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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



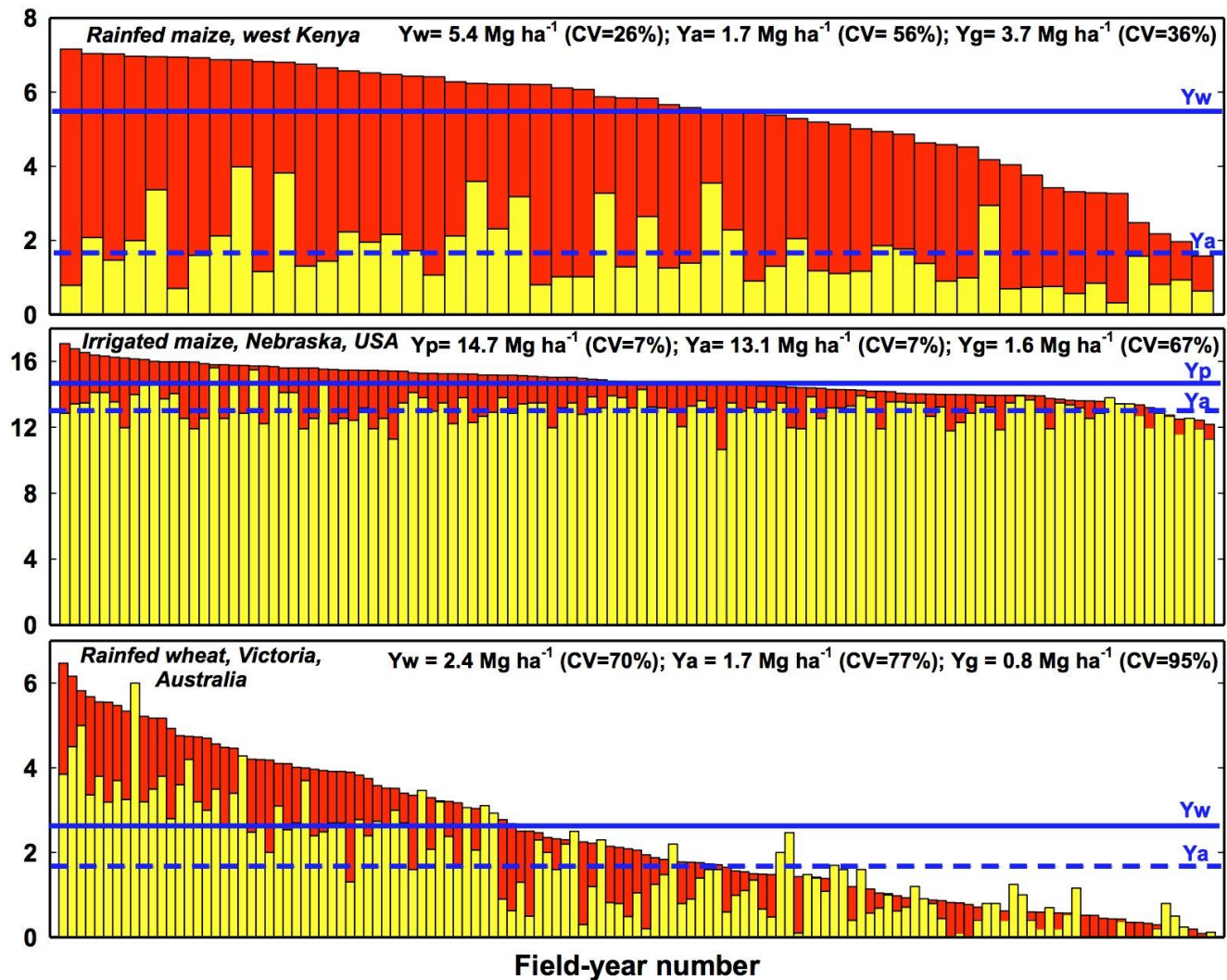
- As a technology company also working on the Sustainable Development Goals, we have been asked to showcase more examples of combining machine learning with other technologies, such as mobile apps, web applications, mechatronics, spectroscopy, and paper.
- Now we will further discuss other applications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



Grain yield (t ha⁻¹)



- 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.

