



# Catalyzing Innovation

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY  
WASHINGTON DC, MARCH 25-29, 2019



## EARTH OBSERVATION – A SUPPORT FOR THE DISTRIBUTED ENERGY SECTOR (MICRO-/ MINI-GRIDS)

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## Corresponding project

### INTEGRATED APPLICATIONS FOR MICROGRIDS IN DEVELOPING ECONOMIES

(ESA AO/1-8891/17/UK/AD; category ESA Express Procurement Plus - EXPRO+)

European Centre for Space Applications and Telecommunications (ECSAT)

funded by



project team



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## Corresponding project

### INTEGRATED APPLICATIONS FOR MICROGRIDS IN DEVELOPING ECONOMIES

- Identification of requirements of Microgrid developers
- Geographic focus on Sub-Saharan countries, South-East Asia (India),
- Goal: Draft setup of an overall service chain
- User engagement: questionnaire to raise discussion on thematic needs & exchange on present solutions/ decisions

### MICRO- OR MINIGRIDS ARE ...

- ... distributed energy systems, capable of generating
  - 1-10kW (Microgrid)
  - 10kW – 1MW (Minigrid)



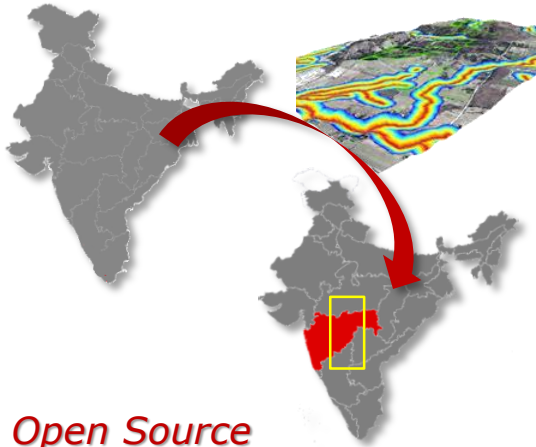


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## Requirements according to scale

### STAGE 1 National/ Super-regional draft segmentation

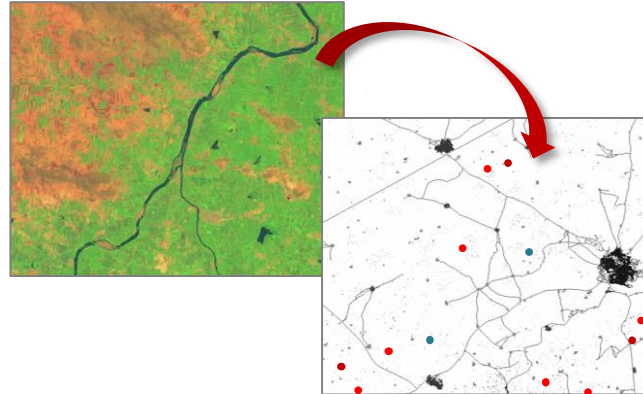


#### Open Source

- GIS data (infrastructure, statistics)
- Global layer (thematic classific. (WSF/GUF, LULC ...))
- Geofactors (climate, terrain, sun irradiance ...)
- Local Policies

PLATFORMS,  
AGGREGATION APPROACHES

### STAGE 2 Regional up-to-date situation analysis



#### HR data analysis (Sentinel)

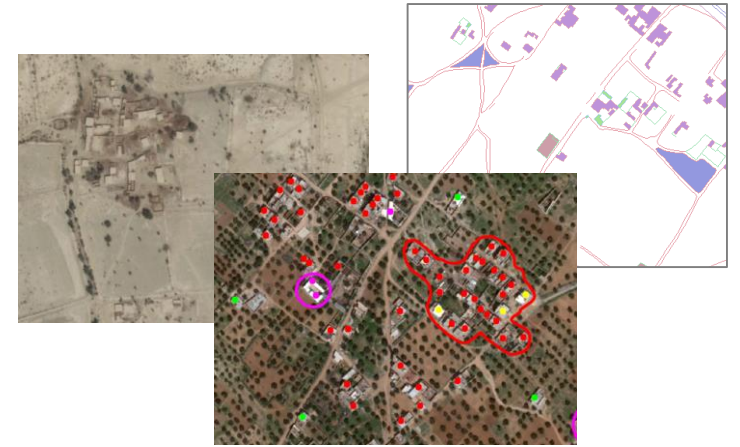
#### Focus of Services:

- up-to-date situation data (infrastructure, urban extent, agricult. productivity, risk exposure, ...)
- supported by open source if applicable

UP-TO-DATE LOW-COST INFORMATION,  
CHARACTER & PRODUCTIVITY  
PROXY OF WELL-BEING

Conflict: actuality, scale; thematic detail

### STAGE 3 Local (Microgrid level) detailed status analysis



#### Human (& VHR data analysis)

#### On-site Survey:

- up-to-date detailed demand assessment (housing details, economic aspects, risk exposure, ...) – VH LOD
- wide initial selection – best fit chosen

LOCAL SOLUTIONS (HUMAN IMPACT),  
FINAL SITE SPECIFICATION

Conflict: LOD; costs; local survey is necessary



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## Finding the right place to act

### REGION OF INTEREST

*general circumstances*

Water situation

Climate

Terrain

Hazards

### EO SERVICES

*large scale aspects*

Landuse/ landcover  
(LULC)

