

MALI

Assessing cropland abandonment in Mopti region with satellite imagery

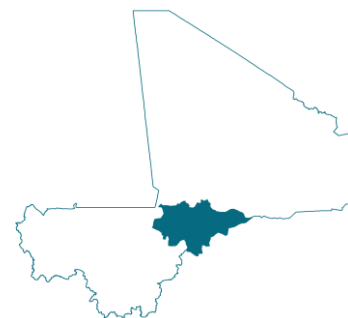
Since 2018, Mopti region has been marred by an escalation in violence. In the eastern part of the region, intercommunal tensions have increasingly taken on the character of a conflict between armed groups, including ethnically based militias and self-defence groups. Rising levels of violence have threatened food security, with a loss of livelihoods for displaced populations, difficulties in cultivating fields and accessing markets for those who have remained in their villages.

Given the vast area of Mopti region, the consequences of the conflict on the landscape are difficult to consistently monitor. Moreover, the access to many communes has been heavily restricted due to the present circumstances. Consequently, little to no field data could be collected in 2019 for some parts of the region. **Satellite imagery** helped to assess the impact of violent events on agricultural land in the region.

In October 2019, the Vulnerability Analysis and Mapping unit (VAM) of the World Food Programme conducted a geospatial analysis, measuring the degree of **change in cultivated areas** between 2019 and years prior to the degradation of the security situation, covering Mopti region. Satellite images acquired between June 15th and October 15th allowed the identification of cropland for each year from 2016 to 2019. In theory, this three-month period covers an annual agricultural season in its various phases: land preparation, planting, growing and early stages of harvesting. This qualitative analysis covers about 3,200 villages: it classifies each village by the degree of cropland change, without providing numbers of lost surfaces nor crop types¹.

The resulting product helps to identify and target vulnerable localities in Mopti region, that have known a decline in agricultural activities in 2019. The triangulation with secondary data underscores a strong correlation between the **security situation** and the **degradation of cultivated areas** across the region; the eastern cercles being the most affected. Finally, the results of this study echo the information that was collected through field interviews in November 2019 and confirm the extremely tough challenges faced by numerous communities in Mopti region.

Map 1 shows in yellow, orange and red the villages for which a light, medium and significant (respectively) decrease in cultivated areas could be detected in 2019 compared to years prior to the deterioration of the security situation (2016, 2017). Grey dots code for villages where no change was evident.



