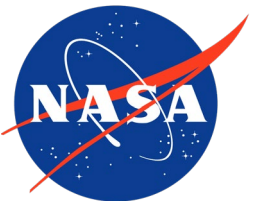


# Assessing the Impact of War on Ukraine's Agriculture from Space

Image: Planet Labs. Mykolaiv, Ukraine, May 16 2022



NASEM Round Table: Advancing Success Towards SDG2 Through Science & Technology. July 13, 2023

# NASA Harvest Ukraine Rapid Assessment Team



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# NASA HARVEST

NASA'S GLOBAL FOOD SECURITY AND AGRICULTURE PROGRAM



**Mission:** to advance adoption of satellite **Earth observations** by public & private organizations to benefit **food security, sustainability & agriculture, worldwide**



For more info: [www.nasaharvest.org](http://www.nasaharvest.org)  
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# Partnership with the Ministry of Agrarian Policy & Food of Ukraine

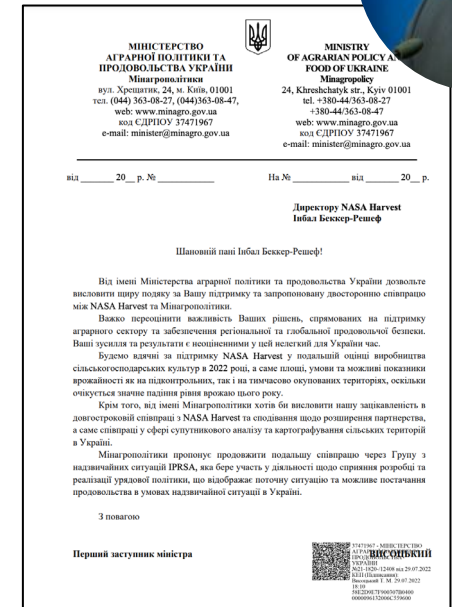


Міністерство  
аграрної політики та  
продовольства України

First Deputy  
Minister T.  
Vysotskyi

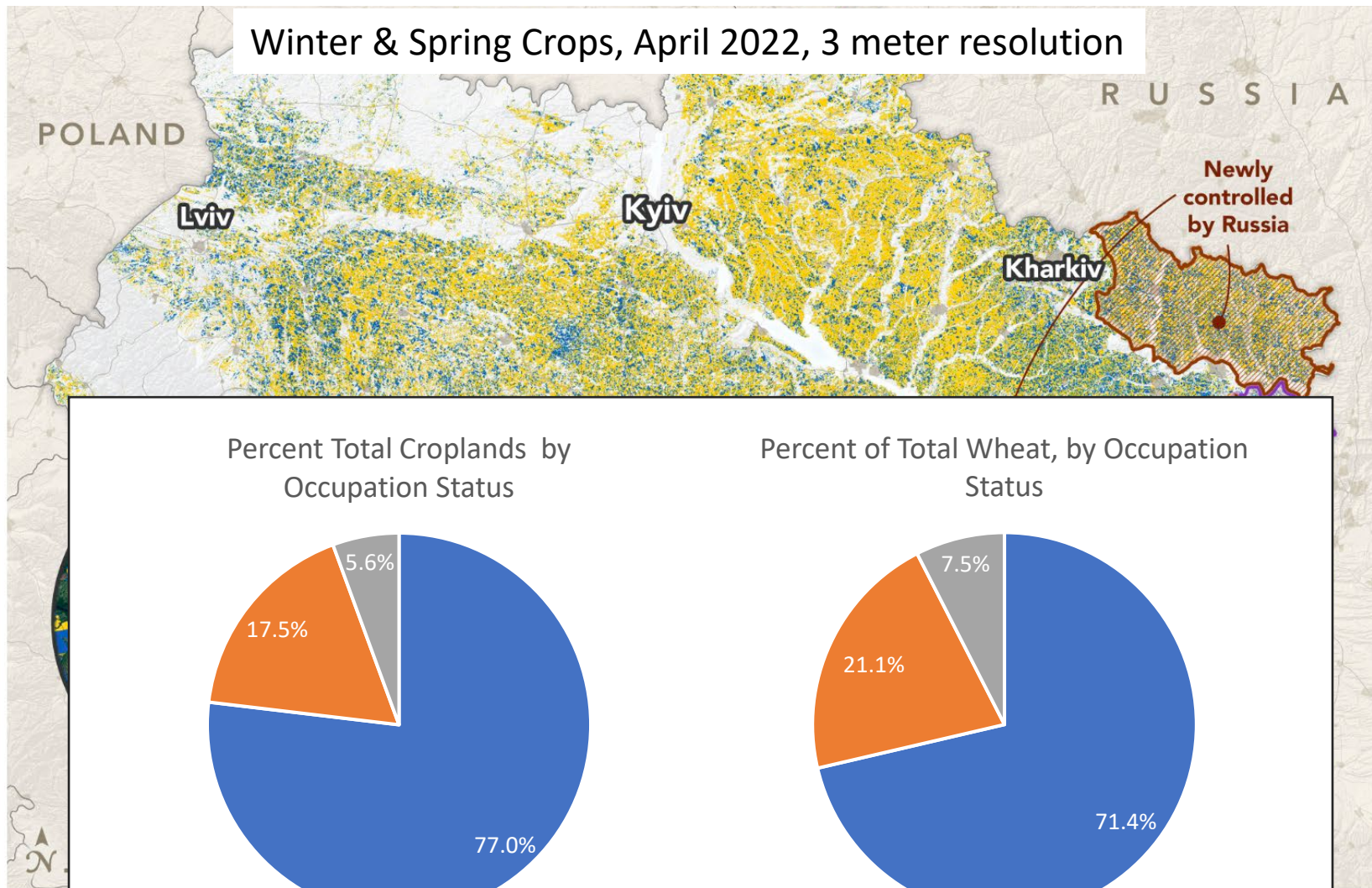
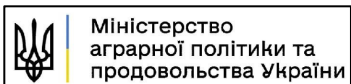


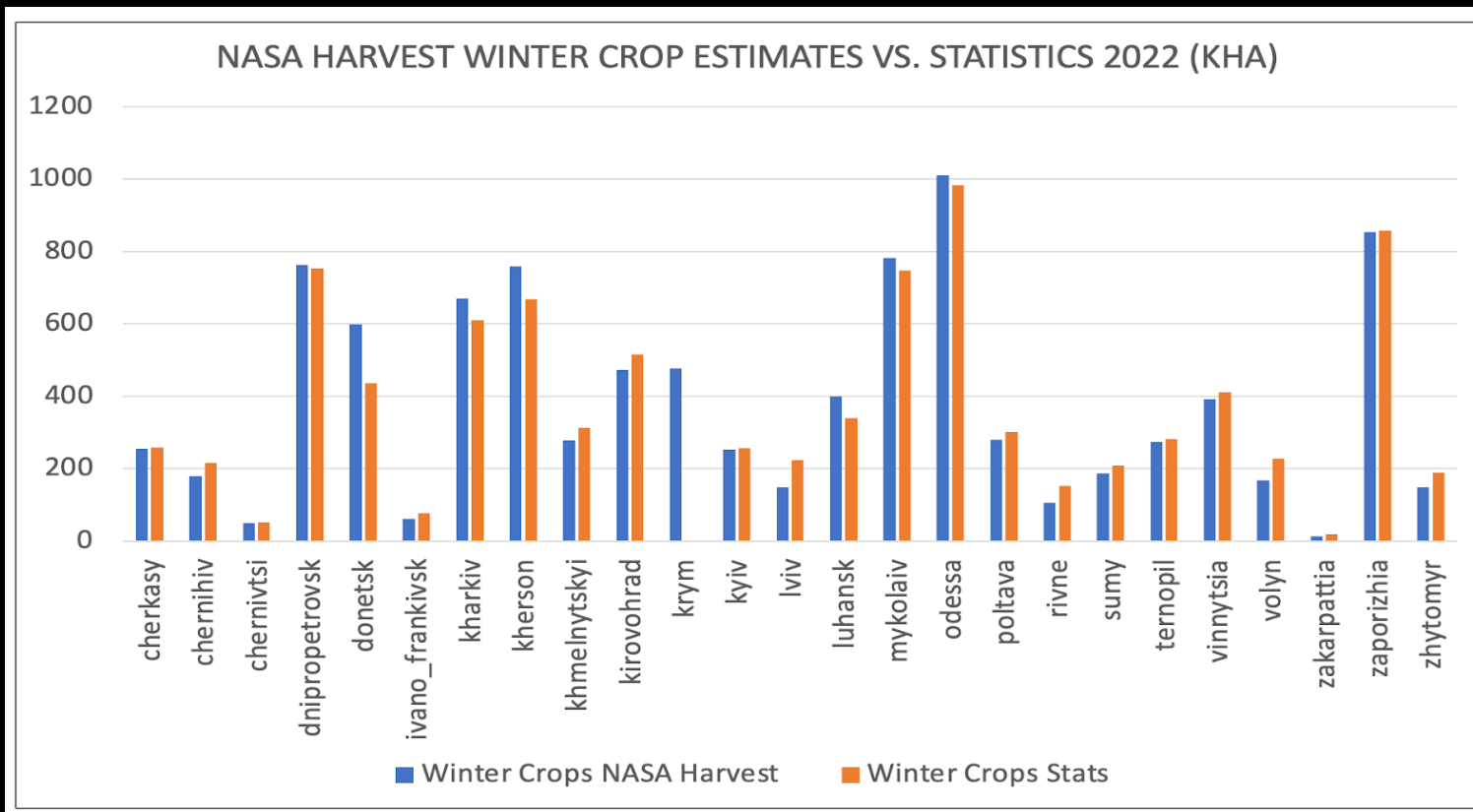
- Builds on longstanding cooperation with various entities in Ukraine including Ministry, Hydromet Center, Kyiv Polytechnic University & USDA FAS attache in Kyiv.
- Short term focus: estimating impact of war on agriculture, particularly within the occupied territories where ground data is not available
- Longer term: boost capacity at the Ministry for use of satellite data in agricultural assessments





# Proportion of cropland under Russian Occupation?





Winter-crop planted  
area estimate  
comparison by Oblast

- NASA Harvest planted area (excluding Crimea): 9.2 Mha  
vs.
- Official planted area estimate (excluding Crimea): 9.1 MHa

Assumption was that  
30% of  
spring/summer crops  
would not be planted  
and similar amounts  
of wheat would be  
left unharvested

## Column: Concerns rise over Black Sea spring crops amid Russia-Ukraine war

By Karen Braun



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# The Guardian

## Ukraine's harvest could be halved this year due to Russian invasion, warns Zelenskiy

President's comments likely to intensify fears of worldwide grain shortage and global hunger

● [Russia-Ukraine war: latest updates](#)



FINANCIAL TIMES

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## Ukraine warns of big cuts to wheat harvest if Russian blockade continues

Black Sea export route key to farmers' 'financial cycle' and easing of global food crisis, says agriculture minister



Ukrainian farmers have struggled with a lack of manpower and trucks, unexploded munitions and mines in their fields © Smoliyenko Dmytro/Ukrinform/ABACA/Reuters



Ben Hall in Kyiv JULY 19 2022

133

**Bloomberg**

Markets

## Half of Harvests in Crop Giant Ukraine Could Be Wiped Out by War

- Conflict, lack of fuel and fertilizers are hindering plantings
- That threatens bigger global shortages and higher food prices

