Zimbabwe – Remote sensing based contribution to the assessment of the 2006 Maize harvest prospects

1. Introduction

Analysis of available remote sensing data was done in order to estimate the 2006 Maize production level for Zimbabwe. The analysis was done as part of the GMFS project and was conducted by Sarmap and VITO.

In general the same approach as described by the FEWSNet report "using remote sensing to assess prospects for the 2006 Zimbabwe maize harvest", issued March 2006 was used, i.e:

- Relating averaged NDVI/VPI to national yield and production
- Estimating production at district level

Different input data and different analysis methods were used and applied.

The first analysis, where NDVI was directly related to production

2. Data

SPOT-VGT data for the period April 1998 to March 2006 was used. The ten-daily images were composited to monthly images in order to eliminate as much as possible anomalies due to clouds or other artefacts. Based on the time series "Vegetation productivity Indicators" were produced and further analysed. The VPI method was originally developed by C. Sannier based on NOAA AVHRR data for a study area in Zambia to estimate maize production. The VPI is based on a statistical distribution of NDVI values put into an historical context. The VPIs were further stratified using the SADC Regional Land Cover Database.

Dry Matter Productivity images, based on SPOT-VGT NDVI data and ECMWF data, were available through EC JRC MARS-FOOD (http://www.marsop.info/). Zimbabwe was extracted from the Africa-wide images for the period 1998 – 2006.

ASAR AP data (15 m resolution) was acquired over 2 main areas, namely and Mashona provinces. Quick assessments were done in order to get an overall view of the territory. Although a multi-temporal images were ordered (from September 2005 to June 2006), not all data has been available. For the Mashona province data was available for 10 October 2005, 29 October 2005 and 13 November 2005. ASAR mosaics were prepared based on the 3 different acquisition dates. For the area data was received upto February 2006, although there was no consistency in data received (different dates for different areas). Based on the ASAR AP data a quick visual assessment was made of cropped areas. This was compared with field pictures, available through FEWSNet from the 2006 USDA\FEWSnet Crop tour in Zimbabwe (2006) and older landsat TM and ETM+ data.

National Maize production figures for Zimbabwe were obtained from FAO stat for the period 1961 – 2005. Production figures from the Production Estimates and Crop Assessment Division (PECAD) at USDA have been retrieved for the period 200-2005 from the above mentioned FEWSnet Report.

The SADC Landcover database was available through SADC-RRSU.

ASAR WS data was acquired, however not used given that not all parts of the countries have been available yet through ESA.

MODIS 250m resolution 16-day composites for the period September 2005 to March 2006 were obtained through EOS data gateway (http://edcimswww.cr.usgs.gov/pub/imswelcome/).

The administrative boundaries were obtained via FAO and were retrieved from the GAUL database.

3. Relating NDVI (VPI) to national yield & production

Data

- VPI images as described above
- Administrative boundaries from the GAUL database
- SADC Landcover database
- FAOSTAT national production and yield figures

Methods

The standard S10 NDVI products were used to calculate monthly Maximum Value Composites (S30 product) for the period April 1998 to March 2006. Based on these time series the VPI method was applied assigning to each pixel a probability level, based on the observed historical value range. The VPI images were further masked with the cropland mask based on the SADC Landcover database "cultivation" class. Statistics were extracted from the resulting images and districts, which were further aggregated (averaged) to obtain national figures for October to March for each year (1998 – March 2006).

The FAOSTAT national production and yield figures were used and normalized, according to the historical possible range of values for the period 1961 – 2005.

The historical time series of FAOSTAT yield and production were compared (Figure 1) and appeared to be highly correlated ($R^2 > 0.7$).

Regression analysis was performed to relate the VPI values (November, January, March) to the normalized production figures and to the normalized yield figures. Relating the VPI values directly to production resulted in a R square value of 0.78. Relating the VPI values to the normalized FAOSTAT yield statistics resulted in a R^2 of 0.87 (Figure 2).

