Food and Agriculture Organization of the United Nations

A rapid geospatial damage assessment of the 2023 conflict in the Gaza Strip on agricultural land and infrastructure

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Executive summary

An ongoing conflict between Hamas and Israel erupted on 7 October 2023 resulting in a siege of strikes by Israel on the Gaza Strip. Over the course of just two months of hostilities, more than 85 percent of the population in Gaza have been displaced (WFP, 2023). The agricultural system across the Gaza Strip has suffered severe impacts due to these hostilities. Nearly all agricultural production and fishing has been halted, even in areas where certain food commodities are available processing and production facilities are shut down due to lack of access to water and electricity (IPC, 2023). This has exacerbated the longstanding humanitarian crisis resulting from the 16-year blockade of Gaza.

The FAO has undertaken a two-phase geospatial assessment of damage to agricultural land and infrastructure during the 2023 conflict in the Gaza Strip. Assessment 1 (A1) focused on depicting damage incurred between 7 October and 1 December, while Assessment 2 (A2) focused on illustrating damage up to 31 December. High resolution and very high-resolution satellite imagery were collected based on the two assessment periods. Damage assessments were conducted to examine damage to agricultural infrastructure, greenhouses and cropland.

As of 31 December 2023, the results of the geospatial analysis of damage to agricultural land and infrastructure indicate significant destruction resulting from the ongoing conflict in the Gaza Strip. The most damaged agricultural infrastructures were home barns (206), broiler farms (172) and sheep farms (149). The total number of damaged agricultural wells in the Gaza Strip was 488. The most affected governorate based on damage to wells was North Gaza (184 damaged). The second most affected governorate based on damage to wells was Gaza (178 damaged).

20.5 percent (261.8 ha) of greenhouses were within 15 m of direct damage impact, incurring significant destruction. Gaza and North Gaza were the most affected governorates based on proportion of greenhouse area damaged (40.0 percent of total greenhouse area in Gaza and 35.5 percent of total greenhouse area in North Gaza). Khan Younis and Rafah were the most affected governorates based on total area of damaged greenhouses (100.5 ha of total greenhouse area in Khan Younis and 87.3 ha of total greenhouse area in Rafah).

27.5 percent (4 319.4 ha) of all cropland in the Gaza Strip has been damaged. The governorate with the most damage to cropland was Gaza, both in terms of hectares and in terms of proportion of land (1 482.1 ha; 41.8 percent of the total cropland area).

In the future, stronger integration of field and remote sensing data and transparent access to satellite imagery are recommended. This will increase the potential to improve consistency of results over time between data sources and support response programs. The population in the Gaza Strip is experiencing prolonged periods of extreme food consumption gaps and severe nutritional vulnerability (IPC, 2023). It is essential to frequently update these results and closely monitor the situation to facilitate the development of coping capacities and the rehabilitation of the agriculture sector over time.

Background

The Gaza Strip is a flat, narrow coastal plain land in the Middle East situated on the Mediterranean coast. It has a total area of 360km^2 with a 40km coastline, a 51km border with Israel and an 11km border with Egypt. The primary crops cultivated are strawberries, cut flowers, citrus, vegetables, almond, dates and guava (UNEP, 2020). 2.2 million Palestinians are living in the Gaza Strip (Palestine Central Bureau of Statistics, 2022a), 41.7 percent of this population being under 15 years of age. The population density is 5 204 people/km^2 (Palestine Central Bureau of Statistics, 2018a), ten times that of the density in the West Bank (Palestinian Central Bureau of Statistics, 2018b). In 2022, the Gaza Strip faces a significant unemployment gap with a rate of 45 percent, notably higher than the West Bank's rate of 13 percent. Deir Al-Balah has the highest unemployment rate at 54.8 percent, followed by Khan Younis at 49.4 percent. In contrast, North Gaza has the lowest rate among Gaza Strip governorates at 38.4. This discrepancy becomes particularly pronounced among young graduates (19–29 years old), specifically those with intermediate diplomas or higher, whose unemployment rate rises to 73.9 percent (Palestine Central Bureau of Statistics, 2022b).

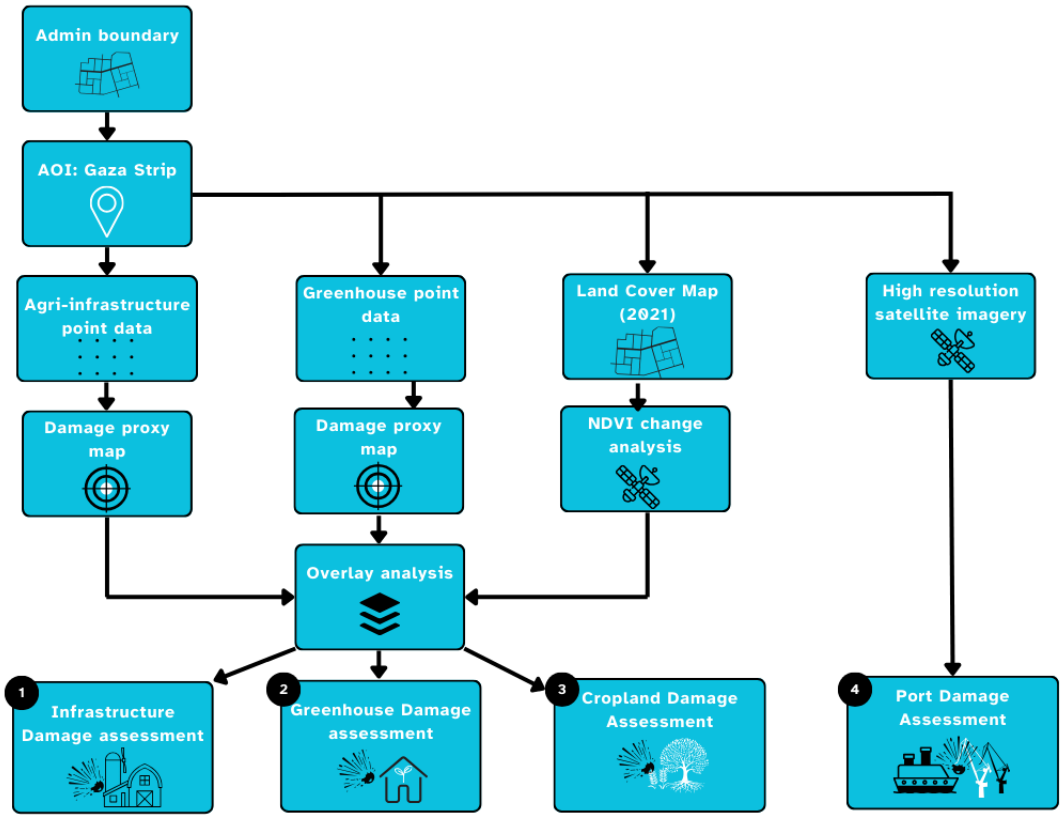
The Palestinian agrifood sector has a significant role in promoting economic growth, social development and environmental sustainability, existing as an important livelihood source for some of the most vulnerable groups such as women and the poor. It acts as a vital coping strategy for Palestinian household in times of crisis as an enabler of food and nutrition security, given that before the conflict 63 percent of the population was moderately to severely food insecure (UNOCHA, 2023). In the Gaza Strip, Israeli occupation limits access to 18 percent of arable land on the eastern and northern borders of the Gaza Strip (Marzin *et al.*, 2019). Israel and the Gaza Strip are separated by a wall with highly regulated border crossings. Export and import regulations are, to a great extent, controlled by Israel, with access to foreign markets restricted (FAO, European Union & CIRAD, 2023). Limited allocation of permits and restrictions along with stringent regulation of movement of Palestinians impedes vital year-round agricultural activities (UNEP, 2020).