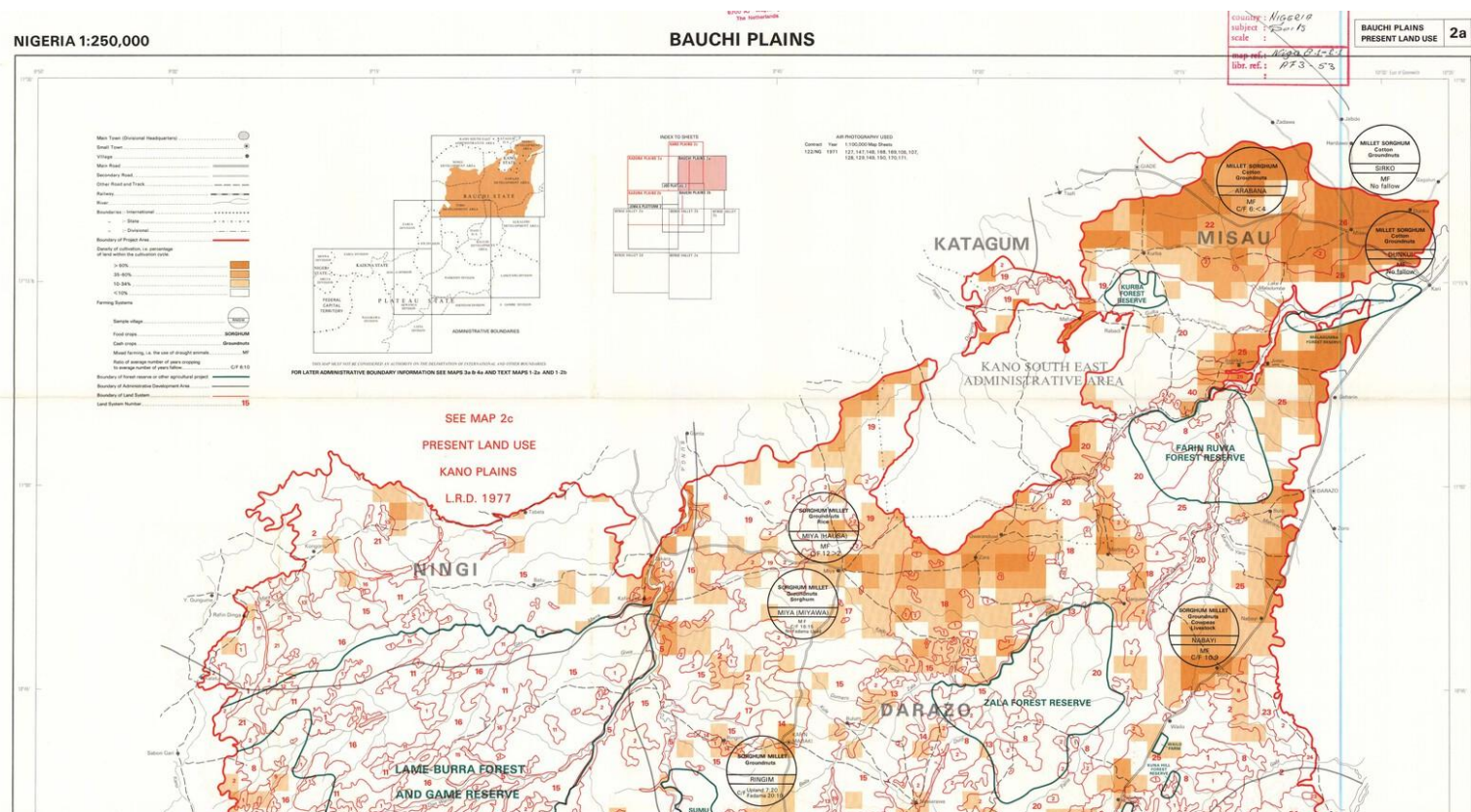
Use Case: Nigeria

- *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



Satellites



Geosurvey



Machine Learning



Maps



Is the Google Hybrid image clear enough?

Yes No

Outline each of the cropland areas that are only inside the box.



Update

View sample

Grid

Color: Blue

☐ Show markers

Markers in a row: 4

Answers submitted by

rborcelo

1 month, 3 weeks ago

Max zoom
Google
Bing



Survey



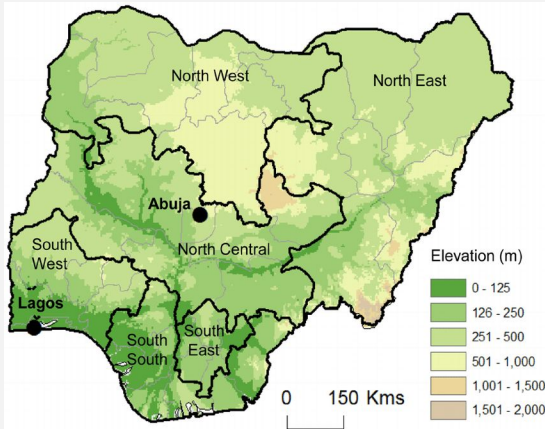
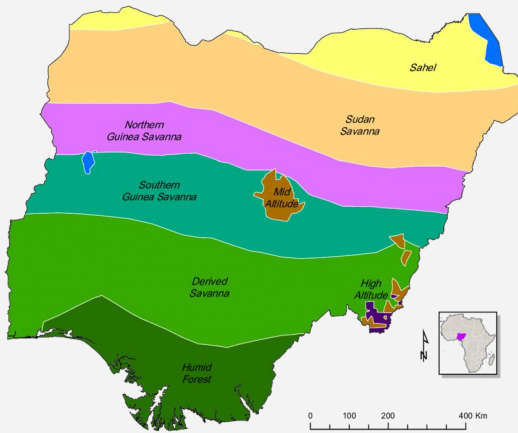
Discuss

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

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

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.