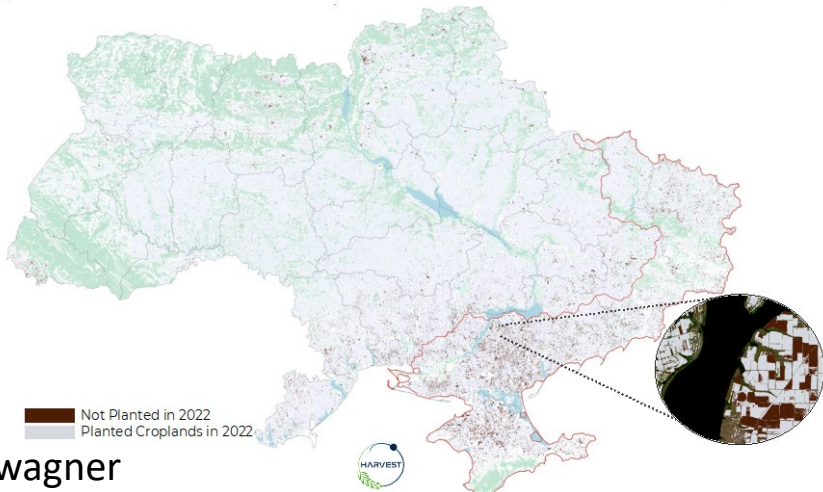
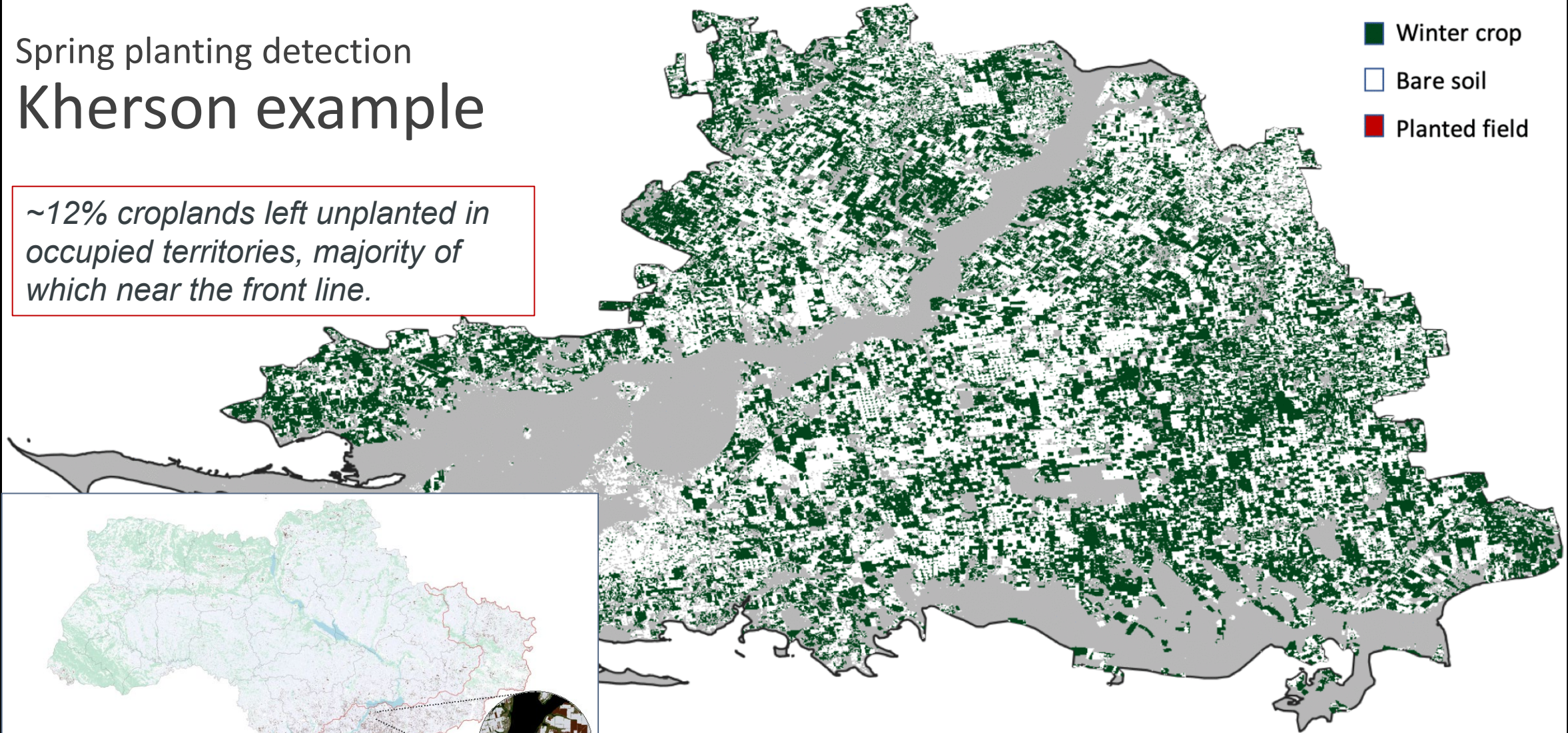


Spring planting detection

# Kherson example

*~12% croplands left unplanted in occupied territories, majority of which near the front line.*

- Non-crop area
- Winter crop
- Bare soil
- Planted field

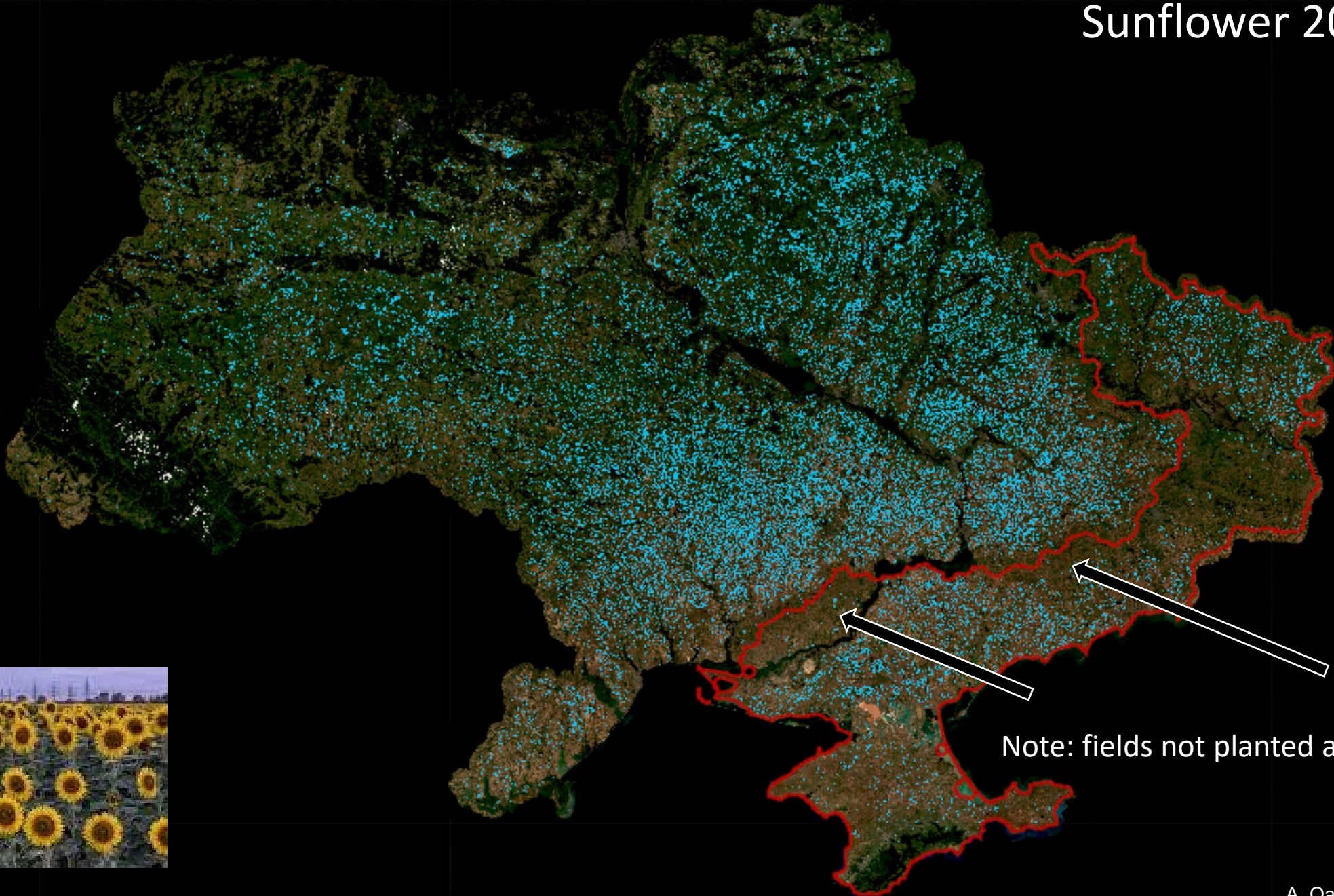


J. wagner

M. Hosseini, S. Khabbazan et al.



# Sunflower 2022



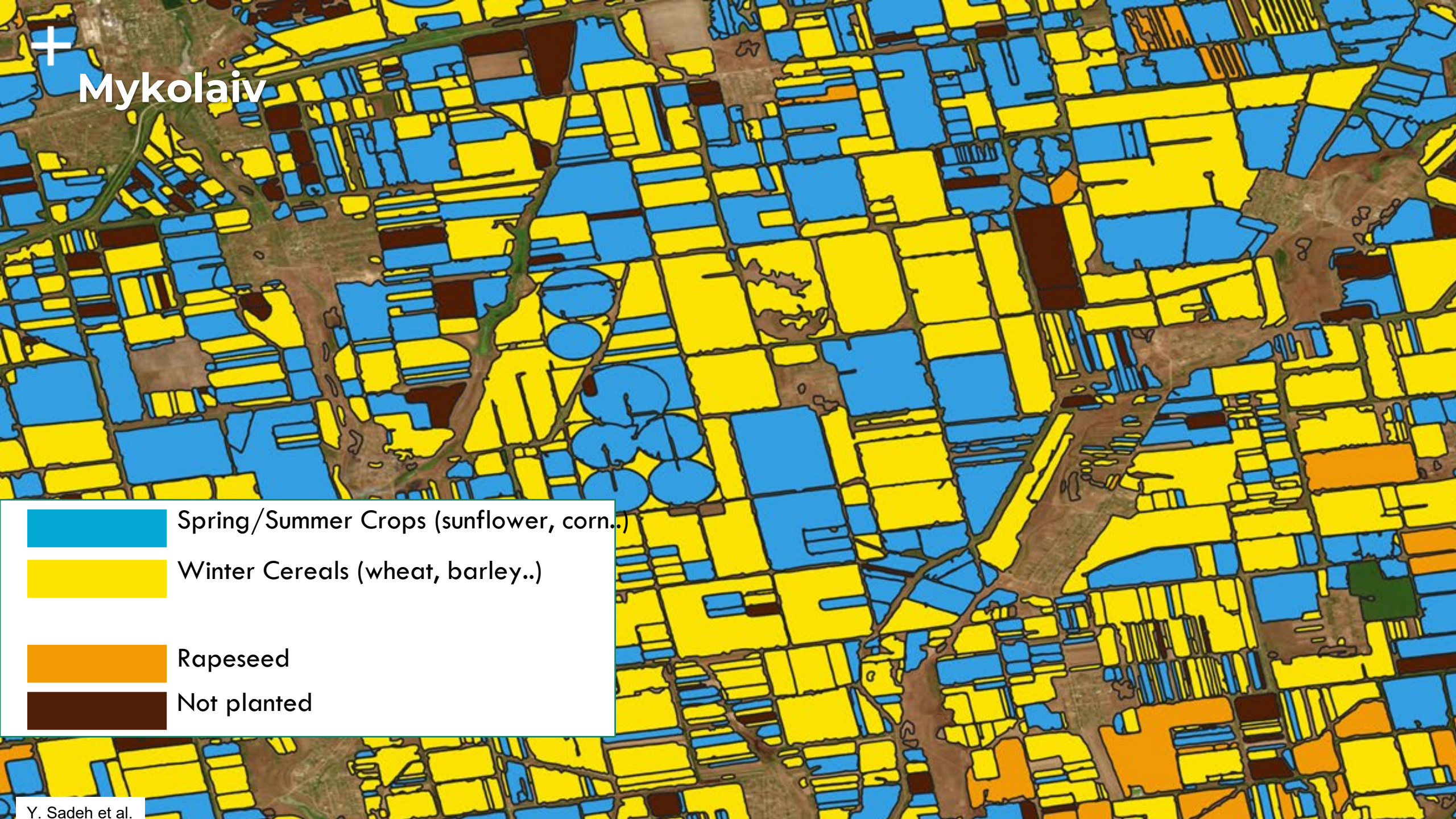
Note: fields not planted along front line!