Currently one of the largest and most rapid internal displacements of recent times is occurring in the Gaza Strip. An ongoing conflict between Hamas and Israel erupted on 7 October 2023 resulting in a siege of strikes being implemented by Israel on the Gaza Strip. On the evening of 7 October Israel also suspended access to electricity to Gaza, escalating to the total discontinuation of provision of resources such as food, fuel, electricity and water to the Gaza Strip on 9 October (UNRWA, 2023). The current conflict in Gaza has already resulted in more than twice as many internally displaced persons (IDPs) as the 2014 conflict. This has exacerbated the established humanitarian crisis due to the 16-year blockade of Gaza. On 24 November a humanitarian pause came into effect, offering a short period of relief from airstrikes and ground clashes for the population until 1 December. Over 90 percent of the Gaza Strip population (about 2.08 million people) was determined to be in IPC Phase 3 or above (Crisis or worse) between 24 November and 7 December 2023 (IPC, 2023). The objective of this geospatial damage assessment is to provide analysis of damage to agricultural infrastructure and cropland during two assessment periods. It applies remote sensing geospatial techniques by utilizing satellite imagery to assess specific damages incurred based on the categorization of key agriculture-based sub-sectors: cropland (agricultural land), agricultural infrastructure (including wells) and greenhouses.

Methodological approach

The methodological approach follows the steps as described in Figure 1. For the analysis of damage to agricultural infrastructure, greenhouses and cropland three input layers were used in an overlay analysis to assess the damage to the agricultural landscape. A feature extent exhibiting the targeted element of agricultural land being assessed was considered; in the case of agricultural infrastructure and greenhouses a 2021 point data layer was used, while in the case of cropland this was comprised of the 2021 land cover map. A damage layer was incorporated into the analysis; for the agricultural infrastructure and greenhouses this consisted of a damage proxy map (DPM), while for the cropland damage assessment changes in greenness was observed using Sentinel 2 data (Figure 1). This approach was developed considering the relevant satellite data and information which was available and accessible within the limited timeframe. The proposed methodological approach can be enriched and expanded with additional data in the future.

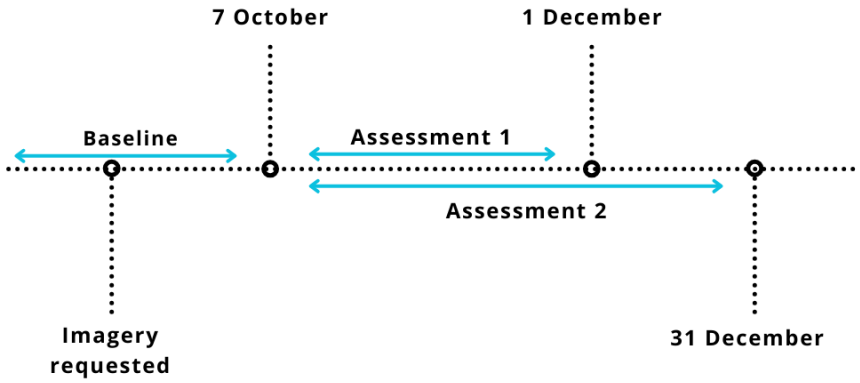
Figure 1. A flowchart describing the methodology of the 2023 damage assessments



Source: Authors' own elaboration.

High resolution and very high-resolution satellite imageries were collected based on two assessment periods. Annex C illustrates the ancillary data for the satellite imagery derived for the damage assessments.

Figure 2. The time period for assessment 1 (7 October–1 December 2023) and assessment 2 (7 October–31 December 2023)

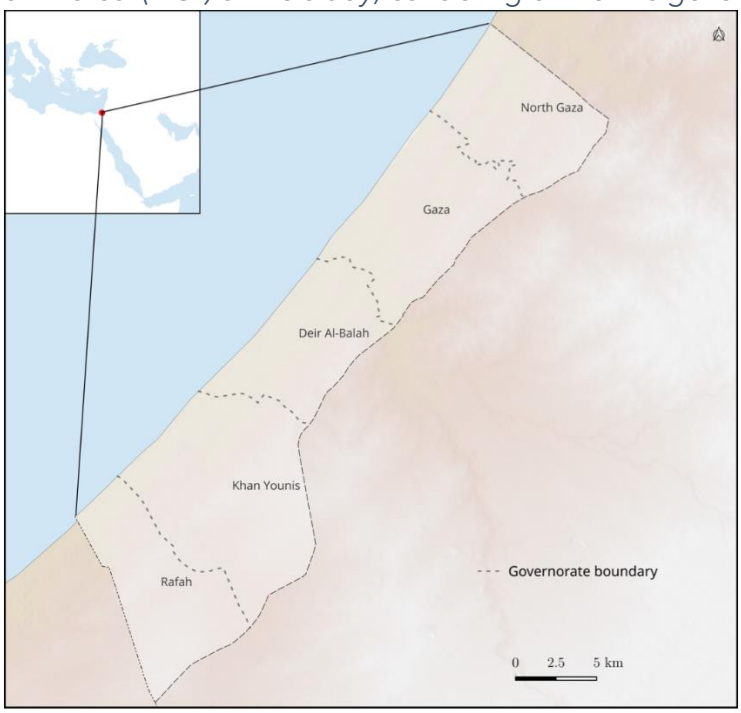


Source: Authors' own elaboration

Selection of area of interest

The area of interest (AOI) was inclusive of all administrative boundaries of the Gaza Strip consisting of the following five governates: North Gaza, Gaza, Deir Al-Balah, Khan Younis and Rafah (Figure 3). The outline of the Gaza Strip was determined using the UN (2020) global administrative world layers.

Figure 3. The area of interest (AOI) of the study, consisting of the five governorates of Gaza



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the author.

Derivation of damage proxy maps

The damage proxy map preparation follows the approach by Tay et al. (2020) using Sentinel 1 data and the module developed on the SEPAL platform[1] for assessing damage proxy maps. It combines two sets of images before and one image after an event. This is a proxy measure of damage estimated by implementing the so-called coherence change detection (CCD) algorithm. Three image pairs were used – two pre-event sets and one post-event set. The coherence layers were calculated for each pair to assess the changes. This damage proxy map (DPM) detects the changes in the built-up area. The drop level depicts the severity of the damage, with a higher drop level indicating higher severity. A drop of coherence by over 0.27 is categorized as damaged.

NDVI change analysis

In assessment 1, Sentinel 2 data from November 2022 and September 2023 was used as a baseline for comparison with November 2023 for NDVI-based change assessment. Significant change in cropland greenness was identified as cropland damage. A decrease of 0.2 or greater was considered as an abrupt change and a potential indication of affected cropland.

In assessment 2, Sentinel 2 data from December 2020, 2021, 2022 and September 2023 was used as a baseline for comparison with December 2023 for NDVI-based change assessment. Pléiades[2] data from 26 December and 30 December 2023 were used to delineate the damaged area from Sentinel 2 based NDVI analysis (Annex E). The severity of the damage to cropland was determined by calculating the percentage and hectares of the damaged area by cropland type (irrigated cropland, rainfed cropland and orchards).

Agricultural infrastructure analysis

The following infrastructures are considered in this assessment: greenhouses, well rooms, animal shelters, sheep farms, dairy farms, ponds, plant nurseries, agricultural supplies, home barns, turkey farms, agricultural stores, rabbit farms, calf farms, pigeon/other bird farms, broiler farms, agricultural storage and port. Annex D contains a table which summarises the definitions for each category of agricultural infrastructure.

