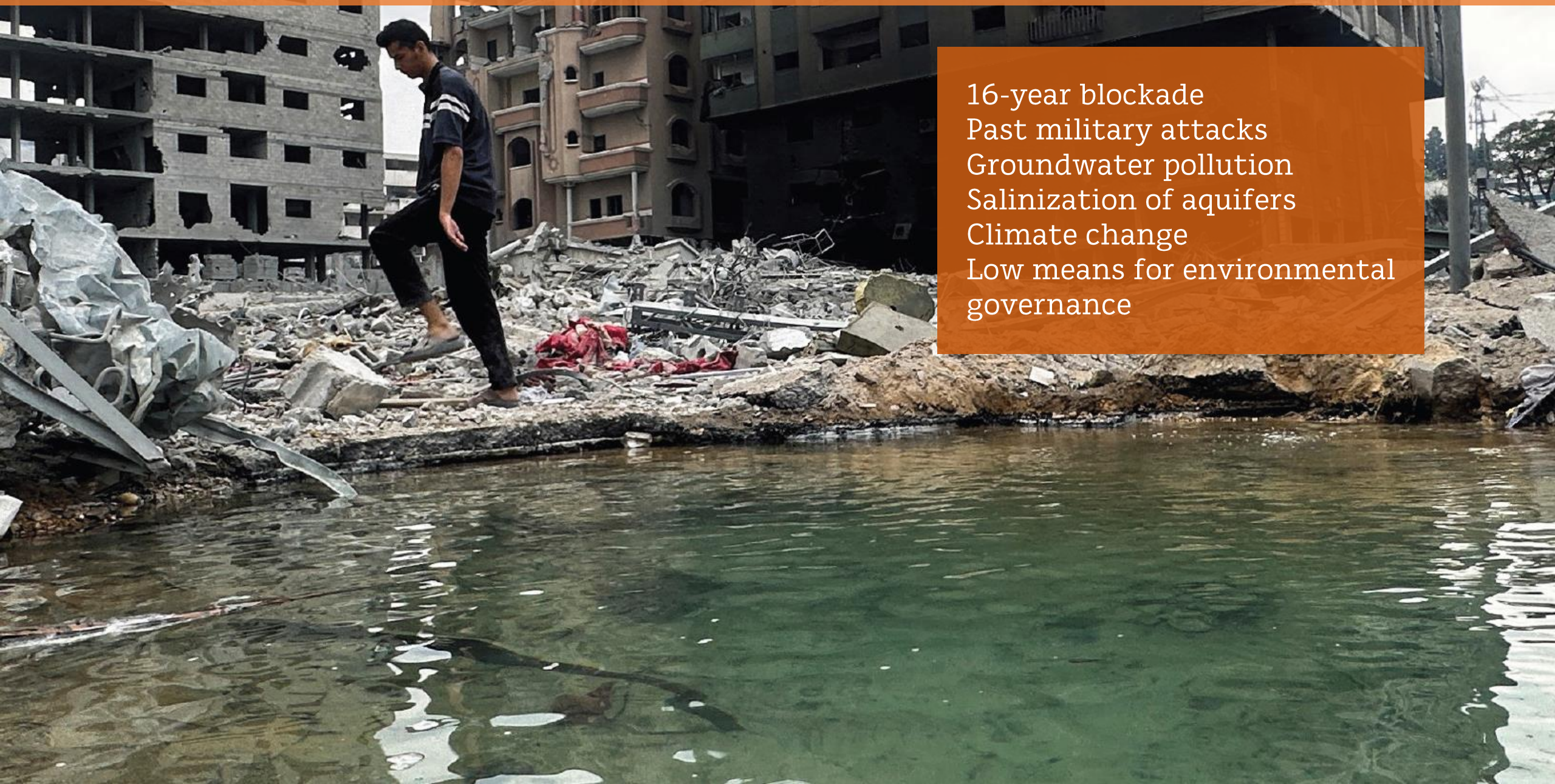




Uninhabitable? The reverberating public health and environmental risks from the war in Gaza



