



GLOBAL  
FOREST  
SURVEY



# Monitoring of Irrigable Agricultural Lands in Euphrates-Tigris River Basin (Syria-Iraq)

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5th INTERNATIONAL WORKSHOP ON SAND AND DUST STORMS  
(DUST SOURCES AND THEIR IMPACTS IN MIDDLE EAST)

Istanbul

23-25 October 2017



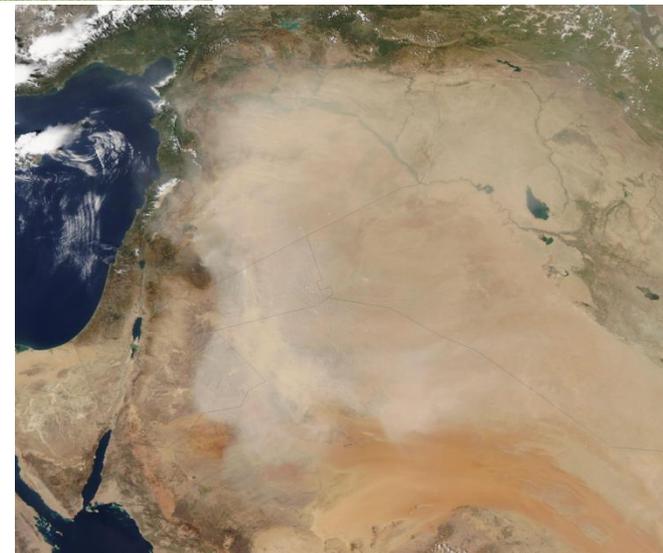


Although there are large uncertainties on the precise numbers, most (about 75%) of current global dust emissions come from natural, not anthropogenic sources.

Climate change is an important potential driver of future wind erosion and Sand and dust storms (SDS) risk, especially the occurrence of more extreme wind events and movement to drier climates



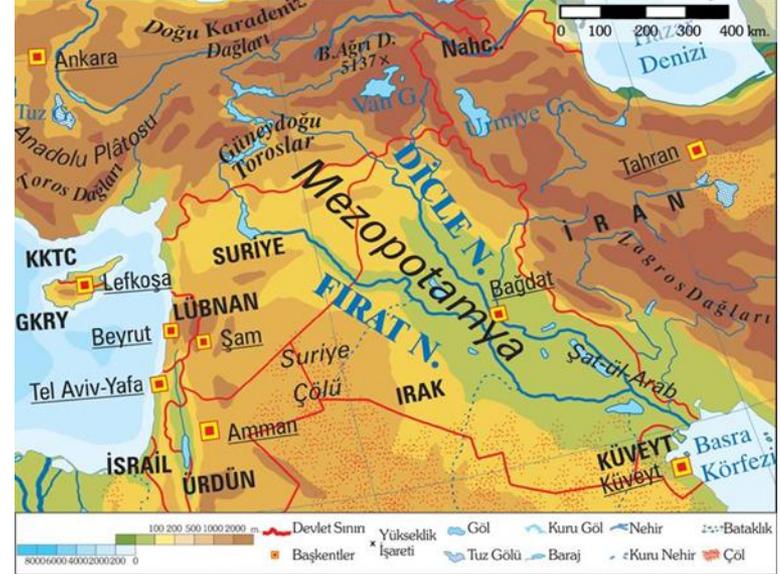
The largest areas with high dust intensities, which derive from both natural and anthropogenic sources, are located in the Northern Hemisphere, mainly in a broad “dust belt” that extends from the west coast of North Africa, over the Middle East, Central and South Asia, to China.





... aggregation!!!





...for water deficiency and draught is the construction of dams in Turkey, Iran and Syria, which have decreased the annual water flow in the Tigris and Euphrates Rivers, and their tributaries!!!???

In addition, **drying the marshes prior 2003** and the obstacles encountered in restoring them is another factor contributing to the generation of these storms.

...had led to enormous decrease in the agricultural lands in Figure , which intern have changed to dry lands and have contributed in desertification, consequently increasing SDS events, **due to disintegration of the soil particles** and wind contributes to the emergence of SDS.



Al-Ansari, N.A. (2013) Management of water resources in Iraq: Perspectives and Prognoses. *Engineering*, 5, 667- 684. <http://dx.doi.org/10.4236/eng.2013.58080>

Al-Ansari, N.A. and Knutsson, S. (2011) Toward prudent management of water resources in Iraq. *Journal of Ad- vanced Science and Engineering Research*, 1, 53-67.

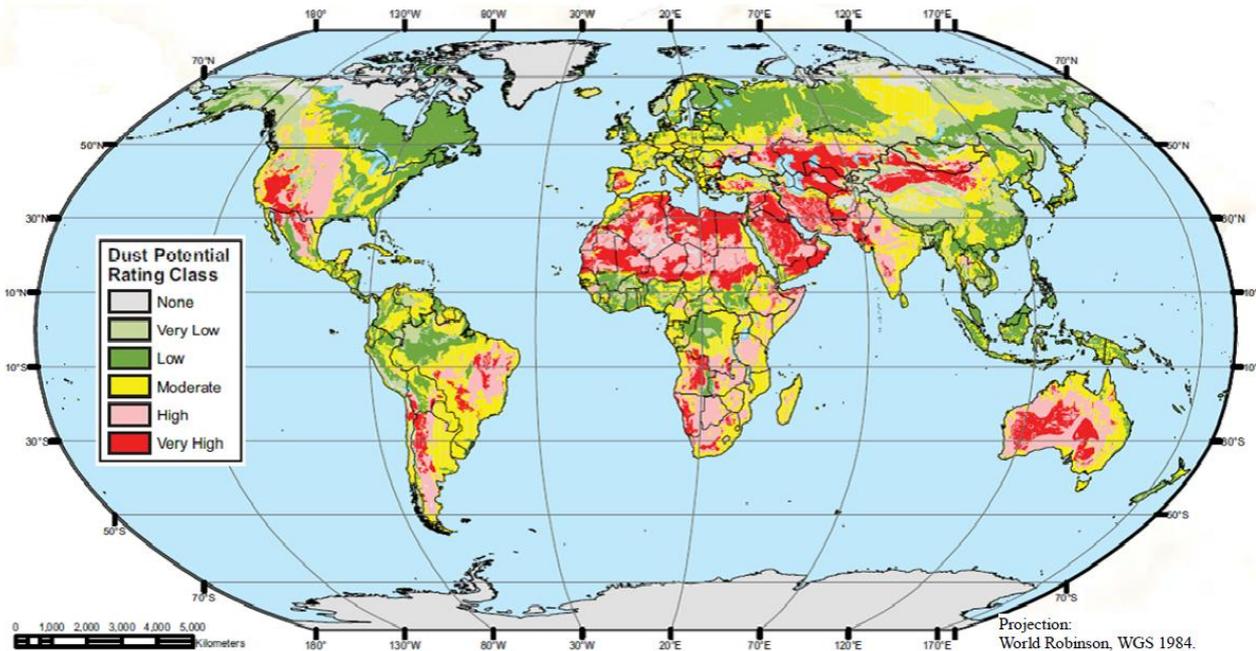
Al-Ansari, N.A., Knutsson, S. and Ali, A. (2012) Restor- ing the Garden of Eden, Iraq. *Journal of Earth Science and Geotechnical Engineering*, 2, 53-88.

