ICARDA

Science for resilient livelihoods in dry areas

Big Data for building Inclusive Agroecosystems

Decoding the big-data ecosystems for efficiency, ecology, economy and impact

Chandrashekhar Biradar

Big Data in Agriculture

10-14 December, 2018, Rabat, Morocco

GEOAGRO GBDX amazon web services Leaflet R Google Earth Engine esri CGIAR Platform for Big Data in Agriculture CGIAR CSI Consortium for Spatial Information

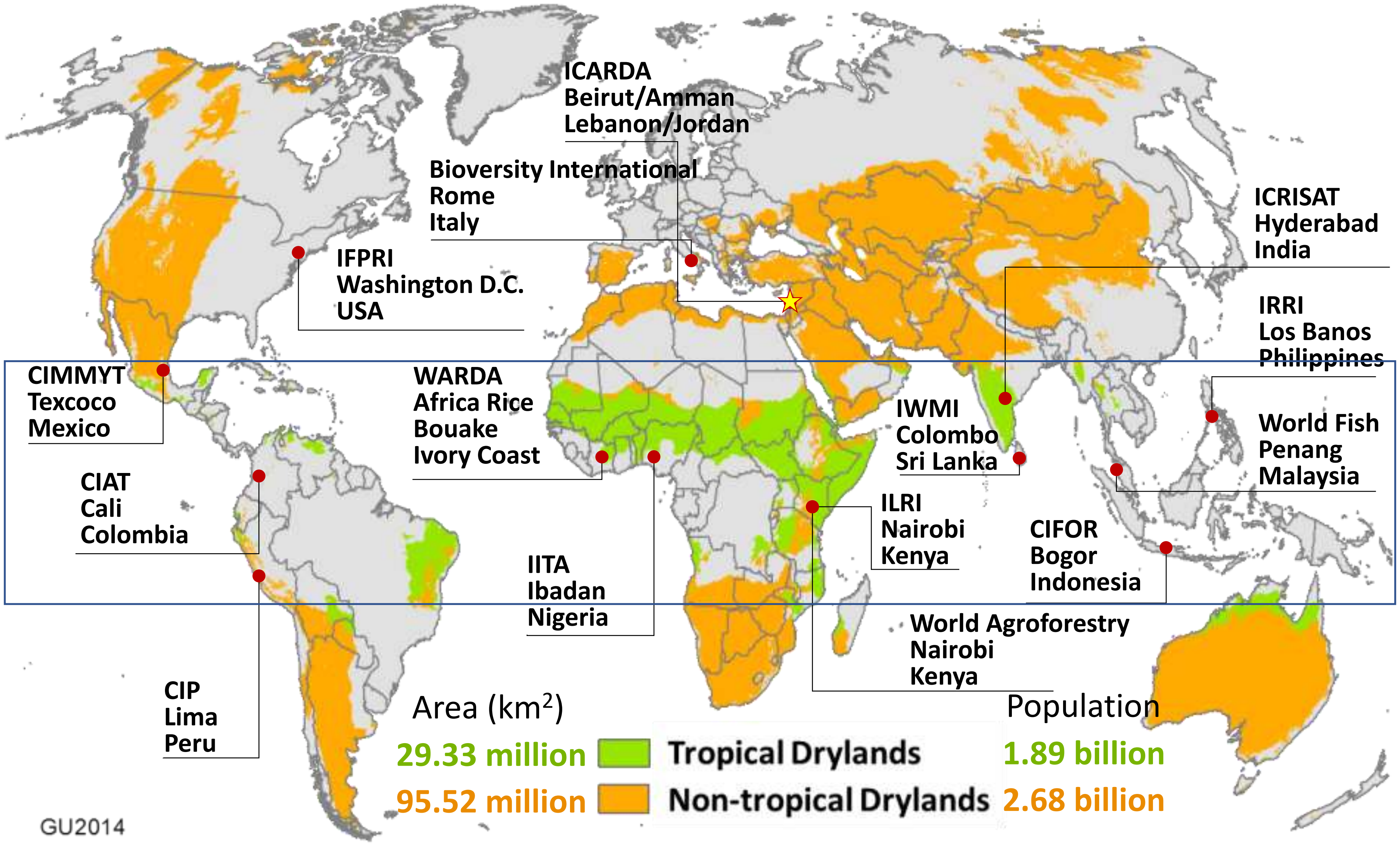
Big Data in Agriculture Course - Rabat - 10 - 14 December, 2018

Sunday 09 Dec 18	Time	Day1: Monday 10 Dec'18	Day2: Tuesday 11 Dec'18	Day3: Wednesday 12 Dec'18	Day4: Thursday 13 Dec'18	Day5: Friday 14 Dec'18
Arrival, Accommodation, pre-planning, logistics check	Theme>>	**Big Data Big Picture**	**Data Collection and Curation**	**Geolocalization & Field Day**	**All about FAIR Data**	**Catalyst of Integration**
	8:30-9:00	**Opening Session and Introduction to Course** (A Amri; C. Biradar)	**Debriefing previous day** (C. Biradar)	**Debriefing previous day** (F. Bonechi)	**Debriefing previous day** (K. El-Shama)	**Debriefing previous day** (B. Mueller)
	9:00-10:30	**CGIAR Approach to Big Data** (B. King)	**Data Repositories & Archiving** (DV, Dspace, Schema - E. Bonaiuti)	**Big Data in Agriculture Analytics** (S. Faissal)	**FAIR Data Principles and Applications** (V. Graziano)	**CapDev Tools for Better Integration** (B. Mueller)
	10:30-11:00	*Coffee break*	*Coffee break*	*Coffee break*	*Coffee break*	*Coffee break*
	11:00-12:30	**All About Big Data and ICTs in Agriculture** (C. Biradar et al)	**Enabling Factors, ICT** (H. Abed)	**Geotagging Research and Outreach activities** (K. El-Shama and C. Biradar)	**Morocco Partners (INRA, ONCA, IAV, P6, +) Data and Presentations**	**Build your own Course in Moodle** (B. Mueller)
	12:30-14:00	*Lunch break*	*Lunch break*	*Lunch break*	*Lunch break*	*Lunch break*
	14:00-15:00	**AGROVOC Use and Contribution** (K. Kolshus, A. Turbati, I. Subiratis)	**BCIP, GRS Data, People and Processes** (Z. Kehel)	**Field Exercise and Demos in INRA/ICARDA premises (All)**	**Data Curation of Existing Datasets** (F. Bonechi)	**How Big Data Shaping CGIAR Ag Research** (J. Koo)
	15:00-16:00	**Harmonizing CGIAR Data** (M. Devare)	**RALS Data, People and Process** (M. Hilali) / **WLEP Data, People and Process** (M. Haddad)	**Field Exercise and Demos in INRA/ICARDA premises (All)**	**International Nursery, Interaction, Data and Use** (A. Niane and K. El-Shama)	**Showcase Data on the Genebank** (A. Tsivelikas)
	16:00-16.30	*Coffee break*	*Coffee break*	*Coffee break*	*Coffee break*	*Coffee break*
	16:30-18:00	**GDPR and IP Rights** (A. Nour) / **Intro Repositories -** E.B.	**Metadata, Spatial Data Curation** (L. Atassi et al)	**Big Data and Tools (GBDX, aWhere, etc)** (S. Ghosh, and C Biradar)	**Ontologies: Why should we use them?** (E. Arnaud)	**Wrap up, Certification and Closing Ceremony** (B. Mueller, C. Biradar)
(core group discussion-	*19:30-21:00*					

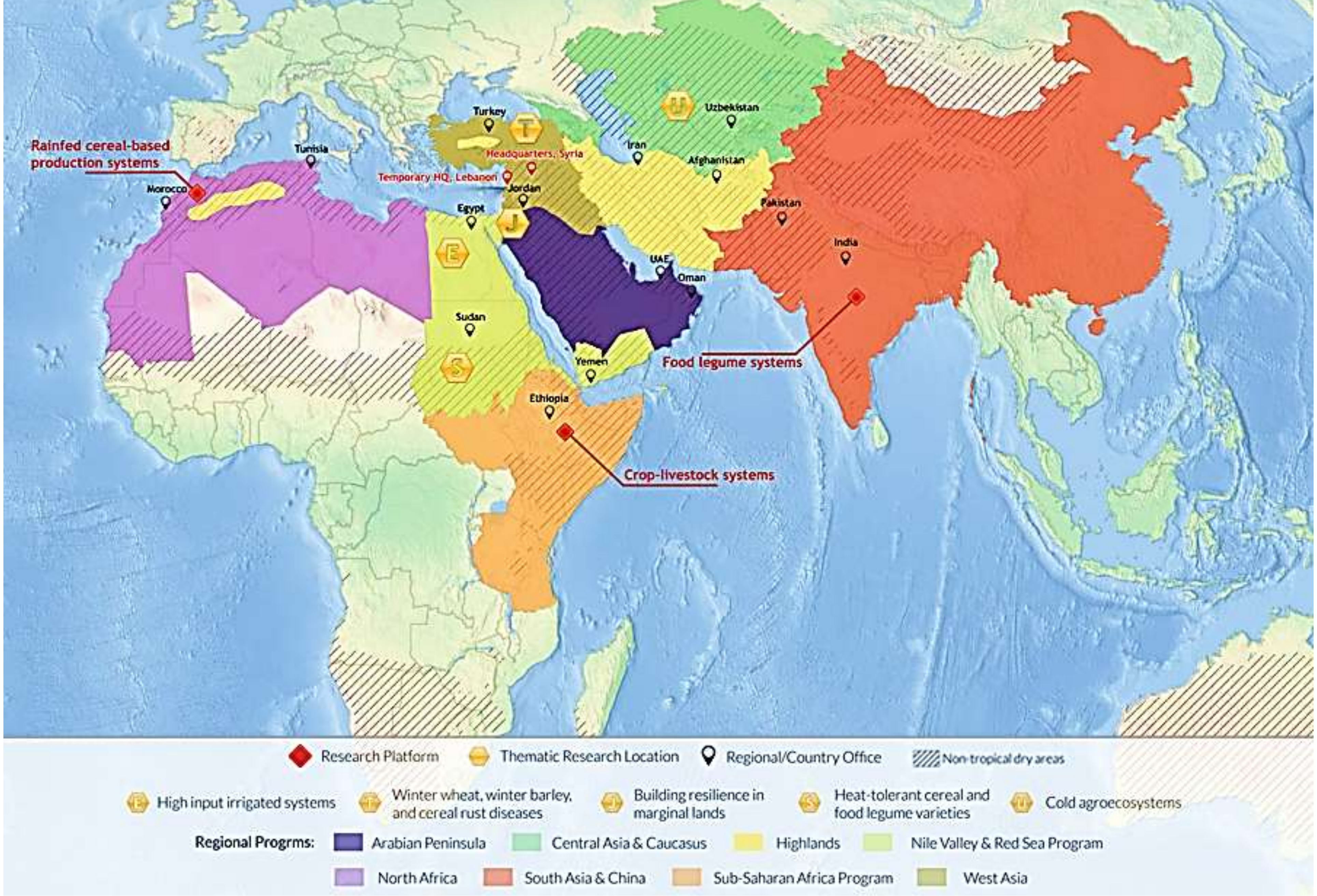
icarda.org
International Center for Agricultural Research in the Dry Areas

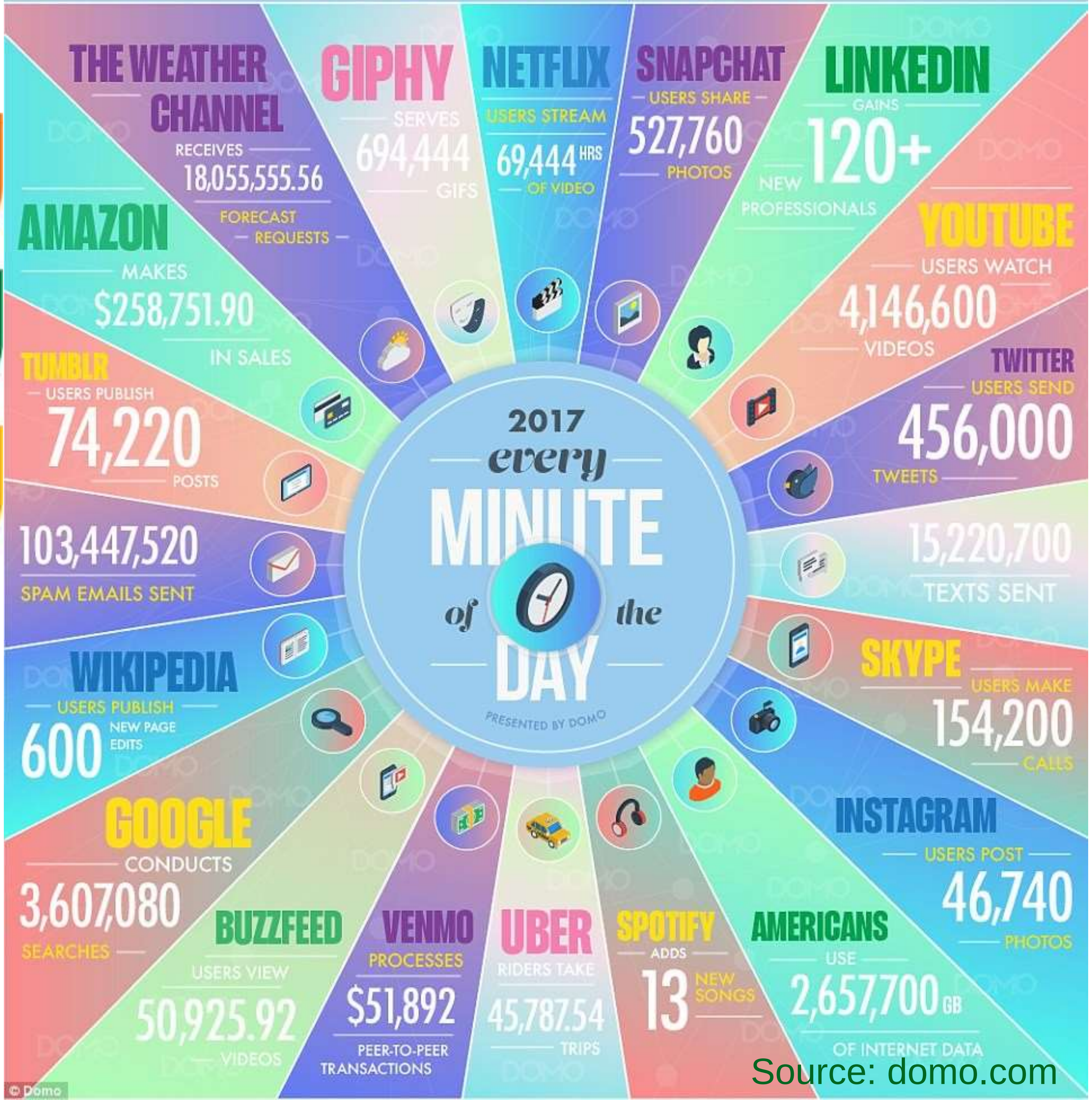
cgiar.org
A CGIAR Research Center
CGIAR

Global Drylands and CGIAR



ICARDA's Research: Programs, Platforms, Research Stations, and office locations





Source: domo.com

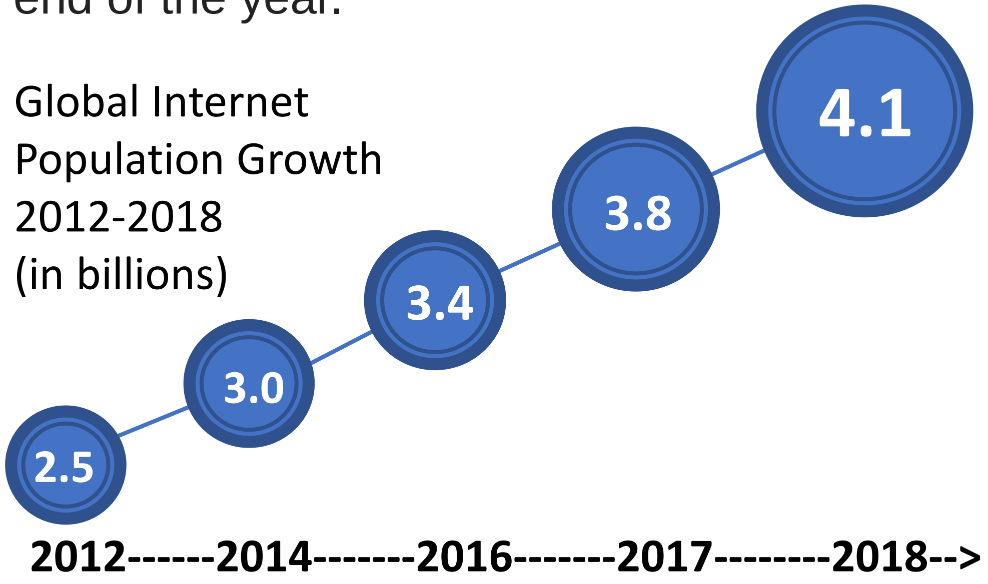
DATA NEVER SLEEPS 6.0

How much data is generated *every minute?*

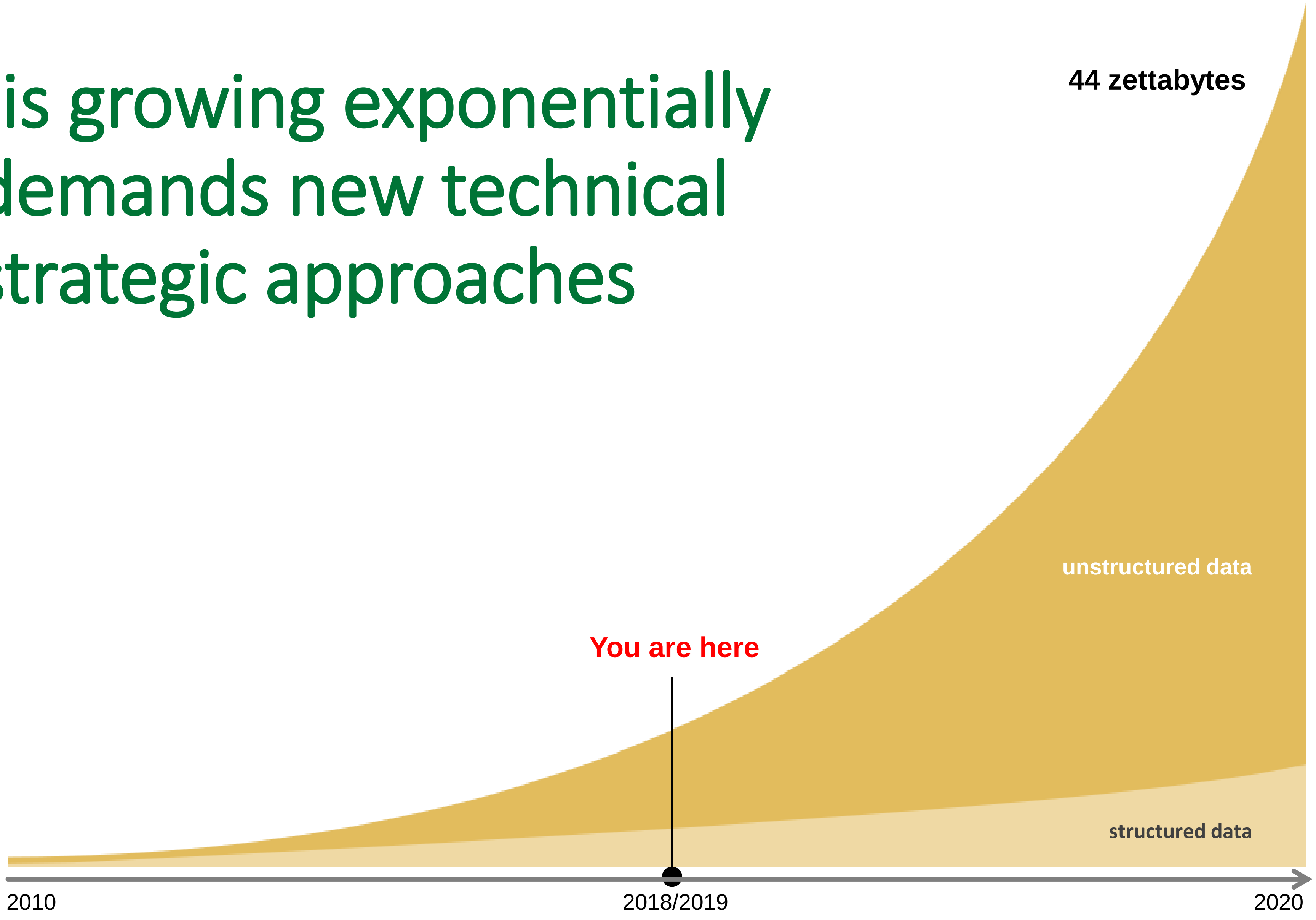
There's no way around it: big data just keeps getting bigger. The numbers are staggering, but they're not slowing down. By 2020, it's estimated that for every person on earth, 1.7 MB of data will be created every second. In our 6th edition of Data Never Sleeps, we once again take a look at how much data is being created all around us every single minute of the day—and we have a feeling things are just getting started.

The World's Internet users growing exponentially. As of June **2018**, 55 % of the **world's** population has **internet** access. Its estimated nearly 4 billion people, or over half of the **world's** population online by the end of the year.

Global Internet Population Growth 2012-2018 (in billions)

