



World Food Programme

NIGERIA SATELLITE IMAGERY ANALYSIS

Cropland change analysis in hard-to-access areas



The security context in parts of northern Nigeria continues to hamper agricultural monitoring and national food security analyses. In collaboration with the European Commission's Joint Research Centre (JRC), WFP uses high-resolution satellite images to evaluate cropland changes in hard-to-reach areas of north-eastern and north-western Nigeria, comparing the situation at the end of the 2020 agricultural season with a baseline prior the beginning of the security crisis (NE: 2010, NW: 2017). In addition, for Borno state, a comparison of yearly changes between 2020 and 2019 is also conducted. The resulting products complement the available information on cultivated agricultural areas, traditionally collected through field surveys.

This note briefly describes the methodology of the analysis and presents the main results, providing an overview of the post-harvest situation in 2020 in 76 LGAs in Nigeria, with regard to the security incidents that have occurred since the beginning of the year. Finally, this document proposes ways in which these products can be used in the Cadre Harmonisé process, more specifically to inform the analysis of contributing factors.

Methodology

High-resolution satellite images (Sentinel-2, ESA/Copernicus) acquired between June 15 and October 15 are processed to detect cultivated land for each year of interest (current and baseline) – this theoretically covers the agricultural season, from land preparation to early stages of harvesting. The temporal (6 days) and spatial (10 metres) resolutions of this satellite imagery allows the detection of fields of any size and results at locality scale. Using a semi-automated method developed for this study, over 8,000 localities were covered, assigning to each village the associated degree of cropland change in its surroundings between 2020 and a reference year prior to the security crisis. The maps produced show in red, orange, yellow and green the localities for which the following changes were detected:

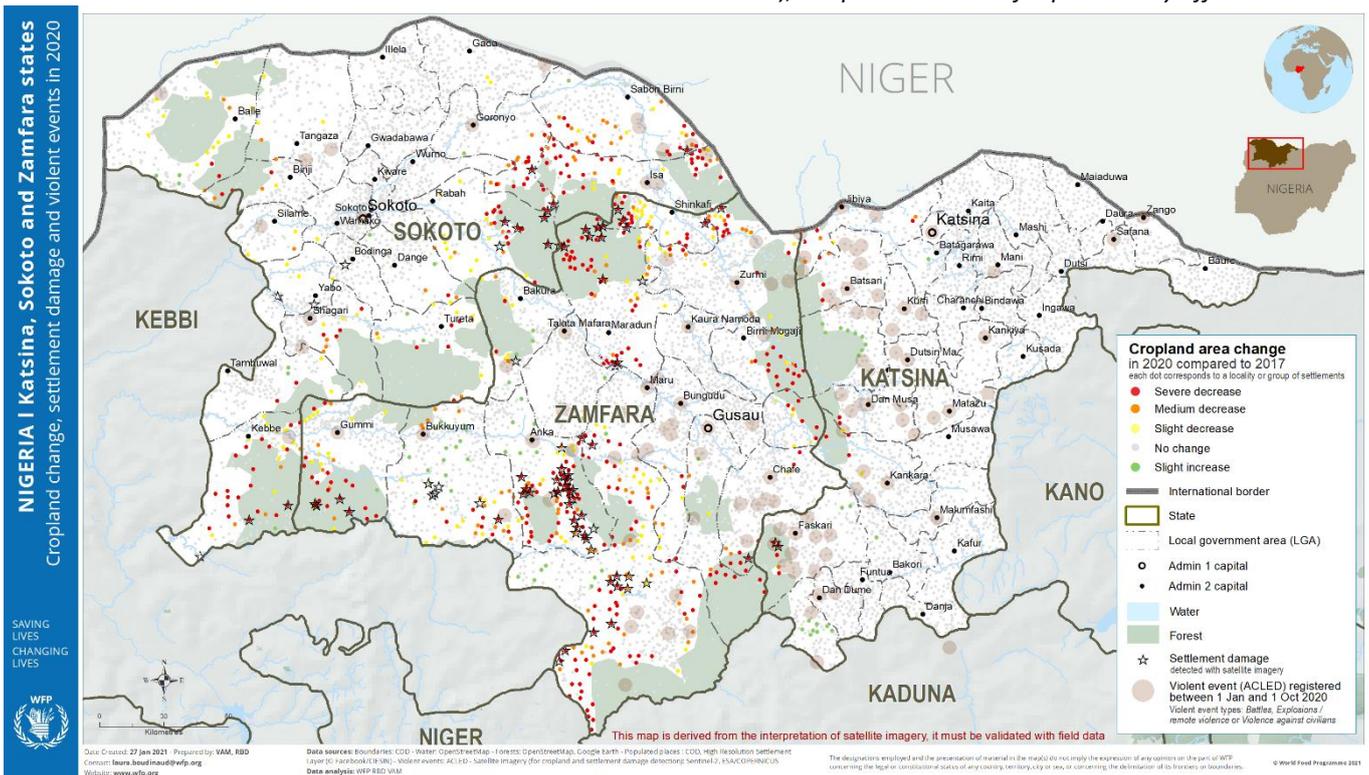
- **Severe decrease** (>50% area loss) in 2020 compared to the reference year

