Using GIS in RPW eradication

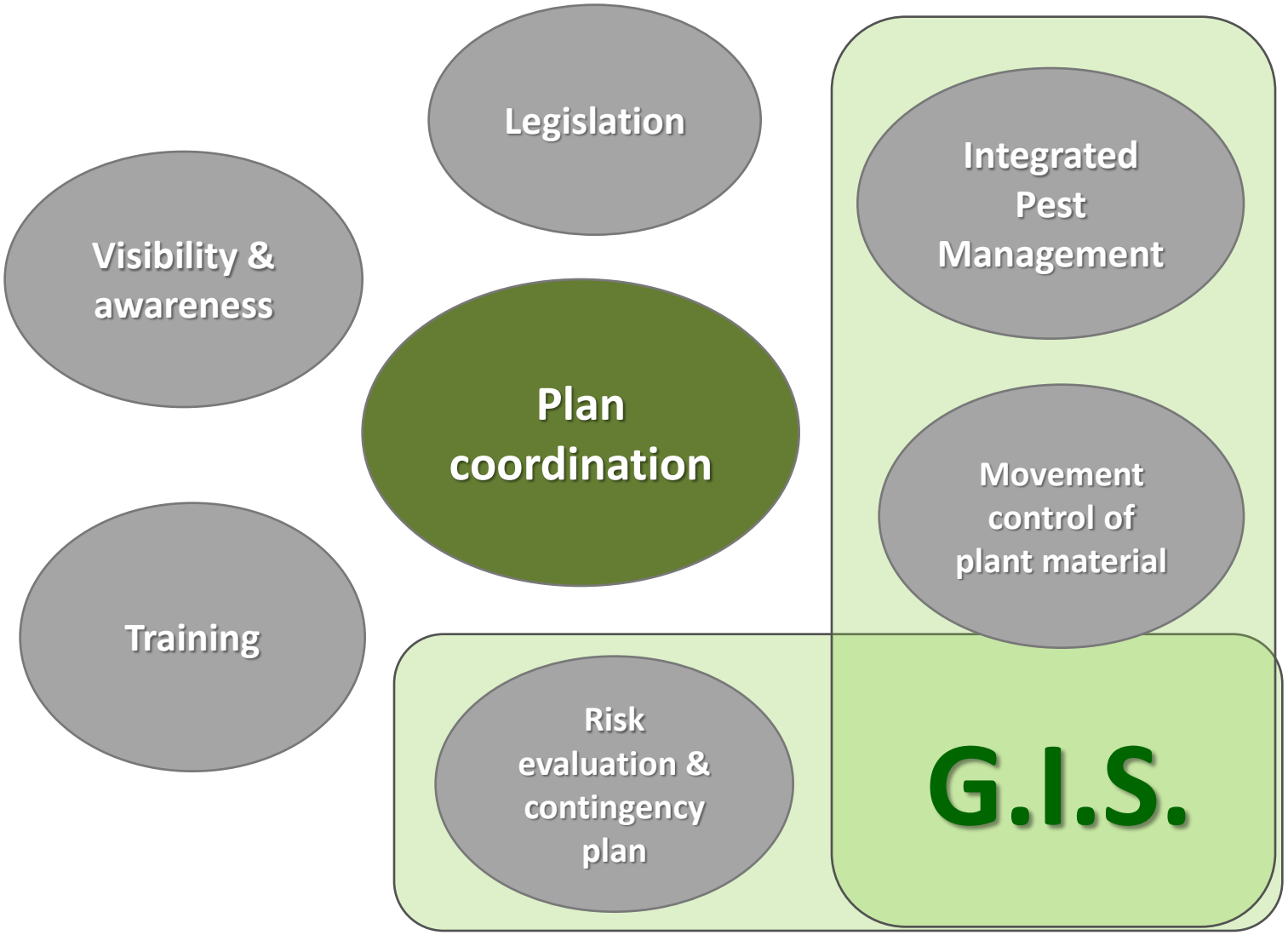
Scientific Consultation and High-Level Meeting
on Red Palm Weevil Management

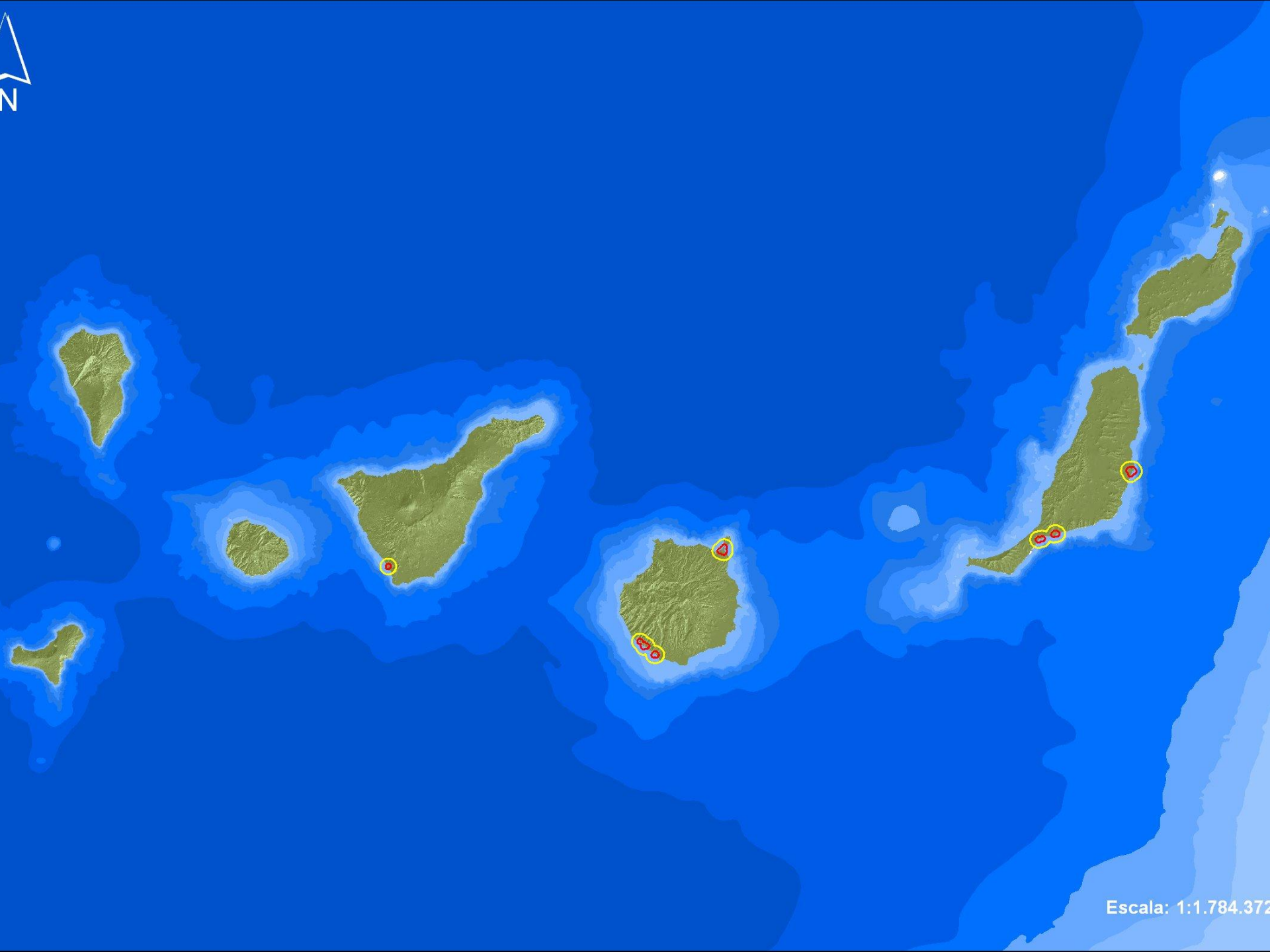
Rome, 29–31 March 2017

Moisés Fajardo

Project Manager
RPW Eradication Programme
Canary Islands

RPW eradication program in Canary Islands

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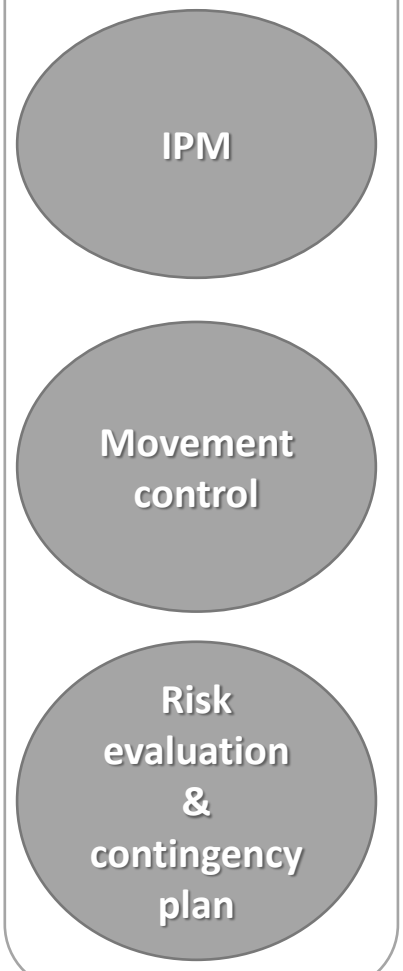
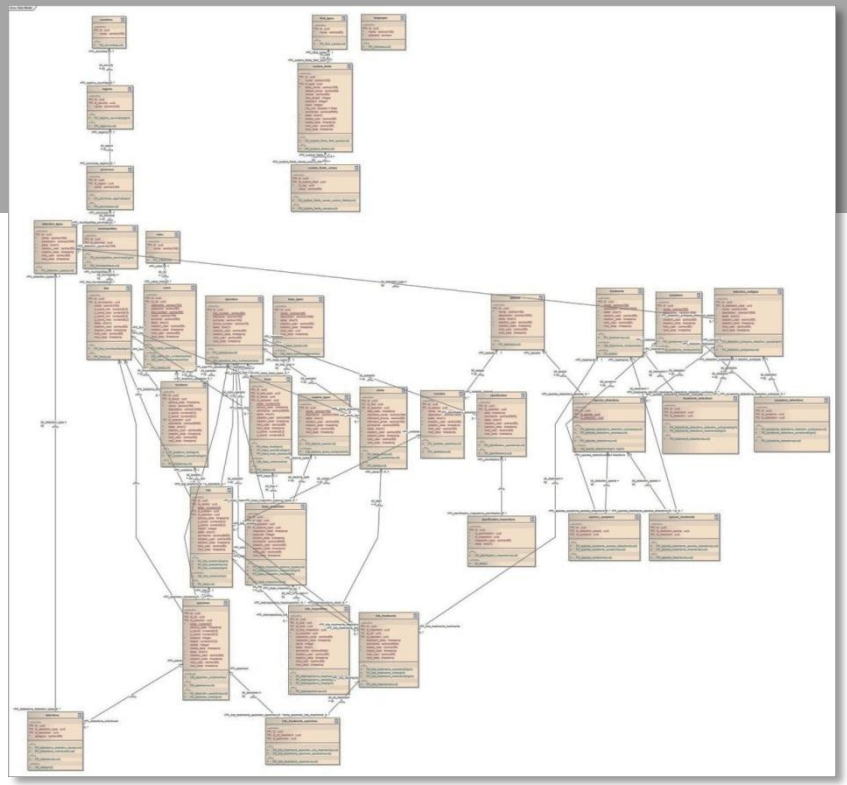
Geographic Information System (GIS)