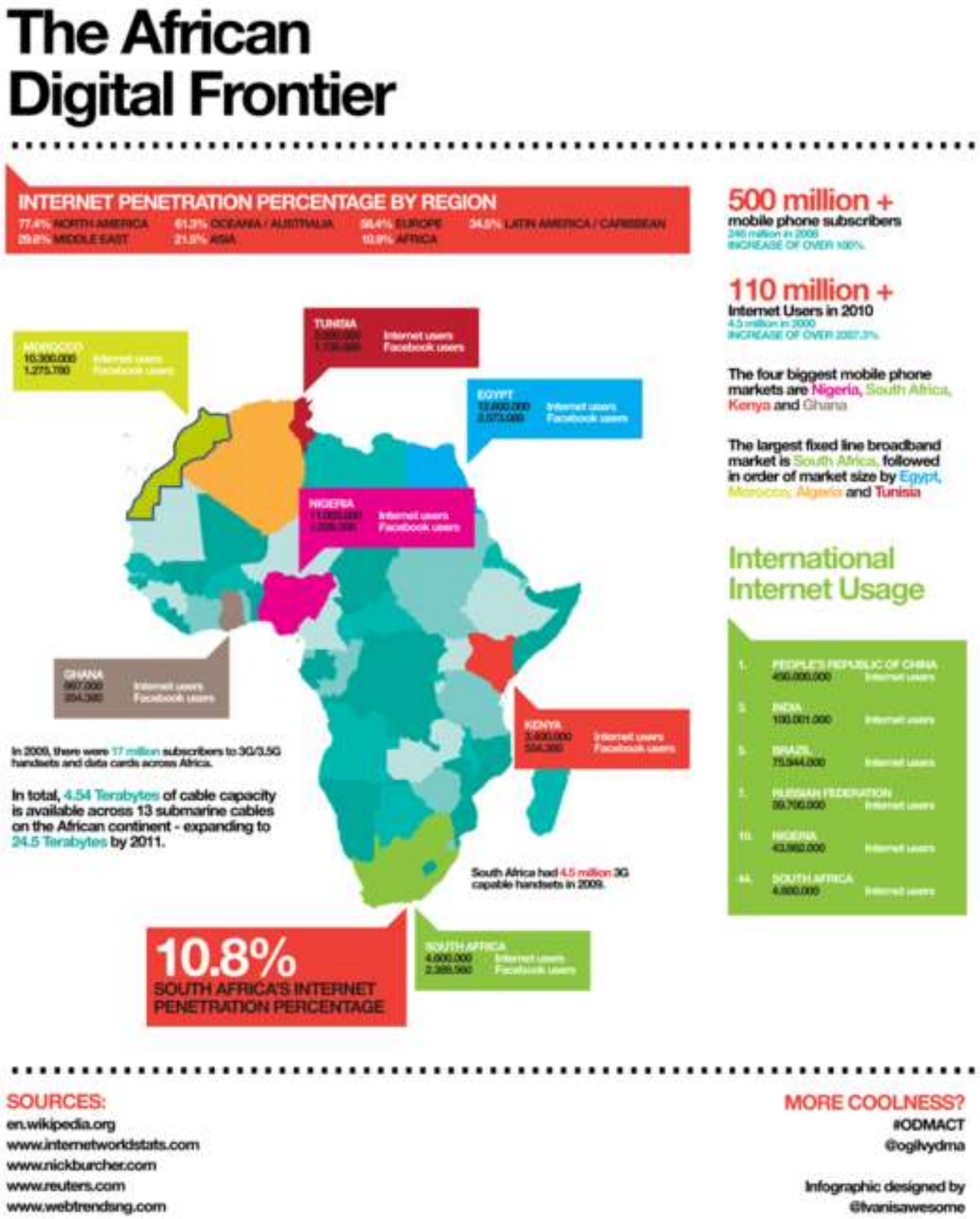


Data is growing exponentially and demands new technical and strategic approaches



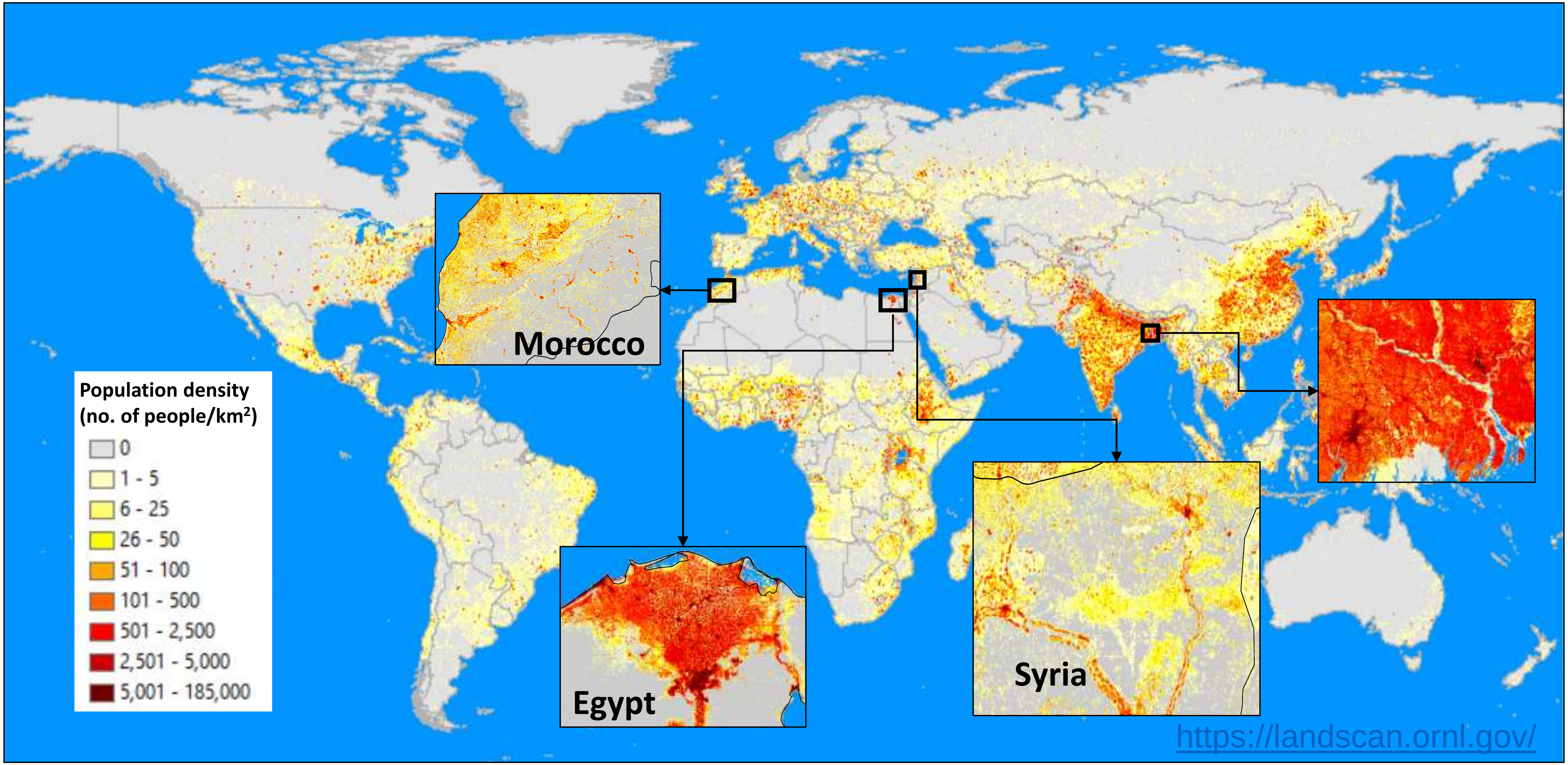
Source: Robin Lougee IBM Research

icarda.org

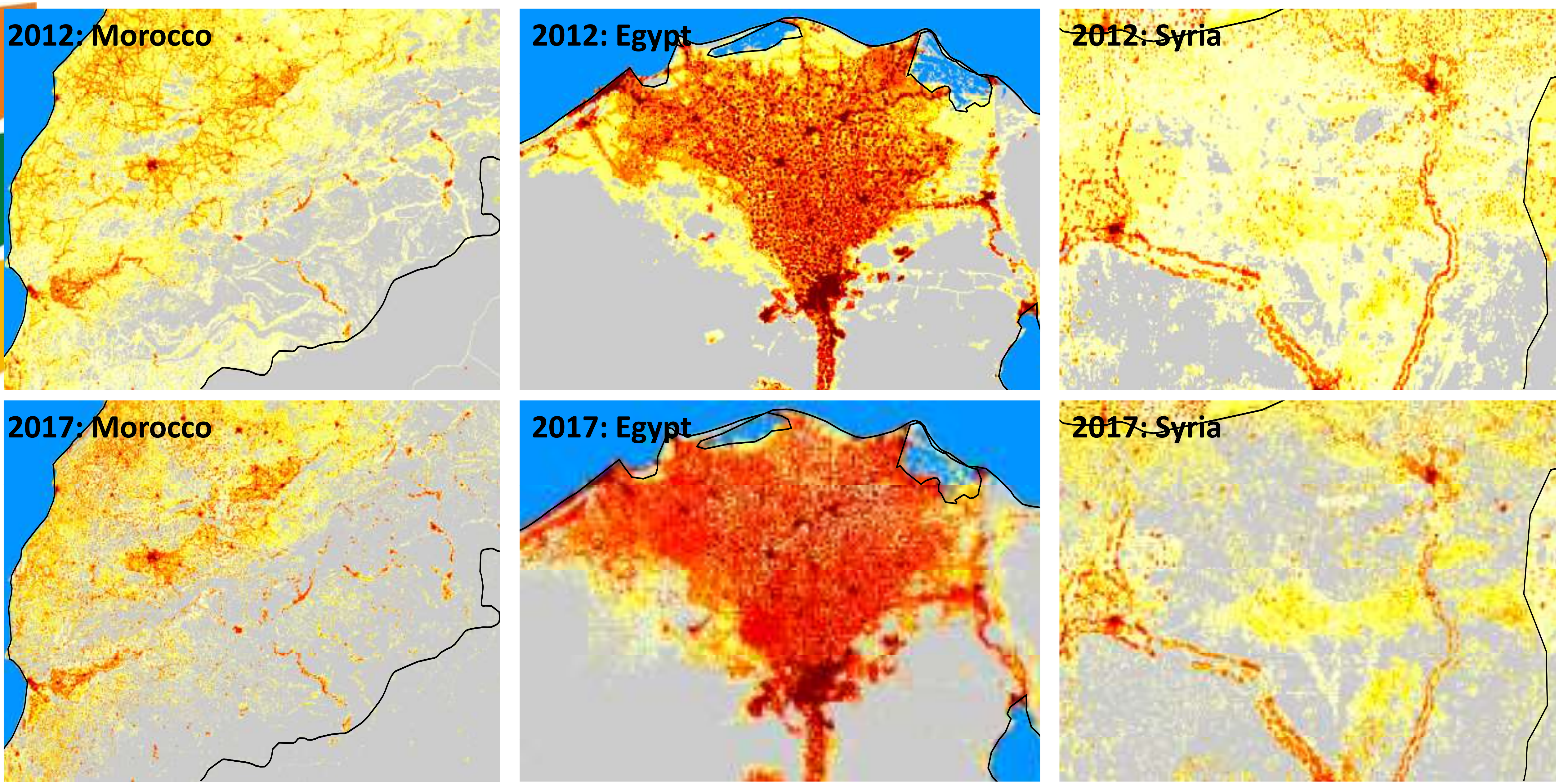


The African Digital Frontier
INTERNET PENETRATION PERCENTAGE BY REGION
77.4% NORTH AMERICA
61.3% OCEANIA / AUSTRALIA
58.4% EUROPE
34.5% LATIN AMERICA / CARIBBEAN
29.8% MIDDLE EAST
21.5% ASIA
10.9% AFRICA
500 million +
mobile phone subscribers
INCREASE OF OVER 100%
110 million +
Internet Users in 2010
4.5 million in 2000
The four biggest mobile phone markets are Nigeria, South Africa, Kenya and Ghana
The largest fixed line broadband market is South Africa, followed in order of market size by Egypt, Morocco, Algeria and Tunisia
MOROCCO
10.300.000 Internet users
1.275.780 Facebook users
TUNISIA
Internet users
Facebook users
EGYPT
Internet users
Facebook users
NIGERIA
Internet users
Facebook users
GHANA
Internet users
Facebook users
KENYA
Internet users
Facebook users
In 2009, there were 17 million subscribers to 3G/3.5G handsets and data cards across Africa.
In total, 4.54 Terabytes of cable capacity is available across 13 submarine cables on the African continent - expanding to 24.5 Terabytes by 2011.
South Africa had 4.5 million 3G capable handsets in 2009.
10.8%
SOUTH AFRICA'S INTERNET PENETRATION PERCENTAGE
SOUTH AFRICA
4.600.000 Internet users
2.388.560 Facebook users
International Internet Usage
1. PEOPLE'S REPUBLIC OF CHINA
Internet users
2. INDIA
100.001.000 Internet users
5. BRAZIL
75.944.000 Internet users
7. RUSSIAN FEDERATION
Internet users
10. NIGERIA
Internet users
44. SOUTH AFRICA
Internet users
SOURCES:
en.wikipedia.org
www.internetworldstats.com
www.nickburcher.com
www.reuters.com
www.webtrendsng.com
MORE COOLNESS?
#ODMACT
@ogilvydma
Infographic designed by
@Ivanisawesome

Changing demography and diets



Migration and aggregated expansion

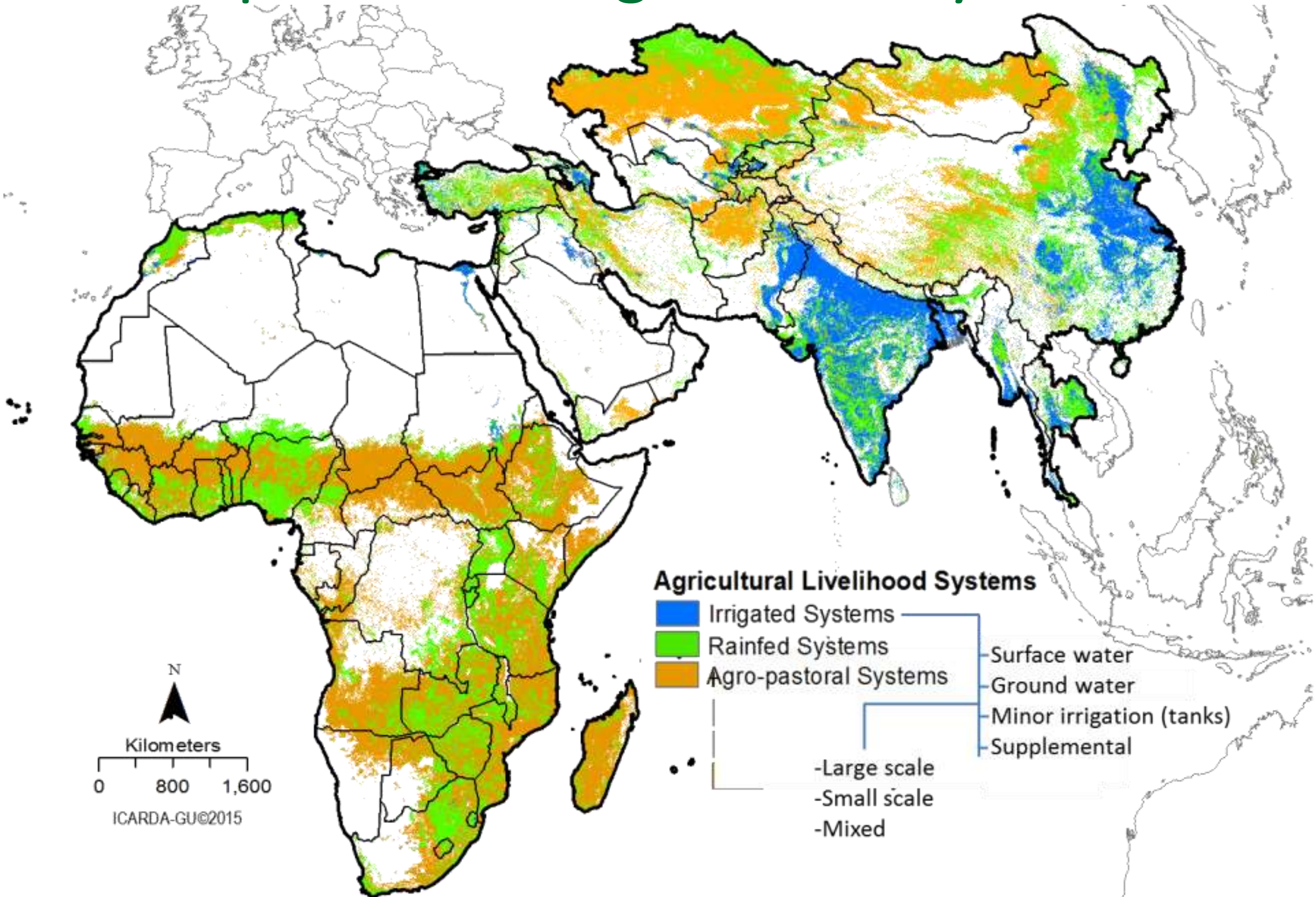


Integrated systems for resilience and risk reduction
[mixed crops, livestock, fish and trees]

Legume as best alternative for improving diet related resource use efficacy

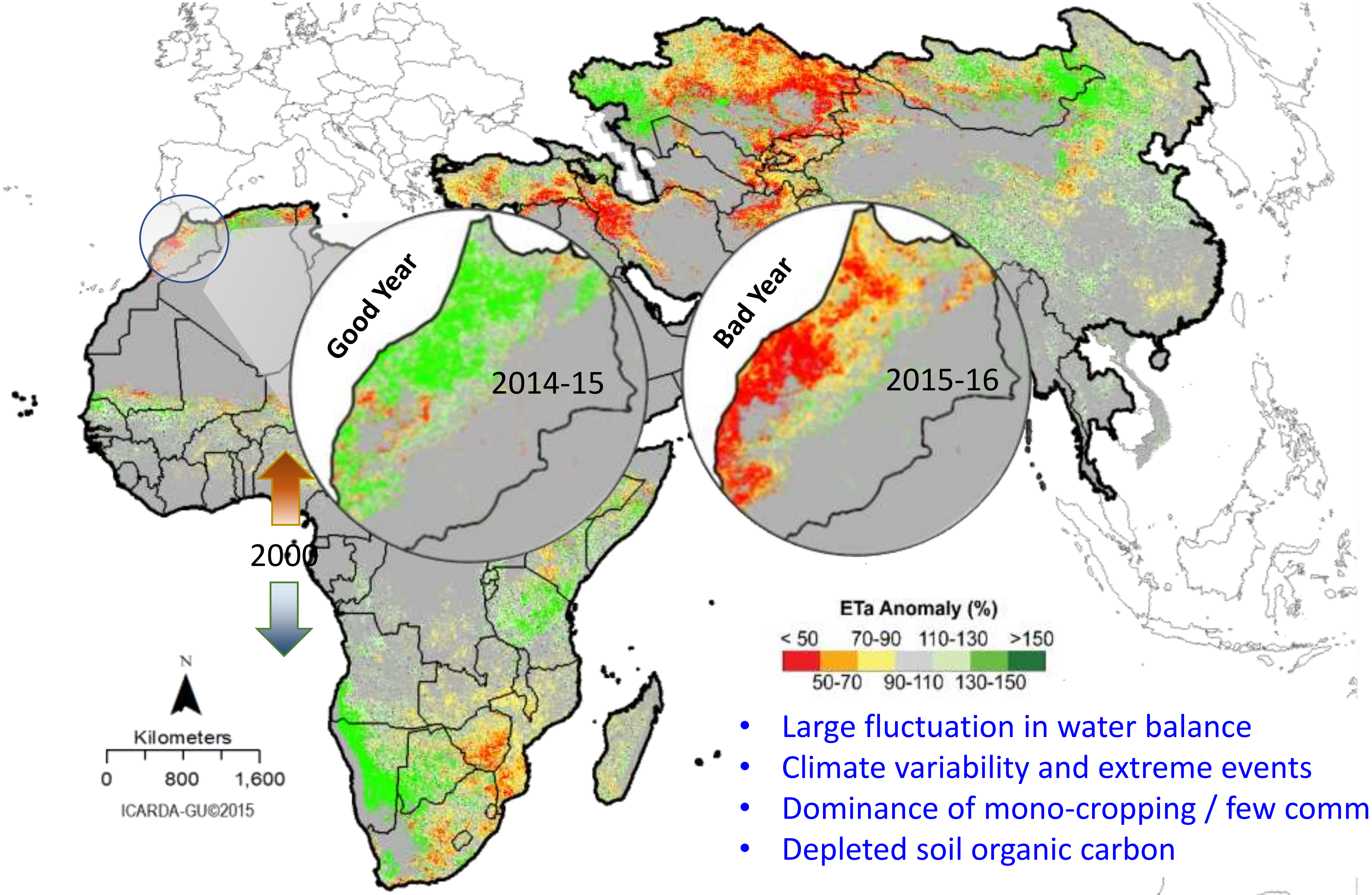
Daal/Falafal	Chicken	Mutton	Beef
1,250lt	4,325	5,520	13,000

Impact on the agricultural systems



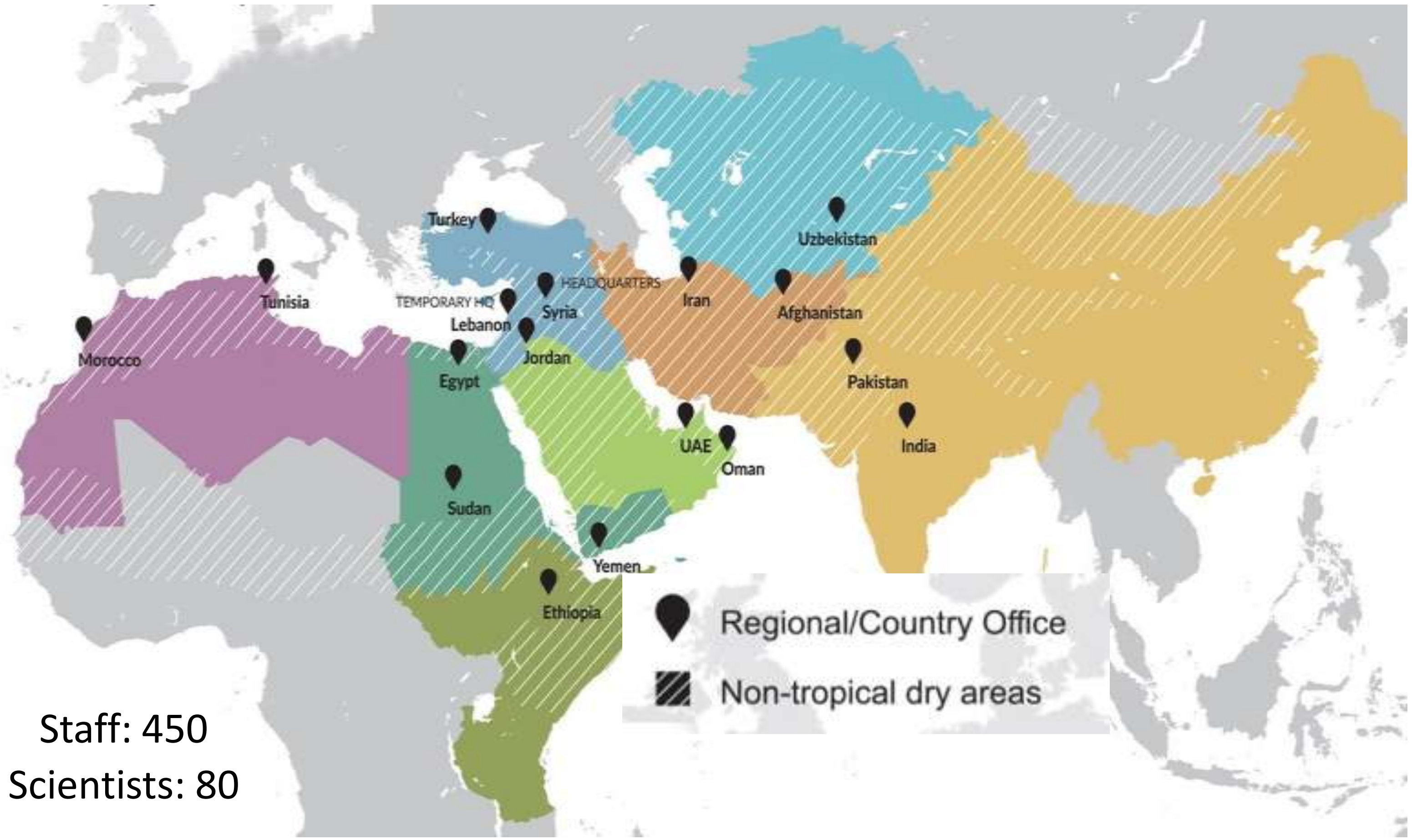
Changing Water Balance

Frequent deviation from long-term averages



- Large fluctuation in water balance
- Climate variability and extreme events
- Dominance of mono-cropping / few commodity focus
- Depleted soil organic carbon

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



Staff: 450
Scientists: 80

icarda.org

www.icarda.org

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

CCTs

- BigData
- Scaling
- CapDev
- Gender

SRPs-strategic research priorities + CCTs-cross cutting themes

Resilient Agroecosystems

Sustainable

Increased land, water and system productivity while safe guarding the environmental flows and ecosystem services

- more **crop** per **drop** -water focus
- in a **inch of land** and a **bunch of crop** -system focus

Knowledge based prioritization (space & time) for better strategy for investment, intervention, implementation and impact

Ecological intensification
Target specific interventions
Bridging yield/data gaps
Resource use efficiency
Nutrition and resilience
Halt land/water degradation
Technology scaling

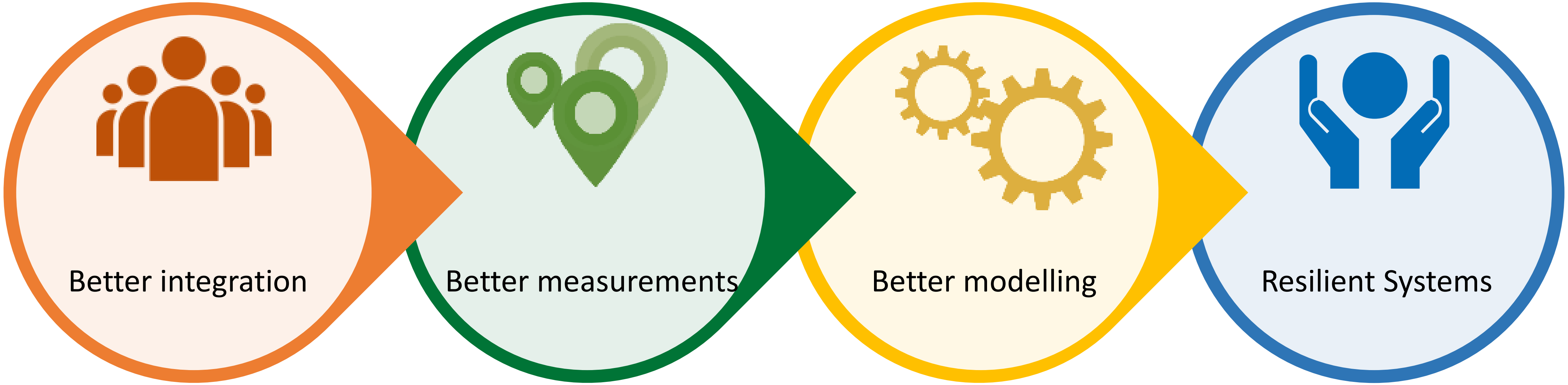
Pulses
Cereals
Animals

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

- Big Data and IC Technologies can support resilient Agri-food systems under Climate Change, Demography, Variability and Uncertainty
- These data driven smart farming systems have huge potential in the dry areas where resource use efficiency is much below its actual potential
- But they can only deliver if applied to Inclusive Farming Systems

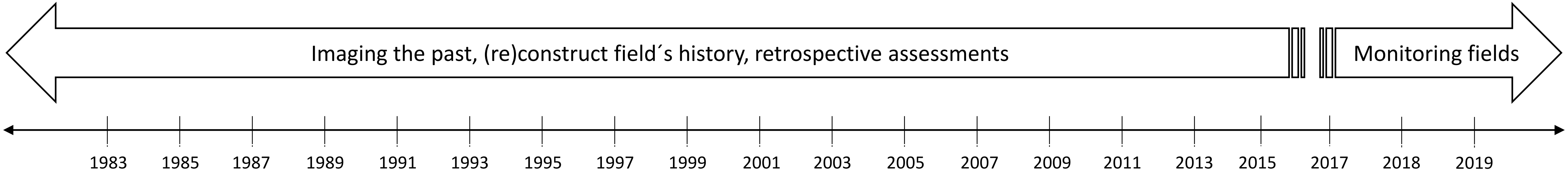
Goal: to harness the capabilities of **Big Data** to accelerate and enhance the impact of international agricultural research, and ***solve development problems faster, better and at greater scale***