- **Medium decrease** (25%-50% area loss)
- **Slight decrease** (<25% area loss)
- **Slight increase** (<25% area gain)
- **Medium increase** (25%-50% area gain)
- **Significant increase** (>50% area gain).

Populated sites where no visible change was detected are represented in grey, including the ones with no agricultural land in both years. These categories are the result of a visual interpretation of satellite-derived composites, not validated with field data.

Finally, violent events recorded in the area between January 1 and October 1, 2020 (source: ACLED) were included in the maps to assess any possible link between crop abandonment and recent insecurity in certain areas.

The map below illustrates the overall situation for the North West part of Nigeria. Detailed maps (by state, including Borno), are provided below for particularly affected areas.



Main results by state

Considering the different contexts in northeast and northwest regions of Nigeria, the choice of the baseline years and the map outputs were adapted in each case. While the Borno region has been the scene of violence for over 10 years, the security context has started deteriorating in the north-western states (Sokoto, Zamfara and Sokoto) more recently.

North East: Borno state

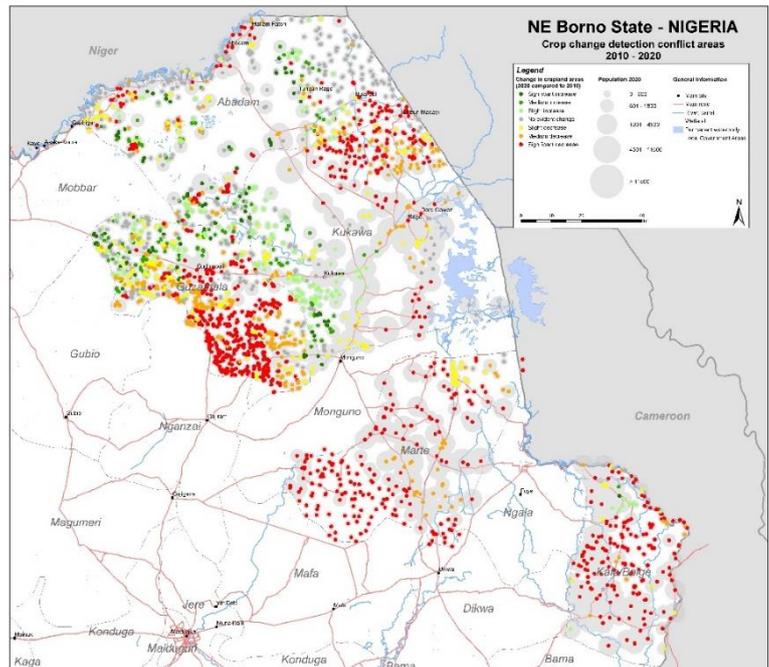
Five Local Government Areas (LGAs) located in the state of Borno were analysed: Abadam, Guzamala, Kala/Balge, Kukawa and Marte. Since 2010, violence has increased in relation to the Boko Haram insurgency and counterinsurgency operations. The state of Borno is the most affected and the one with the most severe humanitarian access restrictions. The conflict has caused a massive destruction of infrastructures, killing of thousands of people and displaced millions of people. This situation has strongly affected the agricultural sector, limited access to the land and population movements causing significant decrease in cultivated land areas and the resulting production of food. Two periods are analysed to report on cropland changes. First, cropland changes for the 2010-2020 period area analysed (current year versus pre-crisis situation). Second, 2020 is compared to the previous year (2019), to capture recent cropland dynamics.

