ASIAN DEVELOPMENT BANK

Crop Mapping and Mobile Data Collection

2023 January 12

QED | https://qed.ai

Climate Resilient Rice Commercialization Sector Development Program, RICESDP
Asian Development Bank (ADB)

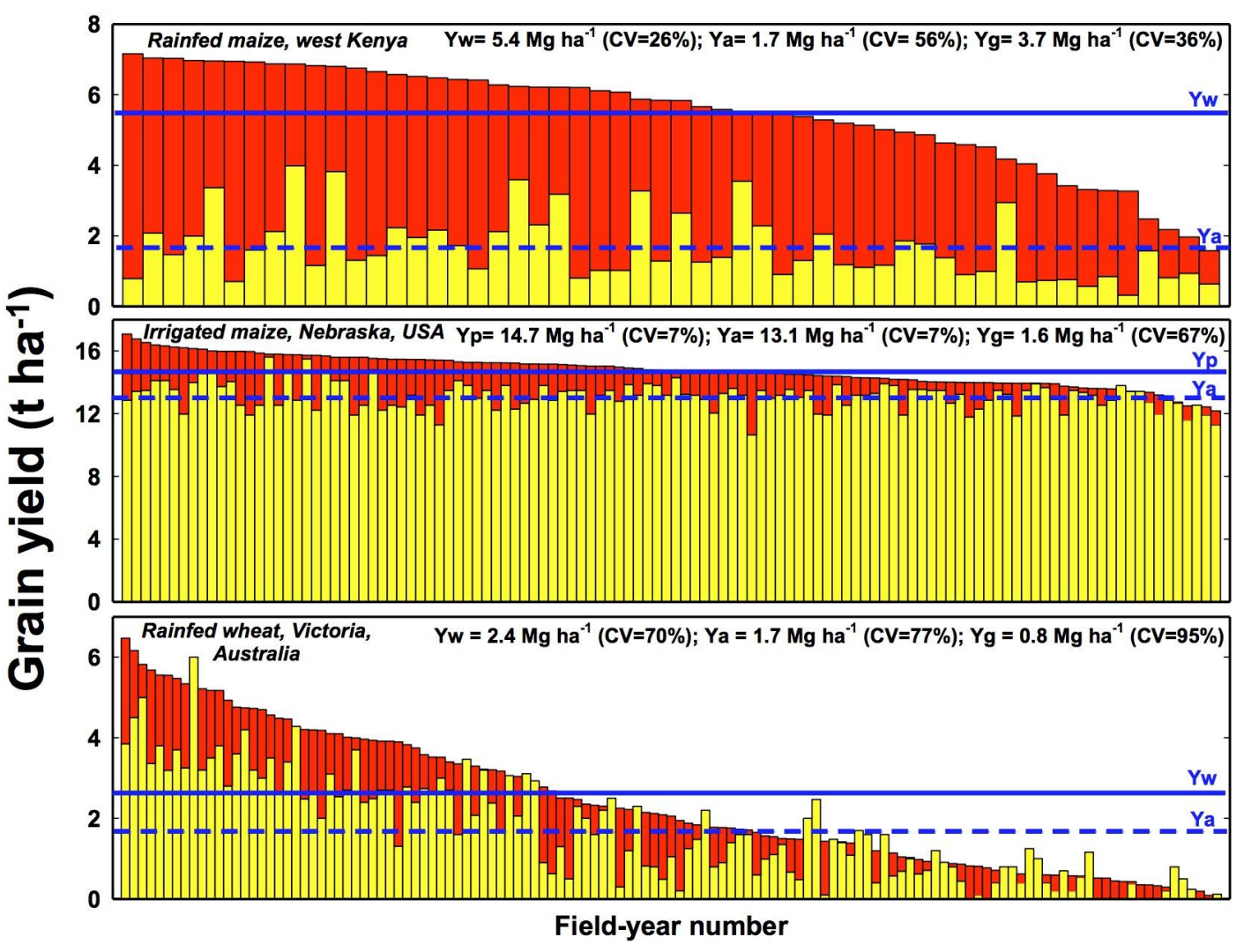
Segue

- As a technology company also working on the Sustainable Development Goals, we have been asked to showcase more examples of combining machine learning with other technologies, such as mobile apps, web applications, mechatronics, spectroscopy, and paper.

- Now we will further discuss other applications of applying A.I. to remote sensing: the mapping of cropland presence. (A more basic problem than mapping plot boundaries.)

Cropland Mapping

Gap I: Yield



yield gap

actual yield

(Ittersum 2013)

Gap II: Fertilizer

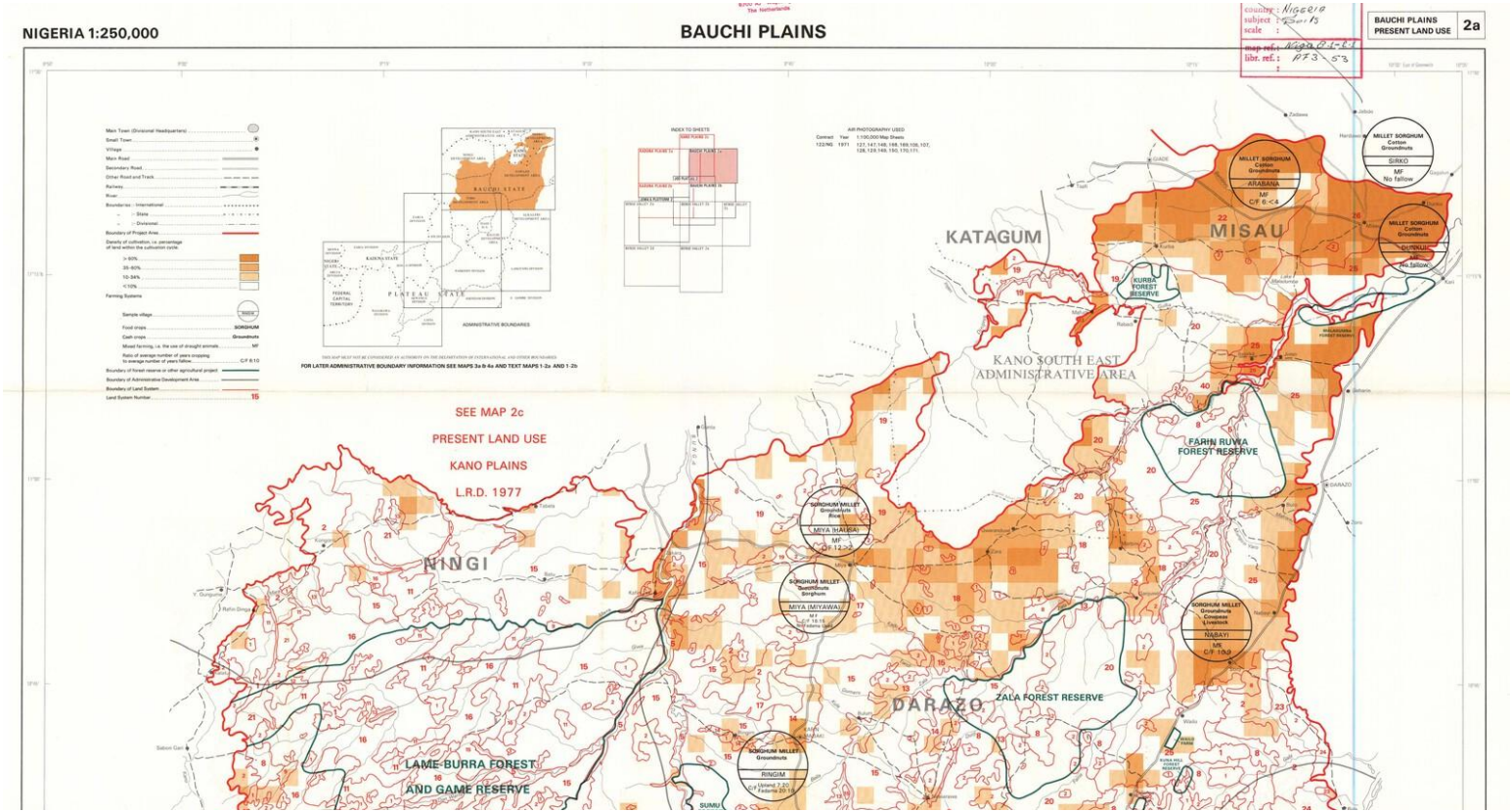
- Fertilizer: extremely effective way to nourish soils and raise yields
- Abuja Declaration on Fertilizers (2006):
  - 50 kg of nutrients / hectare of arable land
- Status in 2022, for Africa
  - 8 kg / ha … only 3% of global consumption
  - 20% of the world's arable land!
- Cropland mapping is necessary to provide up-to-date market statistics for the fertilizer industry to further invest in Africa.