Big Data in Building Resilience

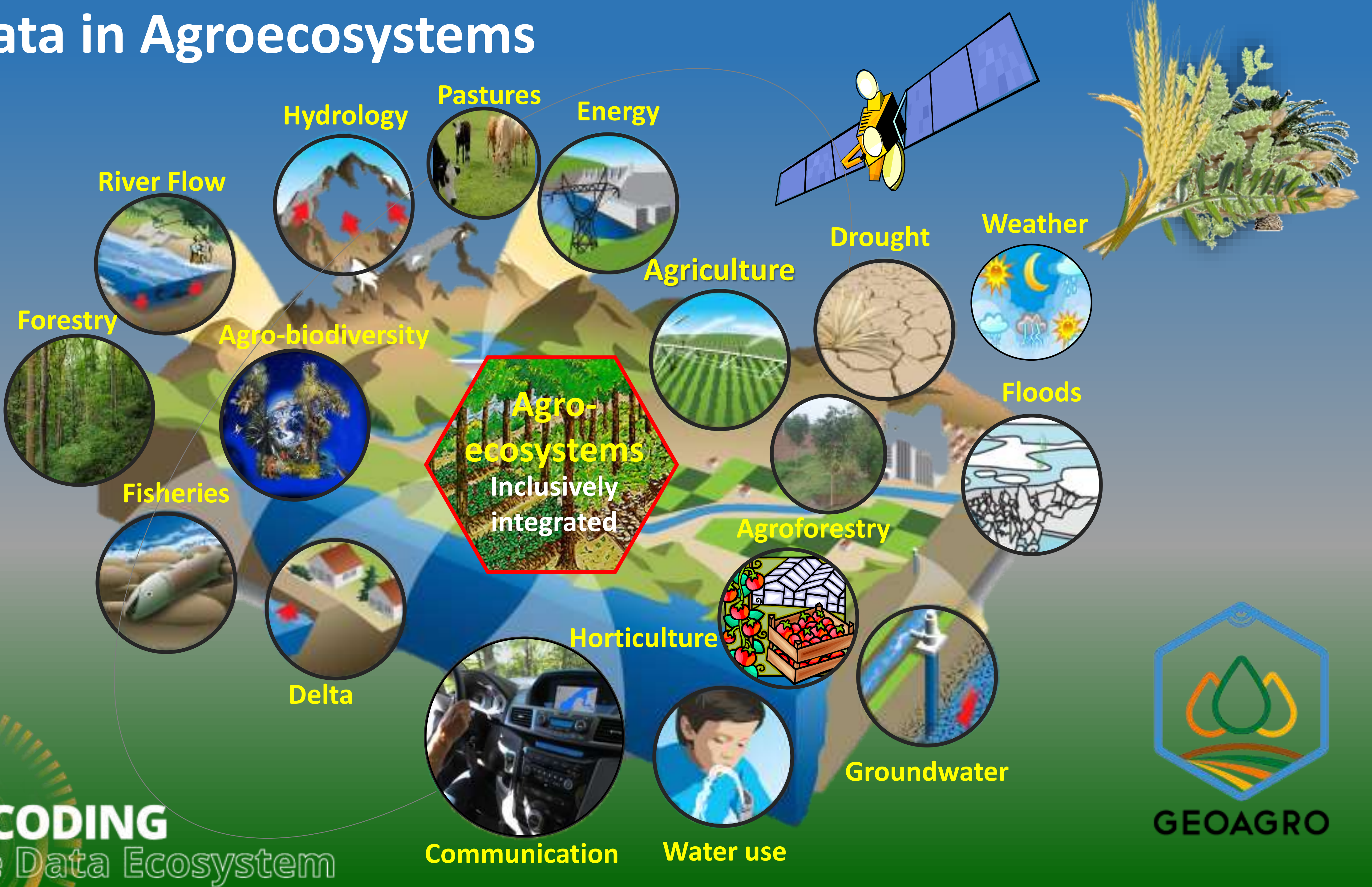


Crop fields for functional productivity are key to exponential efficiency in world largest and oldest industry

“Agroecosystems”



Big Data in Agroecosystems



Role of Geospatial Science, Technology and Applications (GeSTA) in Dryland Systems
Ensuring Food Security
Safeguarding Environmental Flows and ESs
Specific mutual-interaction & synergies between plant and animal species and management practices
Integrated agro-ecosystems: innovative approaches and methods for sustainable agriculture, while safeguarding the environment
Youth
Engaging and empowering young gen. by creating opportunities
156 Remote sensing missions in orbit°
>12 Sensors potential in CRPs/IRPs, etc.
>6 are free
5 1) Ecological intensification, 2) Bridging yield gaps, 3) Input use efficiency, 4) Reduced land degradation, and 5) Location specific interventions.
Mapping present, Emerging, future land use /land cover dynamics, land degradation and desertification, changing demographics, climate change adaptation and impacts
Quantification of dryland agricultural production and livelihood systems
Characterization of vulnerable areas for increasing resilience and assist in identifying mitigation pathways with biophysical, socioeconomic and stakeholder feedback as well as specific needs & constraints
Cooperative Research and Partnerships
Innovations & Integration
Reducing Vulnerability
Measuring Impacts
Sustainable Intensification
Current status, trends, extent, characteristics of crops, pattern, productivity, water use, livestock, biodiversity, soils, & climate
Gender
Address social inequities, greater roles and priorities
Drylands 41% Earth's land area
Increased Food production potential sources
Biodiversity
Spatial enrichment and its role in food security, risk mitigation, & sustainability
Cropping Intensity
21%
7%
72%
Agricultural Intensification
Increase in Arable Land
Measuring the impact at spatial scales, rate, magnitude, synergy among the systems, CRPs, cross-regional synthesis
Mapping the extent of existing & traditional practices, indigenous knowledge, diversity, potential areas for modern & improved, productive, profitable, and diversified dryland agriculture, & linkages to markets
Geospatial commons, KM sharing, stakeholder feedback
Farmers, stakeholders, policymakers, mobilization, & marketing
Assessing the impact of outcomes in Action Sites, post-project implementation, & M&E
Location specific and ecological intensification
Delineation of potential, suitable areas for sustainable intensification, diversification of production systems
People 2.5b Live in Drylands
Assessment of present, emerging & future droughts, floods, pests & diseases, extreme events, infrastructure, migration
Nutrition
Changing diet patterns, nutrition and health
Efficiency
Productivity
Improved Livelihoods
Livestock 1.5b Depend on Drylands
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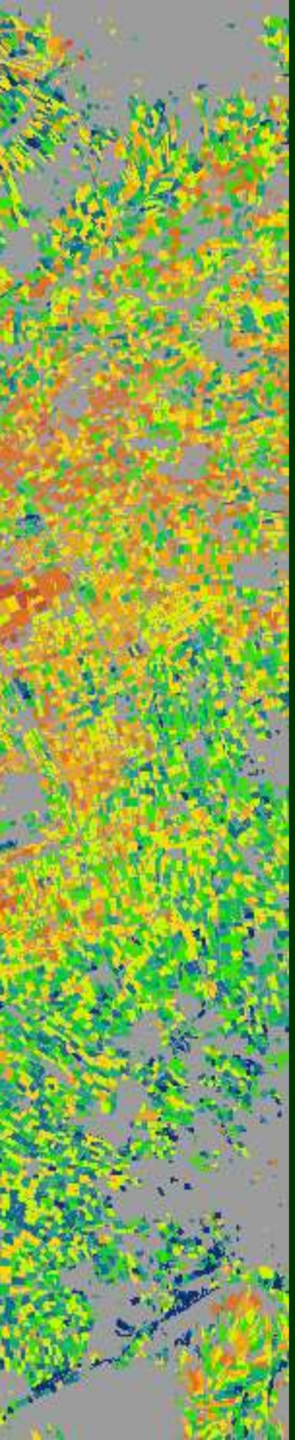
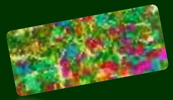
geoagro.icarda.org



Earth Observation Systems for Agro-Ecosystem Research

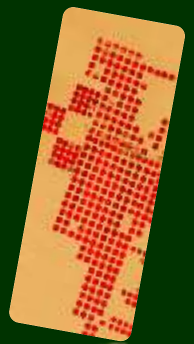
ACTIVE SATELLITE SENSORS AND CHARACTERSTICS



Very High Resolution (Up to - 1 m)

Satellite Sensors	Resolution			Swath (km)
	Spatial (m)*	Temporal (days)	Spectral (Bands)	
GEOEYE-1	1.65 (0.41)	1	B, G, R, IR, P	15.2
IKONOS	3.2 (0.82)	14	B, G, R, IR, P	11.3
PLEIADES-1A	2 (0.5)	1	B, G, R, IR, P	20
PLEIADES-1B	3 (0.5)	1	B, G, R, IR, P	20
Quick Bird	2.4 (0.6)	3.5	B, G, R, IR, P	16.5
WorldView-1	(0.4)	1.2	P	17.6
WorldView-2	1.8 (0.4)	1.2	P, C, B, G, Y, R, RE, IR (2)	16.4
CARTOSAT-2	1	5	P	9.6
CARTOSAT-2a	<1	4	P	9.6
CARTOSAT-2B	<1	4	P	9.6
SKYSAT-1	2 (0.9)	<1 (hourly)	B, G, R, IR, P	8
KOMPSAT-3	2.8 (0.7)	14	B, G, R, IR, P	16.8
KOMPSAT-2	4 (1)	14	B, G, R, IR, P	15
OrbView-3	4 (1)	3	B, G, R, IR, P	14

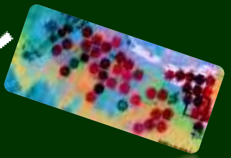
High Resolution (1 to 5 m)



Satellite Sensors	Resolution			Swath (km)
	Spatial (m)*	Temporal (days)	Spectral (Bands)	
CARTOSAT-1	(2.5)	5	P	30
FORMOSAT-2	8 (2)	1	B, G, R , IR, P	24
SPOT-5	5, 20 (2.5, 5)	2-3	G, R, IR, SW, P	60 to 80
SPOT-6 (1.5)	6 (1.5)	2-3	B, G, R , IR, P	60
RapidEye	5	1	B, G, R, RE, IR	77
RESOURCESAT-1	5.8	5	G, R, IR	23, 70
GOKTURK-2	10, 20 (2.5)	2.5	B, G, R, IR, SW, P	20
TH-2	10 (2)		B, G, R, IR,P	60
EROS-A	(1.8)	2.1	P	14
Theos	15 (2)	3	B, G, R, IR	96
BEIJING-1	32 (4)	1	R G, IR	600
PROBA/HRC	18, 34 (5)	7	18	15

Medium resolution (5 - 30 m)

Satellite	Multispectral resolution (m)	B, s	Swath width (km)
ASTER (15m)			
VNIR (Visible Near Infrared)	15	VIR (4)	60
SWIR (Shortwave Infrared)	30	SW (6)	60
TIR (Thermal Infrared)	60	TIR (5)	60
CBERS - 2			
WFI	260	R, IR	890
CCD	20	B, G, R, IR	113
IRMSS	(2.7)	P-	27
LANDSAT 5TM -7ETM	30 (14.8)	B, G, R, IR, SW1, TIR, SW2, P	185
Nigeriasat-X	22	G, R, IR	-
Resourcesat-2/Liss-III	23.5	R, G, IR, SW	141
Deimos-1	22	G, R, IR	600
UK-DMC-2/SLIM6	22	G, R, IR	638
BILSAT-1	26 (12)	R, B, G, IR, P	640
Nigeriasat-1	32	G, R, IR	640
ALSAT-1	32	G, R, IR	640
UK-DMC/EC (DMC)	32	G, R, IR	600
EO-1/ALI-MS	30	B (2), G, R, IR (3), SW (2), P	37
EO-1/ Hyperion	30	220 bands	7,7
ASTER (15m)	15, 30, 90	G, R, IR (2) SW(6), TIR (4)	60
LANDSAT 7ETM+	30m (14.5)	B, G, R, IR, SW (2), TIR, P	185
SPOT-4	20 (10)	G, R, IR, SW, P	60
SPOT-3	20 (10)	G, R, IR+P	60
JERS-1	24 (18)	G, R, IR, IR	75
SPOT-2	20 (10)	G, R, IR	60
SPOT-1	20 (10)	G, R, IR	60
Landsat 5/MSS	80	G, R, IR, IR	185
Landsat 5/TM	30, 120	B, G, R, IR, SW, SW, TIR	185
RESURS-01-1	45	G, R, IR	600

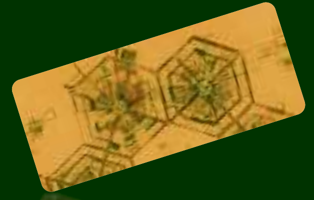


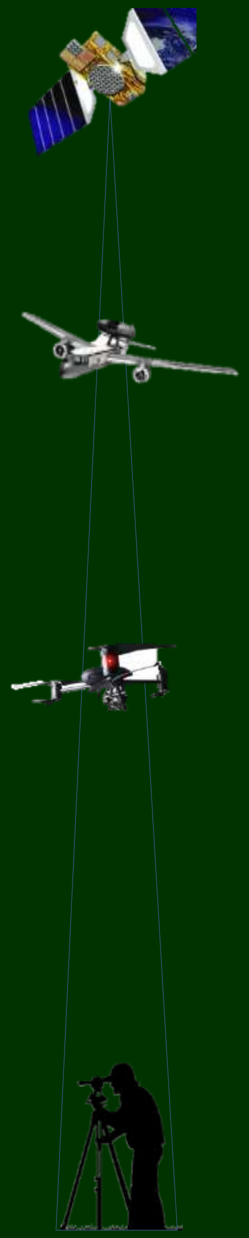
Low or Medium resolution

Satellite	Multispectral resolution (m)	B, s	Swath width (km)
Landsat 8	30 (14.8)	P, C, B, G, R, IR, SW (3)	185
VIIRS	375, 750	22b, s	3000
ASAR	(12.5)	VV 1	5 - 406
MERIS	300	15 b, s	1150
Metosat MSG			
GERB	40000	7	-
SEVIRI	1000, 3000	12	-
SPOT5/VEGETATION 2	1000	B, R, IR, SW (4)	2250
MODIS	250, 500, 1000	36	2330
SPOT4/VEGETATION 1	1000	B, R, IR, SW (4)	60
IRS-1D/ WiFS	188	R, IR (2)	774
Orbview-2/ SeaWiFS	1130	B(2), G (3), IR (8)	2800
IRS-1C/ WiFS	188	R, IR (2)	810
RESURS-01-1/ MSU-S	240	G, R, IR (3)	600
RESURS-01-1/ MSU-SK	170, 600	R, G, IR(2), TIR	600
ResourceSat/AWiFS	56	R, G, IR, SW	740
Landsat 2/ MSS	80	G, R, IR, IR	183
Landsat 2/ RBV	80	G, R, IR	183
Landsat 1/ MSS	80	G, R, IR, IR	183
Landsat 1/ RBV	80	G, R, IR	183

Radar Satellites

Satellite	Bands	Band (Polarity)	Swath width (km)
Sentinel-1			
COSMO-SKYMED 4	1, 5, 15, 30, 100	X-B (HH, VV, HV, VH)	10, 40, 30, 100, 200
TanDEM-X	1, 3, 16	X-B (HH, VV, HV, VH)	1500
COSMO_SKYMED 2	1, 5, 15, 30, 100	X-B (HH, VV, HV, VH)	10, 40, 30, 100, 200
RADARSAT 2	3, 8, 12, 18, 25, 30, 40, 50, 100	C-B (HH, HV, VH, VV)	5 - 500
COSMO-SKYMED 1	1, 5, 15, 30, 100	X-B (HH, VV, HV, VH)	10, 40, 30, 100, 200
Terra SAR-X	1, 3, 16	X-B (HH, VV, HV, VH)	1500
ALOS (PALSAR)	10, 20, 30, 100	L-B (HH, VV, HH, HV, VH)	70
ENVISAT (ASAR)	12.5	C-B (VV)	5 - 406
RADARSAT 1 (SAR)	8,25, 30, 35, 50, 100	C-B (HH)	50 - 500
ERS 2 (AMI)	25	C-B (VV)	100
ERS 1 (AMI)	25	C-B (VV)	100





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Science for Better Livelihoods in Dry Areas

*=Resolution in parenthesis is panchromatic
+=Bands: B-Blue, G-Green, R-Red, IR-Infra Red, C-Coastal blue, Y-Yellow, SW-Shortwave Infrared, M-Mid infrared, P-Panchromatic, H-Horizonal, V-vertcial

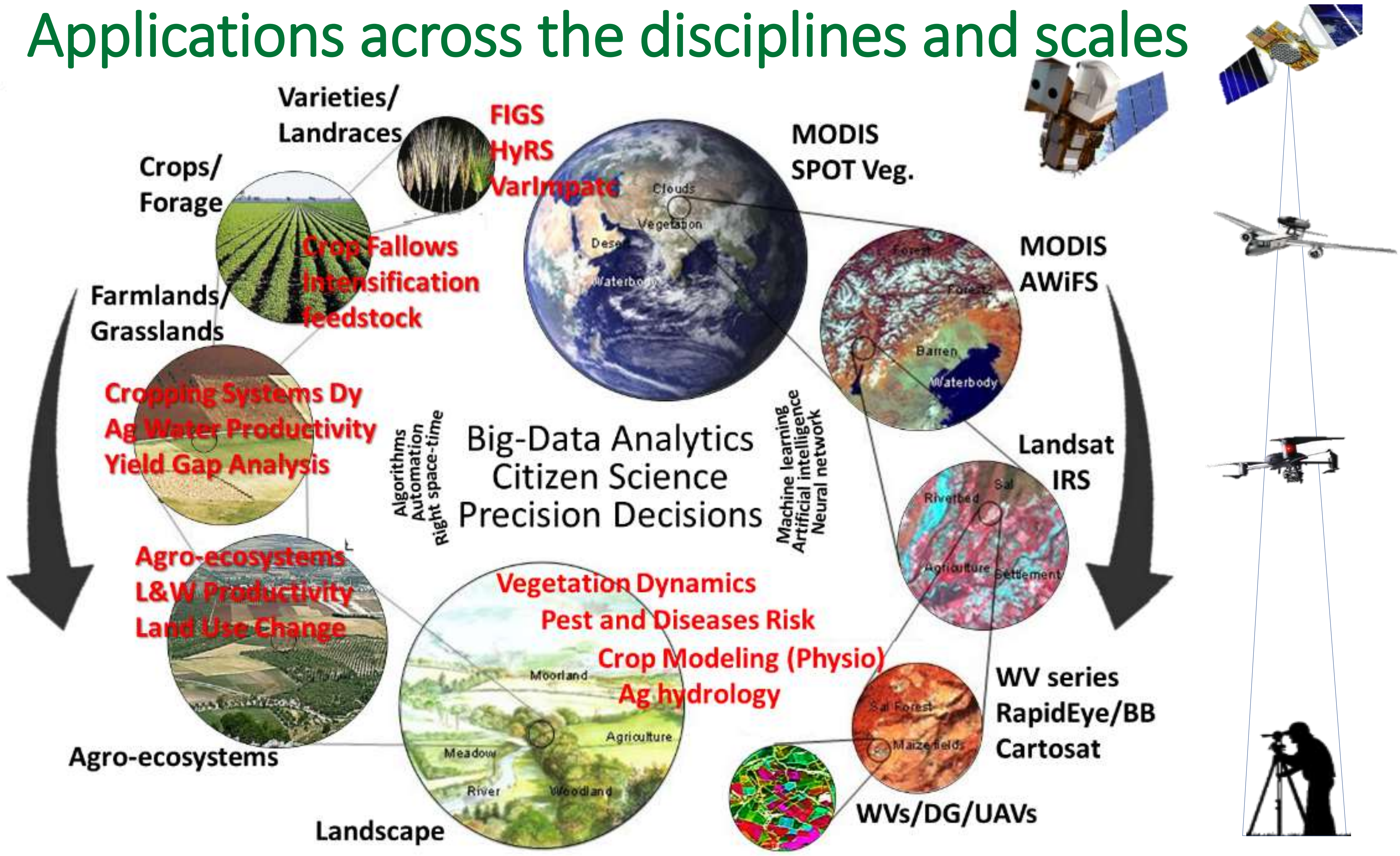
EOS Matrix at Farmscape to Landscape

Biospectral – Biophysical

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			×				×		×

Applications across the disciplines and scales

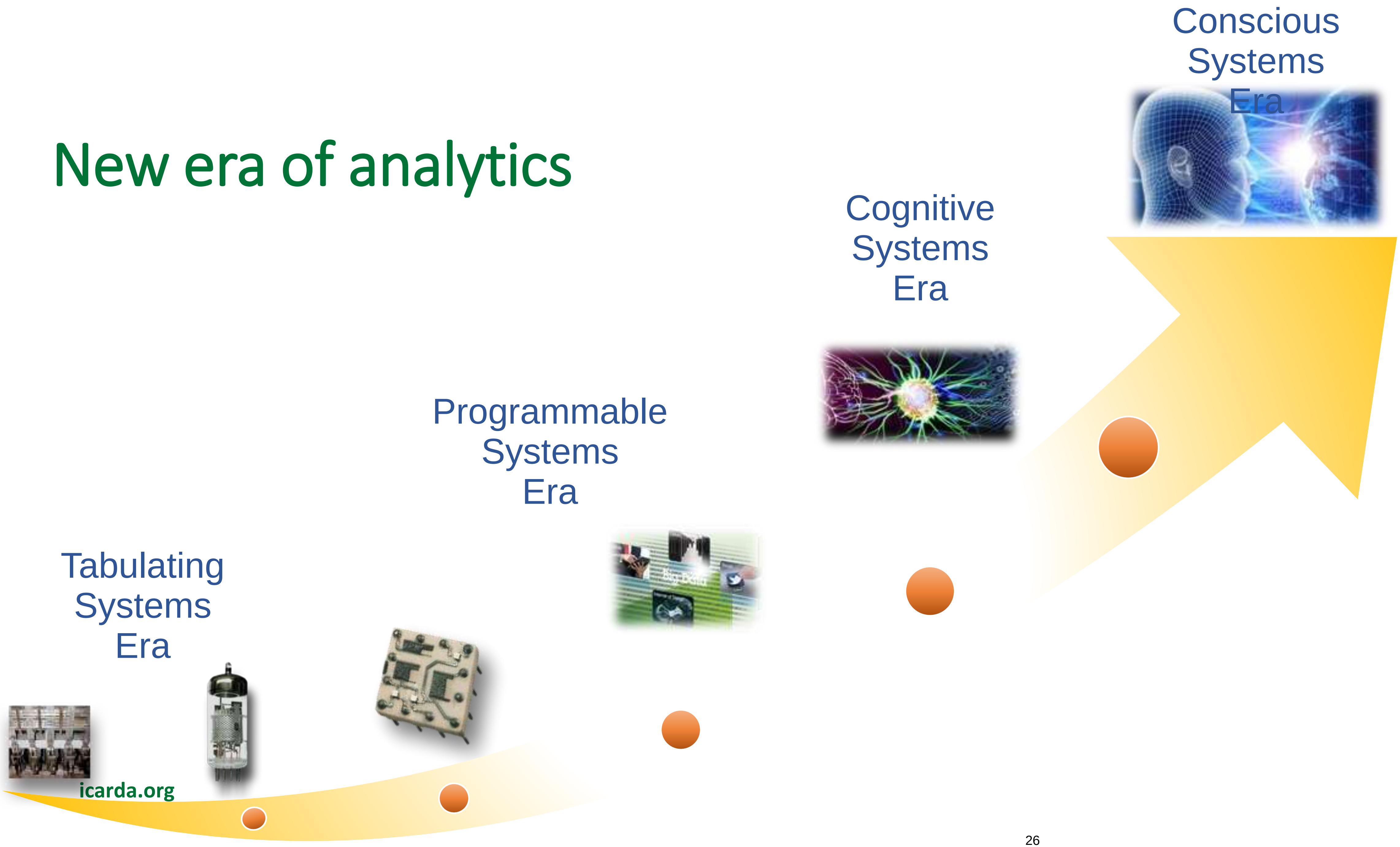


Satellite constellations for Agricultural Applications

Sensor	Wavelengths	Spatial Resolution	Revisit frequency	Temporal coverage
Landsat	Optical (6-9) + thermal	30,60m	16 day	1984-present
RapidEye	Optical (5)	5 m	5 day	2009-present
Skysat	Optical (4)	1m	~weekly	2013-present
WV-2/3	Optical (8)	0.3, 1m	5 day	2015-present
Planet Scope	Optical (4)	3 m	~daily	2014-present
Sentinel-1	C-band radar	10, 20m	6 day	2014-present
Sentinel-2	Optical (13)	10,20,60m	5 day	2015-present
Sentinel-3	Optical (13)	10,20,60m	3 day	2015-present

