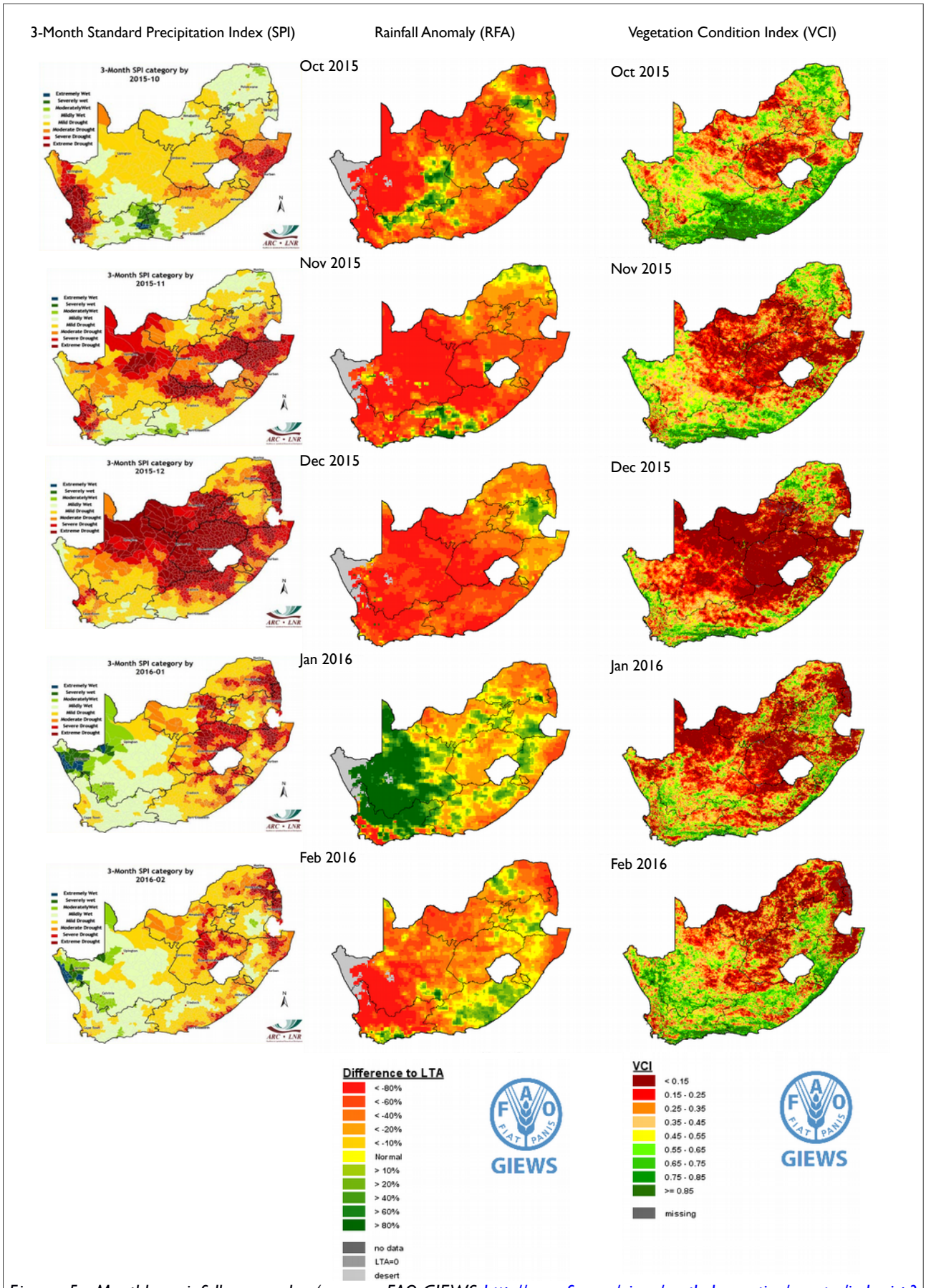

Figure 5: Monthly rainfall anomaly (source: FAO-GIEWS http://www.fao.org/giews/earthobservation/country/index.jsp?lang=en&code=ZAF#), vegetation condition index (Source: FAO-GIEWS) and standard precipitation index (Source: ARC-ISCW http://www.arc.agric.za/Pages/Newsletters.aspx#k=UMLINDI) from October 2015 to February 2016. The images are reproduced as provided by the source, with longitudes and latitudes mapped to a cartesian plane, based on the World Geodetic Survey 1984 origin and ellipsoid.

Therefore, the analyst considered precipitation and vegetation maps for more information.

Precipitation, when compared with the long term average as in the rainfall anomaly (RFA), is an important determinant, although crop and grazing conditions depend as much on the *distribution* of rainfall as they do on the total amount that fell. The standard precipitation index (SPI) takes these factors into account (SPI - McKee et al., 1993) and was formulated to display drought events from rainfall data by quantifying precipitation deficits on different time scales. Spatially, the data are grouped per quaternary catchment for each time period and are based on the historical distribution of rainfall. The time period chosen here is the three-month average, so each image (for each month) represents a moving average over 24 months, twelve months, six months, three months and a single month for that particular month. These are published by the Agricultural Research Council's Institute For Soil, Climate And Water (ARC-ISCW) in their monthly publication "*Umlindi* – the Watchman".

Lastly, the condition of the vegetation shows the impact of rainfall (or the lack of it) on the actual crops and grazing. The vegetation condition index (VCI) has been chosen here.

Figures 3, 4 and 5 contain a time series of SPI, RFA and VCI, starting in December 2014 (in 2014 there was a localised drought in North West Province) and running up until February 2016. The SPI images are for three-month categories, which means they are like a three-month moving average ending at the particular month (e.g. the three-month SPI for November 2015 is the SPI for September, October and November 2015).

The development of the drought is clear. It began in the north of KwaZulu-Natal in December 2014, spread up to southern Mpumalanga in February 2015 and on to North West in March 2015, afflicting Free State in October 2015. The drought reached its worst in December 2015, with the rains finally arriving in the summer rainfall regions in January 2016. A month after the onset of these rains, the natural vegetation was showing recovery, although the cropping season was lost for much of North West, Free State, Northern Cape, northern KwaZulu-Natal, northern Eastern Cape, the lowveld of Mpumalanga and Limpopo and the Swartland area of Western Cape.

The vegetation condition image for January 2016 was chosen because it captures the after-effects of the previous months' low rainfall, as well as the relief that some parts of the country received that month for the limited rains.

Georeferencing, conversion of colour raster images to single-value vector format (Steps 11 to 16)

Much of the analysis depends on ground area measurements, for example the land area common between two overlapping variables. However, considering that the analysis is also at national scale, the maps reprojected to the South African Albers Equal Area Conical coordinate reference system (CRS). This was done by georeferencing the VCI raster image for January 2016 to the South African Albers Equal Area CRS[2] and the result is shown below in Figure 6. The colours in the image where the drought was worst are those with a value less than 0.35, that is: dark red, red and dark orange. The analyst was unable to obtain the original images with pixel values representing the VCI value, so the colour spectrum from this image was converted to suitable values. This was done by converting the pixel colours to greyscale, adjusting the red and green shades so that they do not have the same grey values (dark red and dark green can convert to the same grey shade, but obviously they represent opposite values on the image). This way, the green and red coloured pixels are staggered from one another in terms of grey shading. The result is shown below in Figure 7; note the greyscale value in square brackets (e.g. "[RGB=151]") after the VCI value on the legend.

The country and level 1 boundaries in the raster images needed removal. Fortunately, this was easily done by filtering the greyscale image on black and very dark values. It did, unfortunately, also leave 'holes', 'gashes' or blank values where the lines used to be.

2 The shape of South Africa, which has greater east-west width than north-south height, is suited to a conical projection. If the standard parallels are chosen correctly, Albers Equal Area gives a good representation of land area throughout the country, at the expense of distorting directional accuracy (except along the longitude of centre) and polygon shapes. The standard parallels used in all national maps with this projection are 24.2° S and 32.8° S, with the longitude of centre at 25.1° E. The projection uses the World Geodetic Survey 1984 datum and ellipsoid and measurements are in metres.

