CHINA COUNTRY STRATEGY FOR IRRIGATION

Water Scarcity and Food Security

1. Overview of China's Water Scarcity
2. Impact of Water Scarcity on Food Security
3. Irrigation Strategies to Ensure Food Security
4. Outcomes from a Project Case Study

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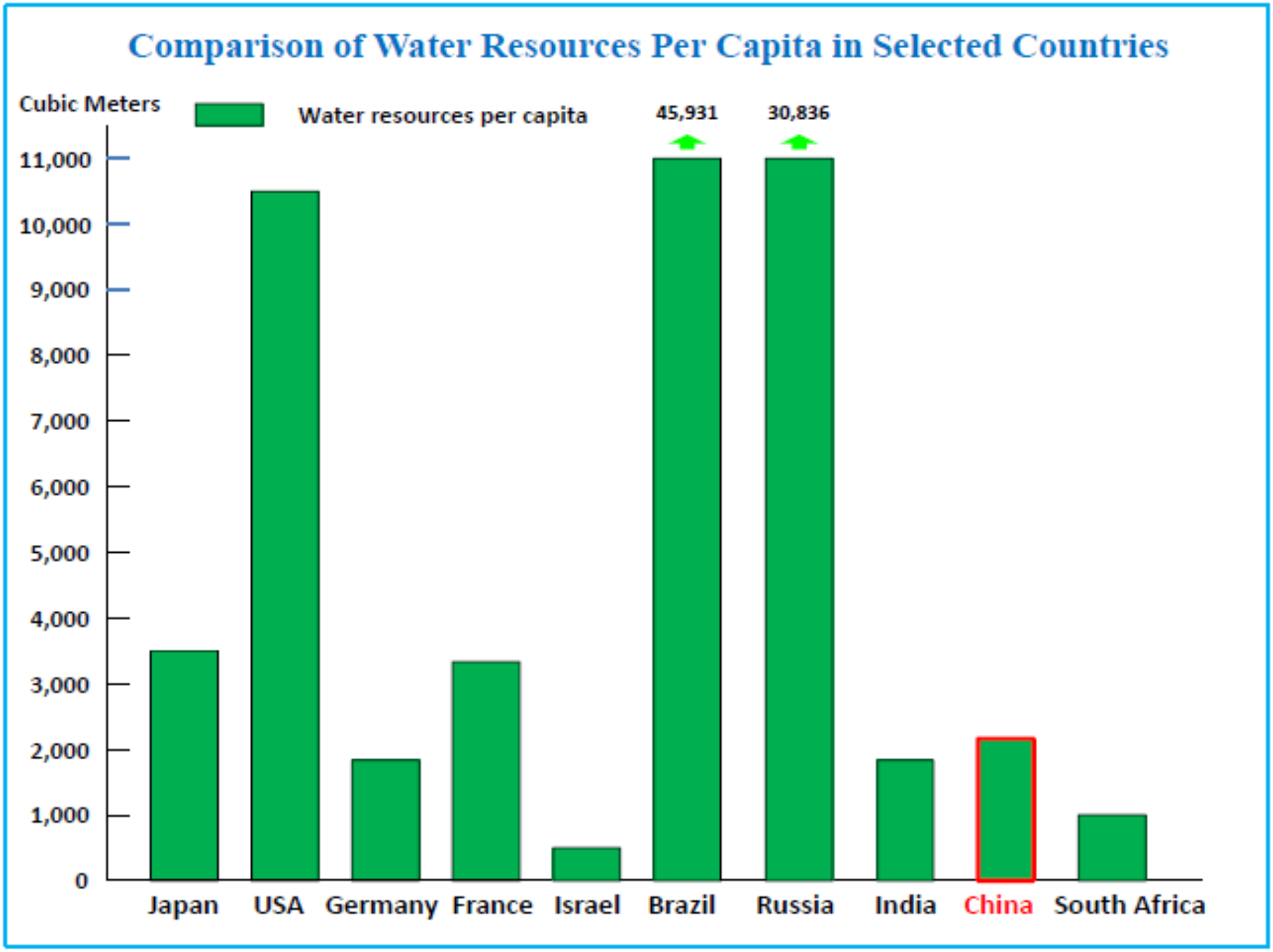
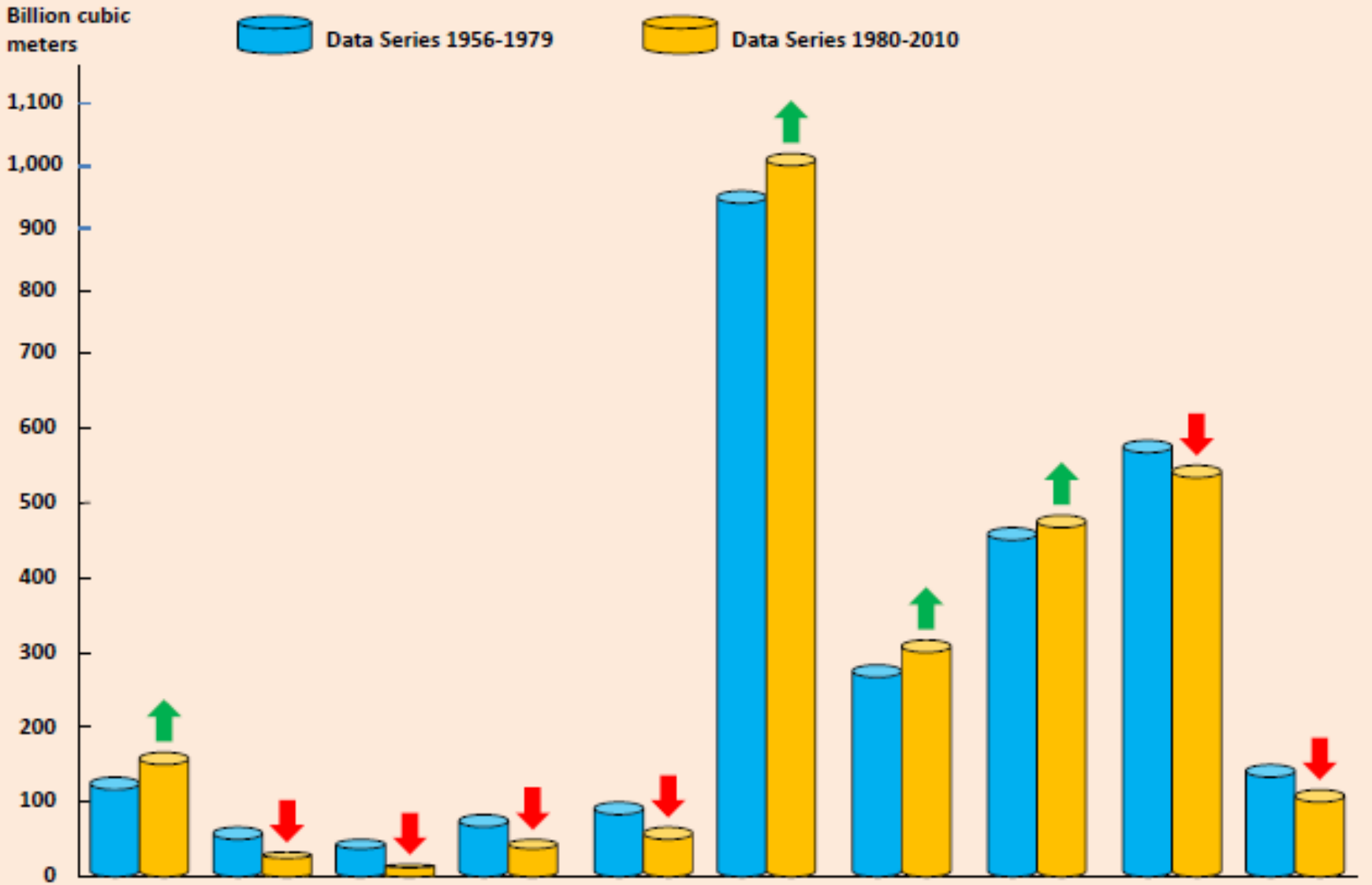
Distribution of Water Resources in China