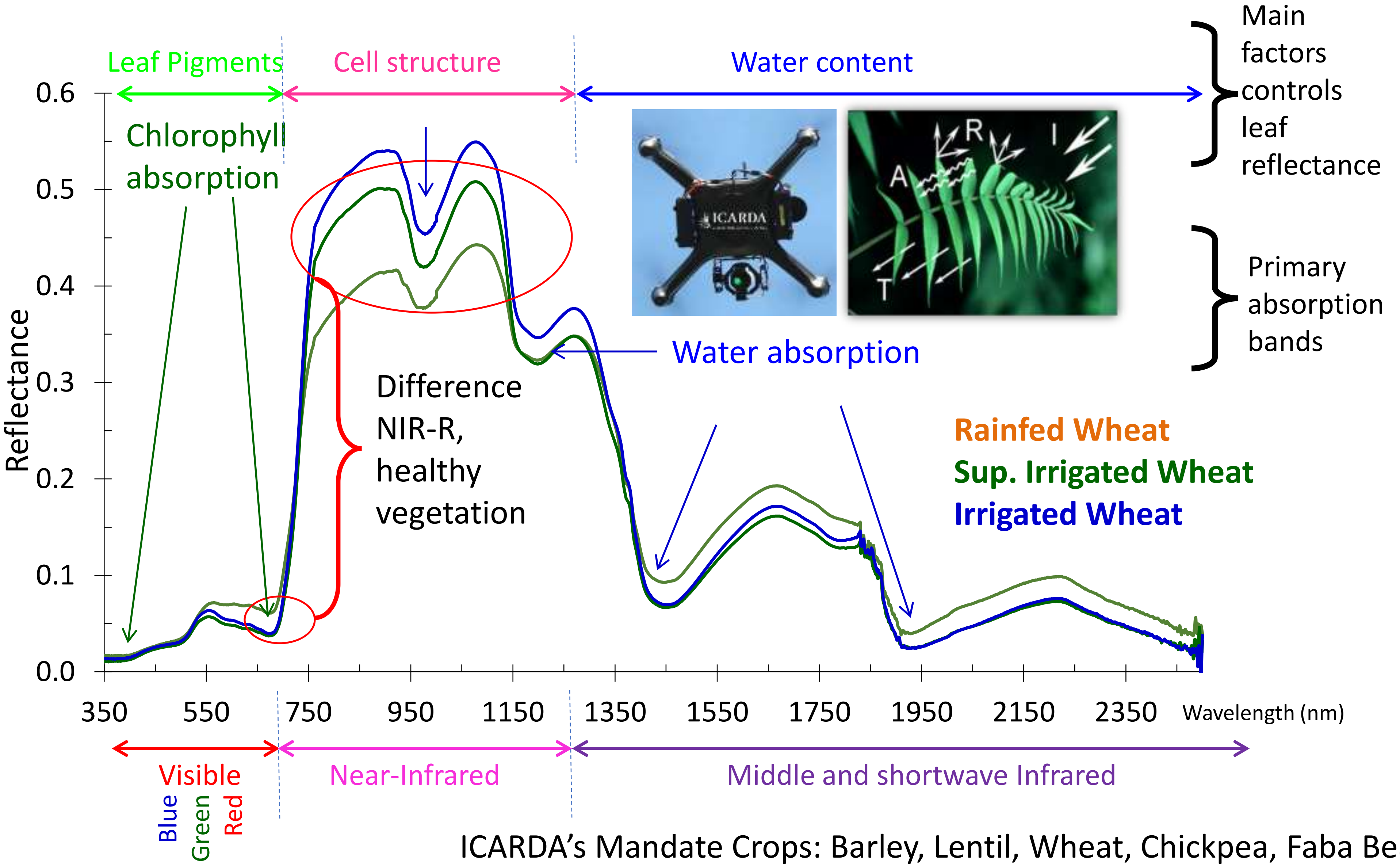
Data fusion has huge potential!

New era of analytics



Reflectance-Based Characterization of Bio-Physical Traits

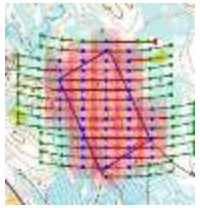
@ cell, leaf, canopy and landscape

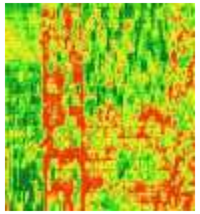


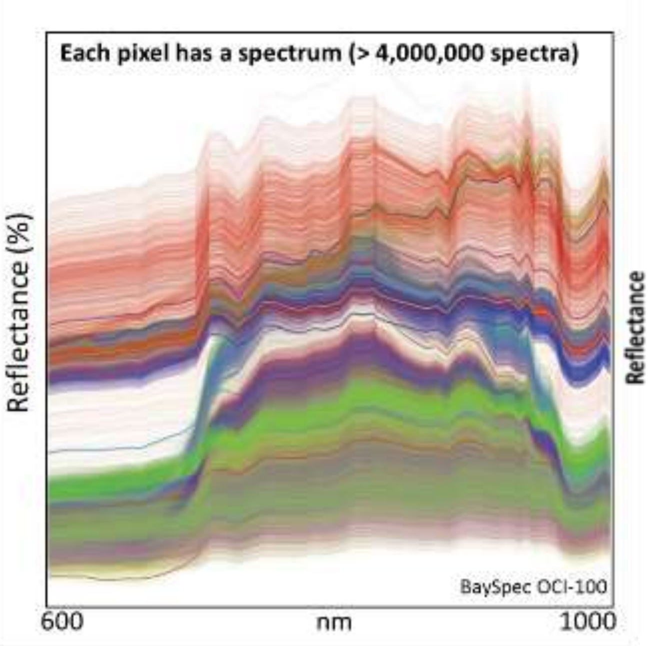
ICARDA's Mandate Crops: Barley, Lentil, Wheat, Chickpea, Faba Bean, Grasspea

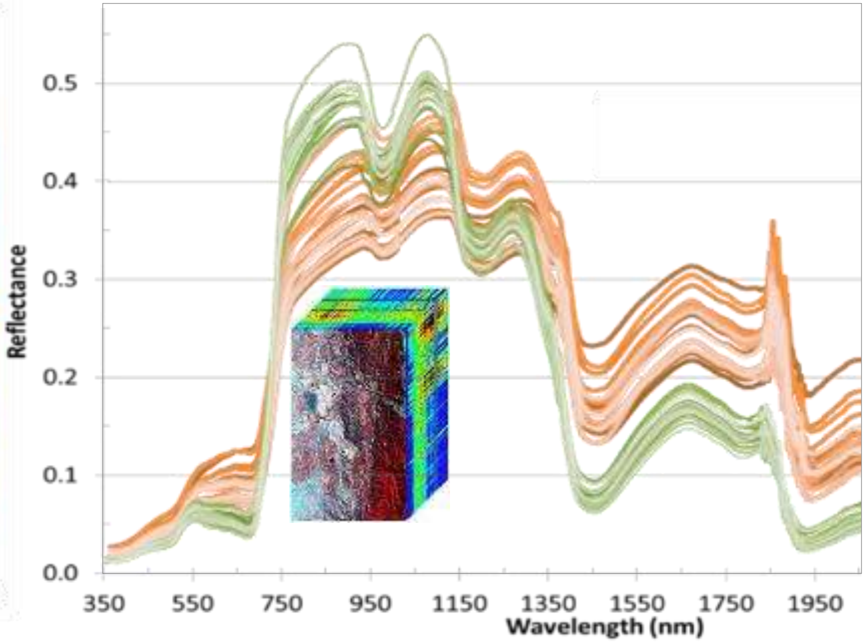
Use of Portable Observation Systems in Research

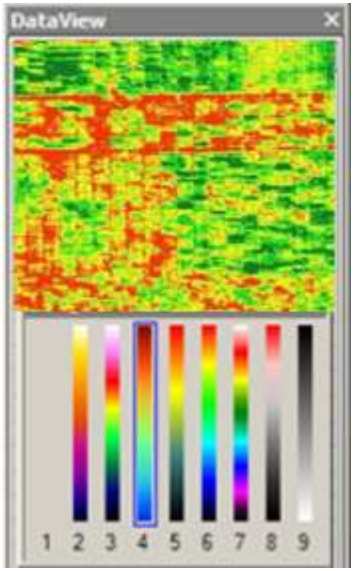
UAV/UAS/AgDrones







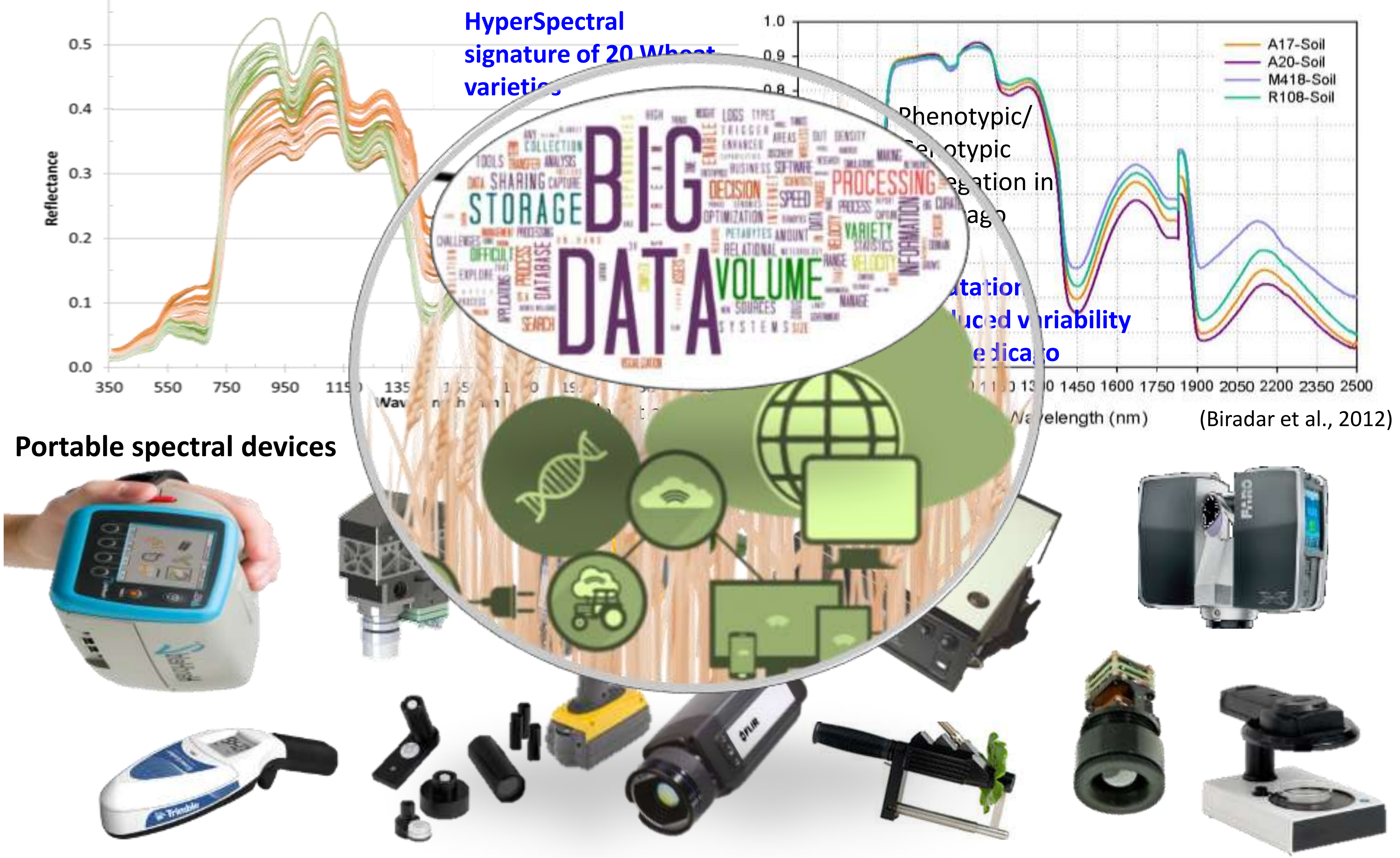


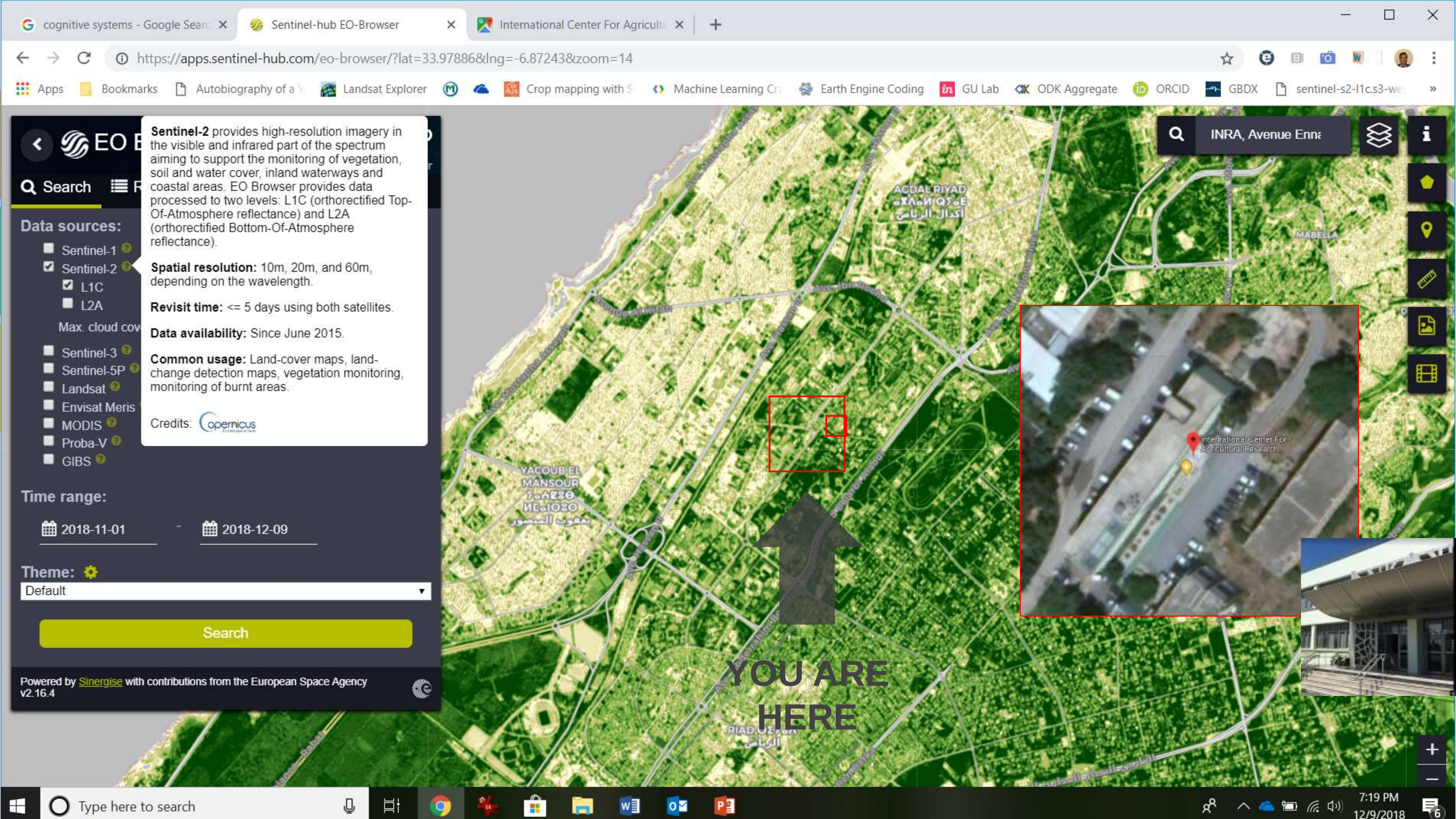


Thermal Palettes

Advanced Sensors and Tools: Hyperspectral, Multispectral, Thermal, Ultraspatial

Big Data + ICT=GeSTA





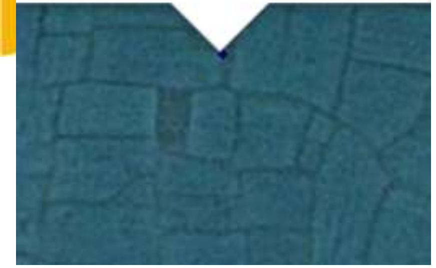
cognitive systems - Google Search
Sentinel-hub EO-Browser
International Center For Agricult
https://apps.sentinel-hub.com/eo-browser/?lat=33.97886&lng=-6.87243&zoom=14
Apps
Bookmarks
Autobiography of a Y
Landsat Explorer
Crop mapping with S
Machine Learning Cr
Earth Engine Coding
GU Lab
ODK Aggregate
ORCID
GBDX
sentinel-s2-l1c.s3-we
Search
Data sources:
Sentinel-1
Sentinel-2
L1C
L2A
Max. cloud cov
Sentinel-3
Sentinel-5P
Landsat
Envisat Meris
MODIS
Proba-V
GIBS
Sentinel-2 provides high-resolution imagery in the visible and infrared part of the spectrum aiming to support the monitoring of vegetation, soil and water cover, inland waterways and coastal areas. EO Browser provides data processed to two levels: L1C (orthorectified Top-Of-Atmosphere reflectance) and L2A (orthorectified Bottom-Of-Atmosphere reflectance).
Spatial resolution: 10m, 20m, and 60m, depending on the wavelength.
Revisit time: <= 5 days using both satellites.
Data availability: Since June 2015.
Common usage: Land-cover maps, land-change detection maps, vegetation monitoring, monitoring of burnt areas.
Credits:
Time range:
2018-11-01
2018-12-09
Theme:
Default
Search
Powered by Sinergise with contributions from the European Space Agency
v2.16.4
INRA, Avenue Enna
AGDAL RIYAD
YACOUB EL MANSOUR
YOU ARE HERE
Type here to search
7:19 PM
12/9/2018

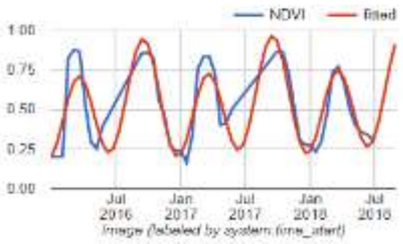
Farming system dynamics at given time and scale

Jamdigri-moved

Jamdigri	
FID	11
BATCH	1
SchemeName	Jamdigri
District	BANKURA
Block	JOYPUR
Scheme_Typ	MDTW
Village_Mo	Jamdigri
Lat	23.07006
Long	87.47454
PhysicalPr	100
HODate	November 6, 2015

Directions: To here - From here

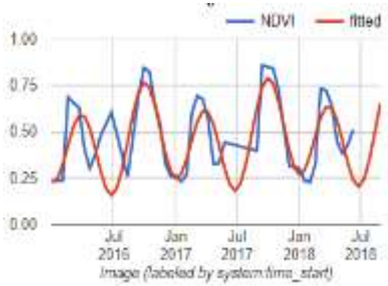




Pakurseni LDTW

Pakurseni LDTW	
FID	115
BATCH	2
SchemeName	Pakurseni LDTW
District	PASCHIM MIDNAPORE
Block	NARAYANGARH
Scheme_Typ	TW
Village_Mo	Pakurseni
Lat	22.19834
Long	87.44147
PhysicalPr	100
HODate	July 18, 2016

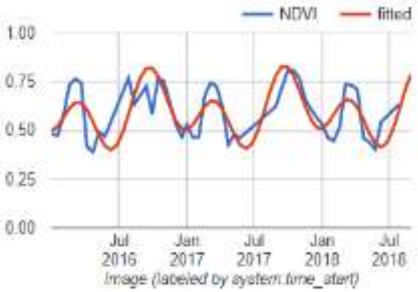
Directions: To here - From here



Hariharpur

Hariharpur	
FID	40
BATCH	1
SchemeName	Hariharpur
District	PASCHIM MIDNAPORE
Block	SABANG
Scheme_Typ	Mini(E) RLI
Village_Mo	Hariharpur
Lat	22.138147
Long	87.630084
PhysicalPr	100
HODate	March 23, 2015

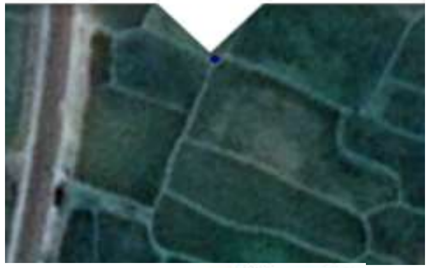
Directions: To here - From here

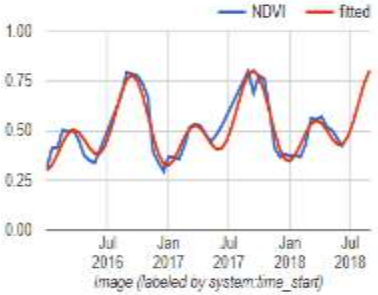


Kalisara LDTW

Kalisara LDTW	
FID	24
BATCH	1
SchemeName	Kalisara LDTW
District	BIRBHUM
Block	MAYURESWAR I
Scheme_Typ	LDTW
Village_Mo	Kalisara
Lat	24.05688
Long	87.84444
PhysicalPr	100
HODate	June 29, 2016

Directions: To here - From here

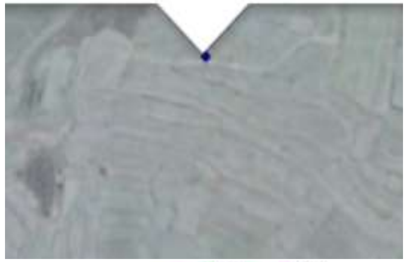


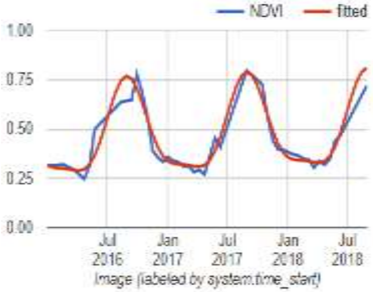


Kundra - IV PDW

Kundra - IV PDW	
FID	294
BATCH	3
SchemeName	Kundra - IV PDW
District	BIRBHUM
Block	RAJNAGAR
Scheme_Typ	PDW
Village_Mo	Kundra
Lat	23.965694
Long	87.356806
PhysicalPr	100
HODate	November 14, 2017

Directions: To here - From here

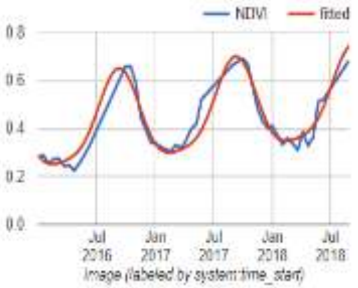




Gosain Bundh SFMIS-moved

Gosain Bundh SFMIS	
FID	71
BATCH	2
SchemeName	Gosain Bundh SFMIS
District	PURULIA
Block	KASHIPUR
Scheme_Typ	SFMIS(40ha)
Village_Mo	Uluberia
Lat	23.477367
Long	86.790317
PhysicalPr	100
HODate	September 10, 2015

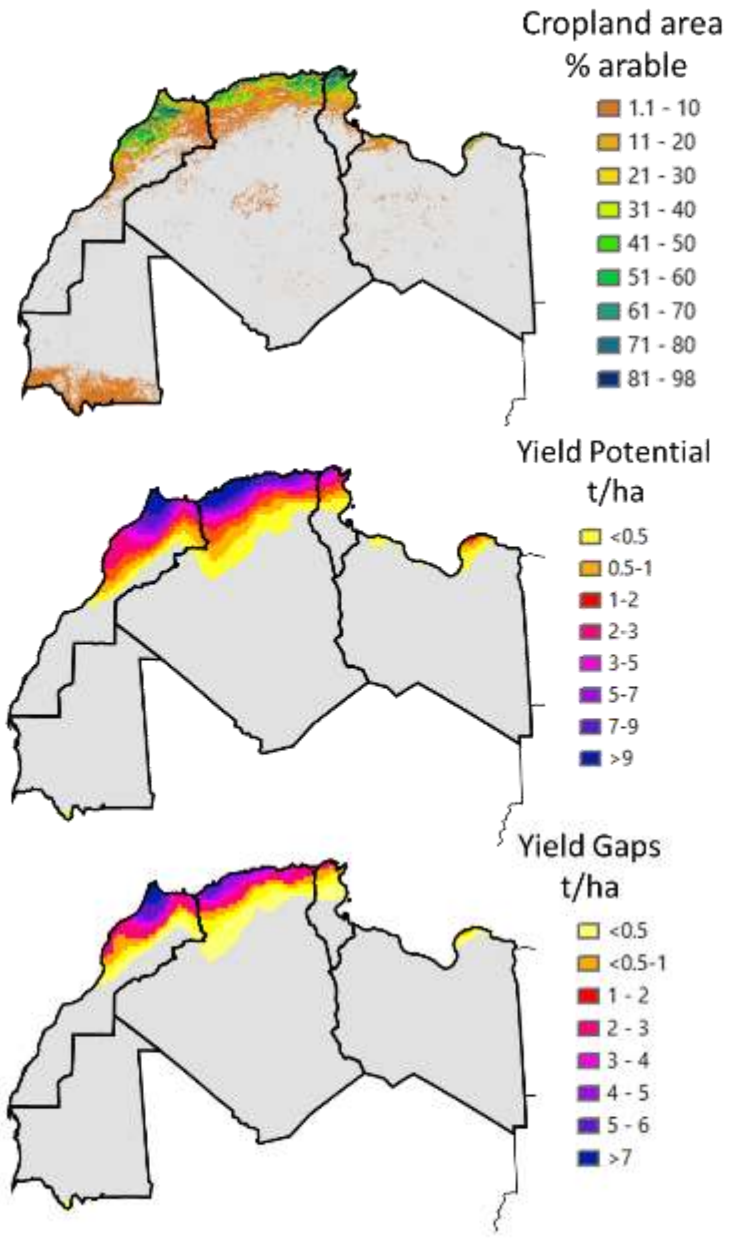
Directions: To here - From here



Highly intensive systems

Less intensive systems

Mapping Yield Gaps



Grain yield at national average (FAO, 2015)