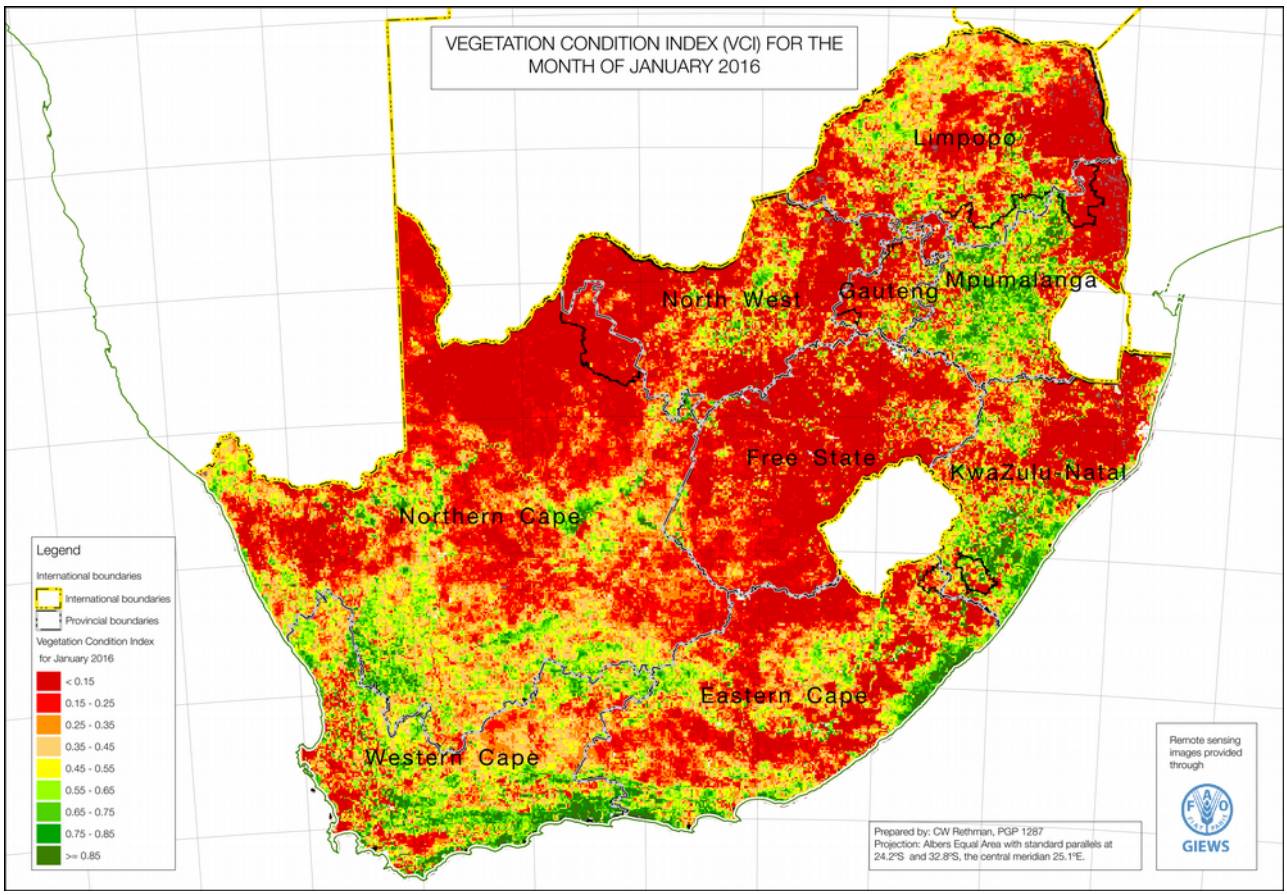

Figure 6: VCI image corrected to the South African Albers Equal Area

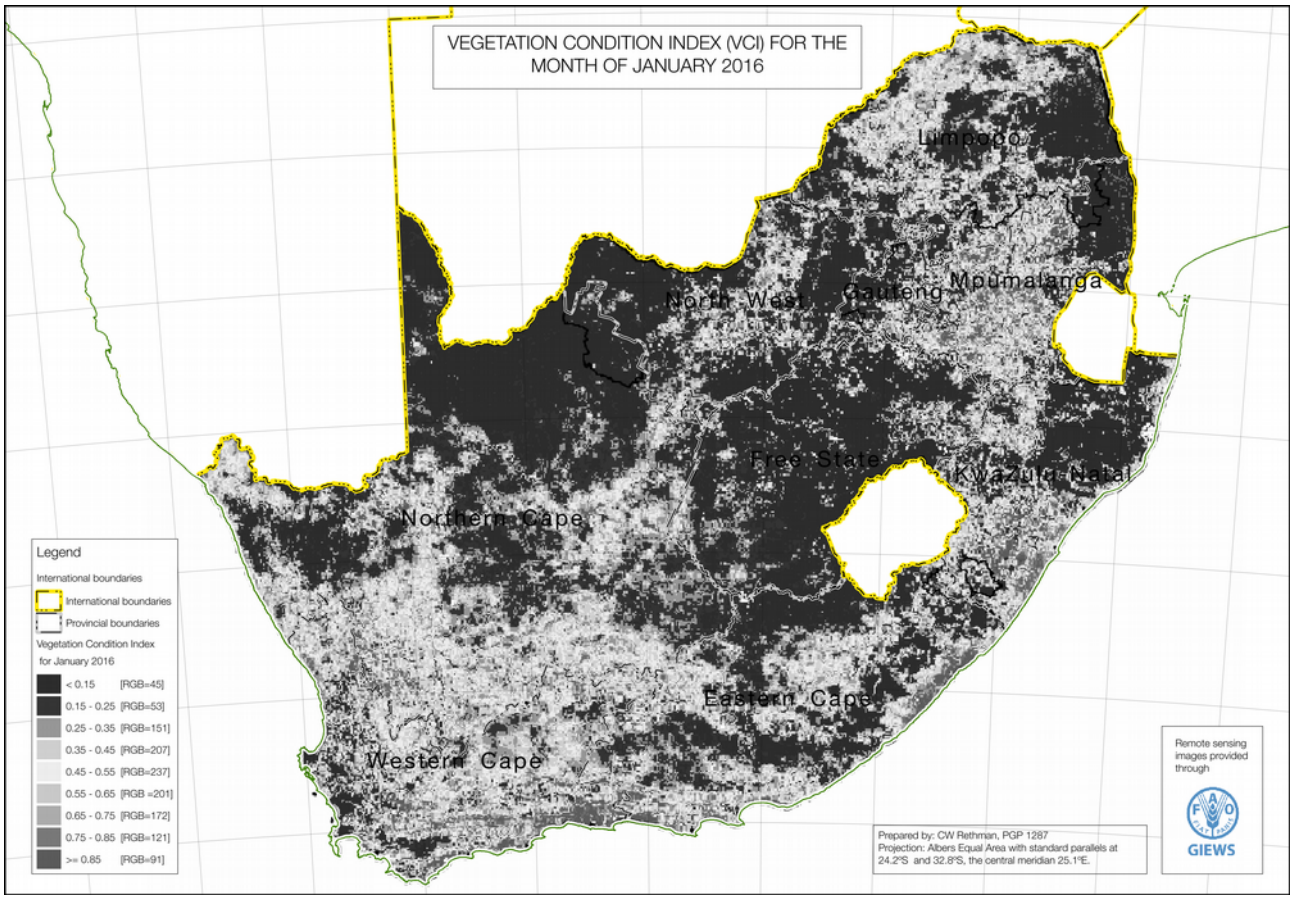

Figure 7: VCI image converted to greyscale, with reds offset from greens to ensure separation of shades

This raster image could then be converted to a vector format. The conversion process applies a union (a 'merge' or 'dissolve') to adjacent pixels having the same shade, so that the resultant vector feature has polygons that comprise one or more pixels, depending on the shade values. The grey-shade values appeared as an attribute column on the vector table and were mapped to the VCI ranges by adding a column with the ranges values as text. The result was imported into PostGIS/Postgres and is shown in **Figure 8**. Note that although this graphic appears to be similar in its presentation as the greyscale image in **Figure 7**, it is in fact fundamentally different because the previously green areas of the map are now lighter than any of the red of orange areas. For example, compare the coastal belt just south of Durban, which was to be green in the original VCI image in **Figure 6**, then became a darker grey in **Figure 7** and a lighter orange in **Figure 8**.

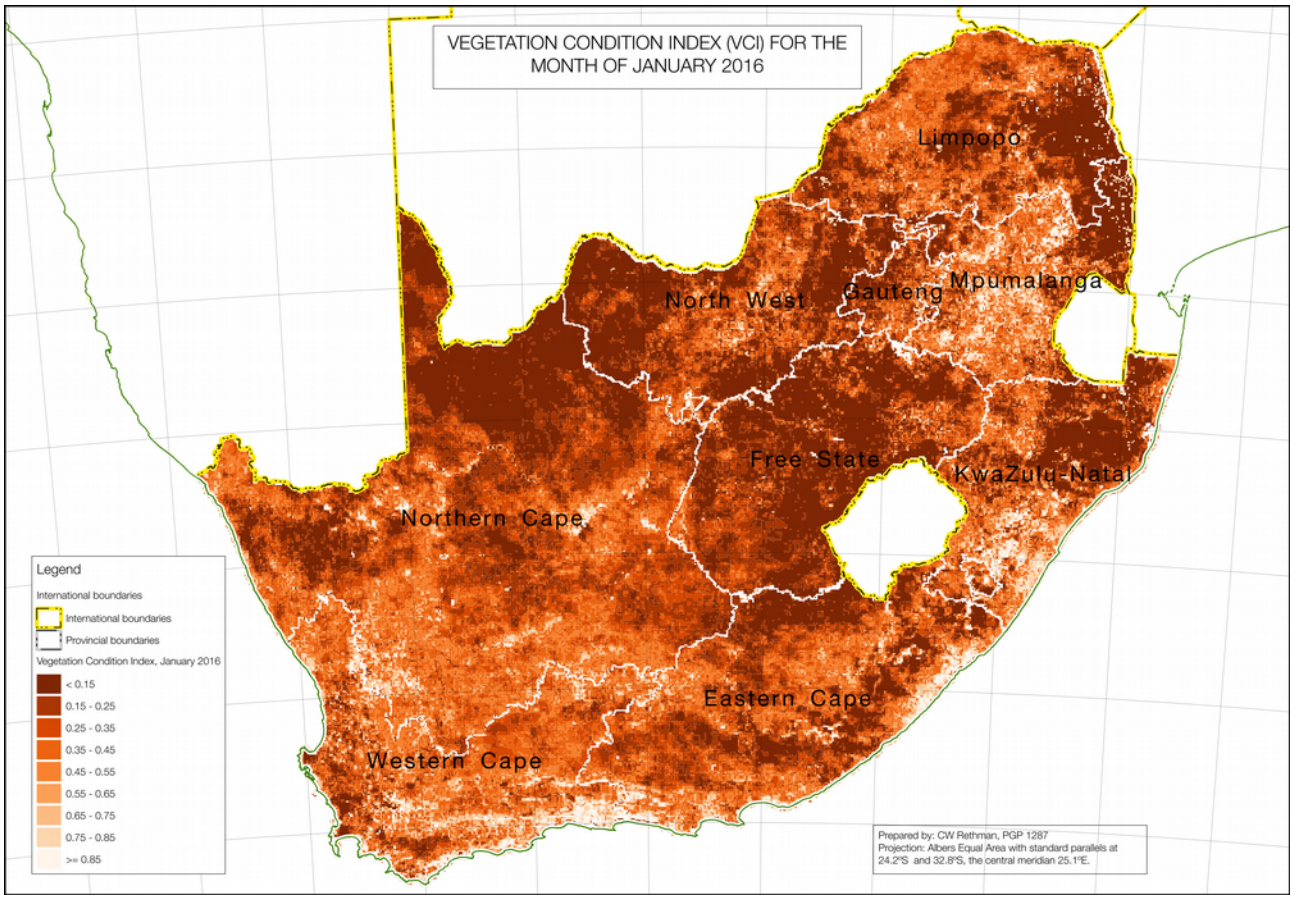

Figure 8: VCI raster image converted to polygon vector format with the VCI value range restored

Buffering, cleaning and filtering out the small groups of pixels (Steps 17 to 19)

Very small areas of low vegetation condition could be considered outliers or anomalies that do not need to be included in the general hazard area. All features smaller than nine pixels were thus filtered out and the remaining features buffered by 1500 metres to ensure that when they are combined by a union into larger polygon features set out as the drought-affected area, they are closer to one another than one pixel width (which is approximately 2500 metres).