Use Case: Nigeria

- *Land:* 923,768 sq. km
- *Population:* 206M ↑
- *Economy:* largest in Africa ↑
- *Food:* net import

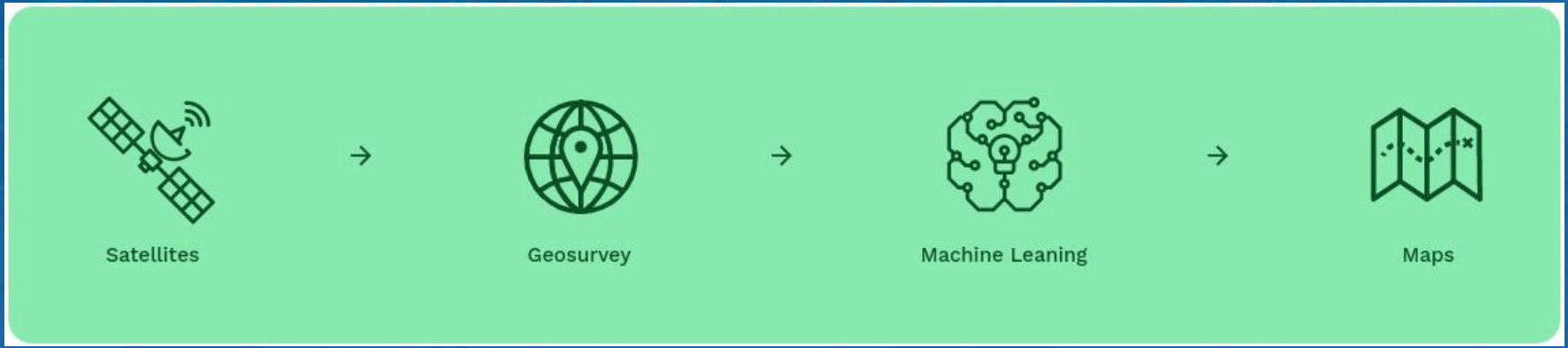
(used to be net export long ago, before the discovery of oil)

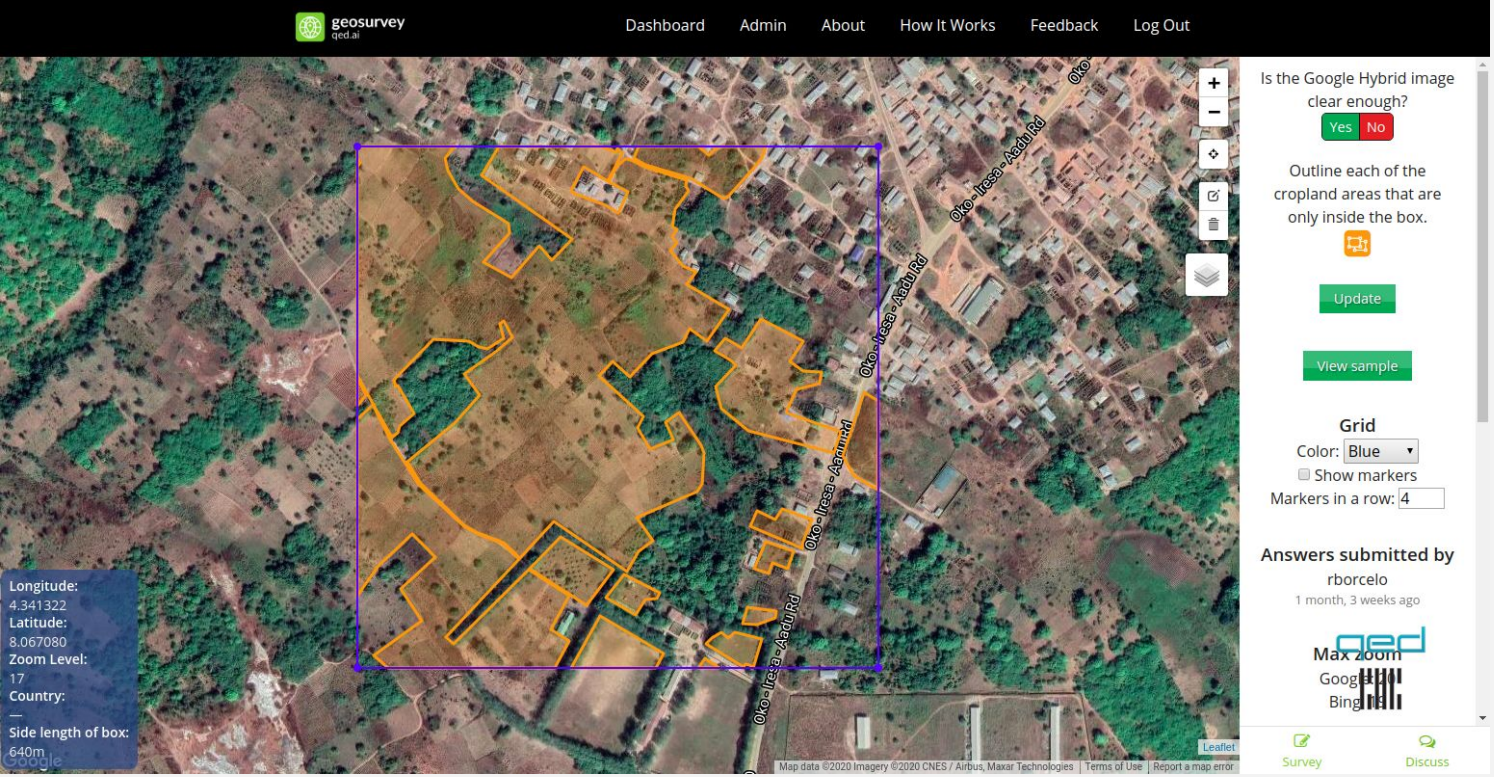
Legacy Crop Maps



1977 (UK Ministry of Overseas Development)

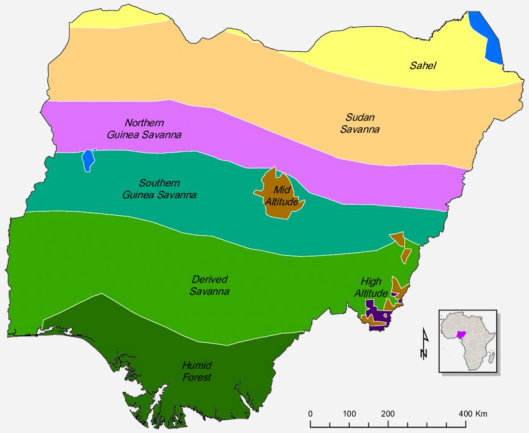
National-Scale Cropland Mapping for Smallholder Ag Systems

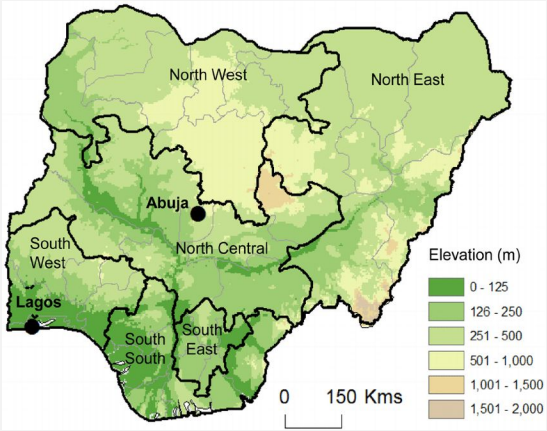




- **Label imagery at scale over the web.**
- **Generates “fuel” for computer vision.**

Geosurvey





Geosurvey Stratification

Landscape diversity:

- Nigeria North Central
- Nigeria South
- Nigeria West
- Nigeria North East
- Nigeria North East N
- Nigeria North East S
- Nigeria Delta
- Nigeria South West

Partitions based on both Agricultural Ecological Zones (AEZs) and political boundaries.