Settlement extent

Transport infrastructure

Terrain data

Agriculture

Industrial activity

Hydrology data

Annual

behaviour of classes

Energy potential map  
(solar, wind, biomass)

Priority factors:

Infrastructure

People

Resources

Risk

MICROGRID

### MICROGRID

Interests

DEVELOPER

Focus

Possibilities

Experience

*investors  
requirements*

### OPEN SOURCE GEO-DATA

Maps LULC *status numbers*

Census Statistics

Transport infrastructure

Main GRID Administration

Settlement extent

Reports

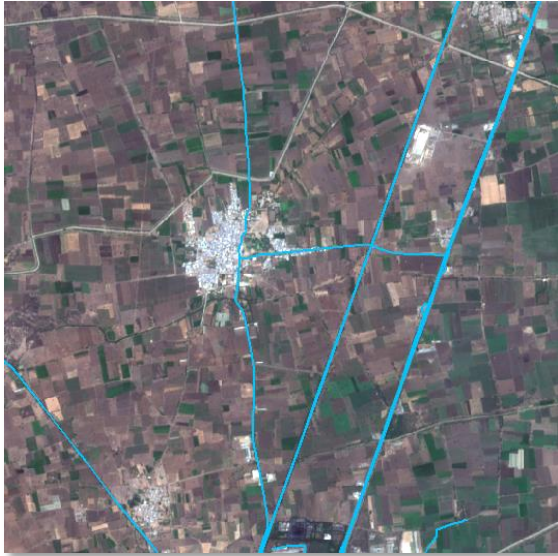
Other infrastructure



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## Considering the context



distribution  
(transport, grid)