Gaza pre-Oct 7: major NR challenges in a degraded environment



16-year blockade
Past military attacks
Groundwater pollution
Salinization of aquifers
Climate change
Low means for environmental
governance

HOW? Open-source research

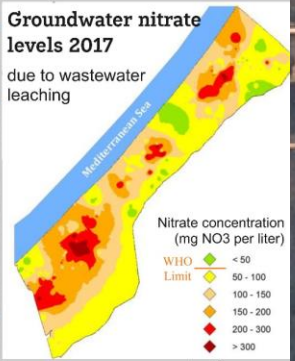
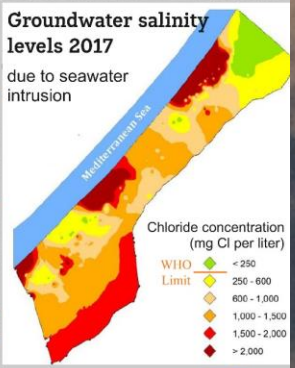
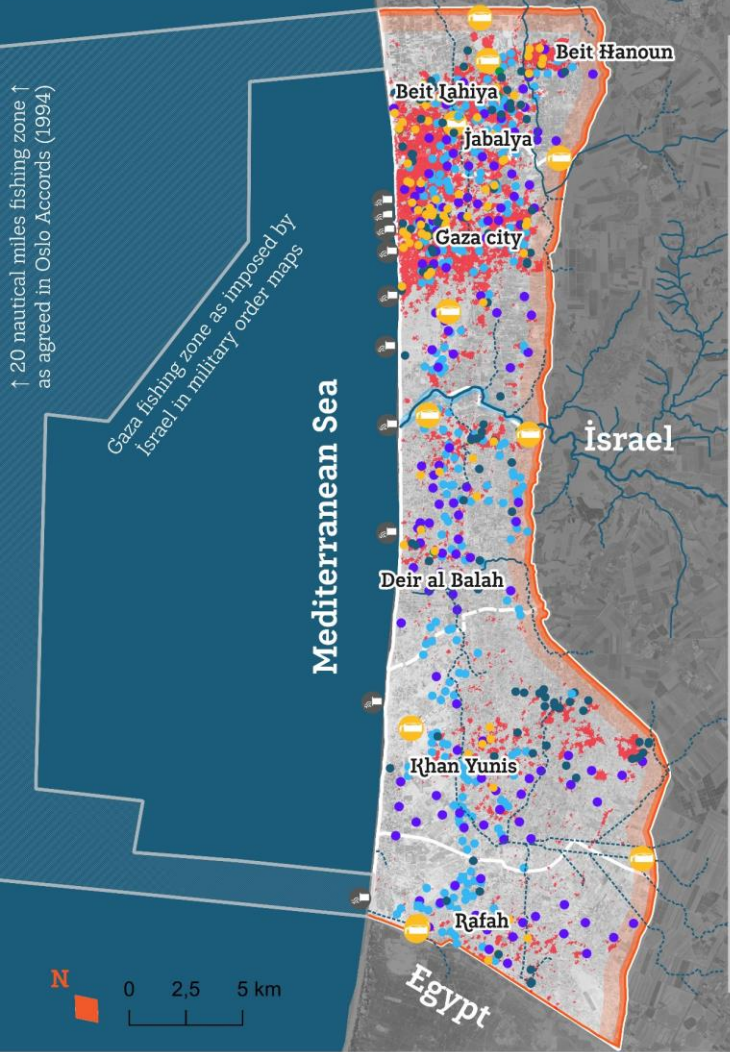
- existing **data** from various researchers and organisations
- **visual** analysis of **satellite** imagery
- **statistical/machine** learning analysis of **satellite** imagery
- news, social media, videos, pictures
- interviews with water specialists and humanitarians working in Gaza, local partners

