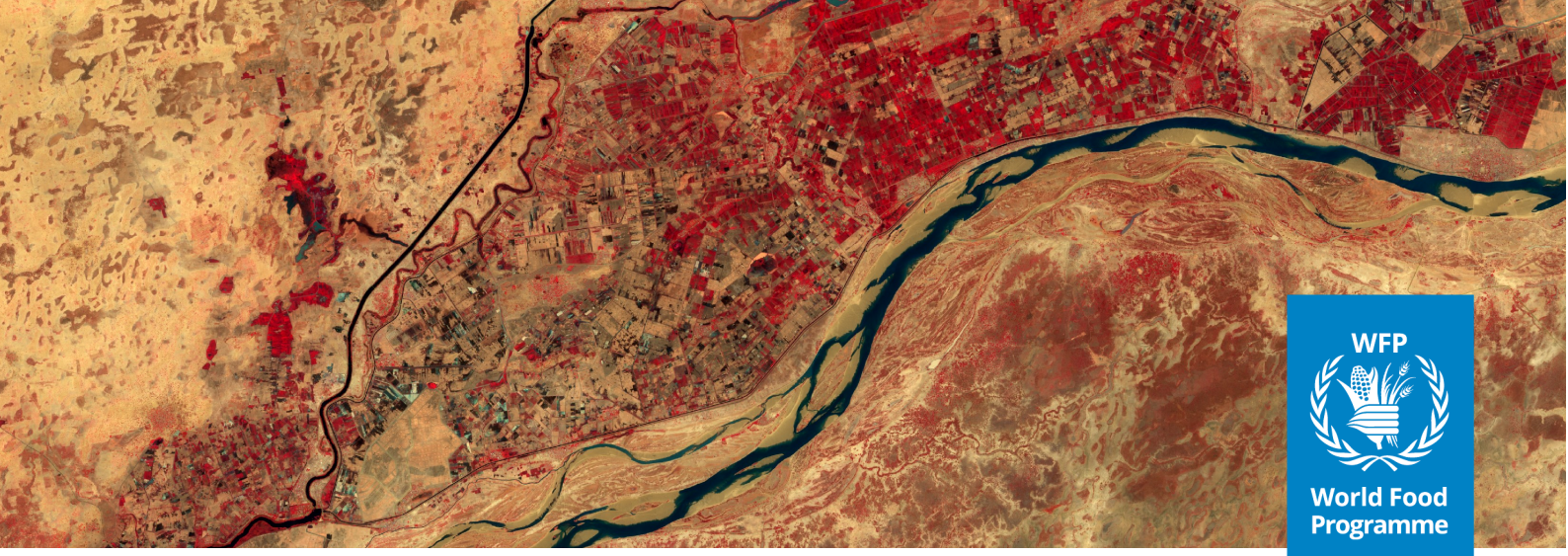


World Food Programme

SAVING LIVES
CHANGING LIVES

Burkina Faso

Satellite imagery analysis 2022

Cropland change detection analysis in hard-to-reach areas

Introduction

Over the past few years, Burkina Faso has seen a significant deterioration of its security situation, particularly in the northern and eastern parts of the country including the Sahel, Nord, Centre-Nord, Centre-Est, Est and Boucle du Mouhoun regions. The security crisis has led to forced population displacements. According to the National Council for Emergency Relief and Rehabilitation, approximately 1.8 million persons had been internally displaced as of 30th November 2022. These population displacements, coupled with an increasing number of violent events, have led to the abandonment of many cultivated lands. Moreover, insecurity also affected the functioning of national food security and agricultural monitoring systems.

To better understand the impact on food security and livelihoods in hard-to-reach areas, WFP has developed a methodology that relies on high-resolution satellite imagery to assess cropland change dynamics. This summary note presents the methodology and the key analysis results. It provides an overview of the post-harvest situation in 2022 in 25 provinces of Burkina Faso, covering nearly 12,000 villages in 6 regions; and proposes ways to use these results in the Cadre Harmonisé process and in targeting activities for the emergency response during the 2023 lean season.