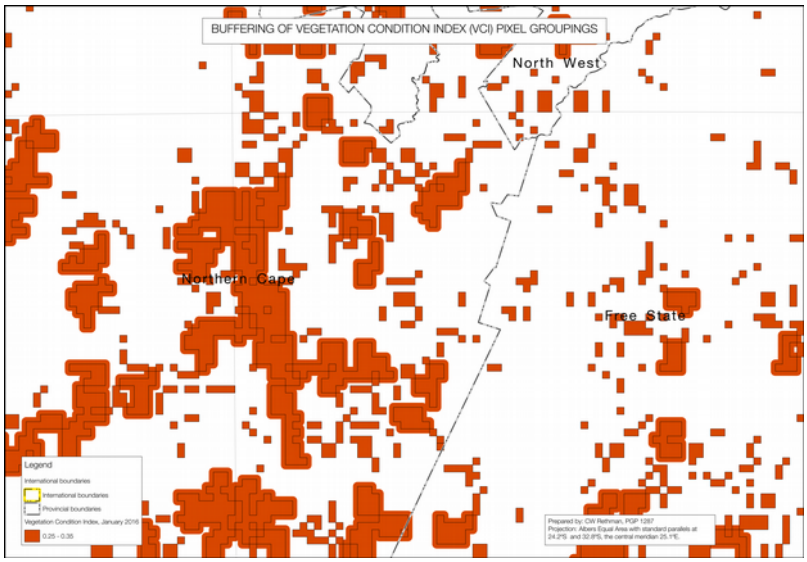

Figure 9: The process of selecting only larger groups of pixels and buffering them, shown for VCI values of 0.25 to 0.35

At this point all the extra graphics and paraphernalia from the remote-

sensing images can be removed as well; they are easily filtered out with simple spatial query parameters.

Obtaining the hazard area; filtering the worst affected pixels and then combining them together with a union (Step 20 and 21)

The threshold for 'drought' conditions was set at all VCI values below 0.35, so

Crop Production

Crop estimates from the Crop Estimates Committee (CEC). Published …

When using production data, it is important to obtain reasonably disaggregated data, such as production per municipality. Using spatial units larger than a municipality in South Africa (district, province or national) could mask out local variations and does not really give the level of spatial variation required. Pro

Remote sensing images from FAO.

Table 1 - Example of the attribute table for the new vectorised feature set made from the

gid	greyscaleRGB	rs_value	

33.

34.

1. The greyscale values (0 to 255) can then be assigned to The remote sensing images use discrete colours to represent pixel values, usually ranging from dark to light or from red through yellow to green

(the author uses an Albers Equal Area projection as the analysis takes place at a small scale (national and provincial), which has too much longitudinal width (> 6 degrees) for Transverse Mercator or Universal Transverse Mercator CRSs, and comparisons are usually made of area units

In each village, the teams held meetings with key informants. The key informants consisted of community leadership such as Headmen, councillors, Municipal Agricultural Demonstrators, Livestock Officers, Community Development Officers and any other informant agreed upon by the Assessment team and the village leadership. The parameters discussed were as follows; rainfall situation, livestock and crop production, income sources and prices for food and selected non-food items.

The four groups reconvened in Tzaneen for data analysis and modelling of the study findings from 19th to 25th March 2015. The analysis started by completing the forms used to collect data in the field. Then

the team separated into the five assessment groups to write and present the overall picture of the area they covered and problems faced as well as lessons learnt. The team thereafter reviewed concepts and were introduced to the analysis process.

The problem specification calculations were done manually using information collected from the field, baseline data and information from recent reports such as the Crop Estimate Survey report. The analysis was done by the team on the HEA spreadsheet using the baseline year data and current year forecasts.

The analysis used resilience level, lower bound and upper bound poverty lines to estimate individuals who are below the thresholds and require policy intervention.

The calculated problem specification percentages, which are the changes in the current year compared to baseline year, were entered into the analysis spreadsheet to calculate the food and expenditure deficit as well as number of people affected. The number of affected people was calculated using small area and enumeration area data for the respective areas for the 2008 Statistics South Africa Population and Household Census.

The results were then pooled together and a report was drafted.

Rainfall and Crop Production

The rainfall season started during the month of October 2009 in some parts of the entire zone, even though the rainfall amounts recorded did not give much moisture for ploughing and planting. Good rains for ploughing and planting activities in some areas started in mid-December 2014. The zones also experienced a dry spell towards the end of December 2014 up to the end of March 2015.

The crops which were planted during the month of November 2014 for the up- or dry-land farmers in the zone were highly affected by the dry spell and a poor yield was realized.

Table 2: Cross-tabulation of populations in livelihood zones and drought/non-drought affected areas against administrative areas

District / Municipalities	Population								
	59202 - ZANOC		59203 - ZASLC		59301 - ZALOF		59302 - ZALOI		Grand Total
	No drought	Drought	No drought	Drought	No drought	Drought	No drought	Drought	
Capricorn	140,826	306,930	38,862	371,556					858,174
Aganang	6,480	123,258							129,738
Blouberg	49,269	84,663							133,932
Lepele-Nkumpi			26,274	163,392					189,666
Molemole	54,114	7,839							61,953
Polokwane	30,963	91,170	12,588	208,164					342,885
Greater Sekhukhune			152,022	646,206					798,228
Elias Motsoaledi			68,067	35,646					103,713
Ephraim Mogale			8,757	37,077					45,834
Fetakgomo			10,026	76,611					86,637
Greater Tubatse			50,154	242,718					292,872
Makhuduthamaga			15,018	254,154					269,172
Mopani			57,594	242,577			10,608	11,778	322,557
Greater Giyani							10,608	11,778	22,386
Greater Letaba			12,774	27,102					39,876
Greater Tzaneen			44,790	133,797					178,587
Maruleng			30	81,678					81,708
Vhembe	72,687	61,041			73,803	317,136		28,500	553,167
Makhado	72,687	60,780			35,391	75,789			244,647
Mutale						6,261		1,407	7,668
Thulamela		261			38,412	235,086		27,093	300,852
Waterberg	41,733	194,454							236,187
Bela-Bela	2,778								2,778
Lephalale	16,137	33,906							50,043
Mogalakwena	22,818	160,548							183,366
Grand Total	**255,246**	**562,425**	**248,478**	**1,260,339**	**73,803**	**317,136**	**10,608**	**40,278**	**2,768,313**

Production estimates for the April-July 2015 harvests shows that when compared with the baseline year, maize was the most affected crop, having been severely affected by the dry spells experienced from January to March and also affected by the heat wave. For major crops including maize, sorghum, beans and vegetables, this year is expected yield to be 5% - 30% of the baseline year. The official data largely confirms the findings of the team.

In general, the farmers anticipated lower yields (per hectare output) in the coming year (2015/16) when compared with the baseline year (2013/14).

Analysis of affected areas

The drought and its impact on cropping was not uniformly distributed across the province; it was not even uniformly distributed across livelihood zones. The team relied on images developed at the Limpopo Department of Agriculture that provide a spatial distribution on the performance of the growing season. **Figure 2** shows a particularly useful image, that of an index on the performance of the season, taking into account factors such as rainfall distribution, insolation, and other growing conditions.

Unfortunately, this image was difficult to translate into a vector format for deriving affected versus unaffected areas because of the grid overlaid onto it. The solution was to resampled it and this was done with an array or grid of vector points that was overlaid onto it. First of all, a grid of pints was constructed so that each point fell inside the pixel 'square' of the image. This is shown as Step 2 in Figure 3, where the points grid has been placed onto the original image. Since the image 'blocks' (between the grey lines) were not even in size, the points grid had to be adjusted to align to a 'best fit'.

A GIS 'plugin' tool (QGIS Desktop Application > Plugins > Point Sampling Tool, www.qgis.org) was then used to extract the red, green and blue values from the original image. The result, Step 3, is shown in **Figure 4**.

To reconstruct a pixel mosaic (without horizontal and vertical grid lines), the points are converted to Voronoi polygons, see **Figure 5**. These polygons are assigned a weighted RGB index (Red: 3, Green: 1, Blue: 5).

All features with the index below 3.78 are then combined in a spatial union (this is also called a 'dissolve' in some GISs), while any features – or holes – three blocks or smaller are discarded. This is Step 5.

The affected and unaffected populations for the four livelihood zones under study are calculated by overlaying the Small Area Layer from Statistics SAs Census data onto the affected areas in **Figure 6**. The SAVAC has attributed each Small Area to its livelihood zone, so the spatial query performs four drought groupings:

1) Small Areas that are *entirely within* the affected area are classified *affected* and are assigned a value of 1.
2) Small Areas that straddle an affected area boundary *and have more than 50%* of their area overlapping it are classified *affected* and assigned a value of 1.
3) Small Areas that straddle and affected area boundary *but have less than 50%* of their area overlapping it are classified *unaffected* and assigned a value of 0.

4) Small Areas that lie *entirely outside* the affected area are classified *unaffected* and are assigned a value of 0.

It is then a simple matter to sum the populations in the Small Areas by their constituent administrative areas (such as Municipality, District) and by livelihood zone. A pivot table is the simplest way to achieve this cross-tabulation. This is presented overleaf in **Table I**.

It must be emphasised that ***drought is only one type of hazard****;* there are other kinds of hazards affecting people such as economic or prices changes. Hence, even people living in non-drought areas may still be at the same risk of food insecurity because of these other factors. Similarly, some people that exposed to a certain kind of hazard may not be vulnerable to it (for example, people earning a salary will likely not be as vulnerable to drought as people whop farm). This means that not all people listed in the above Table I are necessarily at risk. This will be explored in more detail in the next sections, by studying each livelihood system and exploring the impacts of the various changes in environmental and the economic situations for different wealth groups.