A. Qadir et al.



Mykolaiv



Spring/Summer Crops (sunflower, corn..)



Winter Cereals (wheat, barley..)



Rapeseed



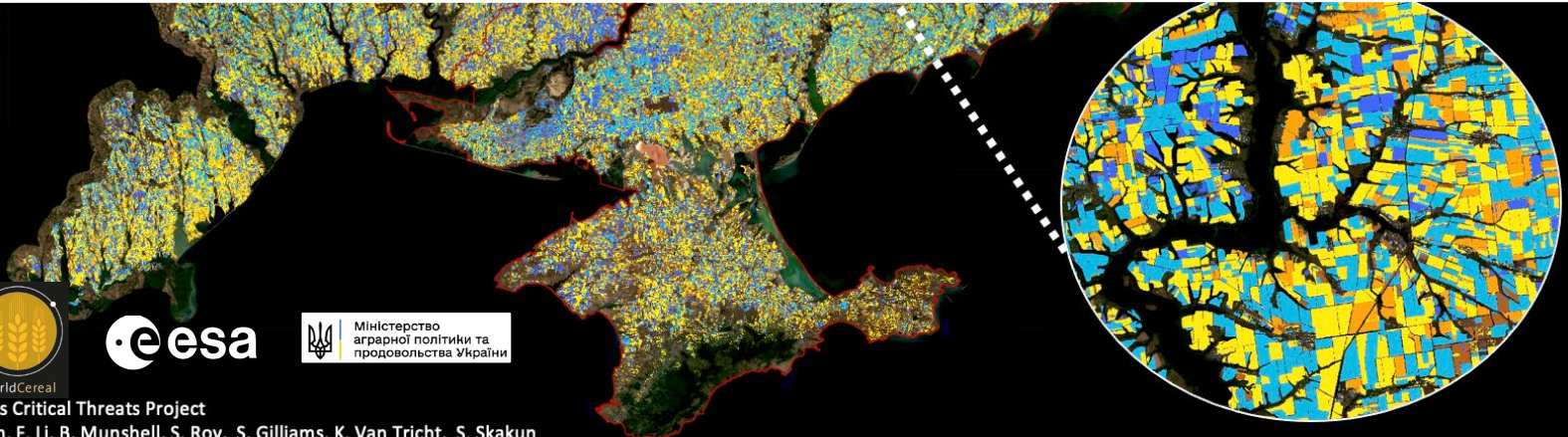
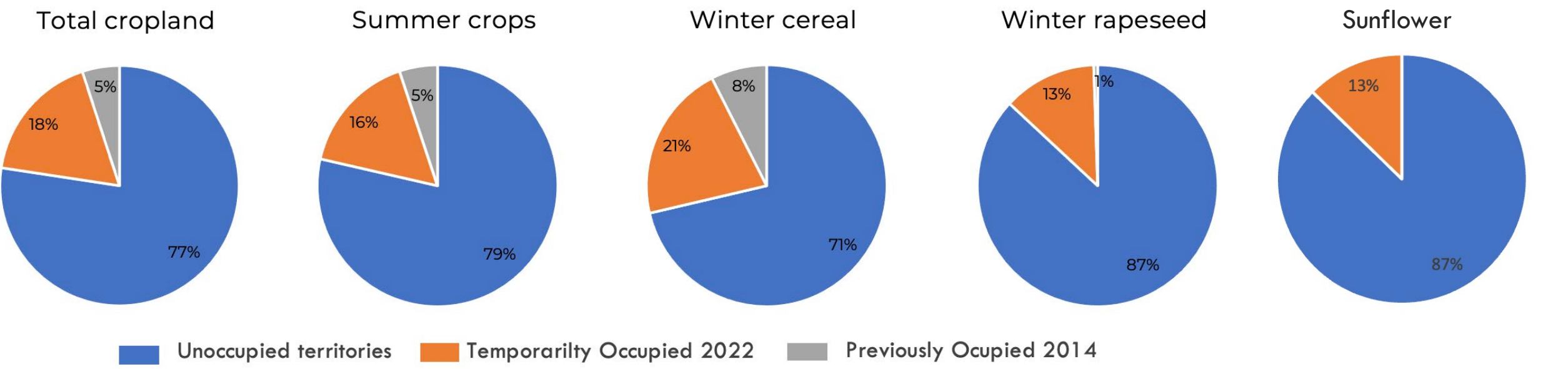
Not planted

# 2022 Crop Type Classification, 3 meter Resolution (Produced in season)



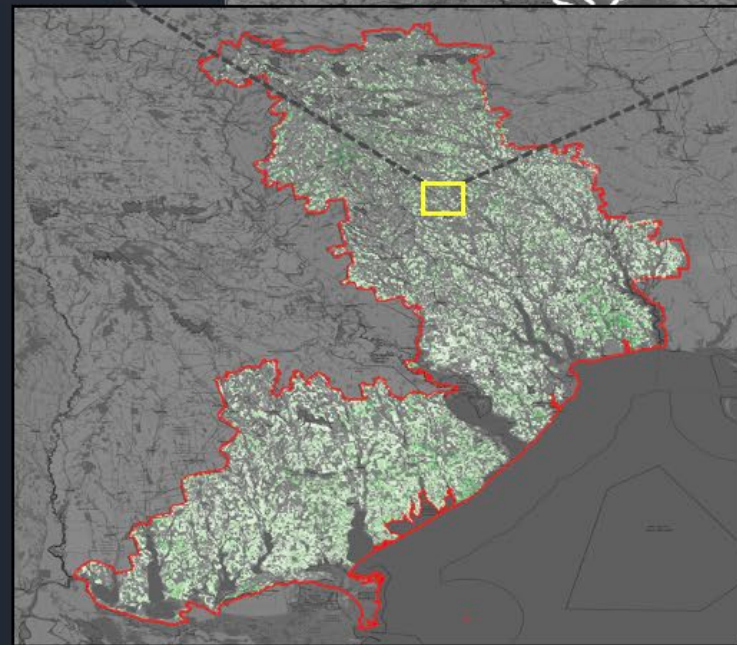
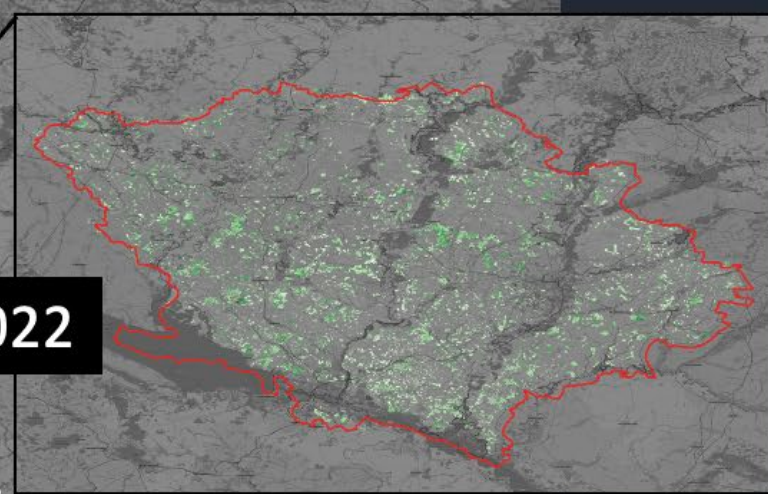
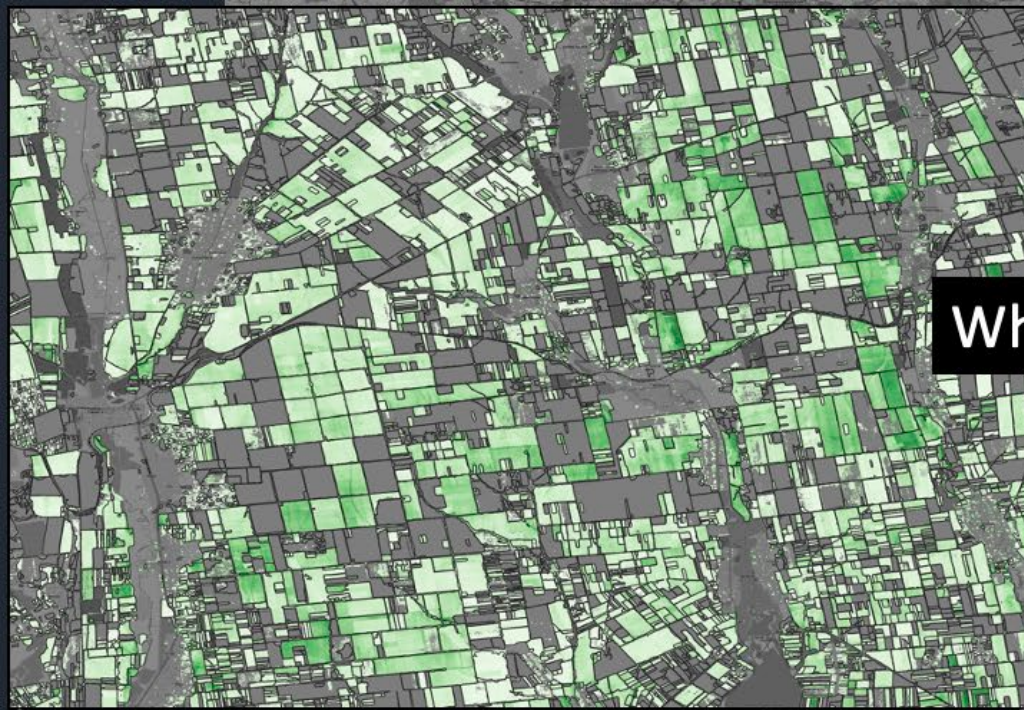
## Ukraine Crop Proportions By Occupation Status