Methodology

Satellite images, namely Sentinel-2 (ESA/Copernicus), were acquired for the main agricultural season (i.e. between 15th June and 15th October) for the current year, the previous year, and a reference year before the start of the conflict in the analysed areas. The cropland changes in the conflict zones are detected by measuring the degree of change between the current year and a reference year, as well as between the current year and the previous year.

The temporal (5 days) and spatial (10 meters) resolution of these images makes it possible to detect fields of any size and to extract results at the scale of localities.

For each year of the study, cultivated areas are detected by calculating the Normalized Difference Vegetation Index (NDVI), which is a vegetation index commonly used in remote sensing. NDVI values for cultivated field during the agricultural season (from the time of the end of land preparation and sowing until the shoots of the drops and start of harvest) differ from those of other types of landscape, including natural vegetation or abandoned fields.

Localities are classified into the following 7 classes in the final map, after comparing the current year with the reference or previous year.

- Severe decrease: >50% estimated area loss.
- Medium decrease: 25%-50% estimated area loss.
- Slight decrease: <25% estimated area loss.
- Slight increase: <25% estimated area gain.
- Medium increase: 25%-50% estimated area gain.
- Significant increase: >50% estimated area gain.

Populated sites where no visible changes were detected are represented in grey, including areas with no visible agricultural activities. These categories are the result of a visual interpretation of satellite-derived composites, that could not be validated with field data.

The advantage of this methodology is that it provides timely, cost-efficient, reliable and evidence-based assessment of conflict impacts on agriculture, in hard-to-reach areas where field data is limited. Moreover, the level of detail of the analysis can directly inform needs assessments and response planning at the locality level.

Analysis results

I. Sahel region

- Significant decreases in cropland were detected in almost the entire region in 2022 in comparison to 2017, particularly in Soum and Oudalan provinces, not far from the border with Mali, where respectively 62% and 49% of villages recorded significant and medium decreases in cropland.
- Due to insecurity in 2020, villages were abandoned in almost the entire province of Soum. Most of the localities in this province may have remained abandoned, since over half of the analysed villages (57%) experienced no change in the analysis of 2022 compared to 2021. However, 19% experienced significant and medium decrease in cropland compared to last year.
- The province of Yagha, which in 2021 had experienced only slight cropland decrease, experienced cropland abandonments in almost all the province in 2022, coupled with massive population displacement. This resulted in 26% of villages recording significant and medium decreases in cropland compared to 2017, and 44% in comparison to last year which makes it the most affected province in the Sahel region.
- Seno province experienced a similar situation to Yagha province in the part close to the border with Niger. However, the situation seems relatively stable. Most of the villages in Seno province experienced no change (over 63% in comparison to 2017 and 69% in comparison to last year). The significant and medium decrease in cropland was observed in 18% of villages in comparison to 2017 and 16% in comparison to last year.
- In comparison to both last year and the pre-crisis situation, less than 1% of villages recorded significant increases in cropland.

II. Est region

- Security incidents were reported mainly in Gourma and Komandjari provinces, and to a lesser extent in Tapoa, and Kompienga. This led to significant cropland decreases particularly in Gourma. However, the situation appears to be stable, as an overall 57% of analysed villages in the region experienced no change, while 10% experienced significant and medium decrease.
- In Komonjdjari, areas that are close to the border with Niger have witnessed intense security incidents, which might be the reason behind significant and medium cropland decrease in 25% of villages in comparison to the pre-crisis situation. However, the situation is relatively stable in comparison to last year.
- Despite the high number of security incidents reported in Tapoa province, 17% of villages reported a significant and medium cropland increase in comparison to the pre-crisis situation; particularly in villages in the north of Tapoa (border with Komondjari province) where increases in croplands were observed.
- Out of the 48 villages that were analysed in Kompienga province, over 62% showed significant and medium cropland decrease in comparison to the pre-crisis situation, and 58% in comparison to last year.
- Gnagna province is the least impacted by insecurity and did not record significant changes in cropland dynamics.