Country	2014	15yrs ave	15yr trend
Morocco	1713	1495	
Algeria	1475	1404	
Tunisia	2149	1820	
Libya	1250	871	

Actual grain yield measured at farm level

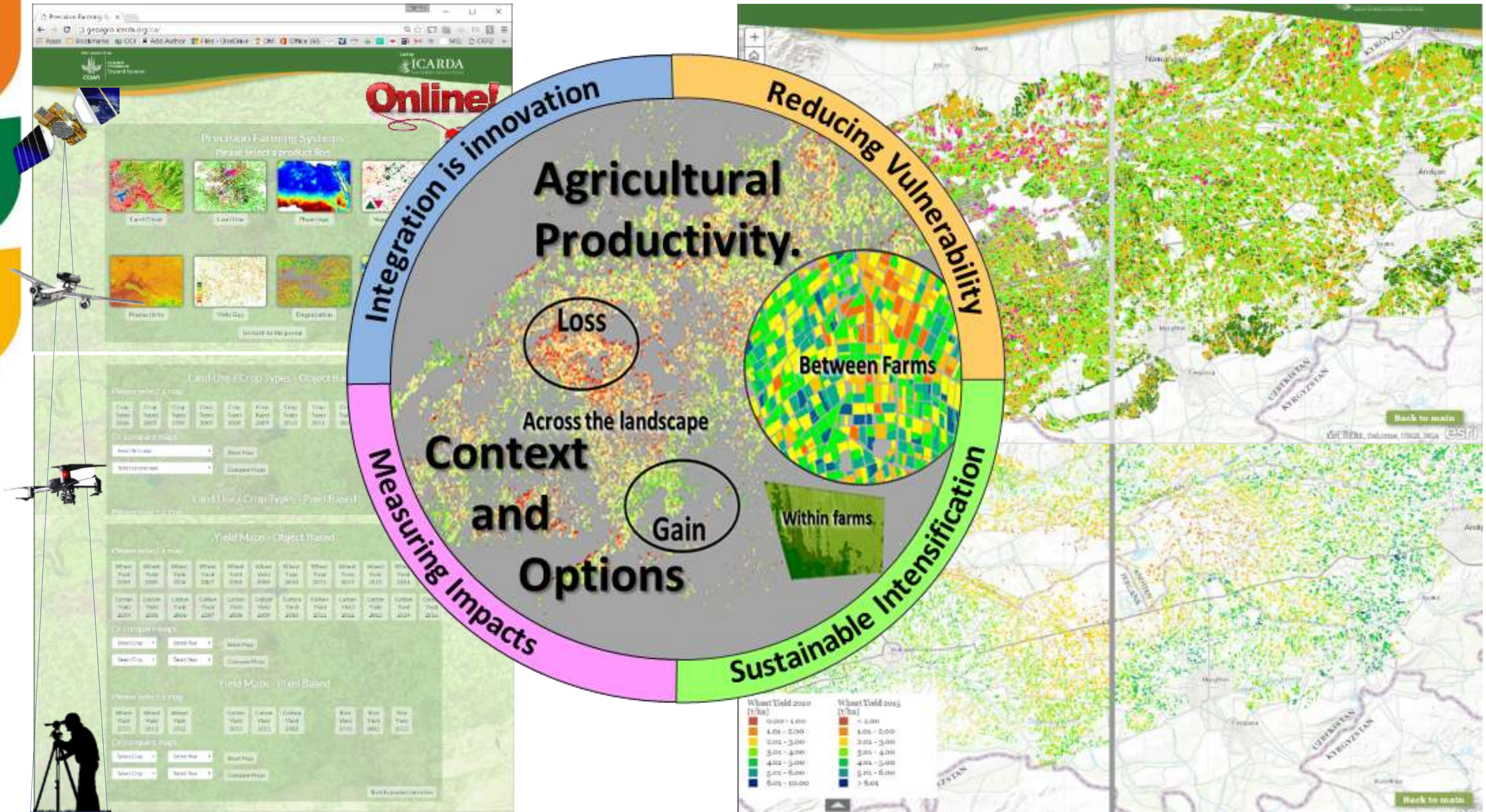
Grain Yeild Measured at Farmers Fields			
Farms	Longitude	Latitude	(kg/ha)
Farm1	6.722111	33.620782	2,125
Farm2	6.716233	33.612049	5,014
Farm3	6.704697	33.578011	2,039
Farm4	6.683507	33.564448	1,579
Farm5	6.695998	33.552394	3,049
Farm6	6.717472	33.569803	2,703
Farm7	6.729286	33.573701	2,452
Farm8	6.690977	33.573454	4,057
Farm9	6.676971	33.599369	2,525
Farm10	6.666595	33.604833	2,195
Farm11	6.707888	33.595405	478
Farm12	6.703041	33.586931	1,233
Farm13	6.695853	33.572357	1,526
Farm14	6.702122	33.562839	1,412
Farm15	6.68507	33.585016	4,626

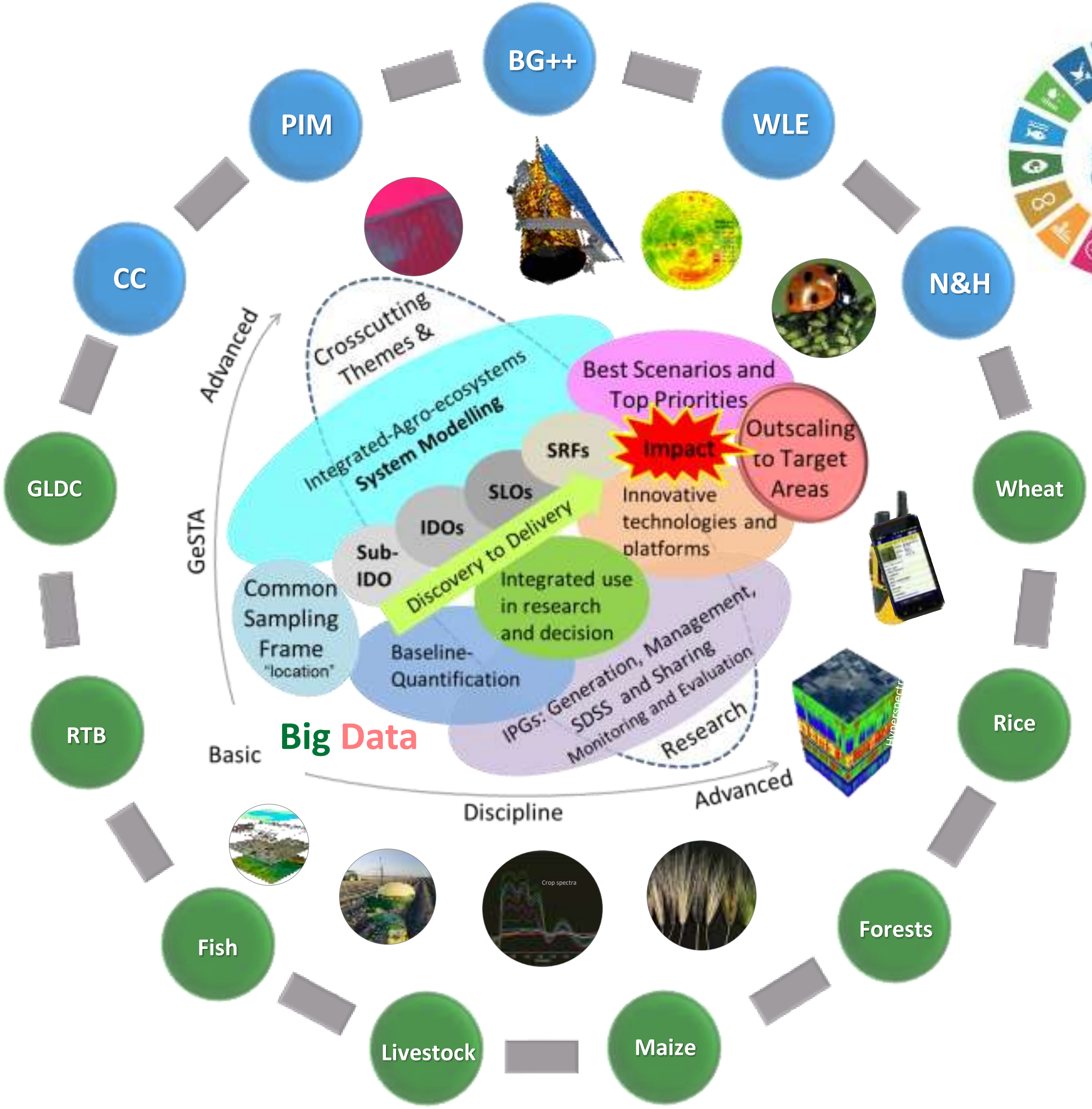
Range b/w
< 1 to 5
t/h

Median
2 t/h.

Quantification of Farming Systems @ multiple-scales

Smart Farming Platform




BG++
WLE
N&H
Wheat
Rice
Forests
Maize
Livestock
Fish
RTB
GLDC
CC
PIM
Crosscutting Themes &
Integrated-Agro-ecosystems System Modelling
Best Scenarios and Top Priorities
Outscaling to Target Areas
Impact
SRFs
SLOs
IDOs
Sub-IDO
Discovery to Delivery
Innovative technologies and platforms
Integrated use in research and decision
Common Sampling Frame "location"
Baseline-Quantification
IPGs: Generation, Management, SDSS and Sharing Monitoring and Evaluation
Research
GeSTA
Advanced
Basic
Big Data
Discipline
Advanced


SUSTAINABLE DEVELOPMENT GOALS

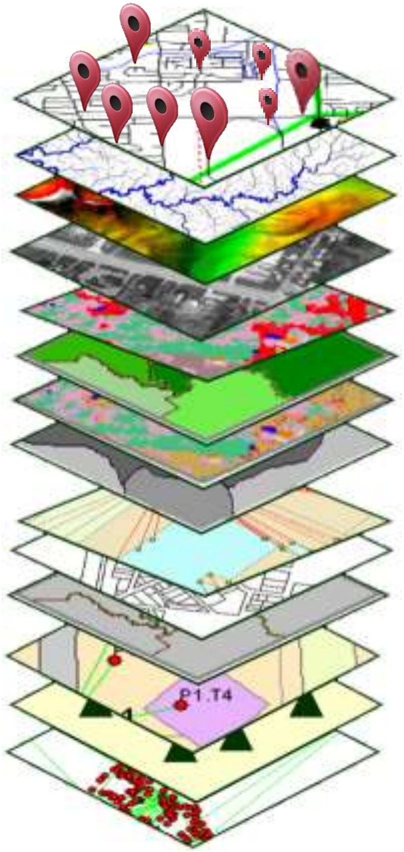

1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
5 GENDER EQUALITY
13 CLIMATE ACTION
6 CLEAN WATER AND SANITATION
15 LIFE ON LAND
17 PARTNERSHIPS FOR THE GOALS

Resilient Agroecosystems

Sustainable

The Big Data

- Geo-Tagging
  research & outreach data
- Satellite data
- Crop data
- Climate data
- Soil data
- Water data
- Topography
- Demography
- Ecological data
- …



Biggest drivers

Computation

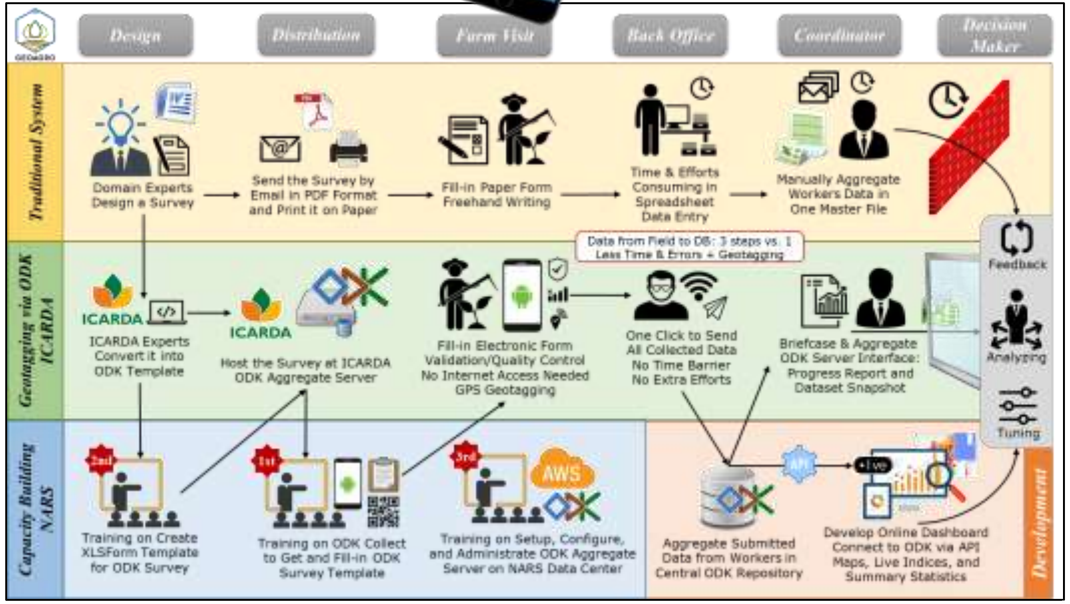
Algorithms

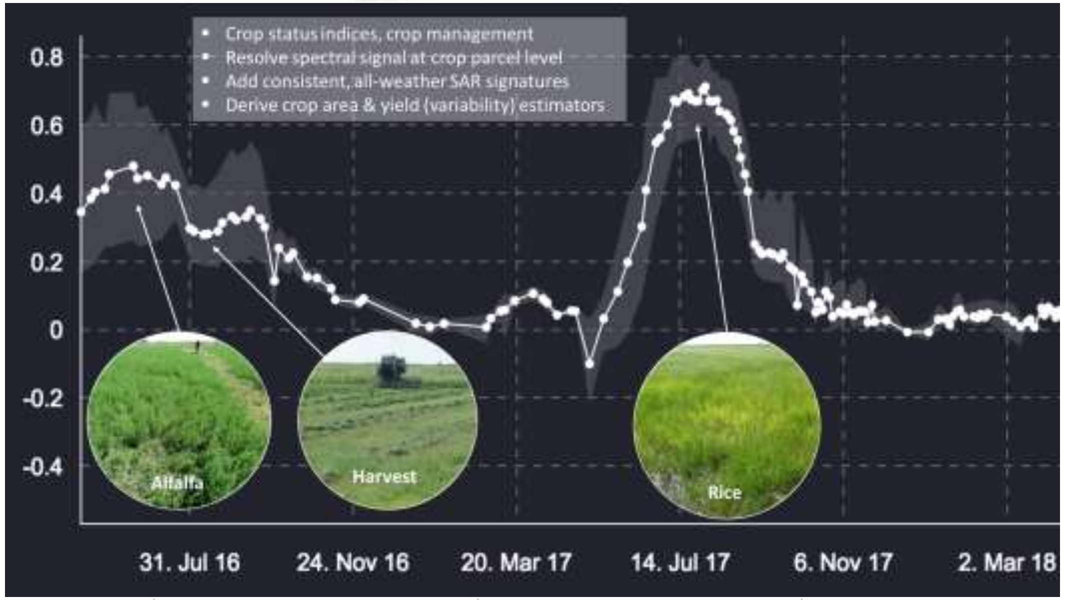
Applications

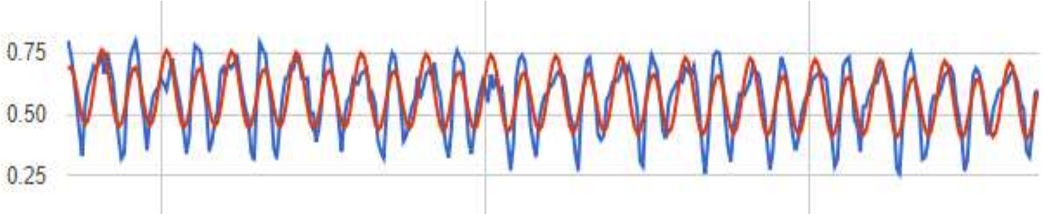
Scalability

- Mapping
- Monitoring
- Targeting
- Estimating
- Forecasting
- Warning
- Lending
- Insurance
- Value chains
- Carbon-Credits