North Eastern Limpopo Open Access Farming (ZALOF)

Villages were visited in Makhado municipality namely: Vuvha and Murunwa, both of which fall under the North Eastern Limpopo Open Access Farming (ZALOF) livelihood zone. The municipality has two service centres, Zhanani and Tshitale. These service centres are characterised with having moderate rainfall and in the September/October (2013/14) planting season for the baselines year, there was adequate infiltration which led to a normal planting season in which maize, beans and vegetables were planted. However, in the last (2014/15) summer season there were not sufficient rains to start planting, except along the rivers where farmers had already started planting crops such as maize and vegetables.

The affected areas were assigned the following problem specifications for crop productions:

Table 3 ZALOF crop problem specifications for affected areas

Crop	Problem Specification
Maize	40%
Beans	19%

Crop	Problem Specification
Pumpkin	65%
Water melon	102%
Groundnuts	0%

Note: A problem specification of 40% implies 60% loss in production for the last year when compared with the baseline.

In the unaffected areas the problem specifications for these items was 100% (no change).

In addition to poor crop performance, milk and meat output dropped and the problem specification for these activities this year is 60%, while that for cattle and goat sales are normal (100%) but for chickens it is 15%.

Southern Limpopo Open Access Cattle and Crops (ZASLC)

Generally the onset of rains last season was delayed and the distribution was poor. Most parts of the zone received medium to low rainfall in the curren

t season. However, some planting rains were received in February but the greater part of the livelihood zone experienced dry spells leading to a 5% to 20% food decrease compared with the baseline. The erratic rainfall was worst in the municipalities of Fetakgomo, Greater Tubatse, Elias Motsoaledi, Ephraim Mogale and Makhudu Thamaga. Maize, sugar beans, cotton and vegetables were most affected by the dry spells.

The affected areas were assigned the following problem specifications for crop productions:

Table 4 ZASLC crop problem specifications for affected areas

Crop	Problem Specification
Maize	29%
Cowpeas	7%
Beans	19%

Crop	Problem Specification
Pumpkin	100%
Water melon	88%
Sweet potato	0%
Groundnuts	0%

Note: A problem specification of 29% implies 71% loss in production for the last year when compared with the baseline.

In the unaffected areas the problem specifications for these items was 100% (no change).

In addition to poor crop performance, milk and meat output dropped dues to poor grazing. The problem specification for these activities this year is 57%, while that for pig sales is 36%, cattle sales is 63%, goat sales is 50%, sheep sales is 58% and chicken sales is 51%.

Northern Open Access Cattle and Dry Land Crops (ZANOC)

Maize, beans, groundnuts, sweet potatoes and vegetables are the major crops produced in this livelihood zone. Generally, the onset of rains last season was delayed and the distribution has been poor and most farmers depend on rain-fed farming. Most areas within Lephalale, Polokwane, Molemole, Aganang, Mogalakwena, Makhado and Mogalakwena were characterised as having had dry spells with minimal to very low rainfall. Maize and cowpeas were the crops that were badly affected by the dry spell.

Table 5 ZANOC crop problem specifications for affected areas

Crop	Problem Specification
Maize	50%
Sorghum	89%
Cowpeas	0%
Beans	83%
Groundnuts	75%

Note: A problem specification of 89% implies 11% loss in production for the last year when compared with the baseline.

In the unaffected areas the problem specifications for these items was 100% (no change).

In addition to poor crop performance, milk and meat output dropped dues to poor grazing. The problem specification for these activities this year is 50%, while cattle, goat and sheep sales remained normal (100%).

Lowveld Open Access Irrigated Cropping Livelihood Zone (ZALOI)

Maize, beans, groundnuts, sweet potatoes and vegetables are the major crops produced. The onset of rains during 2014/15 season was not delayed, comparing with the 2013/14 season. Greater Giyani, Thulamela and Mutale municipalities received the first rainfall in December 2014 and this lasted up until January 2015 in all three service centres (i.e. Hlaneki, Guwela and Mhlava Willem). Mhlava Willem was the only service center that continued to receive rainfall up to March, making their on yield better than other the other service centres. Hlaneki and Guwela service centres received the soil preparation and planting rains but the dry spells resulted in failure for all their crops, except for sweet potatoes. Irrigated crops, for the few households that have access to irrigation (mostly middle and better off households), were also normal.

The affected areas were assigned the following problem specifications for crop productions:

Table 6 ZALOI crop problem specifications for affected areas

Crop	Problem Specification
Maize	37%
Irrigated maize	100%
Cowpeas	33%
Beans	75%
Rape (*morogo)*	5%
Water melon	13%
Sweet potato	100%

Crop	Problem Specification
Groundnuts	5%

Note: A problem specification of 37% implies 63% loss in production for the last year when compared with the baseline.

In the unaffected areas the problem specifications for these items was 100% (no change).

In addition to poor crop performance, milk and meat output dropped dues to poor grazing. The problem specification for these activities this year is 57%, while that for pig sales is 36%, cattle sales is 63%, goat sales is 50%, sheep sales is 58% and chicken sales is 51%.

Livestock prices

Cattle numbers have decreased by about 5% -10% from the baseline and this is attributed to the dry spells, which resulted in livestock loss. However, the price of a bull in the current year has increased by 10% over baseline average price of R5000.

Agricultural income

Due to increased area planted by commercial farmers near the zones, agricultural income activities were available in the current year although farming areas were also affected by the dry spells. Overall, compared with the baseline year, availability of agricultural labour opportunities was considered normal. The price for agricultural labour went up by about 5% over baseline (2013-2014) prices.

Public Works Programme

The number of people employed through this program is almost the same as the baseline year. The wages obtained by households involved in this program slightly increased by less than 3 per cent.

Staple Food Purchase Price Changes

Purchase prices of staple food commodities (maize meal, samp, bread and rice) are projected (by March 2016) to have increased by around 12% from that of the baseline year (April 2013 to March 2014) in Limpopo Province. This is a problem specification of 112% and it is applied to all four livelihood zones. This projection is based on the previous price

changes and on forecasts for inflation generally. This may or may not change in reality—a lot will depend on the domestic supply situation, the country's import requirements and the position with the Rand weakening further against the major currencies.

In rural areas of the province, all livelihood zones, there are fewer outlets and distribution costs mean that staple prices in the villages are higher than in towns or cities. Traders who *increase* their prices of food commodities *beyond that of increases* elsewhere are seen as exploiting vulnerable rural communities. This is because ‘very poor’ and ‘poor’ households in these zones purchase 50–70% of their annual food requirements, increases in staple prices seriously affects their access to food. This is a key parameter for the SAVAC to monitor.

Other Food Items' Purchase Price Changes

The cheapest way for people to obtain the food energy they need is through staple, usually maize. In a situation of outright starvation (a famine situation) it may be necessary for an analyst to focus on this staple acquisition but in South Africa analysts are more concerned with poverty and inequality—which implies that quality of life and living standards are more the issue than mass shortage of food energy.

A diet that is confined to staples is not healthy at all and diversity is essential for people to obtain all the nutrients they require, providing them with the capacity for a productive and dignified life. In order to account this required diversity, the SAVAC and LimVAC were required to refer to standard food baskets used in other surveys, such as the Living Standards Surveys and General Household Surveys. The latter compares levels of consumption with poverty levels, the lowest of which is the Food Poverty Line (FPL). The FPL is composed of a list of varied commodities, the sum of the energy content of which still equals 8800 kJ per person per day (2100 kcal per person per day).

The SAVAC has used the same list of commodities as for its FPL and, taken together with staple, this represents the minimum threshold for household incomes in the villages. SAVAC Rand values for this threshold are similar to the provincial threshold used by Statistics South Africa, the differences reflect the purely rural local variations in prices and availability of commodities.

The non-staple FPL items are projected to increase at the provincial non-cereal food inflation rates, with the projection for the coming months based on the overall inflation projections. The resultant problem specification for the 2015-2016 consumption year for

non-staple foods is 114%, or an increase in prices of 14% since the baseline year (April 2013 to March 2014). This was applied to all four livelihood zones.

Prices of Items Non-Food Basket (Lower Bound Poverty Line and Upper Bound Poverty Line, as well as the Resilience Line)

In addition to non-staple food products, households need to purchase other goods and services that meet their basic needs. These goods and services include items such as soap, paraffin, electricity, matches, salt (zero food energy), tea or coffee (zero food energy), services, schooling, health, veterinary, taxes, community contributions, clothing, communications, transport and so on.

When the cost of the smallest quantity of these commodities is added to that of staple and non-staple food, this becomes the Lower Bound Poverty Line (LBPL). When a larger quantity of each of these commodities is used, it defines the Upper Bound Poverty Line (UBPL).

Lastly, there are important *investments* that households must make each year if they are to have sustainable livelihoods. This means that they must spend on maintenance of all their capital (human, social, physical, environmental and financial) if they are to be able to develop themselves further and withstand or recover from future livelihood hazards. This expenditure therefore includes livelihood-specific investments in inputs for agriculture or business activities (including labour), educational investments, health and nutrition investments. Critically, these investments usually have a knock-on impacts from one wealth group to another; for example, money spent on labour hire by the better-off adds significantly to poorer households' incomes.

The sum of the expenditure on all of these investments with the other preceding expenditures in the UBPL, LBPL, FPL and staple purchase, make up the Resilience Line. Unlike the FPL, LBPL and UBPL, the Resilience Line varies across wealth groups, as households with more productive assets must spend more to maintain and use those assets.

The team used the general prevailing inflation rate with a forecast for the coming months to obtain the change in price from the baseline year (April 2013 to March 2014) to this year (April 2015 to March 2016) for the LBPL, UBPL and the resilience line. The resultant problem specification for these thresholds is 111%, or an 11% increase in prices. This was applied to all four livelihood zones.

Food availability

Generally, food is available in all retail outlets, such as the big grocery chain stores such as Pick’n Pay, Spar, and Shoprite, as well as the smaller local stores. There are some areas within the zones, including Greater Tubatse, Lephalale, Fetakgomo, Mogalakwena, Mopani, Lepelle-Nkumpi, Maruleng and Greater Letaba that need monitoring as they will lose livestock this coming season if the rains are insufficient because of the lack of grazing.