III. Centre-Est region

- Overall, Centre-Est region was the least affected by decreases in cropland areas. Cropland decreases were observed mainly in Boulgou and Koulpelogo provinces with respectively 8.5% and 4% of villages experiencing significant decrease in comparison to the pre-crisis baseline.
- In comparison to last year, no significant changes were recorded across the Centre-Est region.

IV. Boucle du Mouhoun region

- Overall, more than 80% of villages that were analysed in Boucle du Mouhoun region experienced no change compared to the pre-crisis situation and to last year. In comparison to last year, no significant increases in croplands were recorded.
- In Bale, Mouhoun, and Banwa provinces, no major changes in croplands were detected.
- One-third of the analysed villages in Sourou province experienced significant or medium decrease in croplands compared to the pre-crisis situation; and 18% of villages recorded decreases compared to last year. Similarly, medium to significant decreases were recorded in Kossi province in 12% of villages compared to the pre-crisis situation, as well as compared to last year. However, some villages in Sousou and Kossi (2% and 5% respectively) experienced significant increases in cropland.
- Nayala experienced no change from last year, but in comparison to the pre-crisis situation around 4% of villages experienced a significant decrease in cropland.

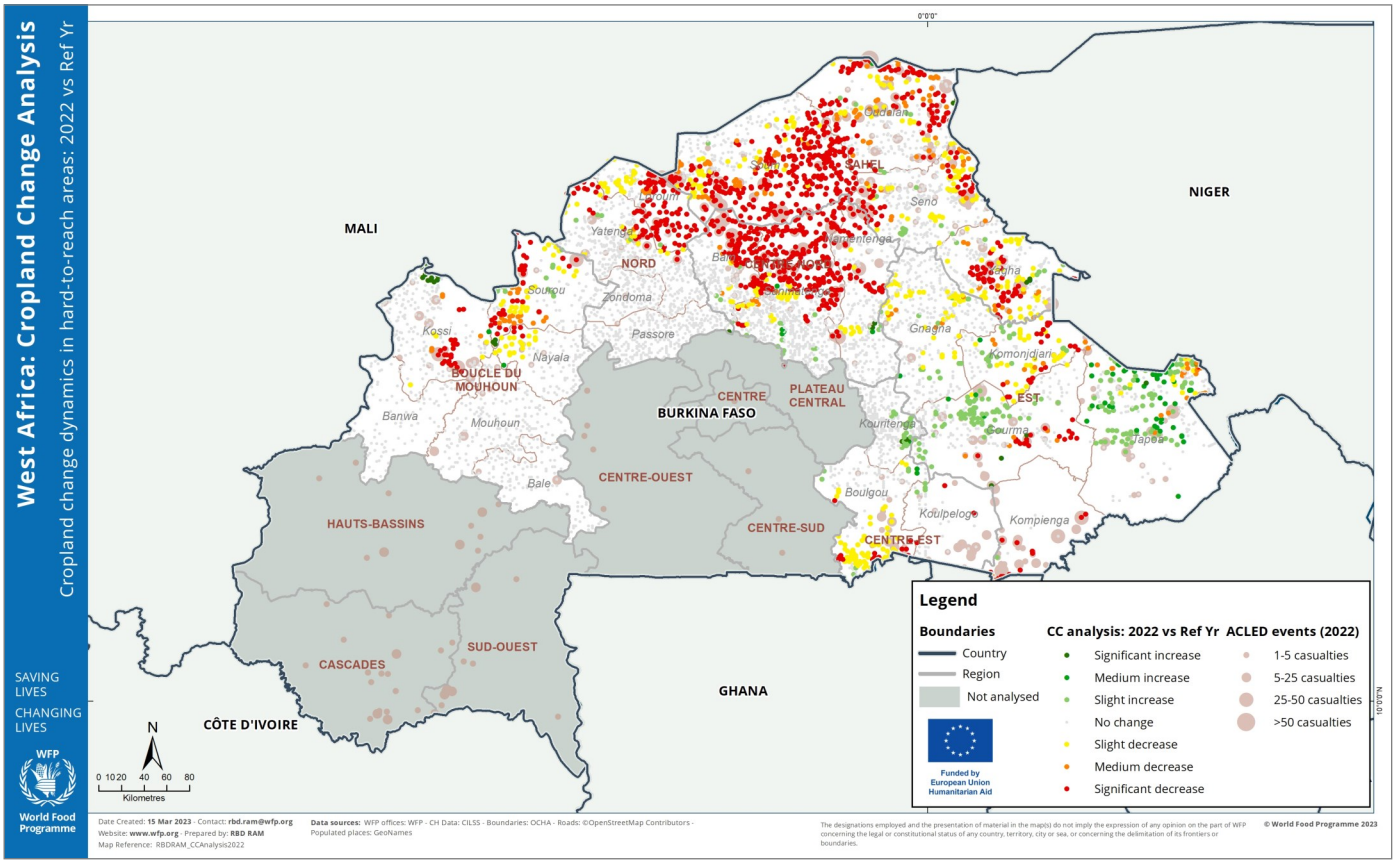
V. Centre-Nord region

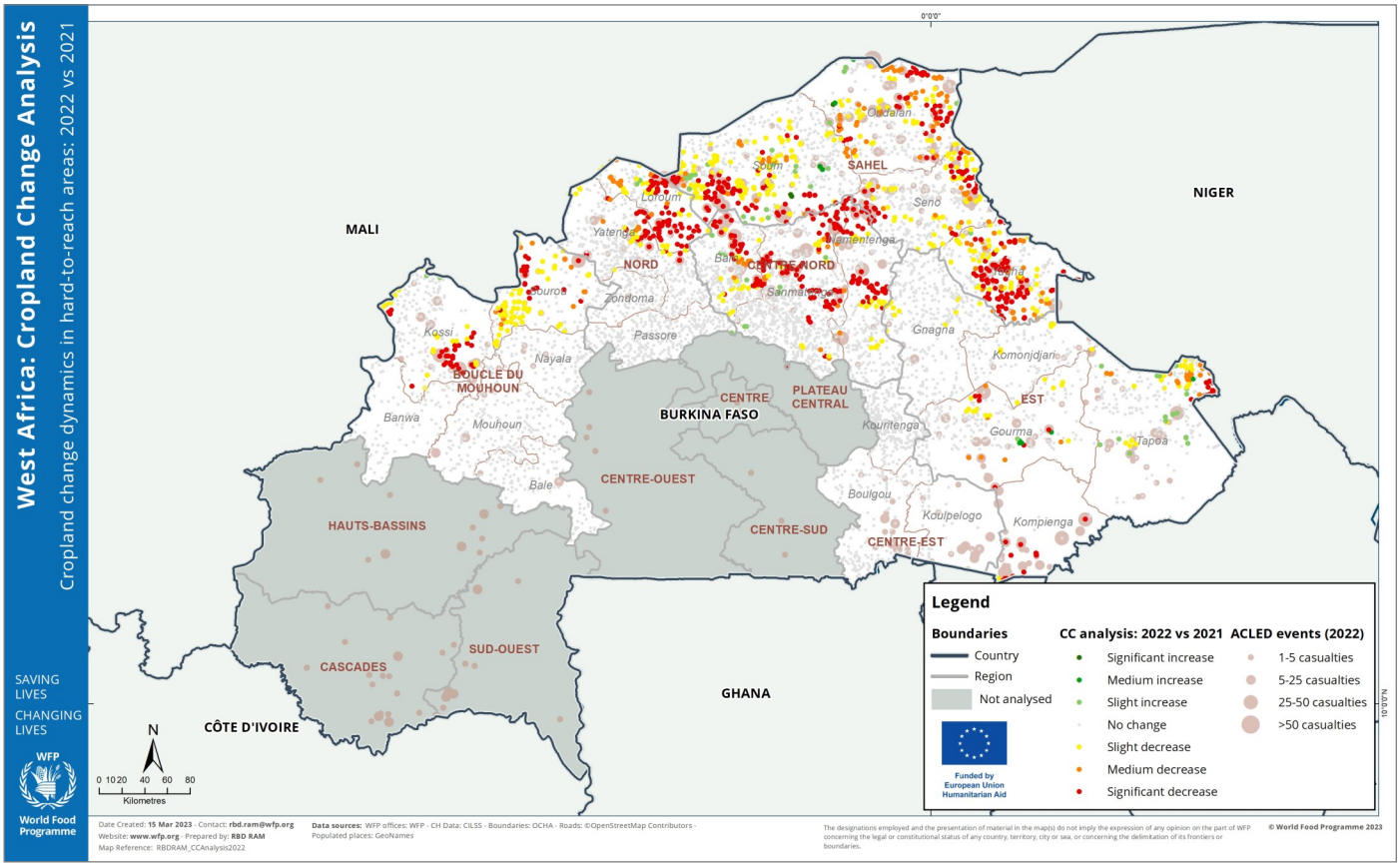
- Over half of the analysed villages in Centre-Nord region showed no changes in comparison to the pre-crisis situation and last year, with 64% and 78% respectively.
- Some areas in Centre-Nord region experienced insecurity, which are the same areas that experienced significant cropland decreases, mainly Sanmatenga and Bam provinces, where 35% and 32% of villages respectively experienced significant or medium cropland decreases in comparison to 2017; and 14% and 18% respectively in comparison to last year.
- Namentenga experienced no increases in cropland from last year; however over 18% of the analysed villages recorded significant and medium cropland decreases compared to last year. In comparison to 2017, 1% of villages showed significant or medium cropland increases; while 16% experienced significant or medium cropland decreases.