Bring that together and **verify**



Direct impacts On water resources

Gaza Strip, Occupied Palestinian Territories



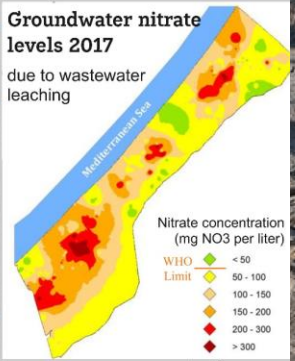
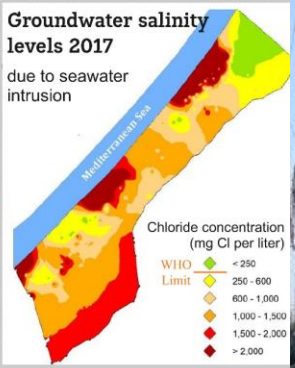
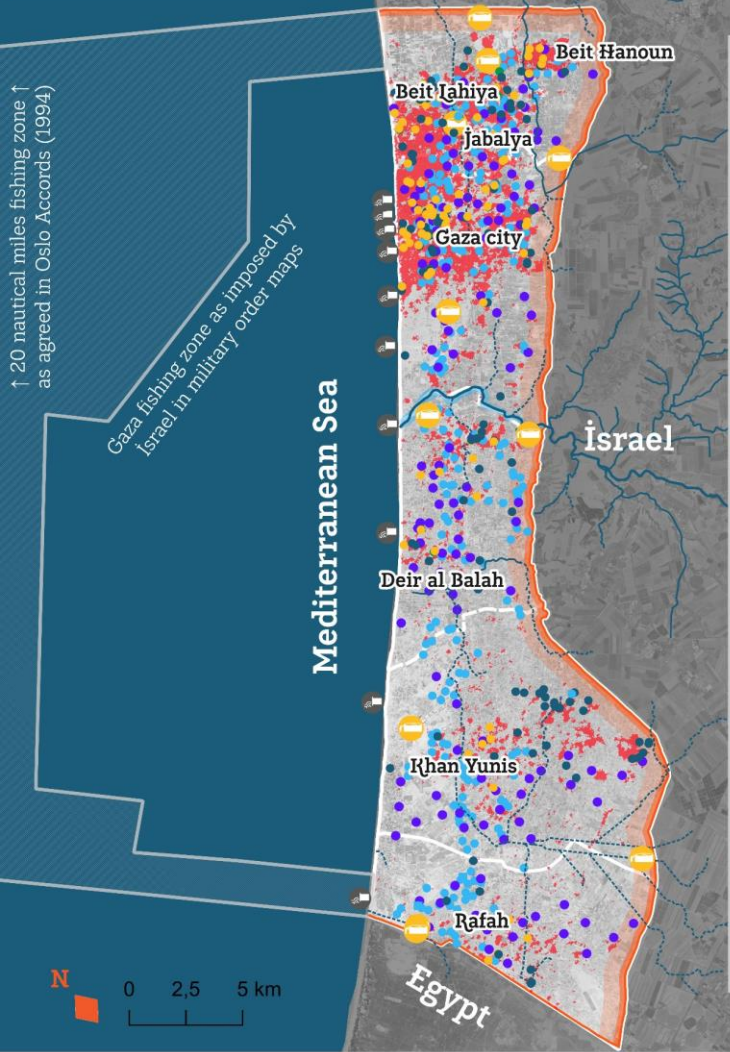
Sources

Water infrastructure: Palestinian Water Authorities (2018) Municipal Wells 2017, Gaza Water Authority (2021) through OCHA oPt, Open Street Map (2023), UNICEF and WASH Cluster (2021), PAX original research of online literature and satellite imagery (2023).
Desalination plants: Abuzerr et al. (2020)
Fishing zone: OCHA oPt (2019), as imposed by Israel in military order maps
Likely building damage: C. Scher and J. Van Den Hoek (2023) CUNY Graduate Center and Oregon State University
Waterways: Open Street Map (2023)
Wadi Gaza protected area: UNEP-WCMC and IUCN (2023) Protected Planet
Gaza borders and restricted access zones: OCHA oPt (2023)
Chloride and Nitrate maps: Palestinian Water Authority (2018) Gaza Water Resources Status Report 2017
Background image: Google Satellite and Flanders Marine Institute (2019) Global Oceans and Seas