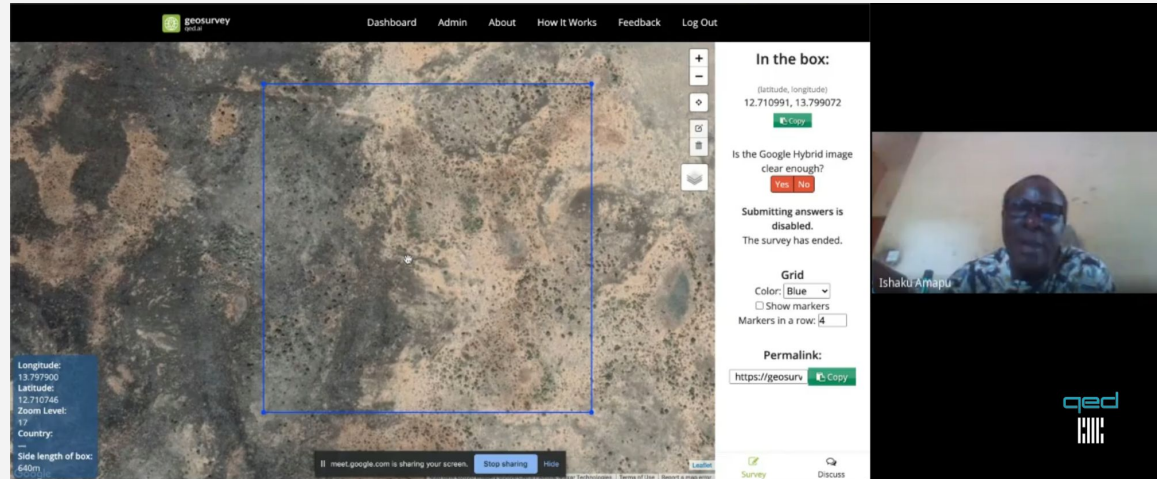
The Geosurvey Podcast: Dry Croplands of Nigeria

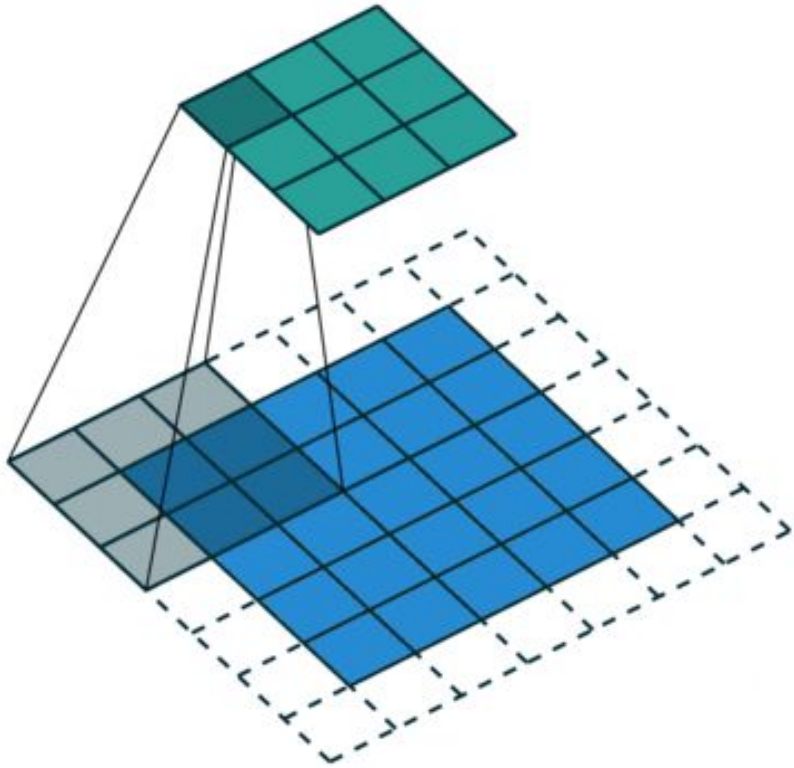
March 18, 2020

Host: Dr. David Guereña (**d**)

Fly-on-the-wall: Dr. William Wu (**w**)