1. Database
2. Mobile application
3. Web application
4. Web viewer

1. Database



ELEMENTS

Traps, palm lots, farmers, nurseries

ACTIVITIES

Chemical treatments, inspections

RESULTS

Catch, inspection results

RESOURCES

Workers, chemical products, trap types

2. Mobile app

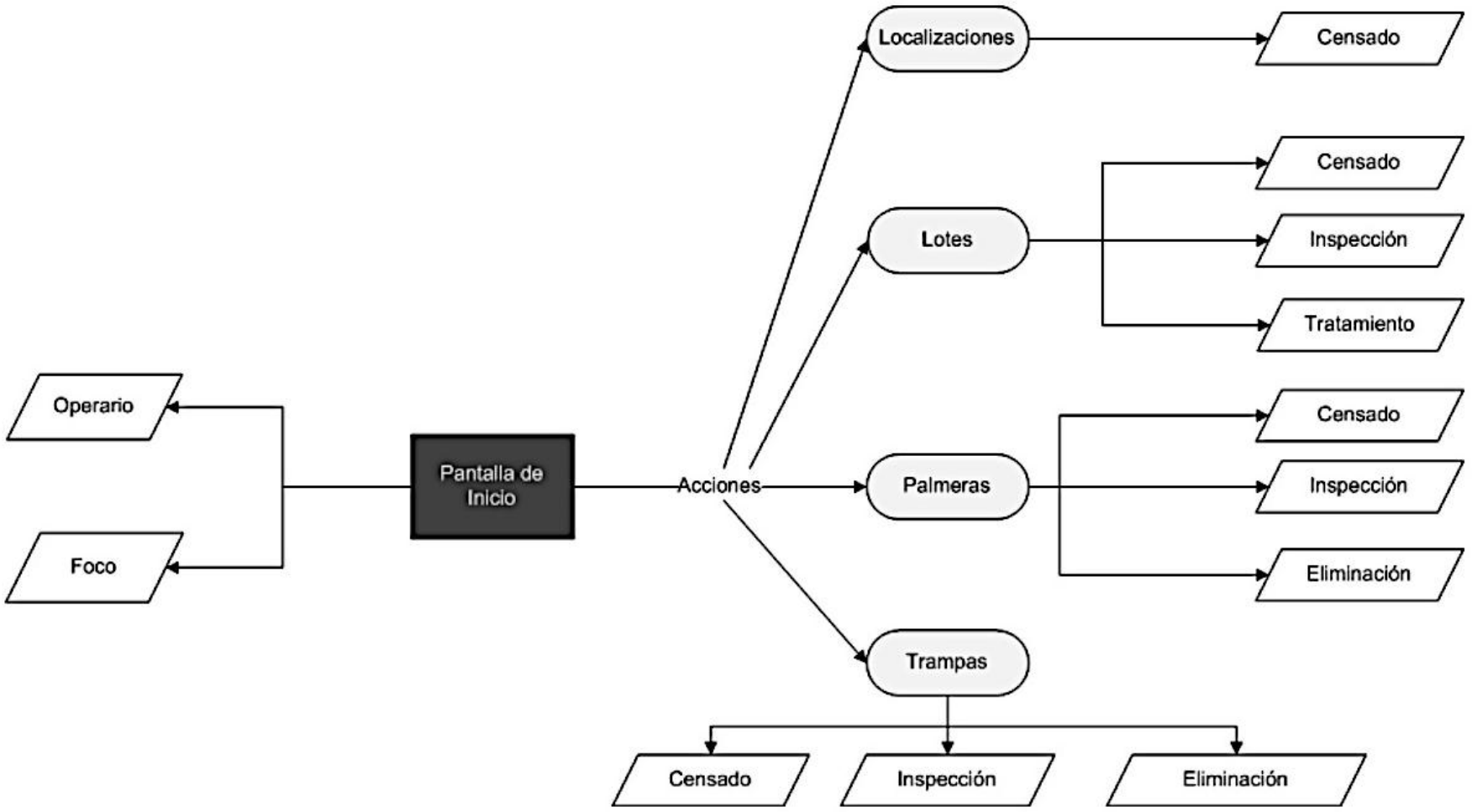
PDA DELL Axim v51
field data collection

VISUAL STUDIO
programming

ULTRALITE
database

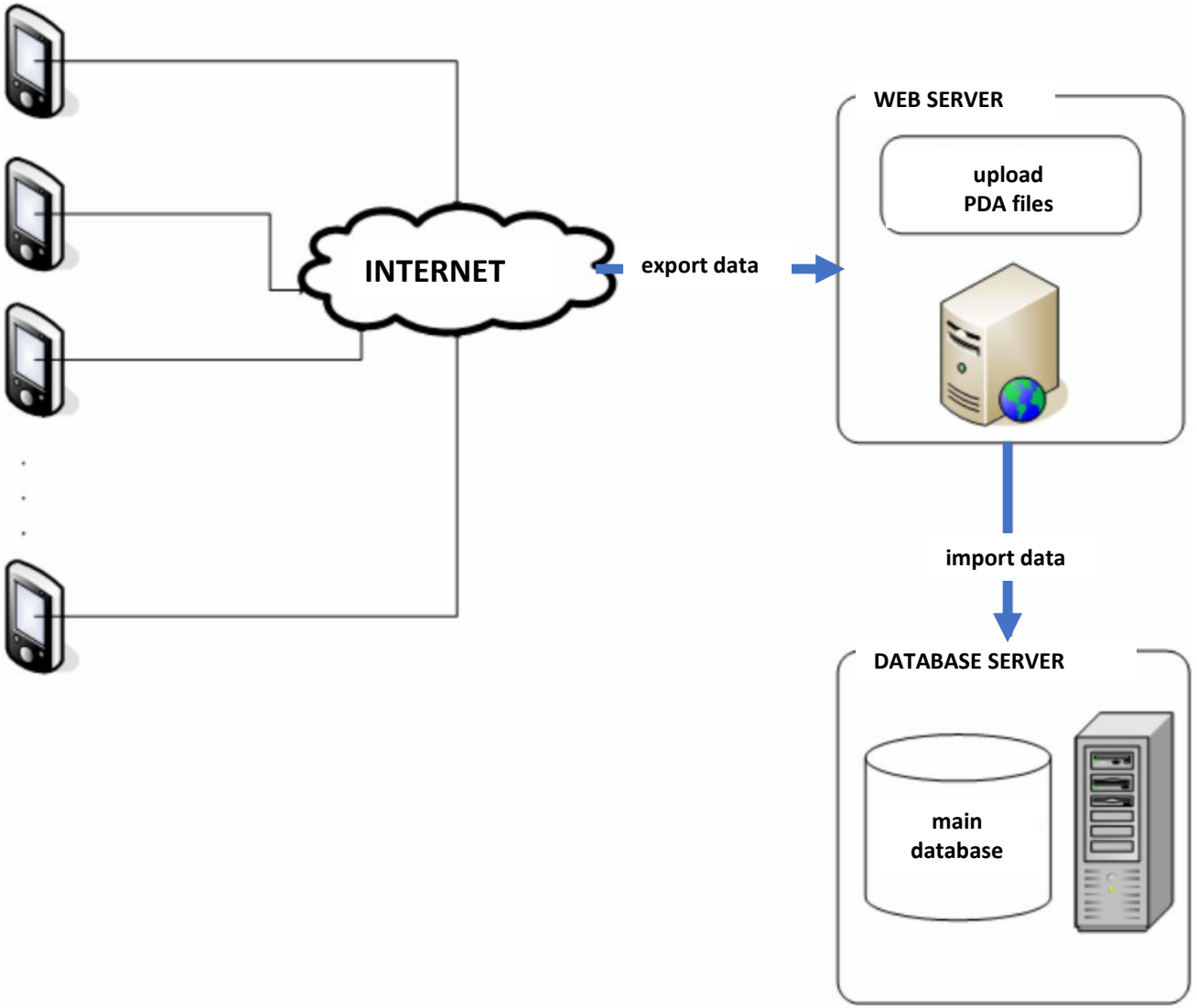
2. Mobile app

SCREENS



2. Mobile app

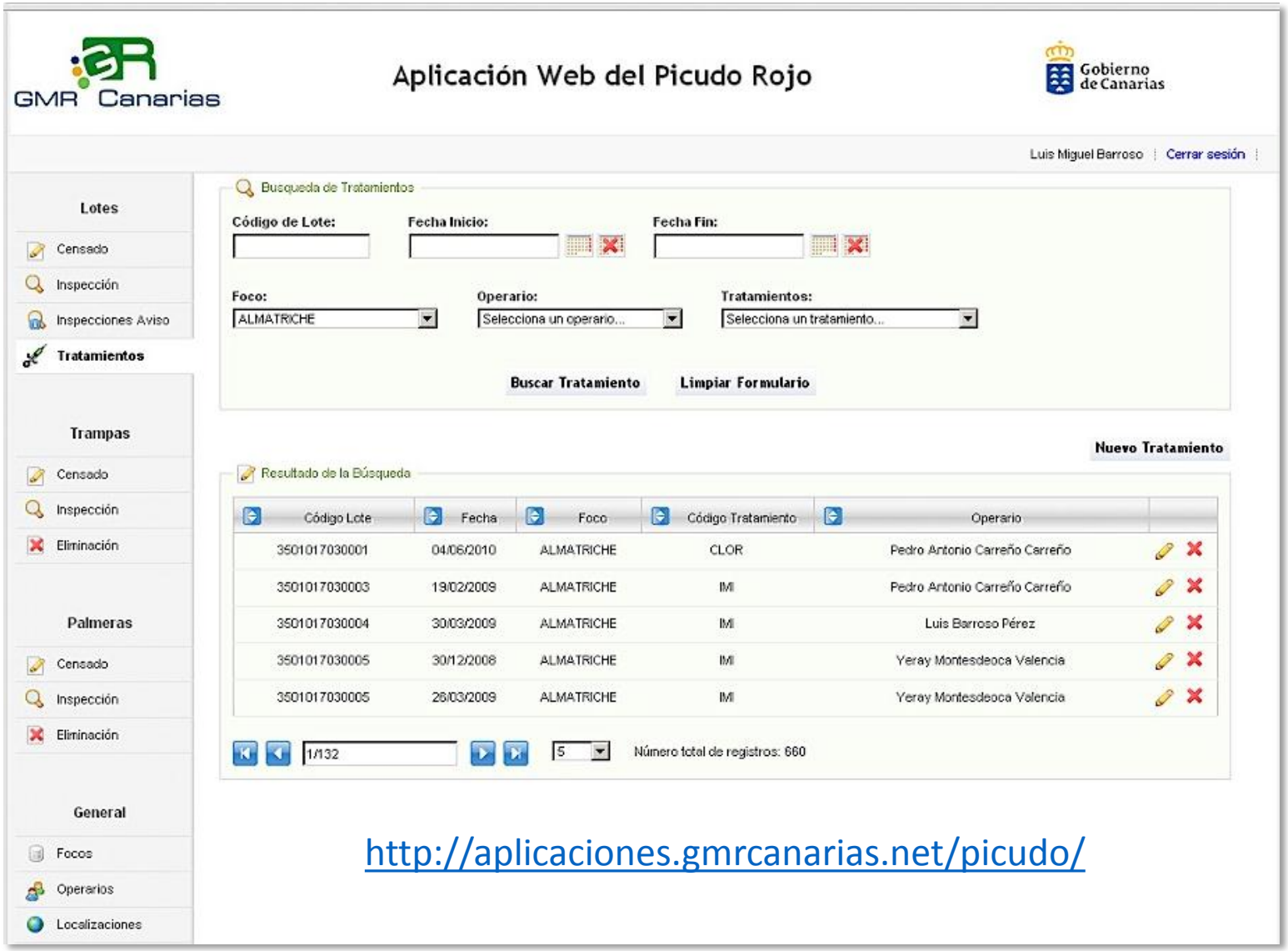
DATA SUBMISSION VIA INTERNET



3. Web application

EDIT & QUERY DATA

- Entry
- Edit
- Query
- Tables
- Graphs
- Reports



http://aplicaciones.gmrcanarias.net/picudo/

4. Web viewer

VIEW & QUERY ONLY

DATA ARCHIVE

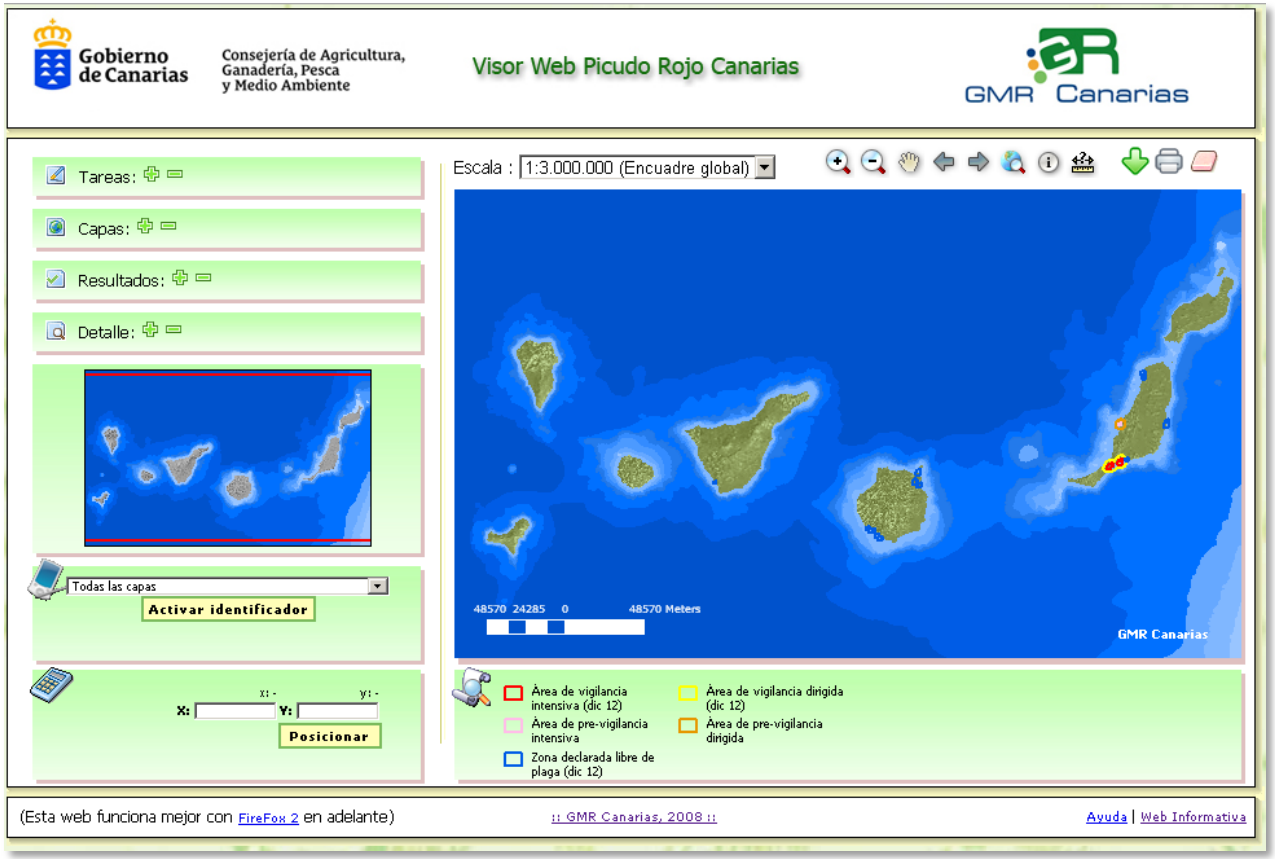
- Lots, palm trees, traps

QUERIES

- Palm trees removed (by date)
- Traps (per catch number)
- Traps with capture (by date)
- Performed work (by lots)

NEW LAYERS

- ArcGIS 9.2
- ArcSDE
- SQL server
- GIS server

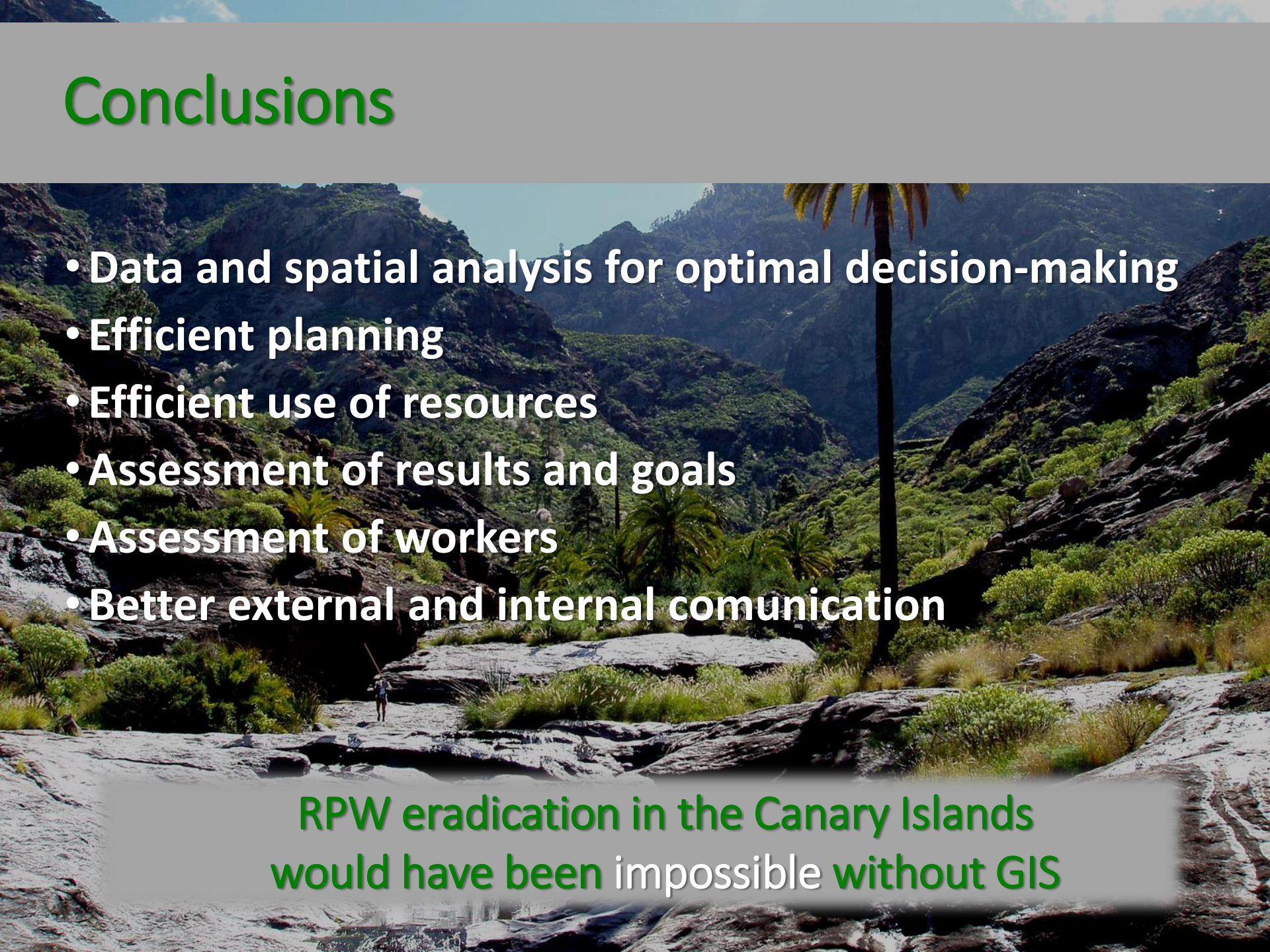


http://visorpicudo.gmrcanarias.com/mapviewer.jsf

Lessons learned

- Open source software
- GSM mobile data service (GPRS)
- Viewer in mobile application
- Planning module
- Export to spreadsheet
- Technicians training

Conclusions



- Data and spatial analysis for optimal decision-making
- Efficient planning
- Efficient use of resources
- Assessment of results and goals
- Assessment of workers
- Better external and internal comunication

RPW eradication in the Canary Islands would have been impossible without GIS

Food and Agriculture Organization of the United Nations

CIHEAM

Scientific Consultation and High-Level Meeting on Red Palm Weevil Management

Innovative solutions using modern technologies (Remote Sensing, GIS) for RPW data management and analysis

- Keith Cressman / Kiran Viparthi (FAO)


SITUATION REPORT 001 30 MARCH 2017

Red Palm Weevil

Global Watch

CAUTION

Saudi Arabia

Current situation

Increased RPW activity in the Arabian Peninsula, new infestations reported in NW Africa and SE Asia.