Current season compared to pre-crisis: 2020 / 2010

Map 2 shows in yellow, orange and red the populated sites (villages, hamlets, etc.) for which a slight, medium or significant decrease in cultivated areas was detected in 2020 compared to 2010. Green symbols represent increases in agricultural use.

The most affected areas are Kala/Balge and Marte with both over 90% of localities with cropland decrease from 2010 to 2020. The LGAs Abadam, Kukawa and Guzamala also show significant cropland losses in more localised areas. During the same study period, the largest cropland increases were in western Kukawa, eastern Abadam, along the former Lake Chad and northern Guzamala.

It is recommended that this product is used as a contributing factor for Availability (see CH recommendations, Page 4).



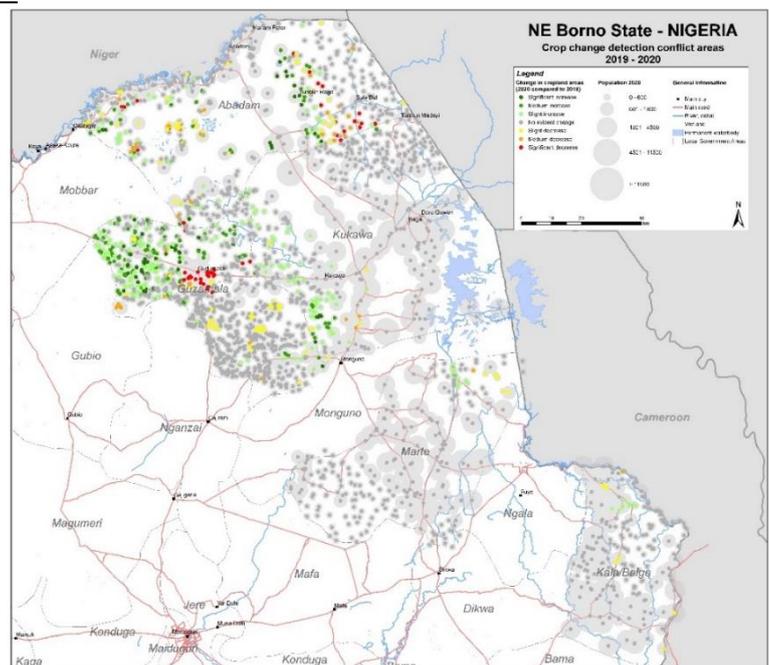
Map 2. Borno state, cropland change between 2020 and 2010

Current season compared to last year: 2020 / 2019

In the 2019-2020 period, fewer to no changes were observed in most of the area of interest. Observed changes are predominantly cropland increases in all five LGAs considered and more importantly in Kukawa, Guzamala and Abadam.

Cropland loss, however, was still observed in Abadam and Guzamala (respectively 17% and 8% of sites surveyed).

It is recommended that this product is used as a contributing factor for Hazards & Vulnerability (see CH recommendations, Page 4).