The damage to agricultural infrastructure was estimated using the available Sentinel 1 SAR images on October 12, 13, 24, 25, November 5, 6, 17, 18, 29 and 30, and December 11, 12, 22 and 23. A multi ring radius area (15m, 30m, 45m radius) around the damage impacted sites was constructed to quantify the extent of damage to agricultural infrastructure. The number of damaged agricultural infrastructures was calculated based on their location within

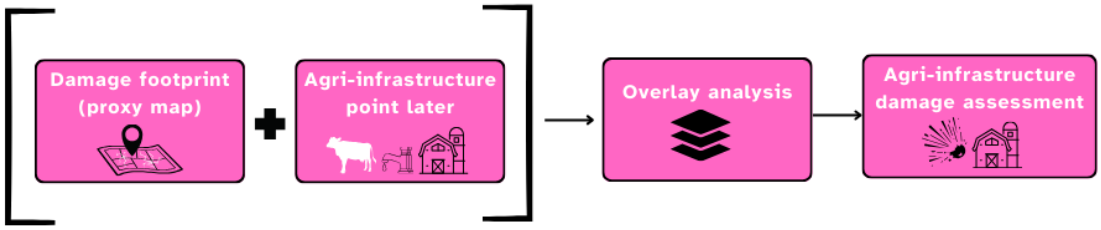
[1] https://sepal.io/

[2] Pléiades @ CNES 2023, Distribution Airbus DS.

a 15-meter radius area around a damaged site. An overlay analysis was conducted using a 2021 point layer of agricultural infrastructure with the DPM (

Figure 4). A hexagonal grid using Inverse Snyder Equal-Area Projection Aperture 3 Hexagon (ISEA3H) was prepared at 17 resolution level (area of a grid is around 40 ha). The grid was used to extract the statistics at the grid level. The damage extent data was overlaid with the grid data to delineate the proportional damaged area. The same method of analysis was applied when quantifying damage to agricultural wells.

Figure 4. Methodology flowchart to assess the damage to agricultural infrastructure

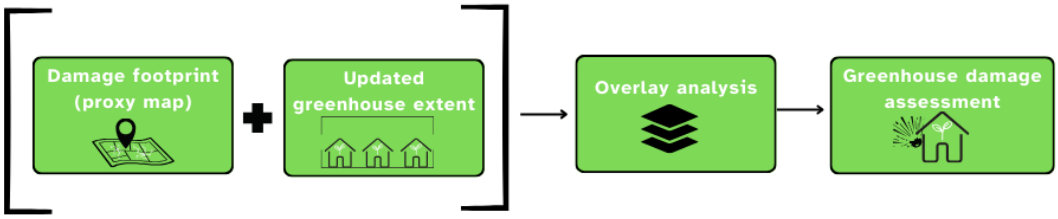


Source: Author's own elaboration.

Greenhouse analysis

The damage to the greenhouses was estimated using the available Sentinel 1 SAR images on October 12, 13, 24, 25, November 5, 6, 17, 18, 29 30 and December 11, 12, 22 and 23. The greenhouse class was isolated from a land cover assessment to update the greenhouse data layer with the point location of 2021. An overlay analysis was conducted using the damage proxy map and the updated greenhouse layer to assess the damage to greenhouses (Figure 5). The area of damaged greenhouses was calculated by overlaying the greenhouse distribution layer on the damage proxy map. The hexagonal grid previously applied using Inverse Snyder Equal-Area Projection Aperture 3 Hexagon (ISEA3H) at 40 ha resolution was also applied to the greenhouse damage extent to derive the proportional damaged area at grid level. Annex B accounts for the differences in greenhouse area data in this analysis and the 2021 census (Palestinian Central Bureau of Statistics, 2021).

Figure 5. Methodology flowchart to assess the damage to greenhouses



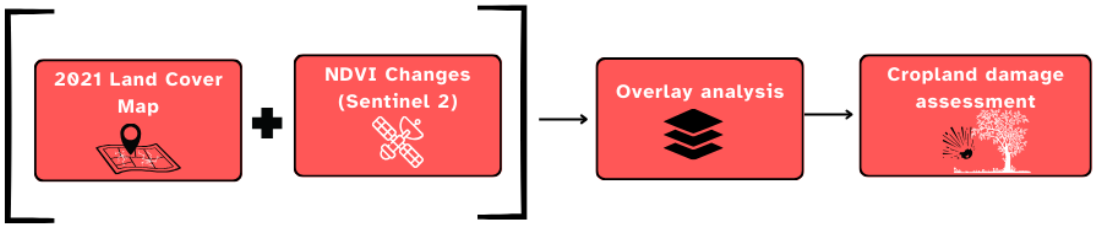
Source: Authors' own elaboration.

Cropland analysis

The severity of the damage to cropland was determined by calculating the percentage and hectares of the damaged area by cropland types. The 2021 land cover map was used as an

input to categorize cropland damage (FAO, 2021); this map was overlayed with the Sentinel 2 NDVI cropland damage analysis to determine the extent of cropland damage by categories of cultivated land (Figure 6).

Figure 6. Methodology flowchart to assess the damage to cropland



Source: Authors' own elaboration.

The severity of damage was determined in terms of the percentage of damaged area and hectares of damaged area. The overlay analysis revealed significant changes in greenness in the cropland areas between the baseline and November and December 2023. The NDVI-based assessment showed a decrease in greenness, indicating potential damage to the crops. The severity of the damage was determined by calculating the percentage and hectares of the damaged area by cropland types, providing valuable information for further analysis. The hexagonal grid previously applied using Inverse Snyder Equal-Area Projection Aperture 3 Hexagon (ISEA3H) at 40 ha resolution was also applied to the cropland damage extent to derive the proportional damaged area at grid level. Annex A contains data from a damage assessment conducted by UNOSAT in which an alternative methodology for cropland damage was employed, the results of which were taken into consideration during this assessment.