Recent reports suggest that there has been an increase in RPW infestations in the major date palm producing areas of **Saudi Arabia** (Gassim, Al Ahsa) and in parts of the **UAE** (Al Ain). Additional teams have been mobilized to enhance monitoring and treatment. New reports of RPW have been received from **Morocco** (south of the Atlas Mountains), **Algeria** (central Sahara oases), **Tunisia** (Tozeur) and **Mauritania** (Adrar oases). Mitigation efforts are underway in all countries. Elsewhere, the situation remains calm.

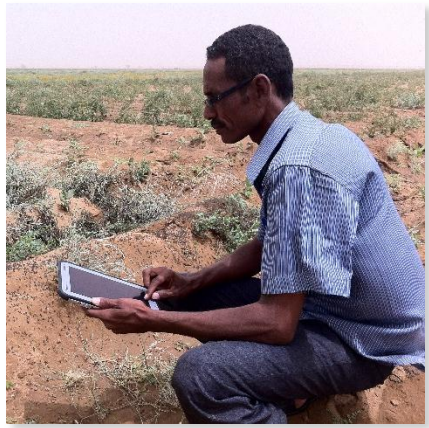
1. collect **2.** analyze **3.** output

information flow

do we really need to collect & analyze RPW data ?

- ✓ assess current situation
- ✓ identify hot spots
- ✓ evaluate spread of infestations
- ✓ plan field monitoring & control priorities
- ✓ determine resource requirements
- ✓ implement multiregional, multidisciplinary strategy
- ✓ carry out early warning & preventive control

standardization = global success



DATA
standard format

ANALYSIS
uniform database

TRAINING
harmonized material

SUPPORT
more effective

learning lessons ...
early warning & preventive control does work !

$570m

Desert Locust control campaign
2003–2005 in 23 countries

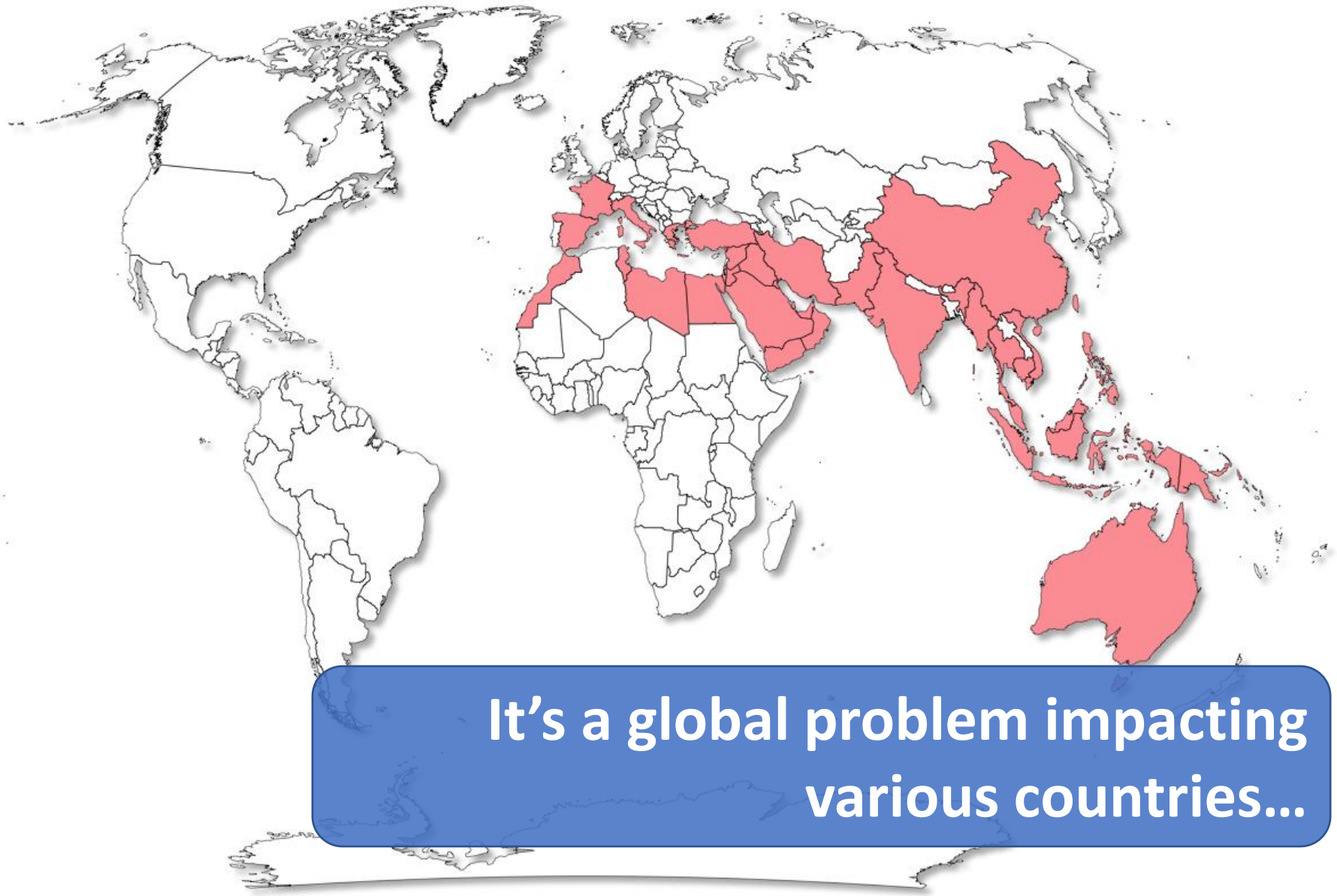
170 years

of preventive control
in 10 countries


How can we achieve
better management of RPW ?

Problem

Problem



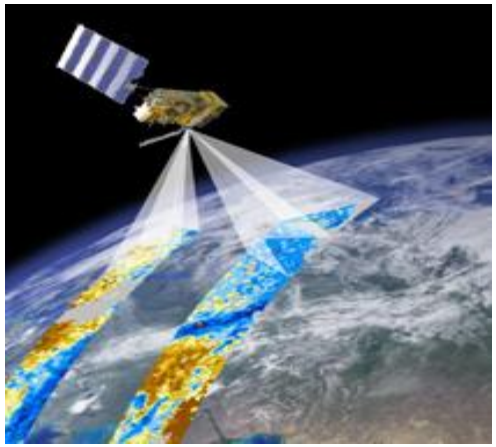
It’s a global problem impacting various countries…

Problem

And so needs management at various national, regional & global levels for better control and protection

Innovative solutions

Using modern tools & technologies in conjunction together with use of **FAO RPW management system** for day-to-day operations

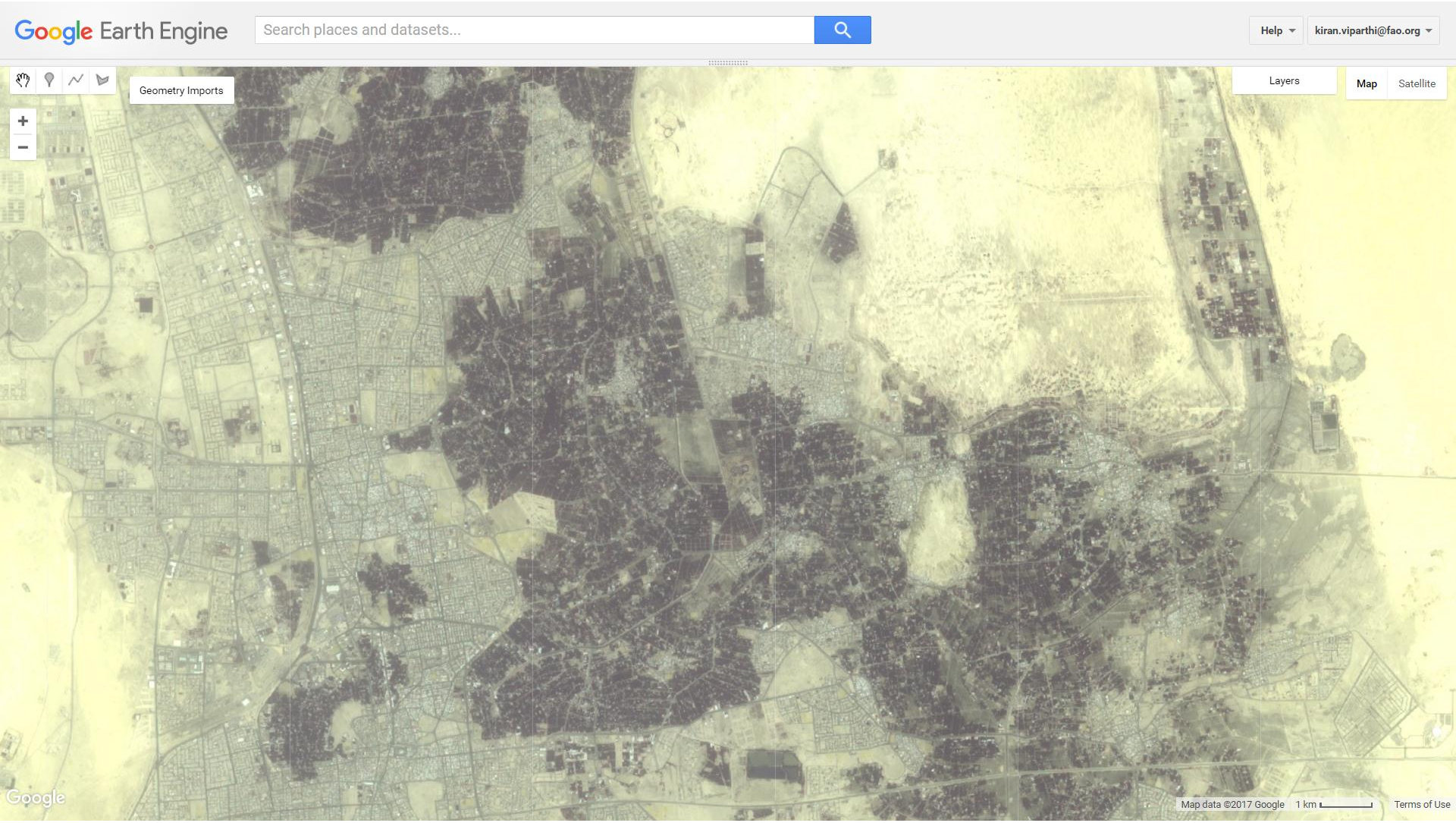


Remote Sensing & GIS

Mobile Data Collection

UAVs / Drones & IOTs

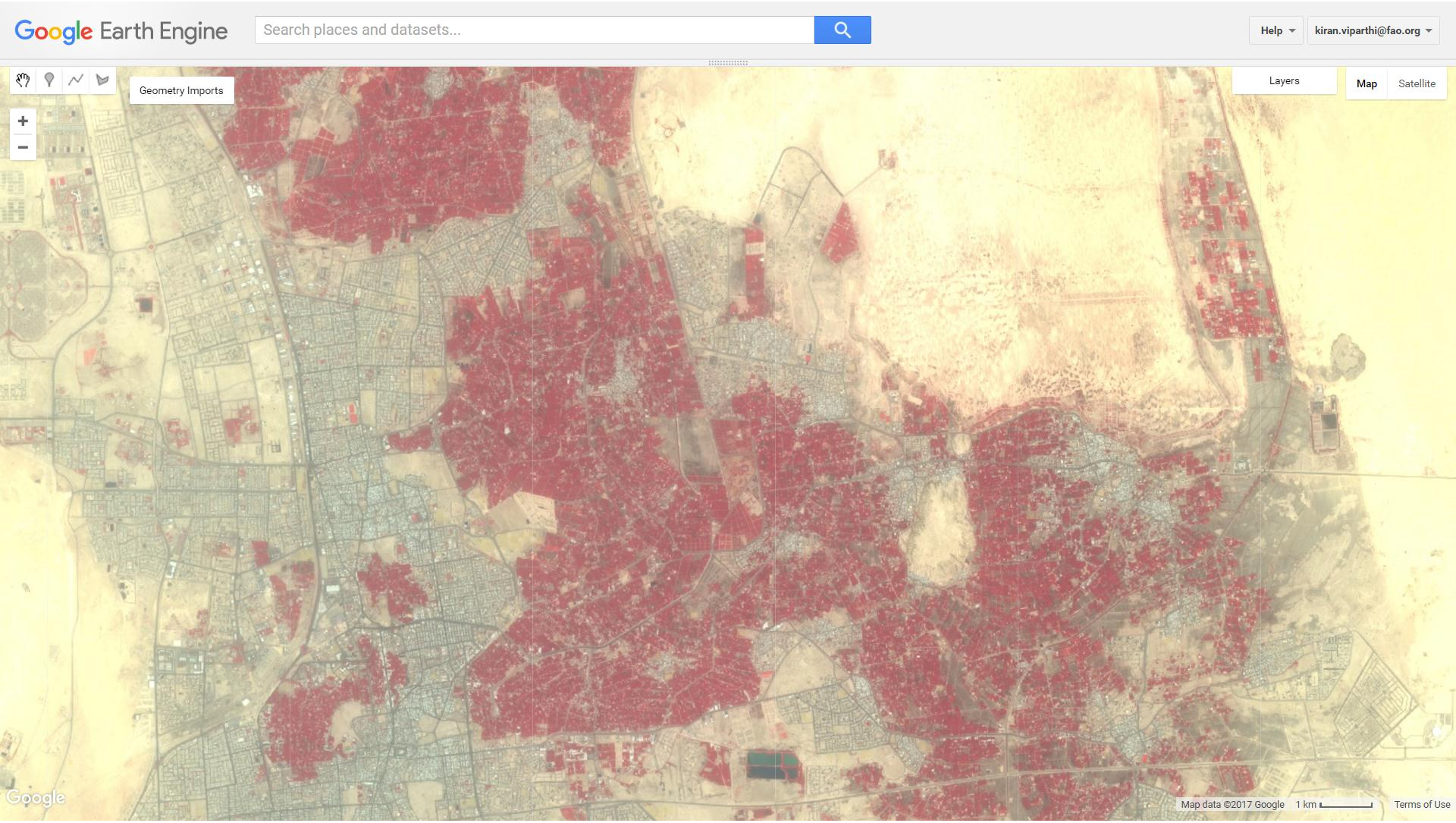
Remote Sensing – Satellite imagery



Sentinel 2 Satellite images

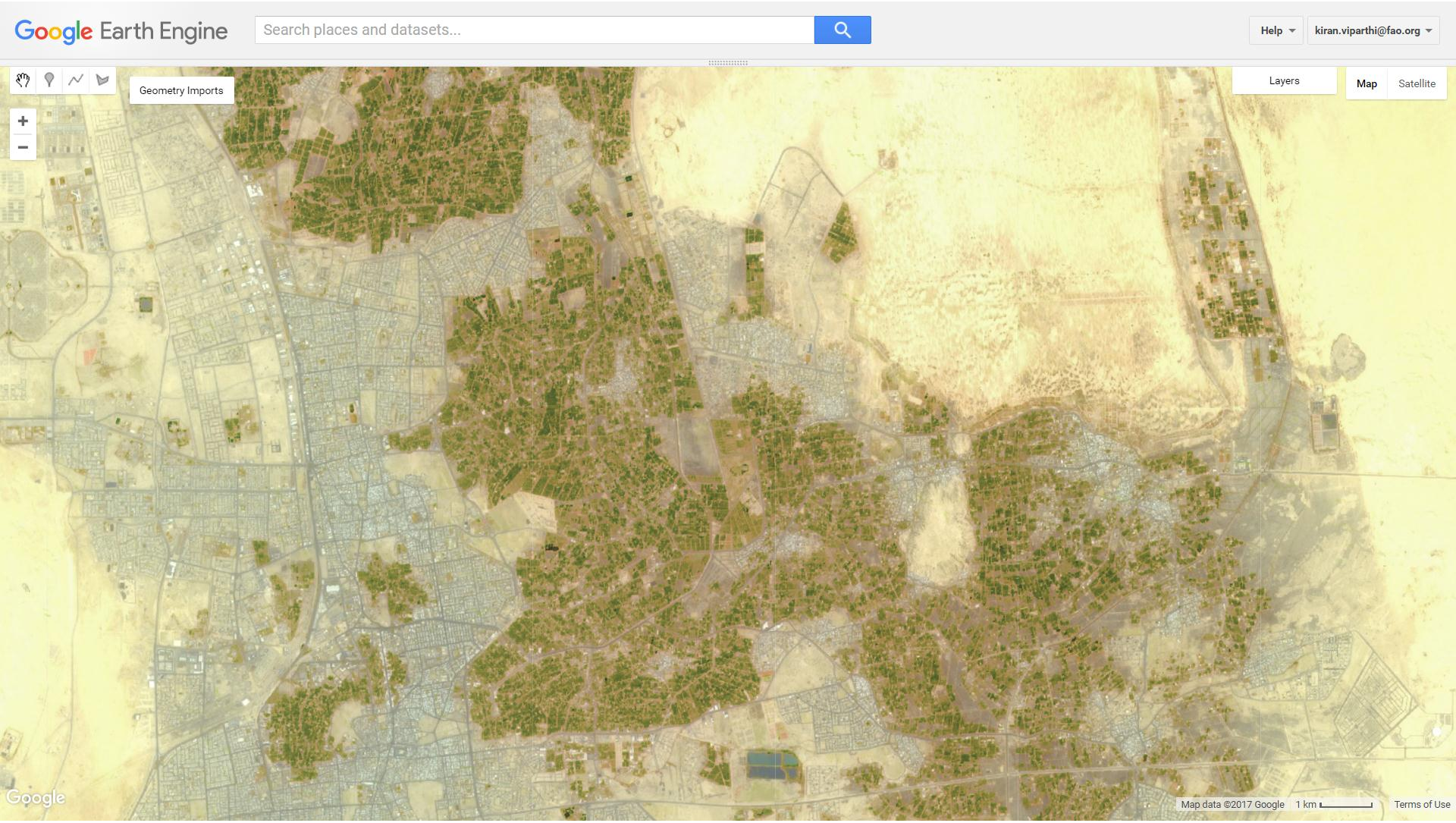
https://code.earthengine.google.com/24f282f82724f23b2e3ac58b7462b70b