Legend

- Water infrastructure**
- Drinking water well
 - Water network (pumps, towers)
 - Wastewater treatment plant
 - Sewer network
 - Desalination plant
 - Storm water infrastructure (dams, weirs, locks, etc.)
 - Marine sewage outlet
 - River/stream
 - Natural and artificial drainage
- Boundaries**
- District boundary
 - Wadi Gaza protected area
 - Enforced fishing limitation
- Closed and restricted border area**
- No-go zone (0-100m)
 - Access permitted on foot and for farmers only (100-300m)
 - Risk zone (1km)
- Likely building damage**
5 Oct - 29 Nov 2023





Sources

Water infrastructure: Palestinian Water Authorities (2018) Municipal Wells 2017, Gaza Water Authority (2021) through OCHA oPt, Open Street Map (2023), UNICEF and WASH CLuster (2021), PAX original research of online literature and satellite imagery (2023).
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Legend

Water infrastructure

- Drinking water well
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- Natural and artificial drainage

Boundaries

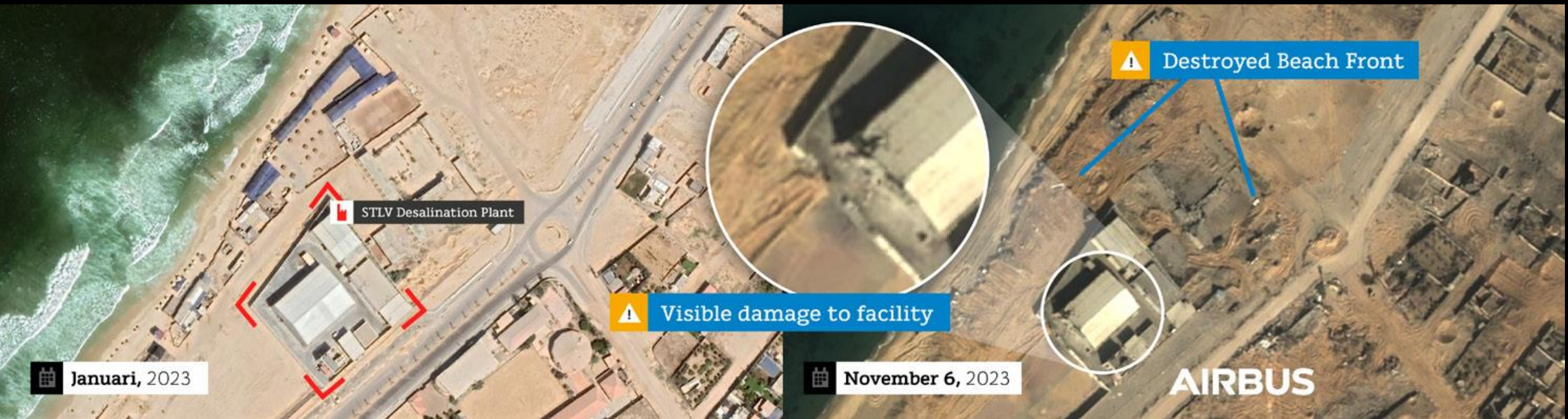
- District boundary
- Wadi Gaza protected area
- Enforced fishing limitation

Closed and restricted border area

- No-go zone (0-100m)
- Access permitted on foot and for farmers only (100-300m)
- Risk zone (1km)

Likely building damage
5 Oct - 29 Nov 2023





STLV Desalination Plant

Januari, 2023

Visible damage to facility

November 6, 2023

Destroyed Beach Front

AIRBUS



Attacks on the Wadi Gaza Wastewater Treatment Plant



Gaza Strip



Visible impact crater from bombs on solar energy field





Indirect impacts On water and health

Damage to Hazardous Facilities

Gaza Strip, Occupied Palestinian Territories



Legend

- Hazardous infrastructure**
 - Industrial facility
 - Power plant
 - Formal landfill
 - Informal waste disposal site
- Population exposure**
per 100m by 100m
 - 600 persons
 - 0 persons
 - Refugee camp
- Likely building damage**
5 Oct - 29 Nov 2023
- Boundaries**
 - District boundaries
 - Closed and restricted border areas
 - No-go zone (0-100m)
 - Access permitted on foot and for farmers only (100-300m)
 - Risk zone (1km)
 - River/stream
 - Natural and artificial drainage network
 - Main road

