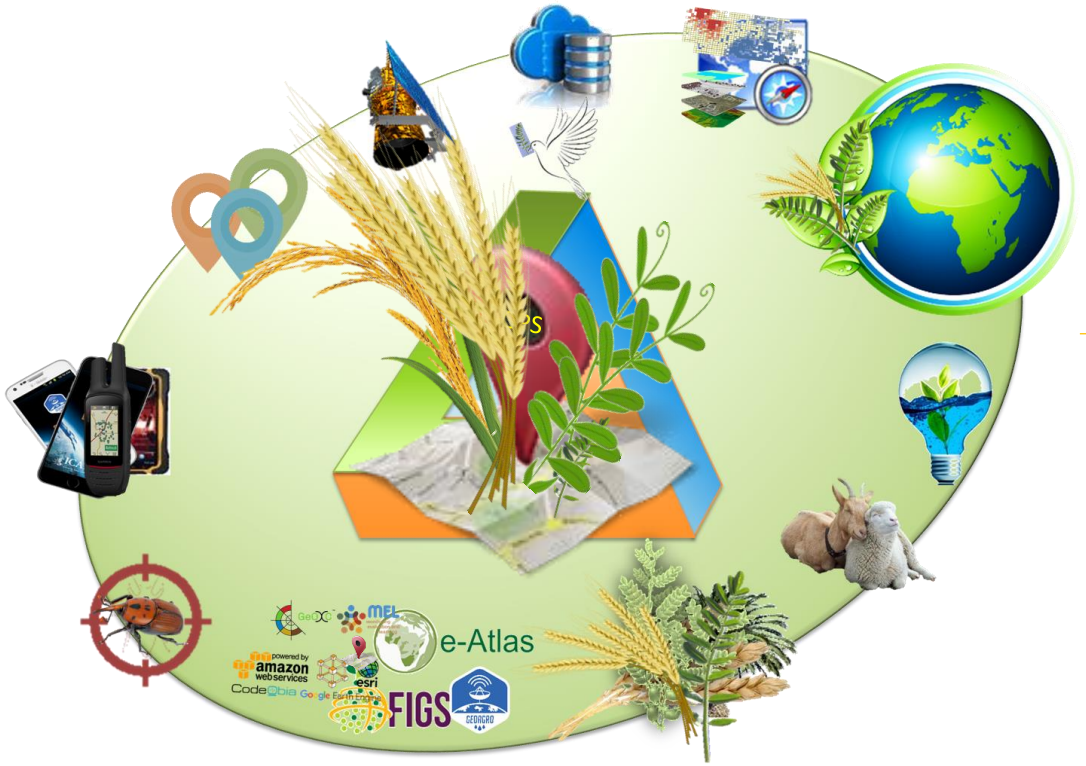
ICARDA

Science for resilient livelihoods in dry areas



EOS Big Data in Agriculture

ICARDA Geoinformatics

31 Oct, 2018, Cairo Egypt

GEOAGRO Leaflet amazon web services Google Earth Engine esri CGIAR

Platform for Big Data in Agriculture

WORLD BANK GROUP

CGIAR CSI Consortium for Spatial Information

icarda.org

International Center for Agricultural Research in the Dry Areas

cgiar.org

A CGIAR Research Center

CGIAR

ICARDA at a Glance

ICARDA is a Decentralized R4D International Institute on Dryland Agriculture combining Component Research and Systems Research

www.icarda.org

Inclusive Agricultural Development in Dry Areas

Increased agro-ecosystem productivity while safe guarding the environmental flows and ecosystem services with focus on resilient intensification of drylands agri-food systems

- in a **inch of land** and a **bunch of crop**

-multi dimensions
-socio-ecological

knowledge based prioritization for better interventions

Ecological intensification
Input Use Efficiency
Bridging Yield Gaps
Conservation Ag Practices
Carbon Sequestration
Land Degradation Neutrality
Technological Scaling

Pulses are the Pulse of the Planet

- food and nutritional security
- resilience and risk reduction
- agro-ecosystem sustainability
- adaption and mitigation
- citizen science and collective actions
- trade, social security and stability

New 9: 5 SRPs + 4 CCTs

Genetic Resources: Mining crop diversity to develop germplasm resistant to heat, drought, cold, disease, higher nutrients; International public goods (open access)

Adaption to Climate Change: Conventional and molecular breeding to develop climate-smart crops and livestock

Building resilience: Integrated crop-livestock farming systems to address economic, social, and environmental conditions

Promoting value chains, policies: Agriculture as an income-generating business for many poor smallholder households

Enhancing water, land productivity: Rainfed, irrigated, and agro-pastoral farming; Reversal of environmental degradation; Enhance intensification

GEOAGRO

CCTs

BigData

Scaling

CapDev

Gender

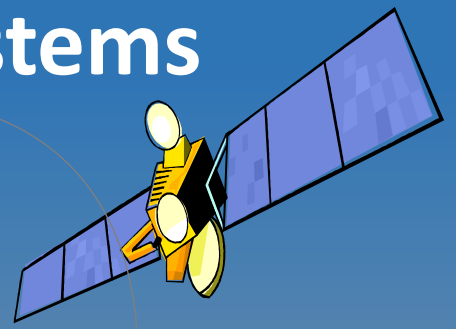
SRPs-strategic research priorities + CCTs-cross cutting themes

GeoAgro Priorities in New Strategy

*Big Data and ICT Platform for ICARDA Research and CGIAR Initiatives (especially **DryArc**)"*

- Advanced level geospatial data analytics and tools for integrated system research
- Earth observation based digital augmentation for sustainable intensification of rice fallows and developed rice fallow information systems
- Quantification of yield gaps, water productivity, and land potential for better targeting developmental interventions
- Build geospatial research data repository and contribute to Center- and CGIAR-level IPGs and open access initiatives (build up on ongoing efforts).
- Continue to enhance Geotagging facility and provide support to program and units for "Geolocalizing" ICARDA's research and outreach activities to build gold mine database to improve science quality and integrated research.