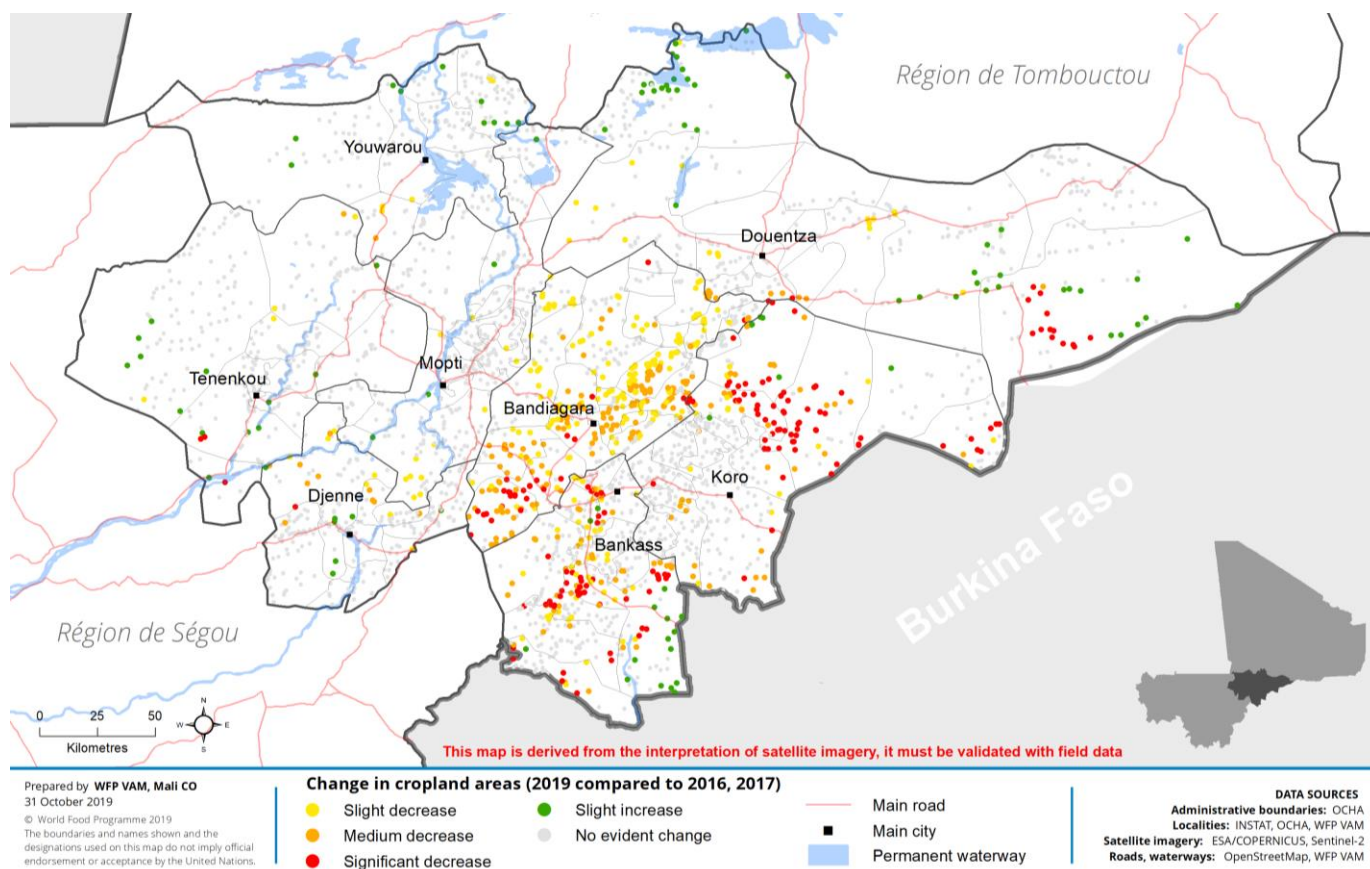
Key points

- Insecurity peaks in 2019 heavily affected agricultural activities in the eastern part of Mopti region
- In total, 25% of villages in the region are affected by a decrease in cropland areas in 2019, compared to pre-conflict years (2016, 2017)
- The most affected areas are Koro, Bankass and Bandiagara cercles, as well as the commune of Mondoro
- Evidence visible from space translate into situations of high vulnerability on the ground: households are forced flee or are confined to their village



Satellite image showing an abandoned village in Mopti region and its surroundings

¹ The methodology is explained and discussed in **Annex 1**.



Map 1. Change in cropland areas, 2019 compared to years prior to conflict, Mopti region

- The cercles most affected by medium and significant cropland diminutions² are Koro, Bankass, Bandiagara et Douentza (exact percentages of impacted villages per cercle are given in *Table 1*). These are the areas where intercommunal tensions have led to many acts of violence in the course of 2019.
- The cercles of Youwarou, Mopti, Tenenkou and Djenne have known less cropland loss than the eastern cercles. No evident change was detected in most villages of the western cercles of Mopti region.
- For 3% of the localities analysed, croplands have slightly increased in 2019 compared to pre-conflict years. This may be due to favourable climatic conditions during the 2019 agricultural season, despite a late start of the rainy season. Another hypothesis, to be confirmed, is that displaced people fleeing to some of those areas began cultivating land that was not previously used as cropland.

² Examples of satellite images are included in **Annex 2** to illustrate cropland loss between 2019 and a previous year.

What about 2018?

Violence in Mopti region started escalating in some specific areas in 2018. Satellite images dated from that year allow to examine the timing of agricultural changes in the region since the conflict has settled in:

Out of the hundreds of villages classified in red (significant loss) and in orange (medium loss) on *Map 1*, approximately one third were **already affected in 2018**; most of which are in Mondoro (east of Douentza cercle) and in Koro cercle. For half of these localities, a **complete loss of cultivated fields** is detected in 2018, followed by a slight recovery in 2019 but still far from normal (2016 and 2017 taken as a baseline). For the other half, communities have not cultivated their fields for two consecutive years. This could also be explained by the displacement of households away from their villages.

For the cercles of Bandiagara and Bankass, most losses in cultivated land occurred for the first time in 2019.

In addition to cropland losses, two specific types of landscape changes were detected during the satellite imagery analysis, specifically in Koro cercle, at the centre of Bankass cercle and to a lesser extent in Bandiagara cercle and in Mondoro commune (east of Douentza):

- For over one hundred localities, crop fields that used to cover a radius of up to 10 kilometres from the village in 2016 and in 2017, were only cultivated in 2019 within a neat radius ranging from 500 metres up to 2 kilometres around the village in 2019. Such variations are presumably based on movement restrictions imposed on civilians by armed actors, through direct threats or acts of violence. This was confirmed in field interviews (see **Annex 3**).

- Around one hundred villages were detected as being possibly damaged or destroyed in 2019. This was confirmed with very high resolution (VHR) satellite images in thirty cases. For the other remainder, no conclusive evidence was available because no recent VHR imagery was accessible (see *Page 5*).

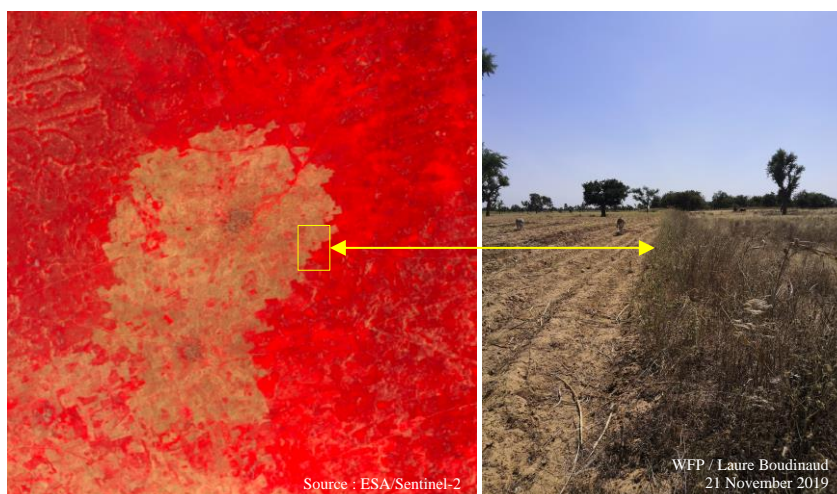


Figure 1. The field picture on the right shows the neat delineation beyond which inhabitants of this village (located in Koro cercle) could not cultivate their fields in 2019. This is visible on the satellite image (left), dated from 18th September 2019: natural vegetation appears in red, while cultivated fields, in beige, surround the two villages.