Remote Sensing – Vegetation Identification



Using MIR and NIR infrared bands

Remote Sensing – NDVI / Classification models

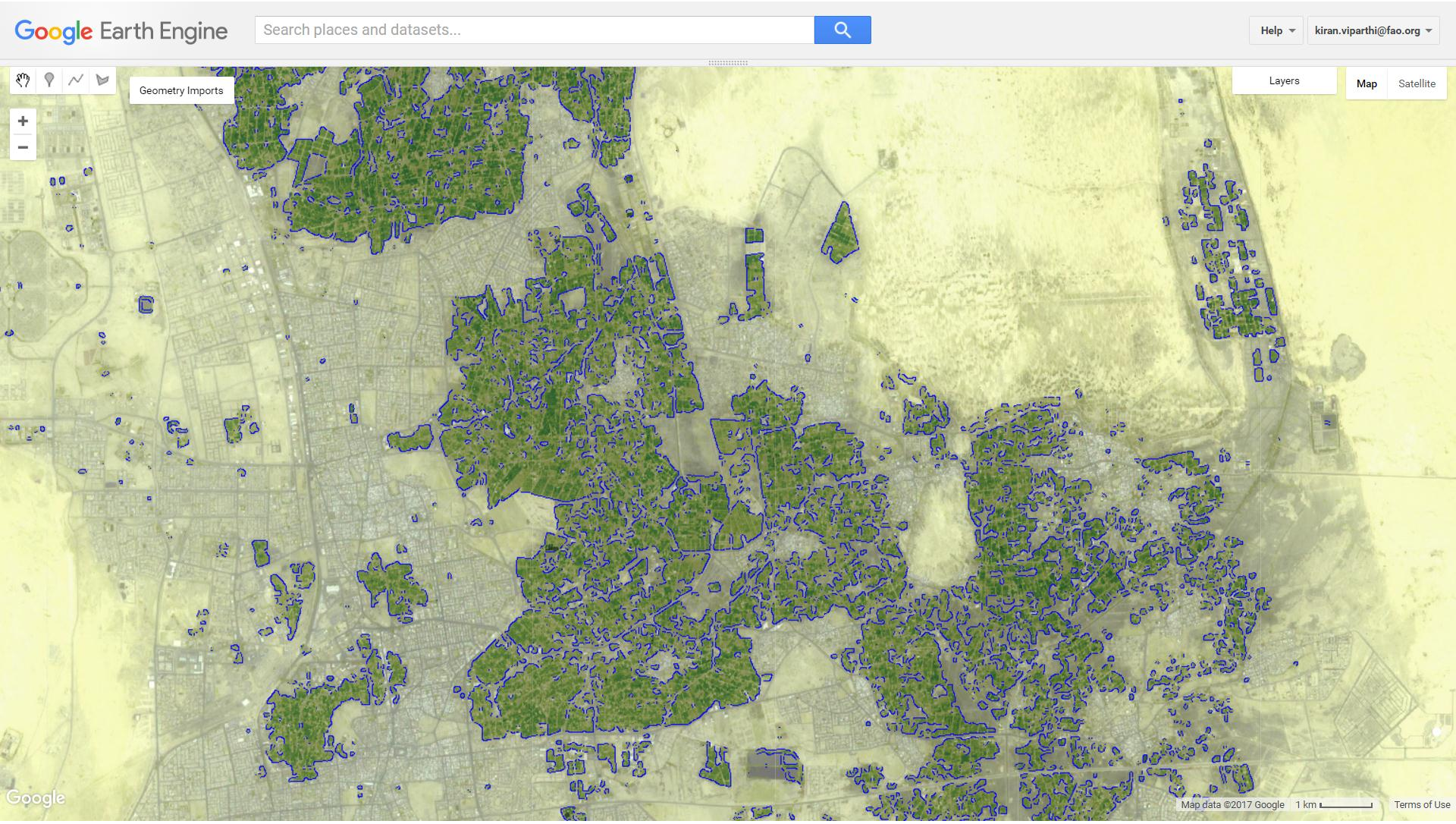


Applying normalized difference vegetation index (NDVI) and random forest classification

Remote Sensing – Vegetation Masking

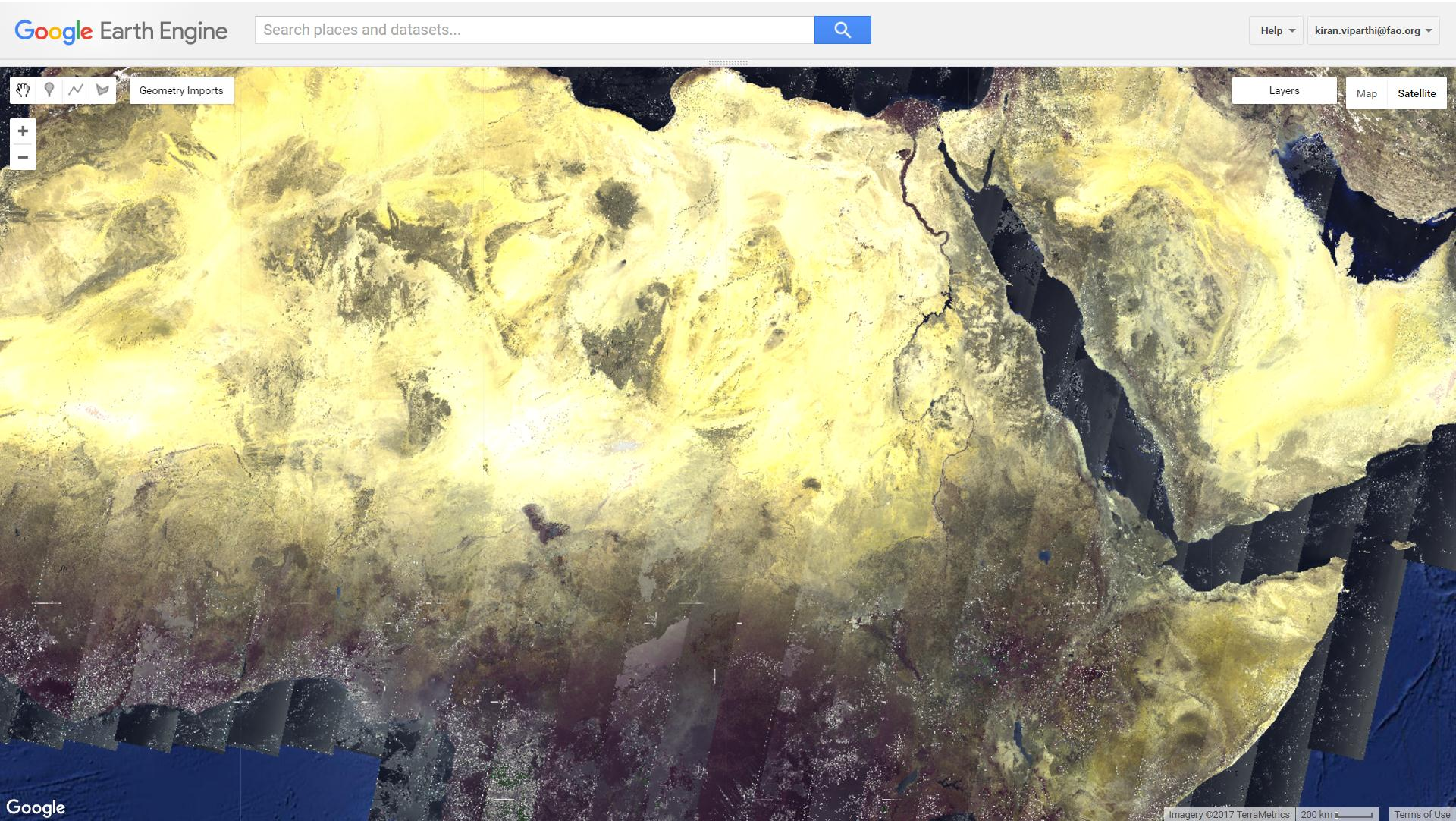
Reducing / Masking to select cropped zones