(As of July 11, 2022)

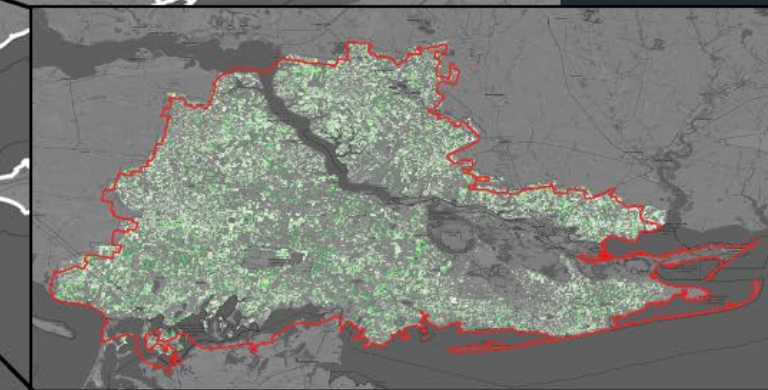


**Reported Yield = 4.4 Mt/Ha**  
**Estimated Yield = 4.6 Mt/Ha**

**Wheat Yield Forecast Model: 2022**



**Reported Yield = 2.6 Mt/Ha**  
**Estimated Yield = 2.9 Mt/Ha**



**Estimated Yield = 3.1 Mt/Ha**

# How do Harvested Fields Appear in Satellite Images?

2022-03-30:  
Winter crop in  
“green”

2022-06-03:  
Good conditions  
early summer

2022-07-03:  
Senescence

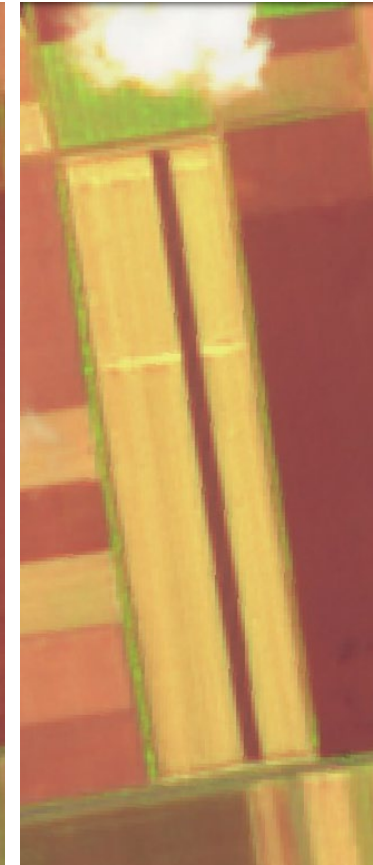
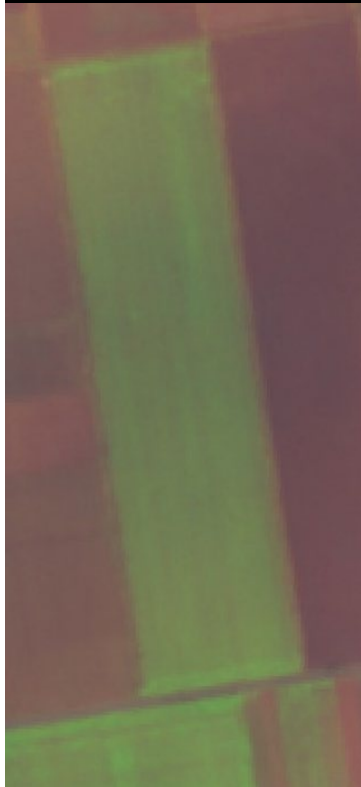
2022-07-15:  
Start of harvest.  
Crop residue in  
“yellow”

2022-07-18:  
Harvest complete

2022-07-23:  
Start of tilling

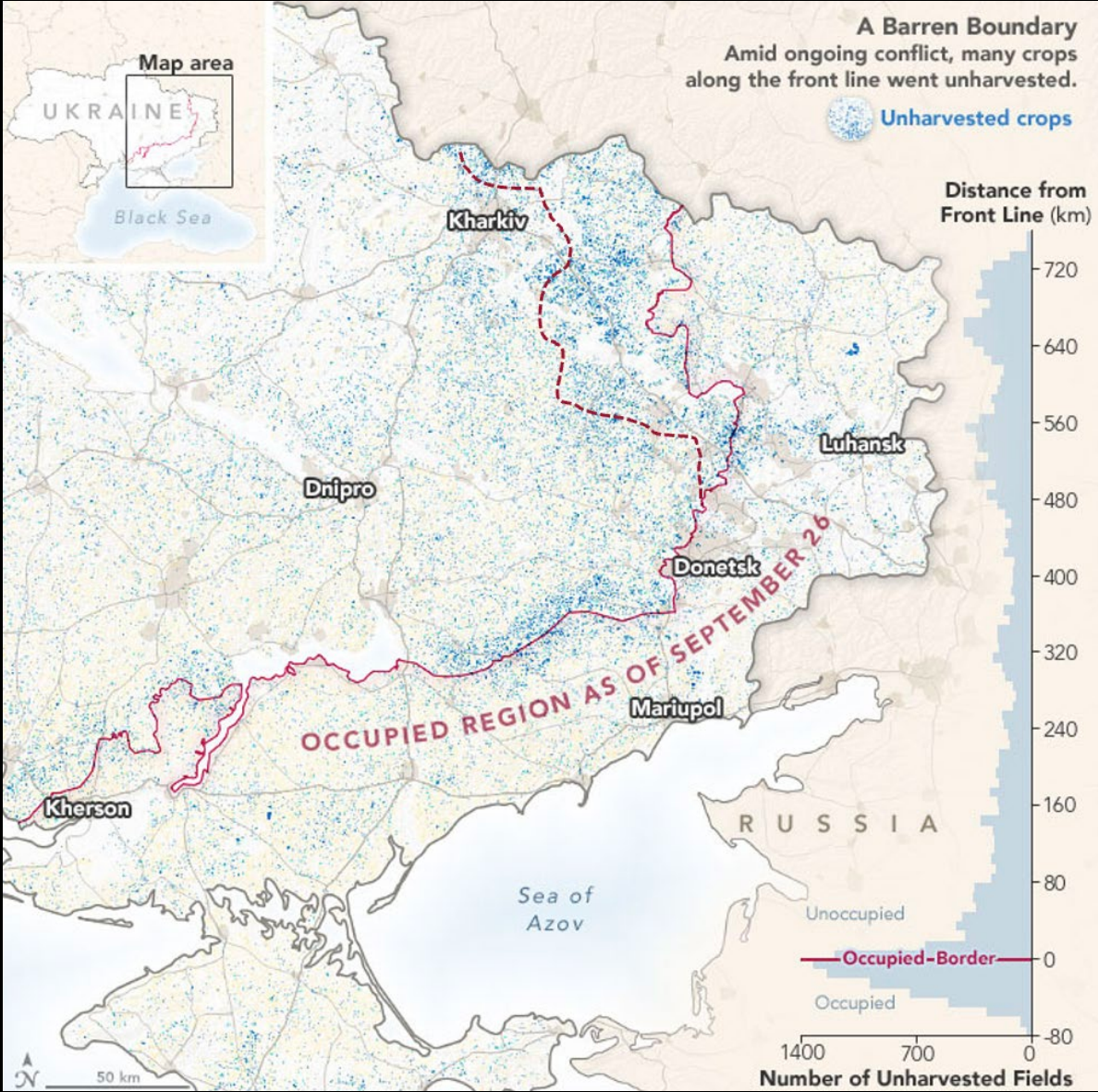
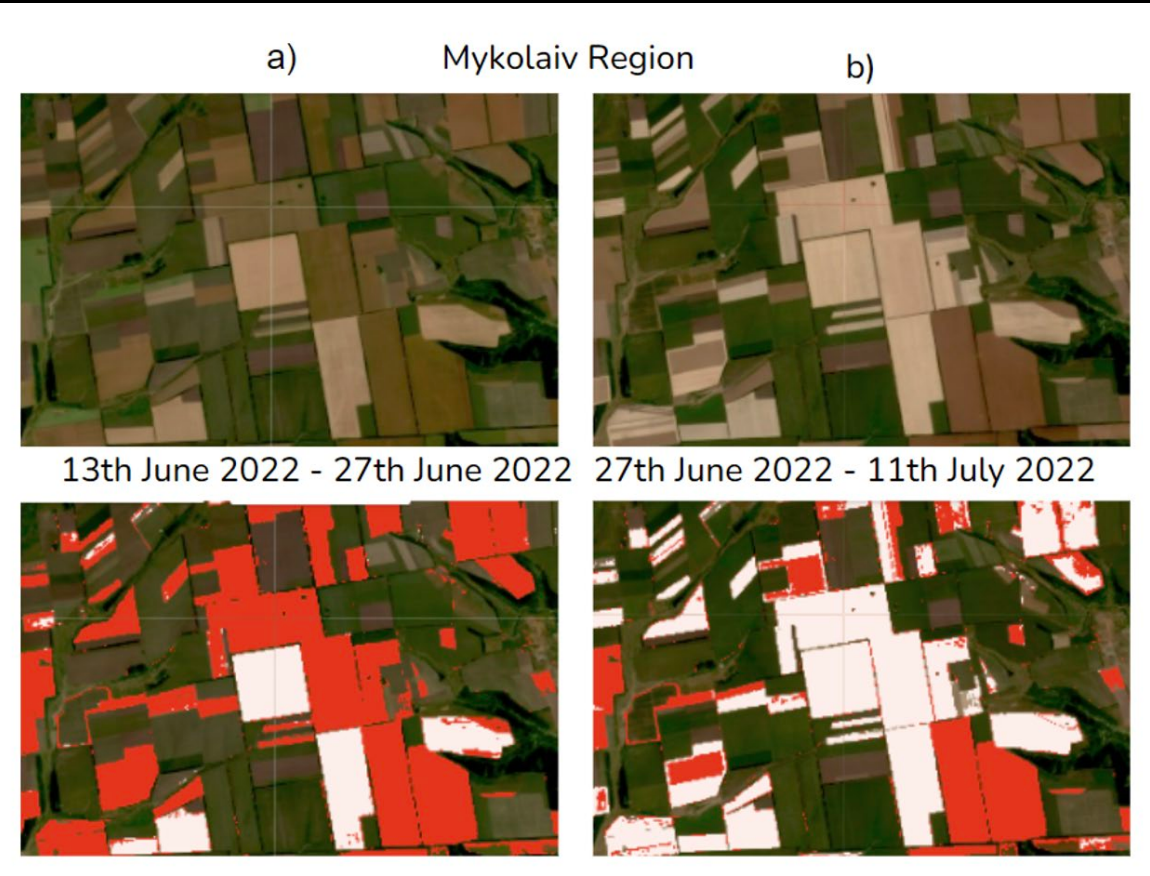
2022-07-30:  
Tilling  
complete