Geosurvey: Analysis

The Geosurvey Podcast:
Dry Croplands of Nigeria

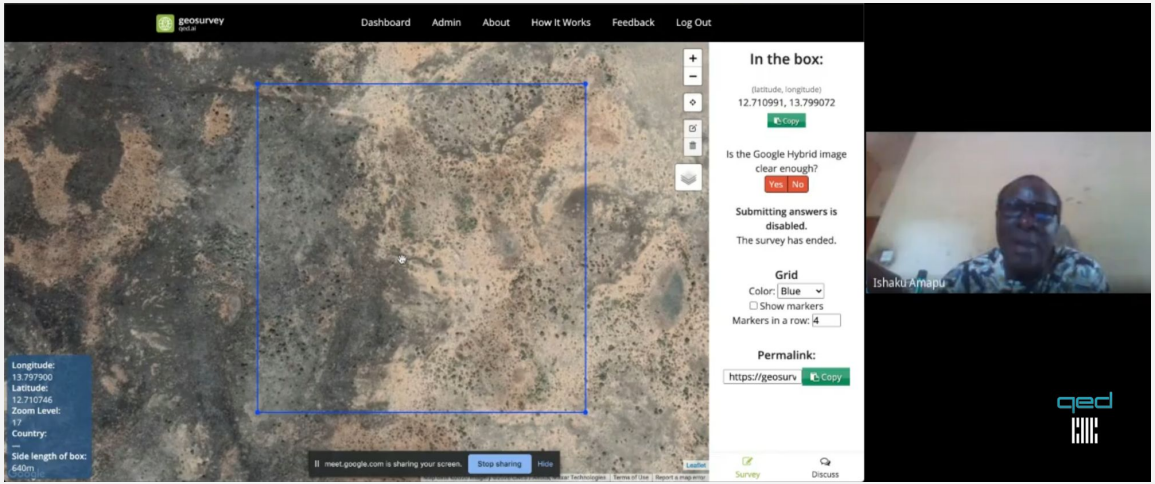
March 18, 2020
Host: Dr. David Guerena (**d**)
Fly-on-the-wall: Dr. William Wu (**w**)

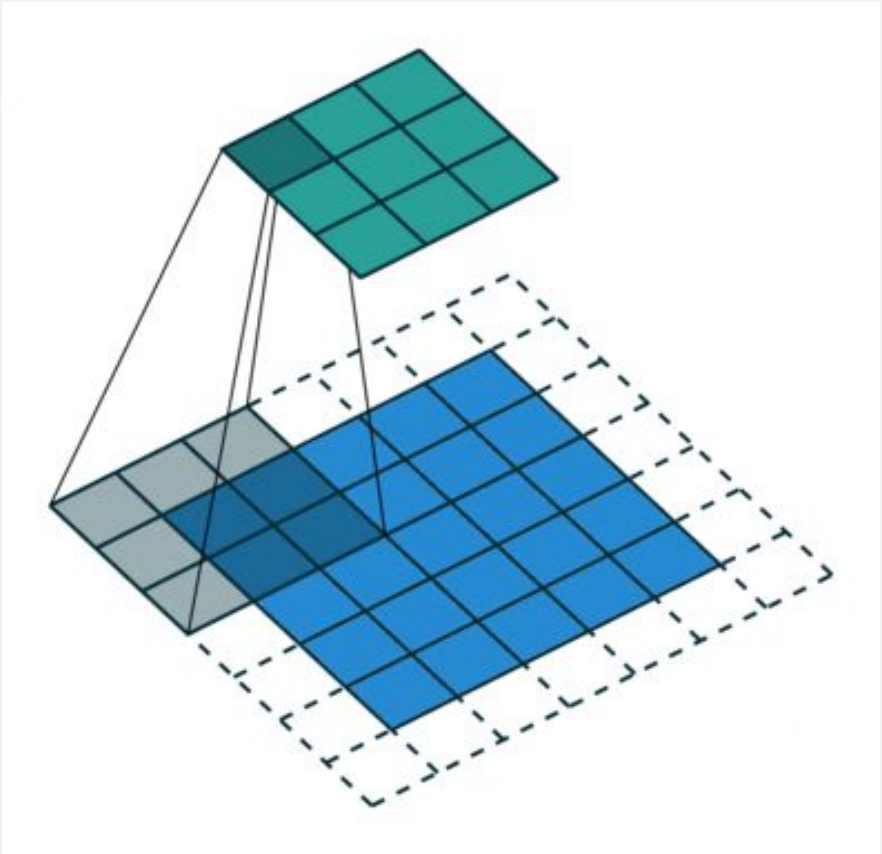
QED | https://geosurvey.qed.ai

geosurvey
qed.ai

Remote sensing is paired with field work and mobile data collection with fleets of motorcycles to cross-check.

Regular collaborations with soil scientists and agronomists to ensure proper imagery interpretation in different zones (dry, wet, riparian) and construct guidelines for surveyors.

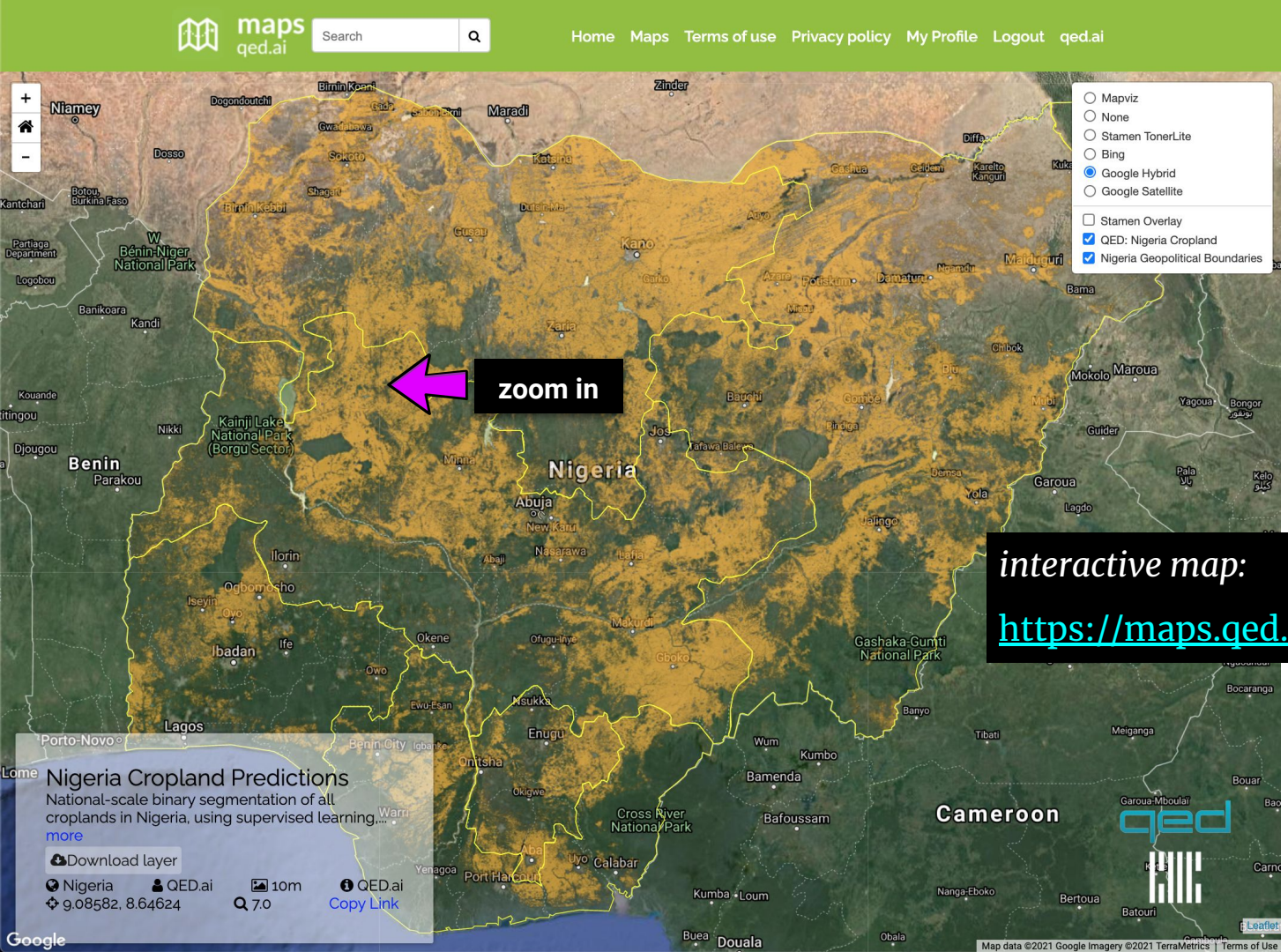




Use **artificial intelligence** to learn patterns from a plethora of examples and extrapolate at national scales.

