Global Croplands Project

Remote Sensing of Global Croplands and their Water Use for Food Security in the Twenty-first Century

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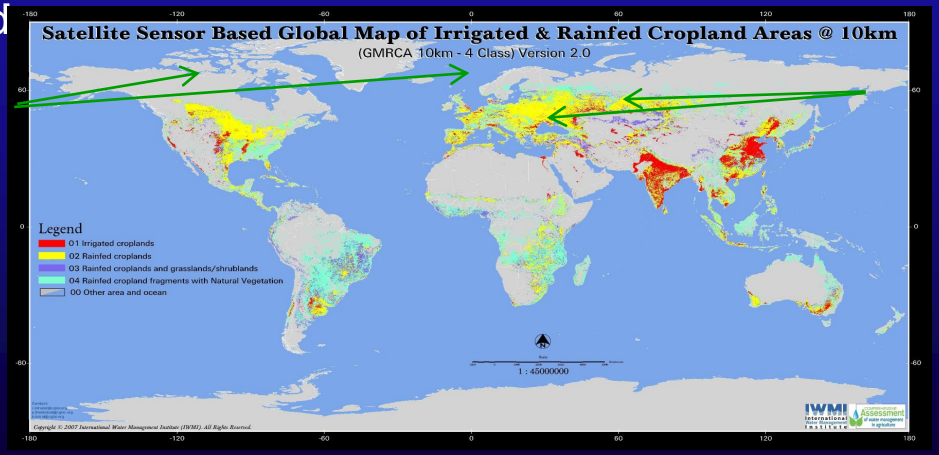
Global Croplands Project - Agricultural Monitoring System Importance, Need, and Scope

1. **Croplands:**
    1. Need rapid and repeatable mapping of croplands using an automated algorithm which incorporates multiple remote sensing data sources & fusion methods;
        1. Frequent (e.g. yearly and seasonal update of agricultural statistics
        2. Spatial view of croplands distribution and their changes over space & time
        3. Accuracy of the algorithm depends on in-situ knowledge of croplands

2. **Water use by croplands:**
    Helps us determine blue water use and green water use accurately;

3. **Food security:**
    If we can achieve 1 and 2 we can make significant contribution towards a food secure world

Green water use: water used by rainfed cropland areas coming from precipitation and soil moisture stored in unsaturated zone



Blue water use: water used by irrigated areas coming from reservoirs, lakes, rivers, deep aquifer water, and direct rainfall over irrigated areas

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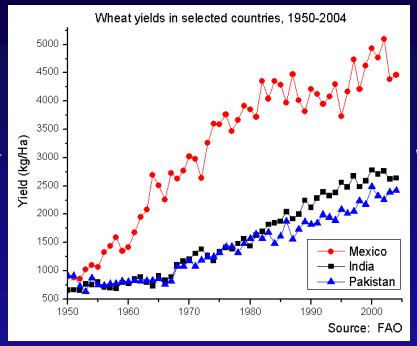
Croplands: 1.53 billion hectares (yr: 2000)