VI. Nord region

- In general, most of the analysed villages in Nord region experienced no change from the pre-crisis baseline or last year, with 83% and 85% respectively. However, significant decreased in cropland was observed in Loroum and Yatenga.
- Insecurity in the north of Nord region had caused significant decreases in cropland areas in 2020. The insecurity situation continued in 2021 (ACLED[1]), namely in Loroum province where 51% of villages experienced significant decreases in cropland in comparison to 2017, and 49% of villages recorded significant or medium decreases in comparison to last year.
- The situation in Yatenga province is slightly improving; as 9% of villages experienced significant or medium decreases in cropland in comparison to the pre-crisis, and 6% in comparison to last year.

[1] *Armed Conflict Location and Event Data Project: https://acleddata.com/.*





Conclusion

The use of satellite images is an effective and innovative way to acquire data in areas that are difficult to access. It makes it possible to overcome the lack of quality, credible and reliable information in areas that are difficult to access due to conflicts or disasters. Cropland change detection analysis in hard-to-reach areas helps to inform the impacts of conflict on farming and food security in conflict zones.

The cropland change analysis conducted at the end of the 2022 agricultural season suggests that security incidents, experienced over the course of the year, appear to have led to wide-spread decreases in agricultural activities in most of northern and eastern Burkina Faso. In general, the analysis shows a strong correlation between insecurity and cropland losses.

The 2022 post-harvest analysis showed slight positive changes in areas that experienced a relative security and vice versa. The Sahel region was the most affected by insecurity in 2022, with 40% of security incidents recorded in the region between 1st January and 30th September 2022 according to ACLED; namely in the provinces of Soum, Oudalan and Yagha. The cropland change analysis highlights **significant decreases in agricultural activities in this region, which are likely to be linked to the security context**.

It can be concluded from the analysis that the loss of cropland was most pronounced along the transhumance corridors that run through the Sahel, Est, Nord, and Boucle du Mouhoun regions. In 2017, which is considered as the pre-crisis reference year, these regions were already experiencing a difficult cohabitation between farmers and herders, as well as between different pastoral communities, over the sharing of natural resources. These tensions appear to have been exacerbated by the deterioration of the conflict, notably by limiting access to pasture and water points.