Vol.5, No.10, 1084-1094 (2013)  
<http://dx.doi.org/10.4236/ns.2013.510133>

### Sand and dust storm events in Iraq

Varoujan K. Sissakian<sup>1</sup>, Nadhir Al-Ansari<sup>2\*</sup>, Sven Knutsson<sup>2</sup>

Natural Science



Therefore, the majority of the Iraq territory is changed into Very High Potential for dust storm areas, except small part in the extreme northeastern part, where it shows Moderate Potential for dust storms, as it is shown in Figure.



❖ There are enormous changes of different climatic factors in Middle East due to global climate change; since the last decade.

❖ Global climate change and GAP project in Turkey are both contributing to the water shortages in Iraq.

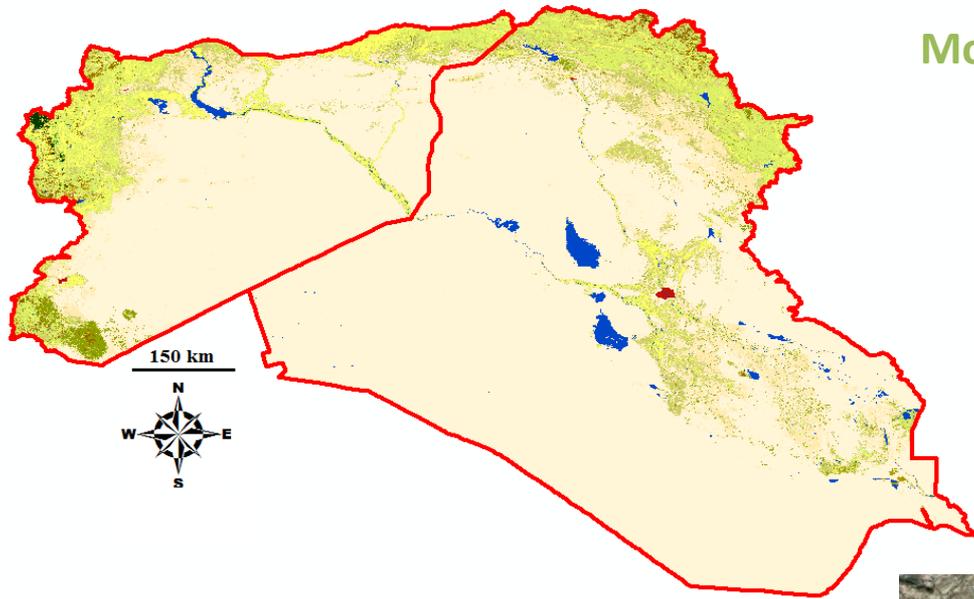
❖ The area experienced enormous changes in annual average temperature, and rain fall had occurred and as a result number of annual dust storms was witnessed in Iraq.



Cloughton, R. (2011) A water crisis awaits Iraq.  
 Wilson, R. (2012) Water-shortage crisis escalating in the tigris-euphrates basin, future directions international, strategic analysis paper.  
 Kami, A. (2011) Iraq may suffer clean water crisis in 15- 20 years, Reuters  
 Sands, P. and Latif, N. (2009) Iraq's new war is a fight for water, the national.  
 IRIN (2013) IRAQ: Water shortage leads people to drink from rivers.  
 Lorenz, F.M. (2008) Strategic water for Iraq: The need for planning and action.  
 Raphael, N. (2009) Water crisis in Iraq: The growing danger of desertification, investors Iraq.  
 UNESCO-Iraq (2013) Iraq's water in the International Press.  
 Chulov, M. (2009) Water shortage threatens two million people in southern Iraq, The Guardian.



# Monitoring of Irrigable Agricultural Lands in Euphrates-Tigris River Basin...



Value	GlobCover global legend	
11	Post-flooding or irrigated croplands	
14	Rainfed croplands	
20	Mosaic Cropland (50-70%) / Vegetation (grassland, shrubland, forest) (20-50%)	
30	Mosaic Vegetation (grassland, shrubland, forest) (50-70%) / Cropland (20-50%)	
40	Closed to open (>15%) broadleaved evergreen and/or semi-deciduous forest (>5m)	
50	Closed (>40%) broadleaved deciduous forest (>5m)	
60	Open (15-40%) broadleaved deciduous forest (>5m)	
70	Closed (>40%) needleleaved evergreen forest (>5m)	
90	Open (15-40%) needleleaved deciduous or evergreen forest (>5m)	
100	Closed to open (>15%) mixed broadleaved and needleleaved forest (>5m)	
110	Mosaic Forest/Shrubland (50-70%) / Grassland (20-50%)	
120	Mosaic Grassland (50-70%) / Forest/Shrubland (20-50%)	
130	Closed to open (>15%) shrubland (<5m)	
140	Closed to open (>15%) grassland	
150	Sparse (>15%) vegetation (woody vegetation, shrubs, grassland)	
160	Closed (>40%) broadleaved forest regularly flooded - Fresh water	
170	Closed (>40%) broadleaved semi-deciduous and/or evergreen forest regularly flooded - Saline water	
180	Closed to open (>15%) vegetation (grassland, shrubland, woody vegetation) on regularly flooded or waterlogged soil - Fresh, brackish or saline water	
190	Artificial surfaces and associated areas (urban areas >50%)	
200	Bare areas	
210	Water bodies	
220	Permanent snow and ice	



Global Land CoverMap, ESA; 2009

excepting Asi River delta



openforis  
COLLECT EARTH

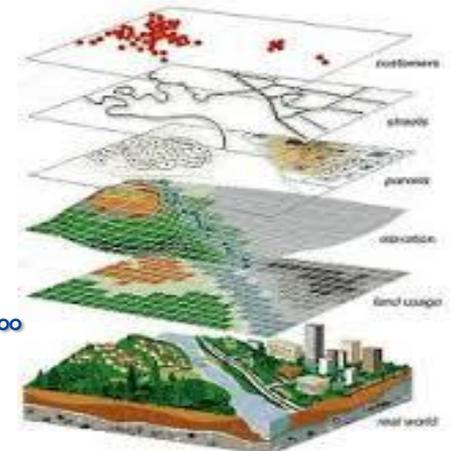
## Multi-purpose land monitoring...

# Vegetation...

*The object which must be monitoring...*



*Remote Sensing...*

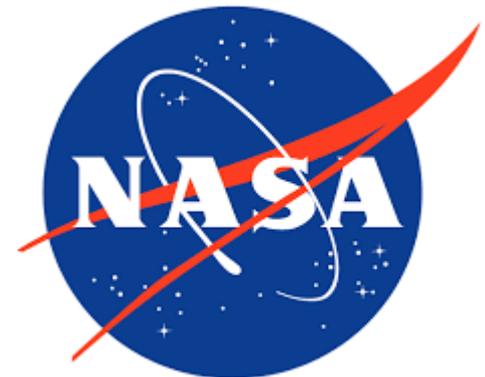


*Objective Methodologies...*

## What is Collect Earth?

- ❖ Free and Open Source tool
- ❖ Very High Resolution multi-temporal images from Google Earth and Bing Maps
- ❖ Landsat 5, 7 and 8, Modis datasets from Google Earth Engine
- ❖ Data Analysis through SAIKU (Statistics Analysis software)