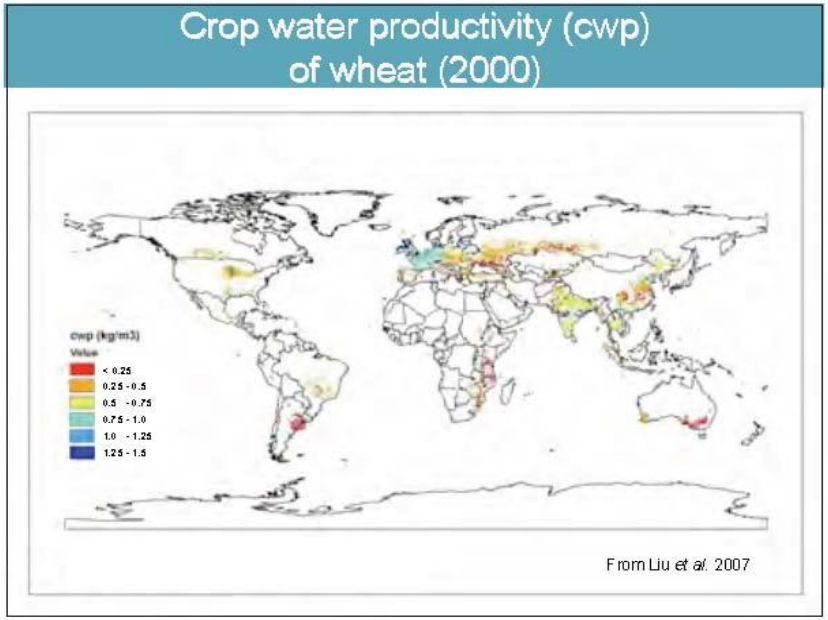
Green Revolution versus Blue Revolution

Green revolution: the focus was on increasing productivity per unit of land (kg\m^2)



Wheat yield not increasing

Blue revolution: the focus is on increasing productivity per unit of water (kg\m^3)



There is tremendous opportunity to increase water productivity of croplands in much of the World's croplands

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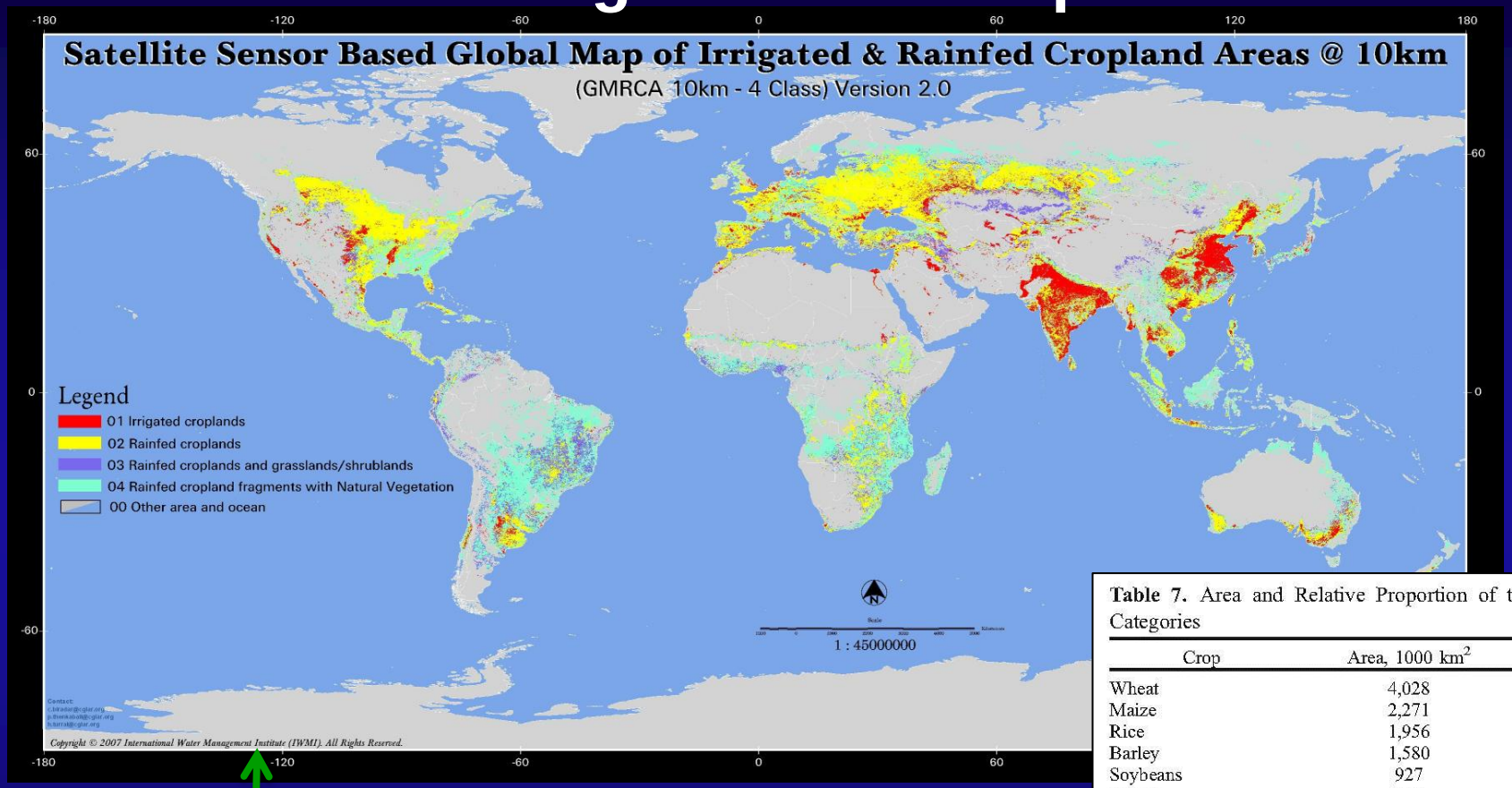
Role of Remote Sensing
To Monitor Agricultural Cropland in GCP