Example Nigeria map:
https://maps.qed.ai/map/ng_cp_preds

Data → A.I. → Maps



QUANTITATIVE ENGINEERING DESIGN

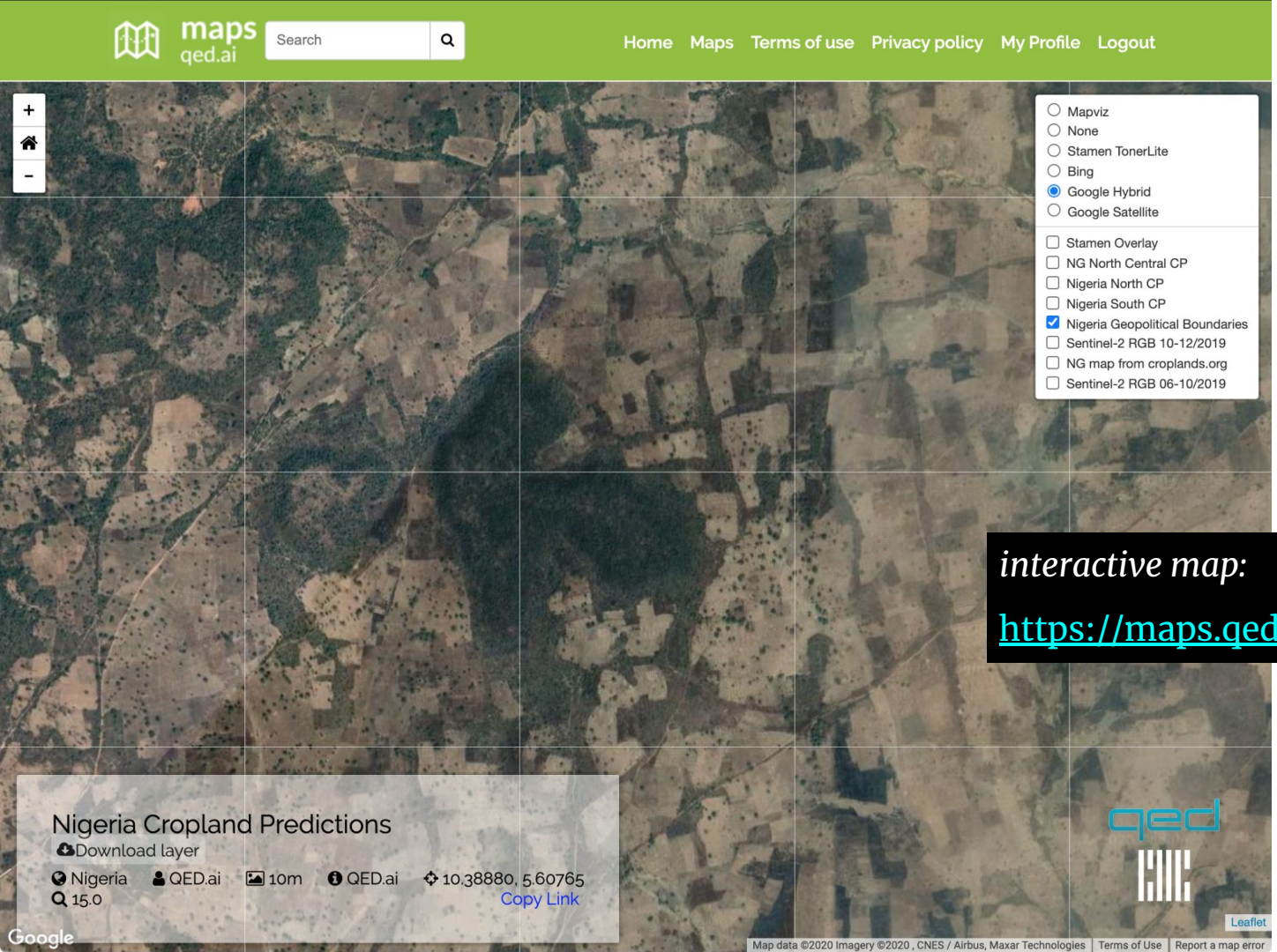
Land Under Production

- *Acc. and precision:* ~85%
- *Spatial resolution:* 10 m
- *Scale:* National
- Derived from 2020 imagery.
- Can be annually updated on a semi-automated basis.

interactive map:

https://maps.qed.ai/map/ng_cp_preds

Maps



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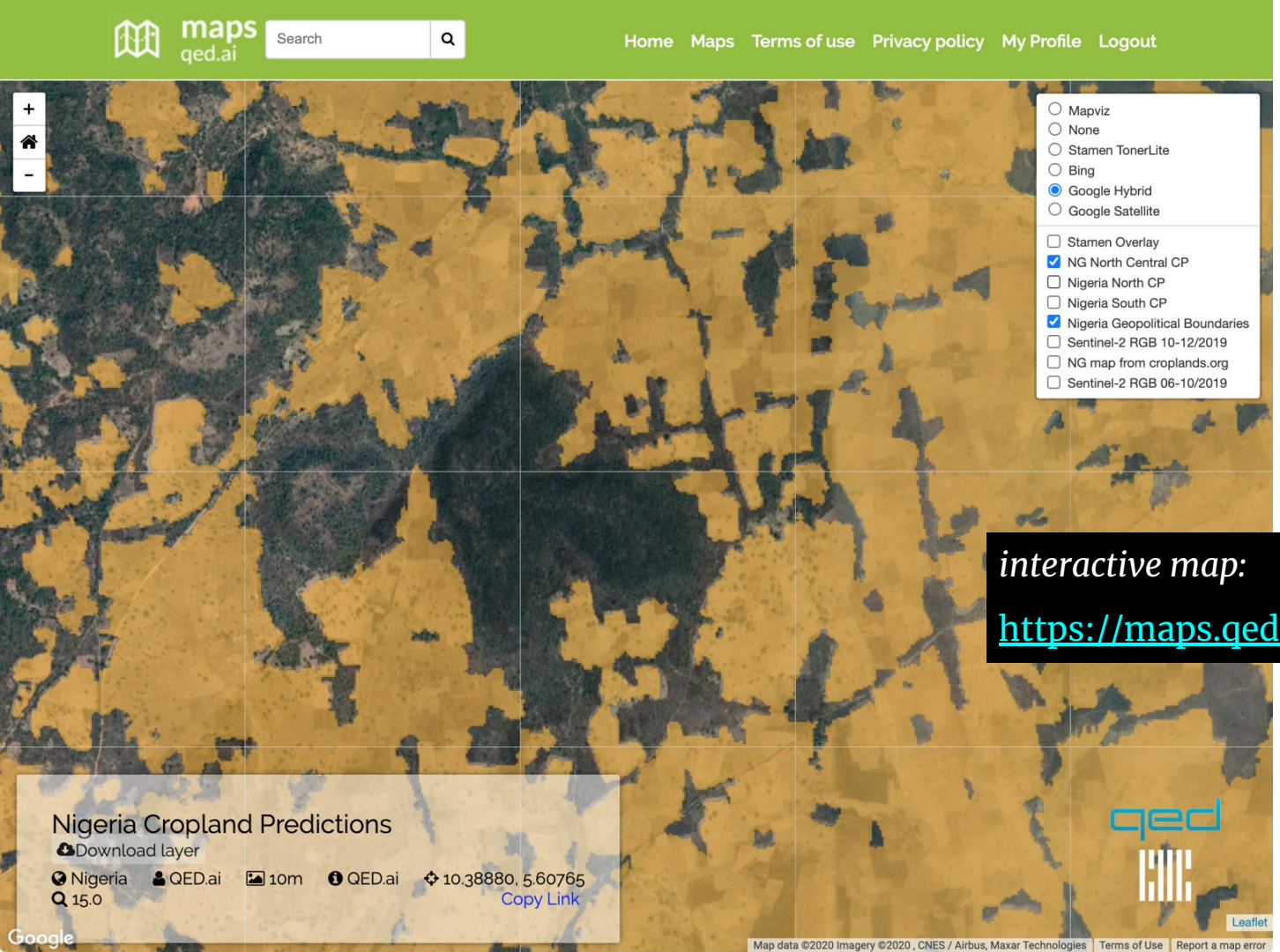