... accessibility



urban footprint &  
type

... number of users



land use &  
annual change

... production potential



hazard type &  
long-term tendencies

... temporal change

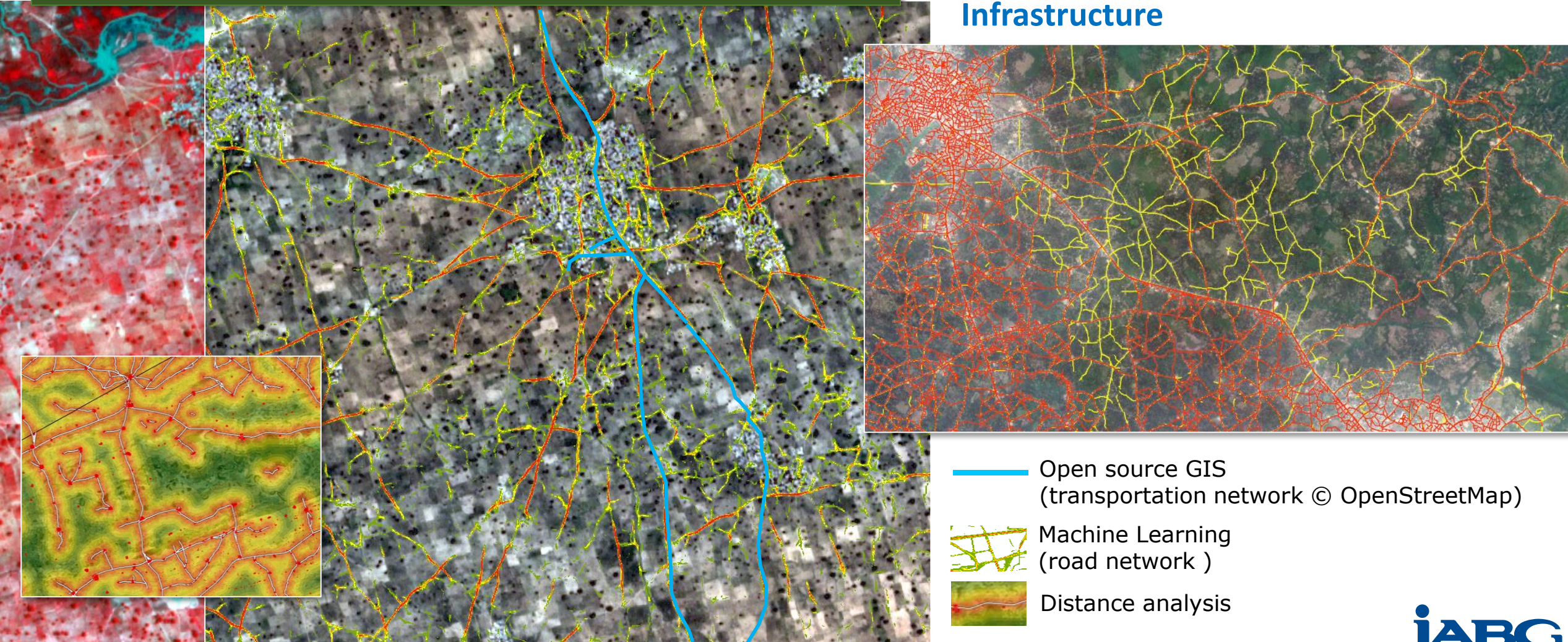


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## Considering the context