EOS Big Data in Integrated Agroecosystems



Pastures

Hydrology

Energy

River Flow

Drought

Weather

Agriculture

Forestry

Agro-biodiversity

Floods

Agro-ecosystems

Inclusively integrated

Fisheries

Agroforestry

Horticulture

Delta

Ecosystem services

Communication

Water use

DECODING

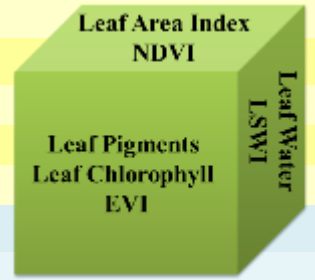
The Data Ecosystem

GEOAGRO

Meta-Matrix of EOS Application in Agro-ecosystems

Example of One Sensor in each Platform/Scale

	Platforms	Ground/*in-situ*		Airborne		Spaceborne				
	Mode	Hyperspectral	Multispectral	Optical	LiDAR	Optical			LiDAR	SAR
RS data characteristics	Sensor	ASD FieldSpec	M× Camera	APs/UAVs	Lidar	WorldView-2	Landsat	MODIS	ICESat*	PALSAR
	Spectral	350-2500nm	4 bands	3-4 bands	1264nm	8 bands	7 bands	7/36 bands*	1264 & 532nm	L band
	Spatial resolution	0.1-1.5m	0.1-0.2m	1-m	20 - 80cm	0.46m Pan; 1.84m MS	15m Pan; 30m MS	250m, 500m, 1000m MS	70m	10m, 20m, 100m
	Swath	1-4m	2-10m	--	1-2km	16.4km	185km	2330km		35-250km
	Revisit	--	--	3-year	--	1.1 days	16 days	1 day	91 days	46 days
Biophysical	Plant biomass	×	×		×	×	×	×		×
	Plant height				×				×	×
	LAI, fPAR, LST	×	×			×	×	×		
	NDVI, EVI, LSWI	×	×	×		×	×	×		
Biochemical	Erosion, Salinity	×	×	×	×	×	×	×		
	Soil moisture	×	×	×		×	×			×
	Chlolophyll	×	×	×		×	x	×		
	Nitrogen	×	×	×		×	×			
	Phosphorous	×	×			×				
	Plant water	×	×			×		×		
Production	GPP	×	×	×		×		×		
	NPP	×				×	×	×		
LULC	land cover/use	×	×	×		×	×	×		×
	phenology	×	×				x	×		×
	Irrigation	×	×	×		×	×	×		×
Terrain	DEM		×	×	×	×			×	×
	Derivatives		×	×	×				×	×
Scale	Tier 1 AOIs	×	×	×	×	×	×	×	×	×
	Tier 2 action sites	×	×	×			×	×	×	×
	Tier 3 AEZs	×	×	×				×	×	×
	Tier 4 Target			×				×		×



Scaling Trade-on/offs

Top-down and bottom-up
Farmscapes to Landscapes

Integrated Agroecosystems combining **Component** Research & **Systems** Research

A multi-scale and multi-criteria R4D

Global

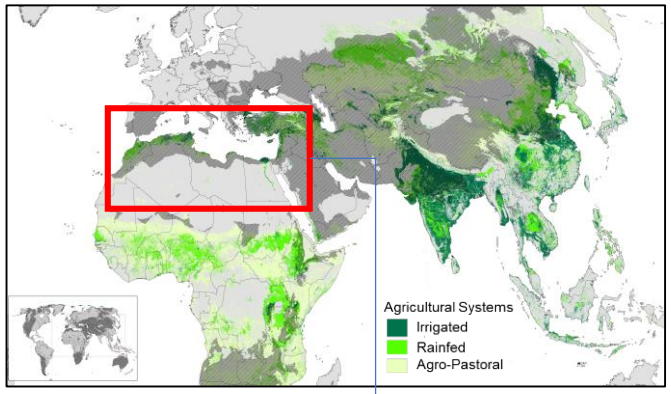
Country

Region

Landscape

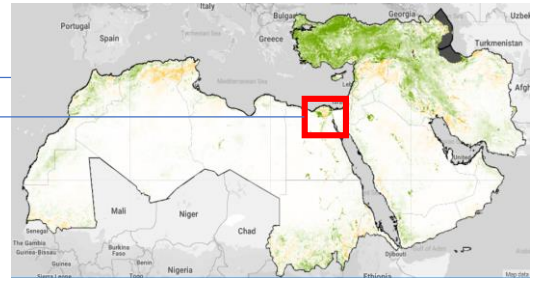
Field

icarda.org

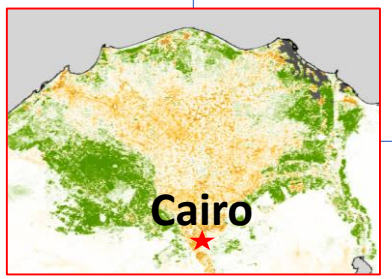


Climate (Variability and Change)