The cropland change analysis between 2017 (reference year) and 2022 shows a significant deterioration (losses of more than 50% of cropland) in Sahel and Centre-Nord regions. The Boucle du Mouhoun, Centre-Est, and Est regions seem less affected than the other analysed regions.

The analysis of the cropland changes in the 6 regions between 2021 and 2022 indicates a significant deterioration in the situation. The analysis highlights significant losses in the border areas with Mali and Niger, but also in the centre of the Centre-Nord and Boucle du Mouhoun regions. With the increase of security incidents at Benin and Togo borders, cropland area losses appeared in those parts between 2021 and 2022.

Since Boucle du Mouhoun region is the breadbasket of Burkina Faso, particularly is the productive area of the Sourou River valley and Kossi, **the significant decrease in cropland areas, as concluded from this analysis, could have a significant impact on the country's overall food security**.

Recommendations

The recommendations include the following.

1. Rainfed production in the Sourou valley in Boucle du Mouhoun region, as well as off-season crop production, are an important source of supply for several regions of the country. Hence, an update of this analysis during the dry season might highlight the specific losses of irrigated areas that might be related to the insecurity that prevails in Burkina Faso.
2. The analysis results could benefit from field validation and triangulation with field data collection, if current security situation allows for it.
3. The analysis of cropland losses does not capture the losses of pastoral resources in relation to insecurity and its consequences on food security. Therefore, this analysis could be complemented by mapping of biomass and access to pasture, to better analysis the impact of access to resources on food security.

Recommendations for Cadre Harmonisé

It is recommended to use this analysis to inform the Cadre Harmonisé (CH) for November 2022, specifically for the following two components.

Availability: As the analysis of crop dynamics is an analysis of vegetation indices, the data produced can inform the analysis of contributing factors under the availability component, in accordance with the provisions of the Cadre Harmonise Manual. If the share of the population affected by a decrease (resp. by an increase) of the area cultivated is larger than 20%, it is likely that the area aggregated food availability is impacted accordingly.

Hazards & Vulnerability: Where a decrease in cultivated area is associated with total abandonment of villages and cultivated fields and/or violent events (based on ACLED data), the information generated can also inform the analysis of contributing factors under the Hazards & Vulnerability component.

As a first step, the proportion of villages/localities that fall into each category of cropland change (no change, slight decrease, medium decrease etc.) is identified. Then, this is translated into proportion of affected population, based on the estimated population by locality. This ensures that changes are not biased, e.g. if the most affected localities are the least populated. The proportion of population by cropland change class is what is used to inform the CH recommendations.

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

For the **Availability** component, the overall positive or negative change (pre-crisis versus present) at locality 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 5% and 10%: slight positive/negative impact.
- If one of the absolute positive/negative changes is between 10% and 20%: medium positive/negative impact.
- If one of the absolute positive/negative changes is greater than 20%: strong positive/negative impact.

For the **Hazards & Vulnerability** component, thresholding takes into account only negative changes observed over the past year. The following thresholds were applied.

- If the negative change is between 5% and 10%: slight negative impact.
- If the negative change is between 10% and 20%: medium negative impact.
- If the negative change is greater than 20%: strong negative impact.

The following table shows the detailed cropland change results in comparison to the Reference year (2017), and the preliminary recommendations for CH to be considered as indicative.