QED | <https://geosurvey.qed.ai>



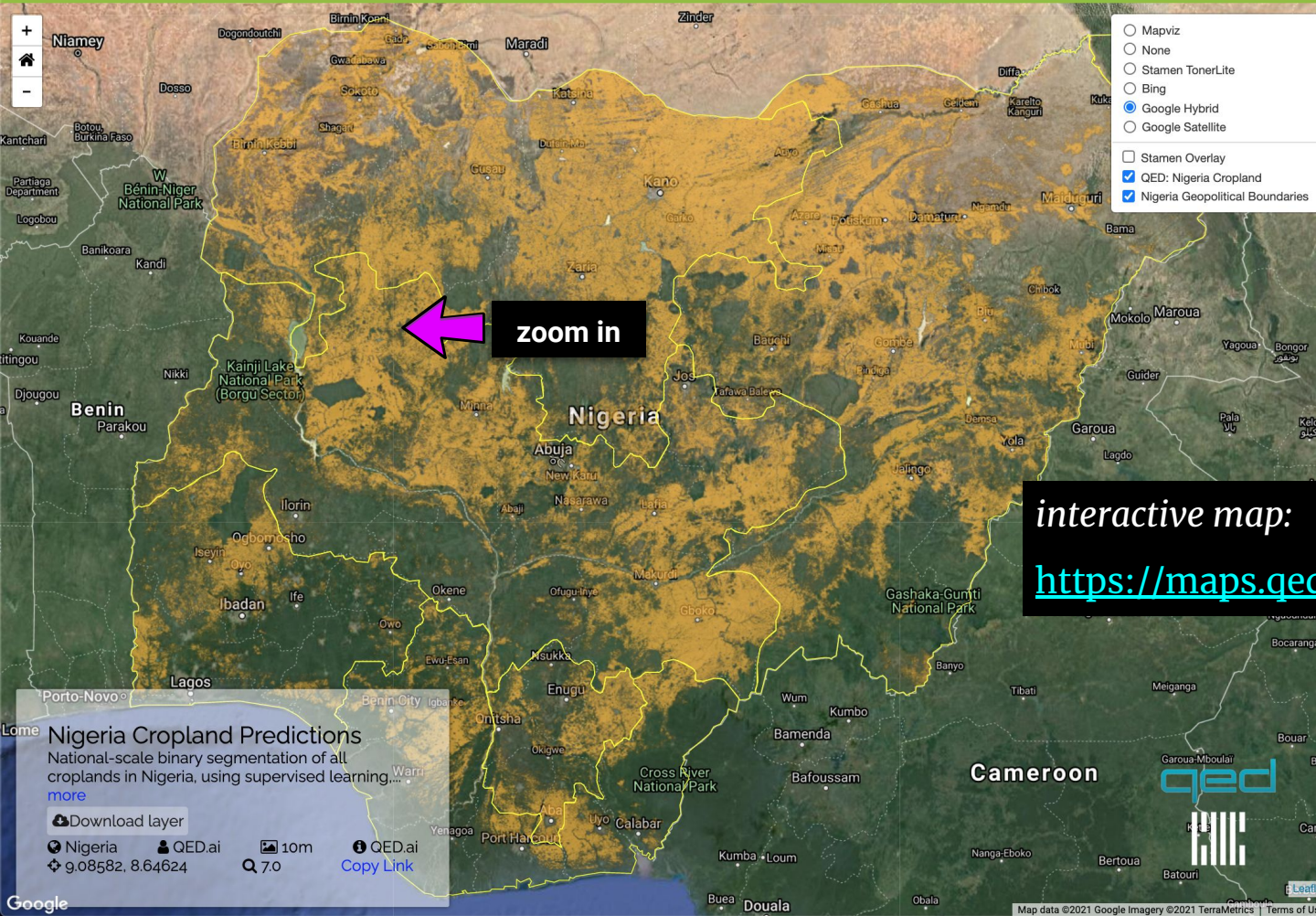


Use **artificial intelligence** to learn patterns from a plethora of examples and extrapolate at national scales.

Example Nigeria map:

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

Data → A.I. → Maps



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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interactive map:

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Maps



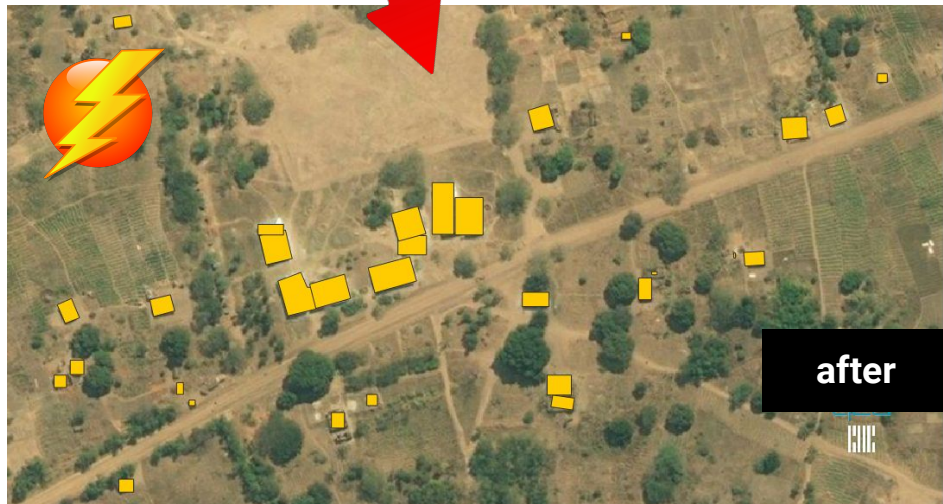
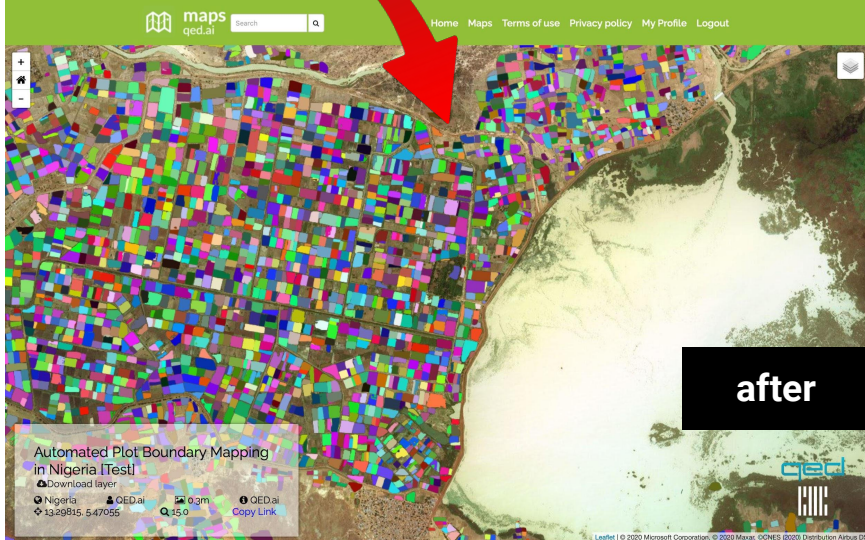
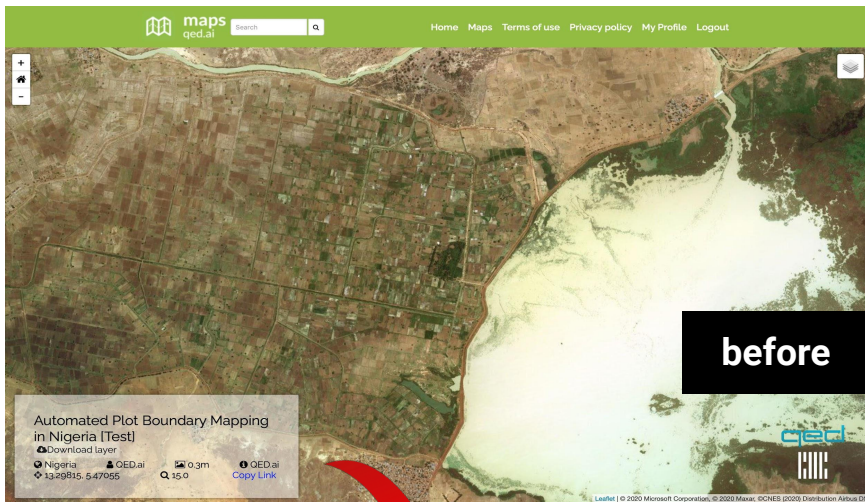
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Maps