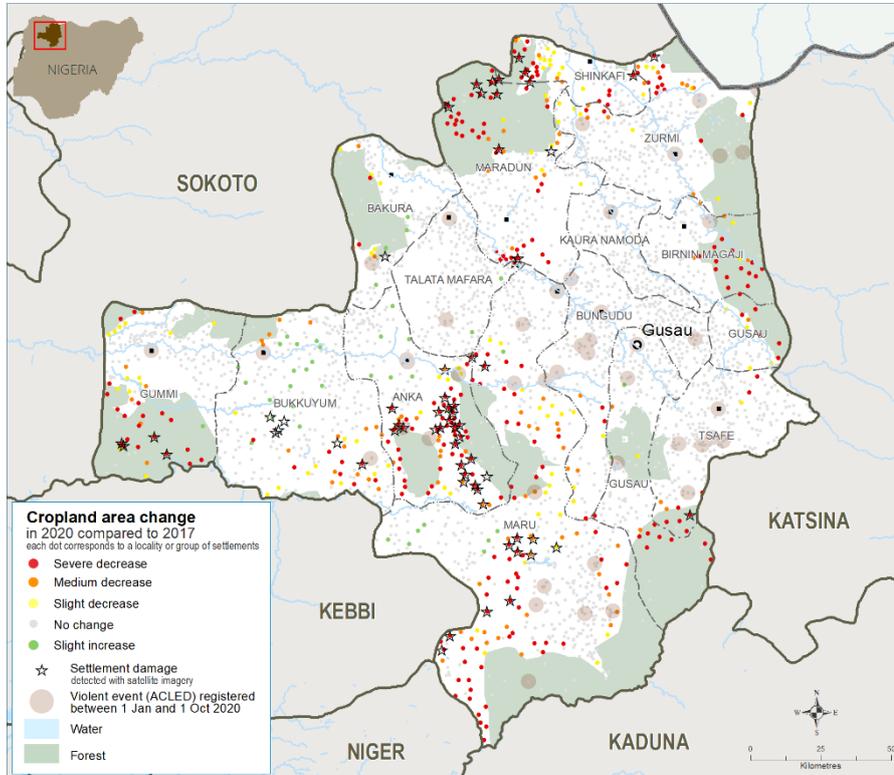


Map 3. Borno state, cropland change between 2020 and 2019

North West: Katsina, Sokoto and Zamfara states

In north-western Nigeria, the security crisis has escalated since 2019. The reference year used for the cropland change analysis, as a baseline to compare the current situation with is 2017. Several LGAs of Zamfara and Sokoto states were heavily affected by cropland abandonment in 2020, most probably due to population displacements or movement restrictions. Most localities impacted by severe cropland loss are situated far from urbanized areas and more specifically concentrated close to forests, where armed groups usually make camps. In addition to cropland losses, important settlement damage was detected in more than 80 villages, most of which occurred between 2019 and 2020 agricultural seasons. It is worth mentioning that, even though the focus was set on those 3 states in the NW, cropland losses were also detected in areas of Kebbi and Kaduna states.

Current season compared to pre-crisis: 2020 / 2017



ZAMFARA. As shown in Map 4, Anka is the most affected LGA in terms of cropland change as well as settlement damage; over one quarter of villages (and estimated population) have known a severe decrease in cultivated areas, and 26 localities were detected as damaged between 2019 and 2020 growing seasons. According to ACLED data, “during the week of 23 March 2020, Nigerian Armed Forces conducted operations against local militias in the Sunke and Bagega area of Anka LGA”.