Field, south of Nyzhni Sirogozy, Kherson oblast → Harvested



  
300 meters

# Monitoring Winter Crop Harvest Progress



# Even Some Shelled Fields Were Harvested

June 1 : Green & field  
shelled

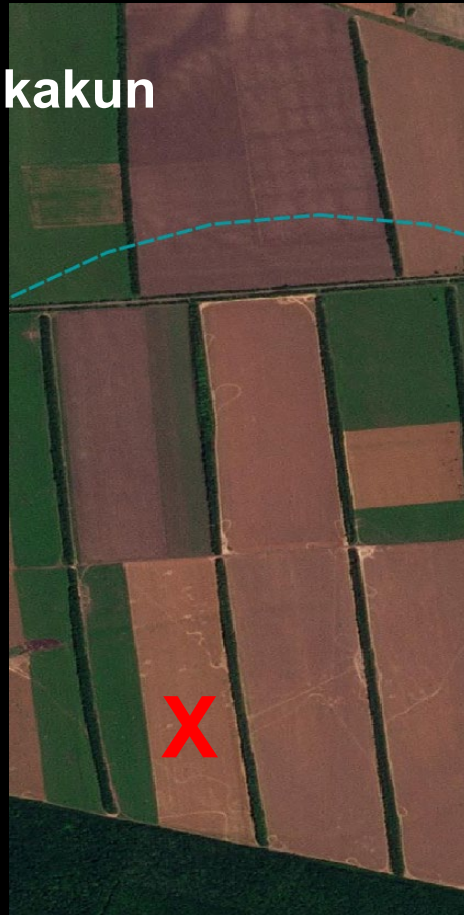
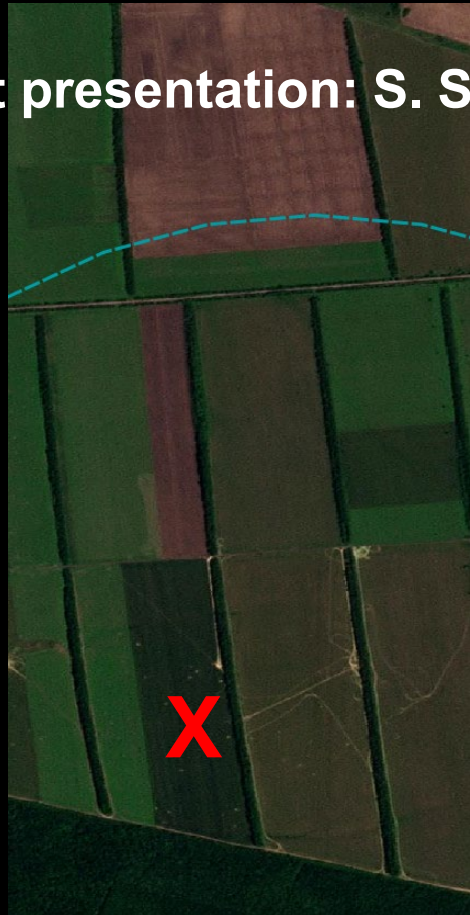
June 4th: vehicle tracks  
Still green

July 2nd: senence

July 29th : ready to harvest

August 9th : harvested

More on this in next presentation: S. Skakun



# NASA Harvest Wheat Production Estimates

**2022 Production *much higher than expected, largely due to higher harvested area***

*~22% of Ukraine's wheat was harvested in occupied territories. This translates to > a billion \$ harvested in Russian controlled territories. Losses are much higher when accounting for destroyed machinery, grain elevators, burned fields & other damage caused by the war*

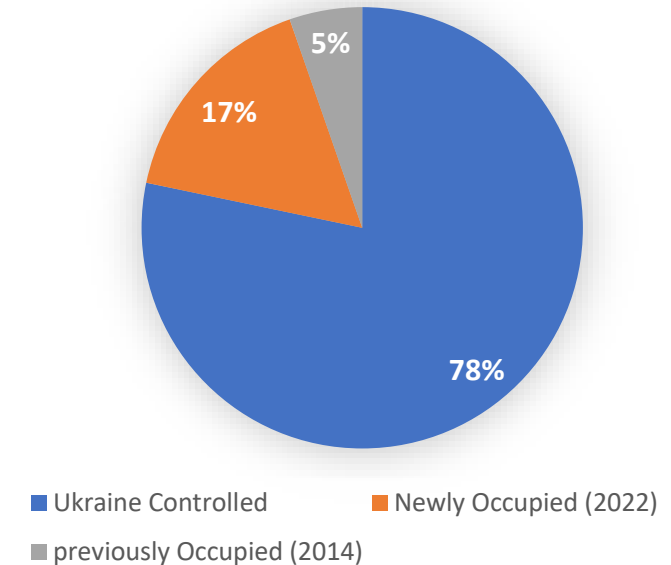
**NASA Harvest Wheat 2022 Estimates**

| Territory          | Production | Yield | Area harvested | Area Planted |
|--------------------|------------|-------|----------------|--------------|
| All Ukraine        | 26.6       | 3.98  | 6.74           | 7.20         |
| Ukraine Controlled | 20.8       | 4.08  | 5.14           | 5.40         |
| total occupied     | 5.8        | 3.66  | 1.60           | 1.80         |

**Comparison with leading wheat estimates**

|                        | NASA Harvest | USDA | FAO  | IGC  |
|------------------------|--------------|------|------|------|
| Production All Ukraine | 26.6         | 20.5 | 20.0 | 21.5 |
| Area Harvested         | 6.74         | 5.25 |      |      |

**Percent Wheat Production by Occupation Status  
(September 26<sup>th</sup>)**

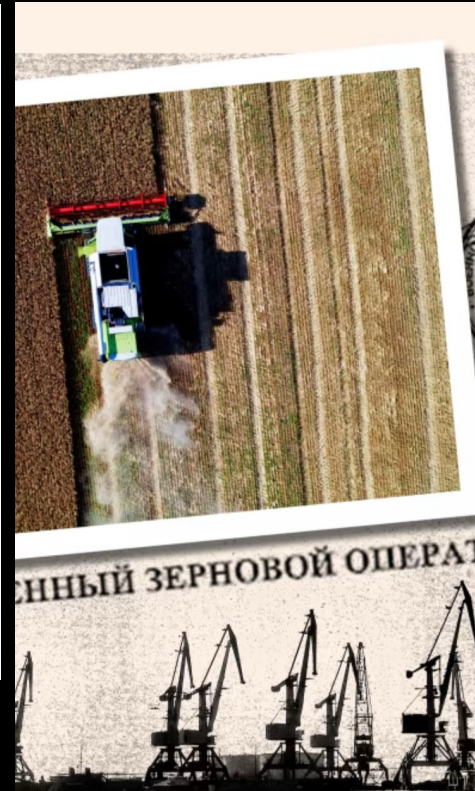


- Area based on satellite driven planted area & harvested estimates
- Yield based on on official harvested yields & NASA Harvest ARYA model where data was not available (in the occupied territories)



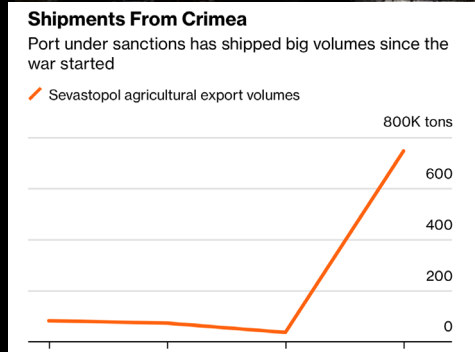
# Where did the 22% (5.8MT) end up & who reaps the economic benefit ?

Azov before picking up the commodity in Sevastopol, as Amur 2501 does on its trips.



Photographer: Chris McGrath/Getty Images

## How Russian Ships Are Laundering Grain Stolen From Occupied Ukraine



FINANCIAL TIMES

The Big Read War in Ukraine + Add to myFT

### How Russia secretly takes grain from occupied Ukraine

Documents and photos reveal a complex shadow operation managed by private companies and arms of the Russian state

*While satellites can provide a lot of critical information, they cannot determine who is harvesting the fields, who is purchasing the grain, where it is stored, or exported to*

# NASA Harvest 2023 Wheat Estimates, June

*Overall estimate is close to 2022 though planted area is lower relative to 2022, and yields are higher*

| Wheat Production (MMT) based on Planted area | Total Occupied | Ukraine Controlled | Total Ukraine |
|----------------------------------------------|----------------|--------------------|---------------|
| Upper Bound                                  | 4.39           | 22.08              | 26.48         |
| Lower Bound                                  | 4.13           | 20.77              | 24.91         |

| Wheat Planted Area M Ha | Total Occupied | Ukraine Controlled | Total |
|-------------------------|----------------|--------------------|-------|
| Upper Bound             | 1.33           | 4.87               | 6.20  |
| Lower Bound             | 1.25           | 4.58               | 5.83  |

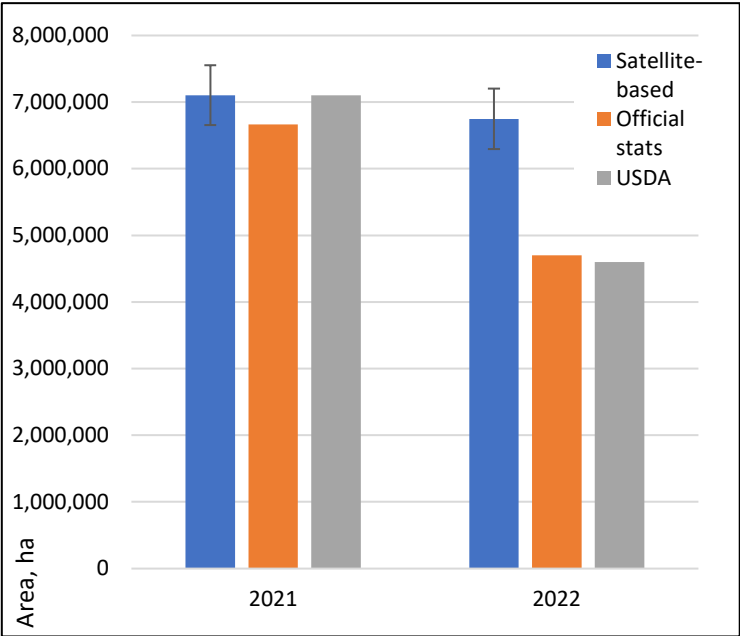
| Wheat Yield | Total Occupied | Ukraine Controlled | Total |
|-------------|----------------|--------------------|-------|
|             | 3.3            | 4.53               | 4.27  |

Wheat in Mykolaiv,  
June 2023



# Sunflower Planted Area & Production Estimates 2022

- NASA Harvest planted area estimate 6.75 Ukraine, & 5.87 Mha Ukraine held territories
  - higher than official stats and USDA
- Decline between 2021 and 2022 of 0.35 Mha primarily from occupied territories
- NASA Harvest yield: 2.38 Mt/Ha
- Total production 16MT for all of Ukraine’s territories, **with about 10% of production coming from Russian occupied areas**



NASA Harvest Sunflower Area Estimates  
2021 vs. 2022

| Sunflower Planted Area Estimates | Ukraine Controlled Territories | Occupied Territories | All Ukraine |
|----------------------------------|--------------------------------|----------------------|-------------|
| Sunflower 2021                   | 5.90                           | 1.20                 | 7.10        |
| Sunflower 2022                   | 5.87                           | 0.85                 | 6.75        |
| Difference 2022-2021             | -0.03                          | -0.35                | -0.35       |