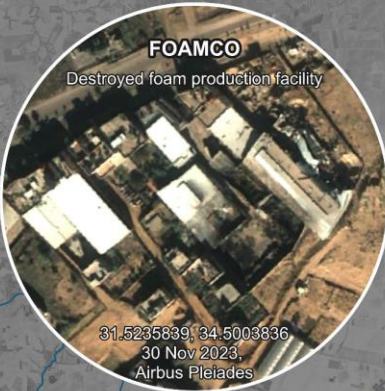
Sources

Industrial hazardous facilities, waste disposal sites, and power plants: PAX research of literature, social media and satellite imagery (2023), OCHA oPt (2014) Wharfs and refugee camps: OCHA oPt (2014) Population: EC (2023) Global Human Settlement population grid 2020 Building damage: C. Scher and J. Van Den Hoek (2023) CUNY Graduate Center and Oregon State University Waterways: Open Street Map (2023) Roads: Palestinian Ministry of Planning, JRC, OCHA (2021) Gaza borders and restricted access zones: OCHA oPt (2023) Background image: Google Satellite and Flanders Marine Institute (2019) Global Oceans and Seas



Damage to Hazardous Facilities

Gaza Strip, Occupied Palestinian Territories



Legend

- | | |
|--|--|
| Hazardous infrastructure | ■ Likely building damage
5 Oct - 29 Nov 2023 |
| ● Industrial facility | |
| ⚡ Power plant | |
| Formal landfill | |
| Informal waste disposal site | |
| Population exposure
per 100m by 100m | |
| 600 persons | |
| 0 persons | |
| Refugee camp | |
| Boundaries | |
| District boundaries | |
| Closed and restricted border areas | |
| No-go zone (0-100m) | |
| Access permitted on foot and for farmers only (100-300m) | |
| Risk zone (1km) | |
| River/stream | |
| Natural and artificial drainage network | |
| Main road | |

Sources

Industrial hazardous facilities, waste disposal sites, and power plants: PAX research of literature, social media and satellite imagery (2023), OCHA oPT (2014) Wharfs and refugee camps: OCHA oPT (2014) Population: EC (2023) Global Human Settlement population grid 2020 Building damage: C. Scher and J. Van Den Hoek (2023) CUNY Graduate Center and Oregon State University Waterways: Open Street Map (2023) Roads: Palestinian Ministry of Planning, JRC, OCHA (2021) Gaza borders and restricted access zones: OCHA oPT (2023) Background image: Google Satellite and Flanders Marine Institute (2019) Global Oceans and Seas