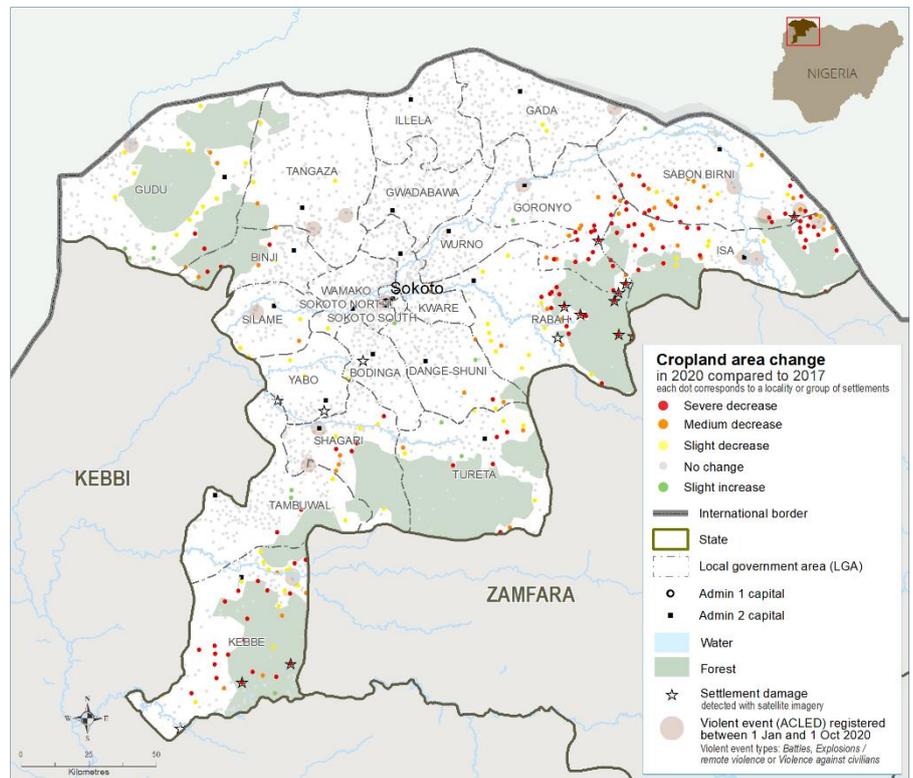
The analysis also shows a significant decrease in agricultural activities in the LGAs of Maradun and Shinkafi, as well as localised areas of Birnin Magaji, Bukkuyum, Gummi and Maru.

It is recommended that this product is used as a contributing factor for Hazards & Vulnerability and Availability (see CH recommendations, Page 4).

Map 4. Zamfara state, cropland change between 2020 and 2017

SOKOTO. Significant cropland losses are detected in villages located East and South of Sokoto state. More specifically, affected localities are situated in the LGAs of Isa, Kebbe, Rabah, Sabon Birni and Goronyo, which have been the scene of increasing tensions (attacks of villages, clashes between the Nigerian and Nigerian Armed Forces and militias, etc.) leading to forced displacement and/or access restrictions. More details at LGA-level are provided at Page 4.

KATSINA. Most LGAs of Katsina state shows little to no change in agricultural patterns in 2020 compared to previous years. Yet, this does not imply security is stable in those areas; on the contrary, ACLED data tends to prove that violent events have increased in 2020. Physical impacts on cultivated land patterns may possibly be detectable in 2021.



Map 5. Sokoto state, cropland change between 2020 and 2017

Cadre Harmonisé (CH) recommendations

It is recommended that the information presented above be used to inform the analysis of the contributing factors of the CH session of March 2021, under two components:

- **Availability:** Since the cropland change analysis is based on the temporal evaluation of vegetation indices, the data produced can inform the analysis of contributing factors under the Availability component, in accordance with the provisions of the Harmonized Framework Manual.
- **Hazards & Vulnerability:** Where a decrease in cultivated area is associated with total cropland abandonment and/or damaged settlements, the information generated can also inform, completed with available information on violent events (ACLED data), the analysis of contributing factors under the Hazards & Vulnerability component.

To facilitate the interpretation of the satellite-derived results, thresholds are proposed. It is important to note that consultations on the thresholding of the cropland change analysis are ongoing at the CH Technical Committee level. The recommendations below are therefore to be considered as preliminary and indicative.

For the **Availability** component, the overall positive or negative change (current versus pre-crisis) at LGA level is used, determined from the difference between medium-significant increases and decreases ratios, both in terms of localities and populations:

- If one of the absolute positive/negative changes is between 10 and 20%: **slight** positive/negative impact.
- If one of the absolute positive/negative changes is between 20 and 30%: **medium** positive/negative impact.
- If one of the absolute positive/negative changes is greater than 30%: **strong** positive/negative impact.