### Infrastructure



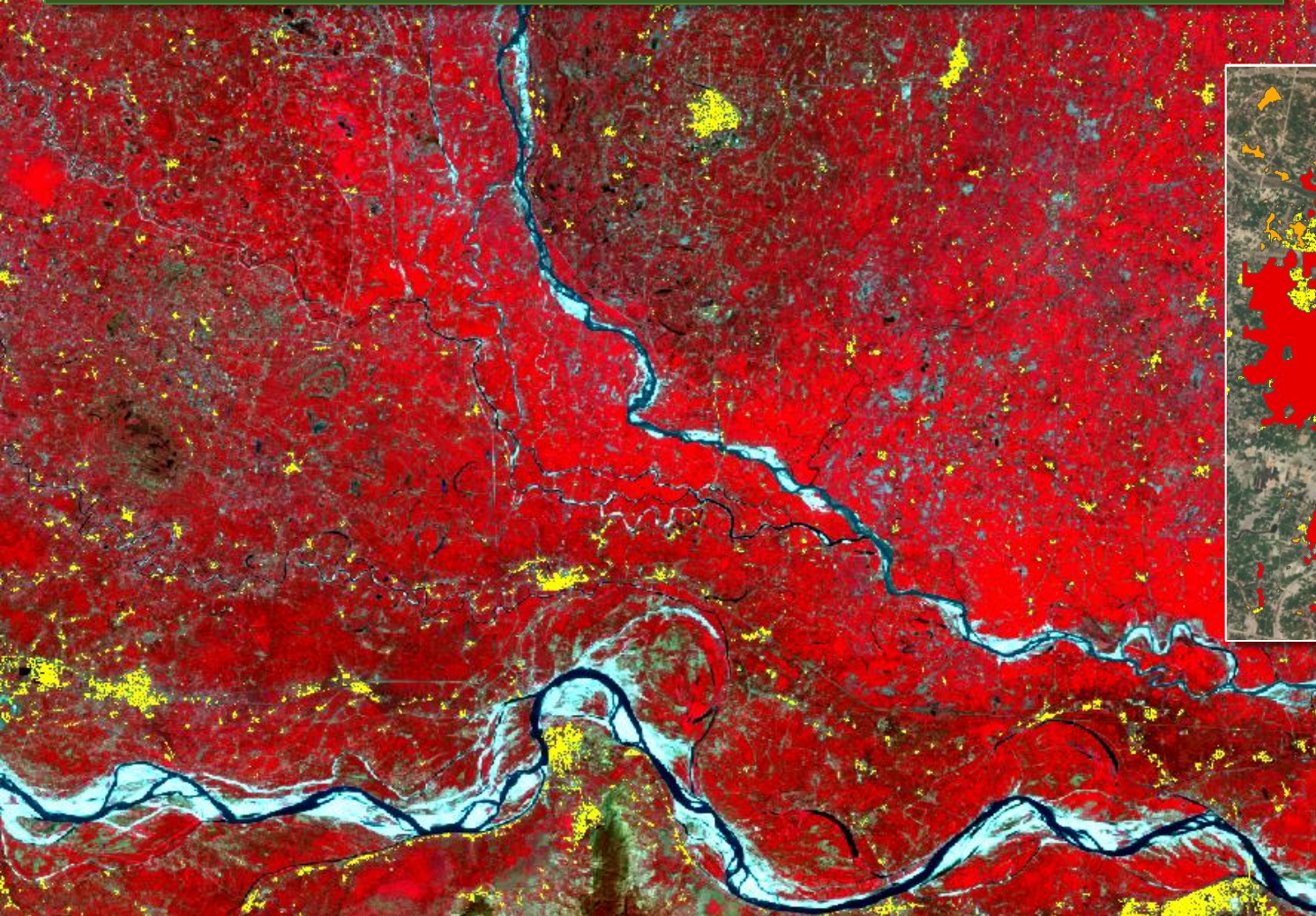
- Open source GIS (transportation network © OpenStreetMap)
- Machine Learning (road network)
- Distance analysis



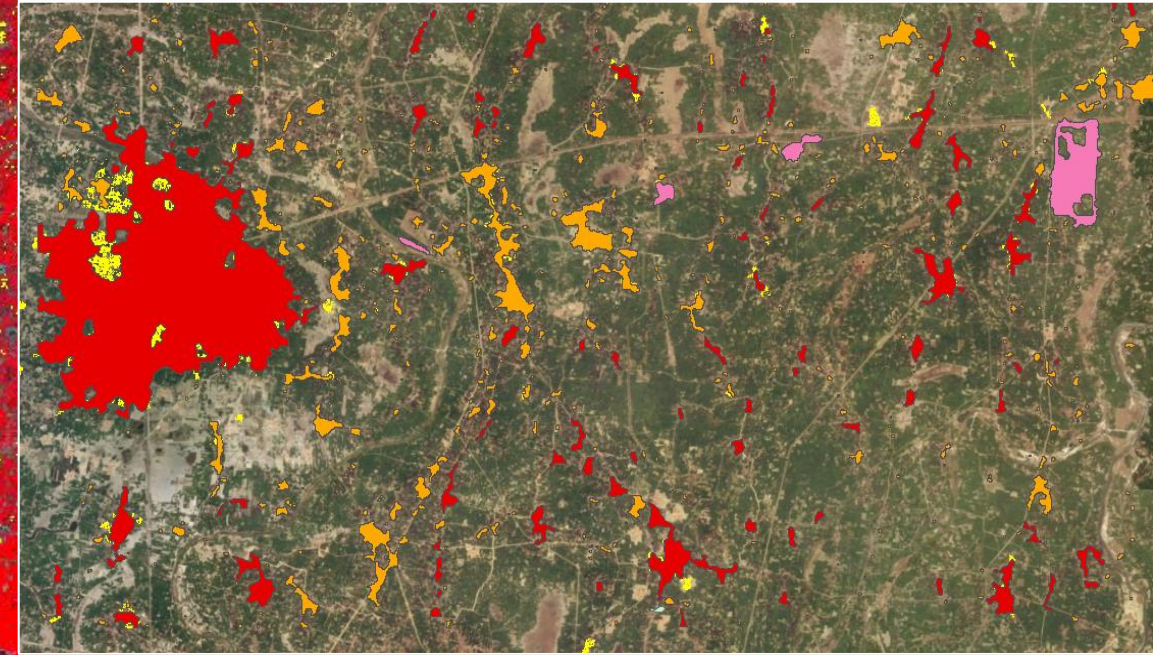
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## Considering the context