Fire at Al Madina Soda Plant

Gaza-City, Palestine



Damage to Agricultural Lands

Gaza Strip, Occupied Palestinian Territories

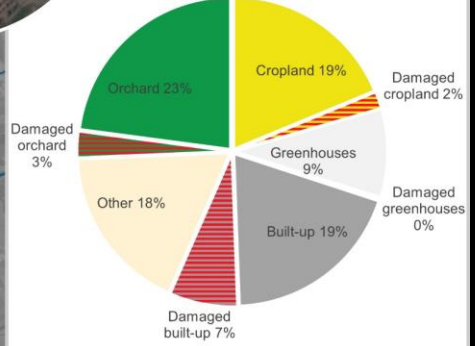


Mediterranean Sea



Likely landcover damage

7 Oct - 16 Nov 2023
Total area Gaza Strip: 365 km²

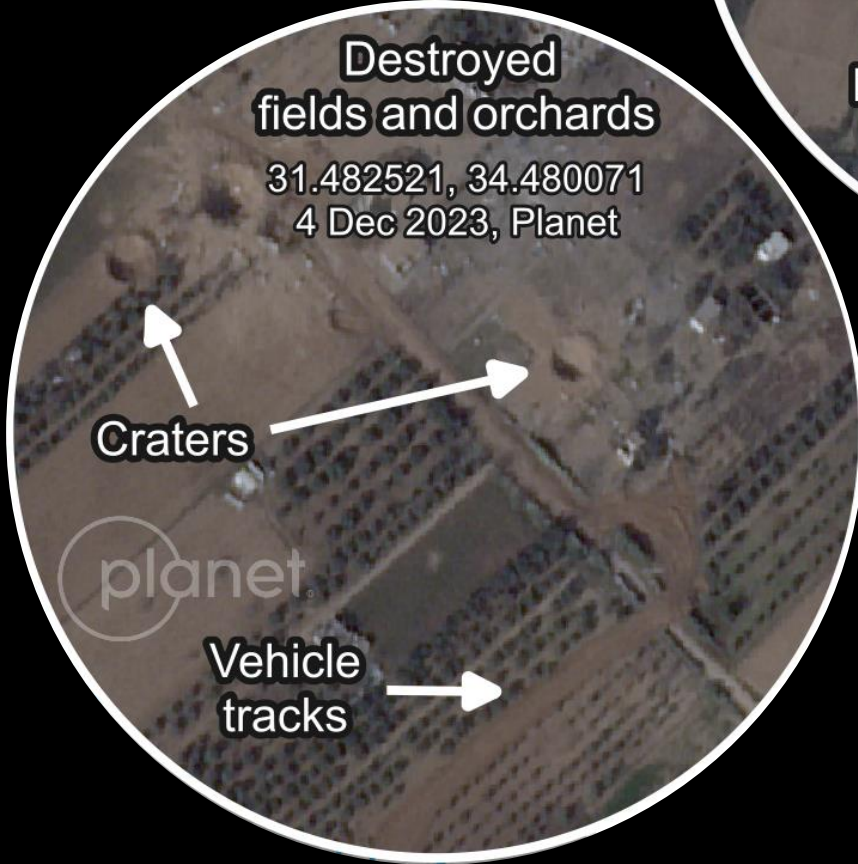


Legend

- | | |
|---|--|
| <p>Land use</p> <ul style="list-style-type: none"> ■ Cropland ■ Orchard ■ Greenhouse ■ Woody vegetation ■ Built-up: low intensity ■ Built-up: high intensity Roads ■ Barren ■ Water | <p>Likely agricultural damage 7 Oct - 16 Nov 2023</p> <ul style="list-style-type: none"> ■ Damaged orchard or damaged field ■ Damaged greenhouse <p>Boundaries and background</p> <ul style="list-style-type: none"> — River/stream --- Natural and artificial drainage network District boundaries |
|---|--|

Sources

Likely land cover and likely agricultural damage: He Yin (2023) Kent State University, based on Sentinel-1, Sentinel-2, and PlanetScope imagery between 7 October and 16 November 2023
Likely built-up damage (diagram): Jamon Van Den Hoek and Corey Scher (2023) Oregon State University, based on Sentinel-1 radar, OpenStreetMap and Microsoft building footprint data between 5 October and 22 November 2023
Waterways: Open Street Map (2023)
Gaza borders: OCHA oPt (2023)
Gaza municipality names: Gaza Housing Council (2019)
Satellite imagery inset: Planet (2023) 4 December 2023
Background image: Google Satellite and Flanders Marine Institute (2019) Global Oceans and Seas





Conclusions

Massive use of explosive weapons in populated areas and rural communities
→ massive human suffering
→ reverberating environmental risks in the short, medium and long-term
→ Health impacts
→ Jeopardizing livelihoods and ecosystems Palestinians depend on

Documenting!

→ new tools are driving decision-making more and more
→ Strengthen accountability over armed conduct

What now? – near term

Immediate and permanent ceasefire

- Adhere to the Geneva List of Principles on the Protection of Water Infrastructure
- Stop heavy explosive weapons in populated areas in the Gaza Strip

Long term

- Strengthen international regime to protect the environment in armed conflict → to protect civilians
- Post-conflict BBB (greener):
 - climate consideration in reconstruction
 - invest in clean-up, remediation and restoration
 - need full-scale environmental analysis

PAX