Summary table by cercle

Table 1 shows a summary of the analysis by cercle. The satellite imagery analysis bases itself on the list of villages that was used for the 2009 national census³; the projected population numbers for 2019⁴ are given for information purposes.

Cercle	Nb of sites	Increase		No change		Slight decrease		Medium decrease		Significant decrease		Population 2019 ⁴
		Nb of sites	%	Nb of sites	%	Nb of sites	%	Nb of sites	%	Nb of sites	%	
Bandiagara	581	0	0%	228	39%	152	26%	173	30%	28	5%	430,896
Bankass	437	16	4%	279	64%	45	10%	45	10%	52	12%	363,978
Djenne	285	7	2%	248	87%	10	4%	19	7%	1	0%	286,497
Douentza	418	36	9%	307	73%	36	9%	23	6%	16	4%	339,026
Koro	490	7	1%	340	69%	20	4%	38	8%	85	17%	498,435
Mopti	383	4	1%	366	96%	12	3%	1	0%	0	0%	507,120
Tenenkou	346	13	4%	317	92%	5	1%	8	2%	3	1%	223,965
Youwarou	226	10	4%	209	92%	6	3%	1	0%	0	0%	149,182
Région	3,166	93	3%	2,294	72%	286	9%	308	10%	185	6%	2,799,099

Table 1. Number and percentage of affected villages by the different cropland change categories in 2019 (per cercle)

- A quarter of the villages in the Mopti region is affected by cropland losses, 16% by medium to significant decrease. The cercles most affected by such losses in 2019 are Koro (25% of villages), Bankass (22%), Bandiagara (35%) and Douentza (10%).
- The cercles of Mopti, Youwarou, Tenenkou and Djenne are less affected: most localities show no evident change in cropland in 2019 compared to pre-conflict years (respectively 96%, 92%, 92% and 87% of villages).

³ Source : Institut national de la statistique (INSTAT).

⁴ Source : Direction nationale de la population (DNPpop).

Correlation with insecurity in Mopti region

The precarious security situation since the end of 2018 has continued to deteriorate during 2019; in June 2019, a peak in both significant violent incidents and the number of victims was recorded⁵. This is also the time of the year when land preparation and planting are underway. The *Armed Conflict Location & Event Data project*⁶ (ACLED) provides georeferenced data on armed conflict events, allowing to map crisis areas. ACLED database was used as a reference to evaluate the geographic distribution of violent events with respect to localities under analysis⁷.

In the period from 1 April to 1 October 2019, 190 of the 305 violent events reported for Mali occurred in the Mopti region. Most of these events (90%) occurred in the four eastern cercles of the region: Bandiagara, Bankass, Douentza and Koro (*Table 2*).

The spatially-explicit relationship between agricultural land abandonment and violent events is shown on *Map 2*. It echoes the assumption that cropland changes may result from the direct or indirect effects of violence.

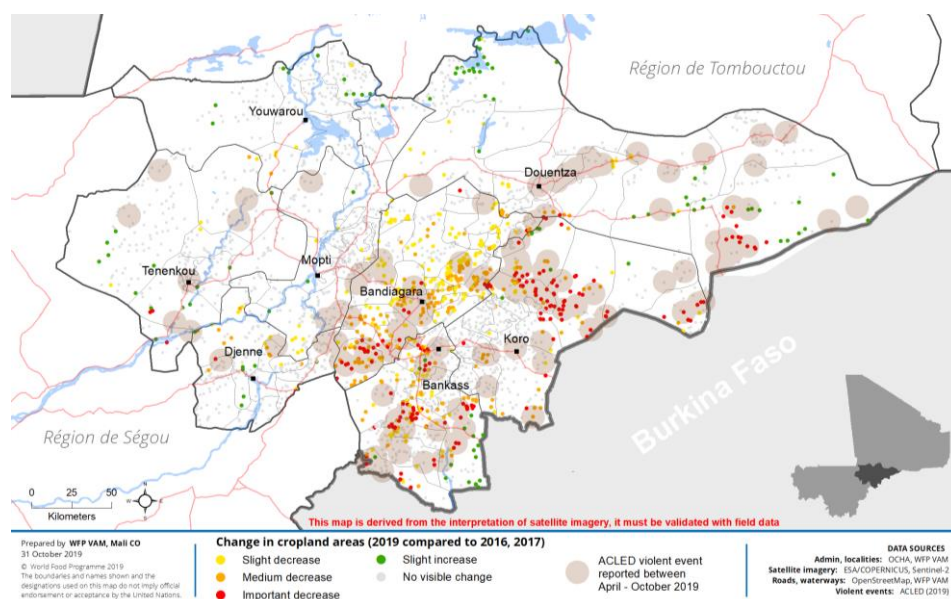
Cercle	Number of events
Bandiagara	40
Bankass	26
Djenne	5
Douentza	55
Koro	50
Mopti	6
Tenenkou	8
Youwarou	0
Total	190

Table 2. Number of violent events⁷ per cercle between 1 April and 1 October 2019 (ACLED)

- Most localities that have seen a decrease in cropland surface areas (highlighted in red and orange on the map) are located in areas where many security incidents were reported.

- Due to the presence of multiple armed groups and exacerbated intercommunal violence, the general security context in the eastern cercles of Mopti region is highly volatile. This situation has certainly influenced the decline in agricultural activities in the cercles of Koro, Douentza, Bankass, Bandiagara.