Maize production levels were calculated based on:

- using the regression equation relating VPI to production
- using the regression equation relating VPI to yield multiplied by area statistics.

Planted areas were derived from the FAOSTAT historical time series (Figure 3). The average of the past 5 years was used (approx 1.3 M ha, corresponding with the 2006 PECAD estimate).

Results

The regressions are based on only 7 points and results should be used with caution.

Data exploration further indicated that the months November, January and March (within the October to March time period) were best correlated with Maize production.

The VPI value for 2006 is 53%. The corresponding national **production** probability value (calculated from the regression equations) was found to be 33%, corresponding with an overall production of 1.19 M tonnes of Maize.

The national forecasted **yield** probability value was found to be 26%, corresponding with an overall maize yield of 8844 Hg/Ha. When multiplied by approx. 1.3M Ha, resulted in an overall Maize production of 1.15 M tonnes of Maize.

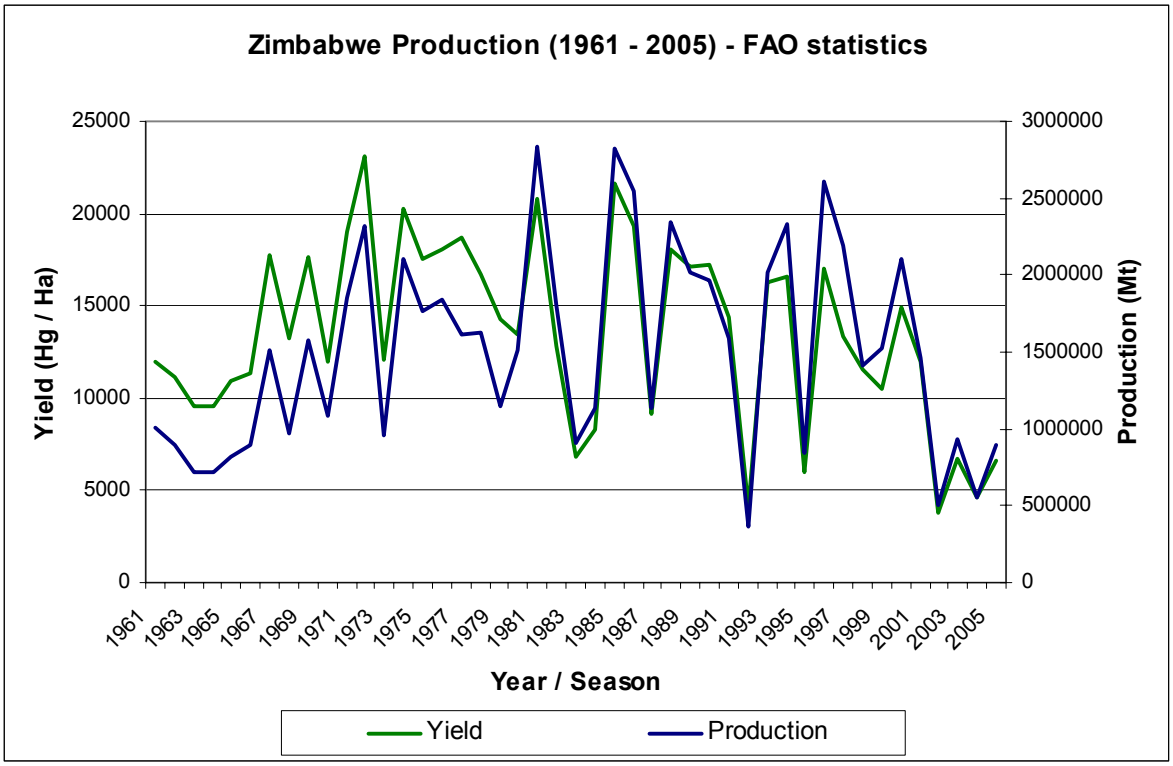

Figure 1. FAOSTAT Maize Yield and Production statistics for Zimbabwe (period 1961 - 2005)