Region	Province	Significant increase	Medium increase	Slight increase	No change	Slight decrease	Medium decrease	Significant decrease	*Impacts of long-term positive and negative changes (2022 vs pre-crisis) on the Availability dimension*
Est	Gnagna	0.00%	0.28%	3.98%	80.40%	13.64%	1.70%	0.00%	No significant impact
	Gourma	1.24%	1.24%	29.75%	57.02%	0.83%	2.07%	7.85%	Light negative impact
	Komonjdjari	0.00%	0.88%	15.79%	26.32%	31.58%	6.14%	19.30%	Strong negative impact
	Kompienga	0.00%	0.00%	4.17%	33.33%	0.00%	4.17%	58.33%	Strong negative impact
	Tapoa	0.37%	16.91%	27.94%	41.54%	4.04%	8.46%	0.74%	Light positive impact
Est Total		**0.28%**	**5.61%**	**16.42%**	**56.96%**	**10.87%**	**4.47%**	**5.38%**	
Nord	Loroum	0.00%	0.00%	0.64%	28.21%	17.95%	2.56%	50.64%	Strong negative impact
	Passore	0.30%	0.00%	0.00%	99.70%	0.00%	0.00%	0.00%	No significant impact
	Zondoma	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	No significant impact
	Yatenga	0.00%	0.00%	1.27%	86.26%	3.56%	0.25%	8.65%	Light negative impact
Nord Total		**0.10%**	**0.00%**	**0.60%**	**83.30%**	**4.20%**	**0.50%**	**11.30%**	
Sahel	Oudalan	0.66%	0.33%	1.99%	39.20%	8.64%	13.62%	35.55%	Strong negative impact
	Seno	0.00%	0.00%	3.72%	63.47%	14.55%	5.26%	13.00%	Medium negative impact
	Soum	0.00%	0.00%	0.20%	29.07%	8.94%	7.11%	54.67%	Strong negative impact
	Yagha	1.13%	0.00%	2.26%	53.58%	17.36%	5.28%	20.38%	Strong negative impact
Sahel Total		**0.36%**	**0.07%**	**1.81%**	**44.03%**	**11.80%**	**7.75%**	**34.18%**	
Centre-Est	Boulgou	0.00%	1.13%	3.39%	50.28%	36.72%	0.00%	8.47%	Light negative impact
	Koulpelogo	0.00%	0.00%	10.00%	86.00%	0.00%	0.00%	4.00%	No significant impact
	Kouritenga	1.27%	0.42%	8.47%	89.83%	0.00%	0.00%	0.00%	No significant impact
Centre-Est Total		**0.65%**	**0.65%**	**6.70%**	**74.30%**	**14.04%**	**0.00%**	**3.67%**	
Boucle du Mouhoun	Bale	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	No significant impact
	Mouhoun	0.00%	0.00%	0.00%	99.52%	0.48%	0.00%	0.00%	No significant impact
	Banwa	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	No significant impact
	Kossi	5.37%	0.41%	0.00%	80.99%	1.65%	2.07%	9.50%	Light negative impact
	Nayala	0.00%	0.90%	0.00%	77.48%	18.02%	0.00%	3.60%	No significant impact
	Sourou	1.84%	0.00%	7.36%	41.10%	16.56%	12.27%	20.86%	Strong negative impact
Boucle du Mouhoun Total		**1.66%**	**0.21%**	**1.25%**	**82.54%**	**5.41%**	**2.60%**	**6.34%**	
Centre-Nord	Namentenga	0.71%	0.36%	1.07%	77.22%	4.27%	0.00%	16.37%	Medium negative impact
	Sanmatenga	0.00%	0.63%	1.88%	58.24%	4.40%	0.78%	34.07%	Strong negative impact
	Bam	0.00%	0.00%	1.10%	62.13%	4.41%	1.47%	30.88%	Strong negative impact
Centre-Nord Total		**0.17%**	**0.42%**	**1.51%**	**63.61%**	**4.37%**	**0.76%**	**29.16%**	
Total		**0.50%**	**1.03%**	**4.03%**	**65.30%**	**7.99%**	**3.16%**	**17.99%**	

The following table shows the detailed cropland change results in comparison to last year and the preliminary recommendations for CH to be considered as indicative.