Results

Result 1: Agricultural infrastructure damage assessment

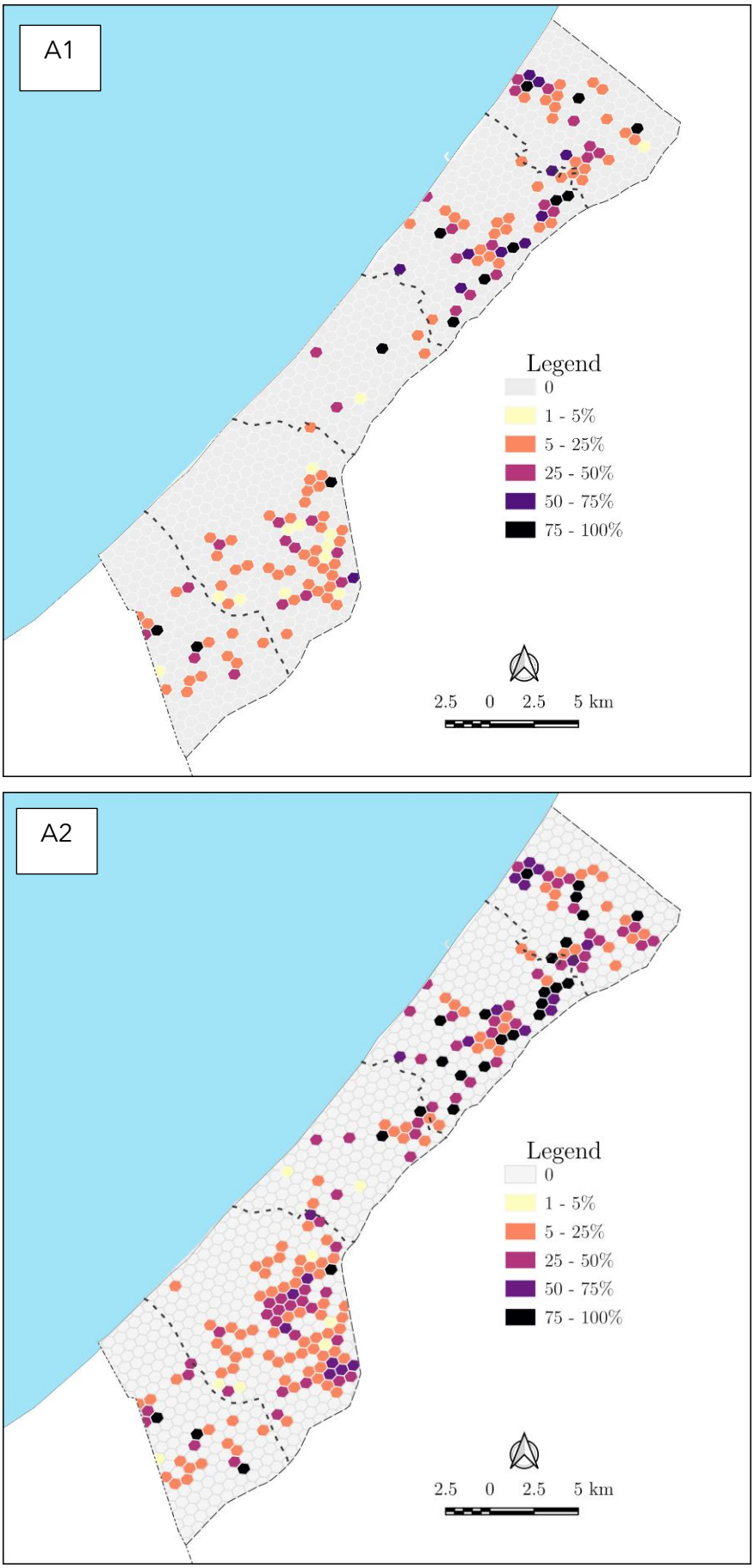
Results of the geospatial analysis reflect the extent of the damage to agricultural land and infrastructure resulting from the conflict in the Gaza Strip. The results indicate that a wide range of agricultural infrastructures have been subject to damage since the beginning of the conflict. Based on the number of damaged infrastructures, home barns (206), broiler farms (172) and sheep farms (149) were the most damaged agricultural infrastructures (Table 1). To provide a comprehensive overview of infrastructures within a maximum of 45m radius, additional information to Table 1 is available at Annex D.

Table 1. Number of agricultural infrastructures damaged as of 31 December 2023 within 15m of the damaged area

Type	Total Number	Number Damaged
Animal shelters	436	94
Sheep farms	793	149
Dairy farms	112	20
Ponds	469	36
Plant nurseries	17	1
Agricultural suppliers	67	5
Home barns	1 043	206
Turkey farms	36	5
Agricultural warehouses	547	76
Rabbit farms	38	9
Cattle farms	34	5
Pigeon/other bird farms	117	29
Broiler farms	1 117	172
Farm storages	344	30

The proportional distribution of damaged agricultural infrastructure in assessment 1 and assessment 2 is shown in Figure 7. Each hexagonal unit in the figure illustrates the number of damaged infrastructures divided by the total number of infrastructures in the area. The assessment 2 (A2) map is accumulative of the damage detected during assessment 1 (A1).

Figure 7. Proportional damage to agricultural infrastructure in the Gaza Strip as of A1 (7 October–1 December) and A2 (7 October–31 December)



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the author.

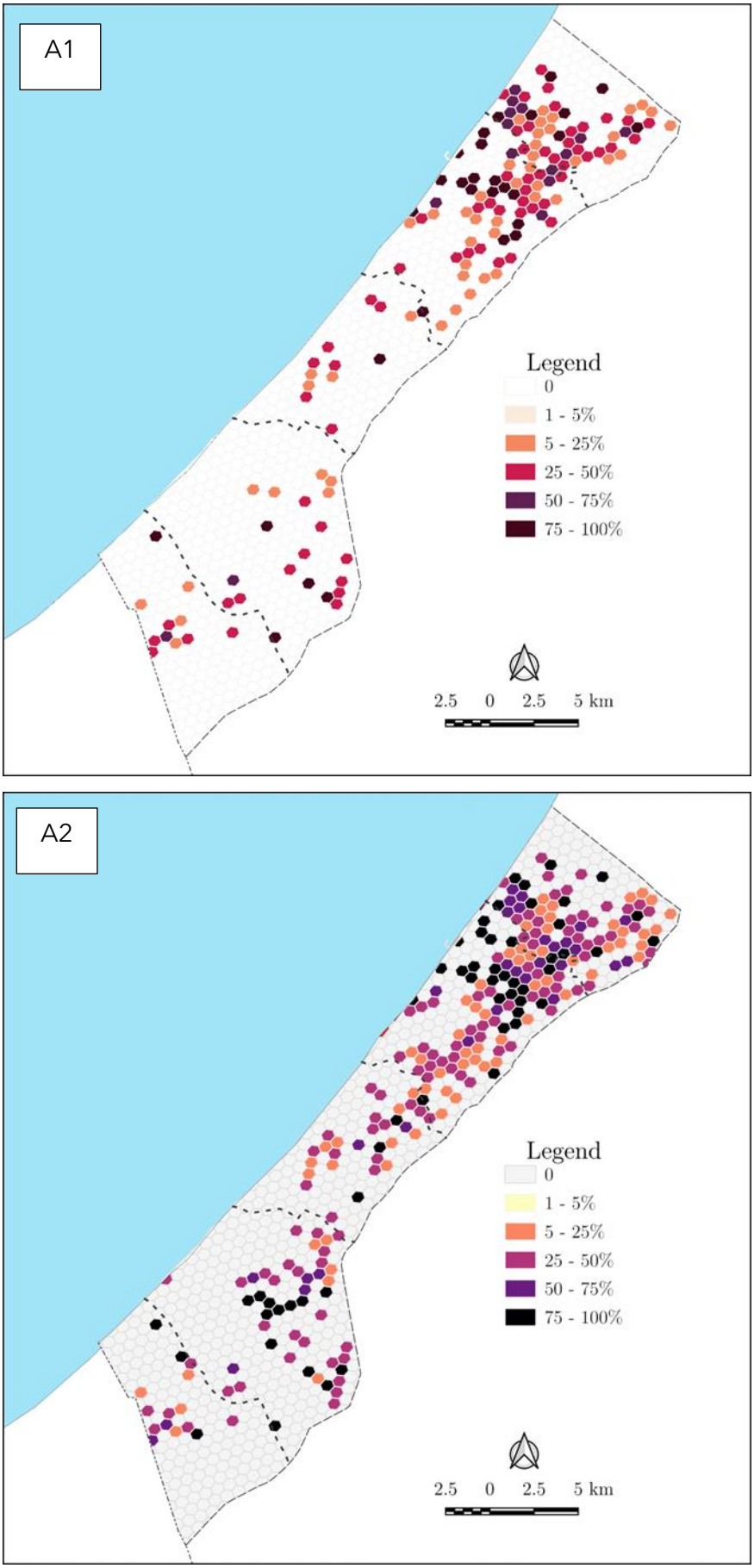
The total number of damaged agricultural wells in the Gaza Strip is 488 (Table 2). Damage to wells was found to be most concentrated in the Northern governorates of North Gaza and Gaza. 184 wells in North Gaza and 178 wells in Gaza were within 15m of damage impacted areas and therefore damaged significantly.