For the **Hazards & Vulnerability** component, thresholding depends on the context of the area of interest and so on the corresponding products (where they are associated with numbers of total cropland abandonments by LGA and/or ACLED violent events):

- **For NE Nigeria:** 2020 versus 2019 negative changes are retained, calculated from moderate and significant decreases; the same thresholds as above are applied.
- **For NW Nigeria:** the number of damaged settlements by LGA is retained: 5 to 11 (**slight** negative), 12 to 20 (**medium** negative) and above 20 (**strong** negative).

The table below shows the resulting contributing factors for the LGAs analysed:

State	LGA	CH recommendations (contributing factors)		Remarks Context elements (source: ACLED)
		Availability	Hazards & Vulnerability	
Borno	Abadam	Medium negative	-	
Borno	Guzamala	Strong negative	Slight negative	
Borno	Kala/Balge	Strong negative	-	
Borno	Kukawa	Strong negative	-	<i>lorem</i>
Borno	Marte	Strong negative	-	
Sokoto	Goronyo	-	Slight negative	Attacks on several villages located in the eastern part, in the course of 2019, killed at least ten residents and have spread fear in this area, leaving over 15 localities without cultivating in 2020 still.
Sokoto	Isa	Strong negative	Medium negative	Early July 2020, unidentified gunmen attacked at least 7 villages: 5,000 people were forced to flee, 6 people killed, and livestock stolen. The attacks are believed to be related to earlier air strikes against militias in Kagara Forest. Fatalities split between 3 events.
Sokoto	Kebbe	Slight negative	-	Little to no violent events were reported to the ACLED database between 2018 and 2020. A significant number of localities have stopped cultivating in 2020 in the surroundings of the forest and a few villages were damaged.
Sokoto	Rabah	Slight negative	Slight negative	Many violent attacks occurred in the course of 2019 during which settlements were burnt, hundreds of cattle were stolen and at least a total of 100 people were killed.
Sokoto	Sabon Birni	Slight negative	Slight negative	Several villages were attacked in April/May 2020, killing 25 residents, and leading to abductions. On 15 June 2020, military forces of Niger attacked alleged bandits in the border area (100 militiamen were reported killed).
Zamfara	Anka	Strong negative	Strong negative	In March 2020, the Nigerian Armed Forces conducted operations against local militias; at least 30 militiamen were killed, camps destroyed, and 22 kidnap victims rescued.
Zamfara	Birnin Magaji	Slight negative	Slight negative	Several attacks by Zamfara communal militias conducted to at least 13 fatalities in 2019. In May 2020, Nigerian Armed Forces conducted air strikes against militia camps on 3 consecutive days (135 militiamen killed in total).
Zamfara	Bukkuyum	Slight negative	Slight negative	Attacks by Zamfara communal militias against several villages were reported in 2019 and in 2020, causing the death of at least 20 people.
Zamfara	Gummi	Slight negative	Slight negative	In November 2019, local militias attacked each other, making at least 23 fatalities. In January 2020, another attack killed around 20 residents.
Zamfara	Maradun	Medium negative	Slight negative	In April 2019, Nigerian Airforce air strikes in Sububu Forest hit camps of Zamfara communal militias (10 militiamen killed). In July of the same year, several communities were attacked (at least 30 fatalities).
Zamfara	Maru	Slight negative	Medium negative	Clashes between Nigerian Military Forces and Zamfara communal militias were reported in March 2019, followed by clearance operations leading to at least 100 fatalities. Since March 2020, several villages were attacked and set on fire, leading to rustled cattle, and killing tens of civilians. Nigerian Air Force then conducted air strikes against militias camps in the forests.
Zamfara	Shinkafi	Medium negative	-	Between March and June 2019, many villages are attacked by Zamfara militias, causing 45 fatalities (farmers were targeted). Military forces launched a mass clearance operation in August of the same year (four villages are cleared, causing at least 20 fatalities). More attacks by armed groups have been perpetrated since Sept 2019, resulting in additional fatalities.