Analysis of the livelihood zones

Analysis was done for both the drought-affected and unaffected areas of each livelihood zone. Both unaffected and affected areas had the same or very similar price problem specifications; the differences being in crop and livestock production.

Affected areas fared slightly worse than unaffected areas but the difference was not substantial, highlighting the relative unimportance of agriculture as a source of food and income, compared with social grants, paid employment and small businesses. The hazards that are more likely to have an impact on livelihoods and consumption levels are therefore those that affect these incomes and expenditure, such as high borrowing rates (affecting the government's ability to deliver on social grants, as well as loans for starting businesses), high food purchase prices and the lack of opportunities for work (agricultural, domestic and short-term contracts, such as construction).

The poorest households invest the least in agriculture; they depend on social grants and casual work as their main source of income. The casual work may be domestic, construction or agricultural—in the case of the latter it may be local (within the village or on commercial farms). The *direct* impact of the drought on them has therefore been the least —*indirectly*, they may suffer from reduced work opportunities. This may seem counter-intuitive to readers schooled in reducing village economies to “subsistence agriculture”. Similarly, the better-off have either full time employment or a small business that cushions their livelihood from losses due to drought or weather hazards. It is actually the 'middle' households who are more dependent on agriculture but lack this cushion and who are most vulnerable to this kind of hazard.

The very poor and poor households do depend heavily on the market for their food and, with the kind of income activities in which they engage in such as weeding work, harvesting work, low-level petty trading, craft selling and domestic work already stretched to the limit, opportunities for them to expand their income are minimal. Hence, their vulnerability is to price changes and shocks.

Wealthier households may dispose of assets or switch non-essential expenditure to food purchases and essential expenditure.

In the baseline year, 'very poor' households in the North Eastern Limpopo Open Access Farming (ZALOF) and Lowveld Open Access Irrigated Cropping (ZALOI) are below the LBPL: the gap is R 4,571 and R 8,843 per household in each zone, respectively. This is expected to rise to R 4,784 and R 9,615 per household in the non-drought affected areas and to R 5,352 and R 10,726 in the drought-affected areas. In all livelihood zones, the 'very poor' are below the UBPL and their Resilience Level, while in the Northern Open Access Cattle and Dry Land Crops livelihood zone and the Southern Limpopo Open Access Cattle and Crops the 'poor' are, in addition to the 'very poor' below the UBPL and Resilience Line—in both drought-affected and -unaffected areas.

In an analysis of this kind in South Africa we are not as interested in starvation or in desperate life-threatening mass deprivation as we are in poverty, living standards and the opportunities people have for escaping the worst conditions. This is especially important when viewed over time, factoring in impoverishment brought on by external events to households' livelihoods. This is because the comprehensive safety net and social grant system ought to cover the bare minimum needs for all citizens, automatically preventing famine or extreme deprivation for the great majority of people. However, the grant system is designed around needs for an *average year*, while this assessment studies the impact of ephemeral change, from one year to the next. Therefore, it is not surprising that there are *no food energy deficits* in any wealth group in any livelihood zone. Much more useful information can be obtained by considering a whole basket of food and non-food goods and investigating physical and economic access to them.

The SAVAC does this by converting all production (including production that is consumed directly) into a cash equivalent, based on what it would cost to have purchased the items consumed directly if they had not been produced by the household, and then adding the cash values together over a whole year to obtain and *annual total income*.

Figures 9, **10**, **11** and **12** show the annual total incomes for all four wealth groups in the all four livelihood zones, for the baseline and the forecast year; the four bars on the left representing the baseline situation and the four bars on the right representing the forecast situation in the drought-affected part of the zone, after the analysis. **It is important to note three important features about these graphs**:

- Each bar represents a “wealth group”—these are groupings of households defined *in local terms* by their productive assets and their livelihood activities. The wealth

groups are broken down into different percentages (the better-off are the fewest); *they are not quartiles;*

- Income values and expenditure thresholds have been normalised to a common household size;
- Income values and expenditure thresholds have been normalised to today's Food Poverty Line cost. This means that the FPL in the baseline is exactly the same as that of the current year. Based on relative cost, the LBPL, UBPL and Resilience lines may be higher or lower in the baseline, as may be the items in the bars.

It can be seen that the Resilience Line varies according to wealth group, generally rising with wealth. This is because resilience is about protecting and maintaining assets and livelihoods, which means households with more assets will need to expend more to maintain them and expenditure by one group of households that directly benefits other groups (such as expenditure by the 'better off' on labour hire or gift provision) must also be protected for these wealth groups.

Southern Limpopo Open Access Cattle and Crops livelihood zone (ZASCL)

Table 6 provides a summary of the total incomes for the 'poor' and 'very poor' wealth groups against this year's poverty lines (FPL, LBPL and UBPL). As can be seen in the table, neither wealth group is below either the FPL or the LBPL, whether drought-affected or not. However, the 'very poor' are below the UBPL in both the drought-affected and not affected areas, while the 'poor' are below the UBPL in the drought-affected areas only. It is important to note that both the 'very poor' and 'poor' also suffer a UBPL deficit in the baseline year—without the drought but under today's price regimes, both wealth groups are actually in a better position; it is only those that are in the drought areas that are worse off.

Table 7 - comparison of 'Poor' and 'Very poor' household incomes between baseline, unaffected and drought-affected areas in the Southern Limpopo Open Access Cattle and Crops livelihood zone this year

Measure	Cash equivalent in today's Rands					
	'Very Poor' wealth group			'Poor' wealth group		
	Baseline	Unaffected areas	Affected areas	Baseline	Unaffected areas	Affected areas
TOTAL Income	39,915	39,151	37,643	52,902	55,066	51,125
FOOD POVERTY	18,679	18,679	18,679	18,679	18,679	18,679

Food Poverty Deficit	0	0	0	0	0	0
LOWER BOUND POVERTY	31,957	31,648	31,648	31,957	31,648	31,648
Lower Bound Deficit	0	0	0	0	0	0
UPPER BOUND POVERTY	55,603	54,745	54,745	55,603	54,745	54,745
Upper Bound Deficit	15,688	15,594	17,102	2,701	0	3,620

Figure 9 is a chart showing the some details of all wealth groups' total income in the *affected part* of the livelihood zone. The chart is based on the cost of the FPL, and normalises all the income as other poverty lines against this; the apparent reduction in incomes actually results from the rise in the cost of the FPL—in purely nominal terms, households' incomes actually rise for the current year (April 2015 to March 2016) when compared with the baseline (April 2013 to March 2014).

High Food Price Scenario

Commercial farmers in South Africa are also facing a production crisis that could result in local supply shortfalls, while the recent slide in the value of the Rand could possibly raise the cost of imports significantly. The 'very poor' and 'poor' households in this zone are very reliant on food purchases, obtaining, respectively, approximately 69% and 63% of their total annual food energy intake from this source. This makes them vulnerable to price increases. For any wealth group to experience a Food Poverty Deficit (and therefore facing starvation) in this livelihood zone, the price of foodstuffs will need to rise by 150% when compared with 2013-2014 levels (the new price would be 2.5 times the baseline). This means that maize, which retailed for approximately R 6.00 a kilogram in 2013-2014, would have to cost R 14.01 currently. For households from any wealth group to fall below the Lower Bound Poverty Line (a measure of dire poverty), the prices of food stuffs will need to rise by 65% when compared with 2013-2014 levels (the new price would be 1.65 times the baseline). This means that maize would cost R 9.28 instead of R 6.00 in the baseline.

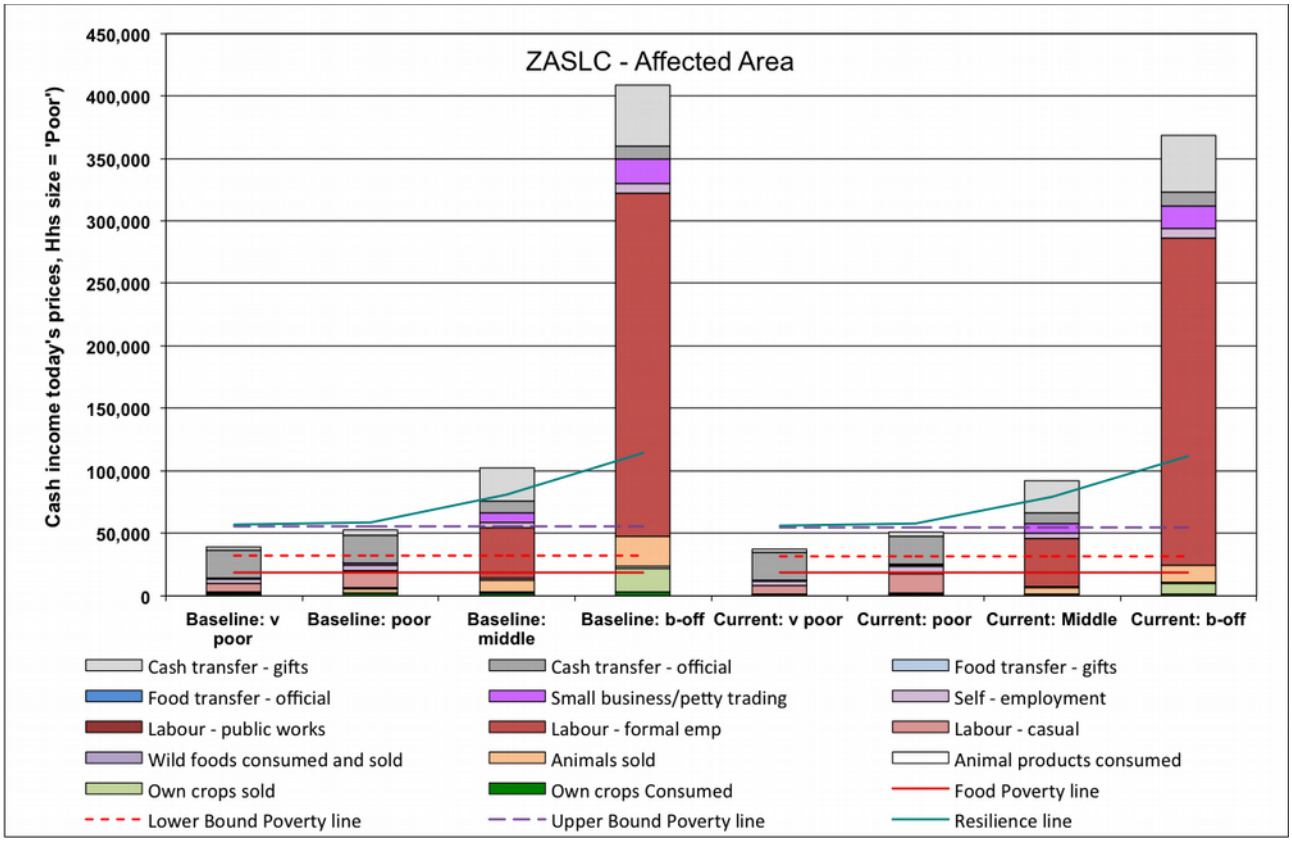

Figure 10:Total income for all wealth groups in the drought-affected areas of Southern Limpopo Open Access Cattle and Crops livelihood zone