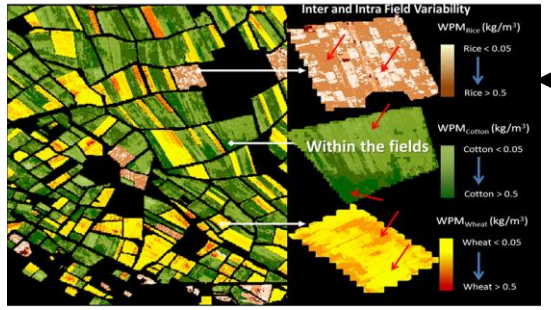
Nutrition Security and Sovereignty



Un-employment
Poverty



NRMs



Functional
Productivity

Supply Chain

Down

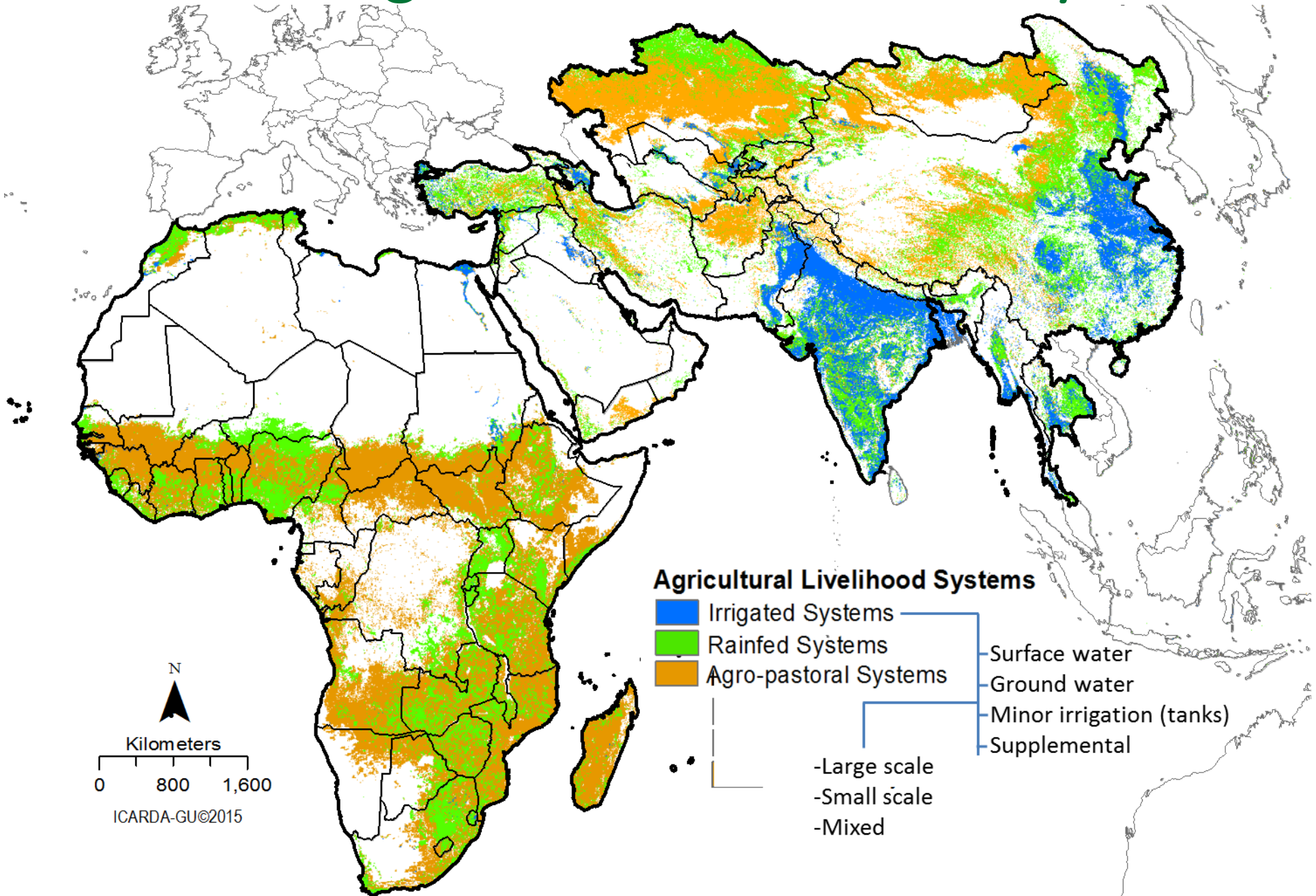
Out

Up

Farm

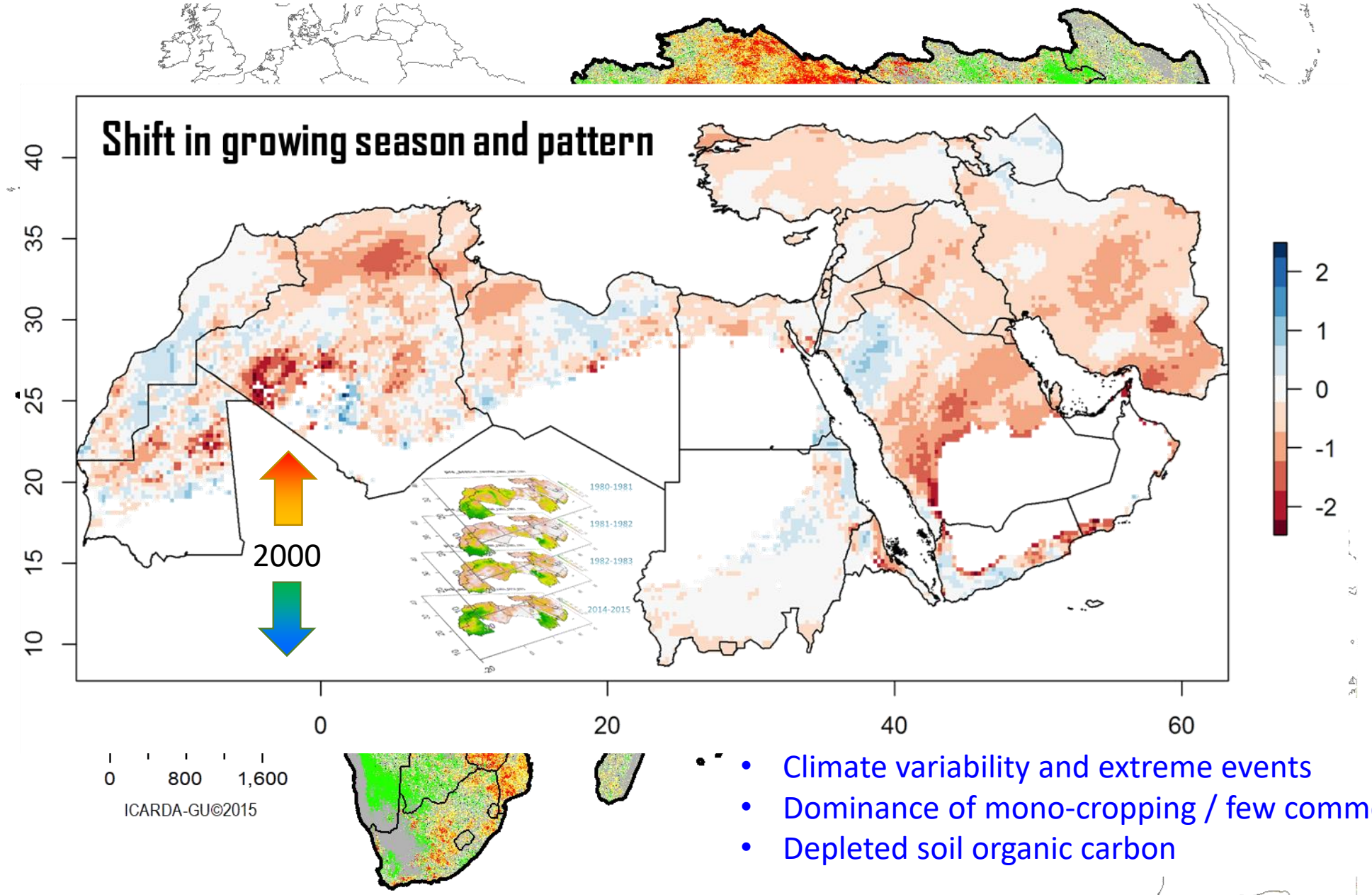
Agricultural Systems
Irrigated
Rainfed
Agro-Pastoral