Region	Province	Significant increase	Medium increase	Slight increase	No change	Slight decrease	Medium decrease	Significant decrease	Impacts of short-term negative changes (2022 vs 2021) on the Hazards & Vulnerability dimension
Est	Gnagna	0.00%	0.00%	0.00%	96.59%	3.41%	0.00%	0.00%	No significant impact
	Gourma	0.00%	1.65%	0.41%	87.60%	5.37%	2.48%	2.48%	No significant impact
	Komonjdjari	0.00%	0.00%	0.00%	94.74%	5.26%	0.00%	0.00%	No significant impact
	Kompienga	0.00%	0.00%	0.00%	37.50%	4.17%	4.17%	54.17%	Strong negative impact
	Tapoa	0.00%	0.37%	5.88%	70.22%	8.82%	8.82%	5.88%	Medium negative impact
Est Total		**0.00%**	**0.34%**	**1.87%**	**85.39%**	**5.61%**	**3.17%**	**3.62%**	
Nord	Loroum	0.00%	0.00%	3.85%	32.05%	15.38%	10.26%	38.46%	Strong negative impact
	Passore	0.00%	0.00%	0.30%	99.70%	0.00%	0.00%	0.00%	No significant impact
	Zondoma	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	No significant impact
	Yatenga	0.00%	0.00%	0.00%	89.57%	4.33%	1.27%	4.83%	Light negative impact
Nord Total		**0.00%**	**0.00%**	**0.70%**	**85.20%**	**4.10%**	**2.10%**	**7.90%**	
Sahel	Oudalan	0.66%	0.66%	1.99%	57.48%	11.30%	14.62%	13.29%	Strong negative impact
	Seno	0.00%	0.00%	0.00%	68.73%	15.48%	4.64%	11.15%	Medium negative impact
	Soum	0.41%	0.41%	3.86%	56.50%	20.12%	4.27%	14.43%	Medium negative impact
	Yagha	0.00%	0.00%	0.38%	40.38%	15.47%	10.57%	33.21%	Strong negative impact
Sahel Total		**0.29%**	**0.29%**	**1.88%**	**56.48%**	**16.22%**	**7.82%**	**17.02%**	
Centre-Est	Boulgou	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	No significant impact
	Koulpelogo	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	No significant impact
	Kouritenga	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	No significant impact
Centre-Est Total		**0.00%**	**0.00%**	**0.00%**	**100.00%**	**0.00%**	**0.00%**	**0.00%**	
Boucle du Mouhoun	Bale	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	No significant impact
	Mouhoun	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	No significant impact
	Banwa	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	No significant impact
	Kossi	0.00%	0.00%	1.24%	76.03%	10.74%	0.00%	11.98%	Medium negative impact
	Nayala	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	No significant impact
	Sourou	0.00%	0.00%	0.00%	46.63%	35.58%	6.13%	11.66%	Medium negative impact
Boucle du Mouhoun Total		**0.00%**	**0.00%**	**0.31%**	**84.93%**	**8.73%**	**1.04%**	**4.99%**	
Centre-Nord	Namentenga	0.00%	0.00%	0.00%	72.95%	8.54%	0.71%	17.79%	Medium negative impact
	Sanmatenga	0.00%	0.00%	0.78%	82.89%	1.88%	1.73%	12.72%	Medium negative impact
	Bam	0.00%	0.00%	1.47%	73.16%	7.72%	4.78%	12.87%	Medium negative impact
Centre-Nord Total		**0.00%**	**0.00%**	**0.76%**	**78.32%**	**4.79%**	**2.18%**	**13.95%**	
Total		**0.07%**	**0.12%**	**1.05%**	**78.21%**	**7.75%**	**3.28%**	**9.53%**	

How can this analysis help emergency response?

This analysis will be used to inform the geographic targeting of WFP's and government's emergency response. The list of localities that have been identified by the analysis, as the most affected by abandonment of agricultural land, will be used as a primary base data for the geographic targeting of vulnerable communes and priority villages for WFP's interventions. Therefore, this list makes it possible to focus on the most vulnerable communes and to contribute to targeting within the national response plan during the lean season. The list will also be used by Food Security cluster partners in planning humanitarian and livelihoods response.

Additionally, the list of the most affected localities can inform the implementation of early recovery activities. The villages on this list will be shared with the World Bank for the activities' planning under the "shock responsive social protection" program.

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