- Tenenkou, Mopti, Youwarou and Djenne cercles recorded significantly fewer violent events during the same period. The presence of one non-state armed group has been deeply rooted in these cercles, implying high criminality but allowing a relatively calm situation⁵. In addition to the local geography (flooded areas), this may explain a more normal roll-out of agricultural activities for these four cercles.



Map 2. Cropland change / violent events in 2019 (Mopti, Mali)

Besides ACLED data, the presented results were triangulated with security information provided by the Malian state early warning system (Système d'alerte précoce), indicating communes that were heavily affected by insecurity (see map in **Annex 3**). A positive correlation is visible for the cercles of Koro (northern half reported as affected by insecurity), Douentza (eastern part), Bankass (most communes) et Bandiagara (western part).

⁵ Source: MINUSMA, JMAC report, August 2019.

⁶ www.acleddata.com

⁷ The event types that were considered are the categories *Battles*, *Explosions / remote violence* and *Violence against civilians*, reported between 1 April and 1 October 2019.

Detection of damaged villages

Over one hundred villages were detected as being possibly damaged or destroyed in 2019; the spatial resolution of the imagery that was used to detect cropland changes being 10 metres, a validation with imagery of higher resolution was required to conclude on the condition of a given village's infrastructures. Thereby, very high resolution (VHR) imagery (source: Digital Globe, resolution: 50 cm) allowed to conclude for 30 villages that they had indeed been heavily damaged. For the other localities, the unavailability of recent VHR imagery prevented any definitive conclusion to be drawn.

Depending on the locality, roofs were taken from structures and villages seem abandoned (top picture), or infrastructure was levelled to the ground (bottom picture). These events occurred in 2018 or in 2019 depending on the area. Damaged or destroyed villages are located in the cercles of Koro, of Bankass and in the south of Bandiagara, areas where significant to complete losses of agricultural fields were detected, and where many armed events were reported.



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Conclusions

Even before the current security crisis, social issues and environmental degradation have been eroding the livelihoods of farmers in the Mopti region: scarcity of fertile agricultural lands matched with a rising population are some of the variables of a very complex equation, which partly fuels the conflict...

In 2019, the deteriorating security situation in the region heavily inhibited agricultural activities in various ways, including through the restriction of physical access to fields by armed actors, or due to the displacement of entire communities. Fields that used to be cultivated have been abandoned for fear of perceived or direct threats of violence. Koro, Bankass, Bandiagara and Douentza are the cercles most affected, due to intercommunal tensions, which have been exacerbated since the end of 2018.

The impacts of such violence could be visualised using satellite imagery:

- Important reduction of cropland areas,
- Neat delimitation of cultivated fields and concentration in the proximity to habitations,
- Damaged and abandoned infrastructures.

These observations were later complemented by exchanges with partners⁸ and a field visit⁹.

Those landscape changes, visible from space, translate into situations of high vulnerability on the ground. On one side, population displacement has considerably increased in the region (from 10,000 in June 2018 to over 61,000 internally displaced people in September 2019¹⁰). Besides, this study highlights a less visible but equally important threat to food security: movement restrictions imposed on civilian populations lead to communities being confined in their villages, who have been forced to abandon agricultural fields due to violent acts or threats. In some villages, the crops that could be harvested were burnt in a spate of attacks that occurred in November 2019. In many areas, harvest will be insufficient to feed the population through 2020. For security reasons, some communities cannot access markets to buy food.

In both cases (displaced or confined communities), populations are almost entirely dependent on humanitarian assistance to survive.

Satellite images can help fill information gaps on those hard-to-access areas, and results of the analysis at village level can support humanitarian decision-making and programming.

⁸ Based on information exchanged with state actors (Direction régionale de l'agriculture) and humanitarian partners (Food Security cluster).

⁹ Conducted on 21st November 2019 in four villages located in the cercles of Koro, Bankass and Bandiagara. See *Annex 3*.

¹⁰ Displacement Tracking Matrix, IOM and Direction nationale du développement social (DNDS), September 2019.

Recommendations

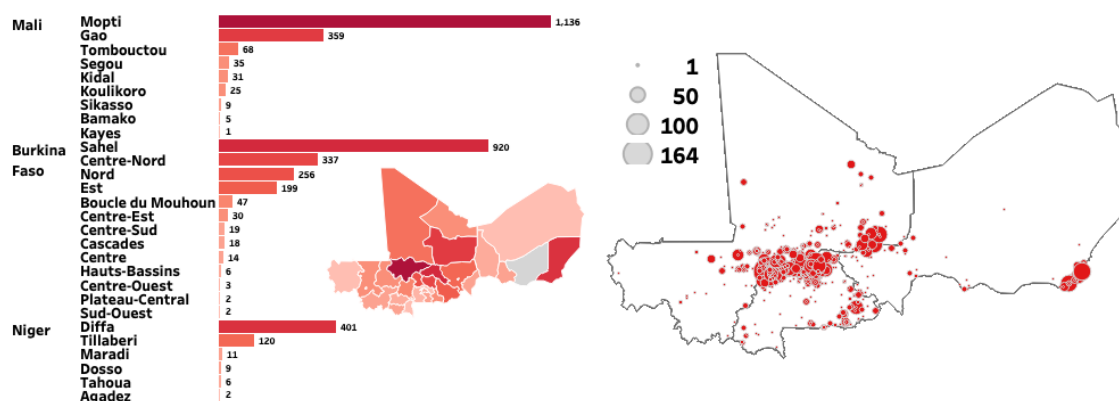
- The results discussed in the present document are intended to feed into humanitarian response mechanisms, as a tool to help target vulnerable communities for more in-depth assessments and delivery of assistance.
- Host communities as well as IDPs should be equally prioritized for food assistance and livelihoods support, especially in villages that were directly affected by cropland losses and where communities may be confined.
- Strengthen the analysis by triangulating the results with additional primary and secondary datasets that could be shared by technical services and humanitarian actors, e.g. agricultural datasets, seasonal monitoring, climatic extreme events (droughts, flooding), market prices, security incidents, needs evaluation, IDPs location, humanitarian assistance interventions, etc. This may provide the foundations for an integrated food security assessment framework in order to identify hotspots of exceptionally vulnerable populations.
- To complement the present study on sedentary farming, conduct a vulnerability study focusing on pastoralism, Mopti being one of Mali's most important region for livestock.
- Ensure up-to-date information is shared with relevant stakeholders to adapt the emergency response as needed through the mobilization of resources and support from regional and international donors.
- Strengthen the technical capacity of UN/NGO, government and local actors in using satellite-derived data, to enhance the quality of information needed for strategic decision-making and coordination of the humanitarian response.
- Continue to alert the world to the magnitude of the crisis and the scale of need in the Mopti region, and more broadly in the Sahel.