Table 2. Number of wells damaged within 15m of damage by governorate in the Gaza Strip as of 31 December 2023

Governorate	Total	Damaged
North Gaza	614	184
Gaza	609	178
Deir Al Balah	464	44
Khan Younis	410	66
Rafah	164	16
Total	2 261	488

The proportional distribution of damaged wells in assessment 1 (A1) and assessment 2 (A2) is shown in Figure 8. Each unit in the figure illustrates the total number of damaged wells divided by the total number of wells in an area. The figure shows that in some areas of the Northern governorates of North Gaza and Gaza 75-100 percent of wells in the area have been damaged. The assessment 2 (A2) map is accumulative of the damage detected during assessment 1 (A1).

Figure 8. Proportional damage to wells in the Gaza Strip as of A1 (7 October–1 December) and A2 (7 October–31 December)



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the author.

Result 2: Greenhouse damage assessment

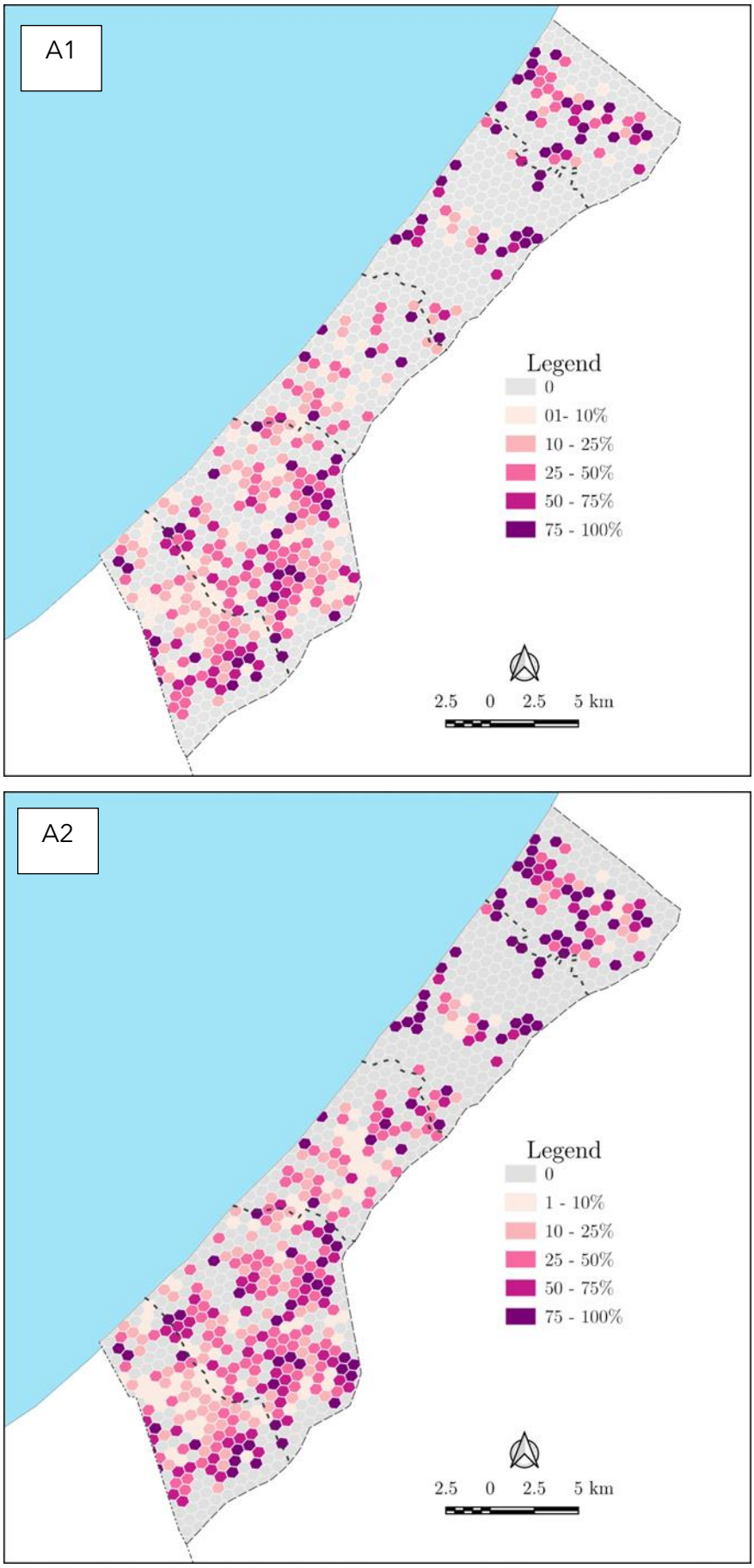
The results exhibit that 261.8 ha or 20.5 percent of greenhouses have been damaged as of 31 December (Table 3). Gaza and North Gaza were the most affected governorates based on proportion of damaged greenhouse area (40.0 percent of total greenhouse area in Gaza and 35.5 percent in North Gaza). Khan Younis and Rafah were the most affected governorates based on total area of damaged greenhouses (100.5 ha of total greenhouse area in Khan Younis and 87.3 ha in Rafah).

Table 3. Damage to greenhouses by governorate in the Gaza Strip as of 31 December 2023

Governorate	Total greenhouse area (ha)	Total damaged area (ha)	Percent damaged
North Gaza	106.9	38	35.5
Gaza	36.0	14.4	40.0
Deir Al-Balah	149.2	21.6	14.5
Khan Younis	425	100.5	23.6
Rafah	558.6	87.3	15.6
Total	1 276.6	261.8	20.5

The proportional distribution of damaged greenhouses in assessment 1 (A1) and assessment 2 (A2) is shown in Figure 9. Each unit in the figure illustrates the total area of damaged greenhouses in hectares divided by the total area of greenhouses in hectares. The assessment 2 (A2) map is accumulative of the damage detected during assessment 1 (A1).

Figure 9. Proportional damage to greenhouses in the Gaza Strip as of A1 (7 October–1 December) and A2 (7 October–31 December)



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the author.

Result 3: Cropland damage assessment

The assessment also investigated damage to cropland as of 31 December. The results found that 31.4 percent of irrigated crops in Gaza were damaged, while 27.3 percent of orchards and 24.5 percent of rainfed crops have also been damaged (Table 5).

Table 4. Damage to cropland in hectares (ha) in the five governorates of the Gaza Strip by land management as of 31 December

Cropland type	Total Land (ha)	Damaged Land (ha)	Percent damaged
Irrigated cropland	2 155.2	676.0	31.4
Orchards	11 670.0	3 184.1	27.3
Rainfed cropland	1 871.7	459.3	24.5
Total	15 696.9	4 319.4	27.5