Geotagging and AgroTagging

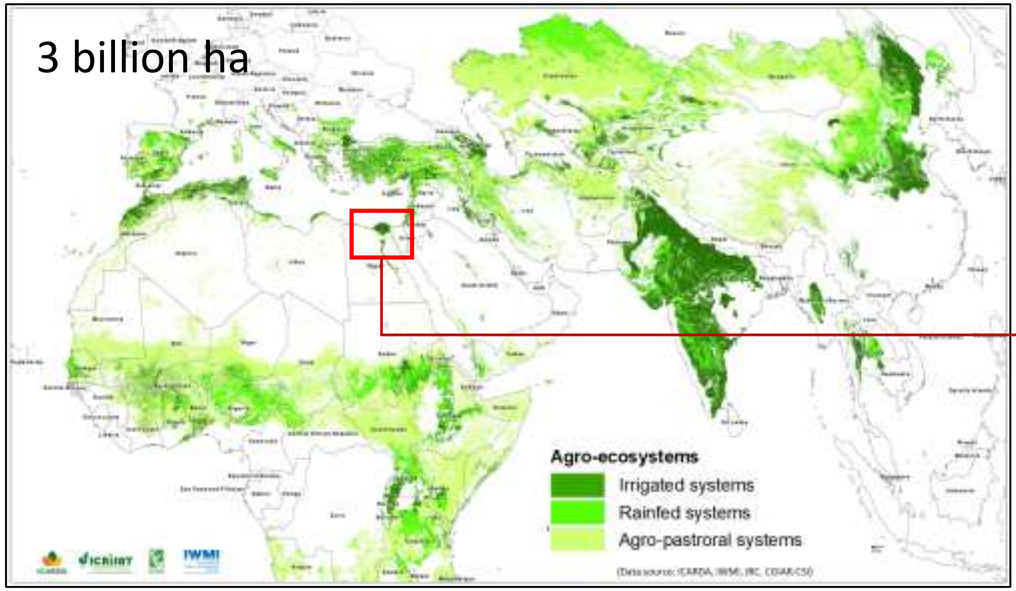




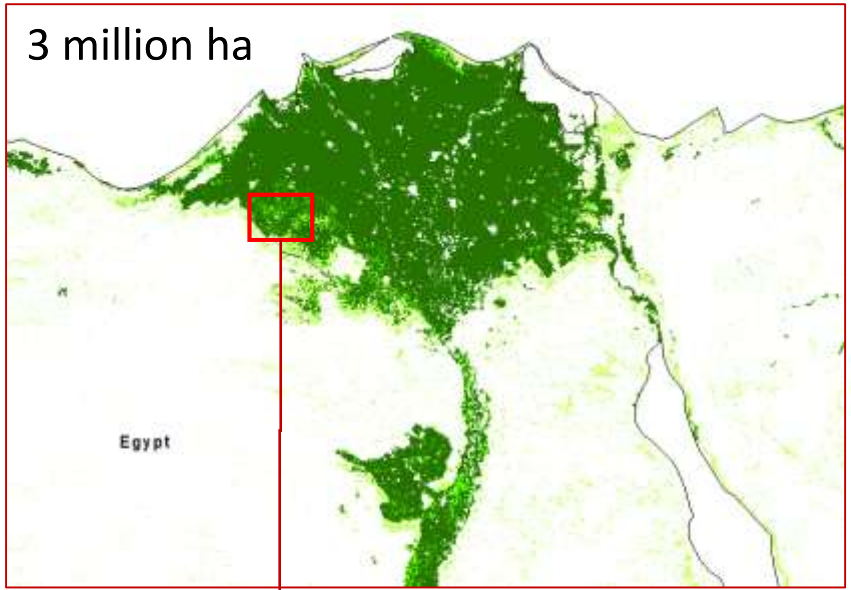


Agroecosystems: scaling innovations and measuring impacts

3 billion ha



3 million ha



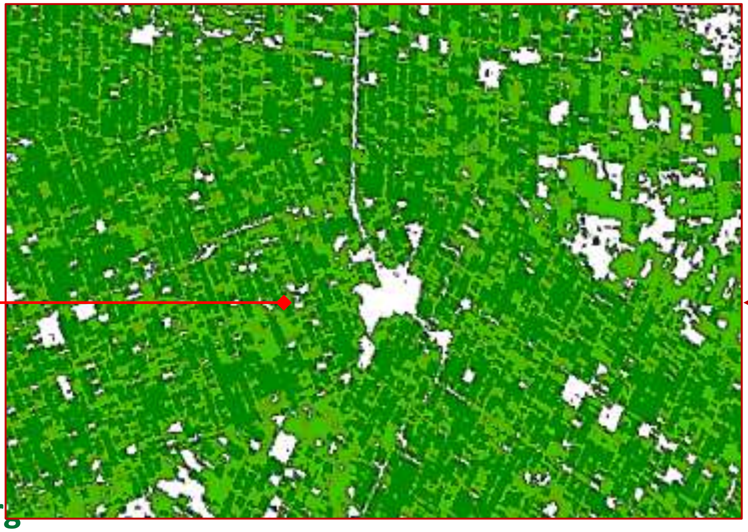
Irrigated systems

Rainfed systems

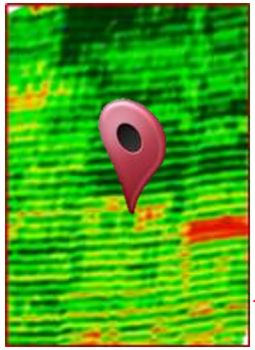
Agro-pastroral systems

300 k ha

30 k ha

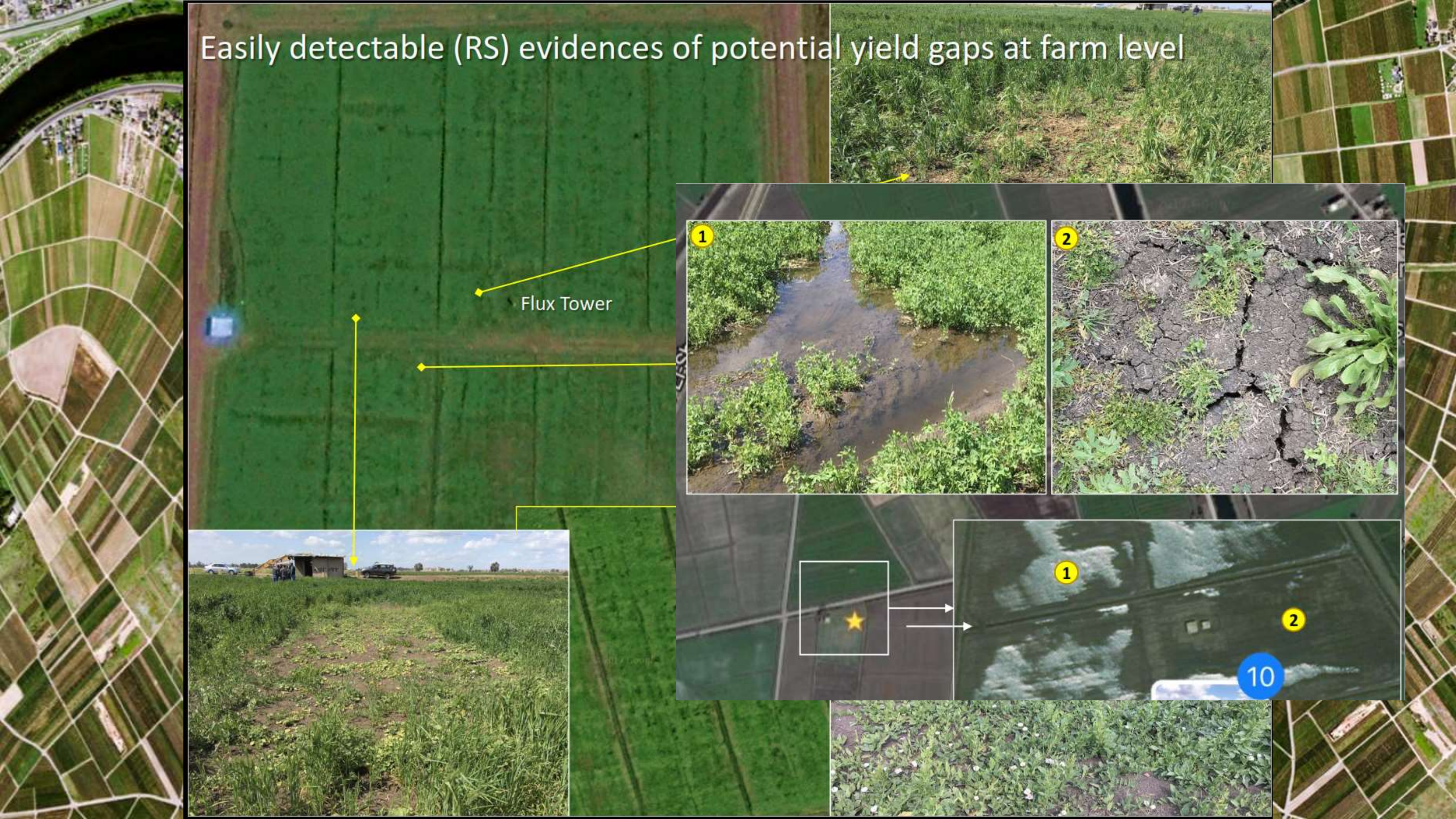


1.3 ha



- Inputs/reuse
- Yield/Production
- Markets/income
- Functional flows

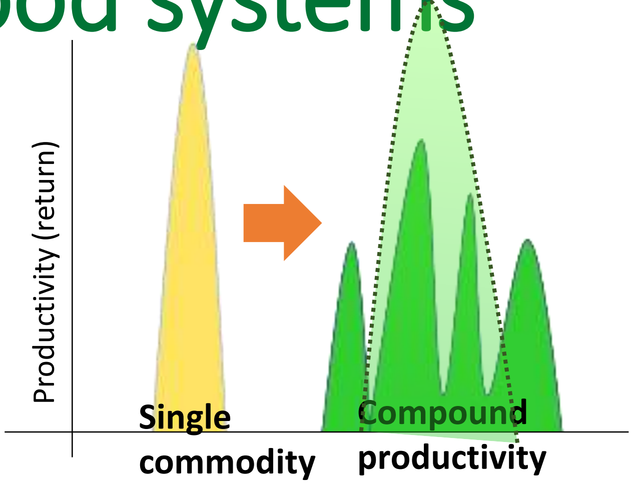
icarda.org

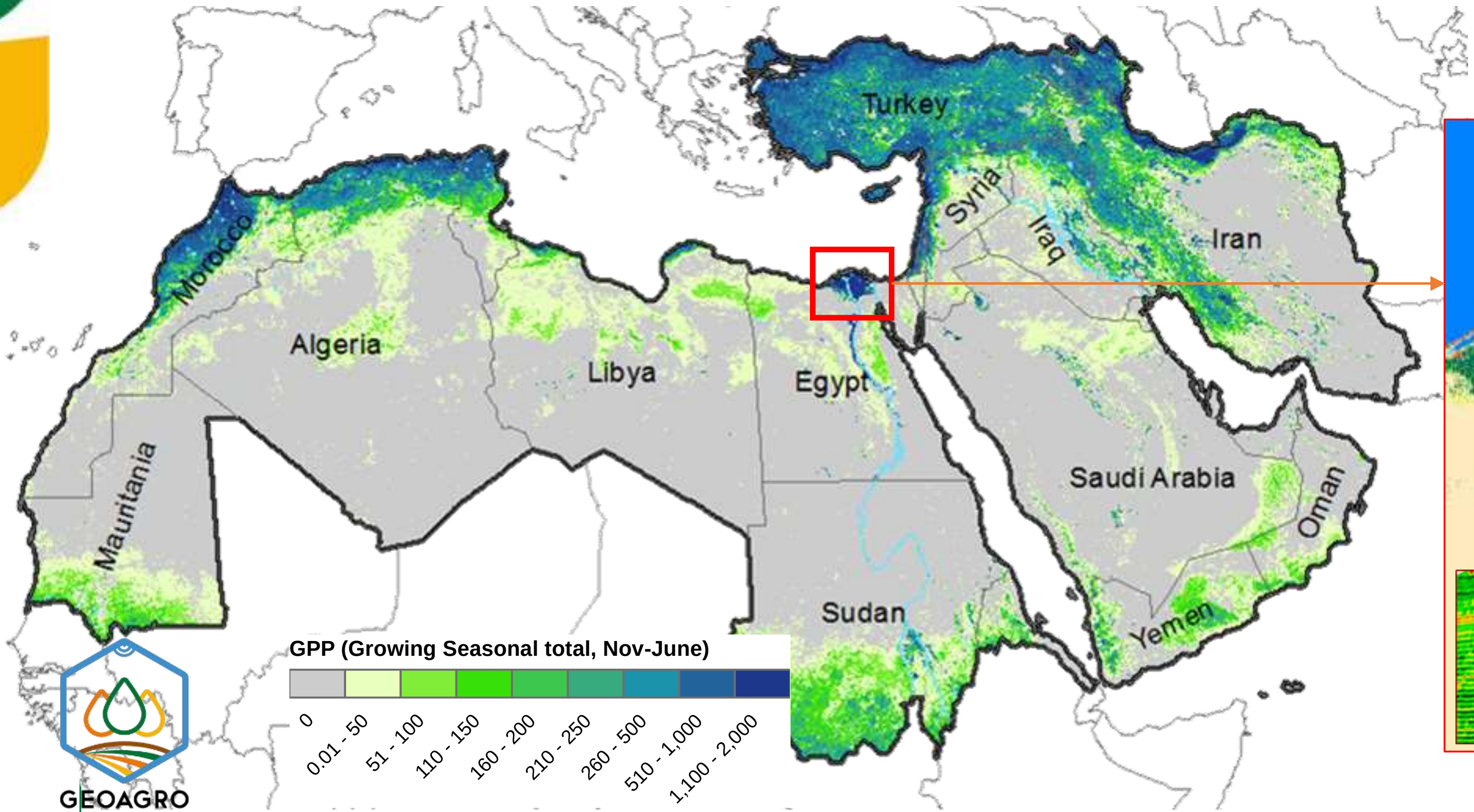

Easily detectable (RS) evidences of potential yield gaps at farm level
Flux Tower
1
2
1
2
10

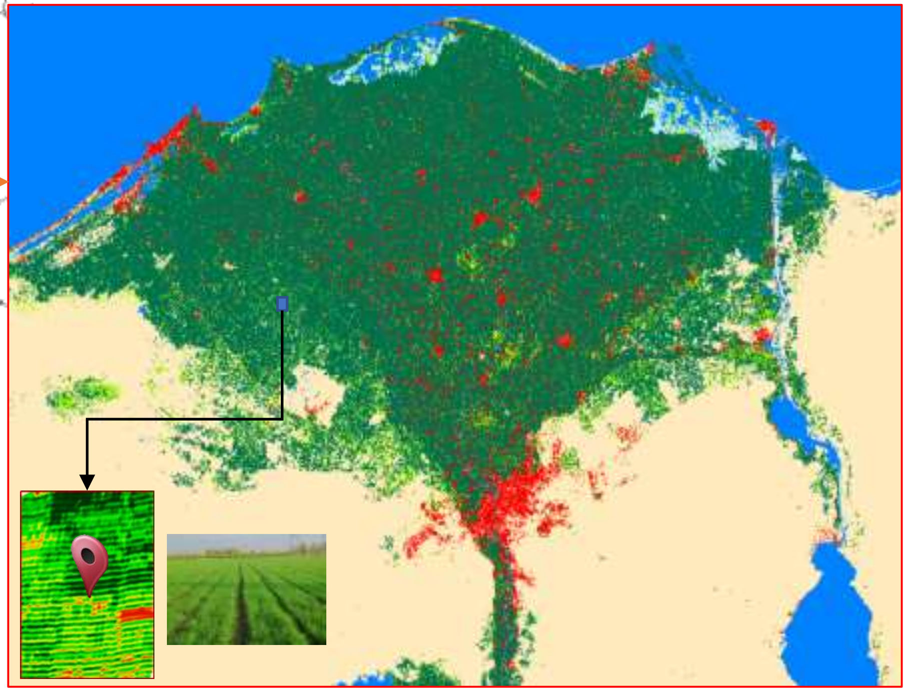
Shift in paradigm for sustainable agri-food systems

Disaggregating yield gaps at farm/pixels scales to target appropriate interventions

Shift in the paradigm from commodity to functional productivity

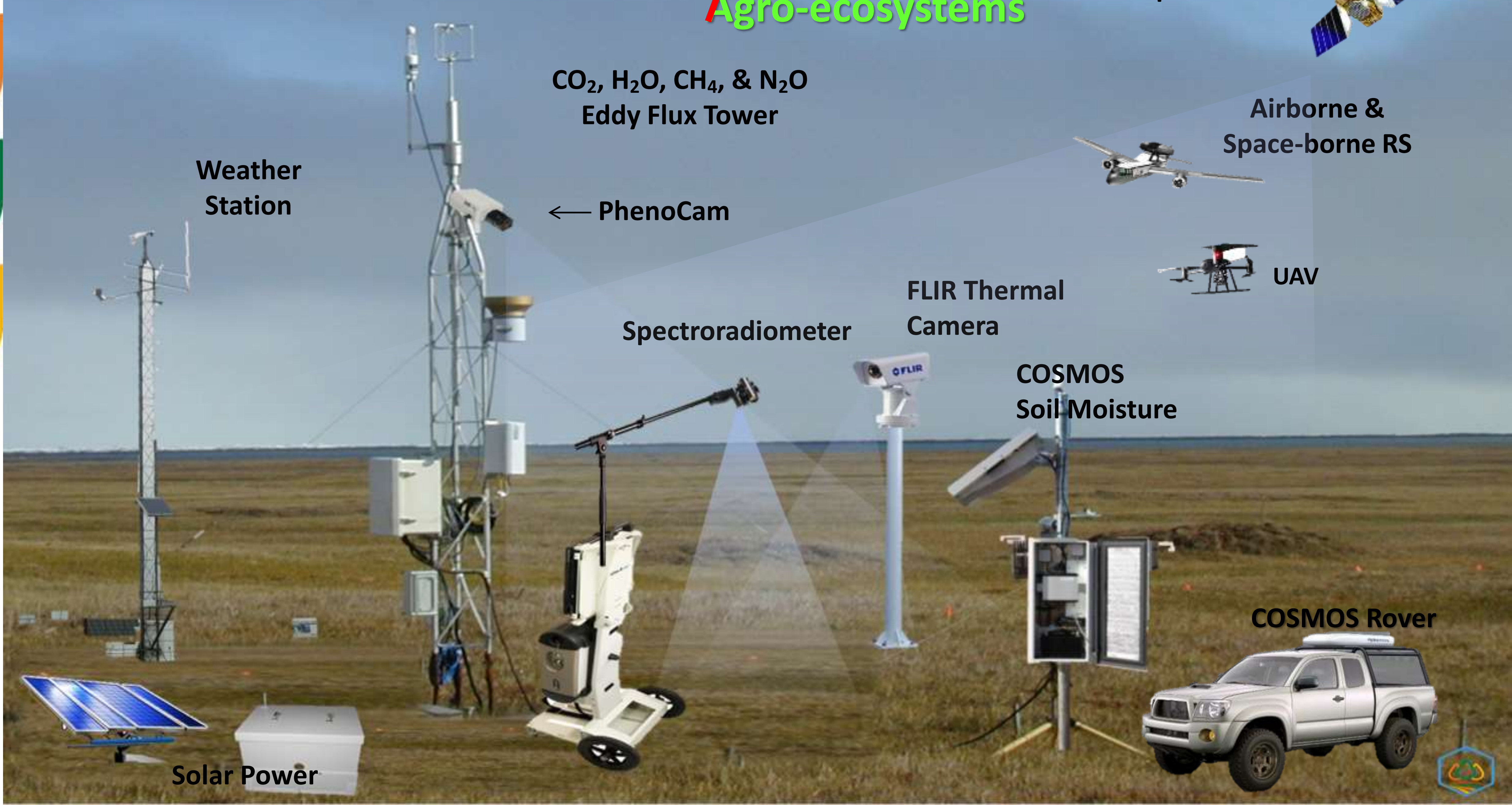






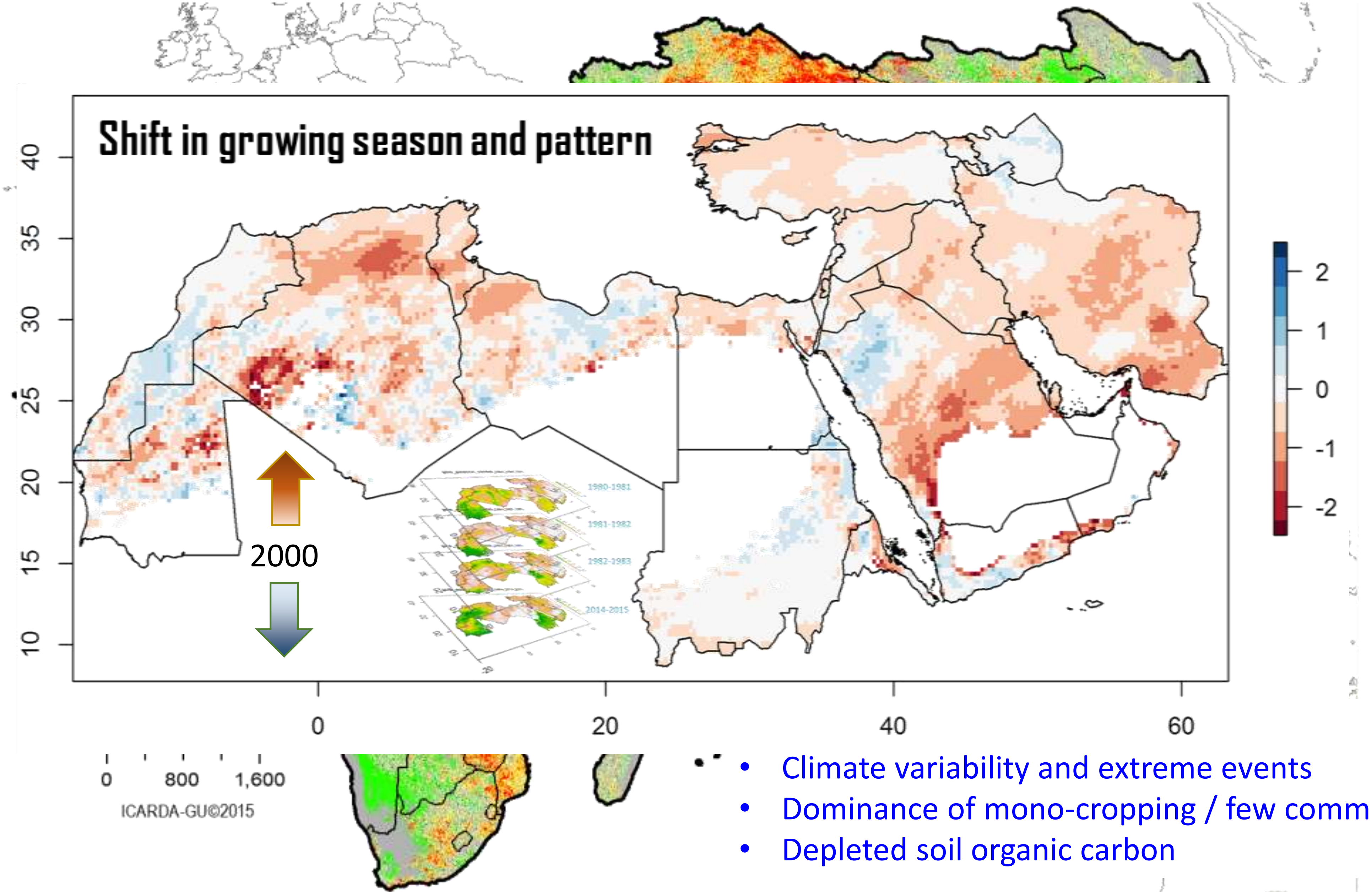
GEOAGRO

Integrated Observation Systems
Agro-ecosystems



Changing Water Balance

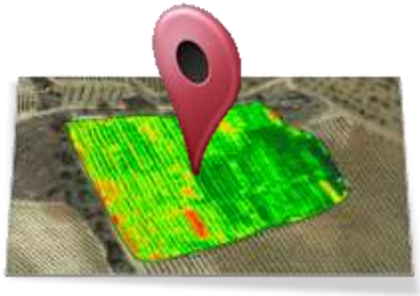
Frequent deviation from long-term averages



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

Copying with water demand

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



Pixel/Farm/Parcel

A single entity for each & every developmental entry point

Build resilient agroecosystems

Financial inclusion

Better livelihoods

Sustainable intensification

Right crop at right place and time

Resilient cropping systems

better integration of crops, livestock, fish, trees & people

<u>Optimizing agricultural water use by integrated approach</u>

compound intensification in cereal based systems

<u>Blockchain for ecological intensification</u>

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

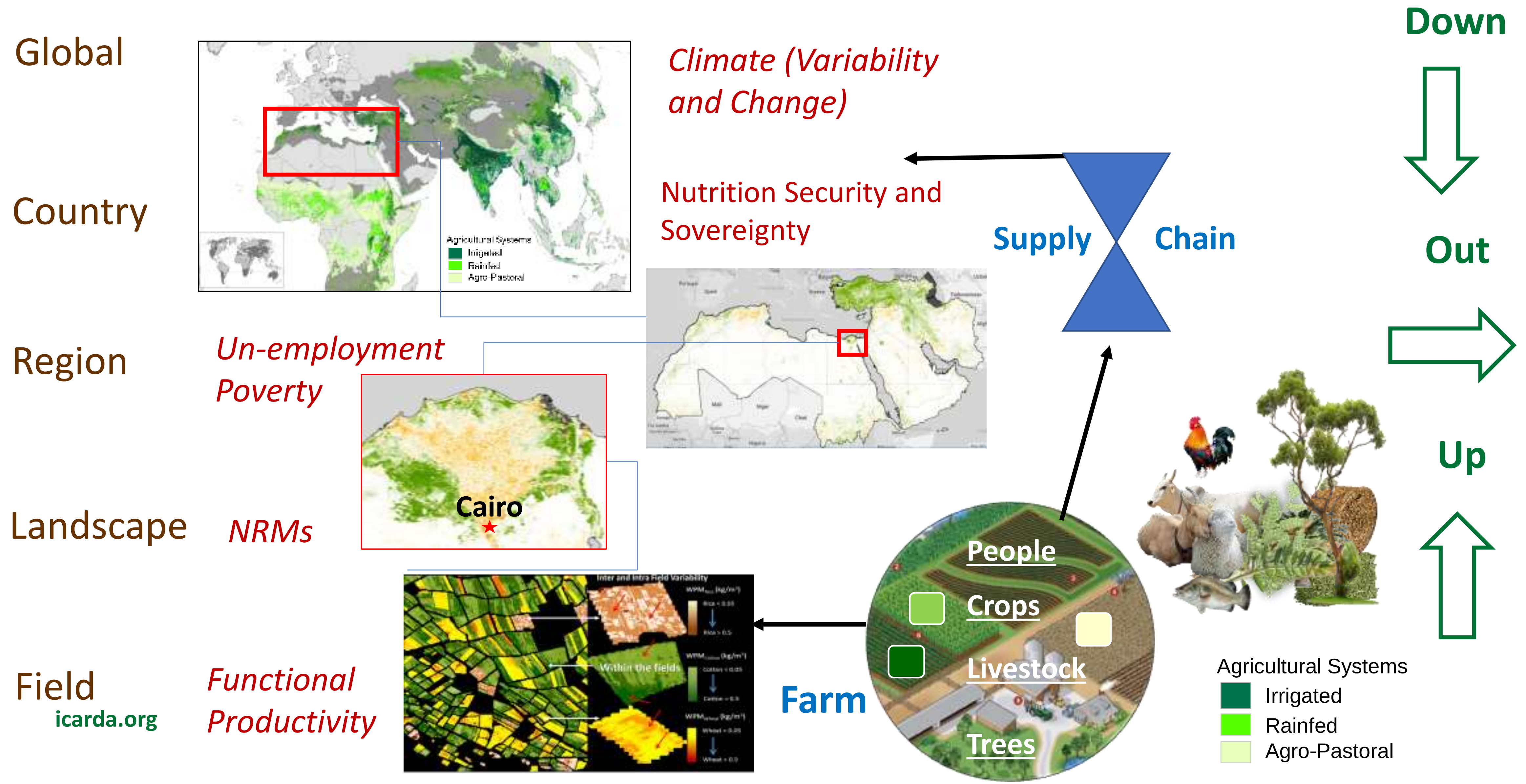
0.3m

Agreements

<Biggest drivers

Integrated Agroecosystems combining Component Research & Systems Research

A multi-scale and multi-criteria R4D



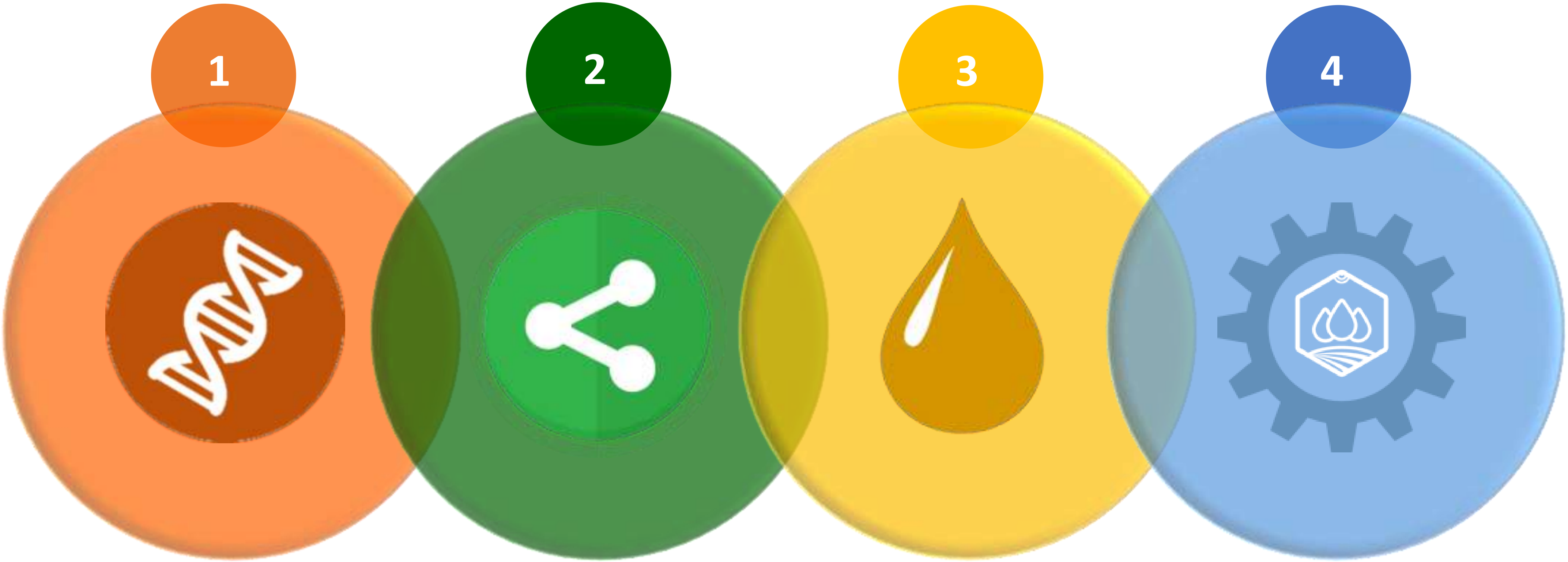
Machine Learning and AI in GeoAgro analytics

- Thousands of research and outreach data points in each season across the agro-ecosystems
- Open source near-real time earth observation data at field, farm to landscape scales
- Enormous power of cloud computing, open access, algorithms, analytics to process data on time
- Smart phone enabled apps and cloud web-GIS for decision making at point, farm and administrative units

AWS Google Earth Engine

Technological Innovations

(integrated systems approach for reducing risks)



Biodiversity & Crop Improvement Program

>> research plots, > farm trials / demonstrations, > international nurseries > germplasms, > NARS partners feedbacks, > etc.

Resilient Agricultural Livelihood Systems Program

>> research plots, > agronomy, >CA/Zero tillage> livestock, > rangelands, > household surveys, > value chains, > etc.

Water, Land Management & Ecosystems Program

>> field data, > raised beds> Field ETs, > AWPs, > soils, > hydrology, > land degradation,> erosion>, hydrology, > etc.

Cross Cutting Themes Big Data and ICTs

>> big-data, > open access resources, > cloud computing, > gender data, > > scaling > capacity dev., > modelling, > etc.

Machine Learning and AI in GeoAgro analytics

Crop types, rotation/sequence, health, productivity, trade

What do we assess?

A:
Crop types, rotation and health mapping

B:
Crop Yield estimation and forecasting

C:
Systems analytics and resource use tradeoffs

At which temporal and spatial scales?