NEXT STEPS

The deterioration of the situation in Mopti has spread across borders into Burkina Faso and Niger; a similar analysis covering the Liptako Gourma would help assess the impacts of conflict on agriculture and population displacement between the three countries

February 2020

A follow-up analysis for the 2020 agricultural season
October 2020



Map 3. Western Sahel: reported fatalities due to conflict between 1 January and 30 November 2019, by region (left) and by location (right)
(Source: ACLED. Infographics: J. Luengo-Cabrera)

Contacts



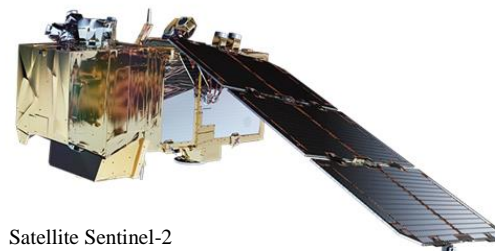
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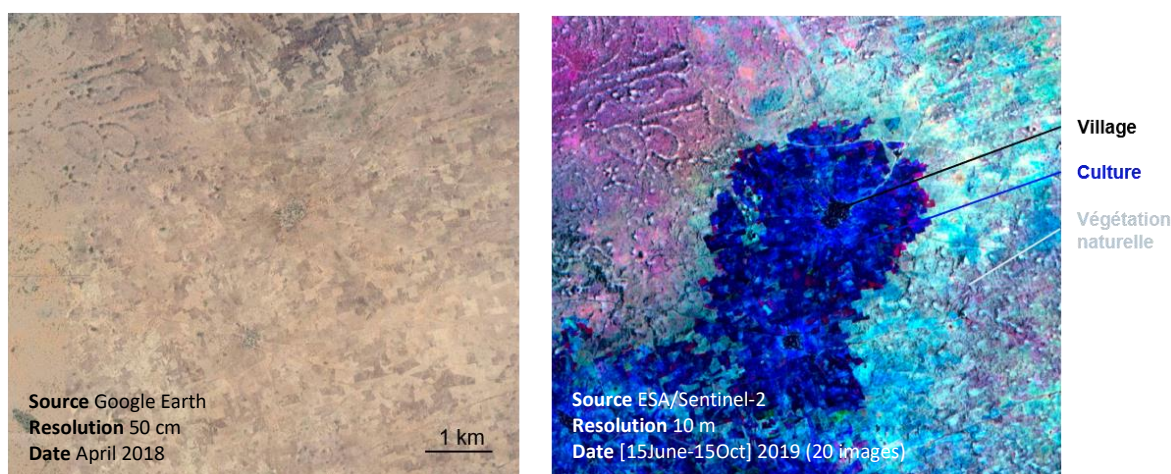
ANNEX 1. Notes on the methodology

The georeferenced information of the 3,166 villages analysed for this study comes from the 2009 census database (source: Institut national de la statistique, INSTAT). Latitude and longitude values were systematically verified with OpenStreetMap, Google Maps or with the satellite images used for the analysis. This enabled to bring corrections to localities with erroneous coordinates. Besides, 105 localities that were visible on the imagery but did not appear on the census list were included in the study.



Satellite Sentinel-2
(ESA/COPERNICUS)

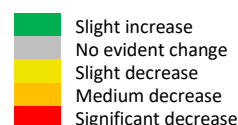
The analysis and interpretation comparing the cultivated surface areas between 2019 and previous years are based on composite products derived from medium resolution optical satellite images, provided by the European Space Agency (ESA). The Sentinel-2 satellites constellation captures an image on any given point on Earth every six days. For the present analysis, Sentinel-2 images are taken during the agricultural cycle in 2019, 2018, 2017 and 2016 (about 20 images per year for each point of interest). A composite map is then produced¹², which categorizes each pixel according to its NDVI¹³ curve from June to October. The image below shows the resulting product (right) compared to the satellite image available on Google Earth (left).