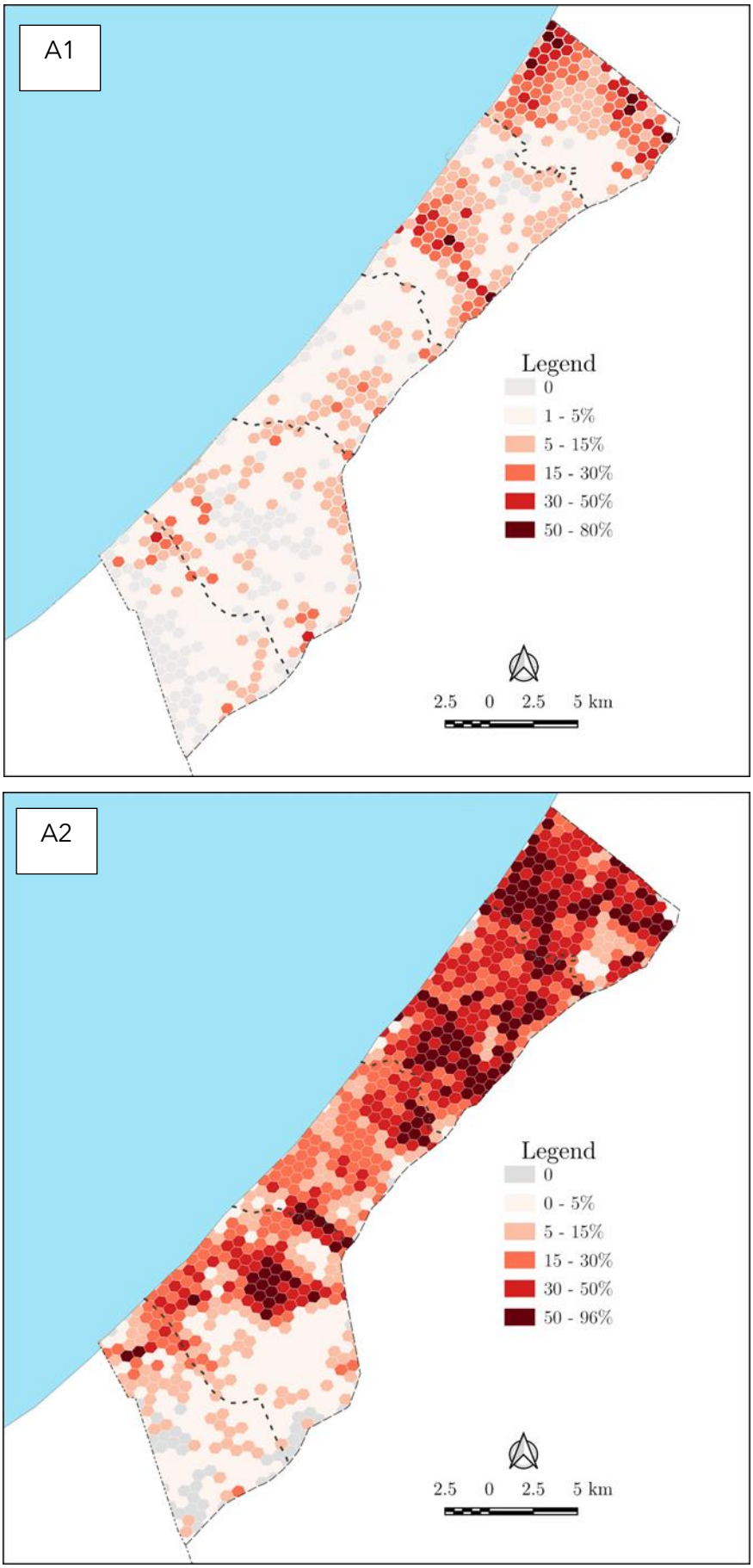
In total, 4319.4 ha (27.5) of cropland in the Gaza Strip has been damaged (Table 4). Gaza was the most affected governorate in terms of area of damaged cropland (1482.1 ha) and proportion of damaged cropland (41.8 percent). It was followed closely by North Gaza, in which 1230.5 ha (39.7 percent) of cropland was damaged.

Table 5. Damage to cropland in (ha) in the five governorates of the Gaza Strip as of 31 December

Governorate	Total Land (ha)	Damaged Land (ha)	Percent damaged
North Gaza	3 098.5	1 230.5	39.7
Gaza	3 545.0	1 482.1	41.8
Deir Al-Balah	2 782.9	754.1	27.1
Khan Younis	4 473.7	719.7	16.1
Rafah	1 796.8	132.9	7.4
Total	15 696.9	4 319.4	27.5

The proportional distribution of damaged cropland in assessment 1 (A1) and assessment 2 (A2) is shown in Figure 10. Each unit in the figure illustrates the area of damaged cropland in hectares divided by the total area of cropland in hectares. The assessment 2 (A2) map is accumulative of the damage detected during assessment 1 (A1).

Figure 10. Proportional damage to cropland in the Gaza Strip as of A1 (7 October–1 December) and A2 (7 October–31 December)



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the author.

Result 4: Port Damage Assessment

This assessment is a comparison between satellite imagery from 30 December 2023 and baseline imagery from 10 August 2023 reveals damage at both tail and head of the west quay, leading to complete detachment from the port (Figure 11). The east quay has also incurred damage, particularly at the tail, however imagery suggests it is not entirely disconnected from the port. The infrastructure at the head of the west quay has been destroyed, along with most of the other infrastructure directly surrounding the port. The majority of the vessels in the port are not seen in the 30 December 2023 image, as they have likely been damaged, destroyed or deserted the port.

Figure 11. A baseline satellite image before the conflict, taken in August 2023, in comparison with a satellite image after the conflict, taken in December 2023

Source: Pléiades @ CNES 2023, Distribution Airbus DS.

Conclusion

The post-conflict rehabilitation of the agriculture sector will require accurate data about the status of agricultural land and infrastructure in Gaza. The humanitarian crisis in Gaza is deteriorating due to the intensification of hostilities; this report assessed the extent of damage to the agriculture sector which has exacerbated the limited access to food due to import restrictions. The use of satellite imagery and remote sensing has the potential to assist and provide timely information to mitigate the food insecurity crisis in the Gaza Strip. This report was based on baseline information and newly acquired satellite imagery and analysis. It can be further enhanced and updated in the future, through better integration of multiple data sources, thus enabling the monitoring and rehabilitation of the agriculture sector.

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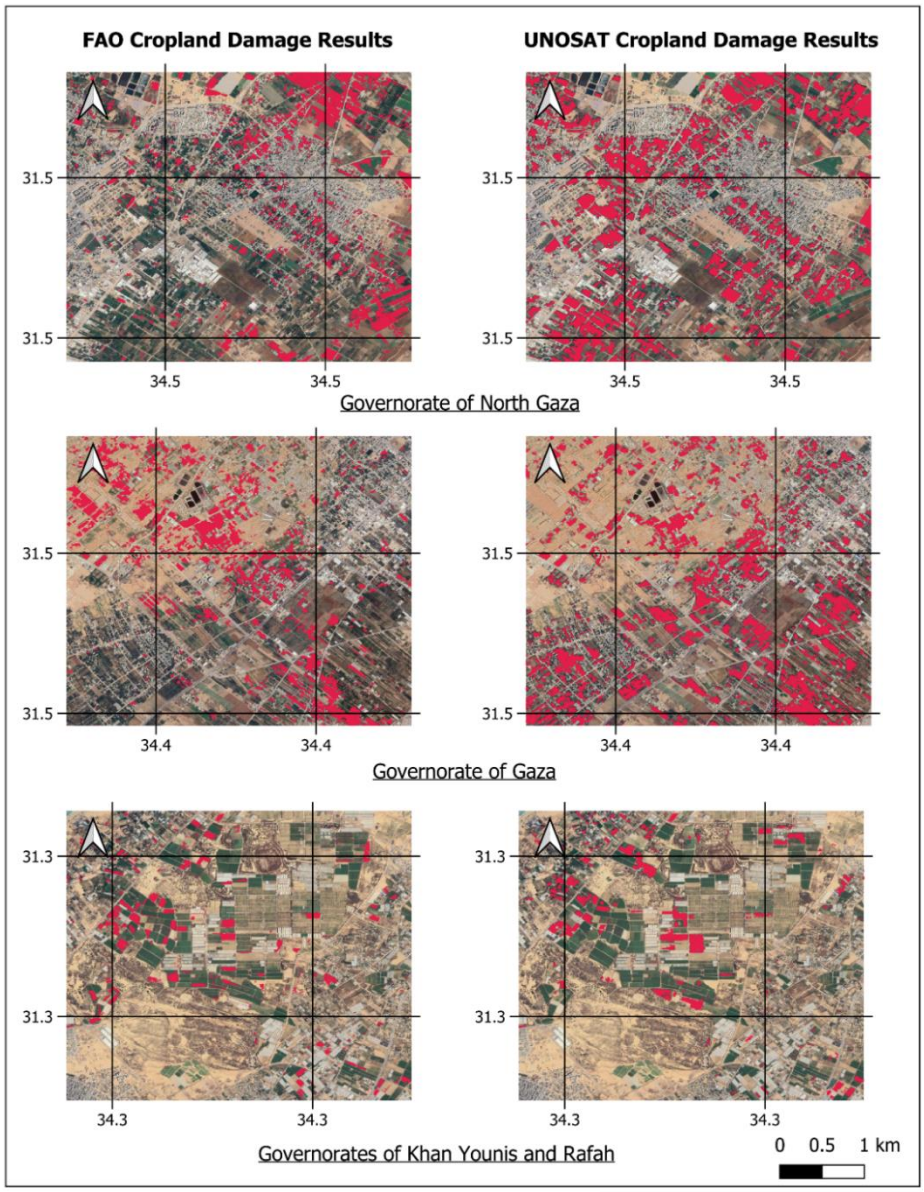
Annex A: UNOSAT agricultural land assessment