Active Agricultural Production Systems



Changing Water Balance

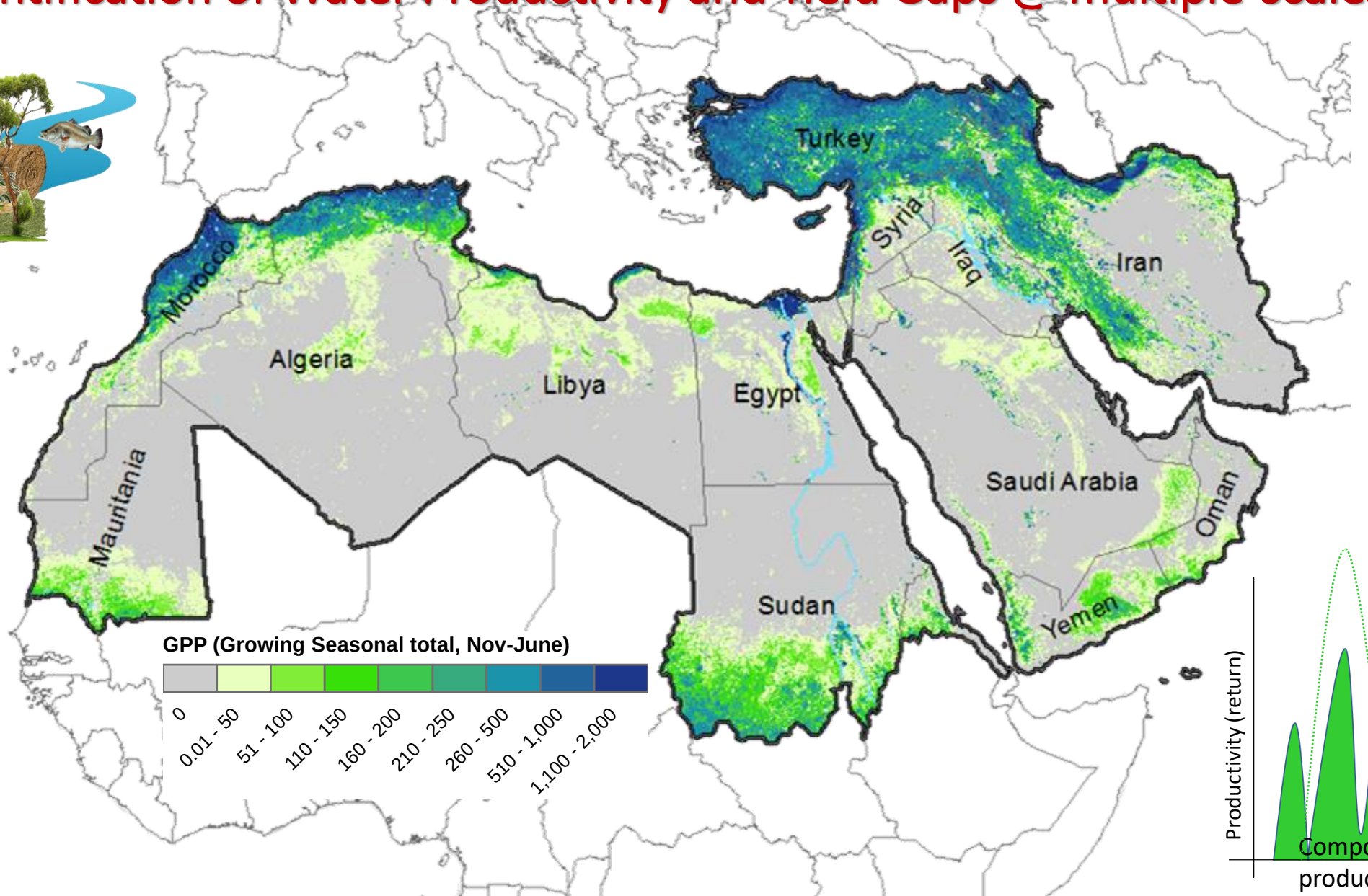
Frequent deviation from long-term averages

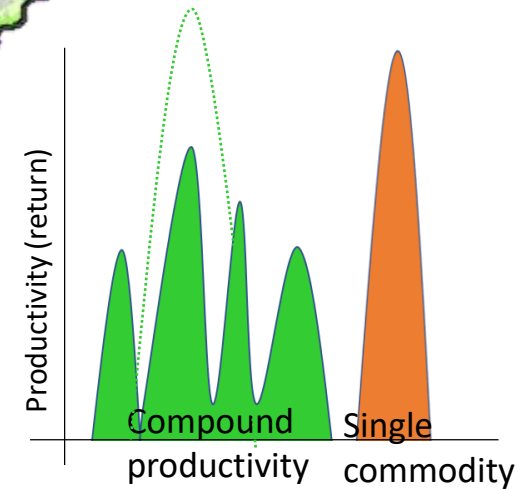


- Climate variability and extreme events
- Dominance of mono-cropping / few commodity focus
- Depleted soil organic carbon

Impact of cropping pattern on yield compounding

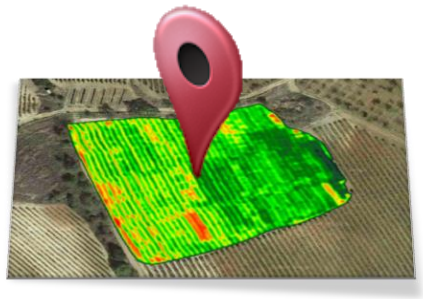
Quantification of Water Productivity and Yield Gaps @ multiple-scales