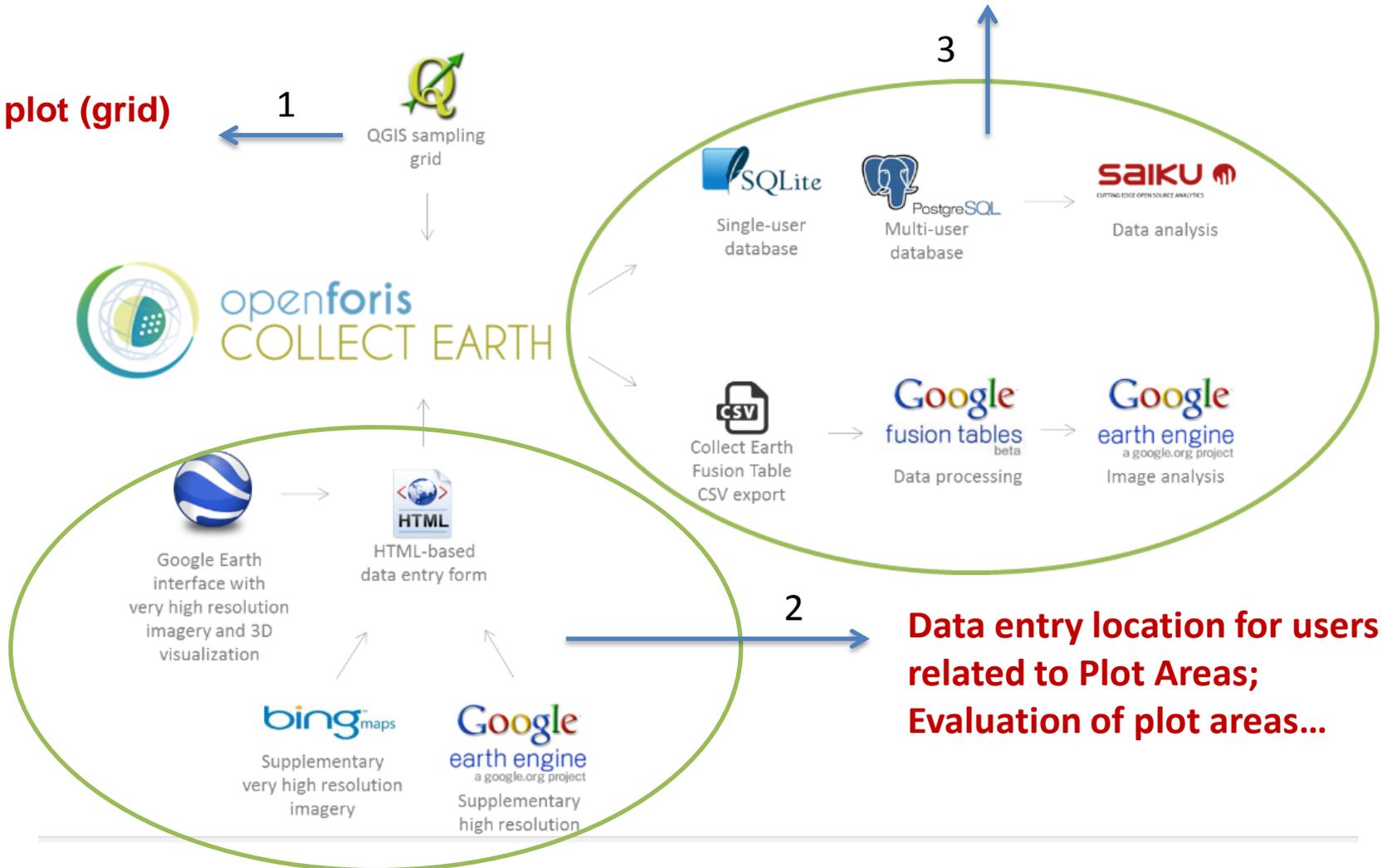
Multi-purpose land monitoring...



# How to «Collect Earth» works... ?

Sample plot (grid)

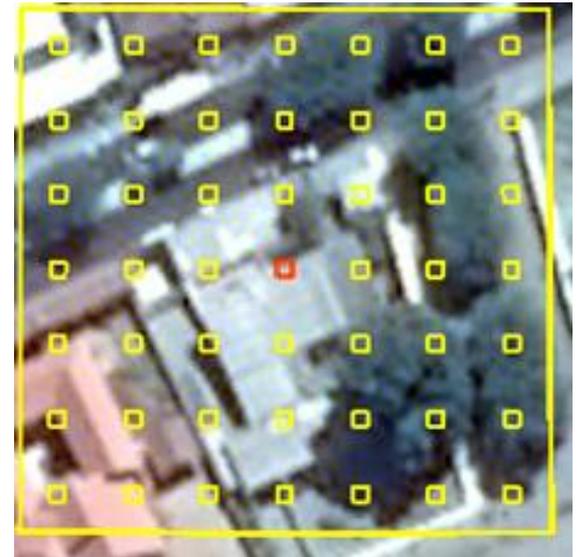
Analysis results  
Numerical data template  
Reporting...



Data entry location for users related to Plot Areas; Evaluation of plot areas...

## Plots (Grids)...

- $\sim$  0,50 ha ( 1 ha can be selected)
- Each plot grid consists of 49 small square points, one center point
- The 49 points in the plot are in square form each 2x2 meters and are 4m<sup>2</sup> area.



# Other data sources related Collect Earth...

Google Earth; Here Maps; Bing Maps, Yandex etc...



- High resolution image data
- Image interpretation from past to present  $\sim$  16 years from the past to the present day

The image is a composite showing various satellite data sources and a land use interpretation interface. On the left, three satellite maps from Bing Maps are shown at different scales: 400 km, 75 km, and 5 km. The 400 km map shows a region in Southeast Asia with coordinates 4° S to 9° S and 144° E to 154° E. The 75 km map shows a similar region with coordinates 5.15° S to 6.15° S and 148.95° E to 150° E. The 5 km map shows a smaller area with coordinates 5.57° S to 5.64° S and 149.94° E to 150° E. In the center, a screenshot of Google Earth Pro shows a satellite view of a river valley with a yellow grid overlay. A sidebar on the left lists 20 data points with IDs and checkmarks. A pop-up window titled 'IPCC' shows a 'Land use' table with buttons for Forest, Cropland, Grassland, Settlement, Other Land, and Wet Land. Below this are sections for 'Land use Category interpretation accuracy' and 'Land use conversion' with buttons for 'Yes' and 'No'. On the right, a large satellite image from Here Maps shows a dense forest landscape with a mountain in the background.

Bing maps

Google Earth

Here maps



# ❖ Vegetation cover rate; ❖ Infrastructure cover rate; ❖ Vegetation monitoring...

[Elements\(A\)](#) [Elements\(B\)](#) [Elements\(C\)](#) [Impact](#) [Land Class](#)  
[FAO-FRA](#) [IPCC](#) [Remote Sensing Info](#)

**Vegetation**

Vegetation type	Vegetation cover
Tree	0%
Shrub	0%
Palm	0%
Bamboo	0%
Crop	0%

**Water bodies**

Water body	Water body cover
Lake	0%
River	0%

[Elements\(A\)](#) [Elements\(B\)](#) [Elements\(C\)](#) [Impact](#) [Land Class](#)  
[FAO-FRA](#) [IPCC](#) [Remote Sensing Info](#)

**Infrastructure**

Infrastructure elements	Infrastructure cover
House	0%
Other buildings	0%
Paved road	0%
Unpaved road	0%

**Other**

Other elements	Other elements cover
Rock	0%
Other bare soil	0%
Other elements	0%

[Elements\(A\)](#) [Elements\(B\)](#) [Elements\(C\)](#) [Impact](#) [Land Class](#)  
[FAO-FRA](#) [IPCC](#) [Remote Sensing Info](#)

**Desertification / Greening trend**

[Desertification](#) [None](#)

[Greening](#)

**Disturbances**

**Disturbance**

<a href="#">Logging</a>	<a href="#">Fire</a>
<a href="#">Grazing</a>	<a href="#">Mining</a>
<a href="#">Garden</a>	<a href="#">Fishing</a>
<a href="#">Other</a>	<a href="#">None</a>