On 17 November 2023 UNOSAT published a map of satellite-detected damage to agricultural land in the Gaza Strip. This was based on an image collected on 26 November 2023, which was then compared to images collected on 1 May 2023, 10 May 2023, 18 September 2023, 15 October 2023, and 7 November 2023. There may be differences in results due to differences in input data, as the UNOSAT assessment included baseline data from the last six years. UNOSAT have since published additional damage assessments on 26 November and 13 December, which exhibited further damage to agricultural land.

Figure A.12. Baseline satellite imagery comparing the FAO cropland damage assessment 1 as of December 1st and the UNOSAT cropland damage assessment as of 11 November 2023



Source: Pléiades @ CNES 2023, Distribution Airbus DS.

Annex B: Agricultural census 2021

The difference between the 2021 land cover national estimates for greenhouse area and the Agricultural Census of Palestine (Palestinian Central Bureau of Statistics, 2021) is due to differences in methodological approaches. The agricultural census 2021 is based on an intensive process of data collection in selected households. The remote sensing land cover assessment is based on baseline information prepared in 2021 and a rapid assessment of greenhouses. Further integration of field and remote sensing analysis would help in ensuring the consistency between the remote sensing analysis (based on satellite imagery) and the census.

Annex C: Ancillary data

A range of data was required to conduct this assessment. It incorporates ancillary information and satellite imagery of the AOI. Multispectral satellite images were required to depict the key agriculture-based sub-sectors of interest and the damage incurred by conflict to those areas. Below, the dataset used in this analysis is outlined.

C.1. Ancillary information

The following ancillary data was used in this assessment:

- Outline of the AOI – the Gaza Strip (UN, 2020)
- Report on agricultural damages after the escalation in 2021 (FAO, 2021)
- Map illustrating the damages of the 2021 report
- Detailed mapping of roads, greenhouses and vegetation layer of the Gaza Strip (2014, or 2021)
- UNOSAT damage assessment data

C.2 High-resolution satellite images

The following high resolution satellite images were used in this assessment:

- Sentinel 1 SAR (resolution 10m) images were used to construct damage proxy maps.
- Sentinel 2 MSI (resolution 10m) time-series images were used to derive a preliminary result on the damage to cropland. Identifying damage to cropland may incur some challenges depending on the timing of images within the crop cycle. Therefore, the procurement of very high-resolution images to map crop types and assess damages at a crop specific level was necessary.

C.3 Very high-resolution satellite images

Pleiades multispectral (resolution 2m) and panchromatic (resolution 0.5m) images for August, October and December 2023 were acquired for validation of results.

Annex D: Auxiliary information on agricultural infrastructure damage

Table D.1. Description of each type of agricultural infrastructure included in the damage assessment

Type	Description
Animal shelters	Designated enclosed spaces providing housing and shelter to livestock and other farm animals.
Sheep farms	Agricultural enterprises focusing on breeding and managing sheep.
Dairy farms	Agricultural enterprises focusing on breeding and managing cows for dairy production.
Ponds	Water bodies designed to collect and store water for agricultural purposes.
Plant nurseries	Specialised facilities for cultivating flowers, trees and other vegetation for eventual sale or use in landscaping.
Agricultural suppliers	Wholesale companies which supply agricultural inputs.
Home barns	Structures on residential properties designed to provide shelter and storage for various agricultural purposes.
Turkey farms	Agricultural enterprises focusing on breeding and managing turkeys.
Agricultural warehouses	Structures used by wholesale companies to store agricultural inputs for eventual sale.
Rabbit farms	Agricultural enterprises focusing on breeding and managing rabbits.
Cattle farms	Agricultural enterprises focusing on breeding and managing cattle.
Pigeon/other bird farms	Agricultural enterprises focusing on breeding and managing pigeons and other birds.
Broiler farms	Agricultural enterprises focusing on breeding and managing chickens for meat consumption.
Farm storages	Structures on a farm which are used to store agricultural products, supplies and equipment.

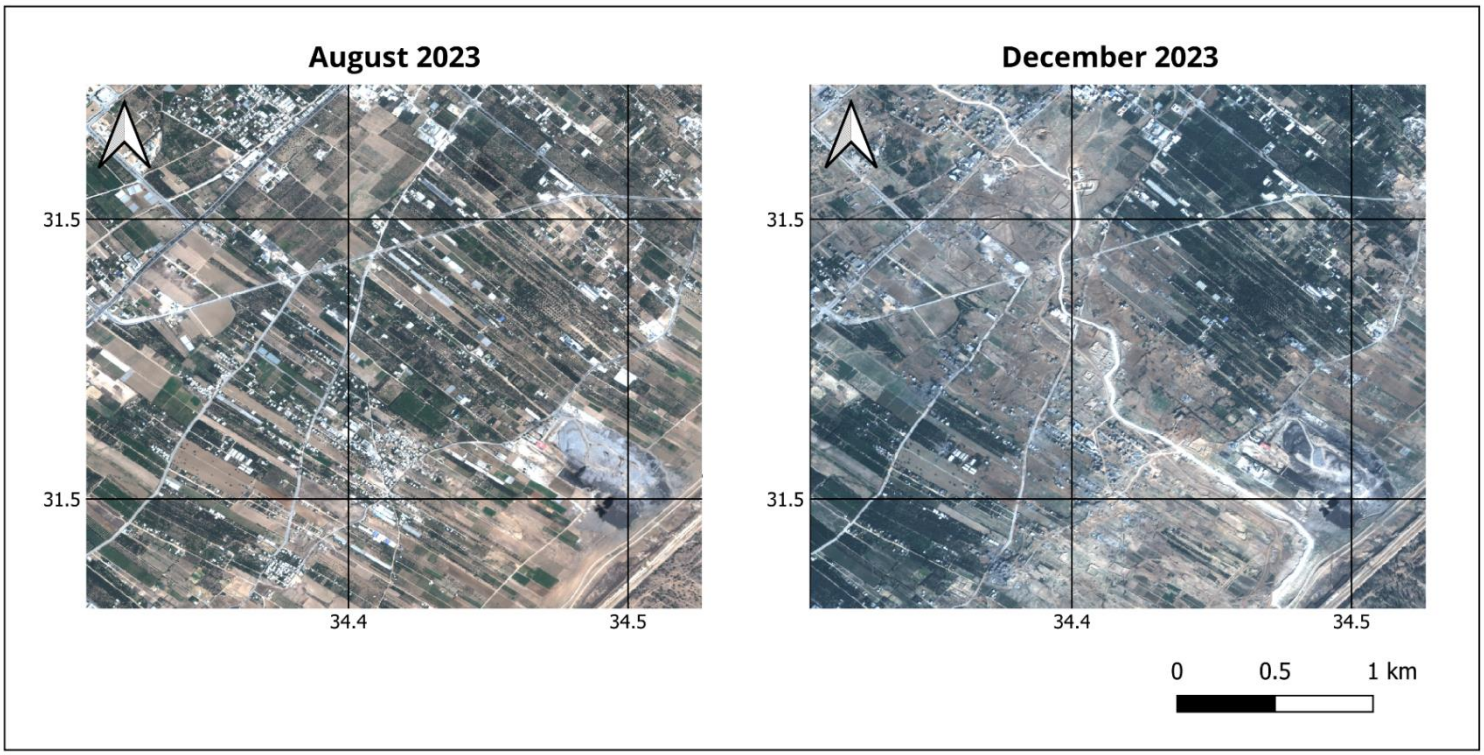
Table D.2. Number of agricultural infrastructures damaged based on the distance from the damaged area as of 31 December 2023