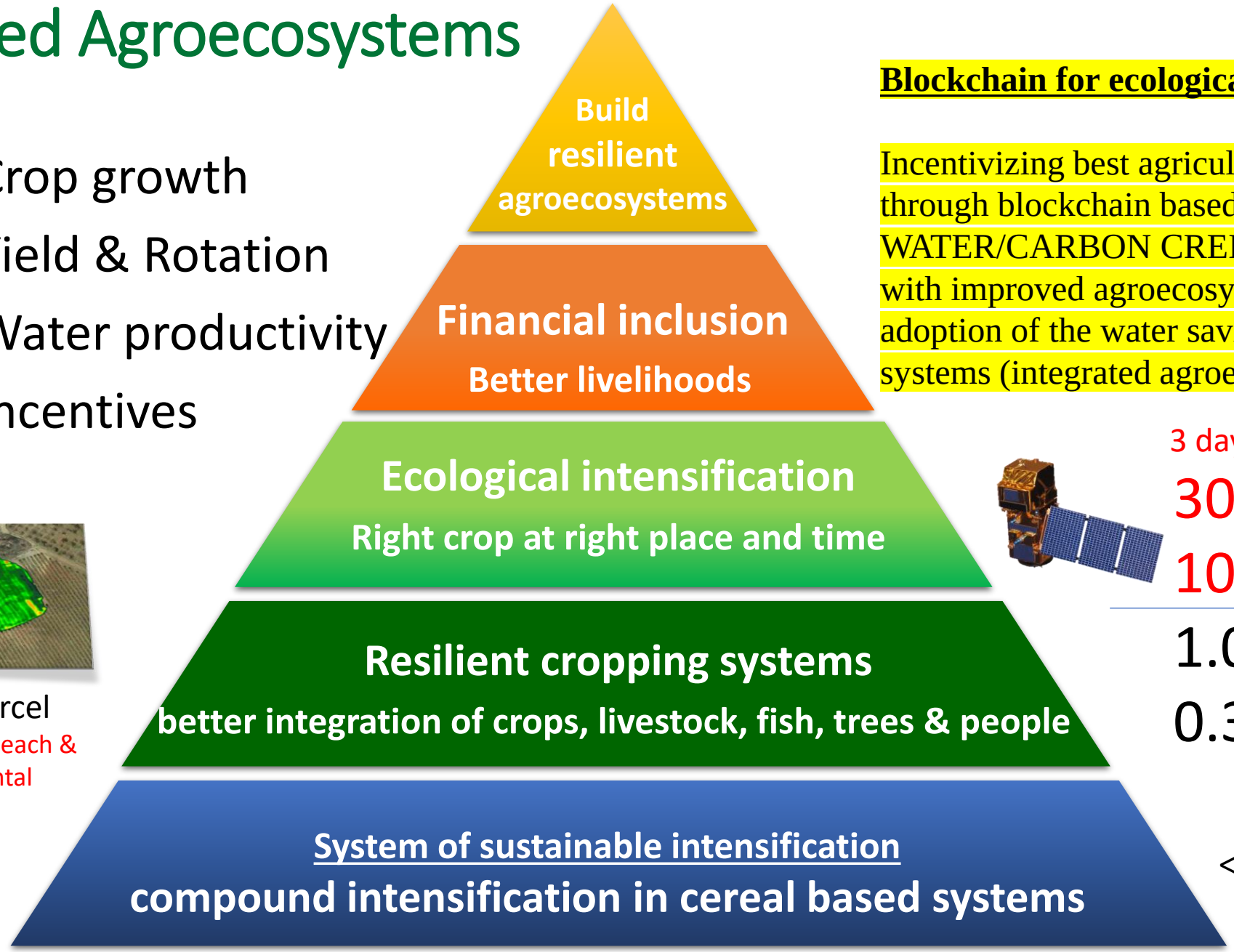
Integrated Agroecosystems

1. Crop growth
2. Yield & Rotation
3. Water productivity
4. Incentives



Pixel/Farm/Parcel

A single entity for each & every developmental entry point



Blockchain for ecological intensification

Incentivizing best agricultural practices through blockchain based WATER/CARBON CREDITS associated with improved agroecosystem health by adoption of the water saving agri-food systems (integrated agroecosystems)

3 days revisit

30m

10m

Open source

1.0m

0.3m

Agreements

<Biggest drivers

Does food legumes can be an option for coping with increased water demand in the dry areas?

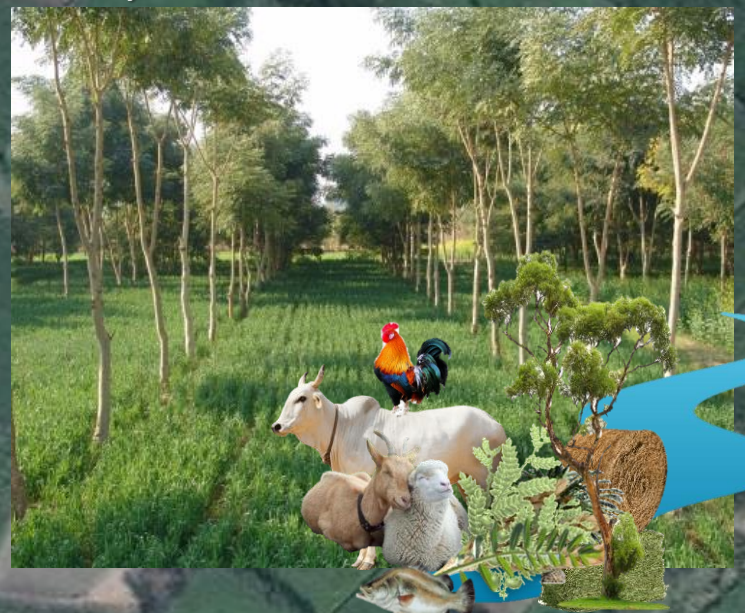
Water productivity of terrestrial food plates (liters/kg)

Daal/Falafal
1,250lt

Chicken
4,325

Mutton
5,520

Beef
13,000



[mixed crops, livestock, fish and trees] –policies

Big-data, Machine Learning and AI algorithms

AI-ML-BigData @ genetics, chemistry, weather, agronomies, trade…

AI
ML

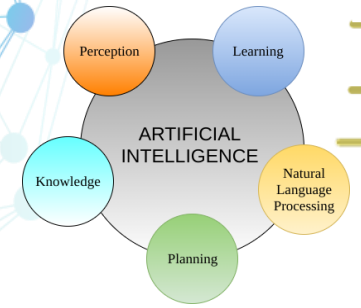
Big
Data

Meta Analytics

deep learning
predictive analytics
machine learning

translation
classification & clustering
information extraction
natural language processing (NLP)