# Khakovka Dam Collapse Assessment

June 6, 2023

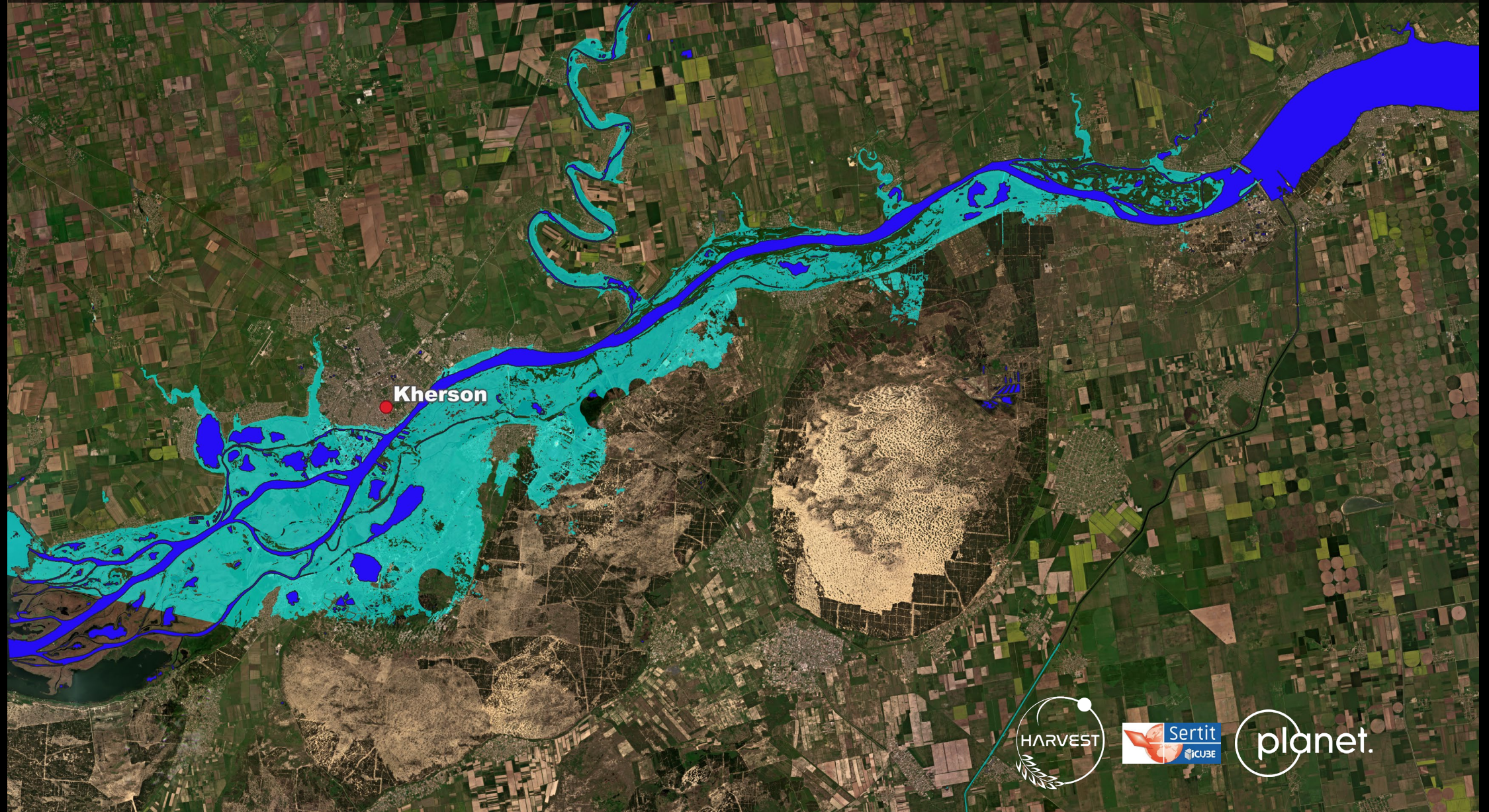
 Khakovka Dam

Image: Planet Scope May, 2023



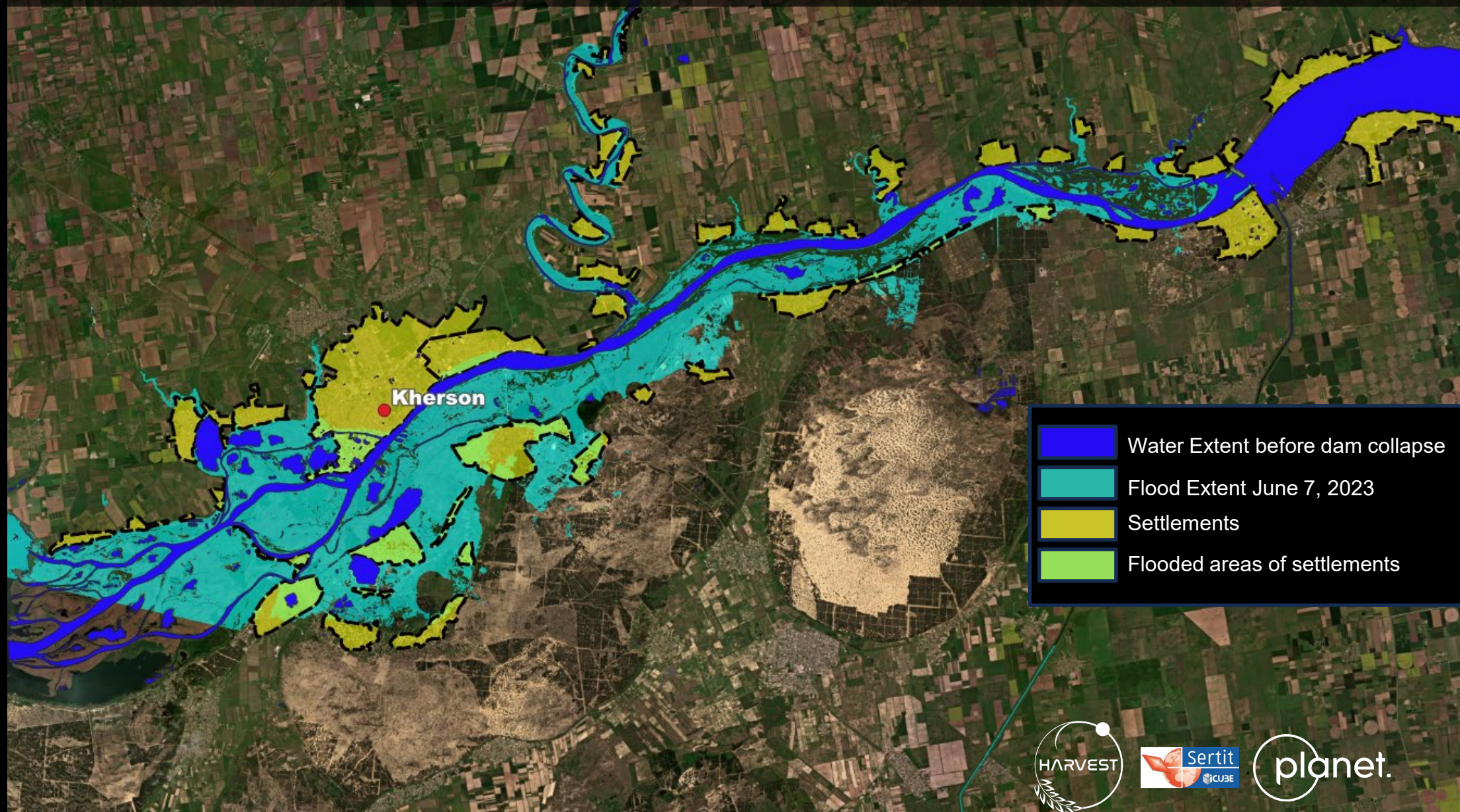
# Flooding Extent (produced on June 8<sup>th</sup>)

Based on 3m Planet Imagery



# Flooding Extent Including Impacted Settlements

Based on 3m Planet Imagery



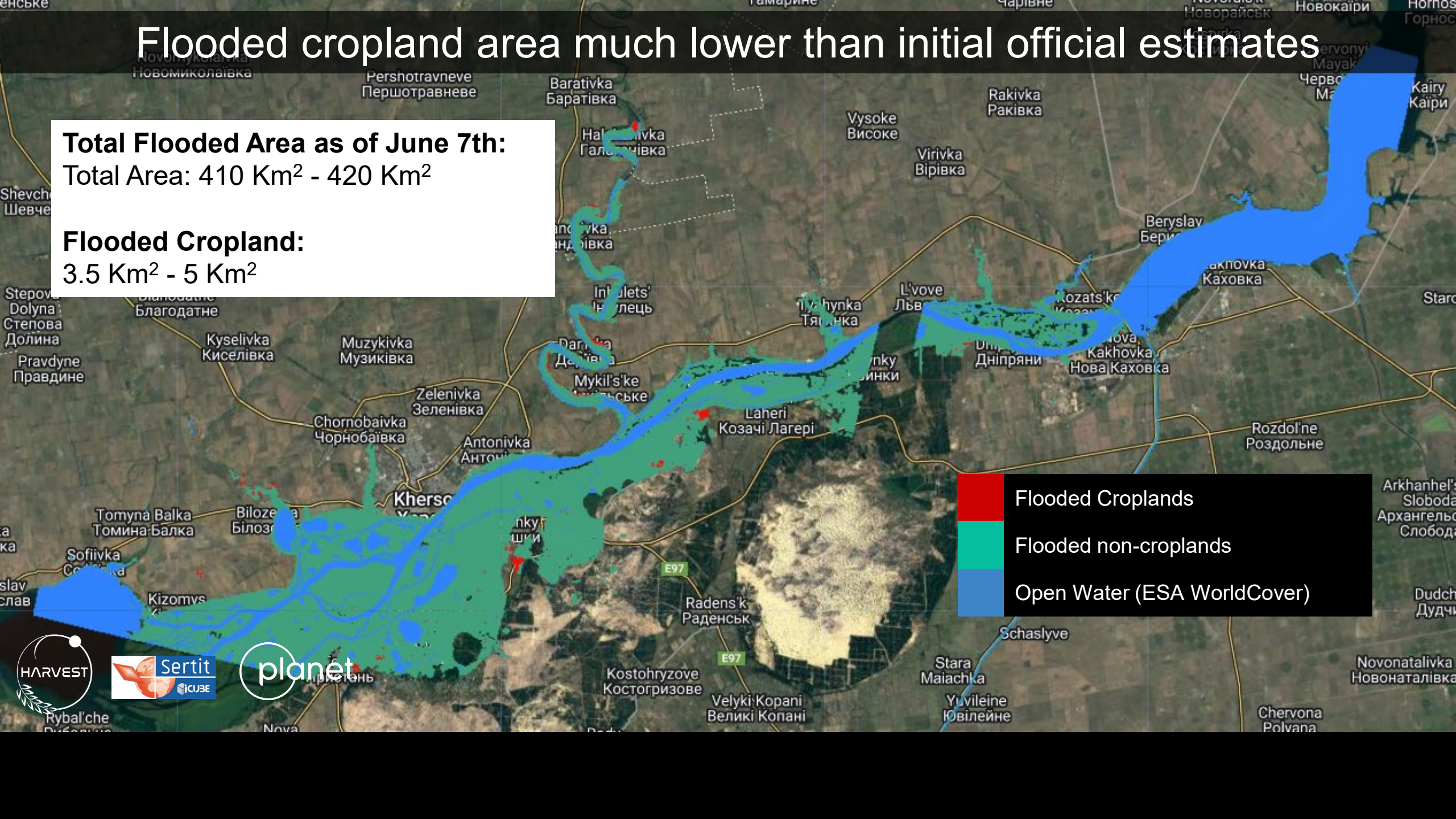
# Flooded cropland area much lower than initial official estimates