Focus on global mapping irrigated and rainfed croplands and computing their blue water and green water use

18 crops occupy 85% of all global cropland areas…..so, we can focus on them

Table 7. Area and Relative Proportion of the 18 Major Crop Categories

Crop	Area, 1000 km^2	Relative Fraction, %
Wheat	4,028	22
Maize	2,271	13
Rice	1,956	11
Barley	1,580	9
Soybeans	927	5
Pulses	794	4
Cotton	534	3
Potatoes	501	3
Sorghum	501	3
Millet	331	2
Sunflower	290	2
Rye	288	2
Rapeseed/canola	283	2
Sugar cane	265	1
Groundnuts/peanuts	247	1
Cassava	235	1
Sugar beets	154	1
Oil palm fruit	72	<1
Total of major 18 crops	*15,256*	*85*
Others	2664	15
Total cropland	*17,920*	*100*

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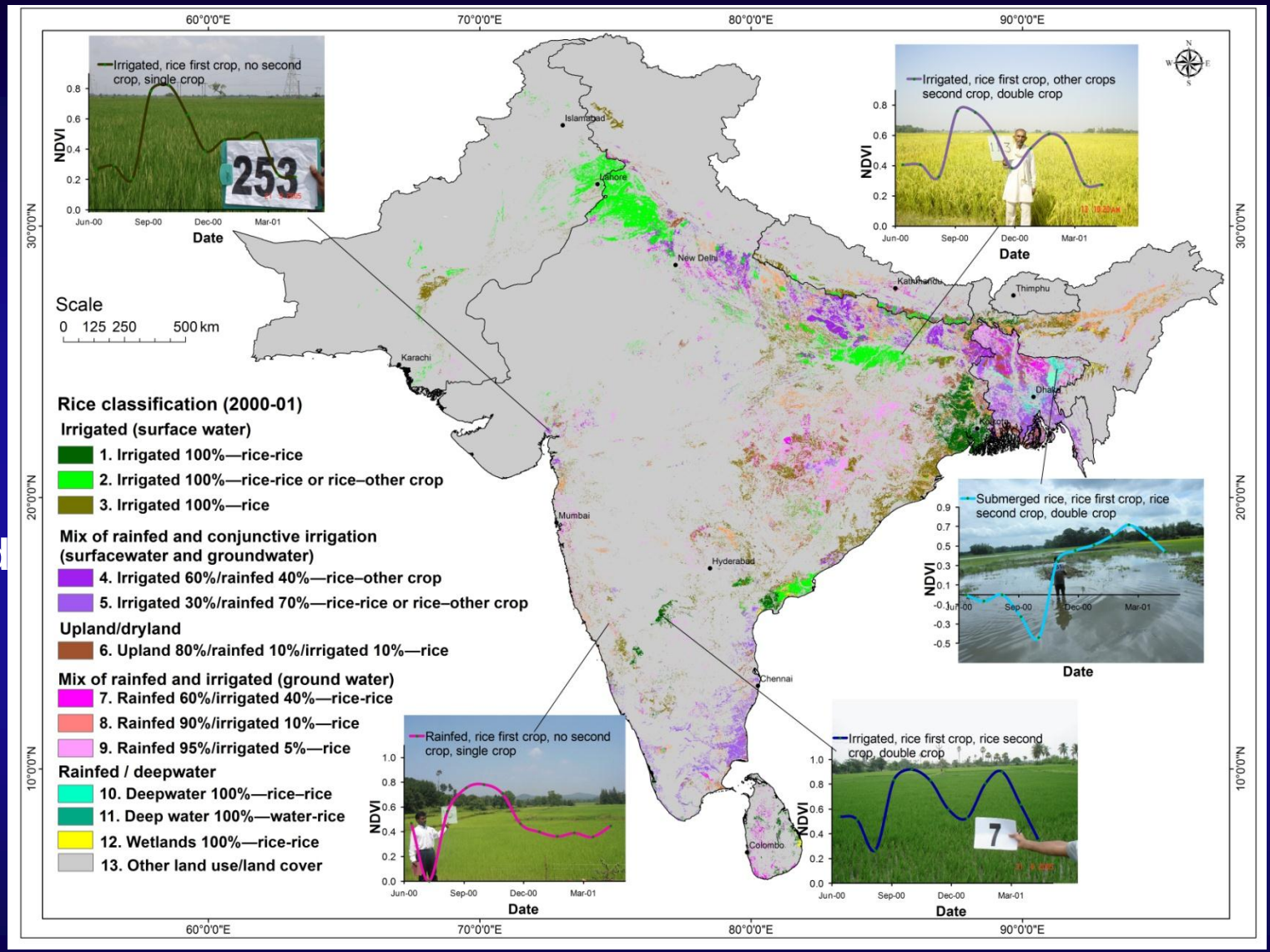