contexts
options
location
typology
Demand driven
Sustainable options



expert systems

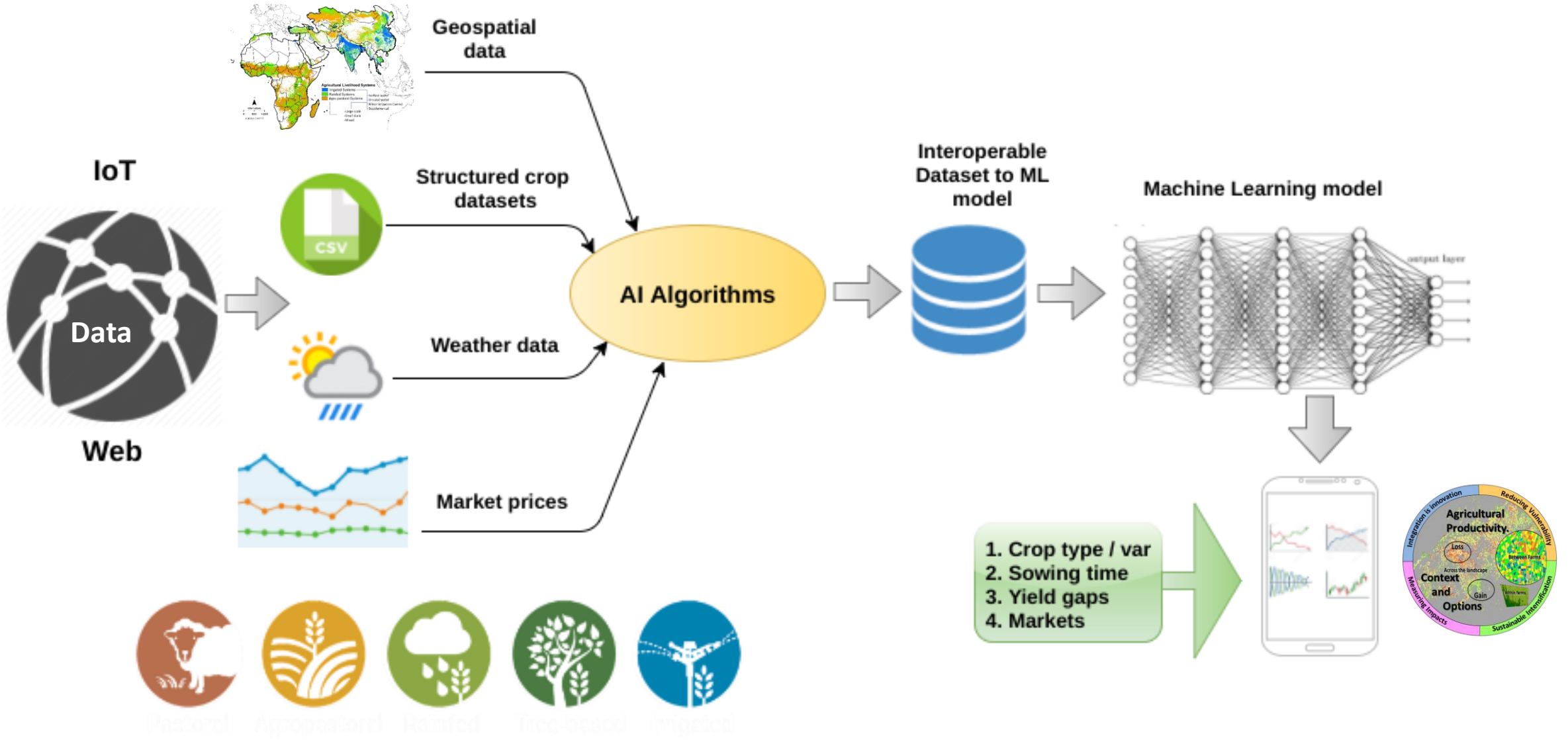
planning, scheduling & optimization

robotics

image recognition
machine vision
vision

Inclusive Agroecosystems

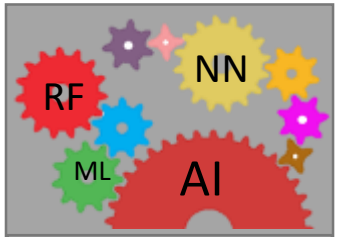
Big-data, Machine Learning and AI algorithms



Digital Augmentation for Accelerating System Intensification

Citizen Science

Community of Practices



Cadastral, Object & Pixel based

Biophysical and socio-ecological

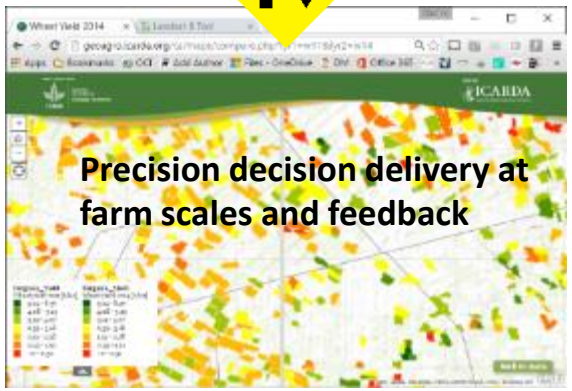
Machine Learning
Crop types, crop intensity, rotation, fallows, crop stress, AET-l8, soil moisture-SMAP