### People



- Global Layer © GlobalUrbanFootprint/DLR
- Urban (dense)
- Urban (sparse)
- Industrial construction



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## Considering the context



## Resources



Characterisation of agricultural use, e.g.



According to vitality (biomass, productivity)  
→ Biomass? Ability to pay?



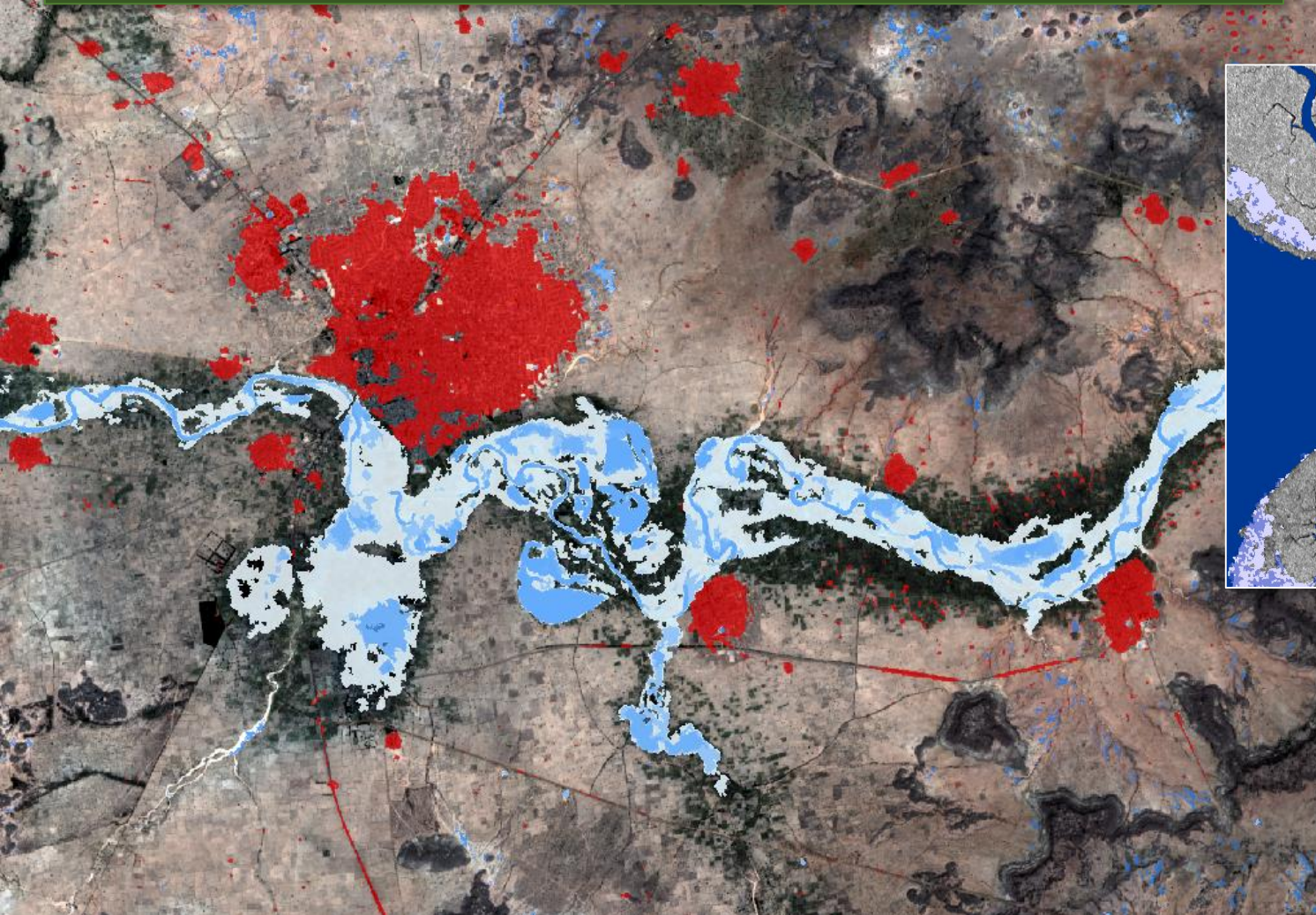
According to management (size)  
→ Production characteristics, ownership