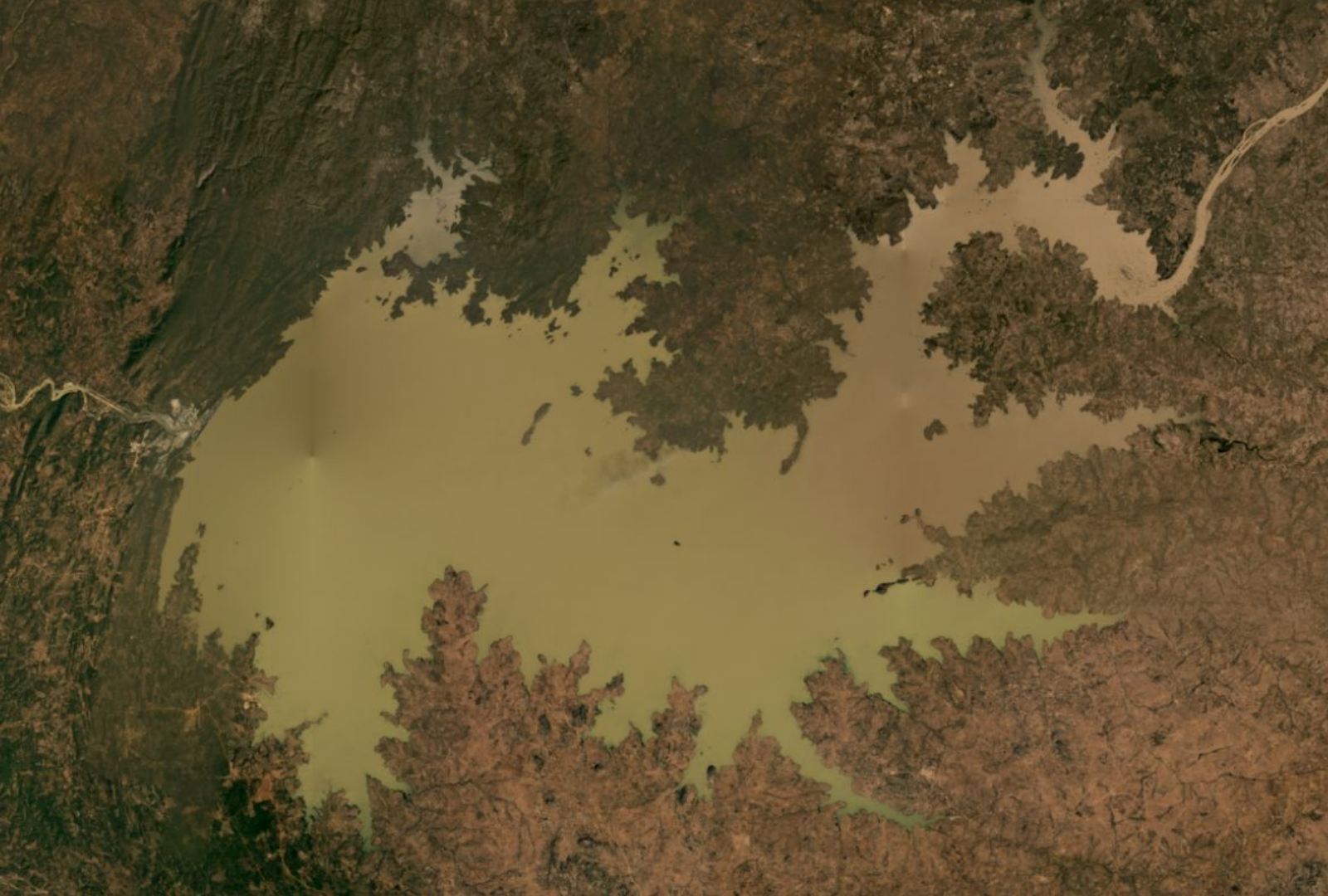
2020 map,
river in
Nigeria,
monitoring of
large
cropland
changes,
induced by a
man-made
dam.