Northern Open Access Cattle and Dry Land Crops (ZANOC)

Table 7 provides a summary of the total incomes for the 'poor' and 'very poor' wealth groups against this year's poverty lines (FPL, LBPL and UBPL). As can be seen in the table, neither wealth group is below either the FPL or the LBPL, whether drought-affected or not. However, the 'very poor' are below the UBPL in both the drought-affected and not affected areas, while the 'poor' are below the UBPL in the drought-affected areas only. It is important to note that both the 'very poor' and 'poor' also suffer a UBPL deficit in the baseline year and *under today's price regimes*, the 'very poor' are actually in a marginally better position, while the 'poor' in the drought areas have a deficit and this deficit is slightly worse than the baseline.

Figure 10 is a chart showing the some details of all wealth groups' total income in the *affected part* of the livelihood zone. The chart is based on the cost of the FPL, and normalises all the income as other poverty lines against this; the apparent reduction in incomes actually results from the rise in the cost of the FPL—in purely nominal terms, households' incomes actually rise for the current year (April 2015 to March 2016) when compared with the baseline (April 2013 to March 2014).

Table 8 - comparison of 'Poor' and 'Very poor' household incomes between baseline, unaffected and drought-affected areas in the Northern Open Access Cattle and Dry Land Crops livelihood zone this year

Measure	Cash equivalent in today's Rands					
	'Very Poor' wealth group			'Poor' wealth group		
	Baseline	Unaffected areas	Affected areas	Baseline	Unaffected areas	Affected areas
TOTAL Income	39,954	41,142	40,808	51,864	52,036	50,603
FOOD POVERTY	21,864	21,864	21,864	21,864	21,864	21,864
Food Poverty Deficit	**0**	**0**	**0**	**0**	**0**	**0**
L O W E R B O U N D POVERTY	35,135	34,833	34,833	35,135	34,833	34,833
Lower Bound Deficit	**0**	**0**	**0**	**0**	**0**	**0**
UPPER BOUND POVERTY	58,769	57,930	57,930	58,769	57,930	57,930
Upper Bound Deficit	**18,815**	**16,788**	**17,122**	**6,905**	**0**	**7,327**

High Food Price Scenario

Commercial farmers in South Africa are also facing a production crisis that could result in local supply shortfalls, while the recent slide in the value of the Rand could possibly raise the cost of imports significantly. The 'very poor' and ‘poor’ households in this zone are very reliant on food purchases, obtaining, respectively, approximately 93% and 70% of their total annual food energy intake from this source. This makes them vulnerable to price increases. For any wealth group to experience a Food Poverty Deficit (and therefore face starvation) in this livelihood zone, the price of foodstuffs will need to rise by 114% when compared with 2013-2014 levels (the new price would be 2.14 times the baseline). This means that maize, which retailed for R 5.38 a kilogram in 2013-2014, would have to cost R 11.50 currently. For households from any wealth group to fall below the Lower Bound Poverty Line (a measure of dire poverty), the prices of food stuffs will need to rise by 46% when compared with 2013-2014 levels (the new price would be 1.46 times the baseline). This means that maize would cost R 7.85 instead of R 5.38 in the baseline.

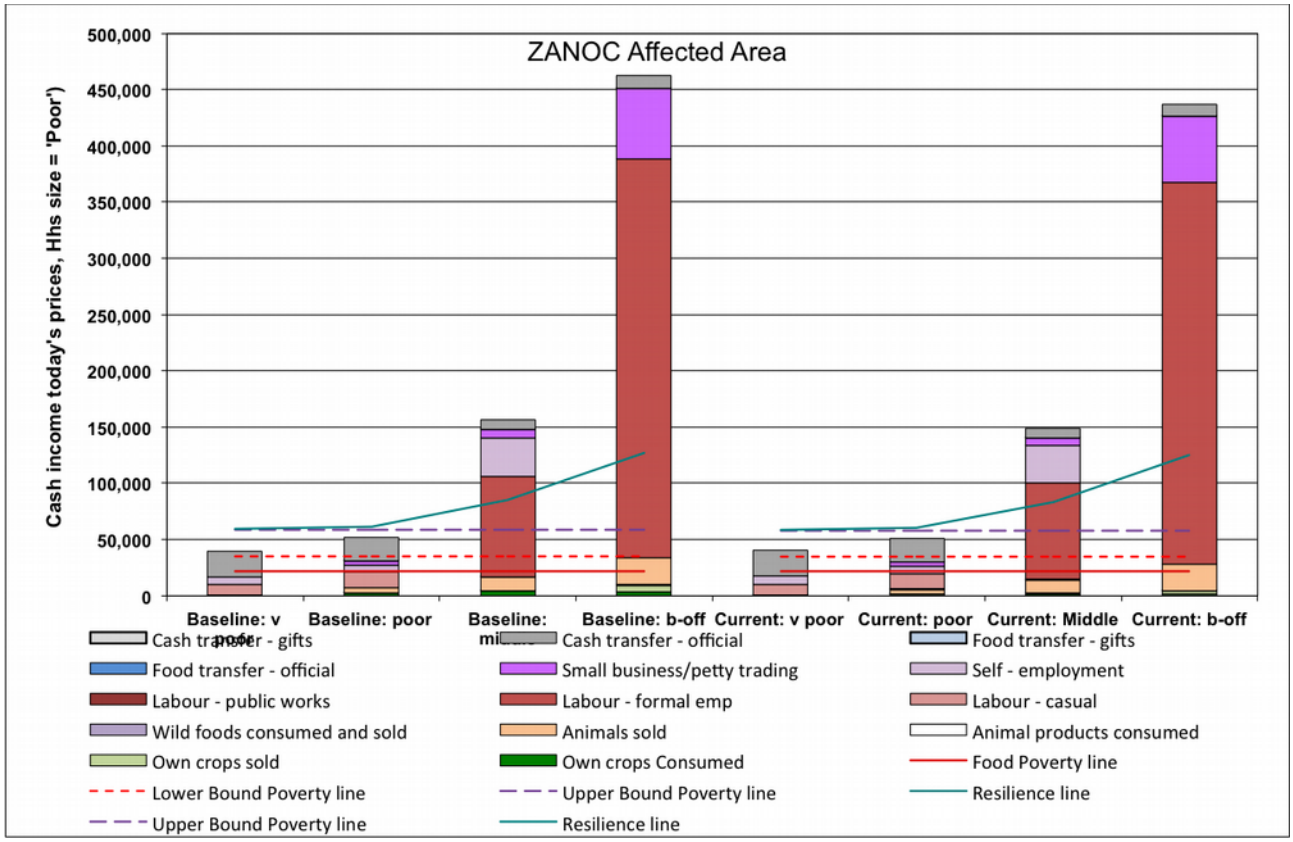

Figure 11:Total income for all wealth groups in the drought-affected areas of Northern Open Access Cattle and Dry Land Crops livelihood zone

Lowveld Open Access Irrigated Cropping (ZALOI)

'Very poor' and 'poor' households in this zone purchase 57% and 65%, respectively, of their total food energy intake. This is somewhat less than other livelihood zones and it demonstrates that they depend a little more on their own agriculture, making them slightly more vulnerable to crop failure from drought than other livelihoods.

Table 8 provides a summary of the total incomes for the 'poor' and 'very poor' wealth groups against this year's poverty lines (FPL, LBPL and UBPL). As can be seen in the table, neither wealth group is below either the FPL, whether drought-affected or not. However, the 'very poor' are below both the LBPL and the UBPL in both drought-affected and non-affected areas, while the 'poor' are not below either. It is important to note that the 'very poor' also suffer a LBPL deficit in the baseline year—this has worsened by R 760 in the non-affected areas and R 2,046 in the affected areas, meaning that their increased poverty is a function of both the present price regime as well as the drought.

Table 9 - comparison of 'Poor' and 'Very poor' household incomes between baseline, unaffected and drought-affected areas in the Lowveld Open Irrigated Cropping livelihood zone this year

Measure	Cash equivalent in today's Rands					
	'Very Poor' wealth group			'Poor' wealth group		
	Baseline	Unaffected areas	Affected areas	Baseline	Unaffected areas	Affected areas
TOTAL Income	38,184	37,030	35,744	80,912	76,632	73,939
FOOD POVERTY	29,947	29,947	29,947	29,947	29,947	29,947
Food Poverty Deficit	**0**	**0**	**0**	**0**	**0**	**0**
L O W E R B O U N D POVERTY	47,026	46,632	46,632	47,026	46,632	46,632
Lower Bound Deficit	**8,842**	**9,602**	**10,888**	**0**	**0**	**0**
UPPER BOUND POVERTY	74,610	73,578	73,578	74,610	73,578	73,578
Upper Bound Deficit	**36,426**	**36,548**	**37,834**	**0**	**0**	**0**