Remote Sensing – Area mapping

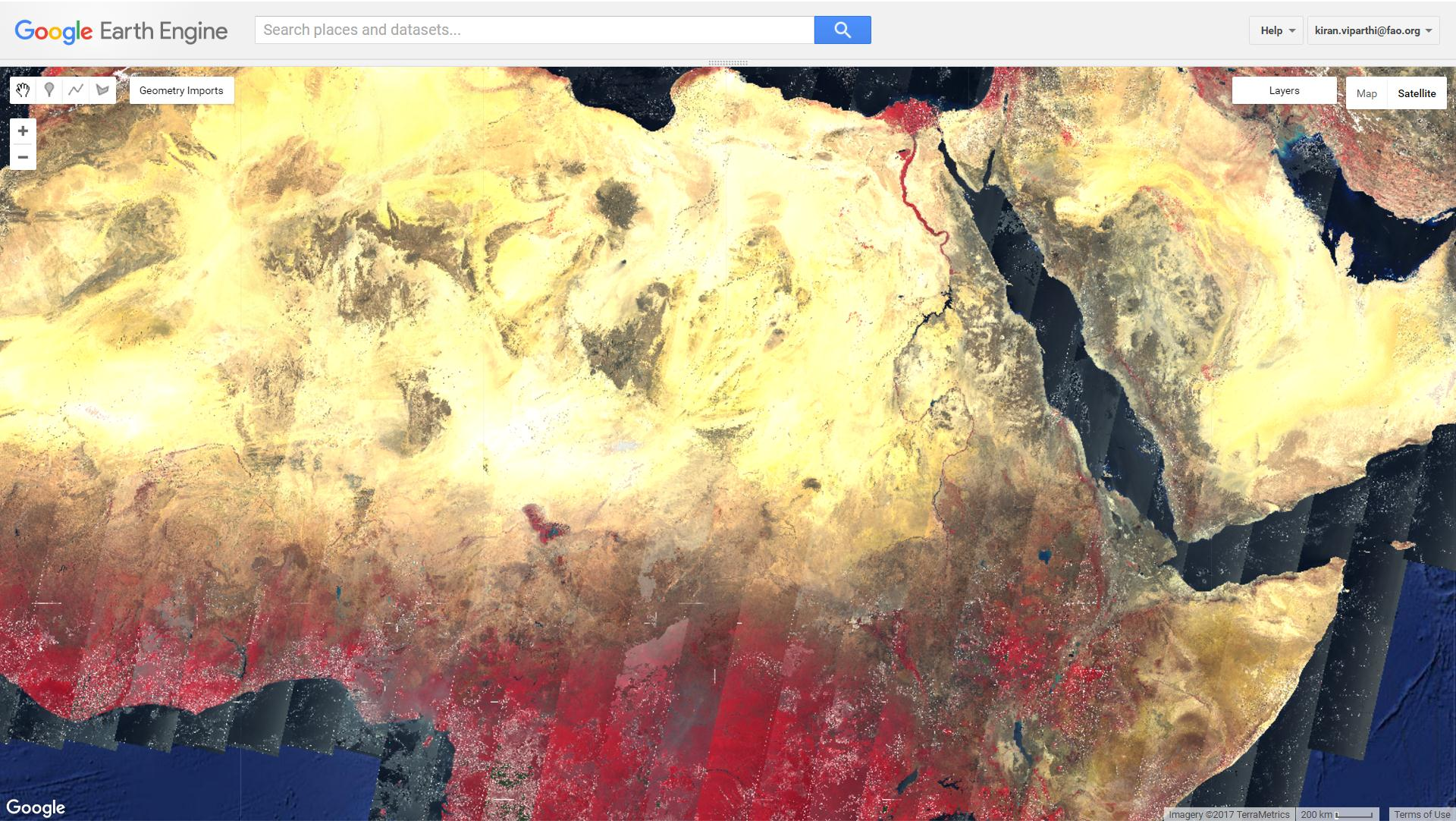


Applying Edge detection to map the areas

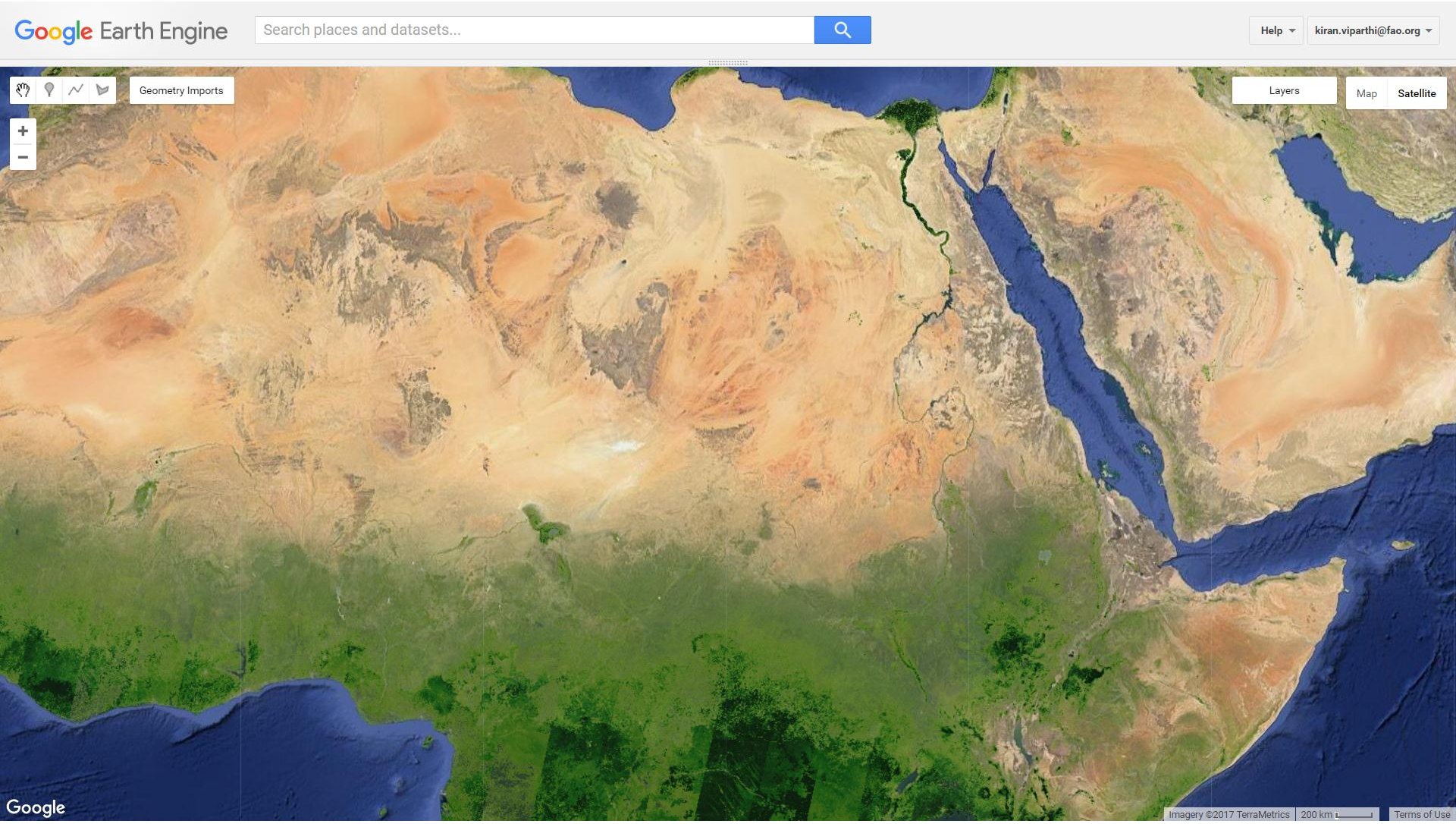
Remote Sensing – Scaled up



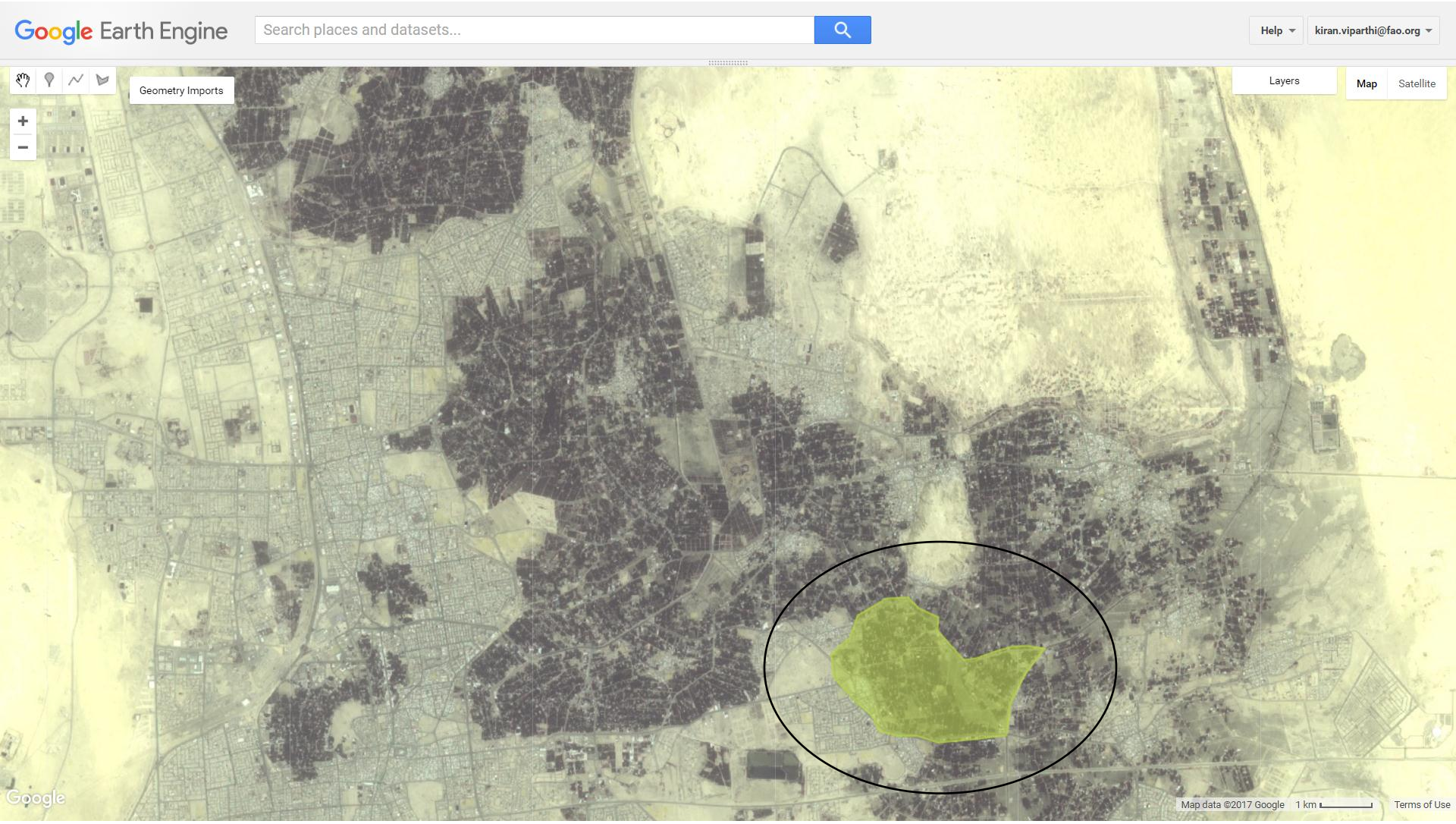
Remote Sensing – Scaled up



Remote Sensing – Scaled up

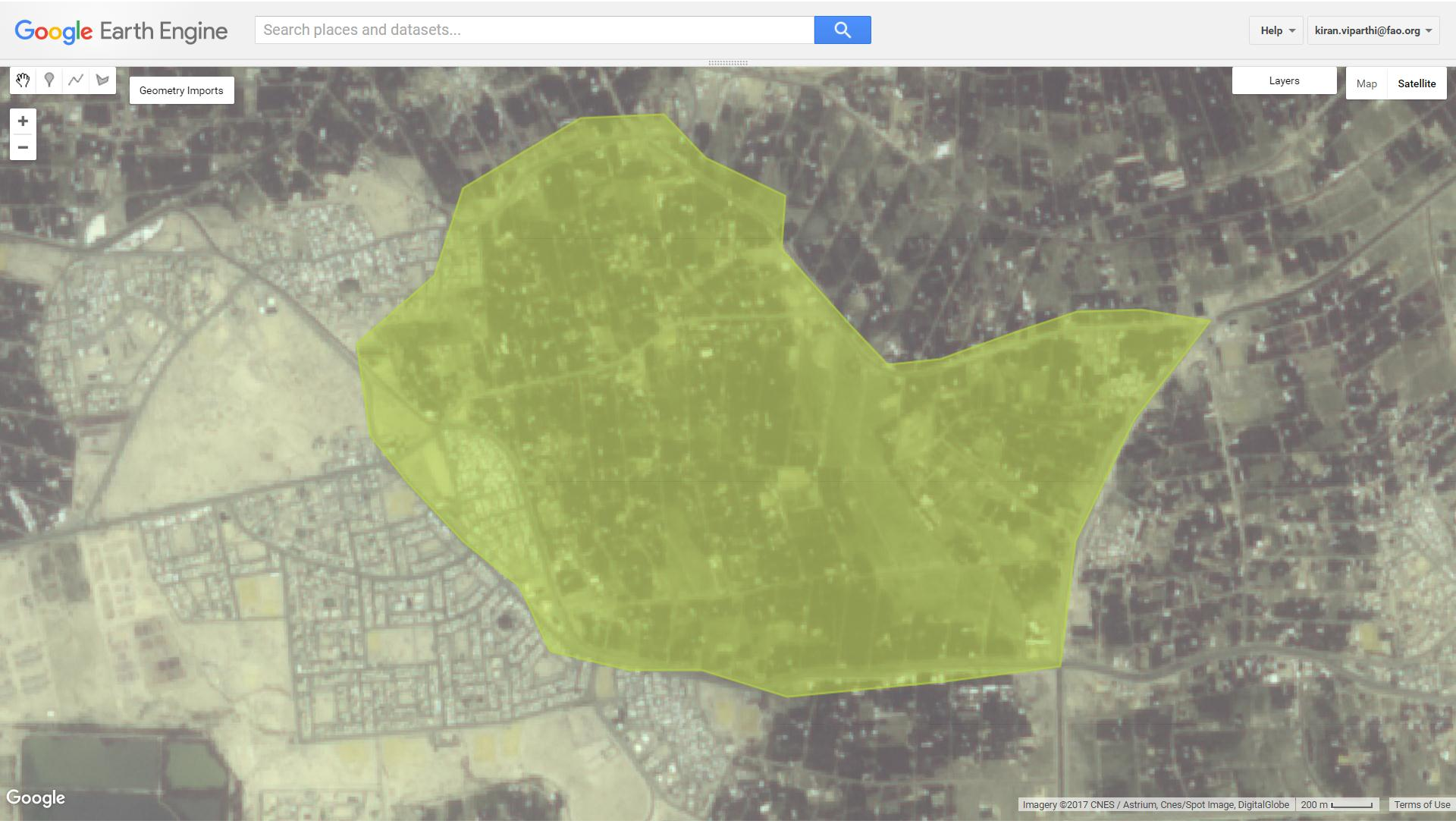


Remote Sensing – Focus Area



Sample area for demonstration purposes

GIS – Traps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200 m
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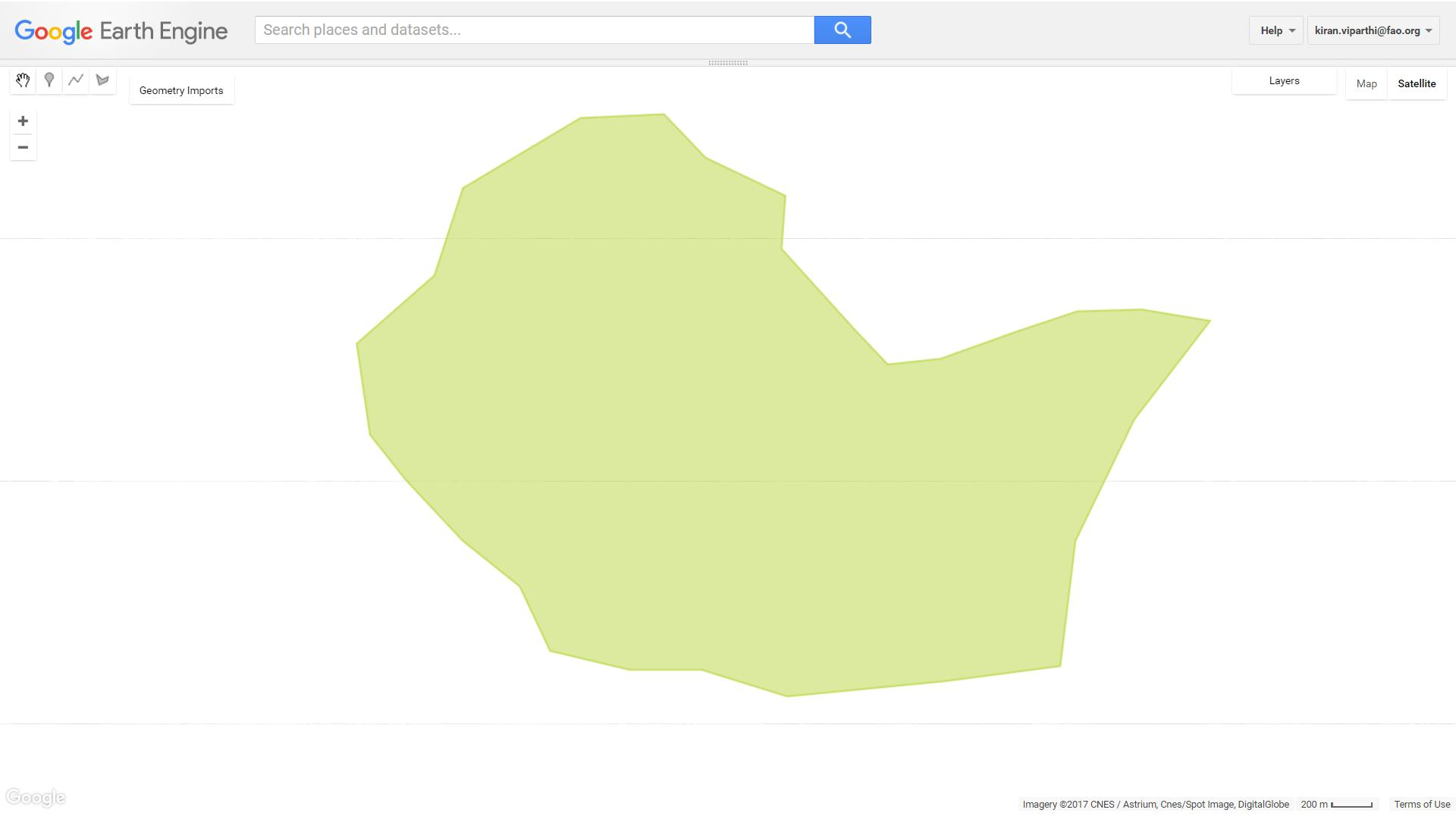
GIS – Traps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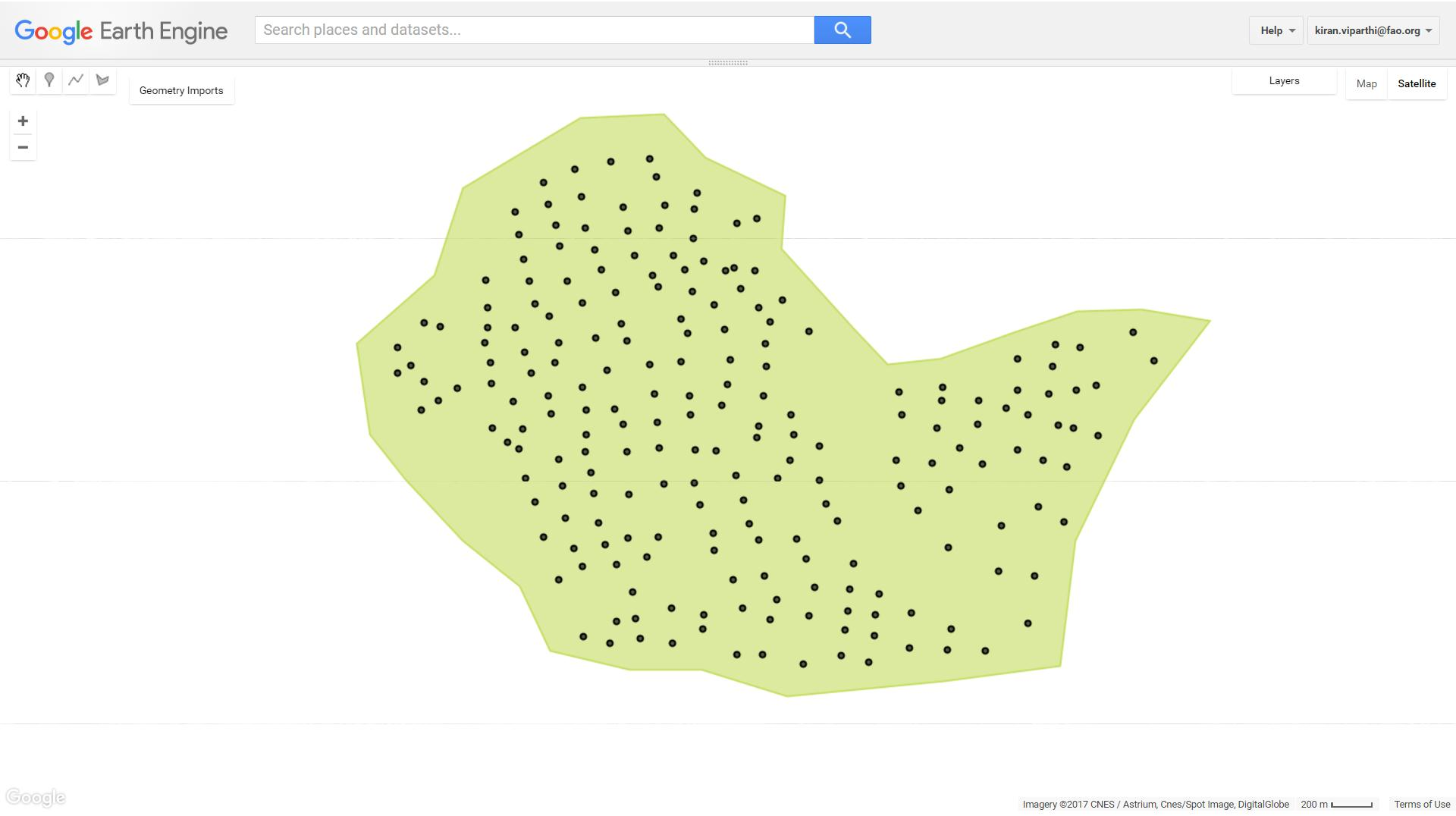
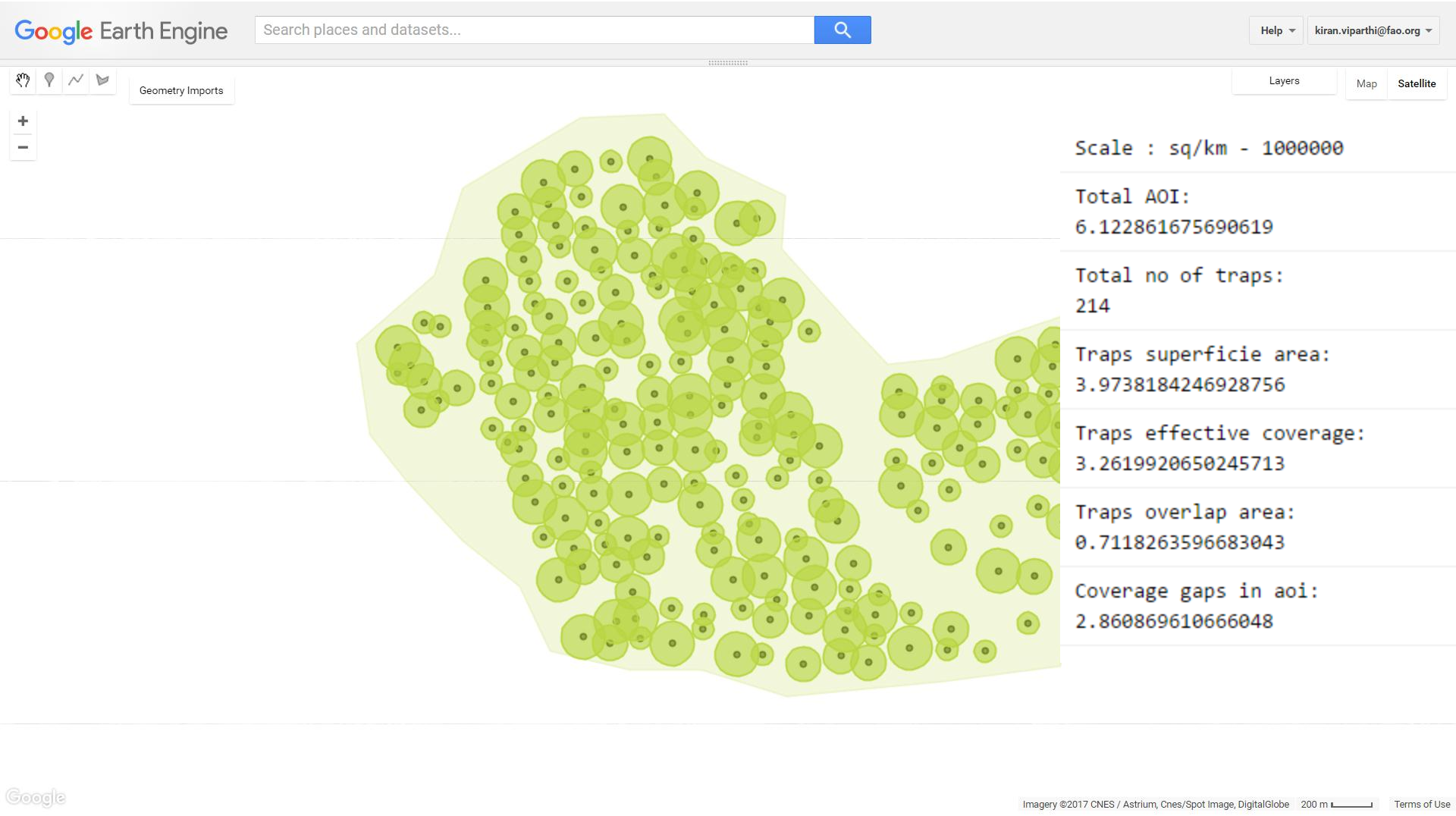
GIS – Traps Mapping