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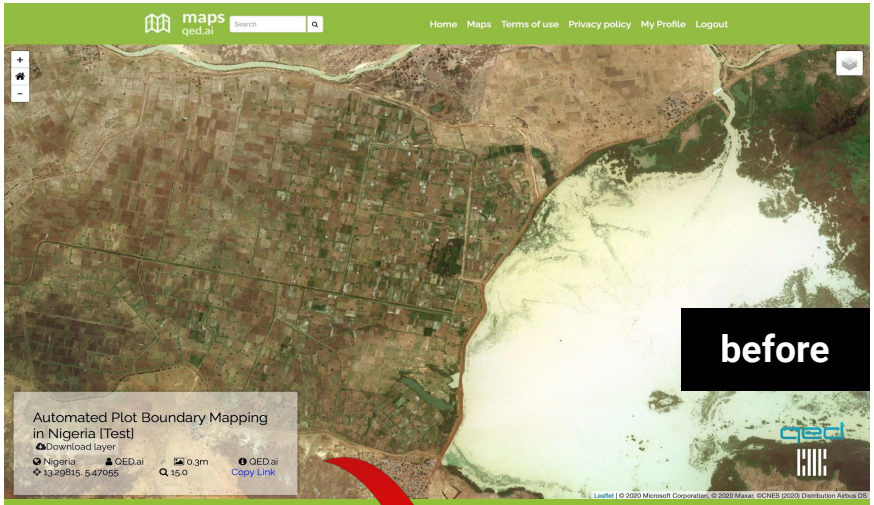
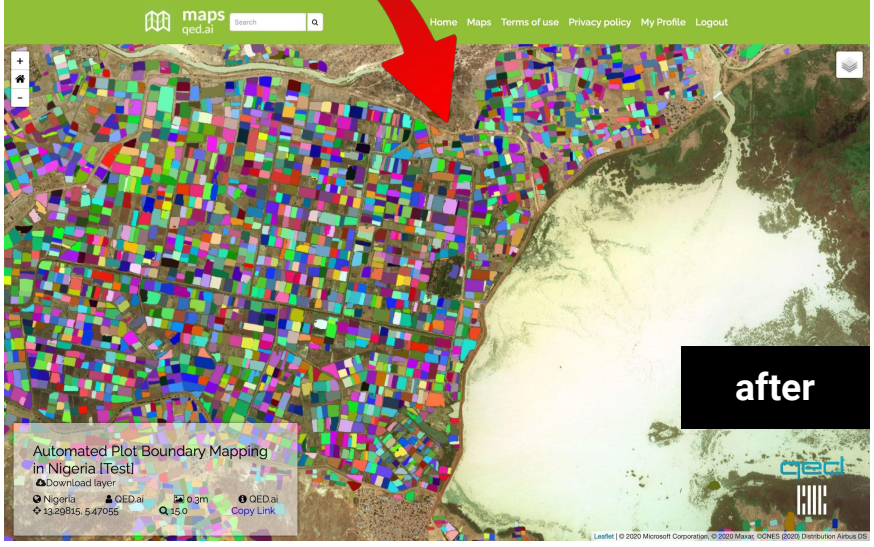
Maps

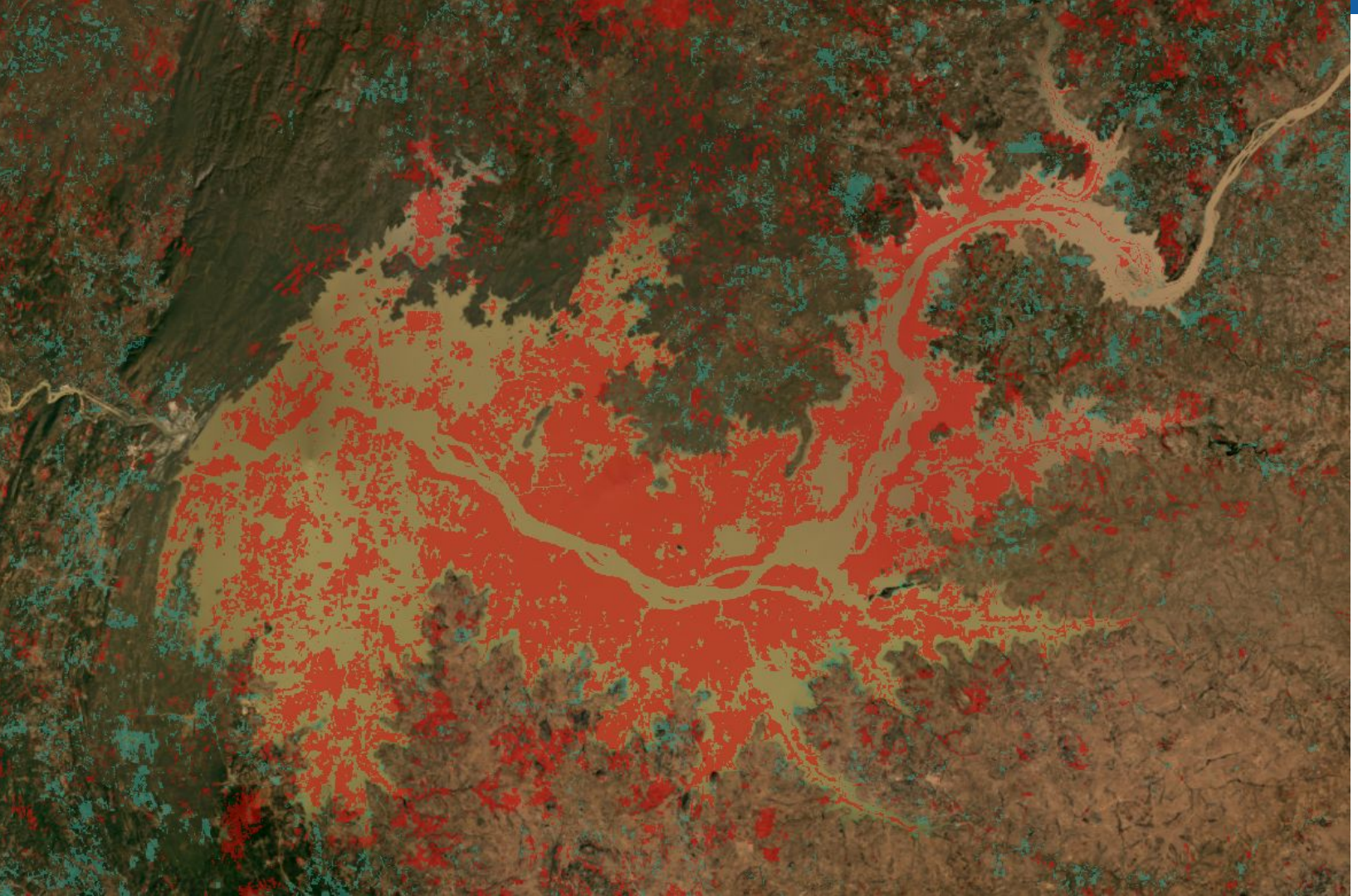
Plots and buildings





2020 map, river in Nigeria, monitoring of large cropland changes, induced by a man-made dam.

Change



2021 map, river in Nigeria, monitoring of large cropland changes, induced by a man-made dam.

Red areas of cropland subtraction were auto-found.

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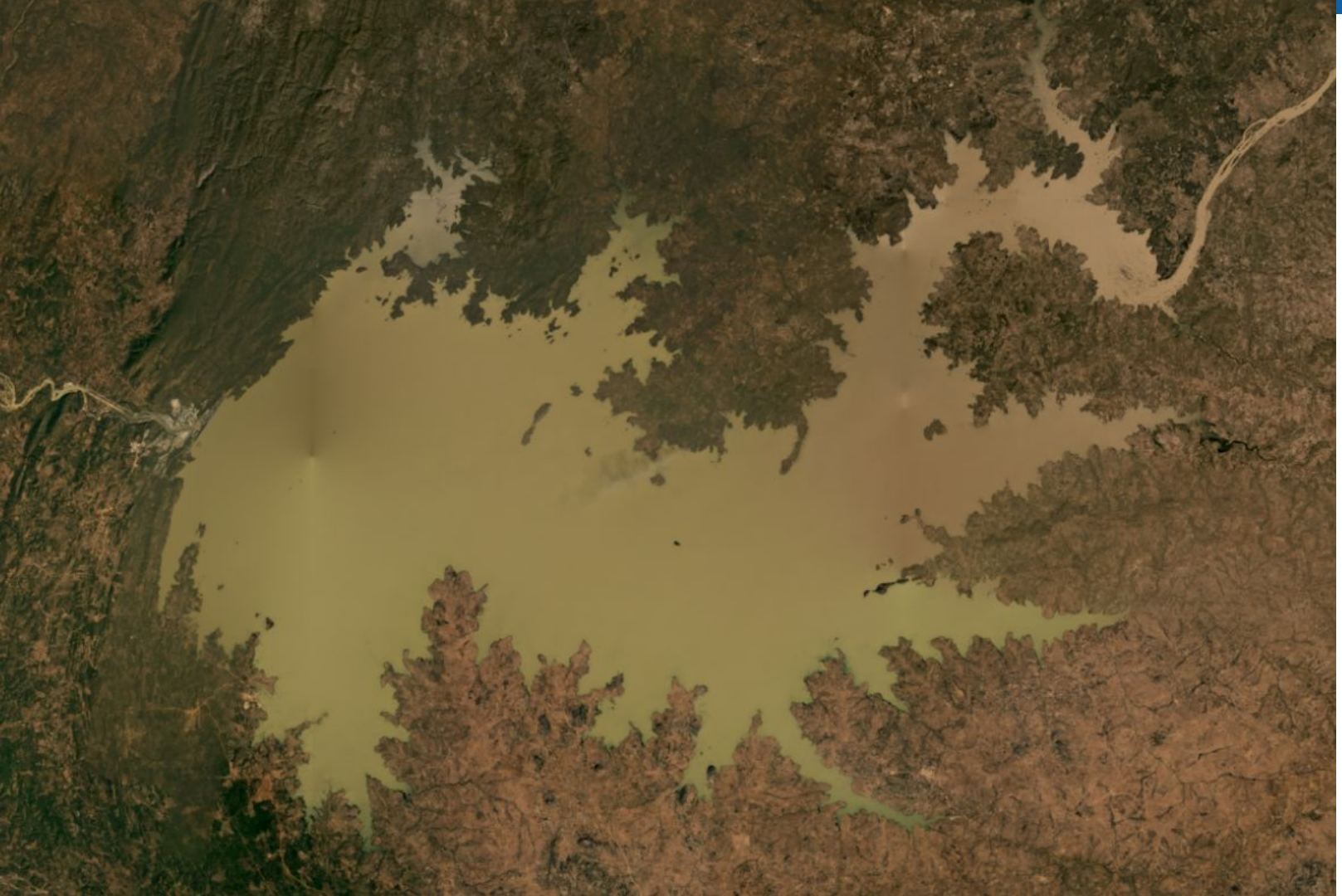