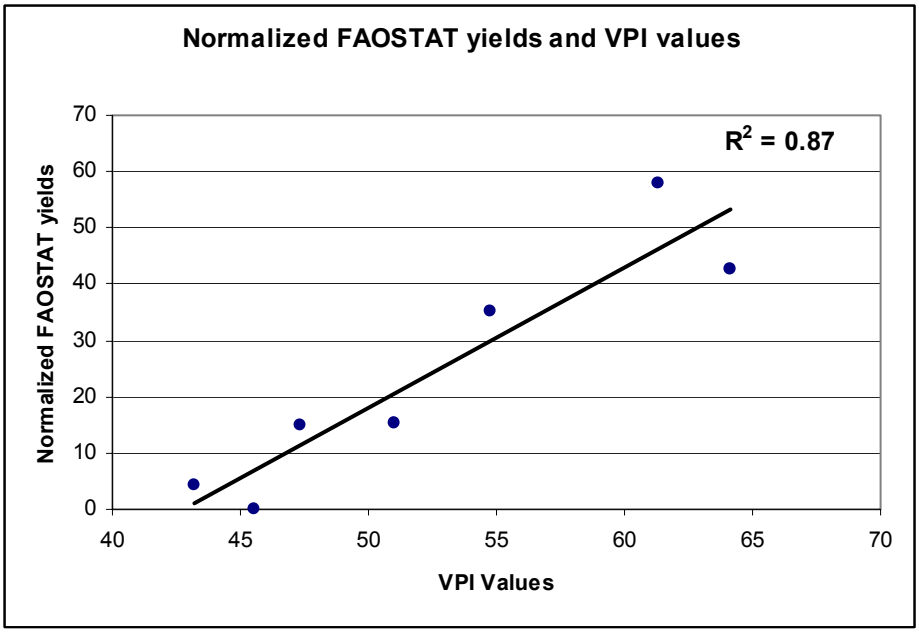

Figure 2. FAOSTAT normalized maize yield values vs. VPI averaged values

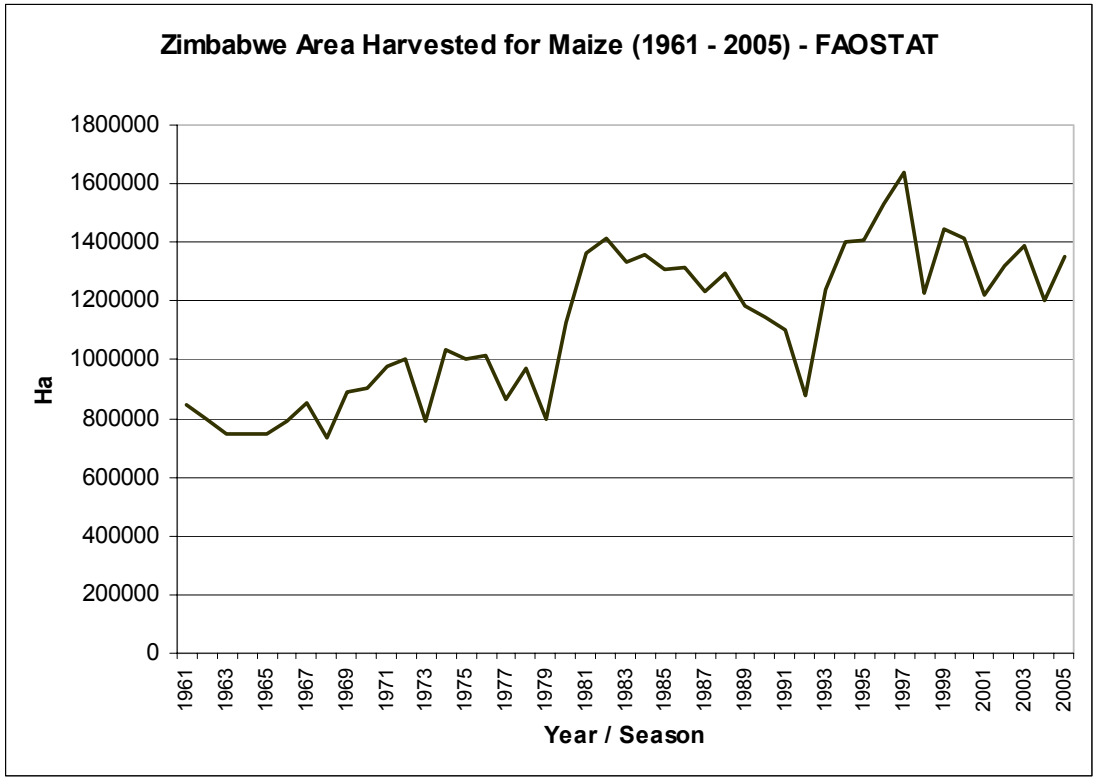