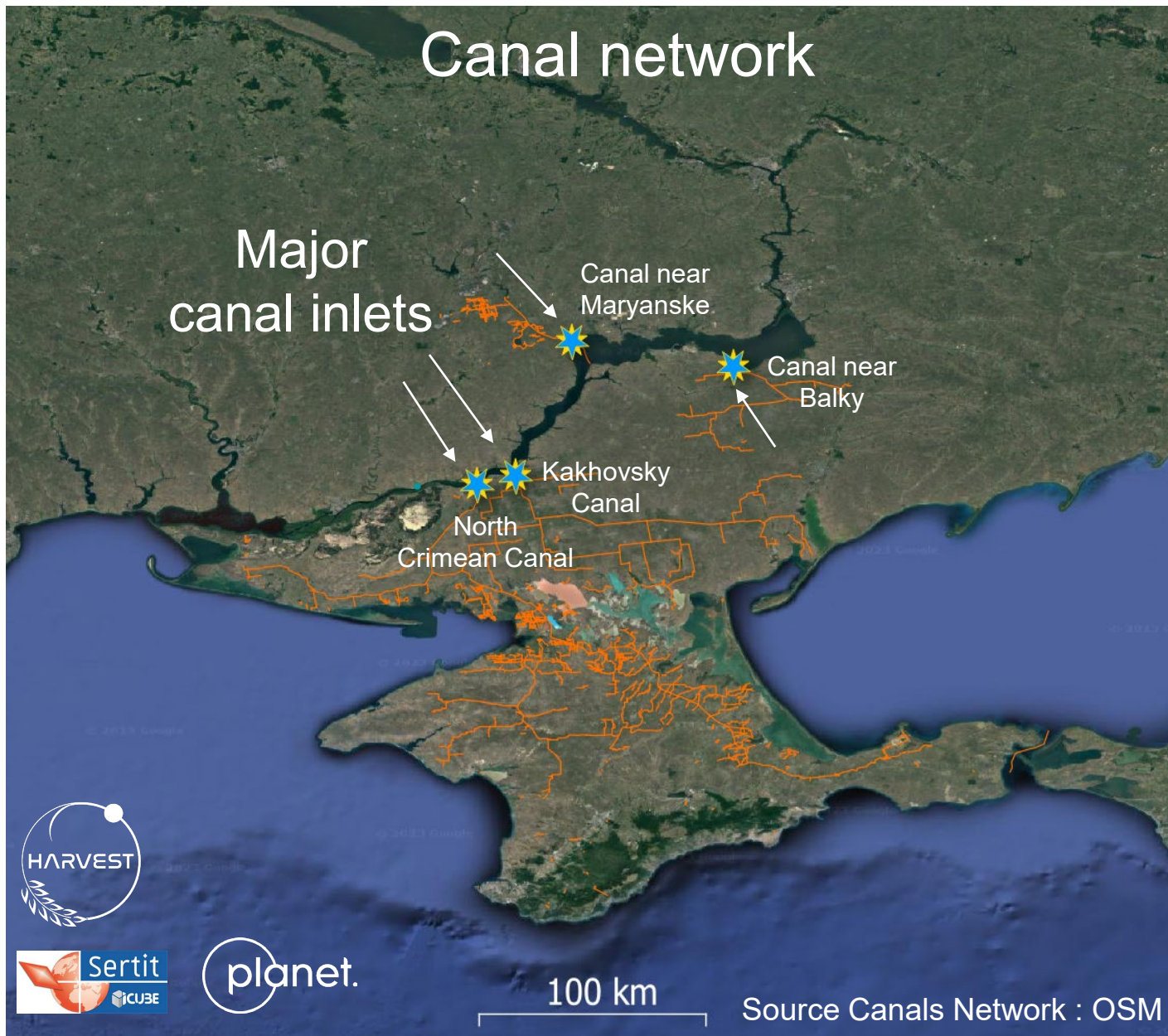
**Total Flooded Area as of June 7th:**

Total Area: 410 Km<sup>2</sup> - 420 Km<sup>2</sup>

**Flooded Cropland:**

3.5 Km<sup>2</sup> - 5 Km<sup>2</sup>





The big issue for agriculture is water for irrigation!

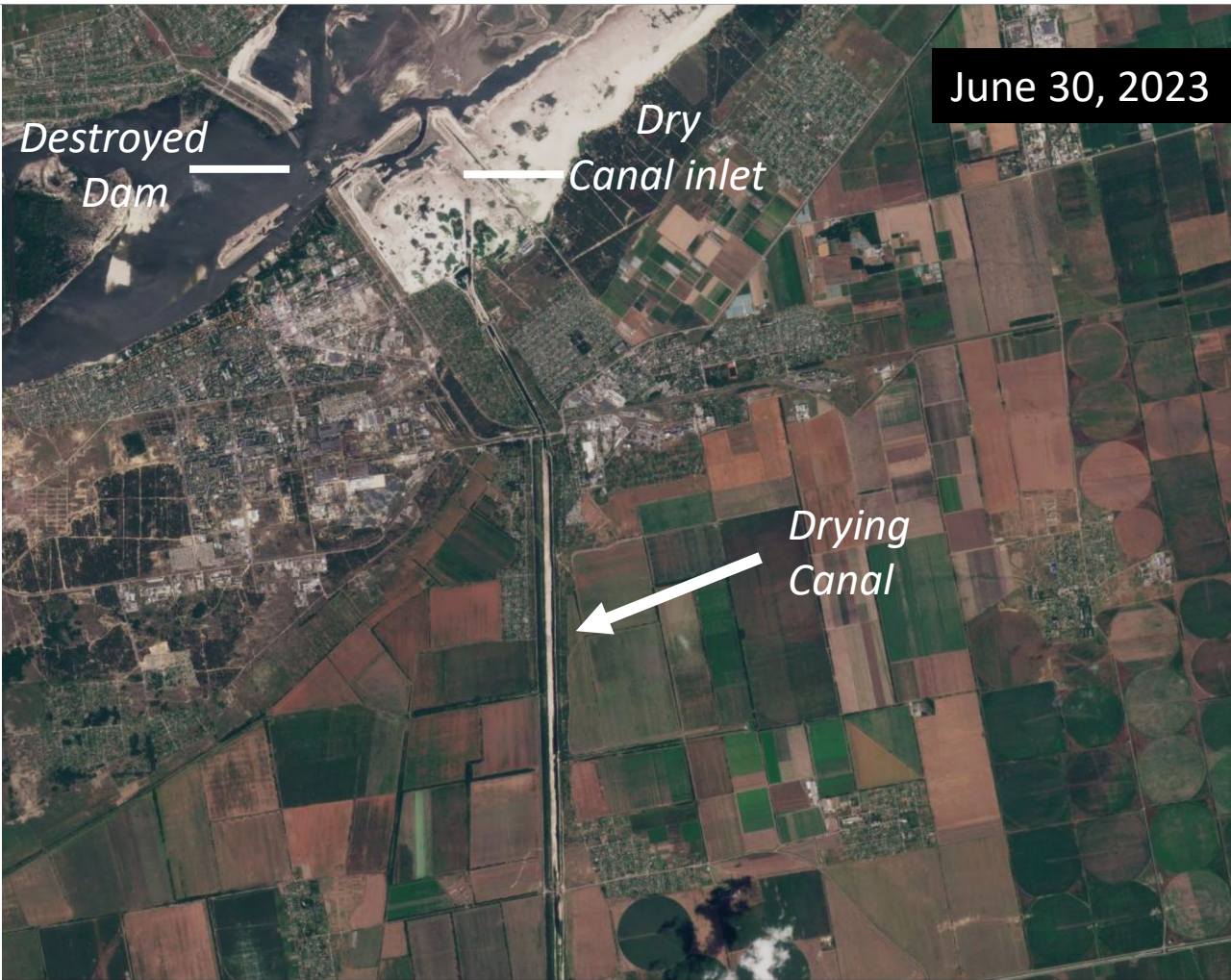
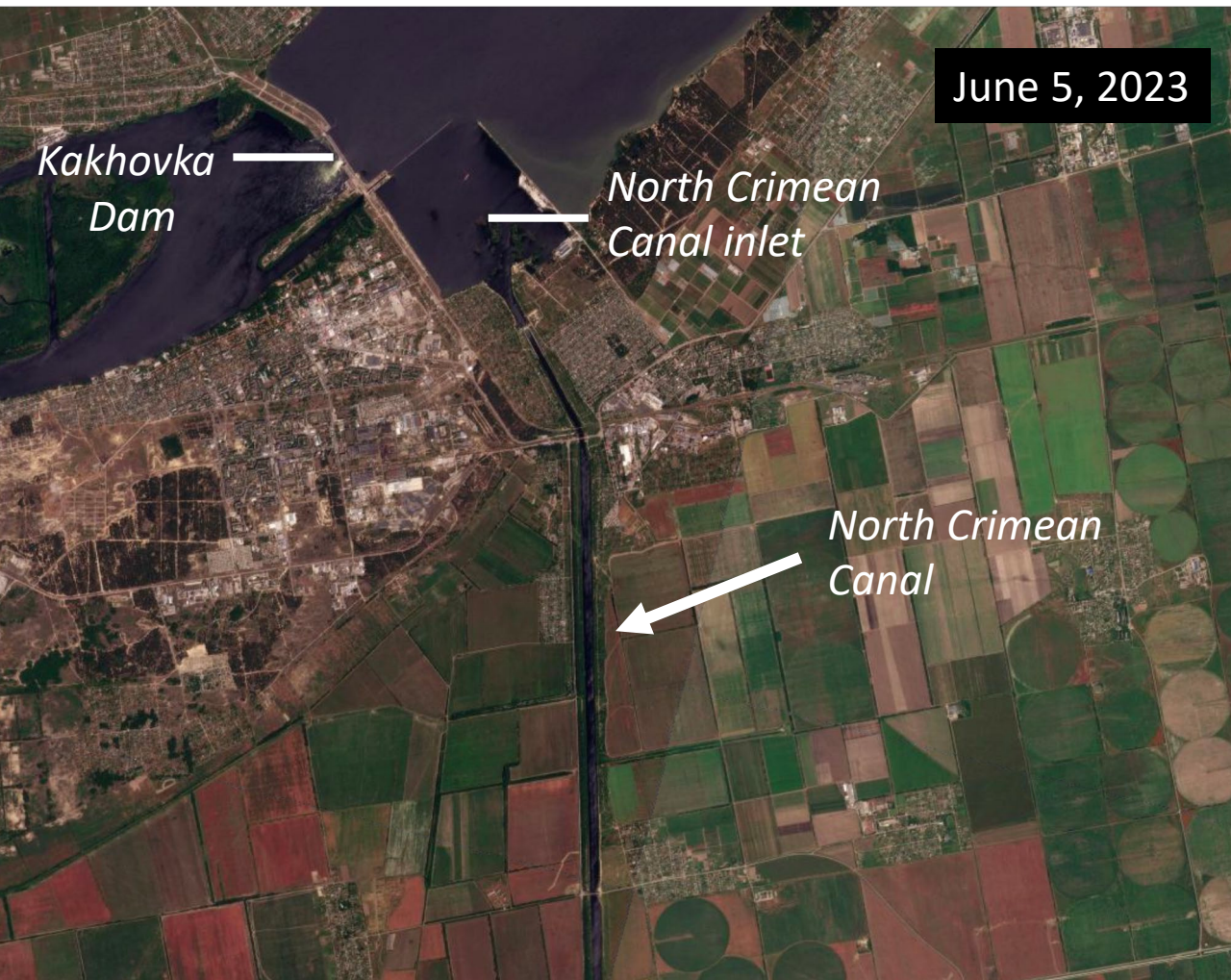
- 4 major irrigation canal inlets
- **All are disconnected**
- Major **implications for irrigated agriculture**, specifically summer planted crops as well as for drinking water
- The reservoir supplied water to more than 12,000 kilometers of canals and potentially **irrigates > 500,000 hectares** of croplands in Kherson, Zaporozhye and Dnepropetrovsk regions