Citizen-Science Cellphone feedback

Direct Access and Markets/Business

Precision-Decision

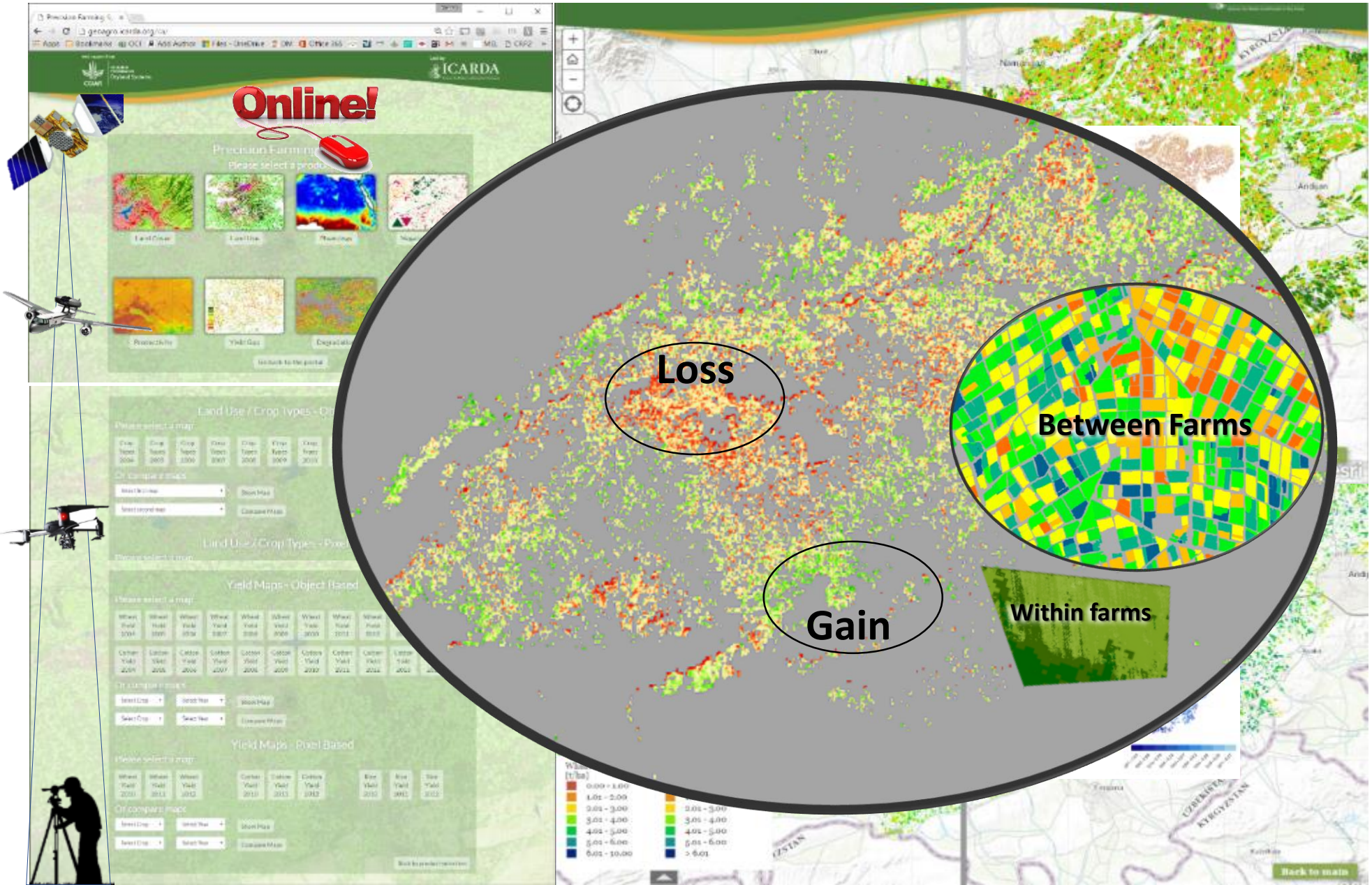
Location Specific Interventions



Right Time Right Place

EOS in Precision Analytics

Automated workflow for operational mapping, monitoring and farm advisory



VegChange MENA - Earth Engine

https://code.earthengine.google.com/59624b672c507ca08261ca0349bd1cd5

Google Earth Engine

Search places and datasets...

Help | c.biradar

Scripts | Docs | Assets

- NDVI Time Series
- NDVI Time Series (Iraq 2)
- NDVI Time Series (Iraq)
- NDVI Time Series (Jordan 250m)
- NDVI Time Series (Jordan)
- NDVI Time Series (Syria)
- NDVI_WBOD
- NDVI_WBOD (copy)
- Sentinel NDVI
- Sentinel NDVI (Jordan)
- VegChange MENA
- WB-OD NDVI
- users/cbiradar/Telangana

VegChange MENA | Get Link | Save | Run | Reset

```
17  */
18
19  // Load the vector/shapefile data, "geometry" is the column name of KML data
20  var fusionID = "ft:148w0BHmEj2P2225vacSaxPmF8bCV5SByWSPBhuox";
21  var MENA = ee.FeatureCollection(fusionID, "geometry");
22
23  // Add ROI shapefile as a layer to the Map
24  Map.addLayer(MENA, {}, "MENA Countries");
25
26  Map.centerObject(MENA, 4);
27
28  var GRAYMAP = [{stylers: [{saturation: -100 }]},
29    {elementType:"labels", stylers:[{lightness: 20 } ]},
30    {featureType:"road", elementType:"geometry", stylers:[{visibility:"simplified"}]},
31    {featureType:"road", elementType:"labels", stylers:[{visibility:"off"}]},
32
```

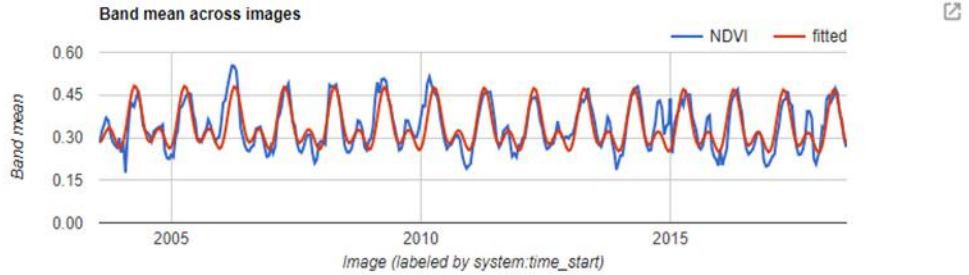
AET

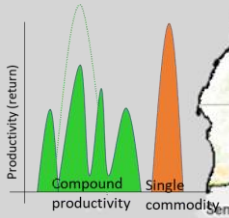
YIELD

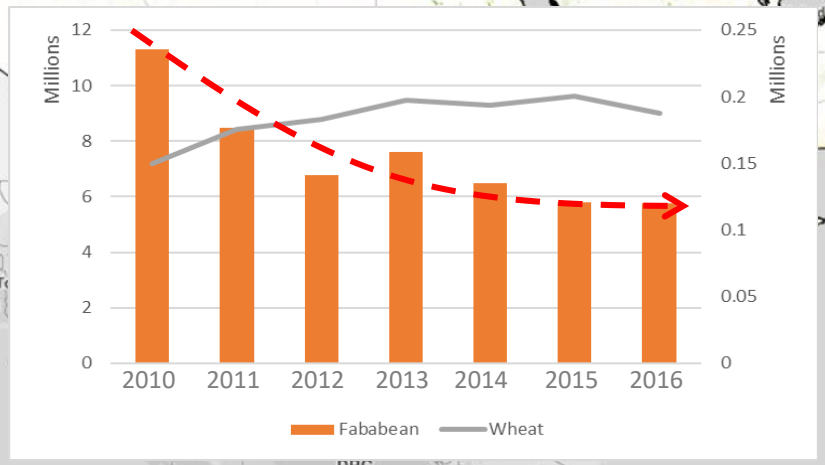
CROP TYPES

Inspector | Console | Tasks

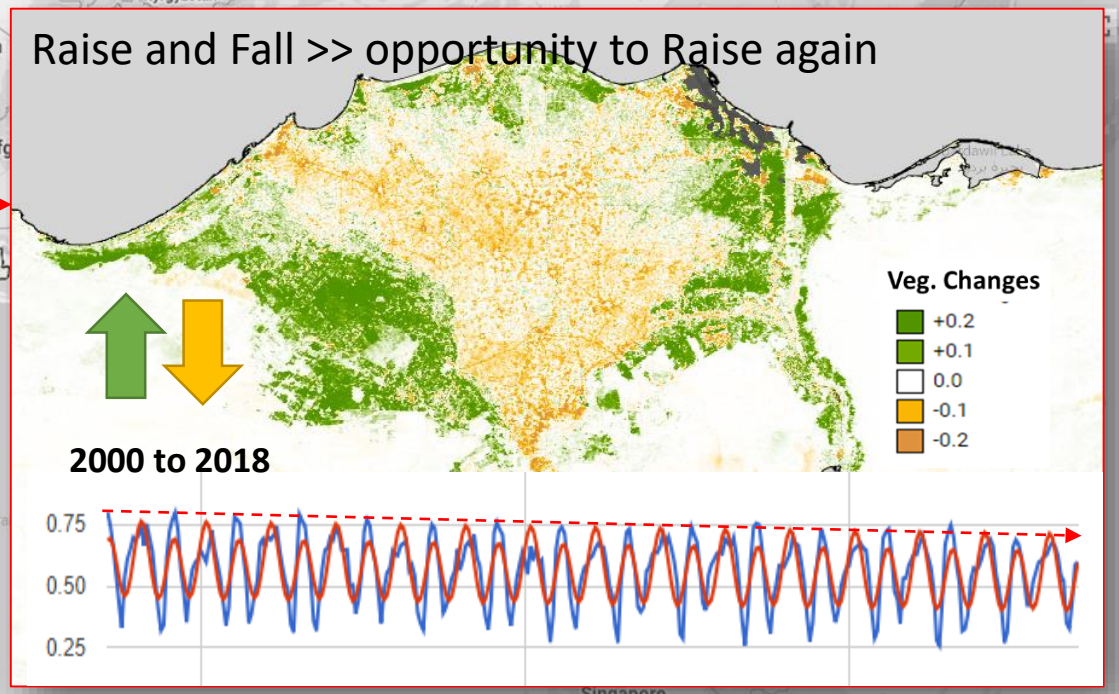
Use print(...) to write to this console.