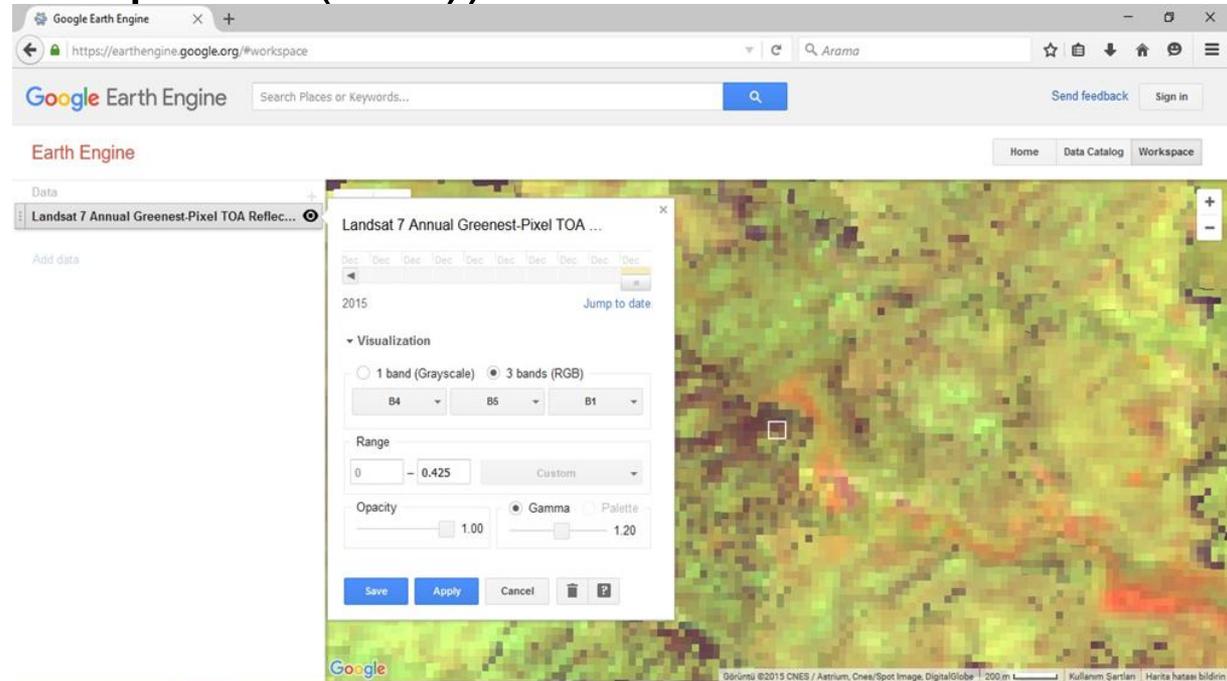
# Other data sources related Collect Earth...

## Google Earth Engine Data



...to make the right decision for analyst

- Data catalog (contains 40 years satellite images )
- Land use classification data using Landsat archive (corrected Top of Atmosphere (ToA))

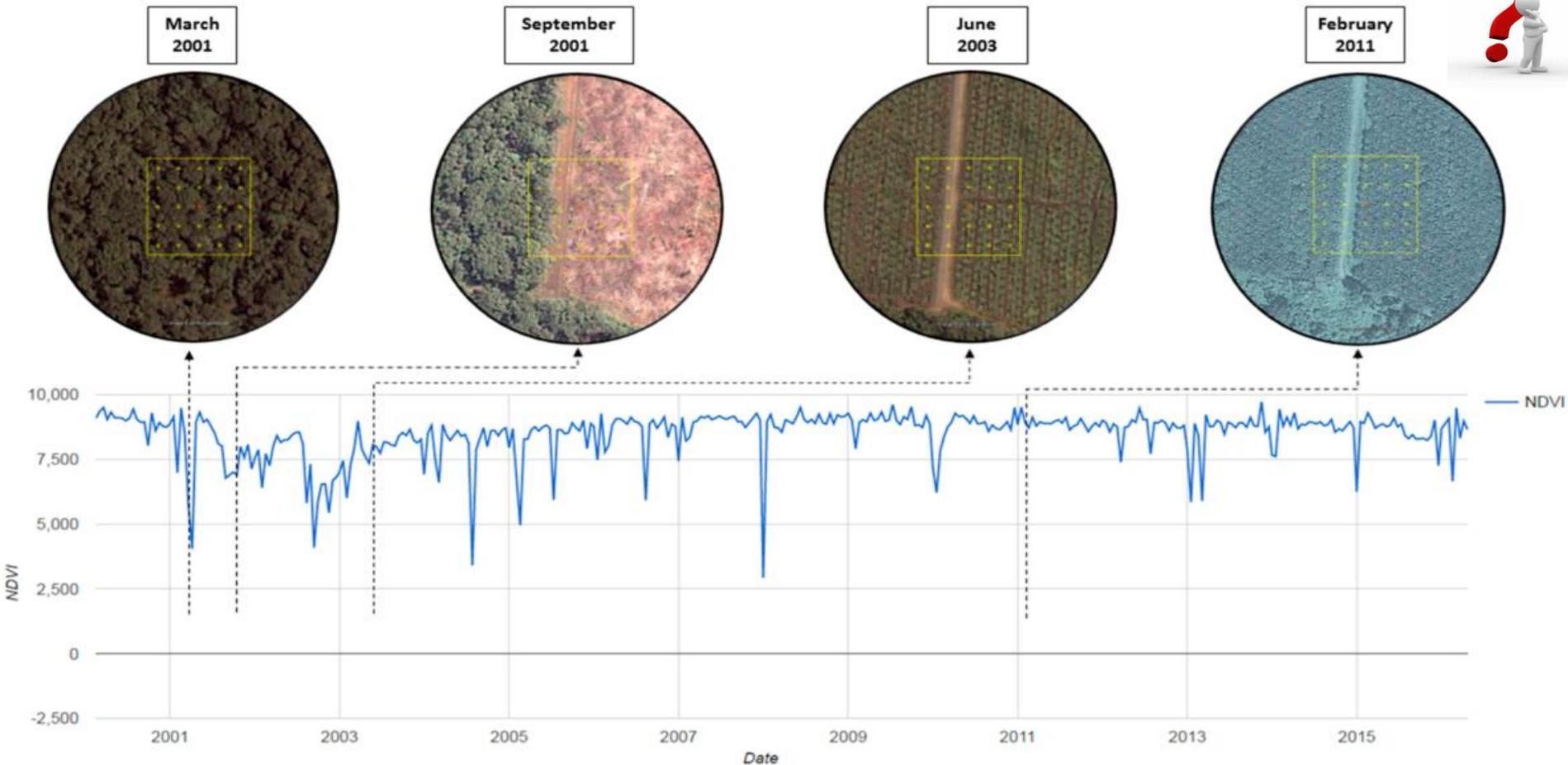


# Other data sources related Collect Earth...



## Earth Engine Playground

- Normalized Difference Vegetation Index (NDVI)
- Normalized Difference Water Index (NDWI)  
...Landsat, Modis produced (months and years)