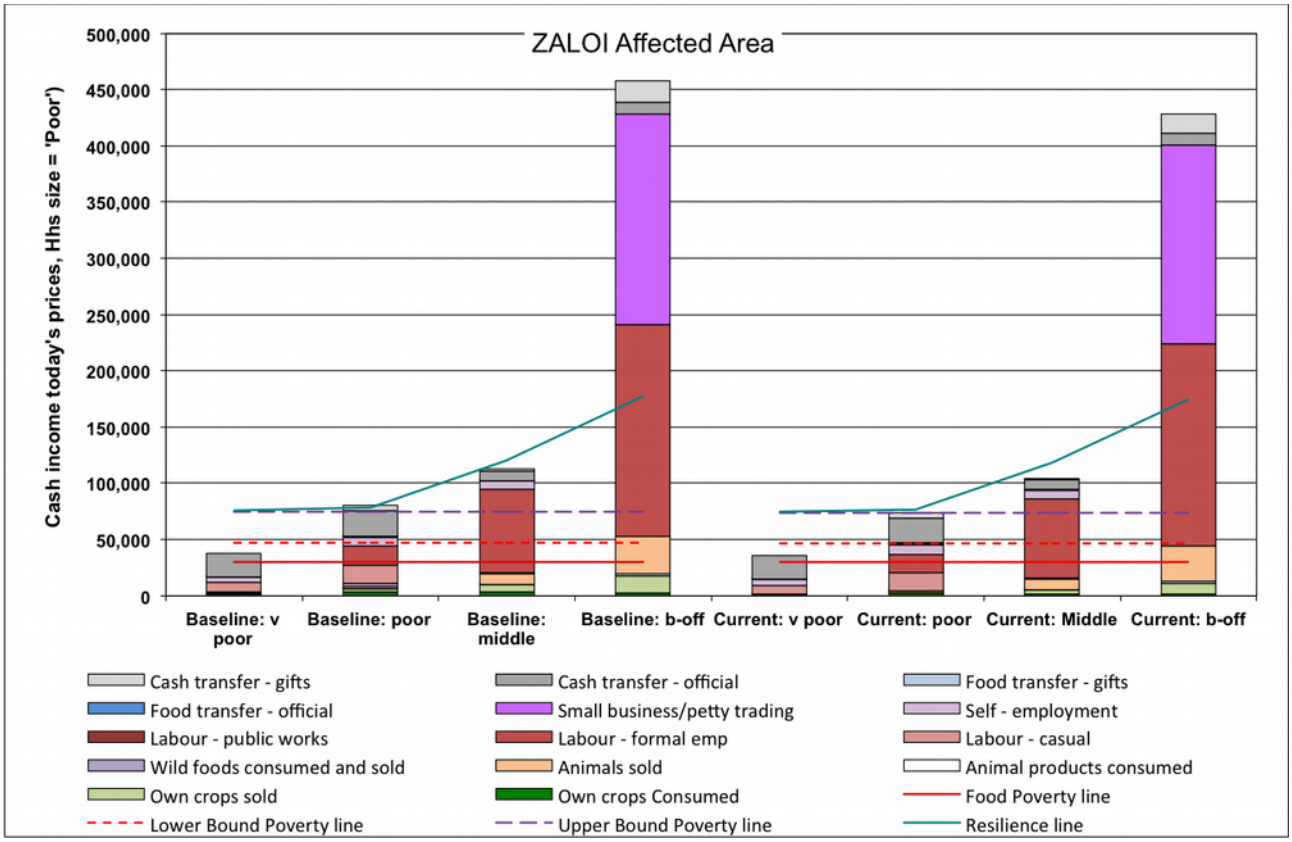

Figure 12:Total income for all wealth groups in the drought-affected areas of Lowveld Open Access Irrigated Cropping livelihood zone

Figure 11 is a chart showing the some details of all wealth groups' total income in the *affected part* of the livelihood zone. The chart is based on the cost of the FPL, and normalises all the income as other poverty lines against this; the apparent reduction in incomes actually results from the rise in the cost of the FPL—in purely nominal terms, households' incomes actually rise for the current year (April 2015 to March 2016) when compared with the baseline (April 2013 to March 2014).

High Food Price Scenario

Commercial farmers in South Africa are also facing a production crisis that could result in local supply shortfalls, while the recent slide in the value of the Rand could possibly raise the cost of imports significantly. Households in this zone are vulnerable to price increases and for any wealth group to experience a Food Poverty Deficit (and therefore face starvation) in this livelihood zone, the price of foodstuffs will need to rise by 39% when compared with 2013-2014 levels (the new price would be 1.39 times the baseline). This means that maize, which retailed for R 4.00 a kilogram in 2013-2014, would have to cost R 5.56 currently.

North Eastern Limpopo Open Access Crop Farming (ZALOF)

'Very poor' and 'poor' households in this zone purchase 38% and 51%, respectively, of their total food energy intake. This is somewhat less than other livelihood zones and it demonstrates that they depend a little more on their own agriculture, making them more vulnerable to crop failure from drought than other livelihoods.

Table 9 provides a summary of the total incomes for the 'poor' and 'very poor' wealth groups against this year's poverty lines (FPL, LBPL and UBPL). As can be seen in the table, neither wealth group is below either the FPL, whether drought-affected or not. However, the 'very poor' are below both the LBPL and the UBPL in both drought-affected and non-affected areas, while the 'poor' are not below either. It is important to note that the 'very poor' also suffer a LBPL deficit in the baseline year—this has worsened by R 184 in the non-affected areas and R 856 in the affected areas, meaning that their increased poverty is a function of both the present price regime as well as the drought.

Figure 12 is a chart showing the some details of all wealth groups' total income in the *affected part* of the livelihood zone. The chart is based on the cost of the FPL, and normalises all the income as other poverty lines against this; the apparent reduction in incomes actually results from the rise in the cost of the FPL—in purely nominal terms, households' incomes actually rise for the current year (April 2015 to March 2016) when compared with the baseline (April 2013 to March 2014).

Table 10 - comparison of 'Poor' and 'Very poor' household incomes between baseline, unaffected and drought-affected areas in the Lowveld Open Irrigated Cropping livelihood zone this year

Measure	Cash equivalent in today's Rands					
	'Very Poor' wealth group			'Poor' wealth group		
	Baseline	Unaffected areas	Affected areas	Baseline	Unaffected areas	Affected areas
TOTAL Income	30,627	30,141	29,469	65,554	63,541	61,814
FOOD POVERTY	21,926	21,926	21,926	21,926	21,926	21,926
Food Poverty Deficit	**0**	**0**	**0**	**0**	**0**	**0**
L O W E R B O U N D POVERTY	35,197	34,895	34,895	35,197	34,895	34,895
Lower Bound Deficit	**4,570**	**4,754**	**5,426**	**0**	**0**	**0**
UPPER BOUND POVERTY	58,832	57,992	57,992	58,832	57,992	57,992
Upper Bound Deficit	**28,205**	**27,851**	**28,523**	**0**	**0**	**0**

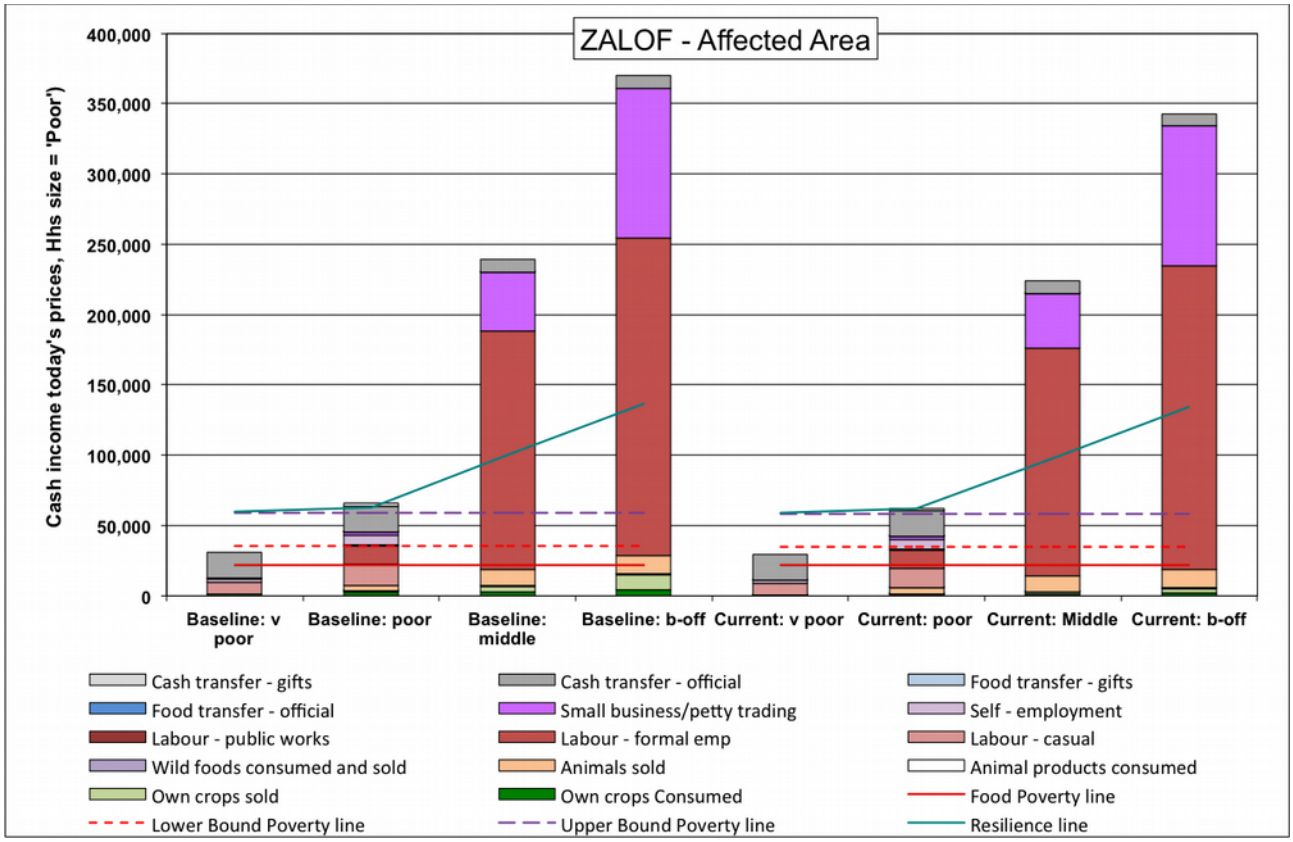

Figure 13: Total income for all wealth groups in the drought-affected areas of the North Eastern Limpopo Open Access Crop Farming livelihood zone

High Food Price Scenario

Commercial farmers in South Africa are also facing a production crisis that could result in local supply shortfalls, while the recent slide in the value of the Rand could possibly raise the cost of imports significantly. Households in this zone are vulnerable to price increases and for any wealth group to experience a Food Poverty Deficit (and therefore face starvation) in this livelihood zone, the price of foodstuffs will need to rise by 61% when compared with 2013-2014 levels (the new price would be 1.61 times the baseline). This means that maize, which retailed for R 5.00 a kilogram in 2013-2014, would have to cost R 8.05 currently.

