



مؤتمر عجمان
الدولي السادس للبيئة
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Monitoring Soil Quality From Space Using Drones, Artificial Intelligence & Machine Learning

By

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TOWARDS >>>>

2071

SHAPING THE

FUTURE

FOR ENVIRONMENTAL

SUSTAINABILITY

Public - عامة





MULTIDISCIPLINARY PROJECT





SOIL AND UNITED NATIONS SDG

Why Soil is important??

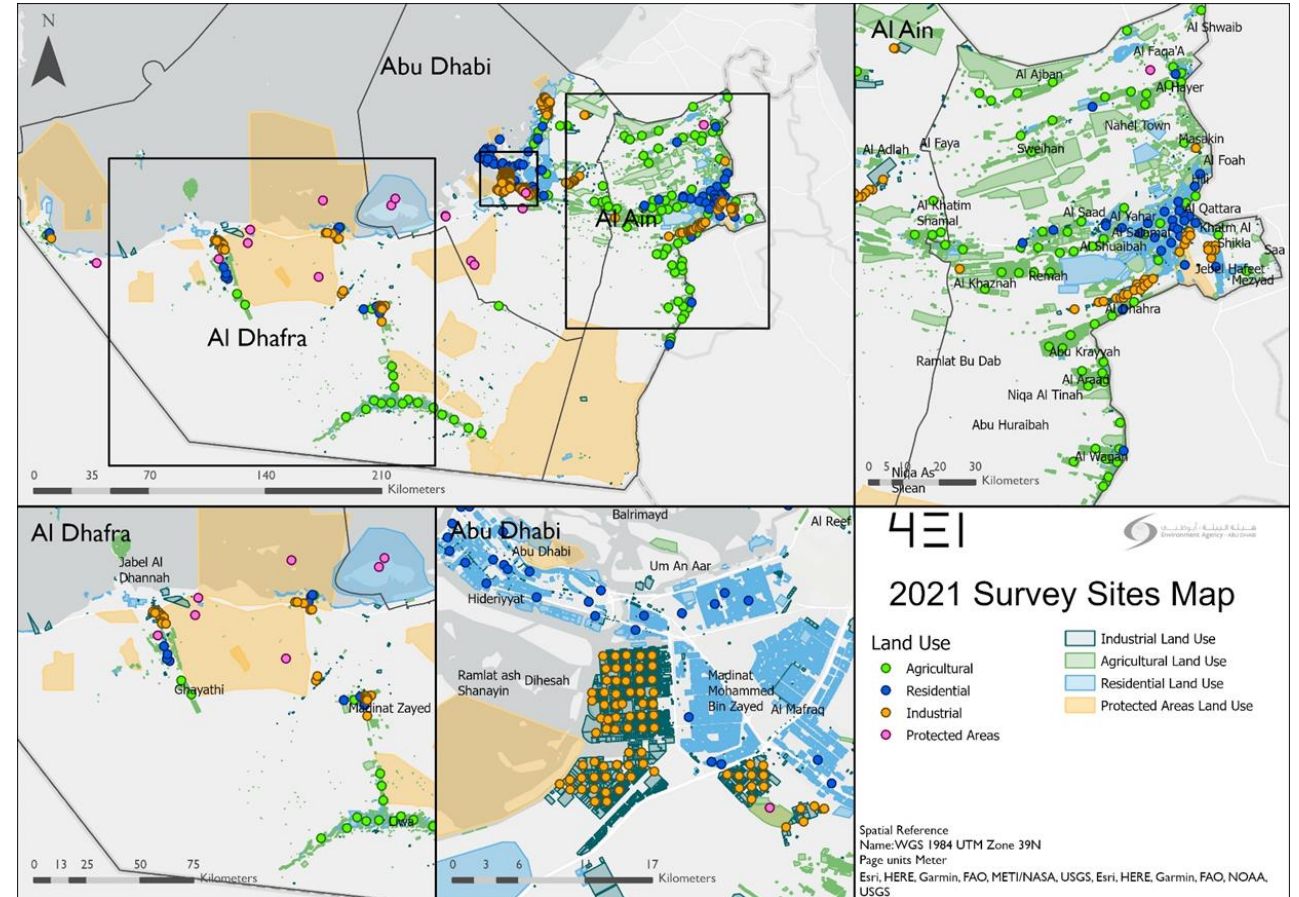
- Many global policy frameworks, including the United Nations Sustainable Development Goals (SDGs), directly and indirectly address land and soil.
- Soil health falls under a total of seven of the 17 SDGs, It is tied to water and air quality, preventing hunger, reducing climate change impacts, and improving population wellbeing and living standards.
- Many of these SDGs cannot be achieved without healthy soils and a sustainable land use.