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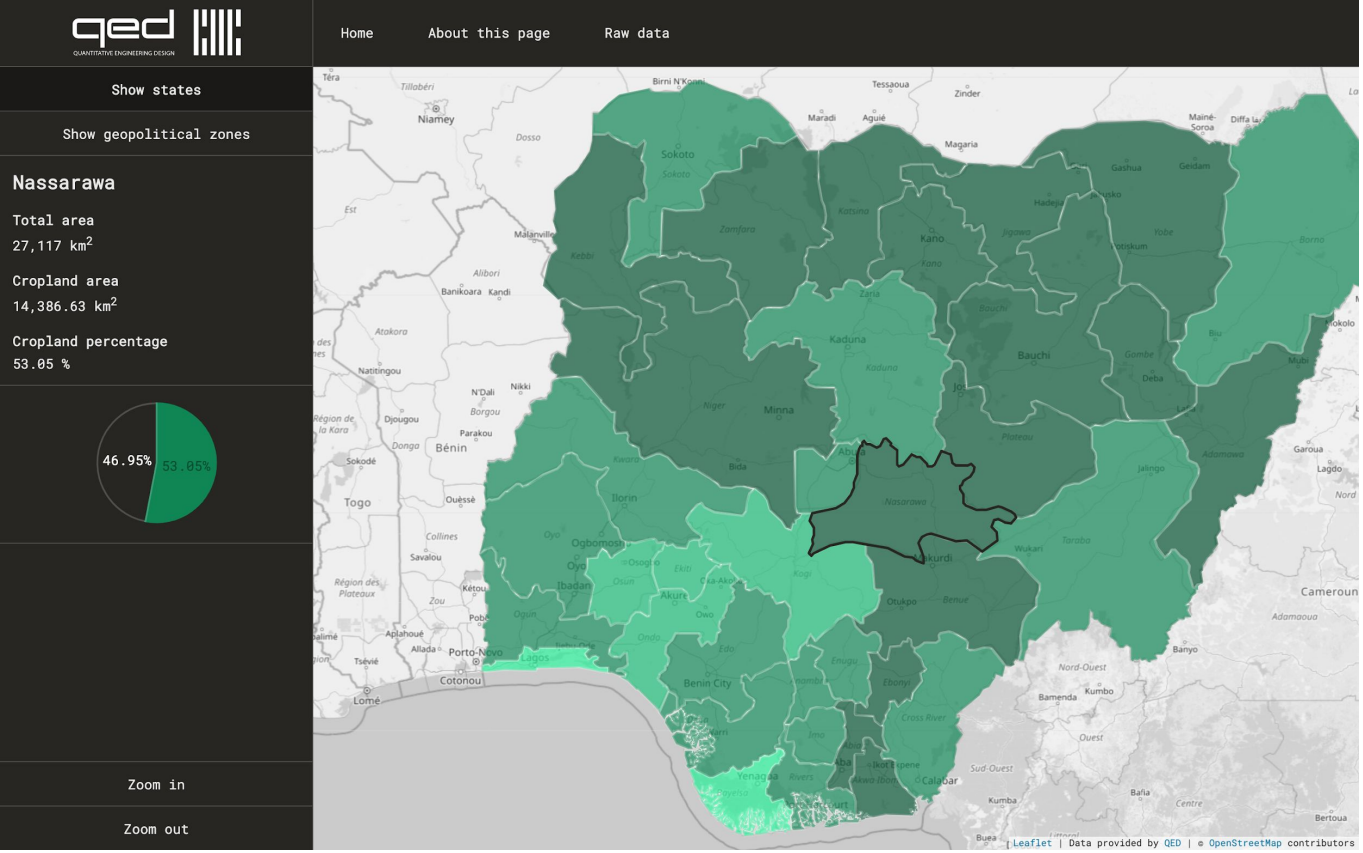


QUANTITATIVE ENGINEERING DESIGN

cropstats-ng.qed.ai

Summarizes cropland stats across all states, with maps and tables.

Totals:

QED: 42,871,400 ha

FAO: 34,000,000 ha *

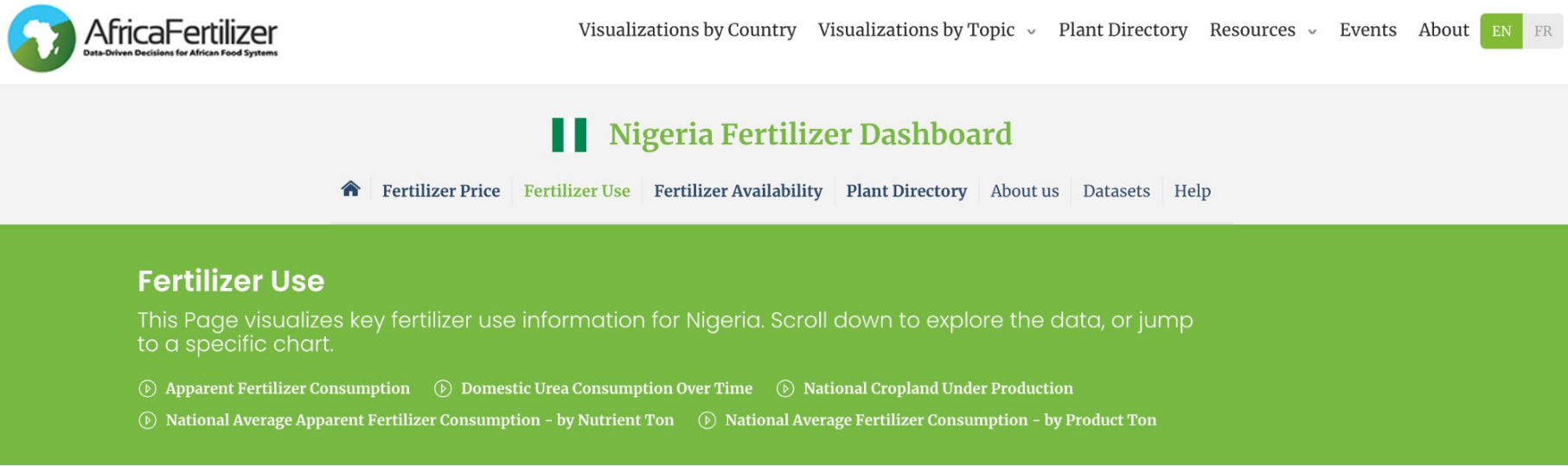
* unchanged since 2013

***Definition for Croplands from QED**: Croplands include land under temporary crops (within season double-cropped areas are counted only once), land under market and kitchen gardens, and permanent crops; land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, including flowering shrubs, fruit trees, nut trees, and vines. Examples include coffee, cocoa, oil palm, and rubber. Excluded are pasture lands (both temporary and permanent), fallow-lands, wood and timber trees.*