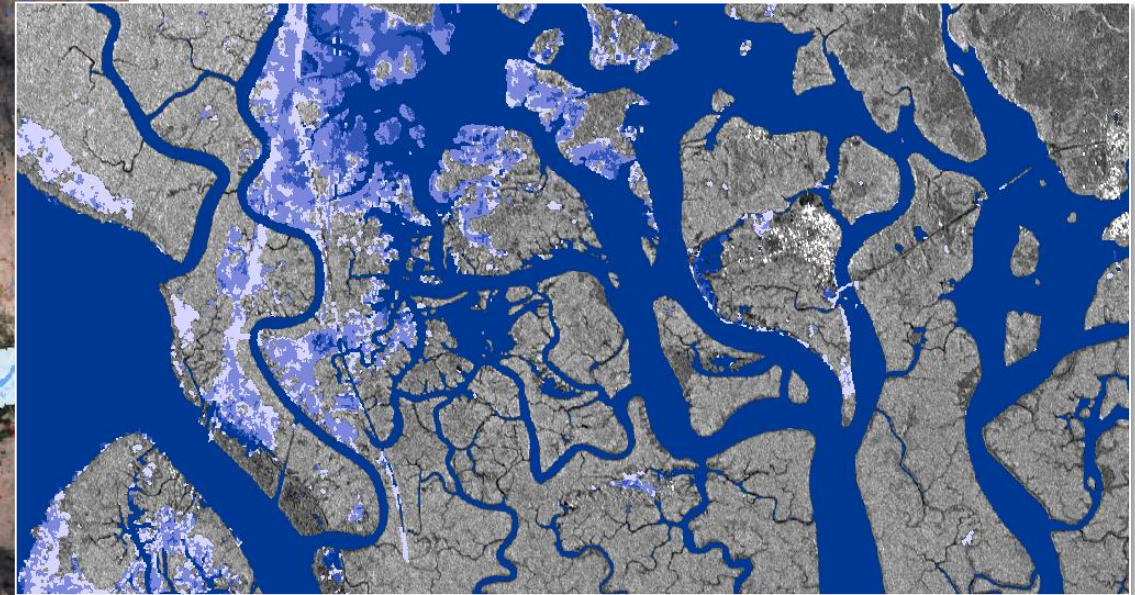
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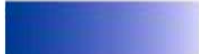
## Considering the context



Risk



e.g. availability and exposure to water  
... other aspects (terrain, ...)

 Water body (recent flooding)



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## Considering the context

Infrastructure

People

Resources

Risk

... accessibility

... number of users

... production potential

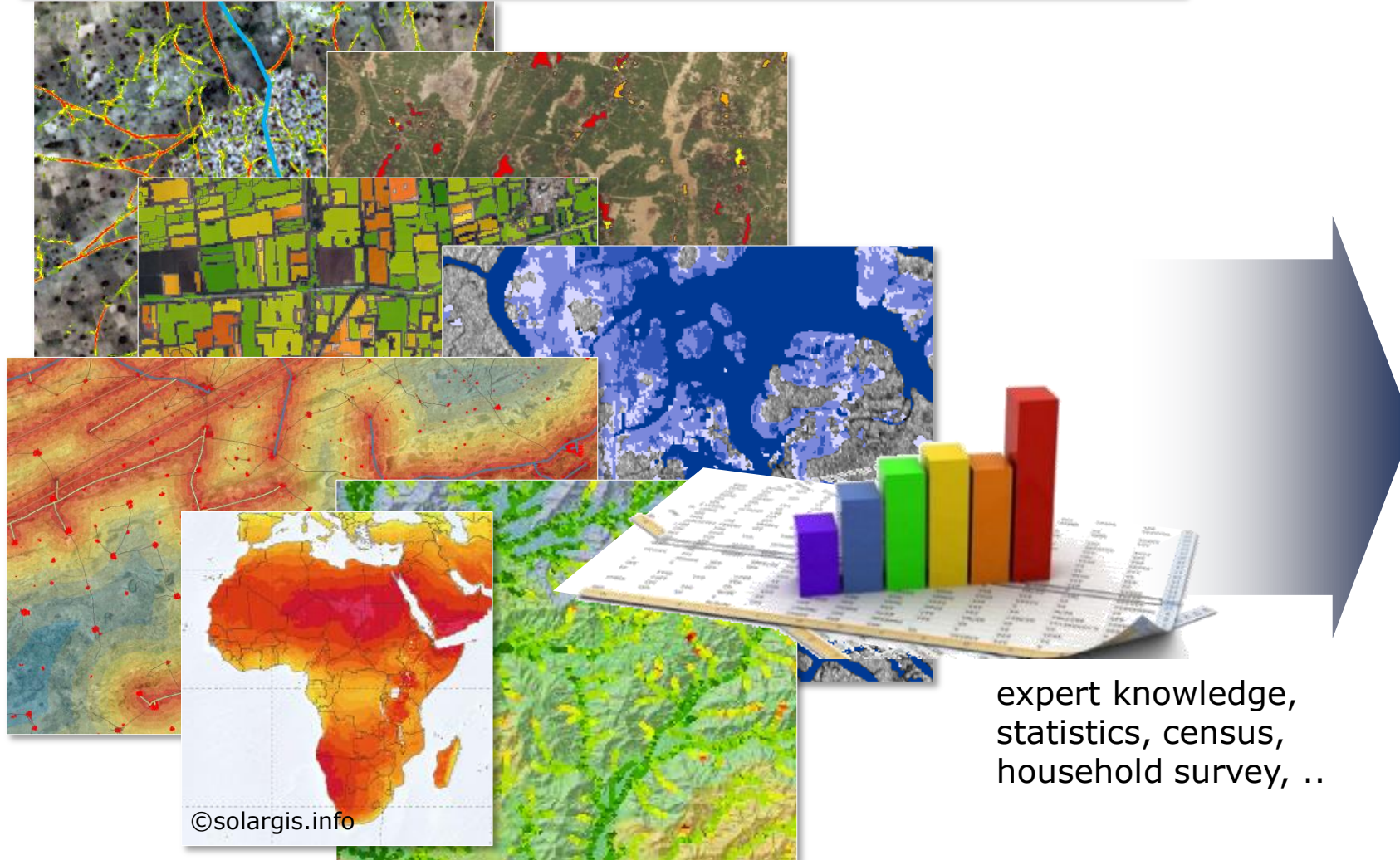
... temporal change



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## Considering the context – Fusion