### Desertification / Greening trend

Desertification  None

Greening

#### Disturbances

#### Disturbance

Logging  Fire

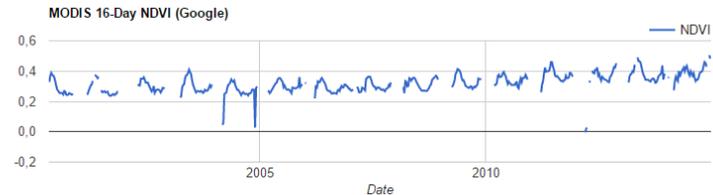
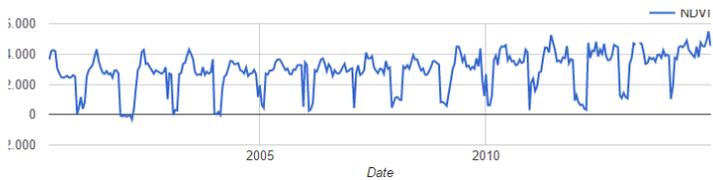
Grazing  Mining

Garden  Fishing

Other  None



# IMPACT; “gains” and “losses”



“gains”



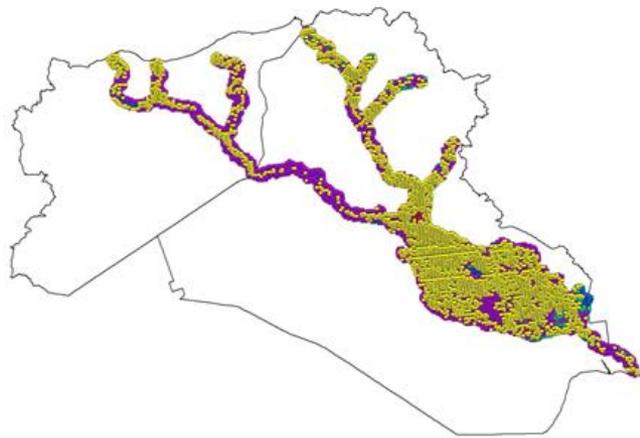
“losses”



❖ Total 8150 plot area...

700000 900000 1100000 1300000 1500000 1700000 1900000 2100000

## Land cover/use classification map (IPCC)



### Lejant

- Agriculture
- Other
- Grassland
- Waterland
- Settlement
- Forest

0 62.5 125 250 375 500 Kilometers

700000 900000 1100000 1300000 1500000 1700000 1900000 2100000

**Total study area: 111386.87 km<sup>2</sup>**

**Agriculture area: 59711.27 km<sup>2</sup> (%53.6)**

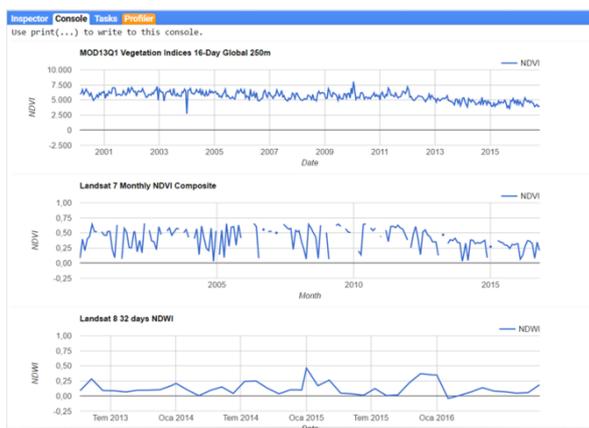
**Other area\*: 38372.55 km<sup>2</sup>**

**Grassland area: 8348.69 km<sup>2</sup>**

**Settlement area: 3577.65 km<sup>2</sup>**

**Forest area: 1376.71 km<sup>2</sup>**

**\*Other area = Bare soil (sand or dune)**



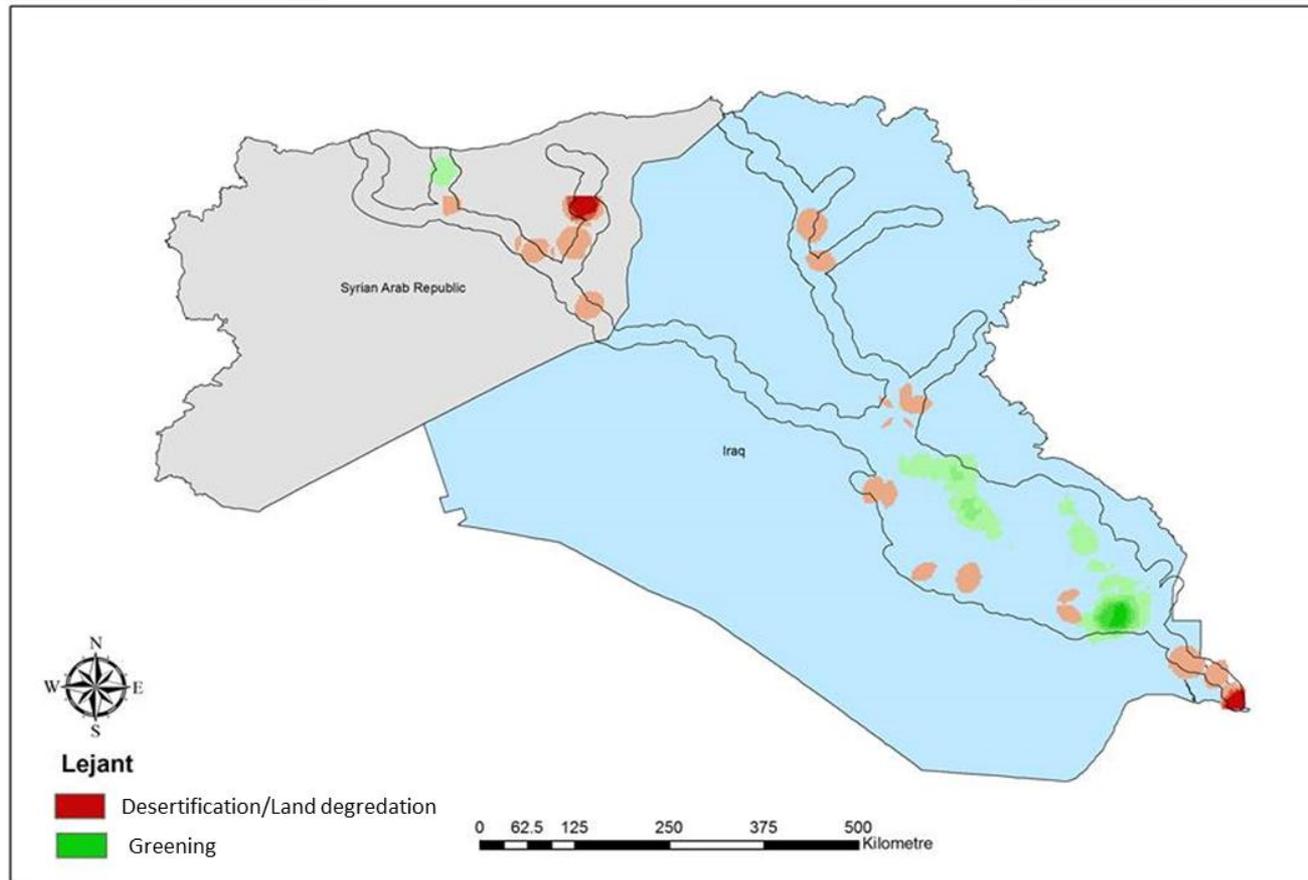
<b><i>Desertification/Land Degradation_Greening Trends</i></b>	<b>Area (km2)</b>	<b>%</b>
<b>Greening</b>	<b>1937.49</b>	<b>1.74</b>
<b>Desertification/Land degradation</b>	<b>731.49</b>	<b>0.66</b>

<b><i>Desertification/Land Degradation_Greening Trends</i></b>	<b>Country</b>	<b>Area (km2)</b>	<b>% *</b>
<b>Greening</b>	Iraq	1826.36	1.64
	Syria	111.13	0.10
<b>Desertification/Land degradation</b>	Iraq	510.26	0.46
	Syria	221.23	0.20
<b>* According to study total area (111386.80 km2)</b>			