Satellite images showing the surroundings of Gawa and Boré, two villages located in the cercle of Koro, Mali. The most recent satellite image available on Google Earth, dated from April 2018, is shown on the left; it is not easy to detect the villages, nor to conclude on the existence of croplands around them. The image on the right is derived from twenty Sentinel-2 satellite images acquired during the 2019 agricultural cycle (15 June – 15 October): villages appear in black, cultivated fields in dark blue all around the settlements, and surrounding natural vegetation is cyan blue.

Through this technique, it is possible to distinguish cropland from natural vegetation, and to detect possible landscape changes by visually comparing the satellite-derived products for the years of interest.

Using the products derived from Sentinel-2 images, each village is classified into one of the five categories: “slight increase”, “no evident change”, “slight decrease”, “medium decrease” or “significant decrease”, according to the cropland change that is detected between 2019 when compared with years prior to the deterioration of the security situation (2016 and 2017), taken as a baseline.



¹¹ In theory, the period from 15 June to 15 October covers an agricultural cycle in Mopti region, from planting to early-stage harvesting.

¹² Processing steps are done using the online platform Google Earth Engine, available at code.earthengine.google.com

¹³ Normalized Difference Vegetation Index calculated with values from the red and infrared bands of the image.

Remote sensing technology is commonly used in the humanitarian sector to provide climatic maps such as rainfall or biomass anomalies at country or region level. They usually rely on low resolution satellite imagery (pixel size ranging from a few kilometres to a few hundreds of metres) that help to better inform stakeholders on the climatic context, and its consequent impact on the agricultural season; such imagery is however not precise enough to draw conclusions on actual field cultivation. In a country such as Mali, where agricultural practices are still very manual and not significantly mechanised, and where plots are small, enhanced medium/high resolution satellite imagery such as ESA Sentinel-2 (pixel size of 10 metres) is relevant to study cultivated areas.

Methodology: pros and cons

The main **advantages** of this type of satellite data and the associated analysis are the following.

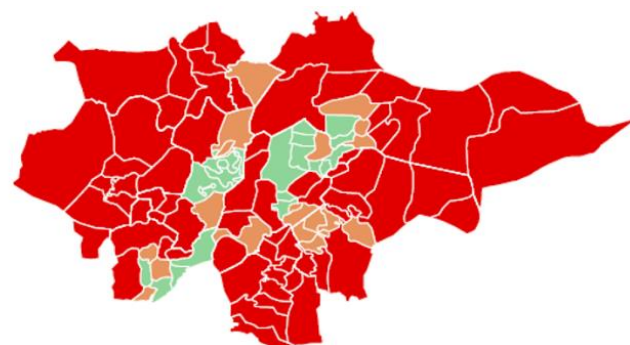
The information is collected at a distance; thus, reducing risks and costs associated with a field visit, especially in hard-to-access and highly insecure areas due to the security context (*Map 4*) or geographical constraints.

Satellites scan vast areas that would otherwise be too large and very time-consuming to monitor from the ground. Sentinel-2 satellites map the entire globe every six days.

This type of analysis provides results at village level, thus complementing datasets that are often aggregated at administrative levels. Such granular data is essential for a finer understanding of the situation in a given area of interest.

Remote sensing data allows baseline analysis; by « going back in time », it can compare a current situation with a past reference. The Sentinel-2 imagery archive starts at the end of 2015.

Finally, satellite images that were used for this analysis (medium resolution) are free-of-charge as are most software to process them.



Contraintes : ● Élevées | ● Modérées | ● Faibles | ● Pas de données

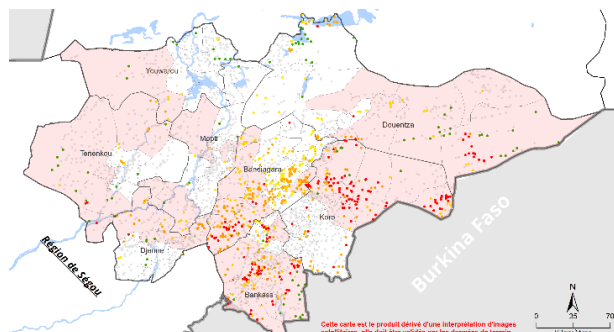
Map 4. Access constraints in the region of Mopti, Mali
(Source: OCHA, September 2019)

However, this methodology also presents some **limitations**:

The interpretation of satellite images must be validated with ground truth data collected on the field; and as such, does not replace field surveys.

Optical satellite image may be partially or entirely covered with clouds when collected, making visual interpretation difficult. For this study, that applied to 3.5% of the localities.