Stats

Adoption into AfricaFertilizer.org

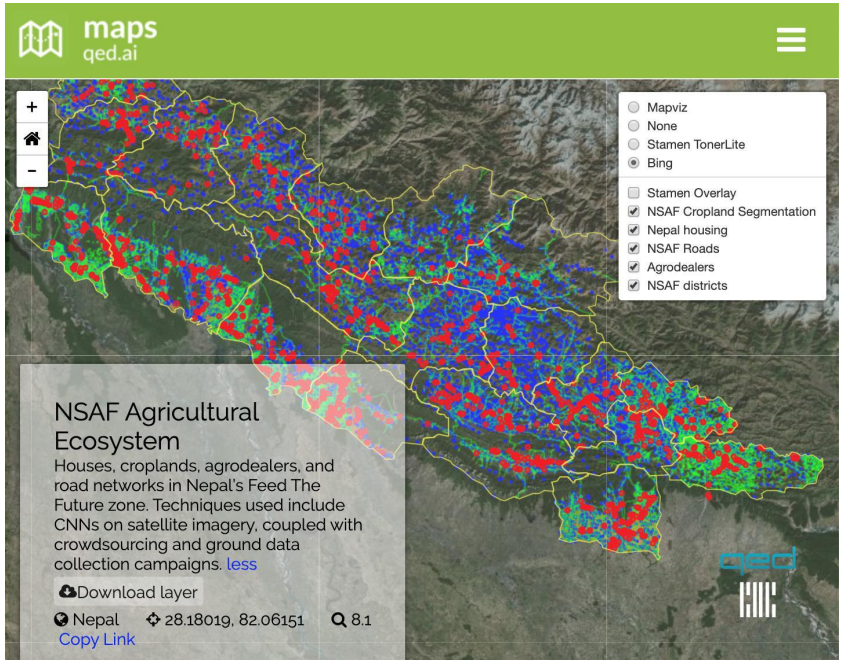
Our cropland maps and statistics for Nigeria and Ghana were merged into AfricaFertilizer.org, which aims to provide an objective source of key performance indicators for the African fertilizer sector.



Nepal

Collaboration with the Nepal Seed and Fertilizer (NSAF) project to build a comprehensive map of the agricultural ecosystem in Nepal:

https://nsaf-geospatial.qed.ai



interactive maps of all crops, buildings, soils, roads, agro-dealers, food processors, financial facilities, etc. throughout Nepal, to advance geospatial agricultural intelligence for public & private sectors

UNITED STATES AGENCY INTERNATIONAL DEVELOPMENT
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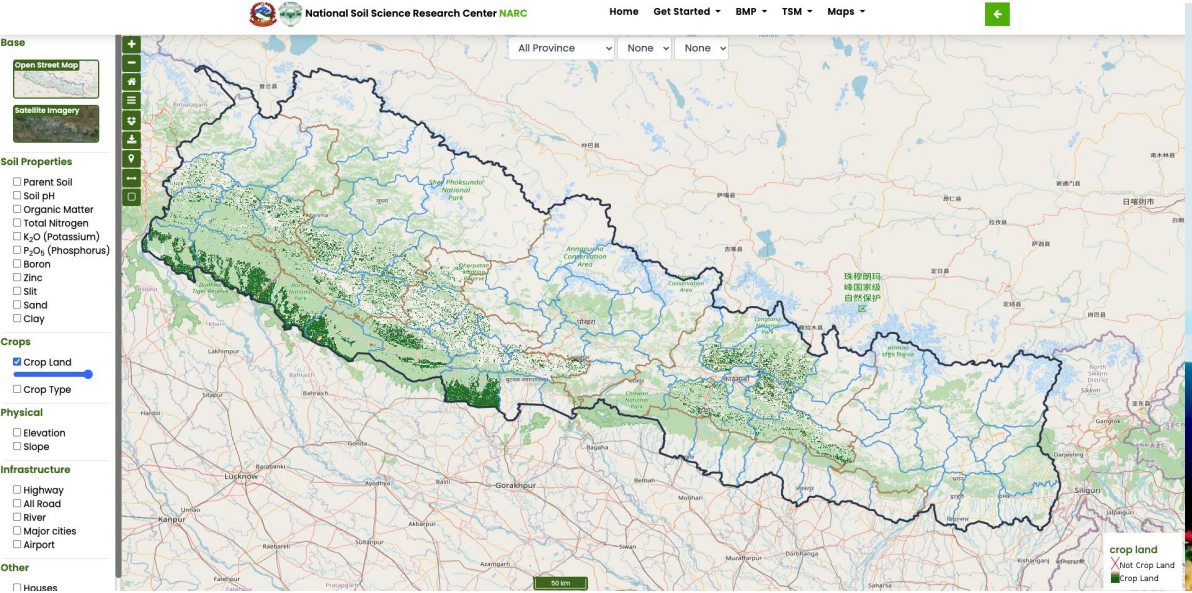
CIMMYT

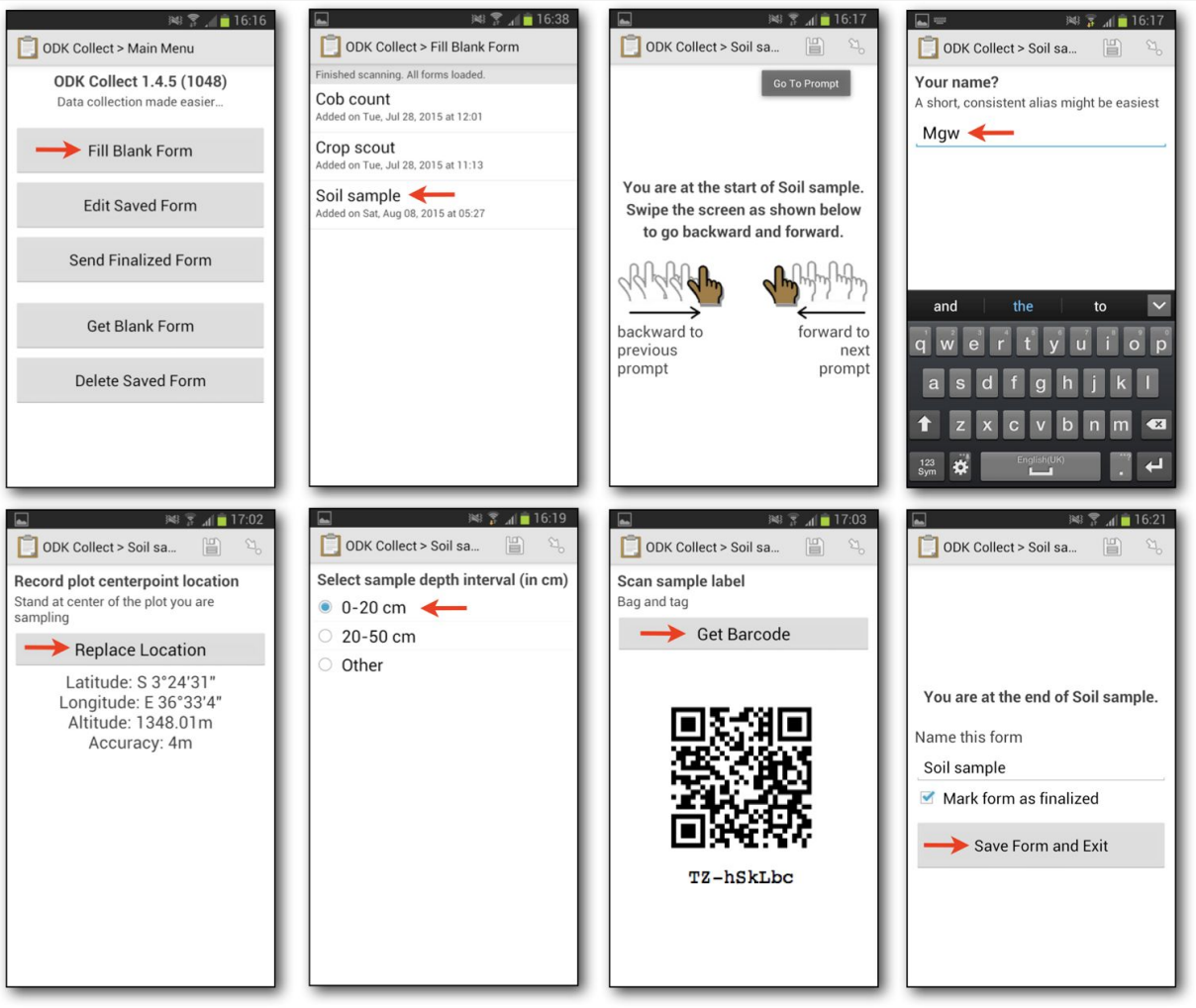
Adoption into National Policy

QED cropland maps for Nepal were officially integrated into agricultural statistics used for national fertilizer subsidy program by the Prime Minister and Minister of Agriculture, and housed at the Nepal Agricultural Research Council (NARC)'s portal.



Ground truth data is key for all these projects. How is it collected?