# Desertification/Land degradation



# Greening



Area (ha)

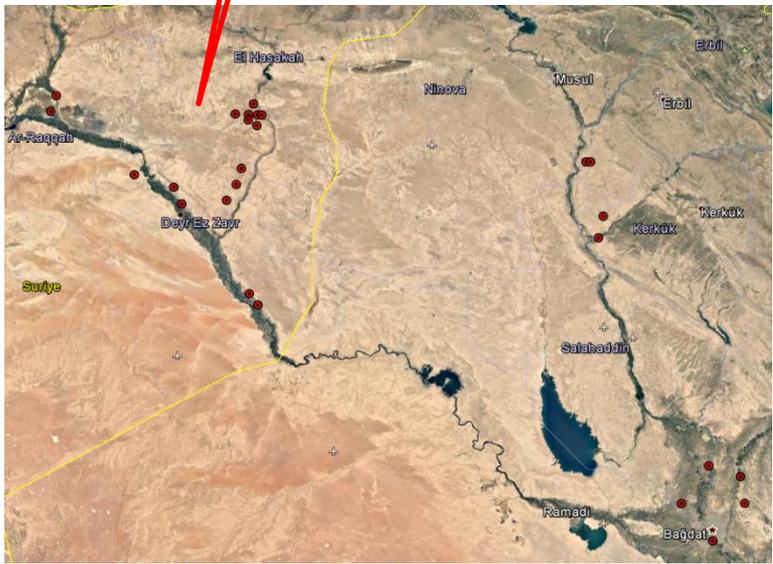
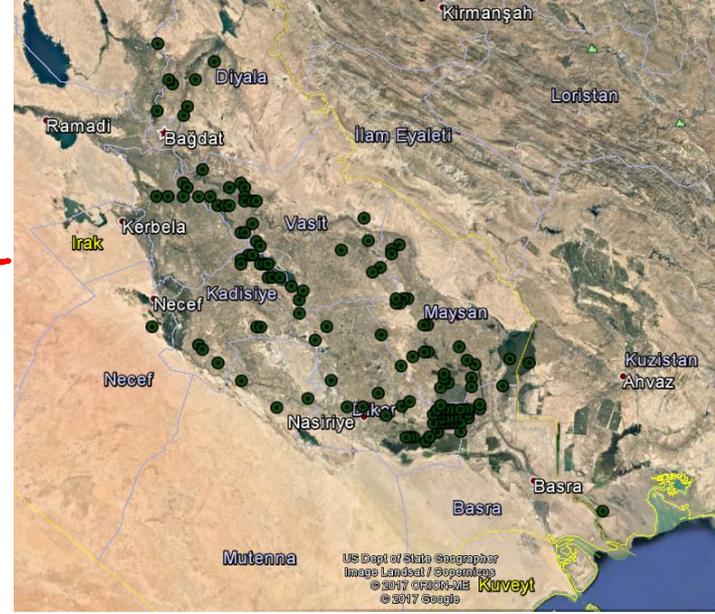
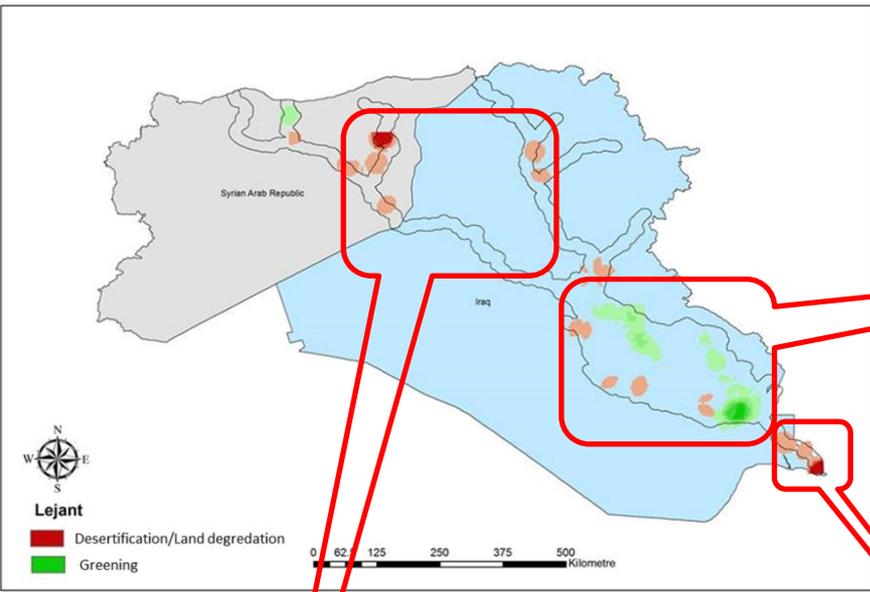
Trend	Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL	
Greening	Iraq	1379.00	8274.00	20686.00	17928.00	6895.00	6895.00	2758.00	9654.00	11033.00	9654.00	20686.00	34474.00	24823.00	6895.00	182036.00	193749.00
	Syria				1301.00	3904.00		2603.00	2603.00		1301.00					11713.00	
Desertification/Land degradation	Iraq	1379.00	4137.00	6895.00	1379.00	2758.00	4137.00	6895.00	15170.00	2757.00	4137.00		1379.00			51025.00	73149.00
	Syria		2.603.00	2.603.00	3.904.00	2.603.00	5.206.00	1.301.00		1.301.00		1.301.00	1.301.00			22.124.00	

## GREENING

Previous land use	Current land use	Country	Land use sub-category	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
				Area (ha)														
Agriculture	Agriculture	Iraq	Irrigable Farming		4137.0	6895.0	1379.00	1379.00	2758.00	2758.00	8274.00	8274.00	9654.00	13791.00	24823.00	19307.00	4137.00	
			Orchard		1379.0													
		Syria	Irrigable Farming				1301.00	3904.00		1301.00	2603.00		1301.00					
Other	Shrubland	Iraq	Shrubland			1379.0	1379.00		1379.00					1379.00	1379.00		1379.00	
	Agriculture		Irrigable Farming													1379		
	Other	Syria	Sand						2758.00			1379.00		1379.00		4137.00	1379.00	
			Sand							1301.00								
Grassland	Grassland	Iraq	Grassland		1379.0	8274.0	12412.0	2758.00			1379.00	1379.00		2758.00	5516.00			
			Grassland														1379.00	
Waterland	Waterland	Iraq	Inorganic Soil											1379.00				
			Riparian Vegetation				2758.00											
			Peatlands	1379.0	1379.0	4137.0		2758.00										
Settlement	Settlement	Iraq	Village												1379.00			

## Desertification/Land degradation

Previous land use	Current land use	Country	Land use sub-category	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
				Area (ha)											
Forest	Grassland	Iraq	Grassland								1379.00				
Agriculture	Settlement	Iraq	Village							1379					
	Agriculture	Iraq	Irrigable Farming	1379.00		4137.00		1379.00	2758.00	1379.00	12412.00	2758.00	1379.00		
			Non-Irrigable Farming					1379							
		Syria	Irrigable Farming			1301.00	1301.00	2603.00	3904.00	1301.00		1301.00			1301.00
	Other	Iraq	Sand								1379.00				
Other	Settlement	Iraq	Village								1379.00				
			City								1379.00				
	Other	Iraq	Sand		4137.00	1379.00	1379.00			1379.00			2758.00		
	Syria	Sand		2603.00	1301.00	2603.00		1301.00					1301.00		
Grassland	Grassland	Iraq	Grassland						1379.00						1379.00
Settlement	Settlement	Iraq	Village			1379.00									