Raise and Fall >> opportunity to Raise again



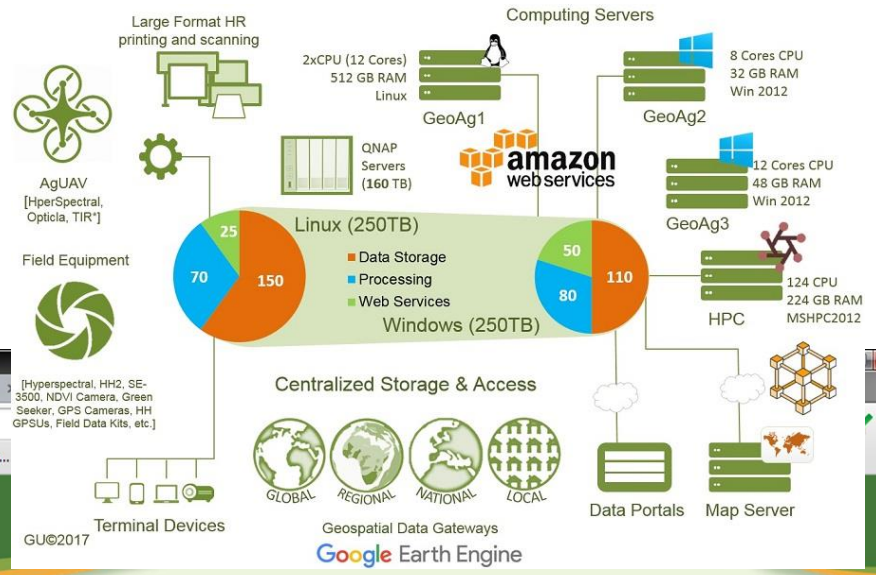
Veg. Changes
+0.2
+0.1
0.0
-0.1
-0.2

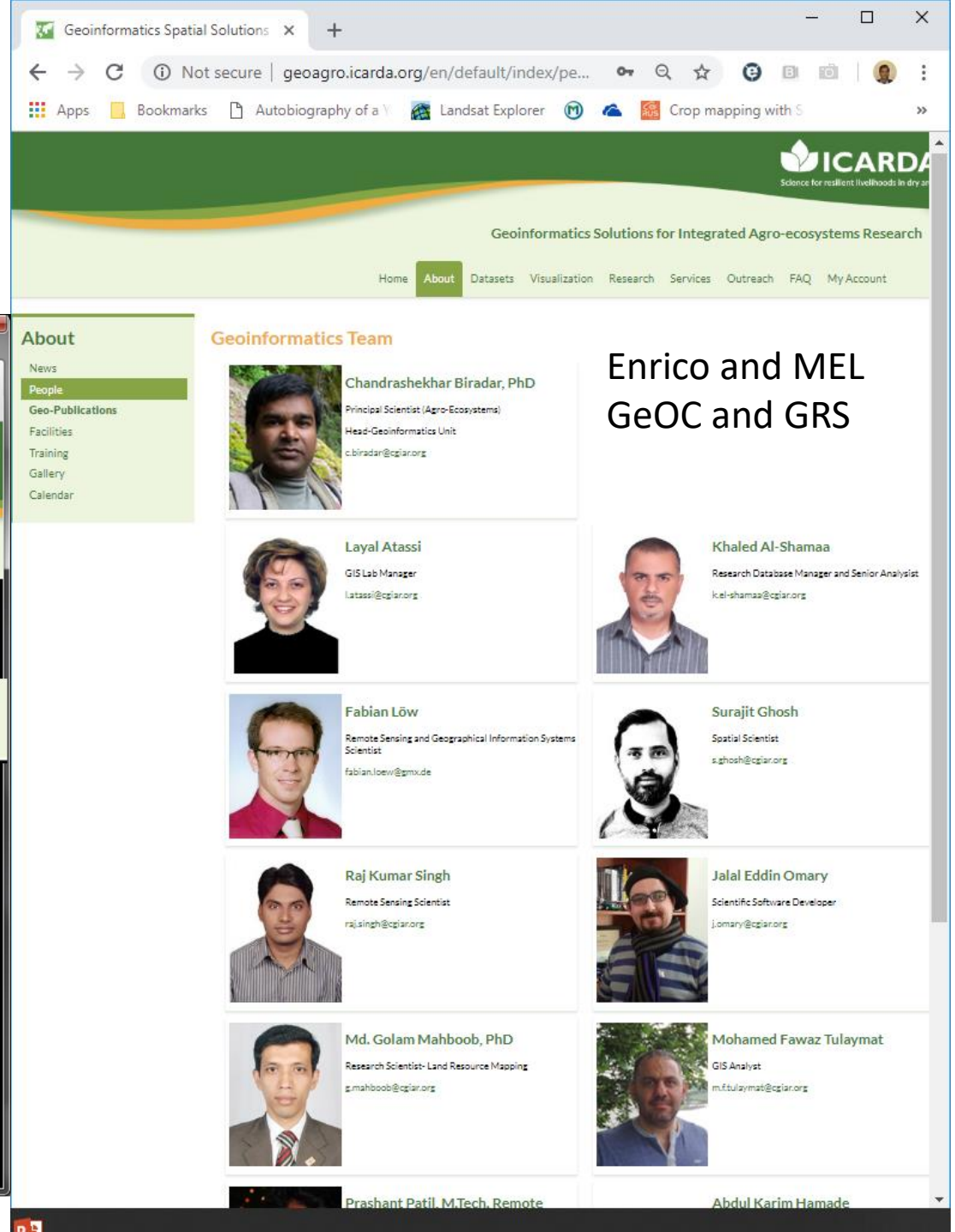
Layers | Map | Satellite | Gray

Google

Map data ©2018 Google, INEGI, ORION-ME | 500 km | Terms of Use

GEOAGRO





Enrico and MEL
GeOC and GRS

Production follows functions

Building functional feedback system through integration of crops, trees and animals

avoid the unmanageable and manage the unavoidable

-IPCC Confronting Climate Change:

Thank You