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.

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.

Change

Show states

Show geopolitical zones

Nassarawa

Total area

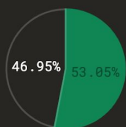
27,117 km²

Cropland area

14,386.63 km²

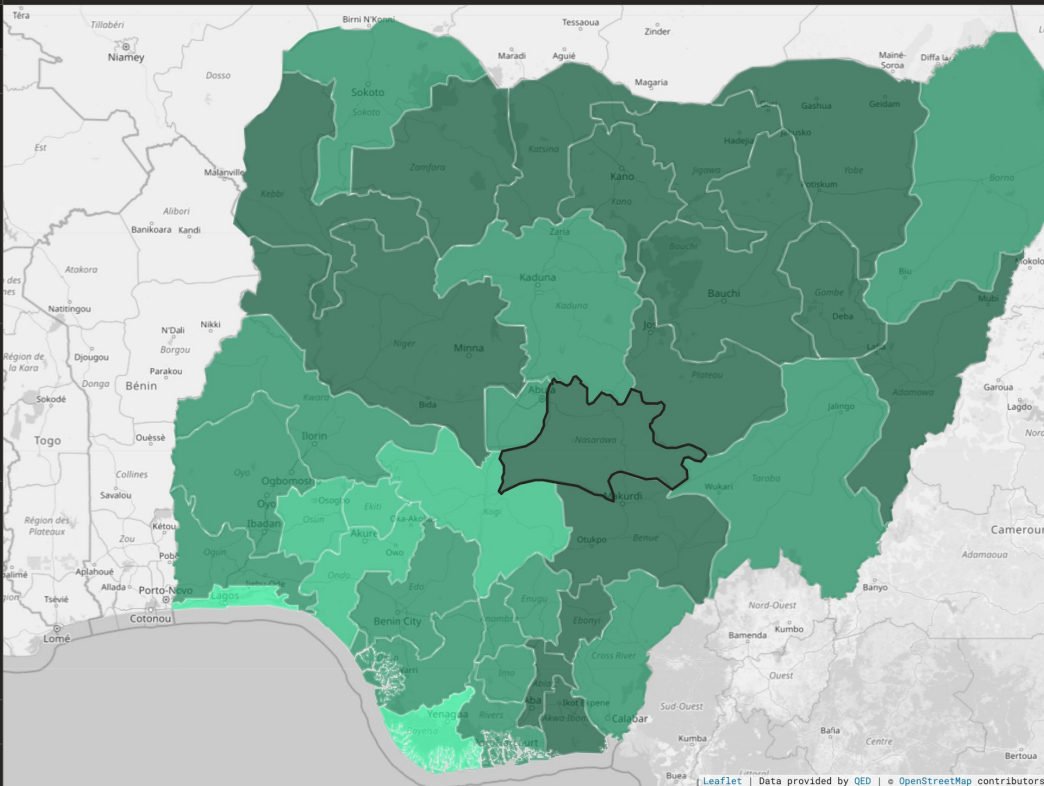
Cropland percentage

53.05 %



Zoom in

Zoom out



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.



[Visualizations by Country](#) [Visualizations by Topic](#) [Plant Directory](#) [Resources](#) [Events](#) [About](#) [EN](#) [FR](#)

|| Nigeria Fertilizer Dashboard

[Home](#) [Fertilizer Price](#) [Fertilizer Use](#) [Fertilizer Availability](#) [Plant Directory](#) [About us](#) [Datasets](#) [Help](#)

Fertilizer Use

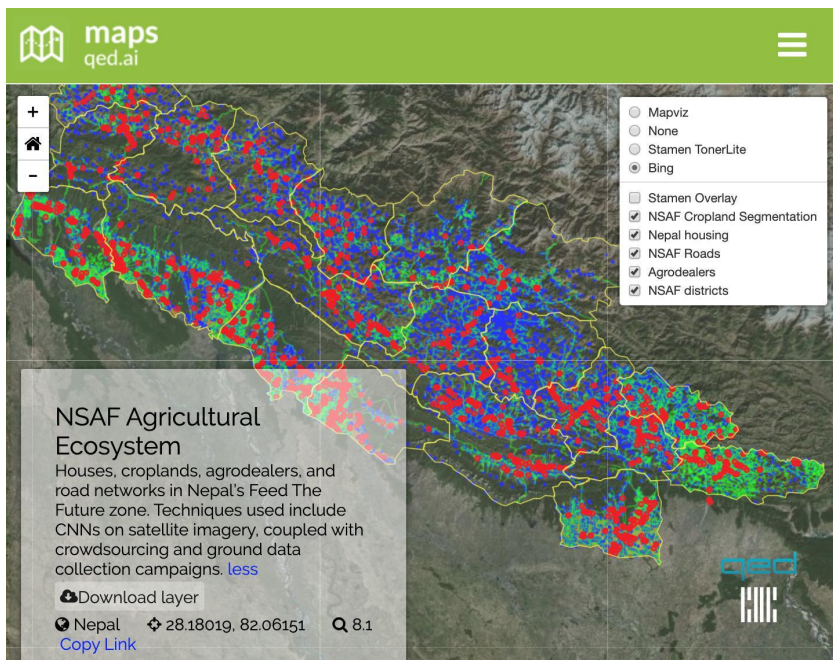
This Page visualizes key fertilizer use information for Nigeria. Scroll down to explore the data, or jump to a specific chart.