Temporal

Mode 1:
Archives and end-of-year

- Land use intensity
- Yield gaps
- Land degradation

Mode 2:
Within-season monitoring

- Early crop acreage estimation
- Crop stress
- Early water demand estimation

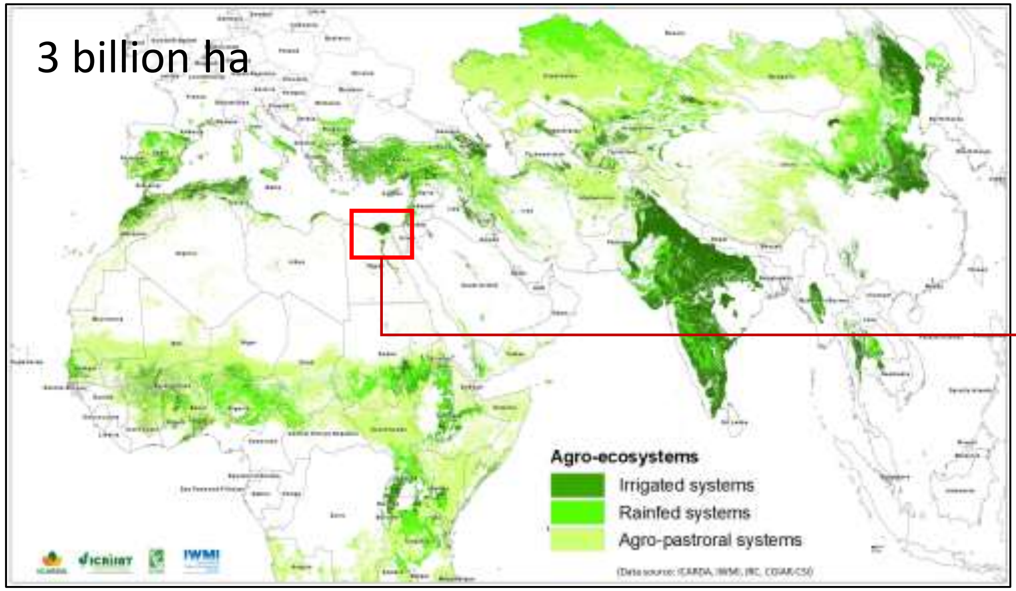
Spatial

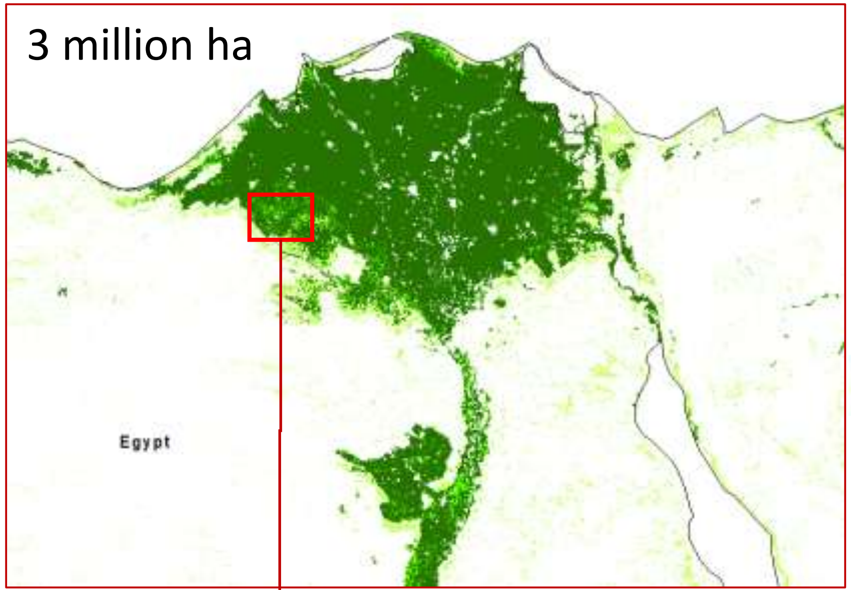
Mode 1:
Pixel-level

Mode 2:
Object-level

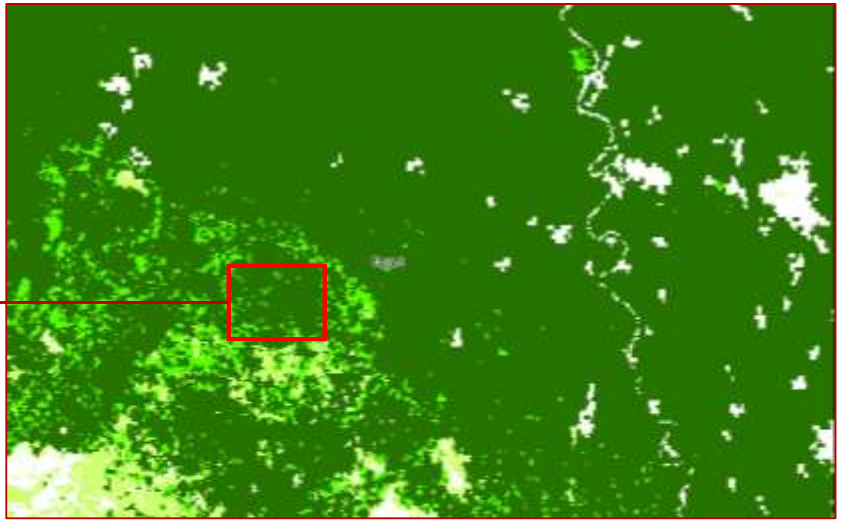
GBDX amazon web services esri Google Earth Engine

Agroecosystems: scaling innovations and measuring impacts

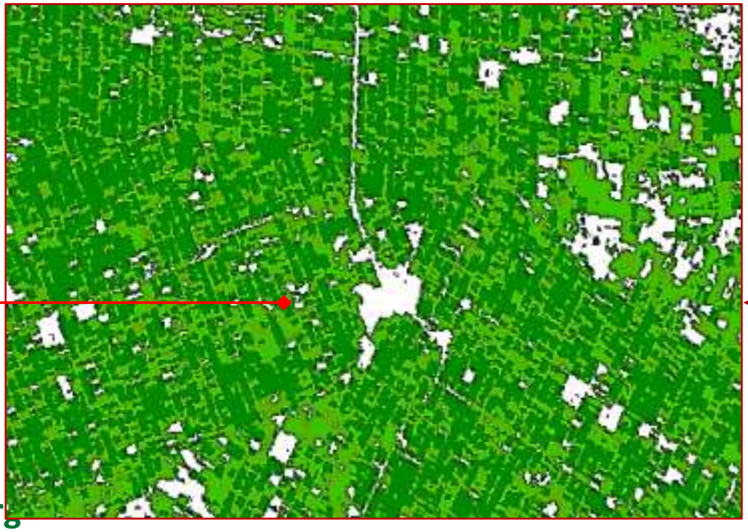




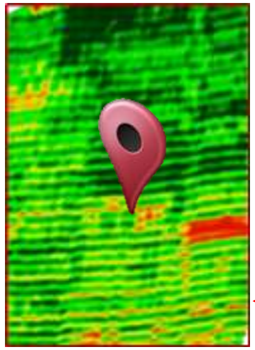
300 k ha



30 k ha



1.3 ha



- Inputs/reuse
- Yield/Production
- Markets/income
- Functional flows

Irrigated systems

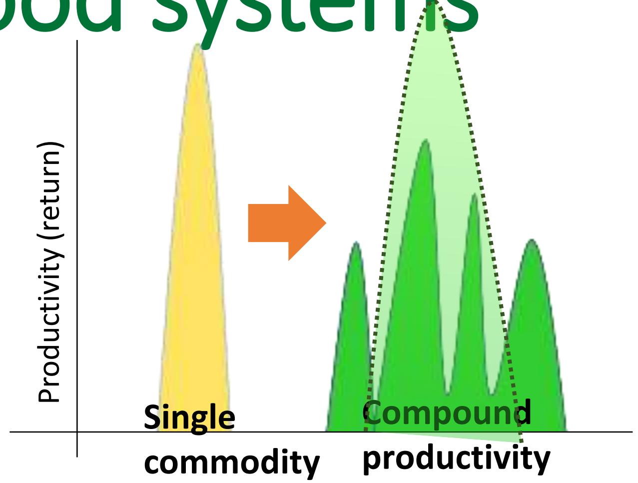
Rainfed systems

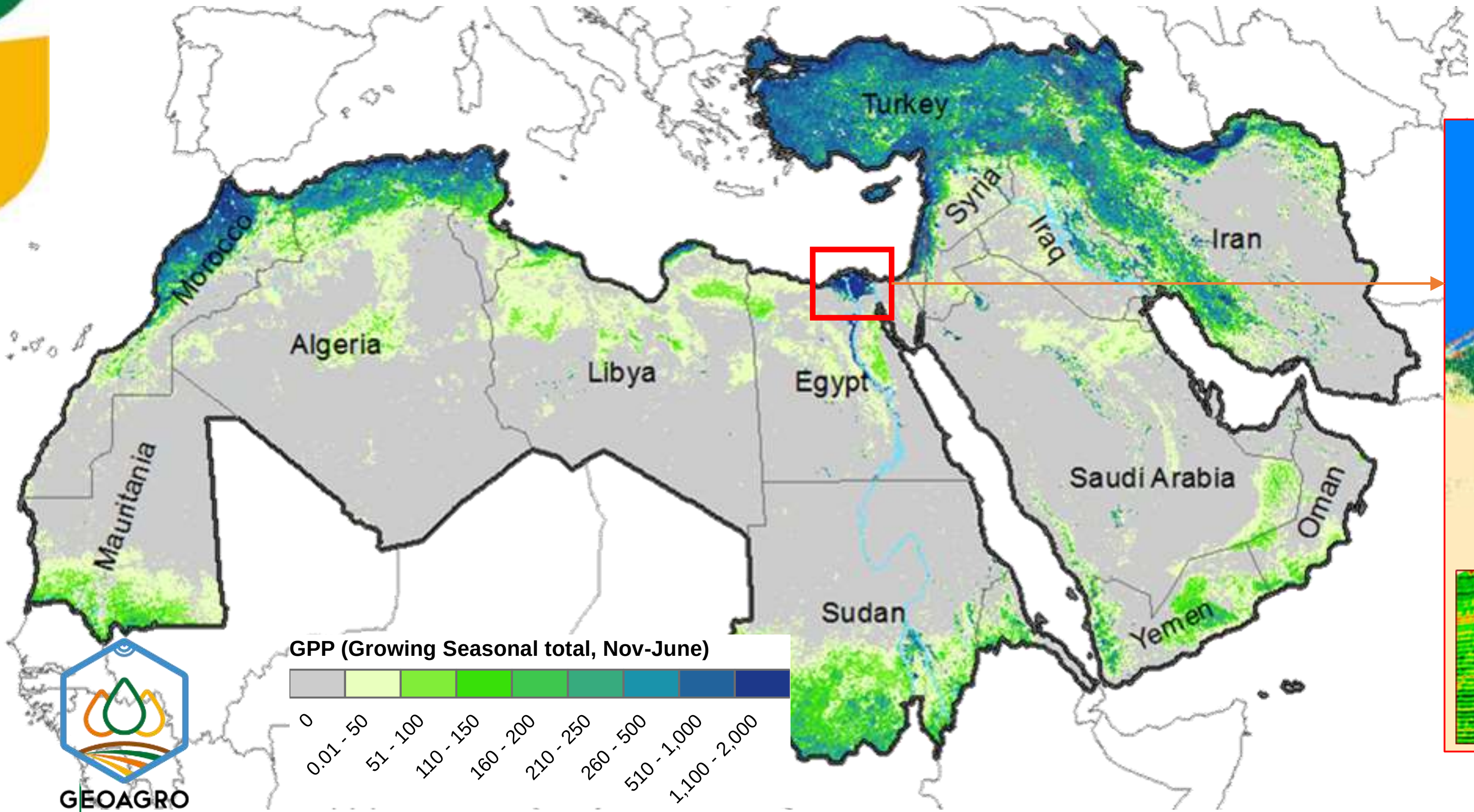
Agro-pastroral systems

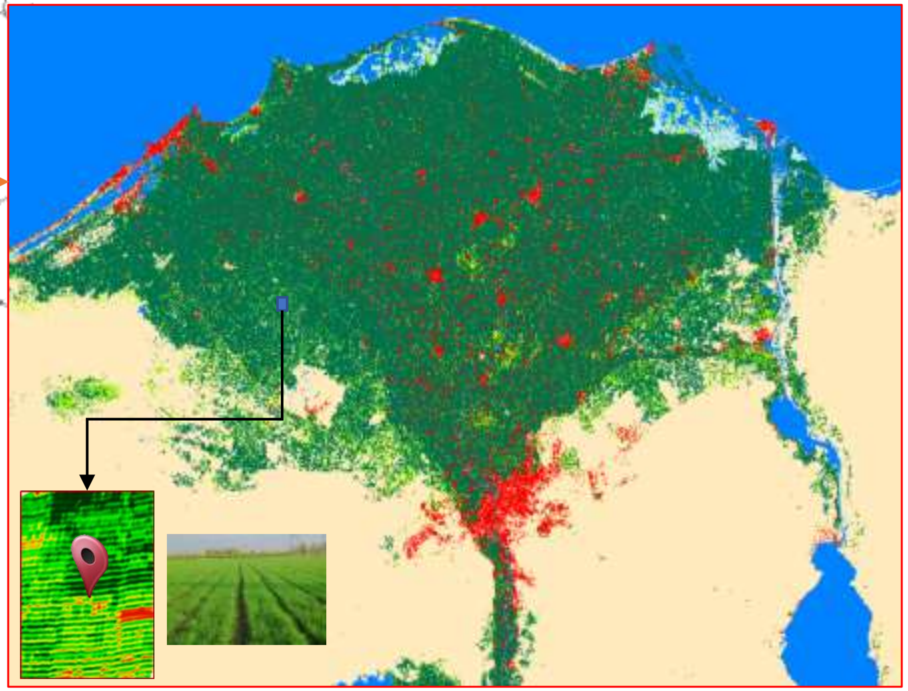
Shift in paradigm for sustainable agri-food systems

Disaggregating yield gaps at farm/pixels scales to target appropriate interventions

Shift in the paradigm from commodity to functional productivity







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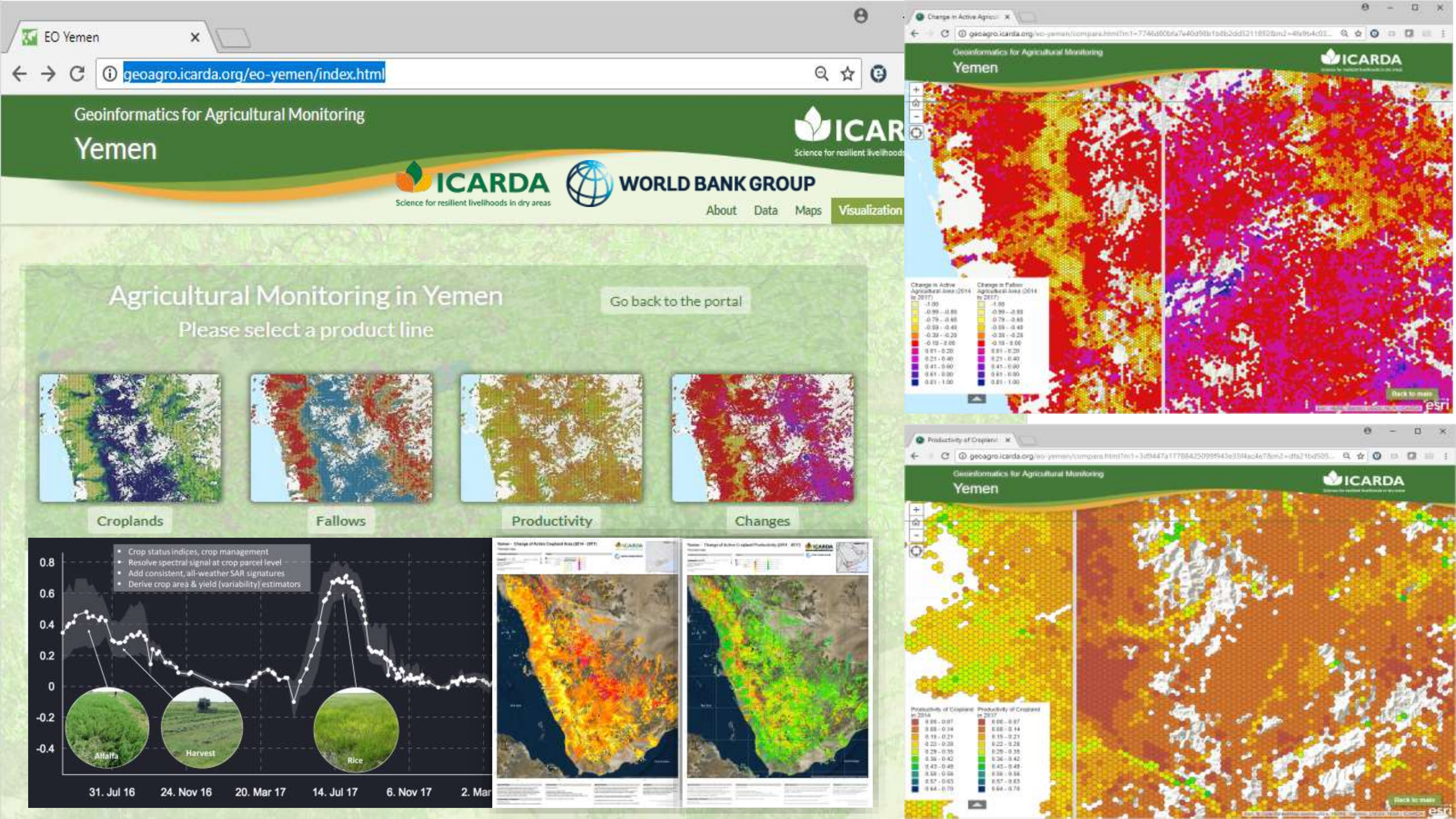

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Productivity
Changes
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Resolve spectral signal at crop parcel level
Add consistent, all-weather SAR signatures
Derive crop area & yield (variability) estimators
0.8
0.6
0.4
0.2
0
-0.2
-0.4
Alfalfa
Harvest
Rice
31. Jul 16
24. Nov 16
20. Mar 17
14. Jul 17
6. Nov 17
2. Mar
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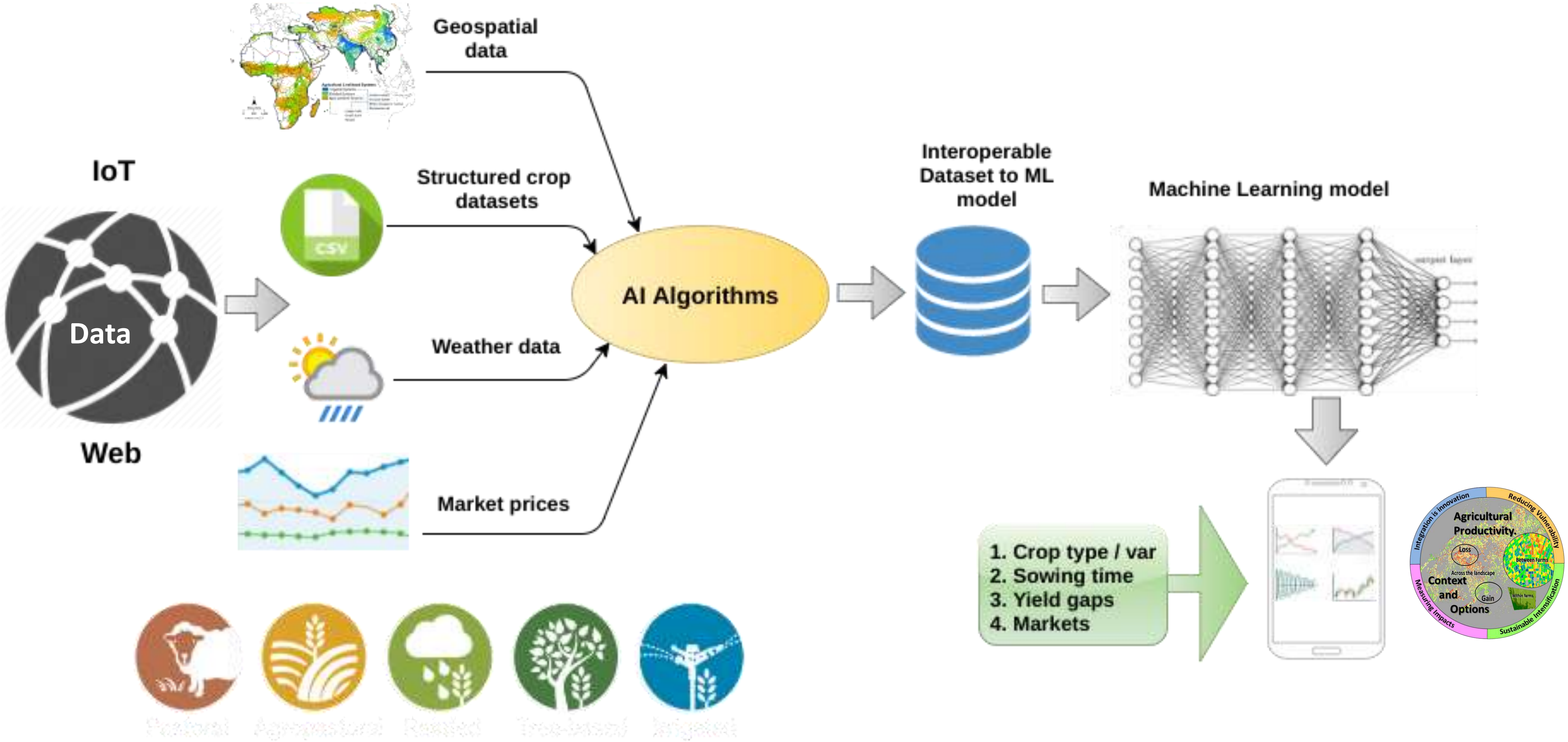
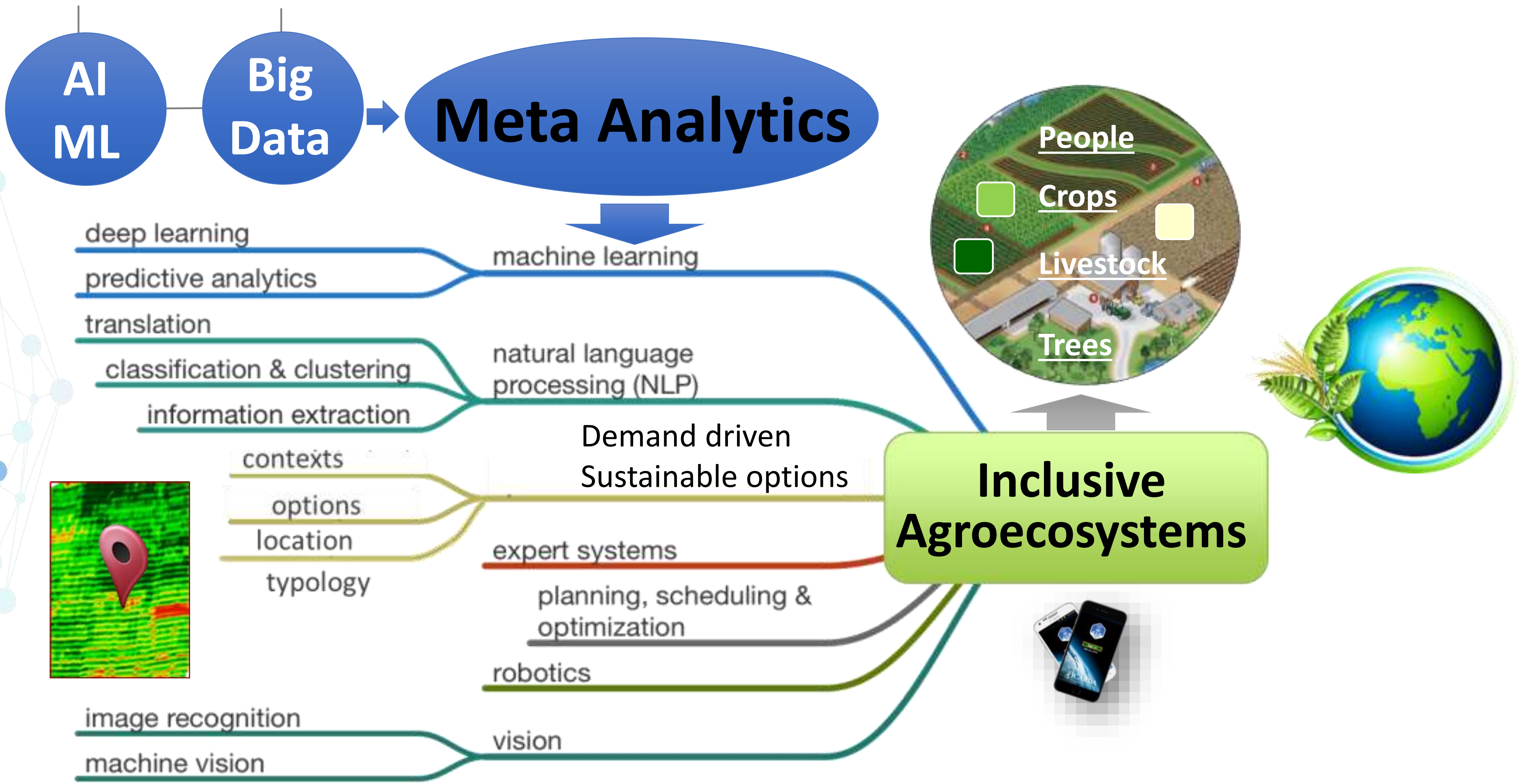
Big-data, Machine Learning and AI algorithms