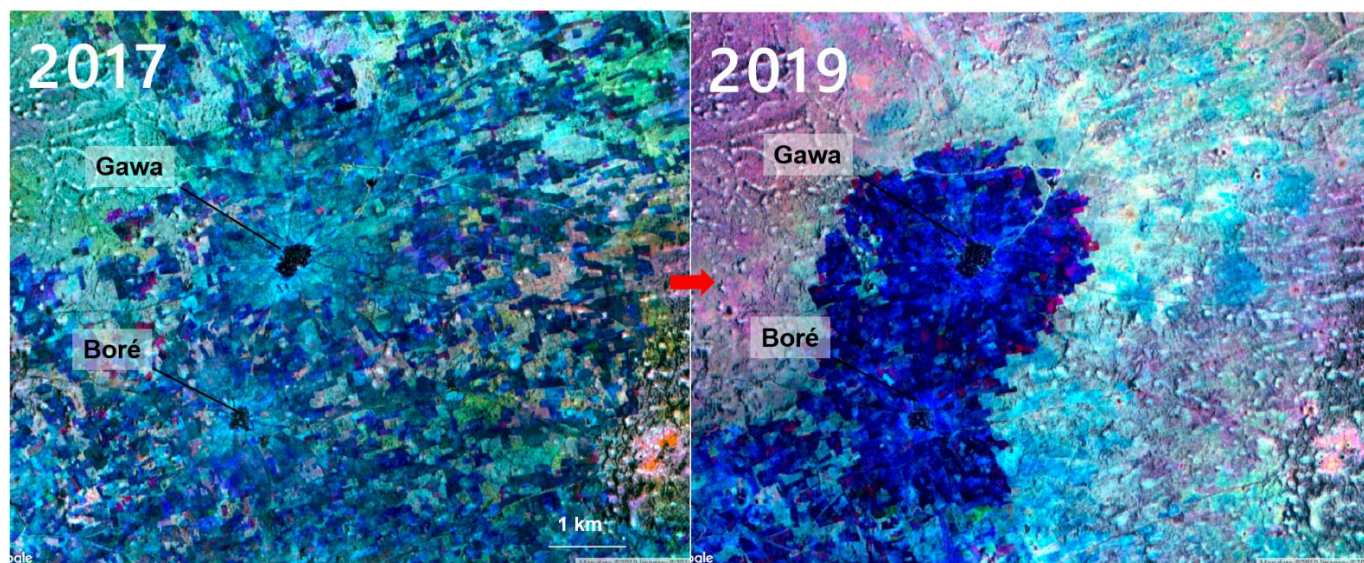
During the interpretation process, some villages were initially classified as 'No cropland', corresponding to localities that do not usually cultivate. Due to the limited prevalence of such villages in the region of Mopti (5.6%) and for clarity purposes, this category was merged with the 'No change' class.



Map 5. Communes affected by insecurity in Mopti, Mali
(Source: Système d'Alerte Précoce, 2019)

ANNEX 2. Examples of satellite imagery

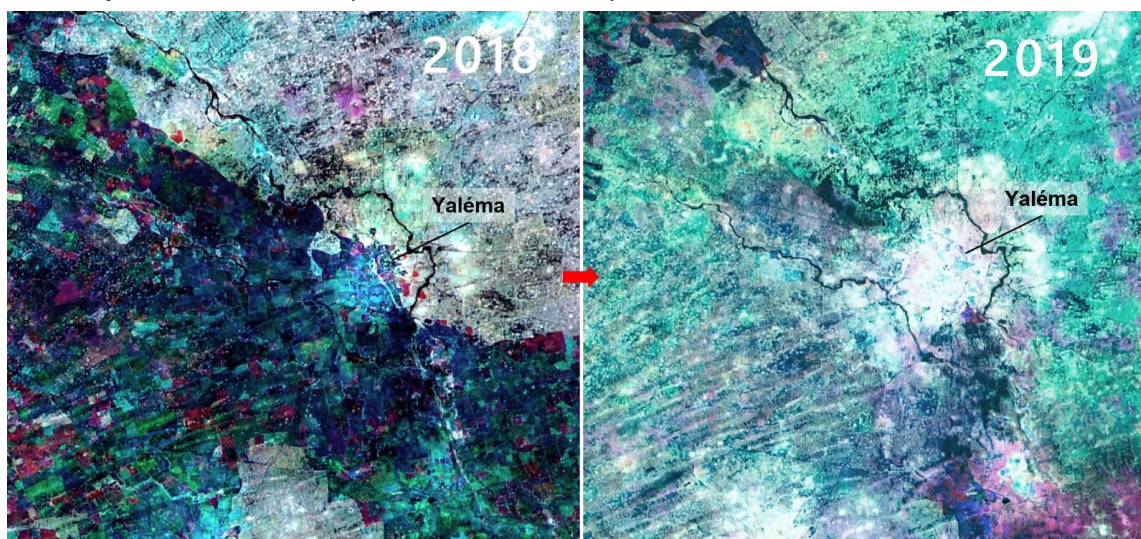
EXAMPLE 1. Gawa and Boré (Koro cercle)



Source: ESA/COPERNICUS, Sentinel-2. Products derived from 20 images acquired between June and October of each year (see **Annex 1**)

The two black marks at the centre of the images represent the villages of Gawa and Boré, located in Koro cercle. In 2017 (left), cultivated fields are visible all around the villages in a 5-kilometre radius: they are the dark blue rectangles singling out from the surrounding natural vegetation, in lighter cyan blue. In 2019 (right), cultivated fields are considerably reduced and concentrated in proximity to habitations, within a 1 to 2-kilometre radius. Since 2017, natural vegetation has grown back beyond the neat circled delimitations. In the present study, these two localities were classified as *significant decrease* (represent in red on *Map 1*). According to 2019 projections, they have a population of 2,497 (source: Direction Nationale de la Population).

Example 2. Yaléma (Bankass cercle)



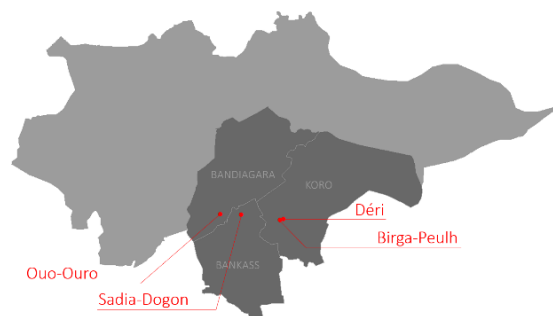
The conflict heavily impacted cultivated land areas around Yaléma, a village of Bankass circle, with a population of 2,422 according to DNP projections of 2019. While croplands are visible in the 2018 imagery (left), almost none are evident the following year (right). The village itself seems to be also damaged.