expert knowledge,  
statistics, census,  
household survey, ..

**Requirements**  
**Interests**  
**Experience**

**DEVELOPER**  
**Possibilities**

Village Data Analytics

*Site Identification as a function of*

- Village size  
hamlet ... city
- Accessibility  
infrastructure distance
- Resources  
dominant size of fields  
potential crop type, ...
- Risk  
natural flooding  
drought
- Other aspects



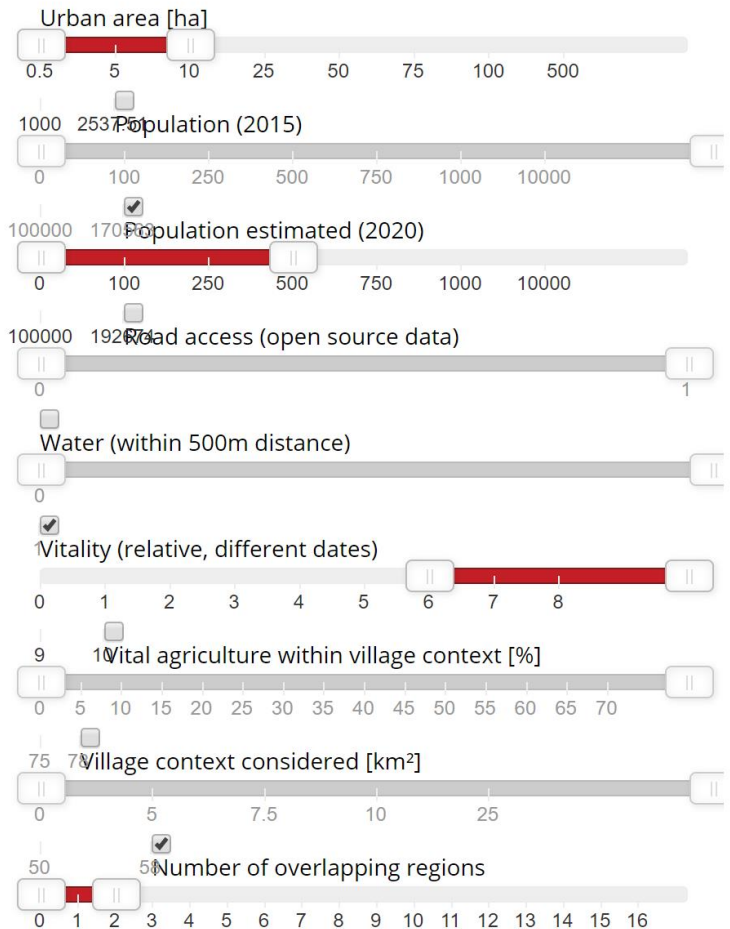
# Sokoto Nigeria

Village Data Analytics

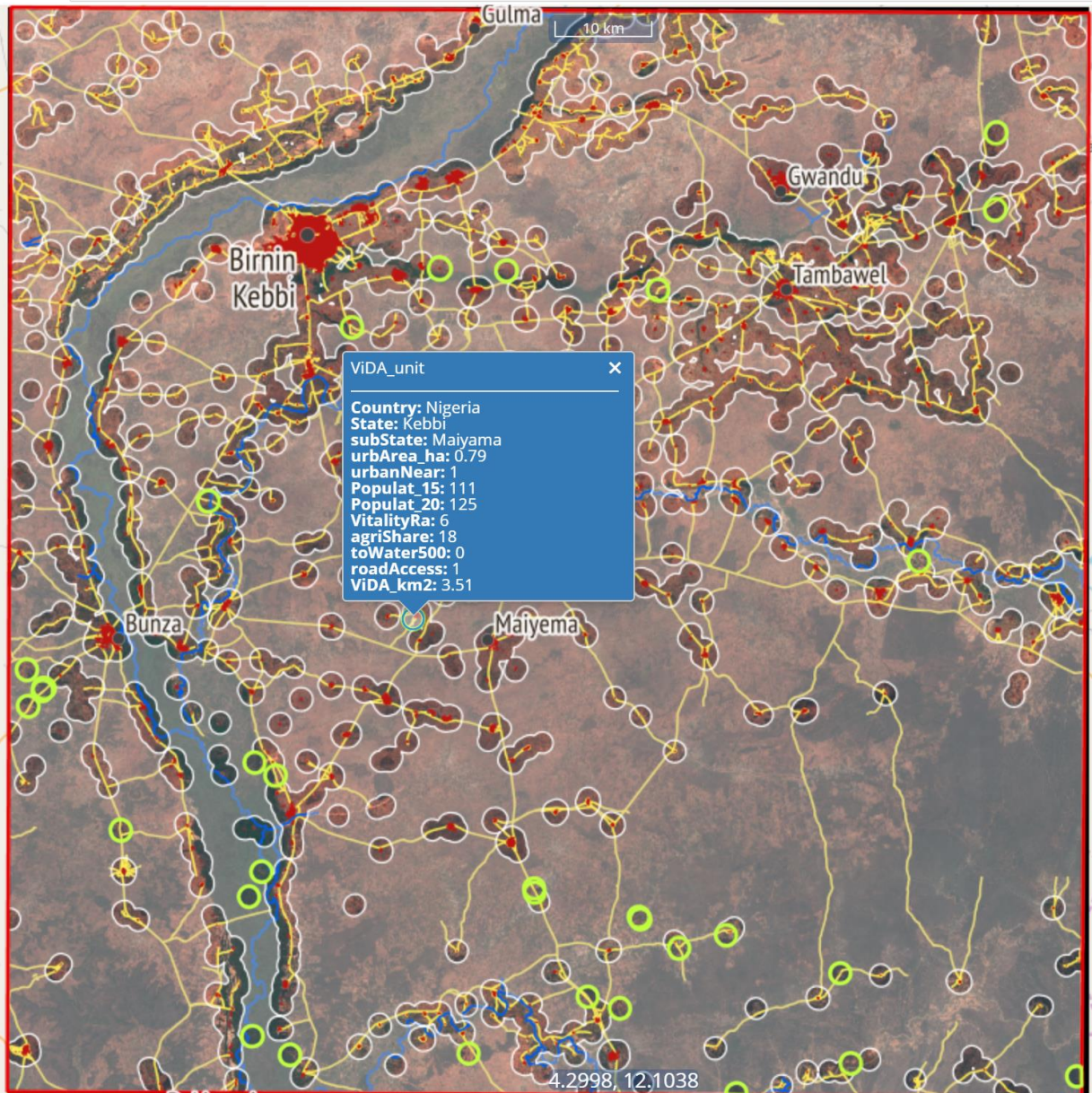
Tools

Layers

Filter - Villages



Map Layer information About





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## Contextual Village Data Analysis



Village Data Analytics

- ... analyzes resources and energy demand of each village
- ... lead to ranking of villages (scoring of the modelling tool) tailored to users requirements
- ... includes ground-truth & survey-data → improve prediction models (AInt, feedback loop)

→ support the decision making process

*from hearsay to data-driven decisions*

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## Contextual Village Data Analysis

Combining common EO analysis methods, Artificial intelligence (AI) & Energy modelling  
Providing cost projections for Microgrid Management (Setup, Operation, Maintenance)  
= InaaS (Information as a Service)



IABG able to support telecommunication issues  
(SatCom Environment)