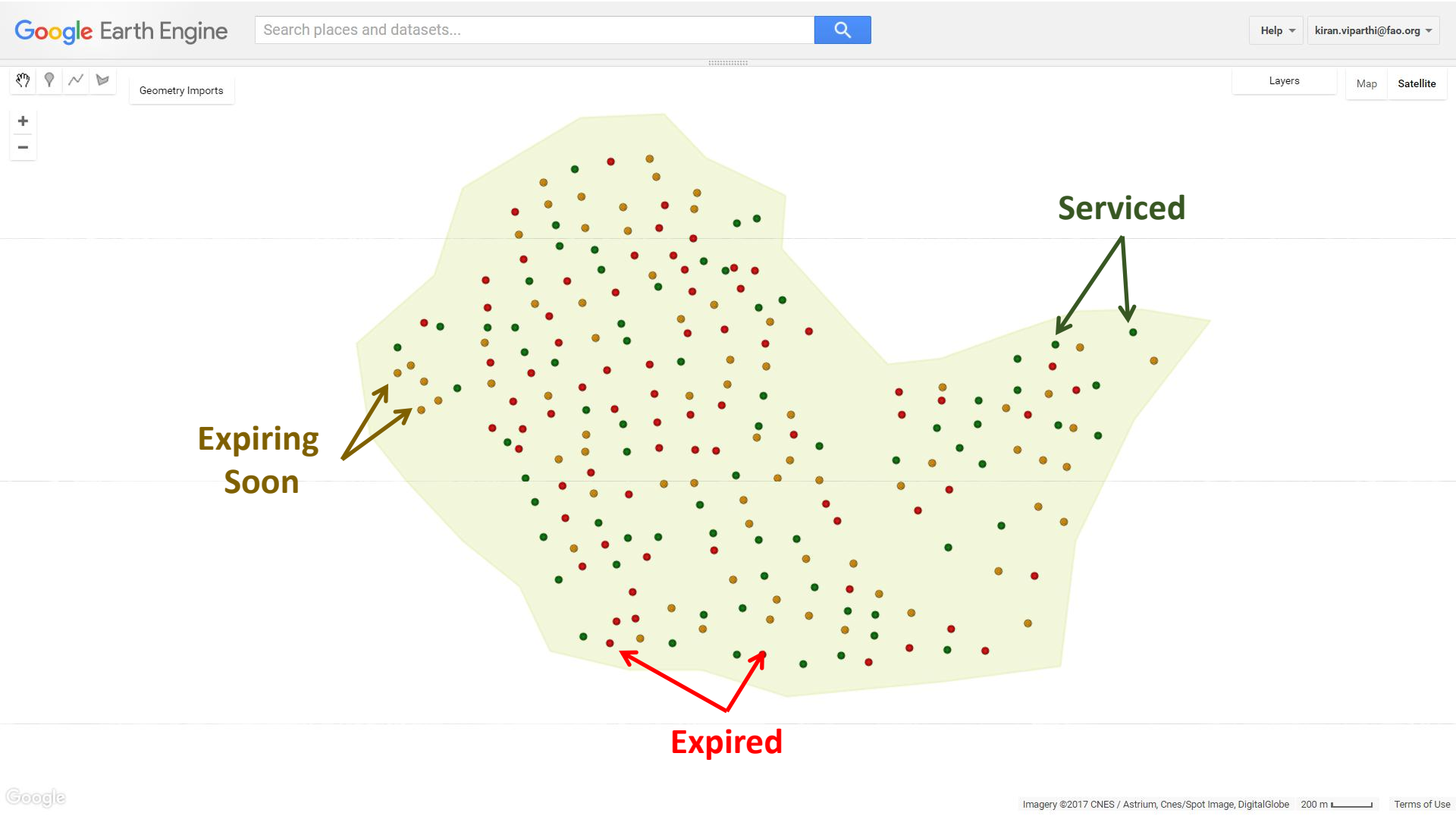


GIS – Traps Coverage

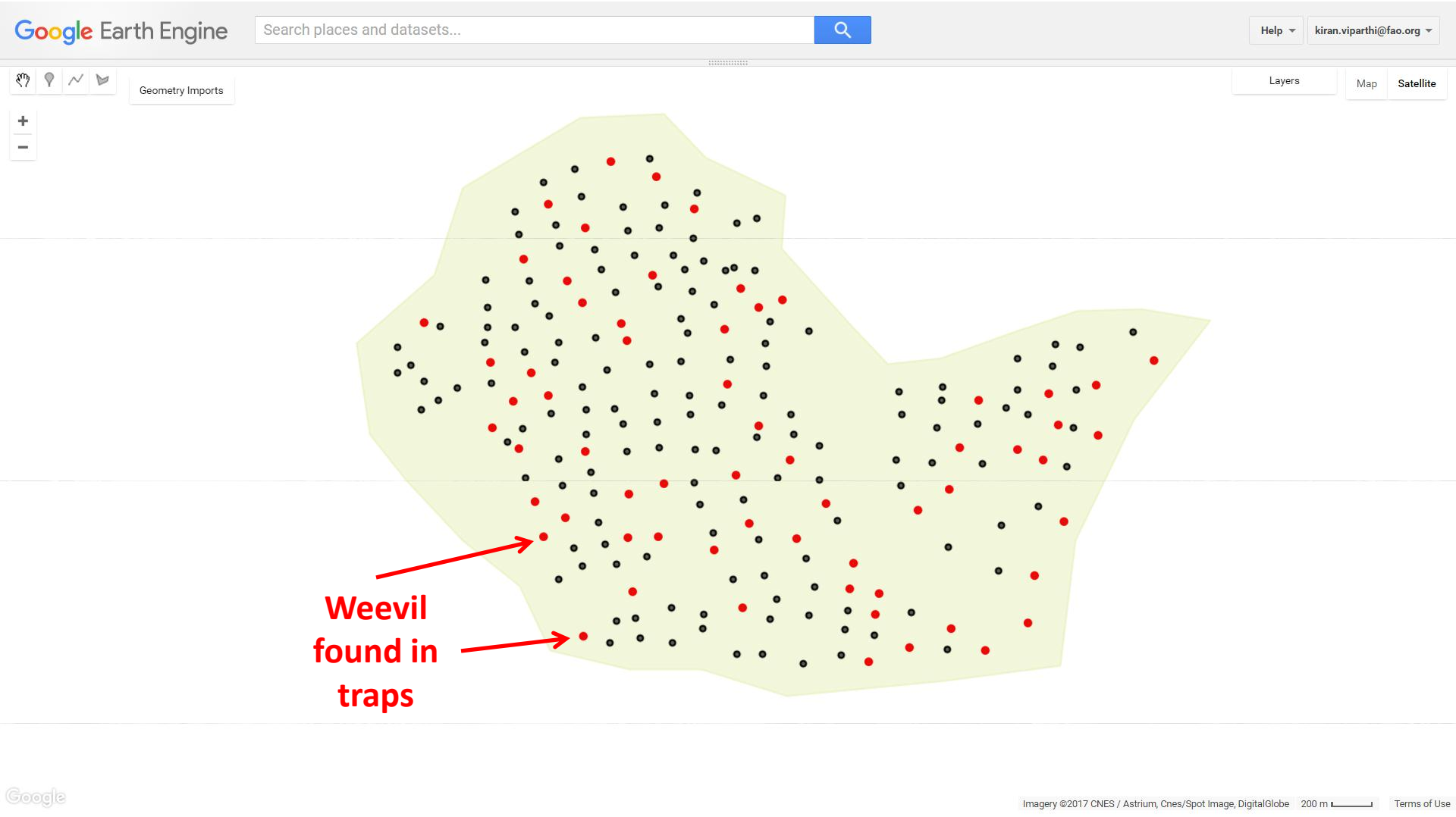


Computation of statistics and quick overview

GIS – Traps Servicing Status Monitoring

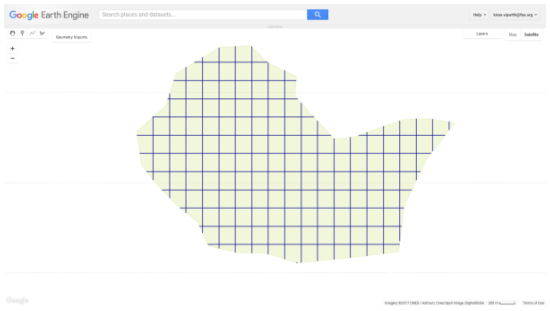


GIS – Traps Mapping for Weevils

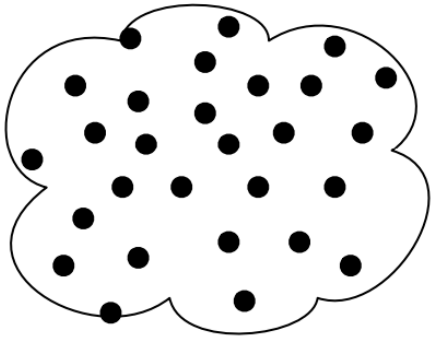


GIS – Weevils Mapping vs Non serviced Traps

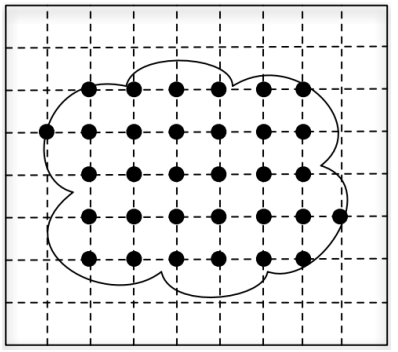
GIS – Traps Optimized Positioning



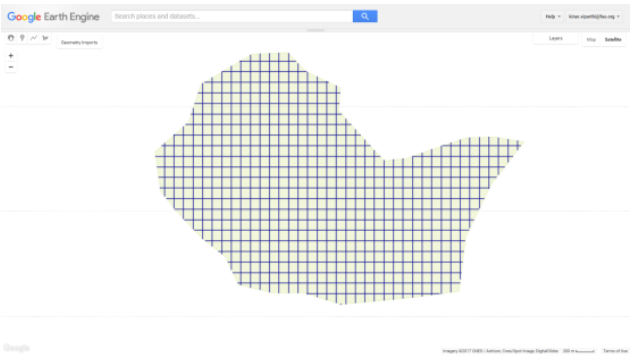
Grid Based



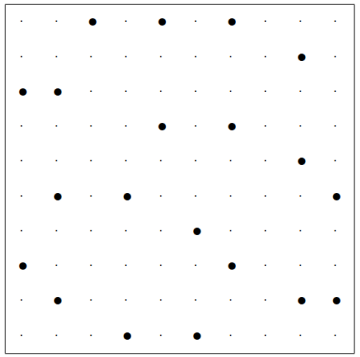
Random target



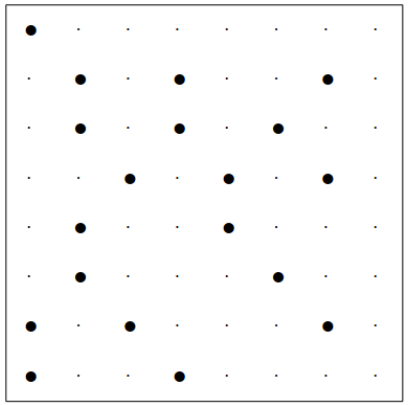
Distance based



High Coverage



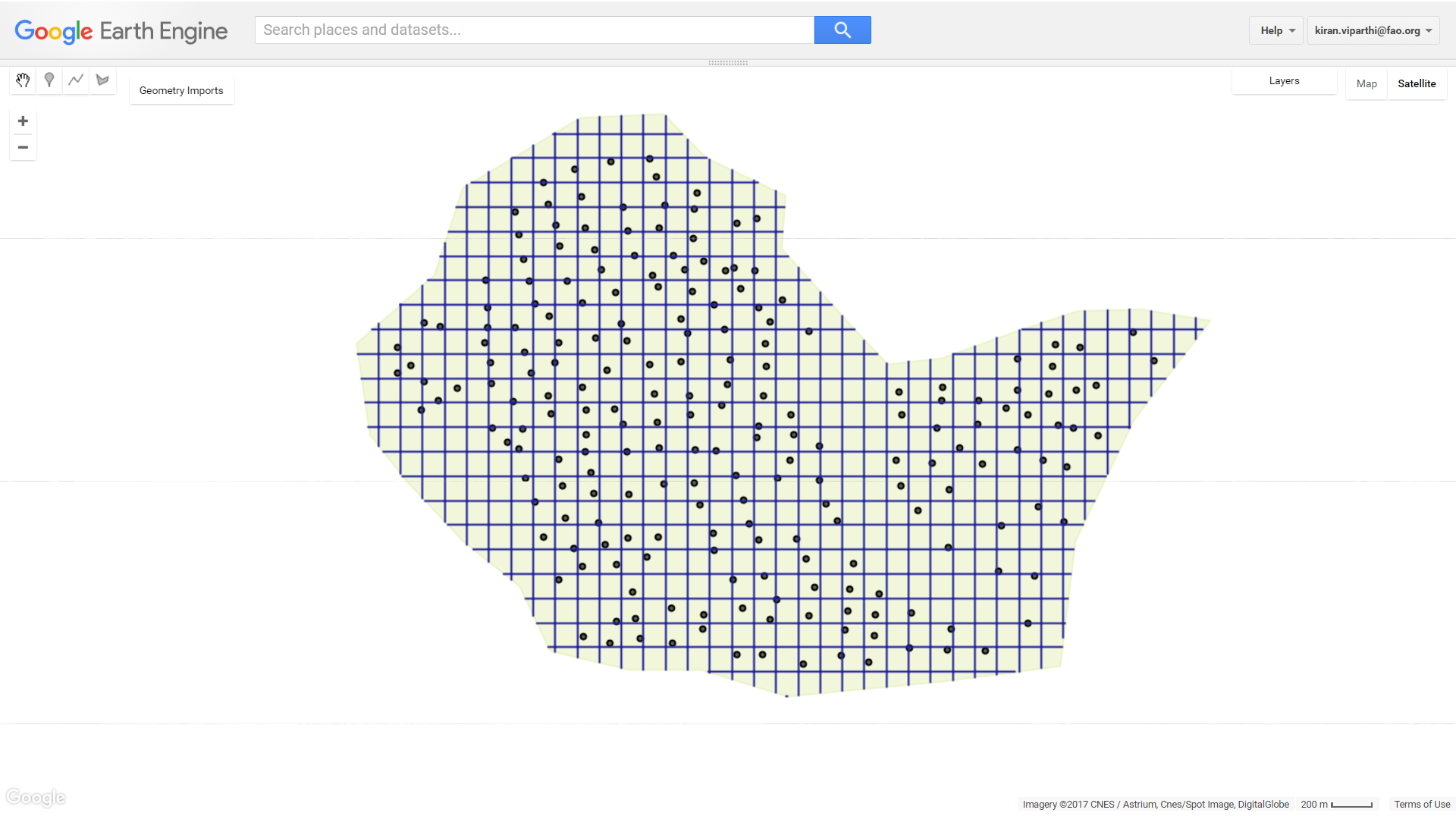
External protection



Easy accessible

Similar to approaches used in setting up optimized mobile network coverage in urban spaces