THE SOIL QUALITY MONITORING PROGRAM

- Provide long term consistent scientific data to support the process of developing policies and regulations and decision making.
- Provide feedback on the performance of environmental policies and regulations related to soil.
- Monitor and assess the impact of human activities on soil quality and determine areas requiring further investigation or remediation.
- Assess the temporal changes in the levels of contaminants.
- The program started 2018
- 4 rounds have been completed
- Certified by ISO 16133:2018
- More than 370 sites with around 600 samples per year
- Preliminary trends determined
- Currently more than 30 Parameters monitored.





THE SOIL QUALITY MONITORING PROGRAM

Although the program is evolving but conventional methods of monitoring are unfortunately limited.

- The need for manpower as it is **labor intensive**.
- **Representation**: sampling all the area is not realistically practical.
- Increasing the **coverage** is a difficult as it requires more manpower and more sampling.
- **Frequency** sampling will multiply all those factors again.

Growing In Any
Direction Will Result In

- ↑ **COST**
- ↑ **TIME**
- ↓ **ACCURACY**



LIMITATIONS OF
CONVENTIONAL
METHODS OF
MONITORING



SOIL MAPPING USING DRONES, ARTIFICIAL INTELLIGENCE (AI) & REMOTE SENSING

INNOVATIVE TECHNIQUES

BUILDING THE BLOCKS FOR IMPROVED SOIL MONITORING

REGULAR

EFFICIENT

ACCURATE

GLOBAL

MONITORING UNAFFECTED BY BORDERS

SUCCESS IN THE TIME OF COVID-19



SOIL MAPPING USING DRONES, AI & REMOTE SENSING

*“The Future Of
Environmental
Monitoring”*

PIONEERING INNOVATIONS IN SOIL QUALITY MONITORING

Combining Drone,
Satellite, Field Survey
and AI to monitor
soil quality is
another
world-first
for the UAE.

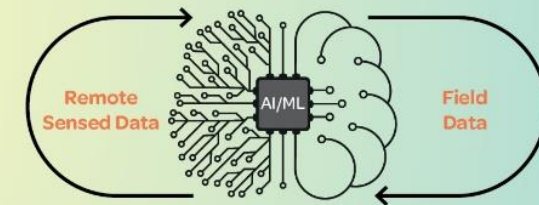
- 1 Satellite data is analysed to understand potential soil health hot-spots over very large regions.
- 2 Drone surveys with high resolution hyperspectral sensors are deployed to understand soil health over continuous regions.
- 3 Targeted soil samples are processed in a laboratory to verify the results found within satellite and drone data.
- 4 Artificial Intelligence (AI) / Machine Learning (ML) processes big data and assesses if area is contaminated.



- A. Ground-Based:** Spectral data recorded using a handheld spectrometer. No disruption to ground soil allowing remote sensing data to be calibrated with soil samples.
- B. Aerial Drones:** A drone flies over the target area several times at different heights using a highly detailed Hyperspectral Sensor. The drone is custom built in the UAE specifically for this project with a load capacity of 20 KG.
- C. Satellite-Based:** Satellites are used for larger areas. Sensors (on satellites and drones) collect data regarding soil health, such as hydrocarbon and metal content.
- D. Soil Samples:** Collected at strategic points within the remote sensing capture area. Samples are used to verify remote data.