Mobile Data Collection

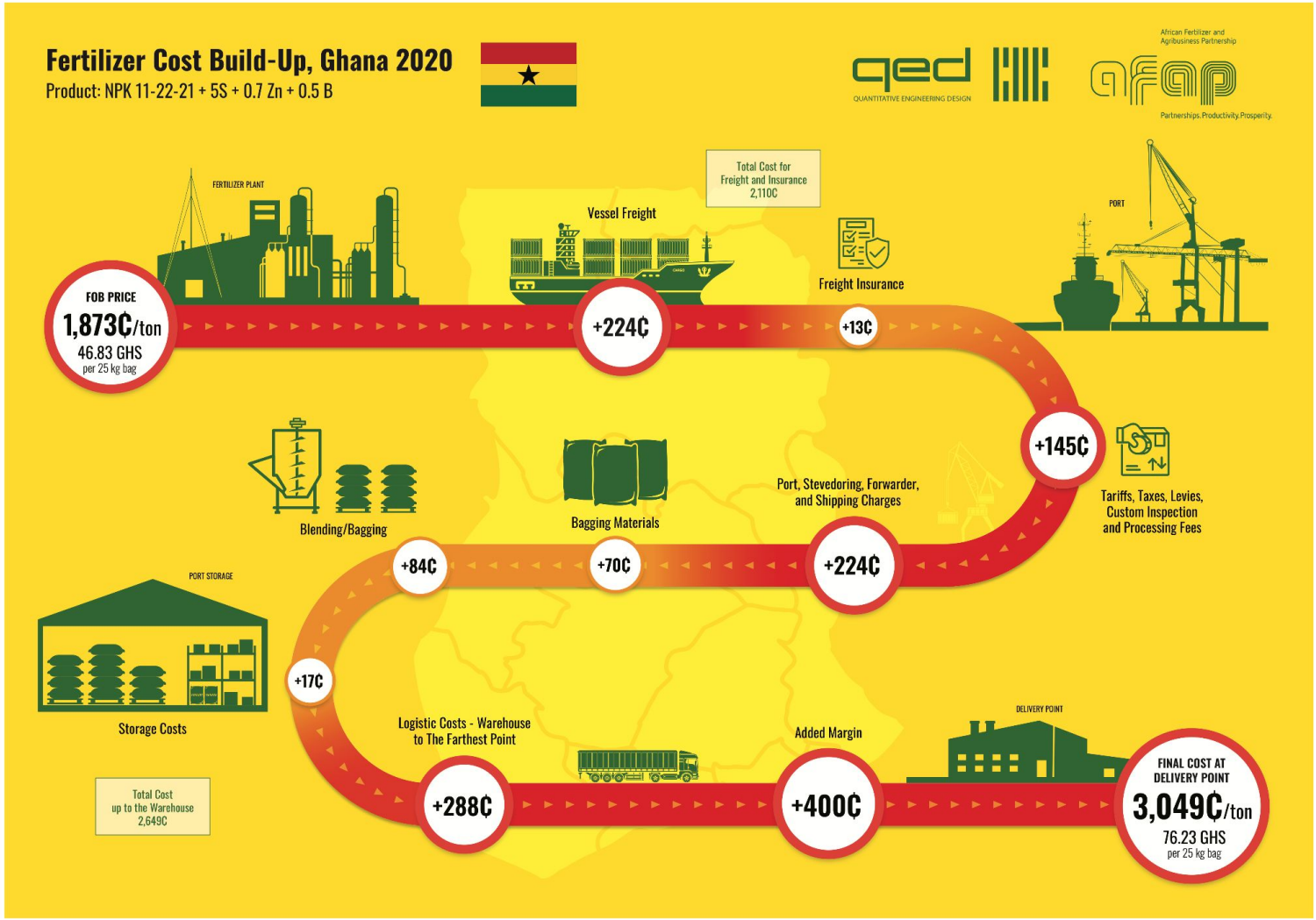


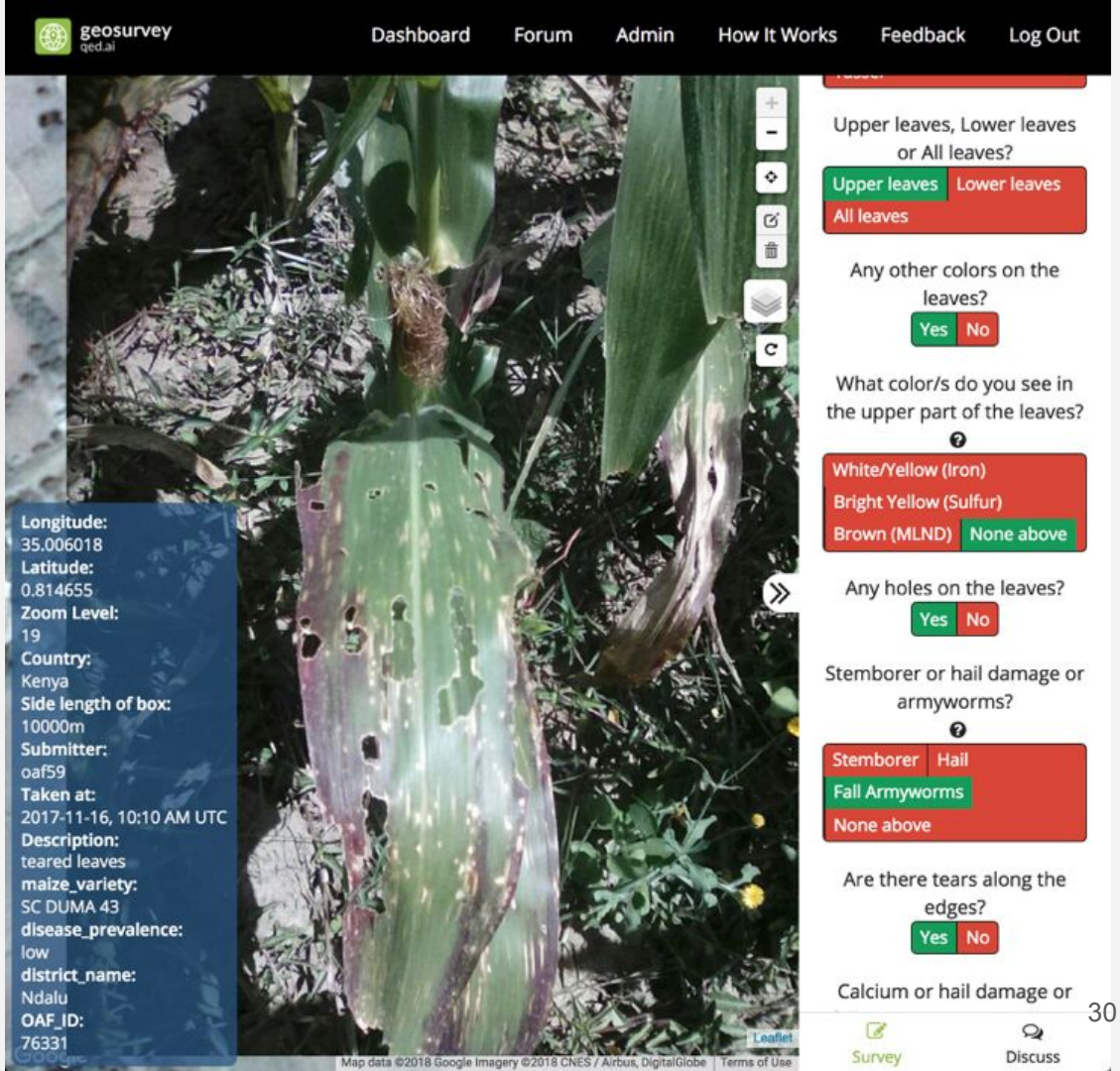
Soil surveying:

End-to-end workflows for soil processing, including barcoding, bagging, tracking of samples

Data gathered by the Africa Fertilizer Agribusiness Partnership (AFAP), supported by digital tools from QED.

Visualization of drivers of cost build-up from fertilizer plant all the way to the delivery point.





Plant telemedicine:

Photos can be submitted via mobile app (left) for diagnosis on the web (right)

geosurvey
qed.ai

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crop health issues are geospatially identified, resulting in maps of fall army worm and specific nutrient deficiencies

Longitude:
34.678613
Latitude:
-0.764842
Zoom Level:
18
Country:
Kenya
Side length of box:
10000m

In the box:

(latitude, longitude)
-0.764838, 34.678611

Copy

Any other colors on the leaves?

Yes No

What color do you see in the lower part of the leaves?

Purple (Phosphorous)
Red/purple/yellow (Magnesium)
Yellow/brown in the middle (Nitrogen)
Yellow/brown along the edge (Potassium)
None above

Any holes on the leaves?

Yes (Stem Borer) No

Any spots on the leaves?

Yes No

Survey Discuss

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geosurvey
qed.ai

Dashboard Forum Admin How It Works Feedback Log Out

built-in help menus and tutorials for plant epidemiology

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Discussion, Questions and Answers

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