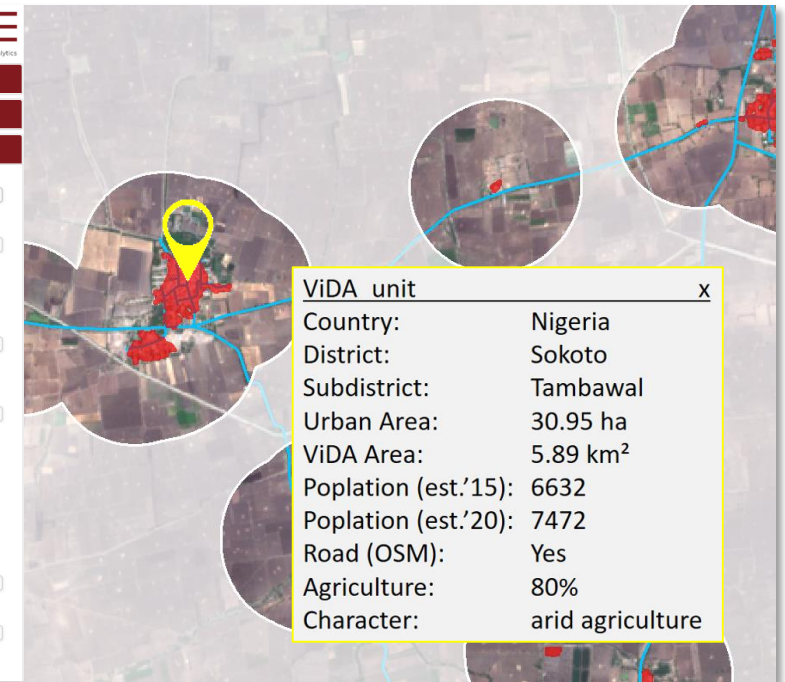
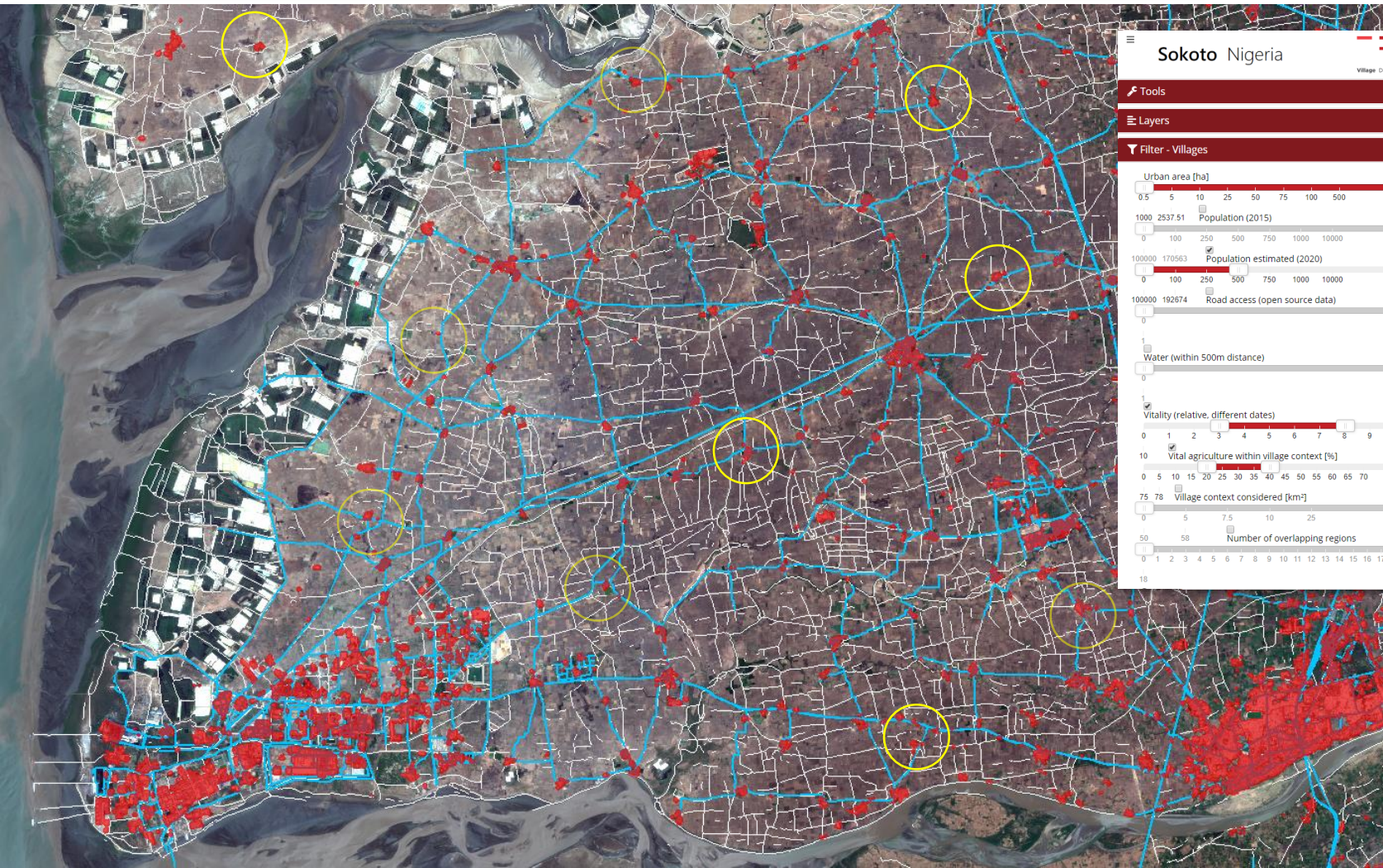
- providing internet (tele-health/-education) if needed
- to contribute to monitoring Microgrids



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## Village Data Analysis



... considers up-to-date  
Decision support for Microgrid developer,  
contextual situation (EO based),  
assumes general ability to  
→ More precise than Stage 1 (national level)  
→ Input for Stage 3  
(on-ground survey/ dialogue)  
will reduce on-site effort needed



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to be continued ...

- User needs defined the overall processing chain/ thematic information layers  
→ focus on follow up of this project
- Energy demand assessment can be reviewed with the new information layer  
→ different information layer available (Sentinels, new technologies)
- Working on increase of automation  
→ scalable service supporting national/ regional policies  
→ close dialogue with the distributed energy sector → feedback



**THE GLOBAL GOALS**  
For Sustainable Development

SDG 7: affordable and clean energy

→ energy = essential need for economic & social well-being

→ electrification Tanzania 15%, Kenya 23%, Nigeria 55%

[Global Energy Architecture Performance index report 2017]



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# Thank You!



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## From Earth Observation to Site identification

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**Prevention project:**  
Integrated Applications for Microgrids in Developing Economies  
(ESA AOI-8591/17/UK/IA)

Access to energy, as an essential need for development, is identified within the Global Sustainable Development Goals (SDG 7: affordable and clean energy). Aim of the presented project was to identify the needs of stakeholders and Microgrid developers within a regional context. A wide-spread questionnaire was developed in order to identify driving thematic elements within the site identification process. Based on the developers feedback services had been established that feed those needs and combine them into a geospatial analysis resulting in a prioritization of sites.

One of the key bottlenecks for Microgrid developers is slow, costly and imprecise site identification based on on-ground surveying. This leads to long project development timelines, low operational margins and restricts access to finance. Overcoming this challenge is crucial as the sector is getting ready to scale in order to meet SDG7 on universal energy access. Our service uses AI based algorithms for a time and cost efficient analysis to provide a ranked list of villages suited and agriculture areas for micro-grid development, based on estimated energy demand, ability to pay, development potential, as well as cost projections for a Microgrid. The proposed analysis fills the gap between national and local investigation and preliminarily addresses the regional context by providing up-to-date information on a high spatial resolution. Electrification supports the sustainable development of villages and enhance the agriculture productivity due to pumping stations for efficient irrigation.