Figure 3. Area harvested (Maize, 1961 - 2005) – FAOSTAT

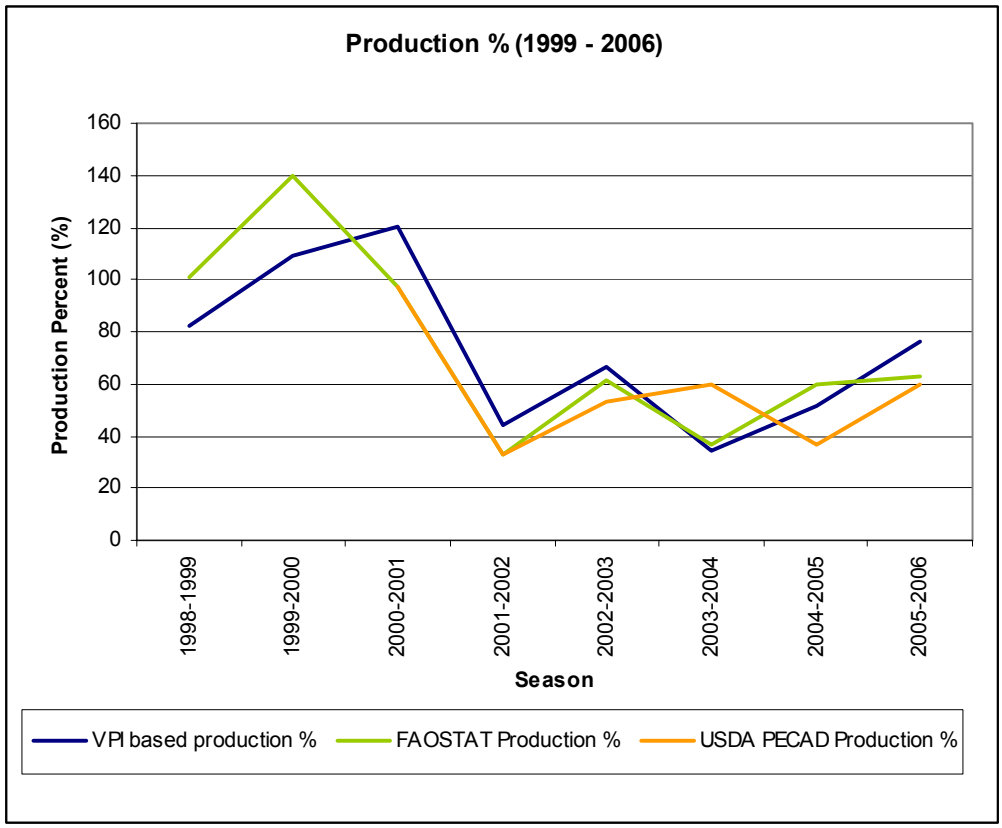

Figure 4. Production Percentage for the Maize production in Zimbabwe (period 1998/9 to 2005/6).