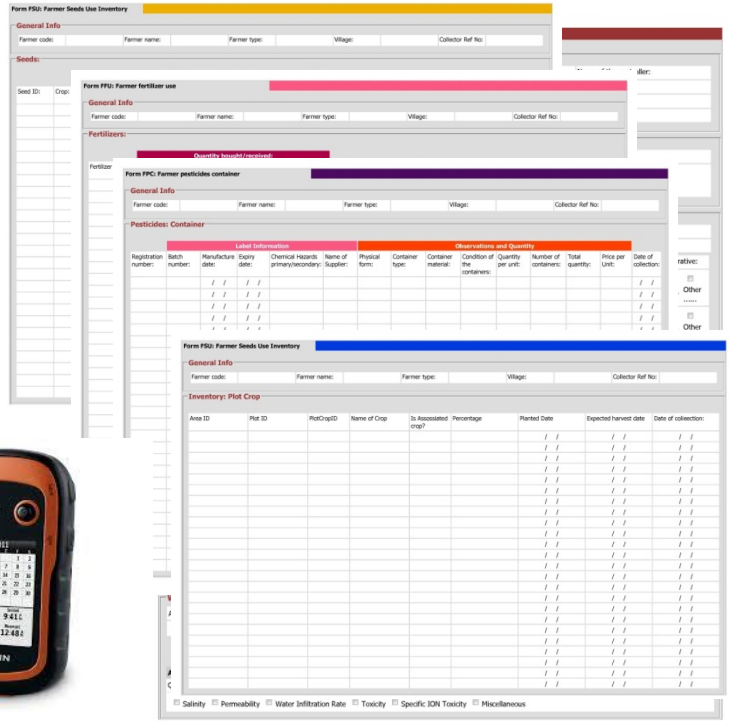
GIS – Traps Positioning Grid model



Mobile Data Collection

Standardized forms globally

Paper Based + GPS

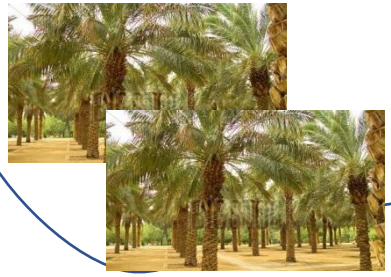


Forms used for RPW data collection globally

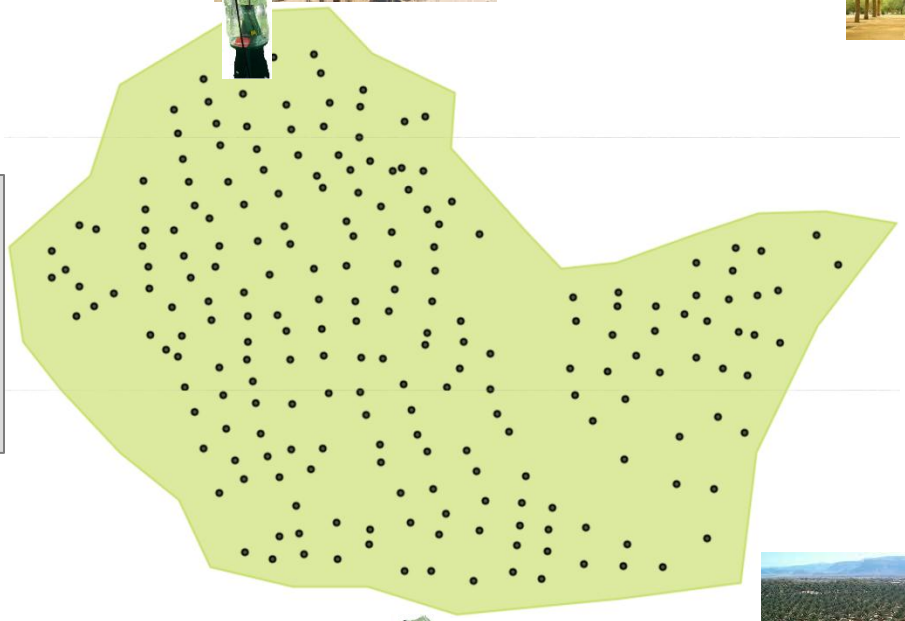
Mobile Data Collection - Workflow

Defining an area for data gathering and monitoring

Sample Area for Demo

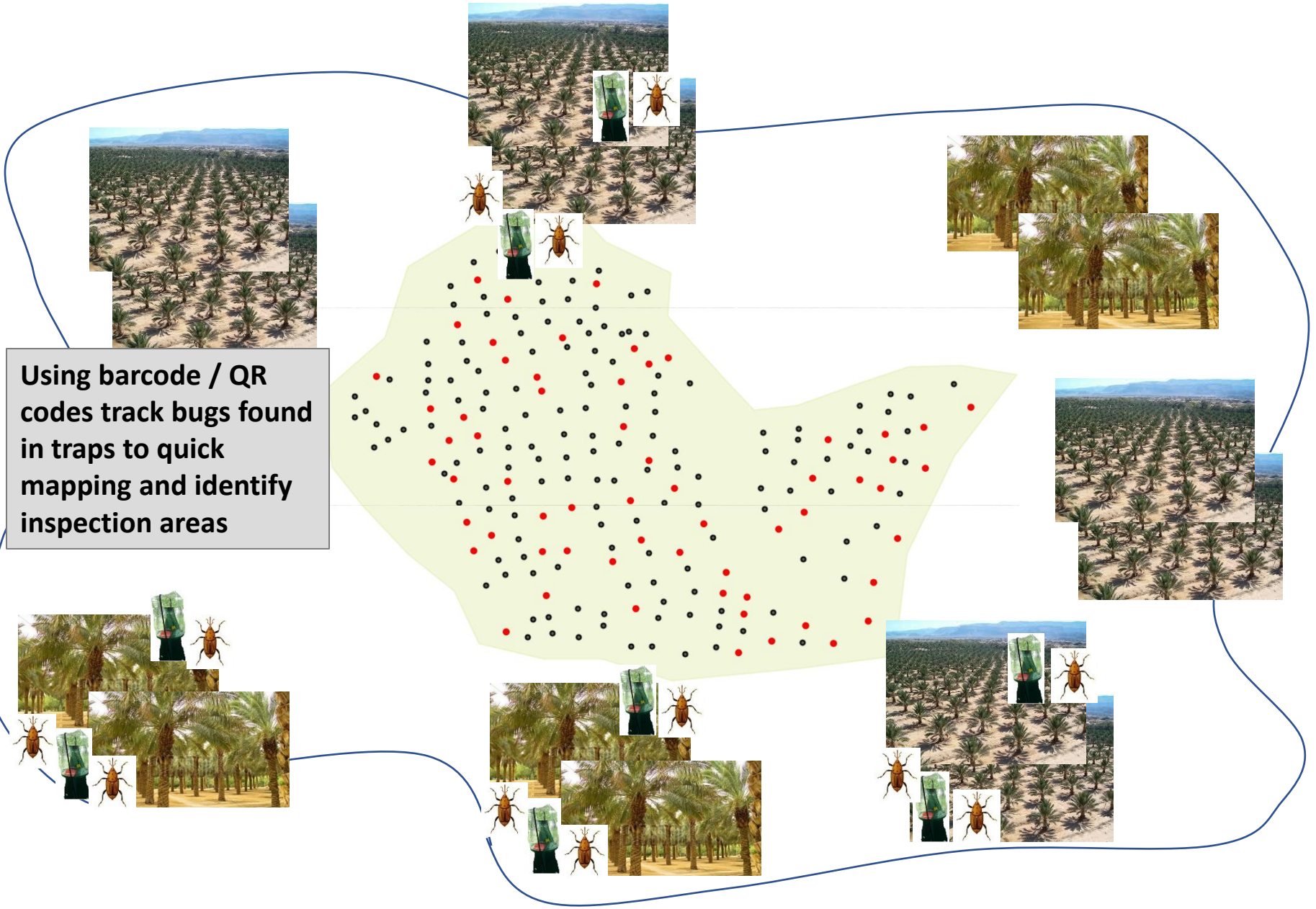


Mobile Data Collection - Workflow



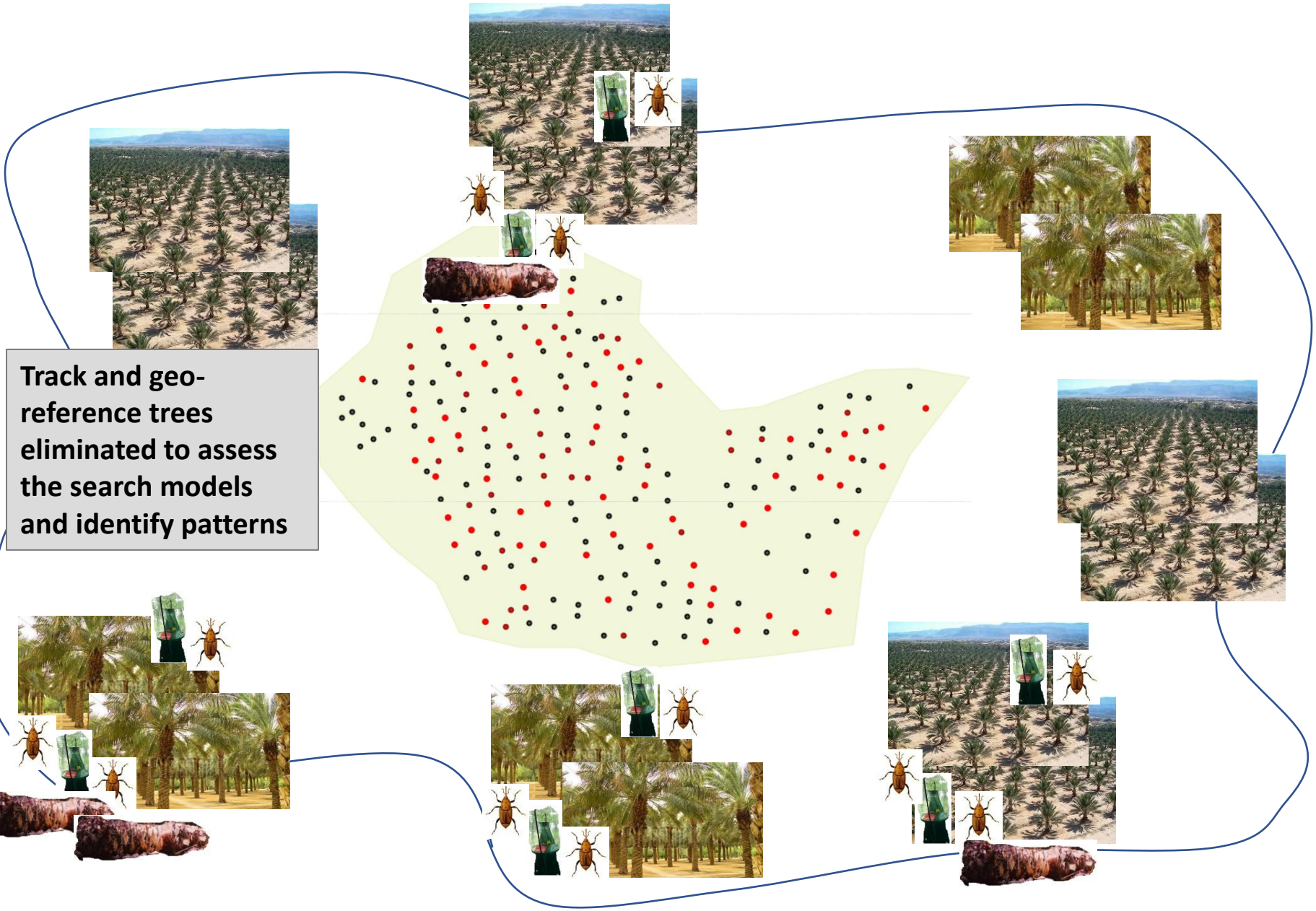
Geo reference and positioning of new or existing traps identified with Barcode / QR code system

Mobile Data Collection - Workflow



Using barcode / QR codes track bugs found in traps to quick mapping and identify inspection areas