Source: ESA/COPERNICUS, Sentinel-2. Products derived from 20 images acquired between June and October of each year

ANNEX 3. Interviews and photos collected on the field

On November 21st 2019, the analysis team conducted a field visit to the cercles of Koro, Bankass and Bandiagara, to gather evidence from inhabitants of some villages identified as affected by significant cropland losses. The team was thereby able to test the interpretation of remote sensing data against ground truth.

Due to the security context and access restrictions, the scope of the survey was restricted, and qualitative interviews could only be conducted in a limited number of villages (see *Map 6*). Despite these restrictions, the field evidence confirmed the hypotheses that were emitted and corroborate the extreme difficulties faced by communities living in these areas.



Map 6. Villages visited in November 2019 to gather ground truth evidence



Photo 1. On the left, a cultivated field after harvest, in the surroundings of Birga-Peulh. On the right, natural vegetation has grown where villagers used to cultivate

The village of **Birga-Peulh** (Koro cercle) has known violence since the end of 2018 and is now under the protection of the Malian armed forces (Forces armées maliennes, or FAMA). While many inhabitants left the village in 2019 to escape from the precarious security situation, in the same period, Birga-Peulh population almost doubled, as hundreds of people from surrounding villages in Koro and Bankass cercles moved to benefit from the military protection. Most of the internally displaced persons in the region and across the other regions of Mali seek refuge with host communities, who often struggle to survive themselves.

In 2019, inhabitants of Birga-Peulh were only able to cultivate in a limited radius (about 1 kilometre away from the village), neatly delineated as shown on *Photo 1*. The reduction in the radius is a consequence of direct acts and threats of violence against farmers, and movement restrictions imposed by armed actors. Before the security situation deteriorated, Birga-Peulh farmers could cultivate fields situated up to 5 kilometres far from the village.

The part of the village facing the neighbouring village, Birga-Dogon, is abandoned and some structure were destroyed during 2019 (*Photo 2*).

Due to security concerns and movement restrictions, inhabitants can no longer access local markets either. Inhabitants stated that between June and September 2019, as a consequence of the overall situation, four persons would die each day due to hunger. This has improved since October 2019, but the village exclusively relies on humanitarian aid.



Photo 2. Destroyed structure in the no man's land between Birga-Peulh and Birga-Dogon



Photo 3. Villagers showing the neat delineation beyond which they could not cultivate in 2019

The village of **Déri**, located a few kilometres from Birga-Peulh, faces similar difficulties, albeit without the permanent presence of Malian armed forces. Inhabitants are confined in the village: they cannot access markets and could not cultivate normally in 2019. The neat delineation between the area that was cultivated prior to 2019 and the natural vegetation that has grown beyond it, about 500 metres away from the habitations, is clearly visible on *Photo 3*. The area beyond the delimitation, which is imposed by armed actors, was cultivated before the security situation deteriorated. Moreover, the sole water-pump in the village was deliberately damaged, thus access to water is the main and most pressing concern of Déri inhabitants.

In Bankass cercle, inhabitants of **Sadia-Dogon** explained they were unable to cultivate all their fields in 2019, due to the violence that shook the area between October 2018 et August 2019. In 2019, they cultivated some 2 hectares compared with 13 hectares before the conflict, representing a 85% loss in cropland surface areas in 2019.

Inhabitants of Sadia-Dogon can still access neighbouring markets to buy food, in particular the one in the city of Bankass.

Two neighbouring villages, Sadia-Peulh and Sadia-Habbe, located only 1.5 kilometre far from Sadia-Dogon, were completely abandoned according to interviews. Populations allegedly went to Mondoro, in the cercle of Douentza. A very high resolution satellite image dated from February 2019 (source: Digital Globe, not shown in this document) confirms that the village of Sadia-Peulh has been entirely abandoned; notably with roofless infrastructure and no evidence of field cultivation during the 2019 agricultural season.



Photo 4. Following direct threats, inhabitants of Déri could not cultivate nor access markets in 2019; this situation of confinement is highly precarious



Photo 5. The abandoned village of Ouo-Ouro (Bandiagara cercle) in November 2019, covered up with natural vegetation

As of November 2019, the village of **Ouo Ouro**, located south of Bandiagara cercle, is completely abandoned. Most of the infrastructure appears to be damaged. Roofs have been taken away from many structures, burnt objects, walls and roofs, are indications of the violence that was perpetrated to the village between June and November 2019; a very high resolution satellite image (source: Digital Globe, not shown in this document) dated from June 2019 shows the village in a normal state, indicating that the attack occurred afterwards.

No evidence of cultivation had been detected on satellite imagery during the 2019 agricultural season. Natural vegetation covers the village's alleys and surroundings.



Photo credits: WFP / Laure Boudinaud

This paper has been prepared by the Vulnerability Analysis and Mapping (VAM) unit of the World Food Programme. The opinions expressed and the arguments employed herein do not necessarily reflect the official views of WFP nor the UN. All efforts were undertaken to objectively interpret remote sensing and contextual data, any error resulting of their interpretation are the sole responsibility of the analysis team. Finally, this document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delineation of international frontiers and boundaries and to the name of any territory, city or area.

Data analysis and report preparation: Laure Boudinaud, geospatial analyst (WFP, Mali country office).

Sources

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