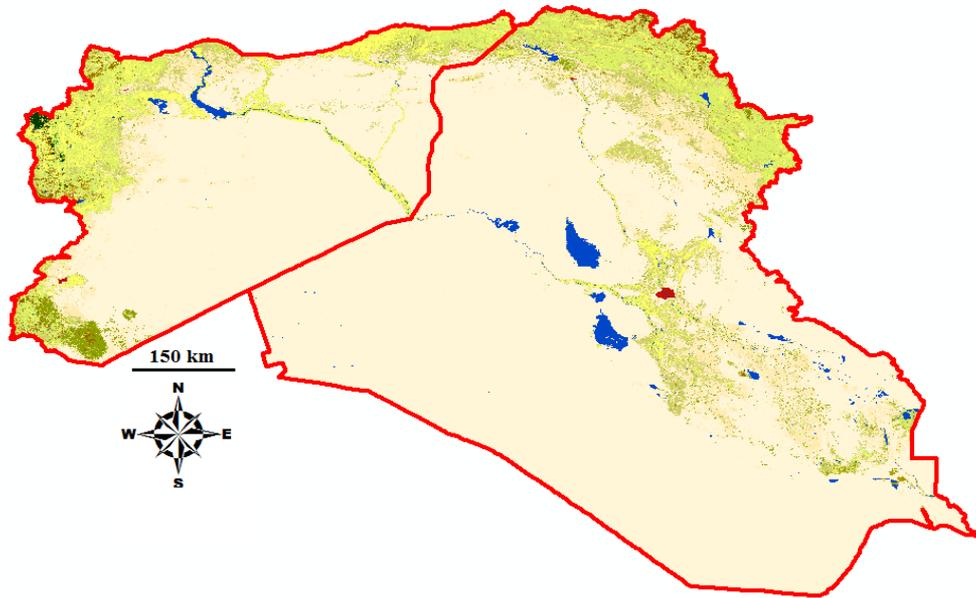


Middle East: ~15000 plot area(0.5 ha)

Iraq and Syria: total 3150 plot

### FAO forestry committee (COFO) drylands monitoring project 2014...

		Iraq	Syria
Desertification / Greening trend	Land class - Main	Area (ha)	Area (ha)
Greening	Forest	23304	15545
	Shrubland	23304	
	Grassland	240821	54294
	Settlement	15545	15545
	Cropland	295215	93170
	wetland	23304	
	Other	139821	23304
Desertification / land degradation	Forest	15545	
	Shrubland	46607	31090
	Grassland	248635	69938
	Settlement	46607	62152
	Cropland	233063	103180
	Other	2105296	994348



Value	GlobCover global legend	
11	Post-flooding or irrigated croplands	
14	Rainfed croplands	
20	Mosaic Cropland (50-70%) / Vegetation (grassland, shrubland, forest) (20-50%)	
30	Mosaic Vegetation (grassland, shrubland, forest) (50-70%) / Cropland (20-50%)	
40	Closed to open (>15%) broadleaved evergreen and/or semi-deciduous forest (>5m)	
50	Closed (>40%) broadleaved deciduous forest (>5m)	
60	Open (15-40%) broadleaved deciduous forest (>5m)	
70	Closed (>40%) needleleaved evergreen forest (>5m)	
90	Open (15-40%) needleleaved deciduous or evergreen forest (>5m)	
100	Closed to open (>15%) mixed broadleaved and needleleaved forest (>5m)	
110	Mosaic Forest/Shrubland (50-70%) / Grassland (20-50%)	
120	Mosaic Grassland (50-70%) / Forest/Shrubland (20-50%)	
130	Closed to open (>15%) shrubland (<5m)	
140	Closed to open (>15%) grassland	
150	Sparse (>15%) vegetation (woody vegetation, shrubs, grassland)	
160	Closed (>40%) broadleaved forest regularly flooded - Fresh water	
170	Closed (>40%) broadleaved semi-deciduous and/or evergreen forest regularly flooded - Saline water	
180	Closed to open (>15%) vegetation (grassland, shrubland, woody vegetation) on regularly flooded or waterlogged soil - Fresh, brackish or saline water	
190	Artificial surfaces and associated areas (urban areas >50%)	
200	Bare areas	
210	Water bodies	
220	Permanent snow and ice	

Tablo 1. Middle East water bodies\*

Country	Area (km <sup>2</sup> )
Turkey	11692
Iraq	5435
Syria	1303

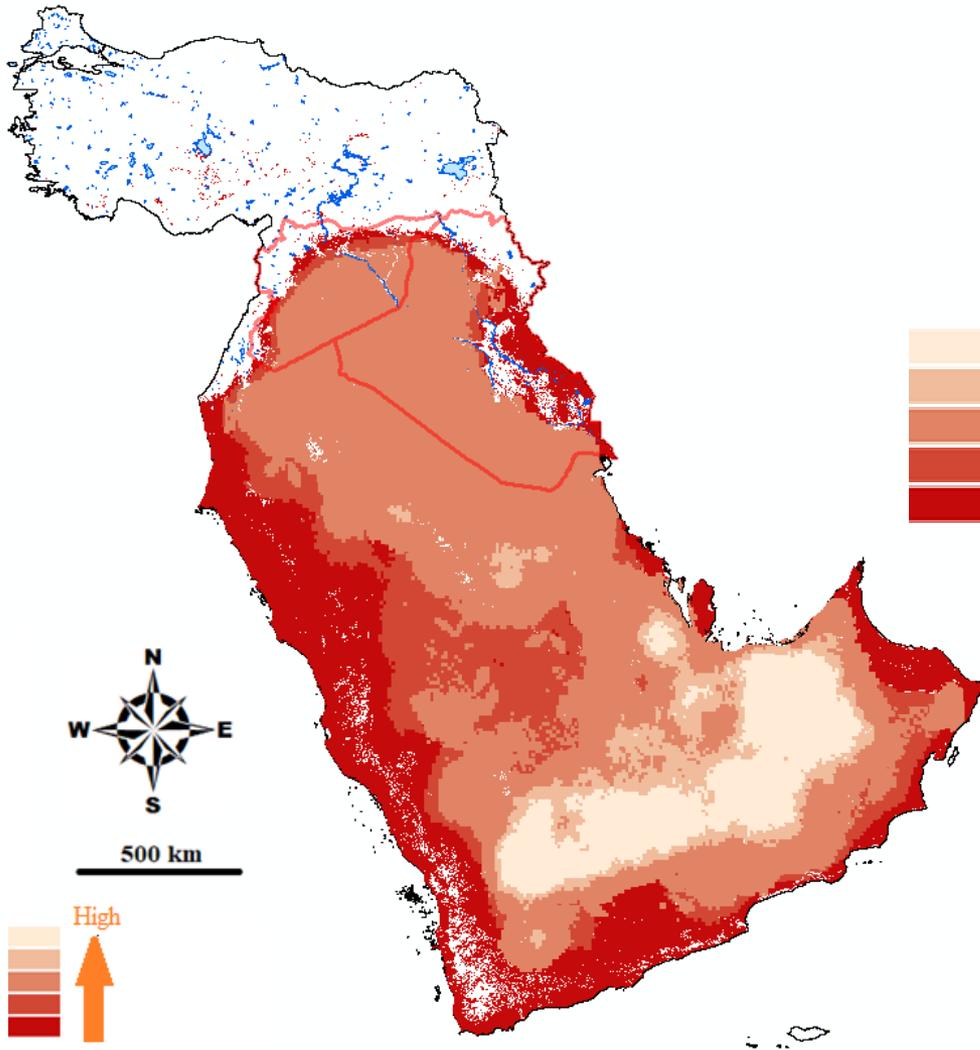
Tablo 2. Middle East agriculture area\*

Country	Area (km <sup>2</sup> )
Turkey	459482
Iraq	48680
Syria	41975

\*Global Land CoverMap, ESA; 2009



~15000 plot area (0.5 ha)