- [▶ Apparent Fertilizer Consumption](#)
- [▶ Domestic Urea Consumption Over Time](#)
- [▶ National Cropland Under Production](#)
- [▶ National Average Apparent Fertilizer Consumption – by Nutrient Ton](#)
- [▶ National Average Fertilizer Consumption – by Product Ton](#)

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>

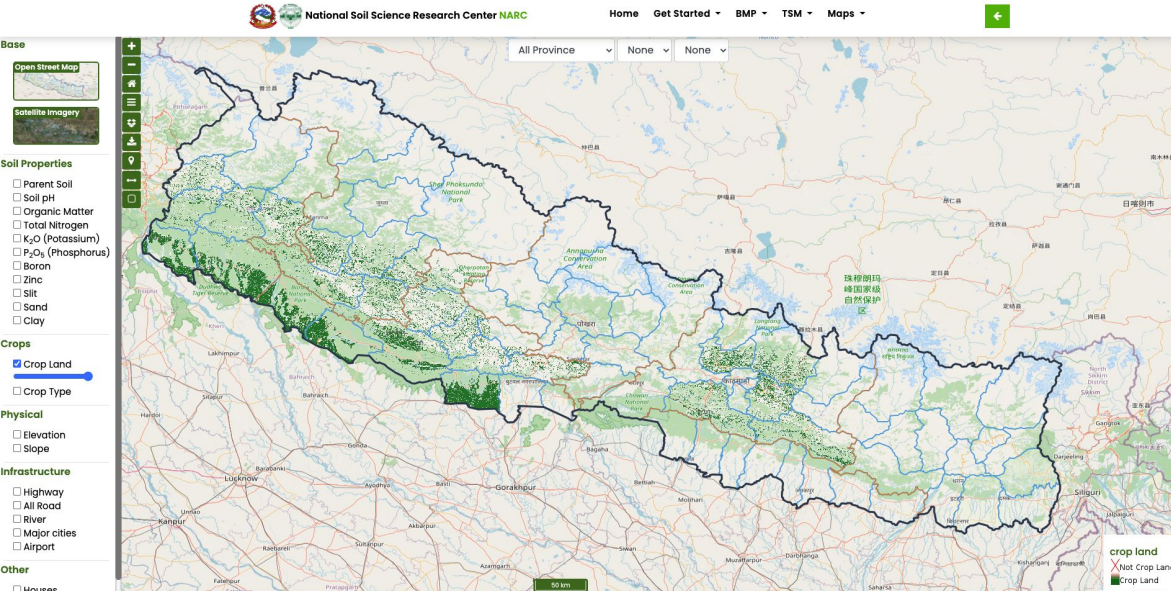


interactive maps of all crops, buildings, soils, roads, agro-dealers, food processors, financial facilities, etc. throughout Nepal, to advance geospatial agricultural intelligence for public & private sectors



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

ODK Collect > Main Menu

ODK Collect 1.4.5 (1048)
Data collection made easier...

→ Fill Blank Form

Edit Saved Form

Send Finalized Form

Get Blank Form

Delete Saved Form

ODK Collect > Fill Blank Form

Finished scanning. All forms loaded.

Cob count
Added on Tue, Jul 28, 2015 at 12:01

Crop scout
Added on Tue, Jul 28, 2015 at 11:13

Soil sample ←
Added on Sat, Aug 08, 2015 at 05:27

ODK Collect > Soil sa...

Go To Prompt

You are at the start of Soil sample.
Swipe the screen as shown below
to go backward and forward.

backward to previous prompt

forward to next prompt

ODK Collect > Soil sa...

Your name?
A short, consistent alias might be easiest

Mgw ←

and the to

q w e r t y u i o p

a s d f g h j k l

↑ z x c v b n m ↵

123 Sym

English (UK)

ODK Collect > Soil sa...

Record plot centerpoint location
Stand at center of the plot you are sampling

→ Replace Location

Latitude: S 3°24'31"
Longitude: E 36°33'4"
Altitude: 1348.01m
Accuracy: 4m

ODK Collect > Soil sa...

Select sample depth interval (in cm)

☒ 0-20 cm ←

☐ 20-50 cm

☐ Other

ODK Collect > Soil sa...

Scan sample label
Bag and tag

→ Get Barcode



TZ-hSkLbc

ODK Collect > Soil sa...

You are at the end of Soil sample.

Name this form
Soil sample

☒ Mark form as finalized

→ Save Form and Exit



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.