Summary of Deficits in Livelihood Zones and Administrative Areas

The household deficits in each analysis are combined with population breakdowns for the livelihood zones in each administrative area. The tables overleaf are arranged as a cross-tabulated pivot table: Livelihood zones are in columns and districts or municipalities are in rows. Numbers are only reported if the livelihood zone is experiencing a deficit for at least one wealth group.

Populations below the Lower Bound Poverty Threshold, with the Total Deficits (total of amount below the LBPL)

		lz_name	Data								
		Lowveld open access irrigated cropping		Northern open access cattle and dryland crops		Southern Limpopo open access cattle and crops		North eastern Limpopo open access farming		**Total Total Deficit Pop**	**Total Total Deficit**
District	Municipality	Total Deficit Pop	Total Deficit	Total Deficit Pop	Total Deficit	Total Deficit Pop	Total Deficit	Total Deficit Pop	Total Deficit		
Capricorn	TOTAL			-	-	-	-			-	-
	Aganang			-	-					-	-
	Blouberg			-	-					-	-
	Lepele-Nkumpi					-	-			-	-
	Molemole			-	-					-	-
	Polokwane			-	-	-	-			-	-
Greater Sekhukhune	TOTAL					-	-			-	-
	Elias Motsoaledi					-	-			-	-
	Ephraim Mogale					-	-			-	-
	Fetakgomo					-	-			-	-
	Greater Tubatse					-	-			-	-
	Makhuduthamaga					-	-			-	-
Mopani	TOTAL	11,420	14,673,076			-	-			**11,420**	**14,673,076**
	Greater Giyani	11,420	14,673,076							**11,420**	**14,673,076**
	Greater Letaba					-	-			-	-
	Greater Tzaneen					-	-			-	-
	Maruleng					-	-			-	-
Vhembe	TOTAL	14,542	19,788,974	-	-			103,239	91,181,310	**117,781**	**110,970,284**
	Makhado			-	-			29,355	25,505,276	**29,355**	**25,505,276**
	Mutale	718	976,950					1,656	1,495,256	**2,374**	**2,472,206**
	Thulamela	13,824	18,812,024	-	-			72,228	64,180,778	**86,052**	**82,992,802**
Waterberg	TOTAL			-	-					-	-
	Bela-Bela			-	-					-	-
	Lephalale			-	-					-	-
	Mogalakwena			-	-					-	-
Total Result		**25,962**	**34,462,050**	**-**	**-**	**-**	**-**	**103,239**	**91,181,310**	**129,201**	**125,643,360**

Populations below the Upper Bound Poverty Threshold, with the Total Deficits (total of amount below the UBPL)

		lz_name		Data							
		Lowveld open access irrigated cropping		Northern open access cattle and dryland crops		Southern Limpopo open access cattle and crops		North eastern Limpopo open access farming		**Total Total Deficit Pop**	**Total Total Deficit**
dc_name	mn_name	Total Deficit Pop	Total Deficit	Total Deficit Pop	Total Deficit	Total Deficit Pop	Total Deficit	Total Deficit Pop	Total Deficit		
Capricorn				327,717	741,776,171	297,987	632,911,657			**625,704**	**1,374,687,828**
	Aganang			94,955	218,791,195					**94,955**	**218,791,195**
	Blouberg			98,022	221,075,181					**98,022**	**221,075,181**
	Lepele-Nkumpi					135,610	290,177,821			**135,610**	**290,177,821**
	Molemole			45,348	98,739,994					**45,348**	**98,739,994**
	Polokwane			89,392	203,169,801	162,377	342,733,836			**251,769**	**545,903,637**
Greater Sekhukhune						560,153	1,209,732,924			**560,153**	**1,209,732,924**
	Elias Motsoaledi					60,540	143,762,910			**60,540**	**143,762,910**
	Ephraim Mogale					32,160	69,454,725			**32,160**	**69,454,725**
	Fetakgomo					62,440	133,098,114			**62,440**	**133,098,114**
	Greater Tubatse					206,940	445,415,785			**206,940**	**445,415,785**
	Makhuduthamaga					198,073	418,001,390			**198,073**	**418,001,390**
Mopani		11,420	53,412,488			210,553	454,797,625			**221,973**	**508,210,113**
	Greater Giyani	11,420	53,412,488							**11,420**	**53,412,488**
	Greater Letaba					26,676	58,994,668			**26,676**	**58,994,668**
	Greater Tzaneen					122,600	267,659,737			**122,600**	**267,659,737**
	Maruleng					61,277	128,143,220			**61,277**	**128,143,220**
Vhembe		14,542	68,763,424	97,878	218,096,241			103,239	488,607,288	**215,659**	**775,466,953**
	Makhado			97,686	217,654,623			29,355	138,530,126	**127,041**	**356,184,749**
	Mutale	718	3,394,741					1,656	7,860,145	**2,374**	**11,254,886**
	Thulamela	13,824	65,368,683	192	441,618			72,228	342,217,017	**86,244**	**408,027,318**
Waterberg				172,857	394,940,806					**172,857**	**394,940,806**
	Bela-Bela			2,035	4,388,012					**2,035**	**4,388,012**
	Lephalale			36,625	82,859,141					**36,625**	**82,859,141**
	Mogalakwena			134,197	307,693,653					**134,197**	**307,693,653**
Total Result		**25,962**	**122,175,912**	**598,452**	**1,354,813,218**	**1,068,693**	**2,297,442,206**	**103,239**	**488,607,288**	**1,796,346**	**4,263,038,624**

Conclusion

In the current year, April 2014 to March 2016, households face problems with the current drought, including reduced food production, reduced opportunities for income, increases in prices of food and increases in prices of other essential household items. This impacts on the poorest households the most.

The ‘very poor’ households in all zones rely mostly on purchases (an average of 85% of their total annual food energy intake) and this makes them vulnerable to food price increases. The combination of high food and other commodity prices, constrained work opportunities (especially through reduced availability of *both agricultural labour and domestic labour opportunities*), augmented somewhat by poor crop production in April 2015, reduces household capacity to access quality food and a decent standard of living, defined by the Upper Bound Poverty Line. In the North Eastern Open Access Crop Farming and the Lowveld Open Access Irrigated Farming livelihood zones, 'very poor' households are living below the Lower Bound Poverty Line. Although the same outcomes exist in the baseline as well, the *margins of deficit have increased this year*.

Approximately 1,796,300 people are below the Upper Bound Poverty Line and their accumulated poverty gap is R 4.263 billion. Approximately 129,200 people are below the Lower Bound Poverty Line and their accumulated poverty gap is R 125.6 million.

Recommendations

1. Government should consider an assistance package for the ‘very poor’ households which are likely to miss some of their livelihood entitlements in the coming three months. This could be in the form of scaling up social relief grants to increase household incomes;
2. The Extended Public Works Programme (EPWP) should be targeted to the very poor and poor households so as to increase the available employment slots, hence improving the frequency a household can benefit from the programme in a year;

3. The current SAVAC projections are based on current conditions such as current price of maize meal. An efficient monitoring system especially for the price of maize meal is required to be able to analyse the likely impact of further price increases on household access to food;
4. There is a high potential to increase household incomes through irrigation of vegetable production which is plentiful in the zone especially during the peak season. There is a need for further investigation of this potential medium- to longer-term economic intervention in the area;
5. There is a need to distribute government agricultural inputs in time to ensure timely operation of agricultural activities;
6. Improve access to community micro-financing for job creating opportunities

Table of Areas Visited

District	**Municipality**		**Selected Areas for the HEA**
Southern Limpopo Open Access Cattle and Crops (ZASLC) Livelihood Zone			
Capricorn	Lepele-Nkumpi	Atleast two	GaMakgoba A
			Kwaripe
			GaThaba
Greater Sekekhukhune	Elias Motsoaledi	Atleast one	Hlogotlou
			Dikgalaopeng
	Ephraim Mogale	Atleast two	Manotolwaneng
			Tsimanyame
			Ngwalemong
	Makhuduthamaga	Atleast two	Manganeng
			Masehlaneng
			Matlakatle
		Atleast two	Ga-Manyaka

	Greater Tubatse		Kgautswana
			Ga-Malekana
	Fetakgomo	All	Mohlaletsi
Mopani	Maruleng	All	Finale
	Greater Tzaneen	Atleast two	Hoveni
			Mulati
			Khujwana
	Greater Letaba	All	Jamela
Lowveld Open Access Irrigated Cropping (ZALOI) Livelihood Zone			
Mopani	Greater Giyani	Atleast four	KaDzingidzingi
			Bode
			KaHomu
			KaHhlaneki
			KaNkomo
Vhembe	Thulamela	Atleast three	Matangari
			Maraxwe
			Makonde
			Mbahela
			Tshiombo
	Mutale	All	Dzimauli
North Eastern Limpopo Open Access Farming (ZALOF) Livelihood Zone			
Vhembe	Thulamela	Atleast three	Malavuwe
			Tshaulu
			Mudzidzidzi
			Mangondi A
			Lambani
			Milaboni
	Mutale	All	Tshixwadza

	Makhado	All (Waterberg team)	Murunwa
			Valdezia
			Vuvha A
Northern Open Access Cattle and Dry Land Crops (ZANOC) Livelihood Zone			
Waterberg	Mogalakwena	All	GaMonare
			Ga-Mushi
	Lephalale	All	Melkbosch
Vhembe	Makhado	All (Waterbeg team)	Maangani
			Zamekomste
	Thulamela		Themba Luvhilo
Capricorn	Polokwane	All	Ramakgaphola
	Aganang	Atleast two	Mohlajeng
			Monotwane
			Glen Roy
	Blouberg	All	Mmankgodi
			My Darling
	Molemole	All	Ga-Sako