# Draining of the Reservoir: Receding Water Line

Major concern for drinking water,  
industry and irrigation



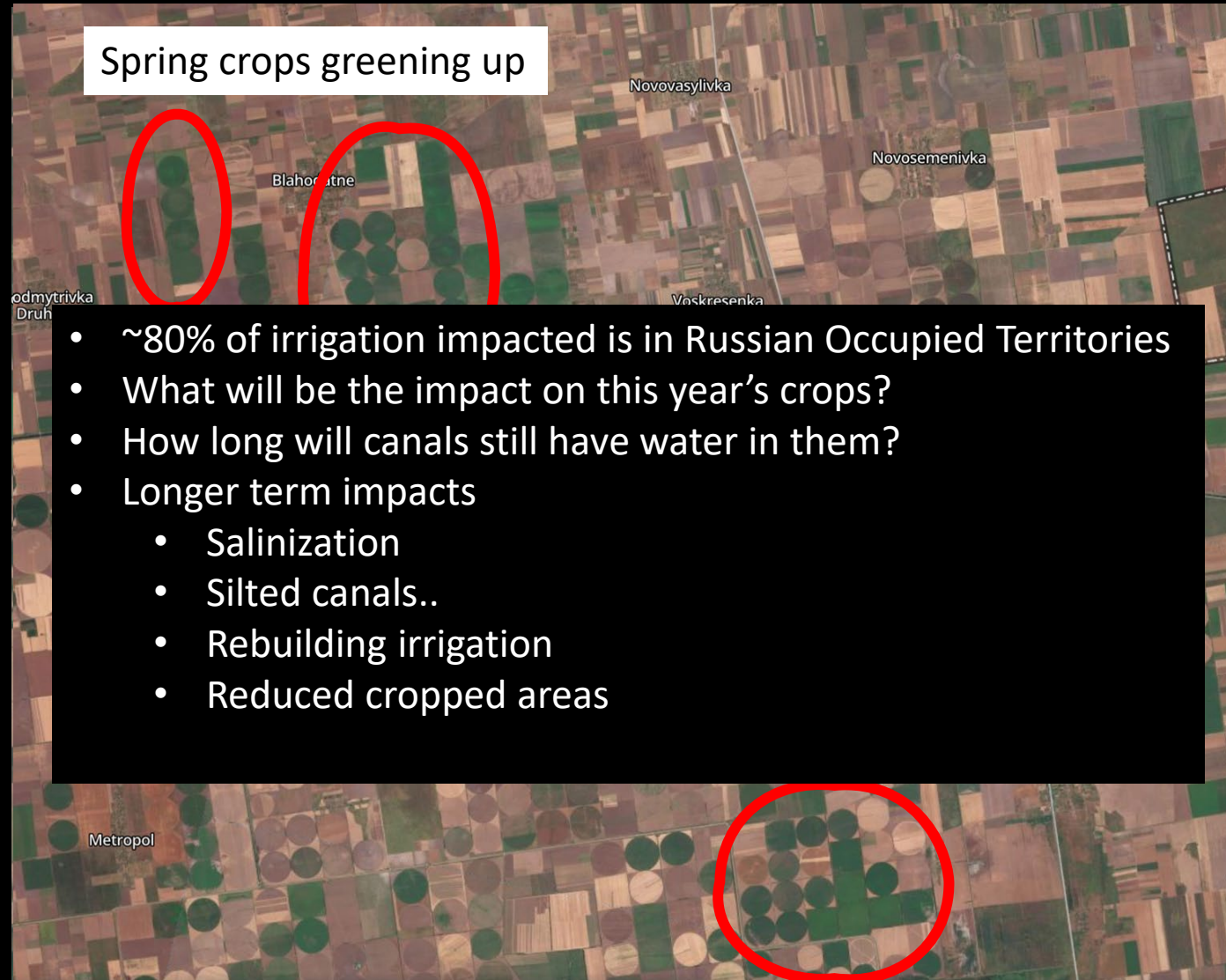
# Diminishing water levels in the North Crimea Canal



# June 5<sup>th</sup>, 2023, Occupied Kherson

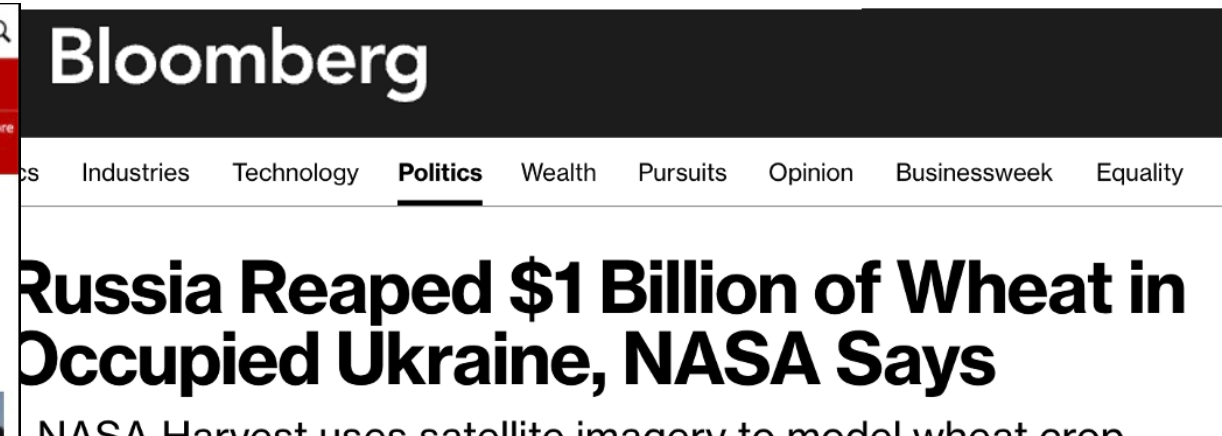
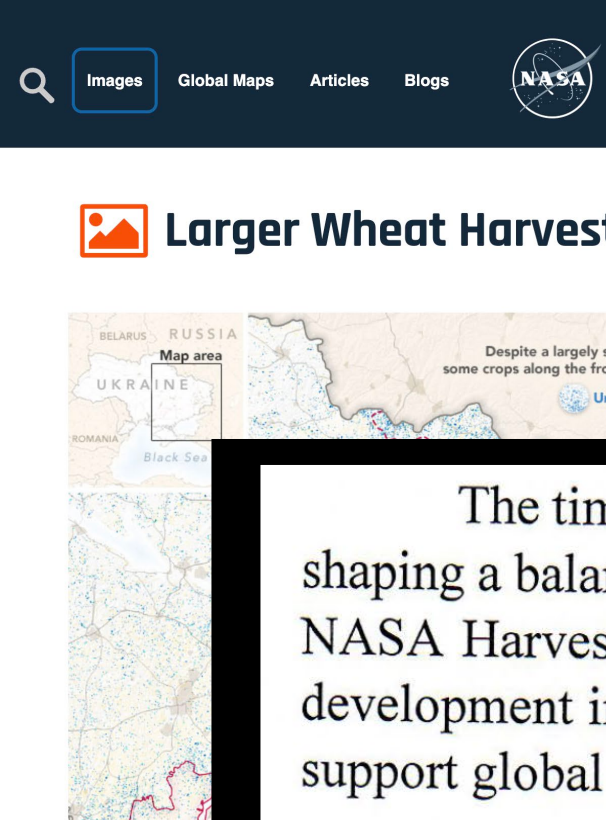


# July 7<sup>th</sup>, 2023, Occupied Kherson



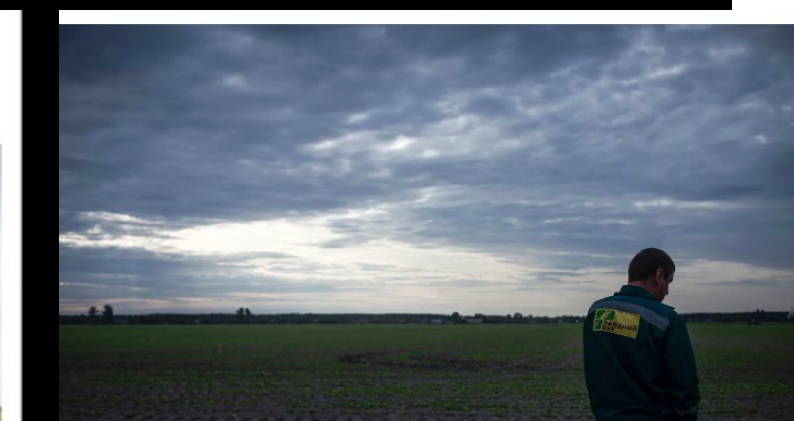
Spring crops greening up

- ~80% of irrigation impacted is in Russian Occupied Territories
- What will be the impact on this year's crops?
- How long will canals still have water in them?
- Longer term impacts
  - Salinization
  - Silted canals..
  - Rebuilding irrigation
  - Reduced cropped areas



The timeliness, objectivity, and transparency of the information remain essential factors in shaping a balanced and effective agrarian policy. We acknowledge and appreciate the vital role of NASA Harvest's solutions and calculations in assessing the real state of agricultural production development in Ukraine, ensuring regional food security, and determining the export potential to support global food security.

Letter from First Deputy Minister of Agrarian Policy and Food of Ukraine, Mr. Taras Vysotskyi



An aerial photograph of a city, likely in South Asia, that has been severely flooded. The water is murky brown and covers most of the ground, with only the roofs and upper floors of many buildings visible. The city extends to the horizon under a hazy sky. A small teal rectangular graphic is located in the top left corner.

Call to Action:

# FACILITY FOR RAPID AGRICULTURAL ASSESSMENTS FOR POLICY SUPPORT & ACTION

---

Address critical information gaps in the face of increasing frequency and severity of extreme events due to a changing climate, conflict and war, market uncertainty and other unforeseen events and disasters that impact food production, trade, access and ultimately Food Security

[www.nasaharvest.org](http://www.nasaharvest.org)



@HarvestProgram

Thank you!  
Questions?

Contact: [ireshef@umd.edu](mailto:ireshef@umd.edu)