Type	Total	Within 15 m		15 to 30 m		30 to 45m	
		Damaged	Percent	Damaged	Percent	Damaged	Percent
Animal shelters	436	94	21.6	42	9.6	37	8.5
Sheep farms	793	149	18.8	66	8.3	58	7.3
Dairy farms	112	20	17.9	12	10.7	13	11.6
Ponds	469	36	7.7	33	7.0	36	7.7
Plant nurseries	17	1	5.9	0	0.0	2	11.8
Agricultural suppliers	67	5	7.5	0	0.0	2	3.0
Home barns	1 043	206	19.8	108	10.4	88	8.4
Turkey farms	36	5	13.9	2	5.6	3	8.3
Agricultural warehouses	547	76	13.9	57	10.4	39	7.1
Rabbit farms	38	9	23.7	4	10.5	4	10.5
Cattle farms	34	5	14.7	1	2.9	4	11.8
Pigeon/other bird farms	117	29	24.8	11	9.4	7	6.0
Broiler farms	1 117	172	15.4	86	7.7	91	8.1
Farm storages	344	30	8.7	22	6.4	27	7.8

Annex E: Examples of damages to agricultural land observed from very high-resolution imagery

Pléiades multispectral (resolution 2m) and panchromatic (resolution 0.5m) images for August, October and December 2023 were used to validate the damage assessment results. Comparison between imagery from August 2023 and December 2023 validates the damage that cropland in the Gaza Strip has been subject to.

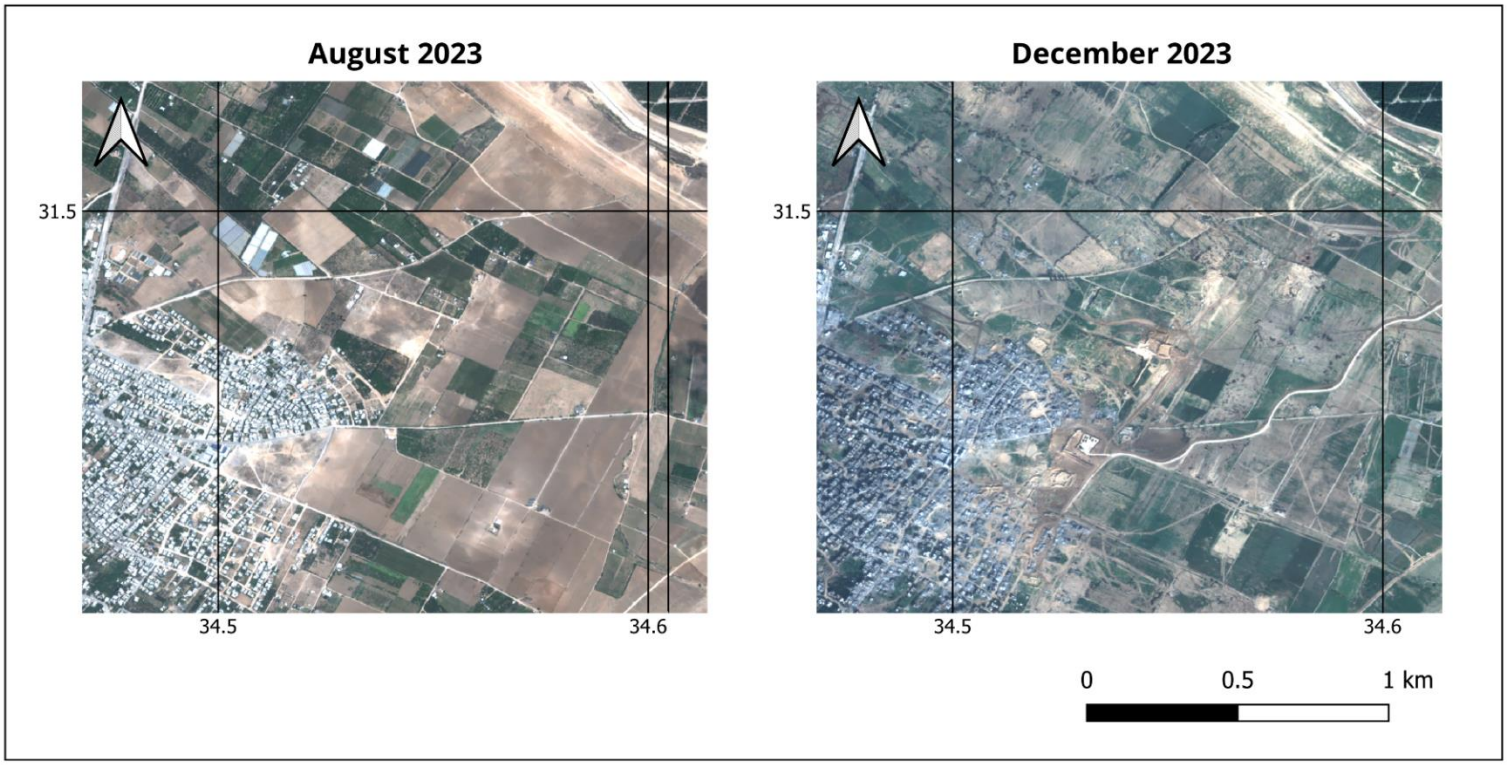
Figure E.2. Pléiades multispectral images from August 2023 and December 2023 of cropland in the governorate of Gaza



Source: Pléiades @ CNES 2023, Distribution Airbus DS.

Figure E.2 shows damage to cropland in the governorate of Gaza since the conflict began. The August 2023 image depicts cropland and orchards which are divided distinctly into fields. The December 2023 image shows the near total destruction of all visible cropland. It appears that heavy vehicles have created new tracks eradicating crops and cultivation which was previously on the land. Plots which have not been destroyed appear to be overgrown and without maintenance, likely due to displacement.

Figure E.3. Pléiades multispectral images from August 2023 and December 2023 of cropland in the governorate of North Gaza



Source: Pléiades @ CNES 2023, Distribution Airbus DS.

Figure shows damage to cropland in the governorate of North Gaza since the conflict began. The August 2023[3] image depicts cropland which is structured and well maintained. The December 2023 image shows extensive damage to cropland. Heavy vehicles have destroyed fields as tracks have established trajectories directly through cropland.

[3] There is a gap in the August 2023 imagery due to a gap between satellite images attained.

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