Global Croplands Project - Agricultural Monitoring System

Focus on individual crops of great significance for Food and Water Security



Way Forward: MODIS 500 m time-series data alone to map rice areas of South Asia was insufficient

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Opportunities for Increased Crop Water Productivity ("crop per drop")

To improve knowledge base of water productivity:

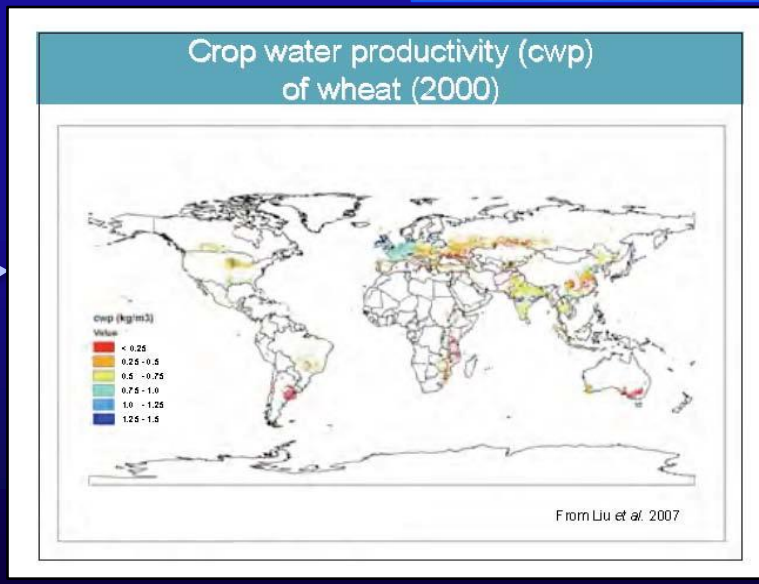
Apply: An innovative approach of water productivity (WP, productivity per unit of water) mapping using advanced remote sensing data (hyperspectral-hyperspatial-advanced multispectral) that "pin-points" climate-induced water loss and\or areas of poor cropland WP.