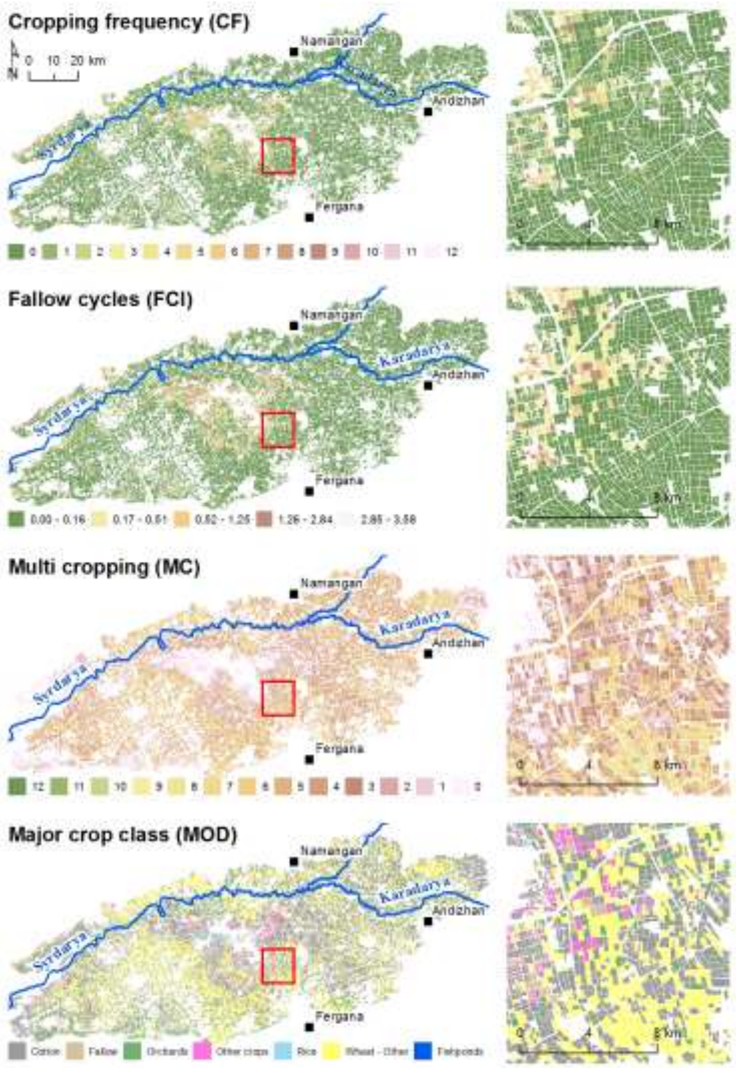


Big-data, Machine Learning and AI algorithms

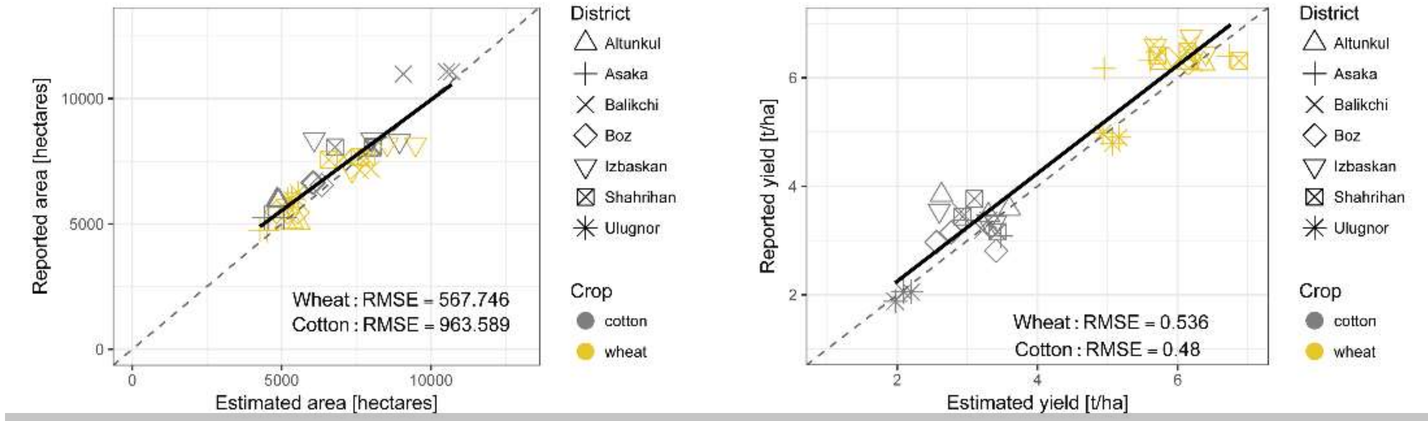
AI-ML-BigData @ genetics, chemistry, weather, agronomies, trade…

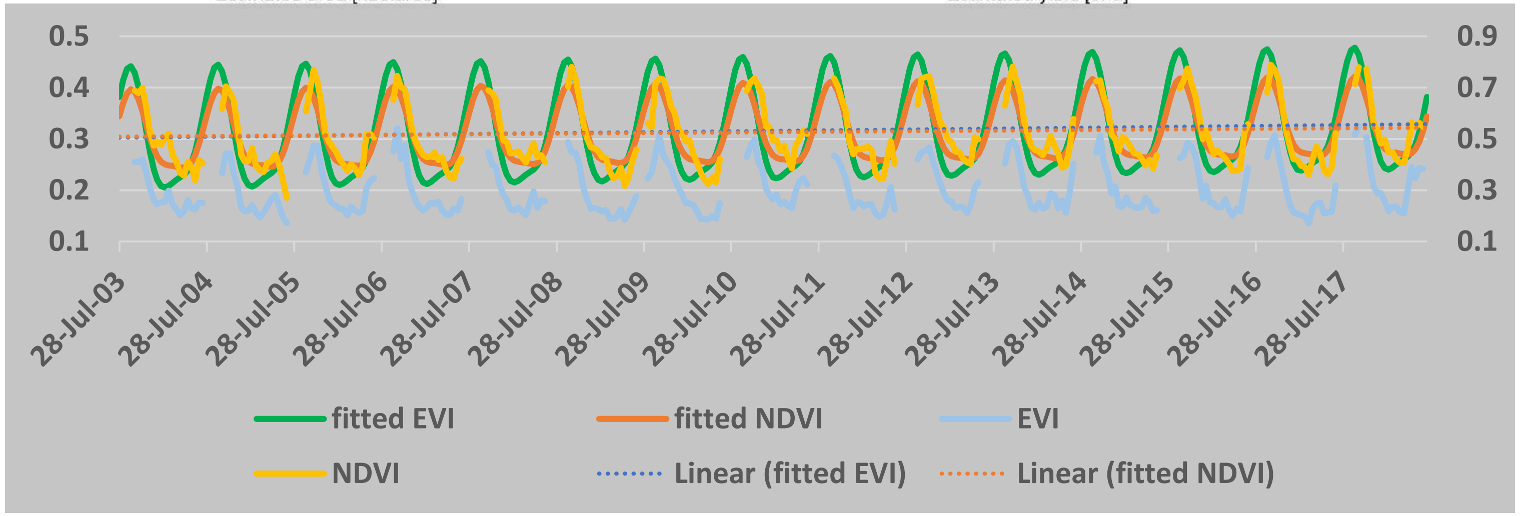


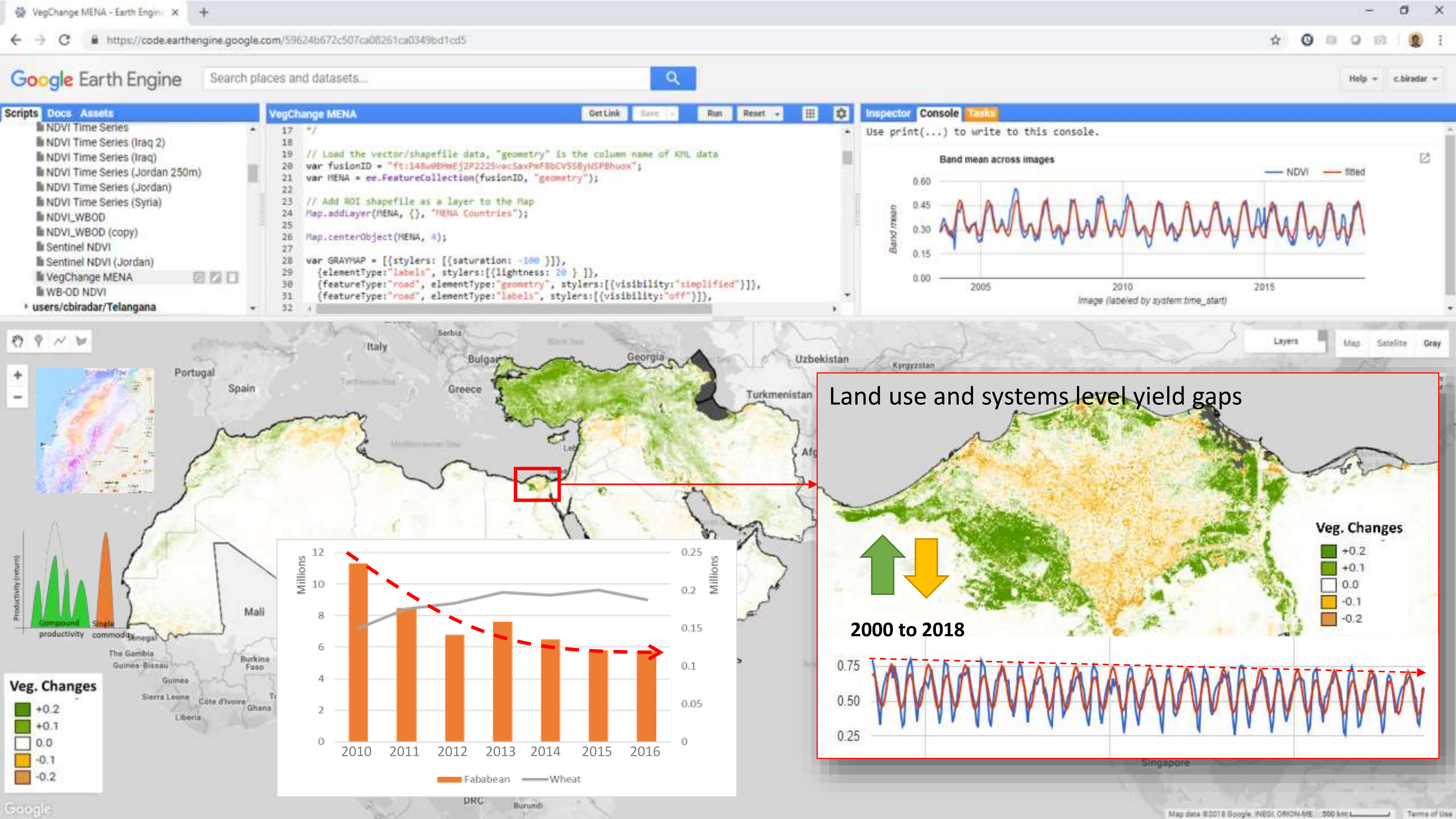
Multi-year mapping of the crops, intensity and rotation



Quantification of the decadal dynamics of the land use, crop types, cropping intensity and rotation at the field level.

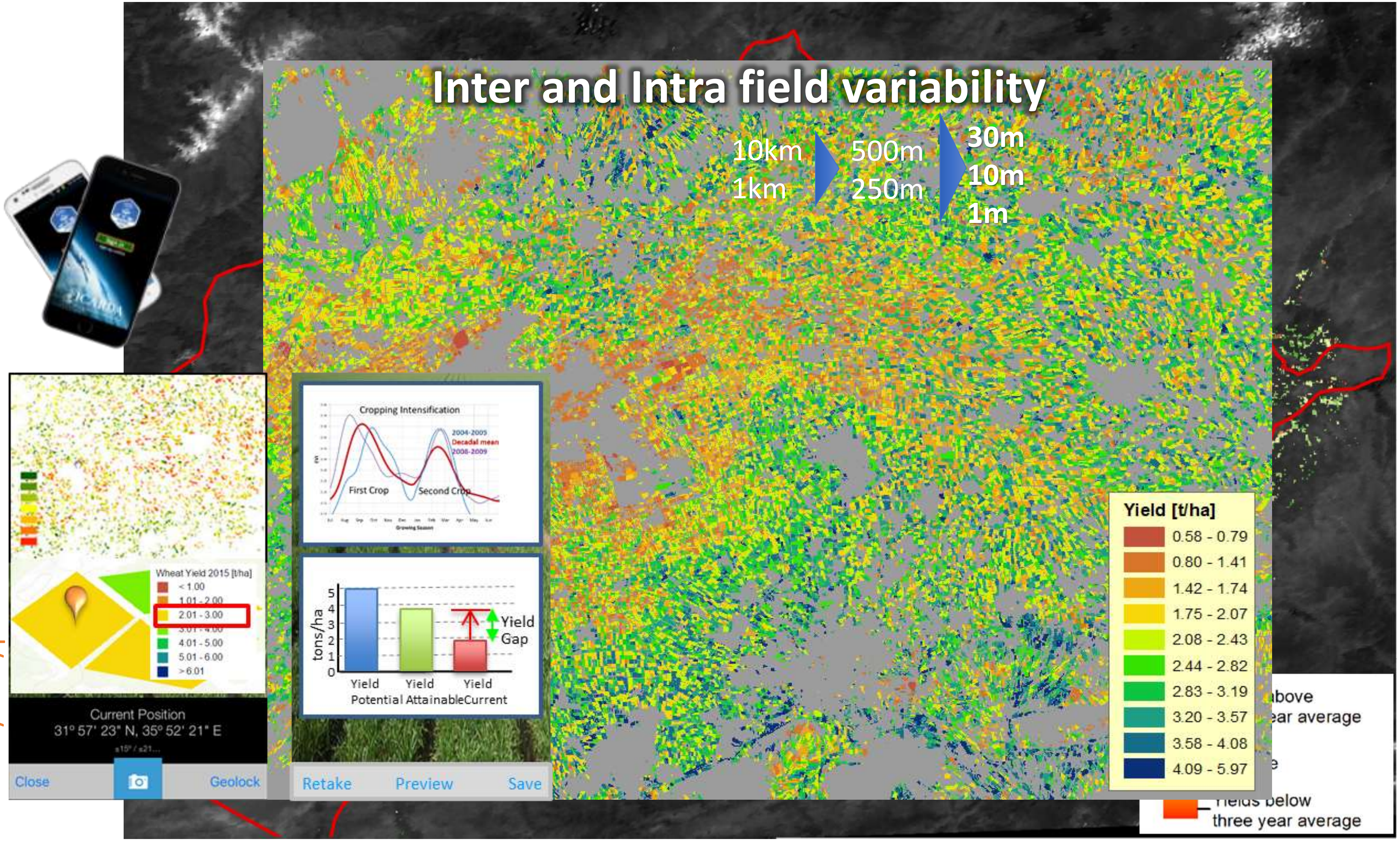






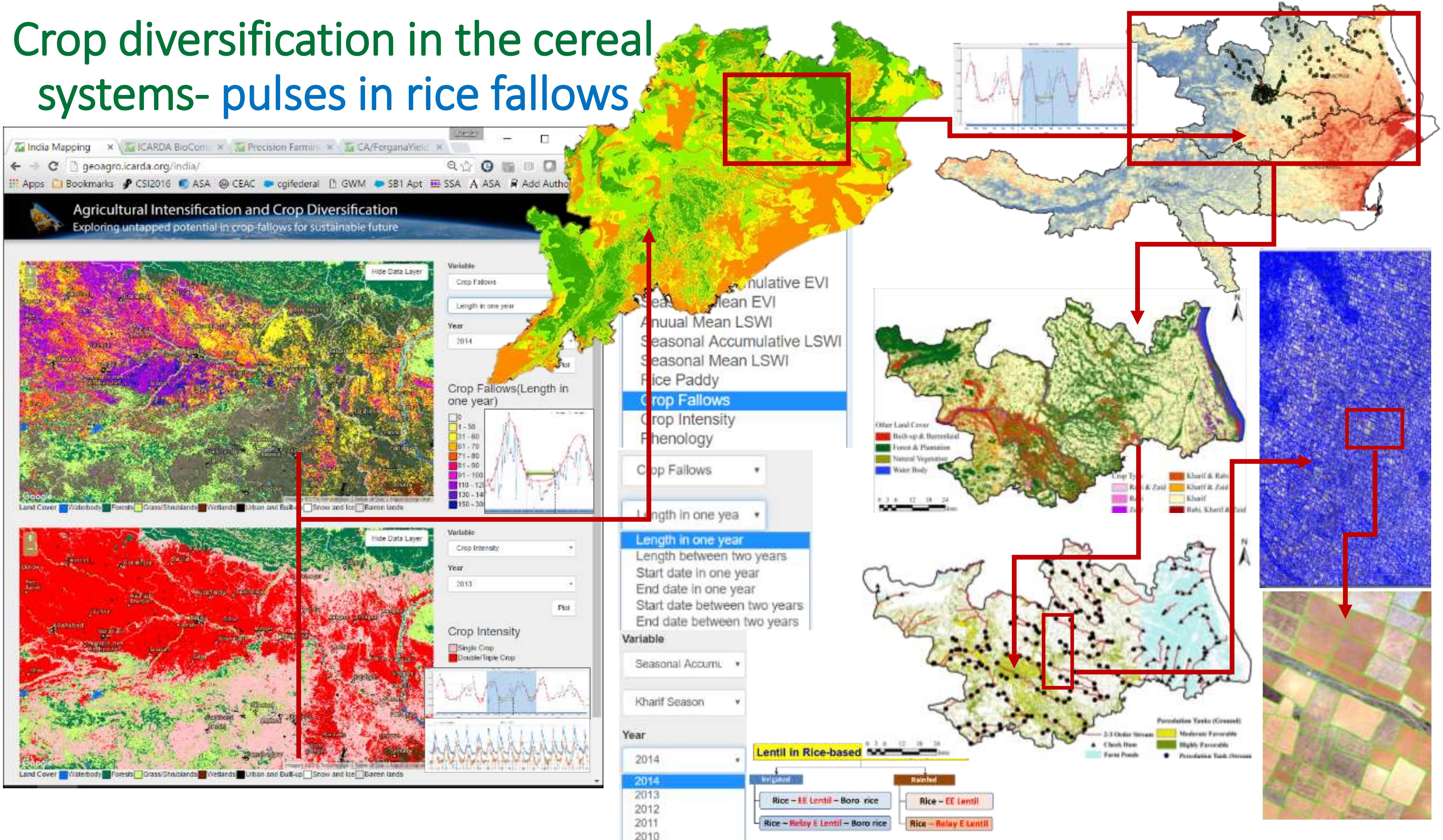
VegChange MENA - Earth Engine
https://code.earthengine.google.com/59624b672c507ca08261ca0349bd1cd5
Google Earth Engine
Search places and datasets...
Scripts Docs Assets
NDVI Time Series
NDVI Time Series (Iraq 2)
NDVI Time Series (Iraq)
NDVI Time Series (Jordan 250m)
NDVI Time Series (Jordan)
NDVI Time 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
// Load the vector/shapefile data, "geometry" is the column name of KML data
var MENA = ee.FeatureCollection(fusionID, "geometry");
// Add ROI shapefile as a layer to the Map
Map.addLayer(MENA, {}, "MENA Countries");
Map.centerObject(MENA, 4);
Inspector Console Tasks
Use print(...) to write to this console.
Band mean across images
NDVI fitted
Band mean
0.60 0.45 0.30 0.15 0.00
2005 2010 2015
Image (labeled by system:time_start)
Land use and systems level yield gaps
Veg. Changes
+0.2
+0.1
0.0
-0.1
-0.2
2000 to 2018
0.75 0.50 0.25
Compound productivity
Single commodity
Productivity (return)
Millions
12 10 8 6 4 2 0
0.25 0.2 0.15 0.1 0.05 0
2010 2011 2012 2013 2014 2015 2016
Fababean Wheat
Veg. Changes
+0.2
+0.1
0.0
-0.1
-0.2
Portugal Spain Italy Greece Bulgaria Georgia Uzbekistan Turkmenistan Kyrgyzstan Serbia Mali Senegal The Gambia Guinea-Bissau Guinea Sierra Leone Liberia Côte d'Ivoire Ghana Burkina Faso DRC Burundi Singapore
Layers Map Satellite Gray

Productivity dynamics, pattern and yield gaps



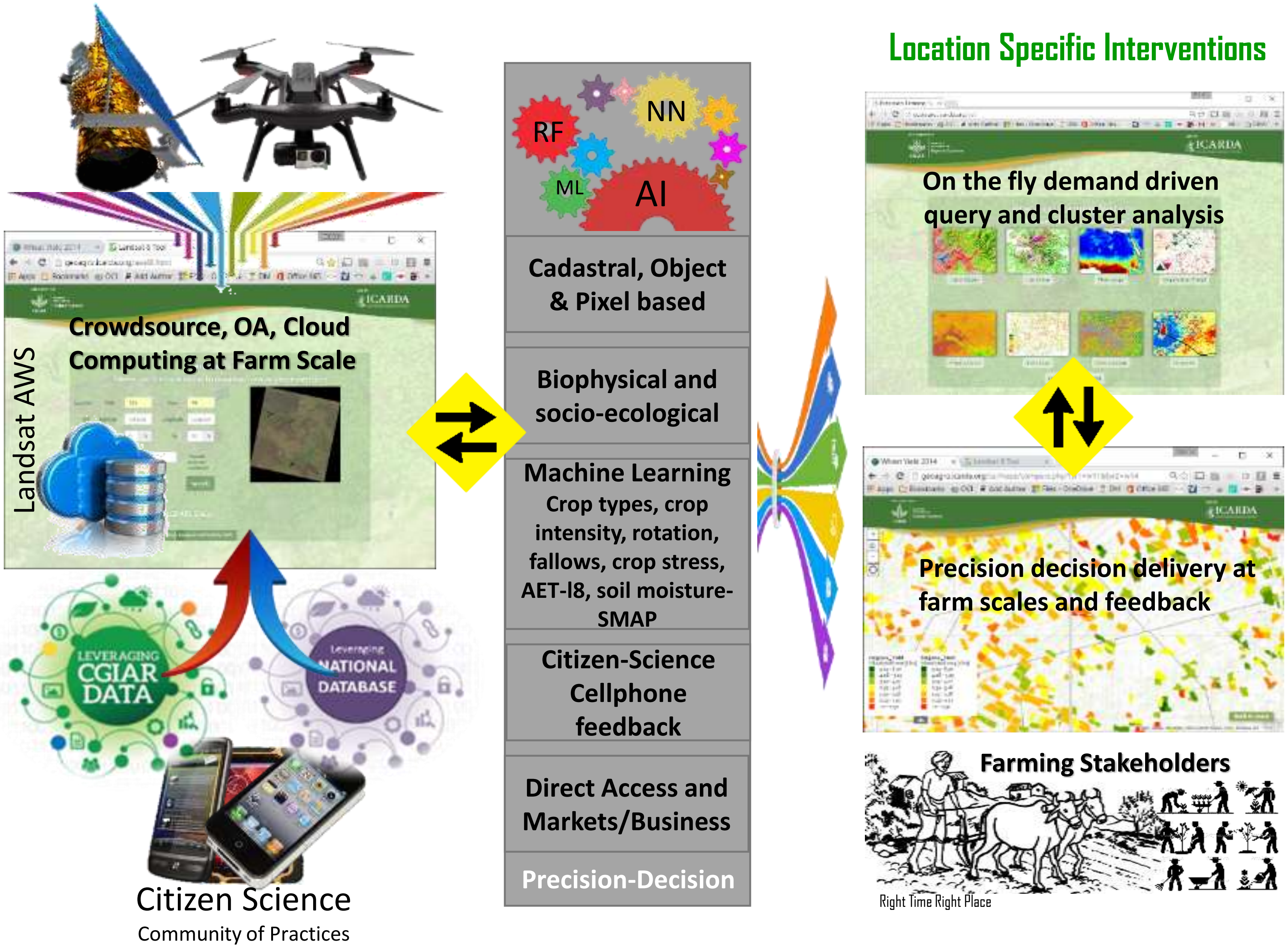
System efficiency at farm/field/pixel level

Crop diversification in the cereal systems- pulses in rice fallows



Smart Farming Systems Platform

Digital Augmentation for accelerating sustainable intensification

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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

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Head-Geoinformatics Unit

Principal Scientist (Agro-Ecosystems)