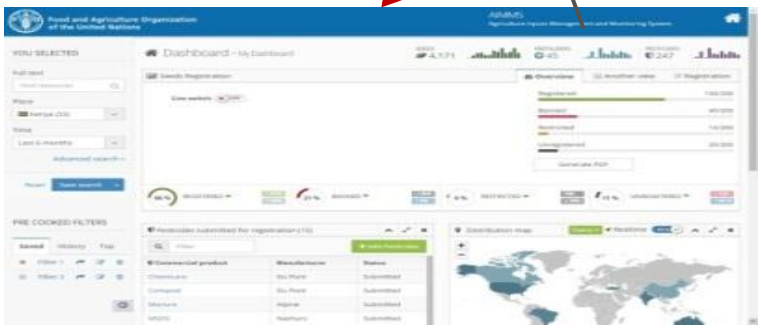
Mobile Data Collection - Workflow



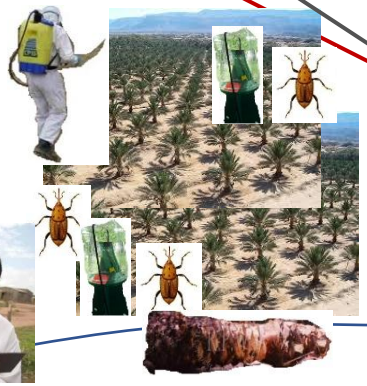
Track and geo-reference trees eliminated to assess the search models and identify patterns

Mobile Data Collection - Workflow

Data gathered, analyzed for informed decision-making and actions performed by the team

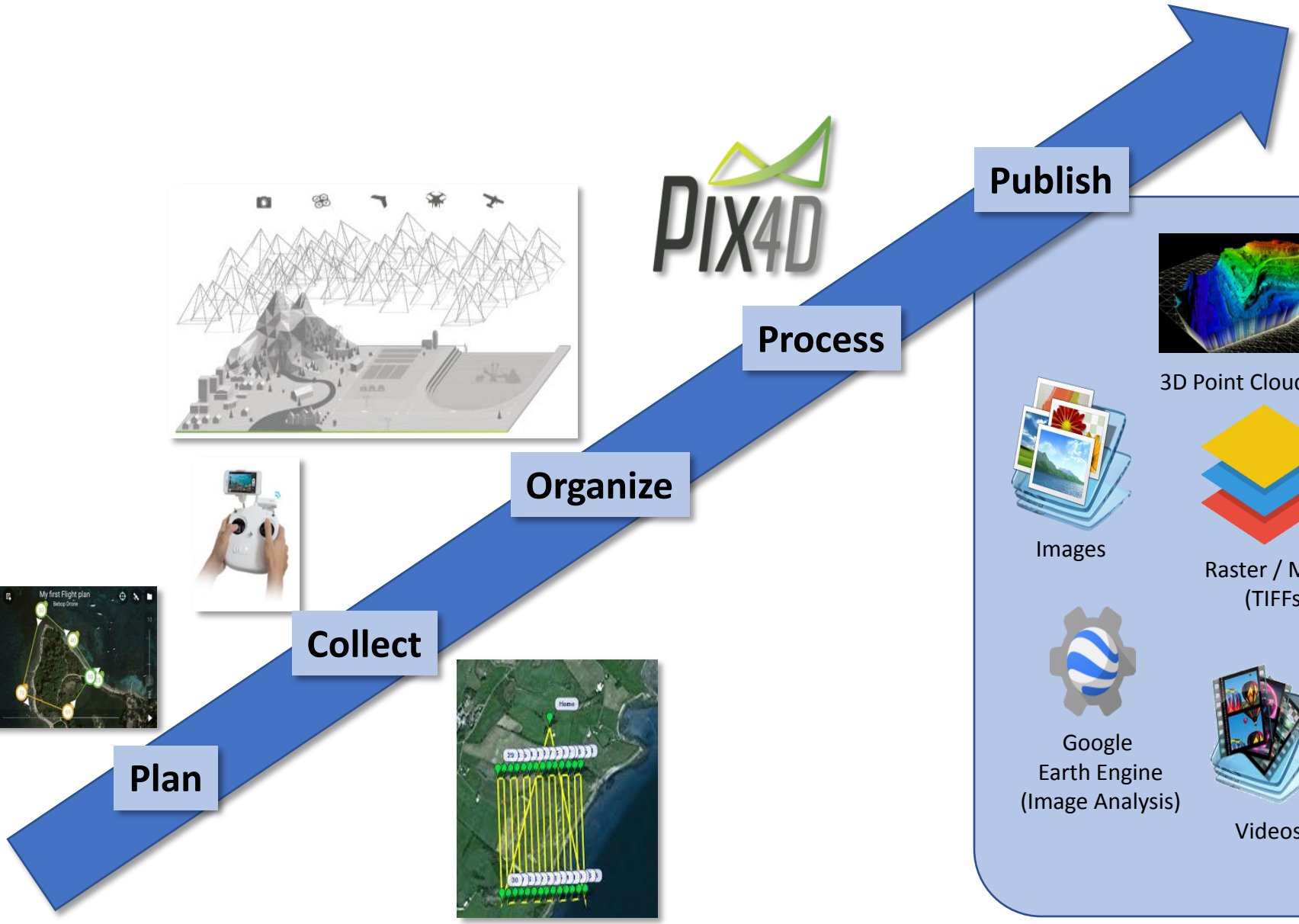


RPW Unified Platform



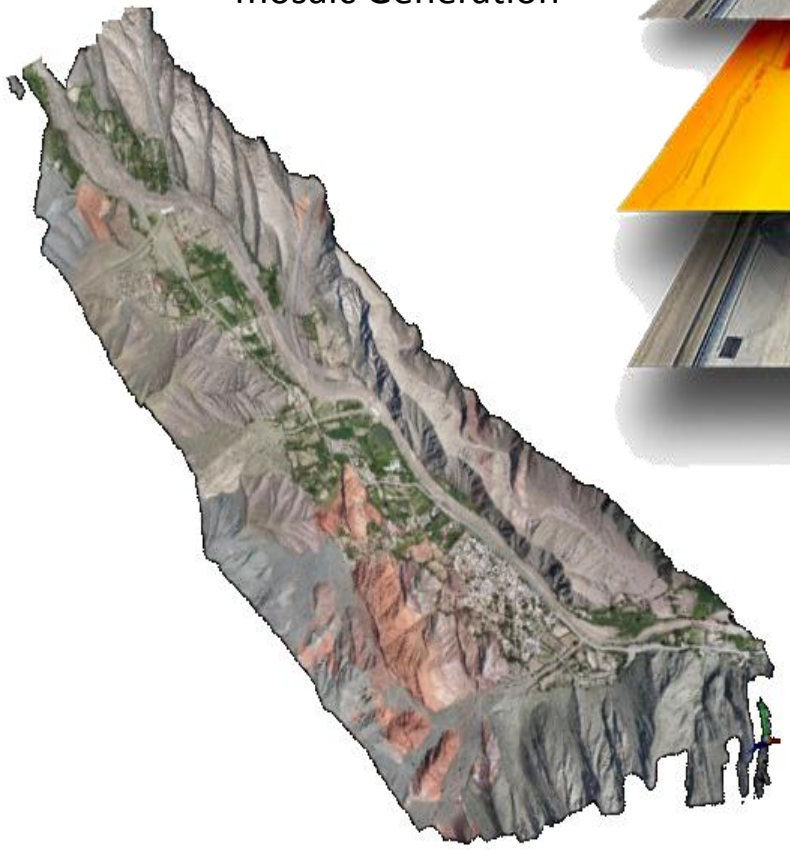
UAVs / Drones / IOTs

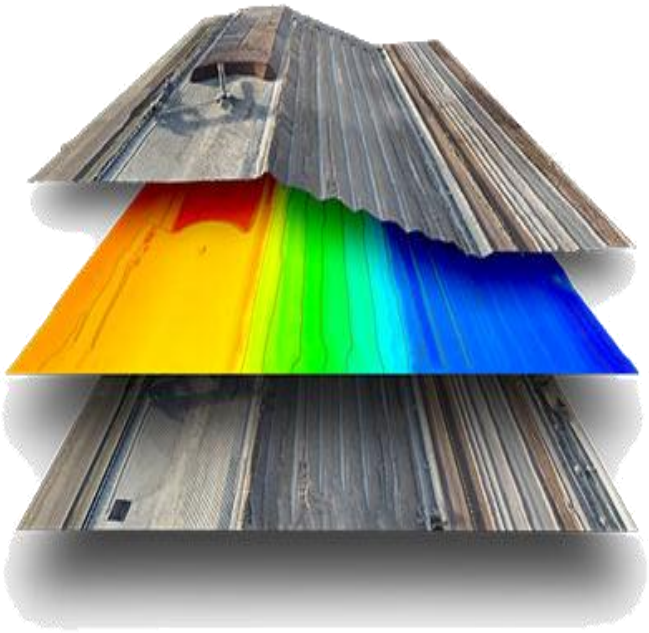
UAVs / Drones / IOTs - Workflow



UAVs / Drones / IOTs - Outputs

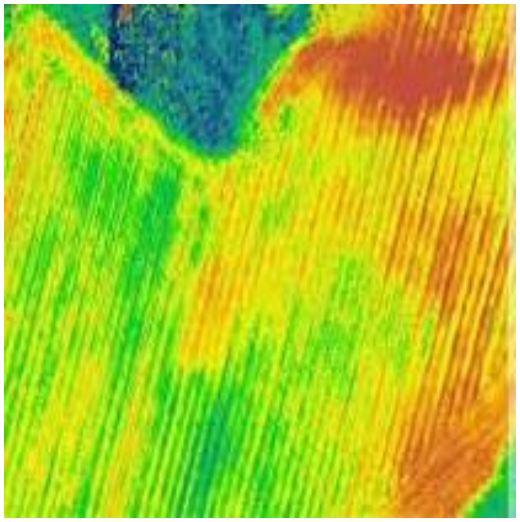
3D models, Point cloud Densification and DSM Ortho mosaic Generation





Raster Maps for dissemination and additional data processing

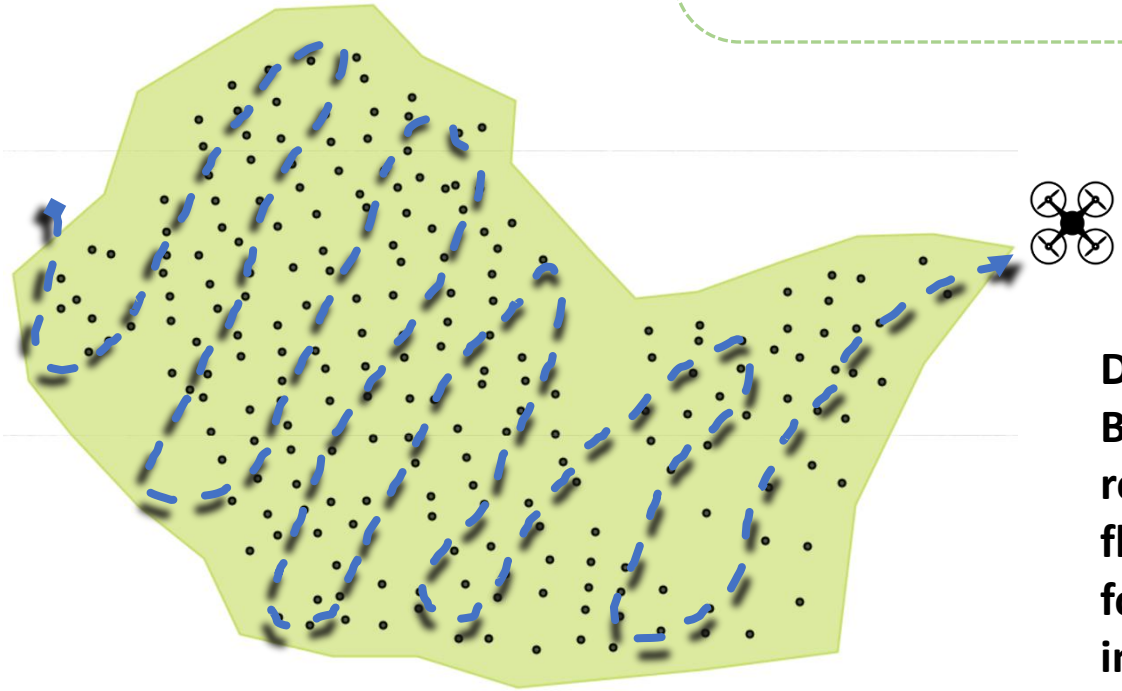
Infrared camera images for vegetation analysis, contours and water stress detection.



UAVs / Drones / IOTs – Data Collection

Smart Electronic Traps (IOTs)

- **GSM**
- **Mesh Technology**
- **Bluetooth**

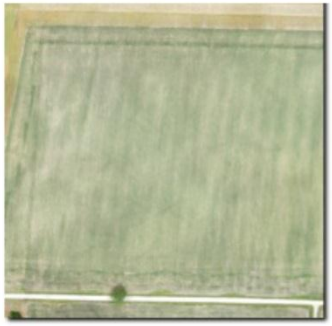


Drones mounted with Bluetooth 4 (1 km range) readers/devices with optimized flight routes help collect data for decision making and rapid interventions

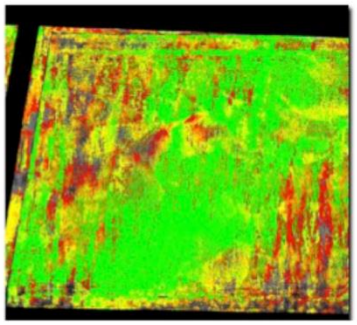
1 week manual effort = 30 mins drone flight

UAVs / Drones / IOTs – Data Analysis

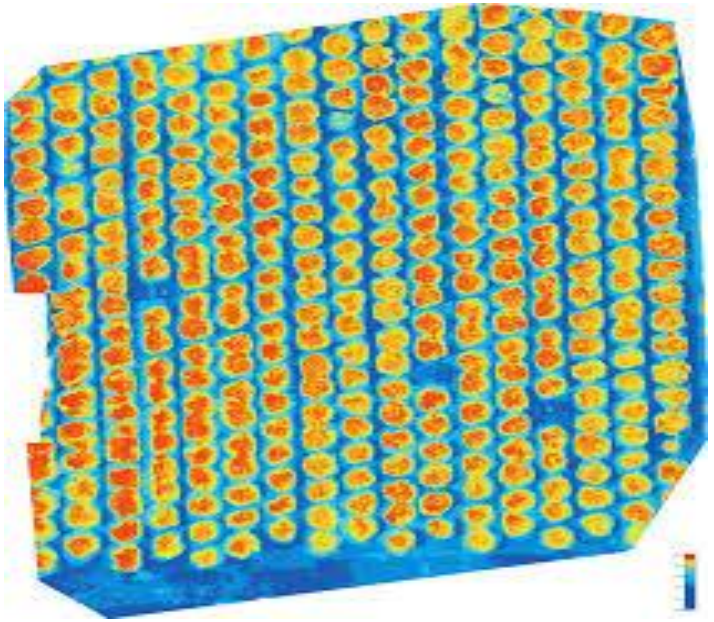
Drones mounted with infrared cameras help in identification of infested trees



RGB Image



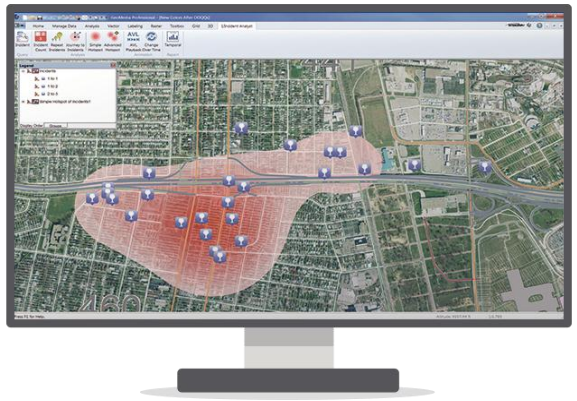
False color NDVI



Summary

1

Hi-Res Satellite Images
Optimal Trap Positioning
Automated identification of the palm crops
Assessment of effectiveness



Observers

"Paper" Forms

"Smart" Forms

2

"Dumb" Trap

3

"Smart" Trap

4

Drones

if funding is available, FAO with its global reach can…

- ✓ setup, deliver, manage & update unified platforms at the national, regional & global levels
- ✓ develop standardized and harmonized innovative data collection & analysis tools
- ✓ provide national training, support & capacity building