Which: Will lead to informed application of management practices and associated water savings (leading to "new water" banks) enhancing sustainable ecosystem services…

By: Selecting pilot studies where key World Crops are grown will pin-point the high and low water productivity and establish linkages between water, climate, and food that are critically important, both ecologically and economically.

$$WP\ (kg\backslash m3) = \frac{\text{Crop Productivity } (kg\backslash m^2)}{\text{Crop Water use } (m^3\backslash m^2)}$$

WP is crop water productivity (kg/m3)/($/m3)
Crop Productivity in units of Biomass (kg/m2) or Yield (tonn/ha) or Value ($/ha)
Water use is seasonal actual ET (thousand m3/ha)



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Global Croplands Project
Agricultural Monitoring System

1. **Costs:**

Global agricultural cropland monitoring system

4.5 million over 5 years

2. **Timeline**

Global agricultural cropland monitoring system

5 years

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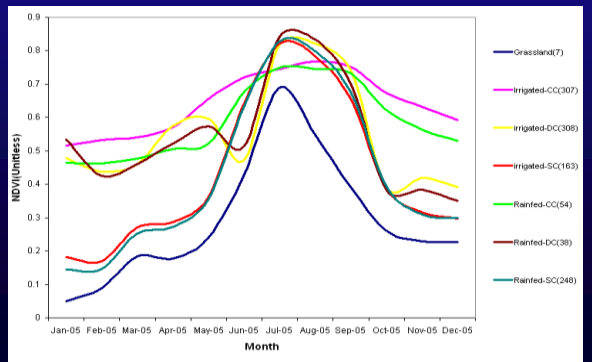
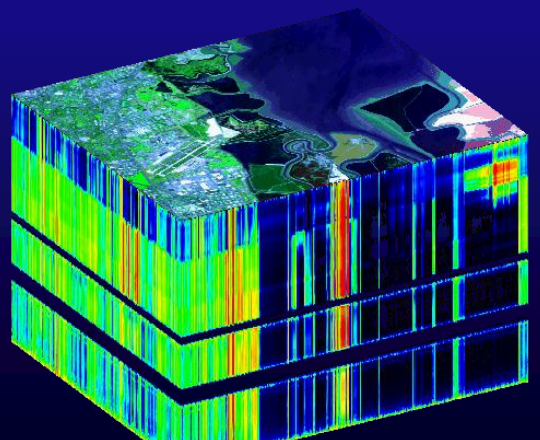
Challenges

1. Systematic Global Field-plot Data to support Remote sensing
2. Development of Automated Cropland Classification Algorithms
3. Multi Sensor Data Fusion
4. Knowledge Gaps in Understanding, Modeling, and Mapping Crop and Water Productivity
5. Need Very high resolution Data (< 5 m) to Resolve Fragmented Croplands





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Products and Outcome

1. Create a "knowledge warehouse of data and products" on global croplands and their water use;
2. Facilitate a "System for sharing algorithms , models, and maps" on global croplands and their water use;
3. Produce a "State of Art knowledge gateway through peer-review articles\special issues\books" on global croplands and their water use.

Contributing to global food security

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GCP in Agricultural Cropland Monitoring

- Framework of best practices of advanced geospatial information system on croplands and their water use.
- The system will be global, consistent across nations and regions by providing information such as:
  - (a) crop types,
  - (b) precise location of crops,
  - (c) cropping intensities (e.g., single crop, double crop),
  - (d) cropping calendar,
  - (e) crop health\vigor,
  - (f) watering methods (e.g., irrigated, supplemental irrigated, rainfed),
  - (g) flood and drought information,
  - (h) water use assessments, and
  - (i) yield or productivity (expressed per unit of land and\or unit of water).
- Using Landsat, Resourcesat, MODIS, and national statistics, field data, topography, and precipitation data.

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Books

Hyperspectral Remote Sensing of Vegetation (Taylor and Francis\CRC press)

Remote Sensing of Global Croplands for Food Security (Taylor and Francis\CRC press)