Fertilizer Cost Build-Up, Ghana 2020

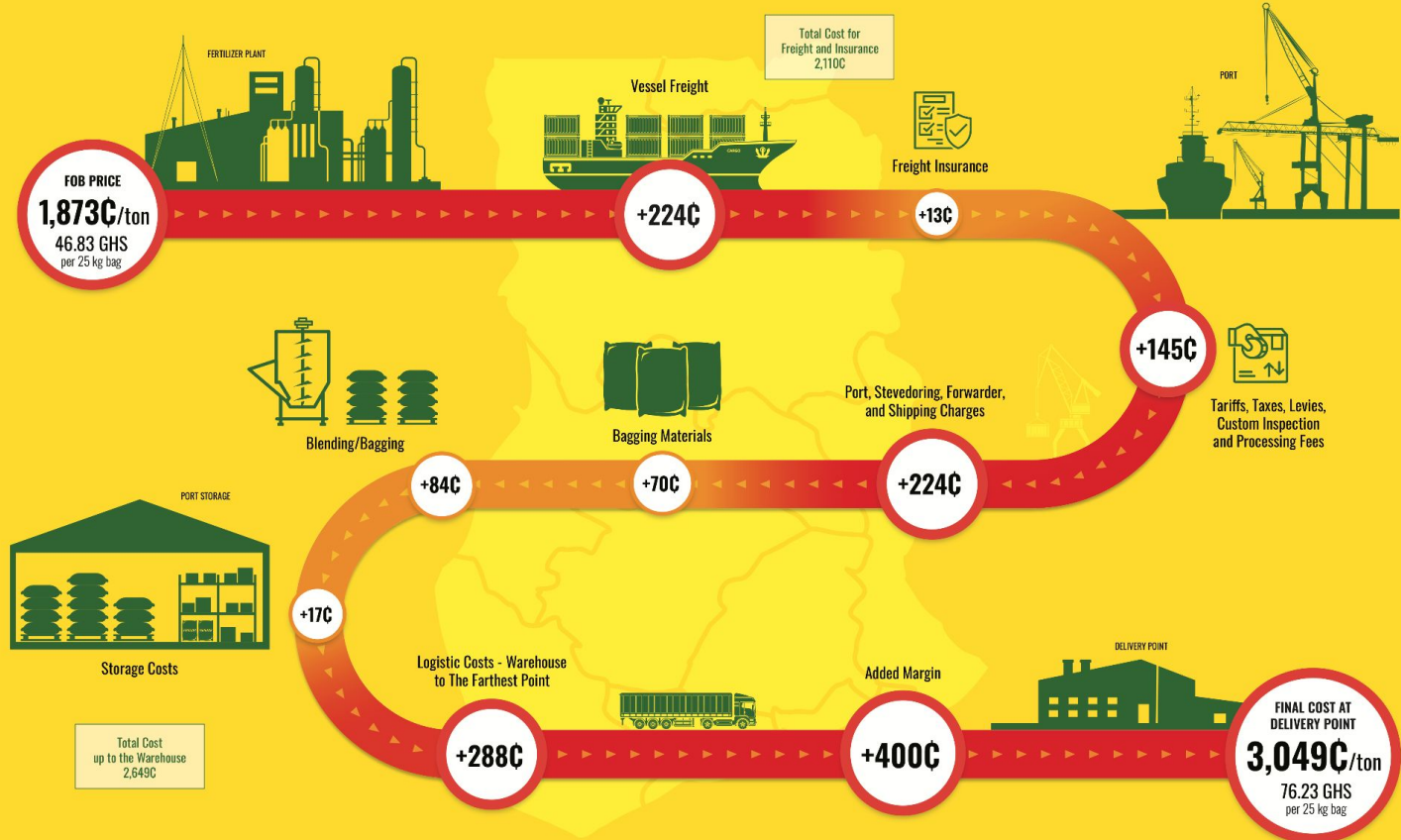
Product: NPK 11-22-21 + 5S + 0.7 Zn + 0.5 B



qed
QUANTITATIVE ENGINEERING DESIGN



African Fertilizer and Agribusiness Partnership
afap
Partnerships. Productivity. Prosperity.





Plant telemedicine:

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

Create Sample

Vegetable Doctor

What kind of plant is it?

☐ Beetroot
☐ Carrot
☐ Lettuce
☐ Pepper
☐ Potato

Submit all the questions to proceed

geosurvey qed.ai

Dashboard Forum Admin How It Works Feedback Log Out

Upper leaves, Lower leaves or All leaves?

Upper leaves Lower leaves All leaves

Any other colors on the leaves?

Yes No

What color/s do you see in the upper part of the leaves?

White/Yellow (Iron) Bright Yellow (Sulfur) Brown (MLND) None above

Any holes on the leaves?

Yes No

Stemborer or hail damage or armyworms?

Stemborer Hail Fall Armyworms None above

Are there tears along the edges?

Yes No

Calcium or hail damage or

Longitude: 35.006018
Latitude: 0.814655
Zoom Level: 19
Country: Kenya
Side length of box: 10000m
Submitter: oaf59
Taken at: 2017-11-16, 10:10 AM UTC
Description: teared leaves
maize_variety: SC DUMA 43
disease_prevalence: low
district_name: Ndalul
OAF_ID: 76331

Map data ©2018 Google Imagery ©2018 CNES / Airbus, DigitalGlobe

Leaflet Survey Discuss

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
Google



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](#)

built-in help menus and tutorials for plant epidemiology



Purple
(Phosphorus)



Red, purple, yellow
(Magnesium)



Yellow/brown down
the middle (Nitrogen)



Yellow/brown along the
edges (Potassium)

In the box:

(latitude, longitude)
-0.764838, 34.678611

Copy

Any other colors on the
leaves?

Yes

No

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Yes (Stem Borer)

No

Any spots on the leaves?

Yes

No



Discussion, Questions and Answers

web: <https://qed.ai>

email: info@qed.ai