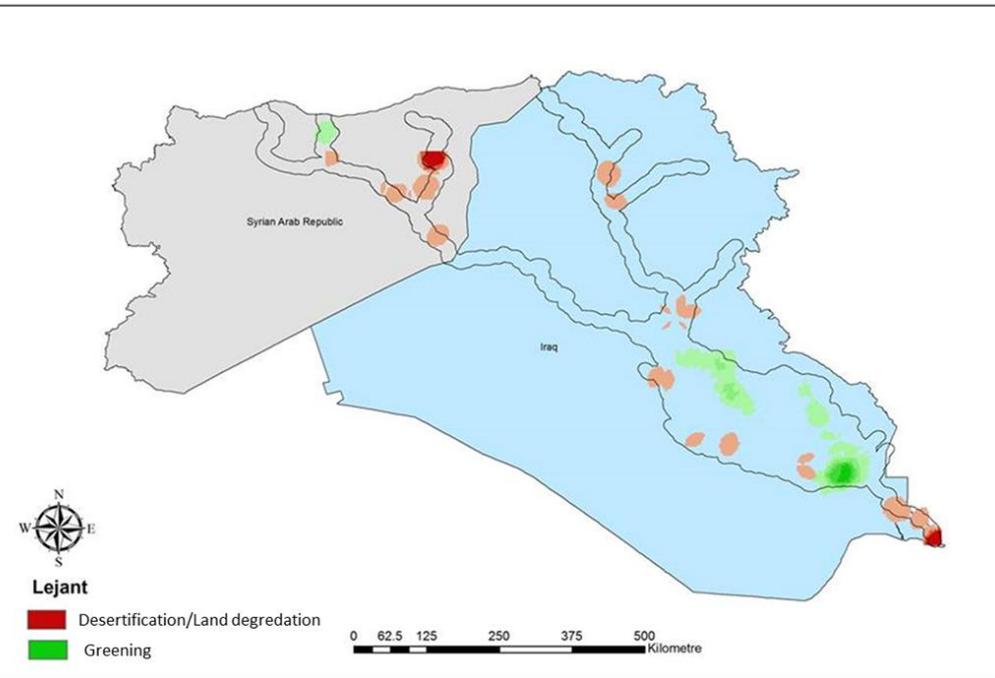


Sand/Dune sources risk level	Alan (km <sup>2</sup> )
Level 1 (high)	341865.00
Level 2	230020.00
Level 3	1607398.00
Level 4	390889.00
Level 5 (low)	765707.00
<b>TOTAL</b>	<b>3335879.00</b>

<i>Sand/Dune sources risk level</i>	<i>County</i>	<i>Area (km<sup>2</sup>)</i>	<i>Sand/Dune sources risk level</i>	<i>County</i>	<i>Area (km<sup>2</sup>)</i>	
Level 1 (high)	Oman	22 673.00	Level 4	Iraq	12 160.00 (%2.7)*	
	Saudi Arabia	254 000.00		Israil	1 214.00	
	United Arab Emirates	34 931.00		Jordan	9 915.00	
	Yemen	30 261.00		Kuveyt	488.00	
Level 2	Oman	24 655.00		Lebanon	32.00	
	Saudi Arabia	164 947.00		Oman	44 403.00	
	United Arab Emirates	15 510.00		Palestina	430.00	
	Yemen	24 908.00		Qatar	1.00	
Level 3	Bahrain	483.00		Saudi Arabia	280 990.00	
	Iraq	283 185.00 (%63.6)*		Syria	18 564.00 (%9.8)*	
	Israil	1 295.00		Yemen	22 691.00	
	Jordan	65 419.00		Level 5 (low)	Bahrain	51.00
	Kuveyt	15 950.00			Iraq	68 831.00 (%15.0)*
	Oman	145 111.00			Israel	10 016.00
	Palestina	46.00			Jordan	11 347.00
	Qatar	1 886.00			Kuveyt	27.00
	Saudi Arabia	832 815.00	Lebanon		915.00	
	Syria	101 151.00 (%53.7)*	Oman		78 507.00	
	United Arab Emirates	22 787.00	Palestina		1 638.00	
	Yemen	137 271.00	Qatar		9 487.00	
			Saudi Arabia		359 153.00	
		Syria	16 828.00 (%.8.9)*			
		Turkey	6 443.00			
		United Arab Emirates	6 074.00			
		Yemen	196 390.00			
		TOPLAM	3 335 879.00			
		* % by total area of the country				

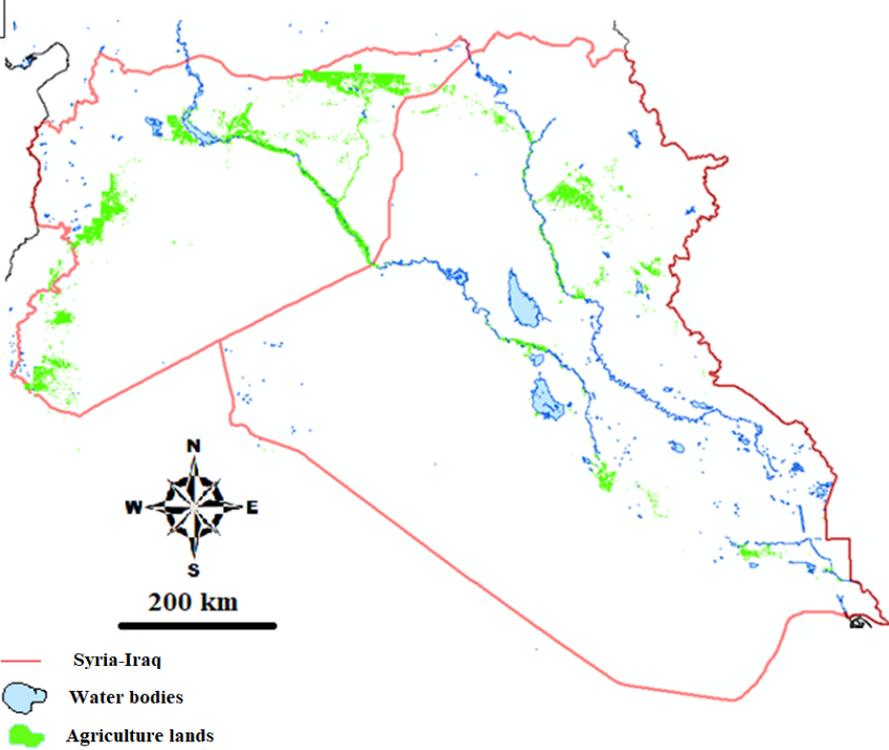
66.04 % of the total area of Iraq;

53.32 % of the total area of Syria are in the bare soil (sand/dune area)



The ratio of agricultural land within the sand/dune resources region to total agricultural areas in Iraq and Syria;

Syria: 25.90% (10873.00 km<sup>2</sup>)  
 Iraq: 10.50% (5110.00 km<sup>2</sup>)





# Thank



تعرف إمري ماروف مخالفات، أنيل منكر  
...iyiliği emret kötülükten alıkoy...



Assoc. Prof. Ayhan ATEŞOĞLU  
aatesoglu@yahoo.com