Artificial Intelligence (AI) and Machine Learning (ML)

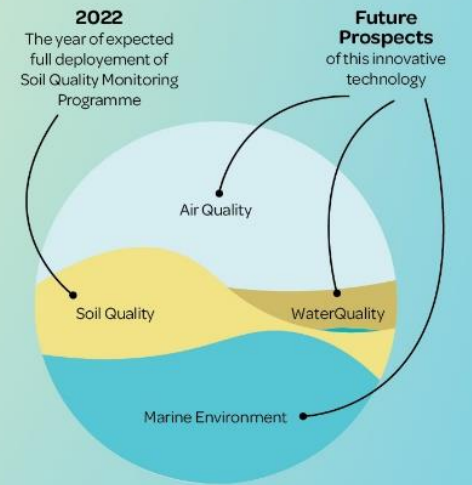
Innovative use of Artificial Intelligence (AI) and Machine Learning (ML) analysis is used to correlate remotely sensed data with field data. Both field data and remote sensing data is voluminous and complex to interpret. AI and ML will identify very small changes in the physical environment to provide indicators of soil health anomalies. The algorithms that are developed will be constantly trained and improved. In the future they can be used to automatically scale up over larger areas.



- Benefits:**
- Produce data with confident levels of accuracy across large areas within 24 hrs.
 - Enable EAD to identify critical areas and prioritise remediation and conservation resources.
 - Introduce significant savings to conduct soil contamination analysis.

The Benefits for Abu Dhabi

- This innovative service is earmarked to go from pilot to fully deployed by the end of 2022.
- Repeatability is key. Monitoring programme methods used to continually monitor and detect changes in the soil quality of Abu Dhabi.
- Operation stage is aimed to improve and increase knowledge of soil health - particularly in fragile ecosystems such as Abu Dhabi.
- Develop these frameworks and methodologies so that future governments can manage their countries assets through change intelligence powered by space data.
- Methodology is currently only used to monitor the health and quality of soil within the Abu Dhabi Emirate. Once proven successful, it can also be used to monitor other assets, such as the marine environment, water and air quality.





SOIL MAPPING USING DRONES, AI & REMOTE SENSING

*“The Future Of
Environmental
Monitoring”*





OUTCOMES

ACCURACY

- The hyperspectral drone sensor provided promising initial results for the identification of concentrations of certain contaminants such as **Arsenic, Lead, Nickel, Cobalt, and Copper.**

EFFICIENCY

- Each flight is expected to cover an area of 15,000m sq (1.5HA) . An average of 5 x sites per day will be surveyed (75,000m sq / 7.5HA).
- The hyperspectral sensor, provides data with a resolution of 5cm.





OUTCOMES

COST EFFECTIVE

- Drone surveys are conducted faster-reducing time reduces over all cost.
- Drone surveys require less manpower -reducing cost.
- Drone surveys allows rapid actions and interventions - decreases the cost of remediation and intervention.

INTELLIGENT AI

- With each new flight, the AI model learns new patterns and increases prediction accuracy requiring less ground truthing samples to the extent where it might replace traditional methods.

ALLOWS RAPID ACTIONS

INTELLIGENT AI

FASTER

DECREASES COST

LESS MANPOWER

INCREASING THE COVERAGE





OUTCOMES

SAFETY

- Monitoring is done without the need for human access to site.
- Less need for sample collection (sampling process).
- Environmental pro-activity vs re-activity.

“EAD protect the environment from potential contamination instead of reacting to an existing contamination.”

COVID-19

- This type of remote sensing monitoring technique will stop for nothing! Not even COVID-19 could stop you from a scheduled drone flight or analyzing a set of satellite imagery to get your scheduled data set!





ADDED VALUE

- **Point source mapping:** we can enhance the analysis and interpretation by mapping possible point sources such as proximity to particular industrial activities, or the suitable placing of residential areas or infrastructure.
- Building of a **spectral library:** will be the first in the region and there is a great need for it.
- This technology can also be used to **monitor other assets.** For example, marine water quality, and air quality.
- **Enforcement and Permitting:** Check compliance and ensure proper actions were taken by the involved parties.
- **Fill the historical data gaps:** use the algorithm to apply to historical satellite data if available, so we can explore trends which will greatly improve our knowledge and enhance our modeling capabilities.





THE FUTURE OF ENVIRONMENTAL MONITORING

The Future Will Definitely Rely On Remote Technology For Many Things. Regardless Of The Technology Whether Using Satellites, Drones, Robots Or Even Technologies Not Invented Yet. Moreover, AI Is Here To Stay. It Is Proving It Has A Place In All Facets Of Life And Science.

“EAD is making sure we are on the forefront of the path to the future leading in development and implementation”



THANK YOU

For further questions, you may contact me at
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A technical report has been published that is considered as a
reference on the use of drones and AI in monitoring soil quality.
You can view at EAD website



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