Comparison of Water Resources Per Capita in Selected Countries
Cubic Meters
Water resources per capita
45,931
30,836
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Japan
USA
Germany
France
Israel
Brazil
Russia
India
China
South Africa

Impact of Climate Change on Water Availability in China's Large River Basins



Background Information on China's Irrigation

f Water on Food Security

- ***China's total effective irrigation areas account for 48% of the total arable land, about 13% of the effective irrigation areas will be affected by drought due to inadequate or inefficient irrigation systems;***
- ***China's average irrigation efficiencies range from 30% to 50%, compared to 60 to 90% in some other countries. Low irrigation efficiency has resulted in low agriculture production in irrigated areas;***
- ***China's average water productivity in irrigated areas range from 0.6 to 1.0 kg per cubic meter of consumptive use of water, compared to 1.5 to 2.0 kg in some other countries. Low water productivity has resulted in waste of water in irrigated areas.***

China Country Strategies for Irrigation

Water on Food Security

Core:

To increase irrigation efficiencies by irrigated agricultural water savings !

Conventional approach to irrigated agricultural water savings

- *Increase water use efficiency with improved technologies to "save" water and then use "saved" water to expand irrigated area or other uses, e.g. urban water supply;*
- *Believe that it would save 30% of extra water resources if water use efficiency is raised by 30%.*
- *Two key indicators to evaluate effectiveness of water savings: (1) the improved irrigation efficiency and (2) the increased areas where improved irrigation technologies are applied.*


CHENGAN COUNTY (HEBEI) – CHINA
Using Sprinklers


CHENGAN COUNTY (HEBEI) CHINA
lining of canals and ditches

Problems on conventional approach

- *Case 1 from Turpan of Xinjiang: Improved water use efficiency makes 30% of reduction in water delivery from a reservoir. The reservoir supplied all "saved" water to other water users !*
- *Case 2 from Guantao of Hebei: Improved water use efficiency makes a village of farmers be able to irrigate more land. The village irrigated more land with "saved" water!*
- *Field observation showed that the above two cases consumed much more water than before, which contributed to serious overdraft of groundwater and degradation of ecosystems !*
- *The effective irrigated area in China has increased by about 8 million hectares during the past 30 years without largely increasing the total use or withdrawal of water, however, the annual overexploitation of groundwater has reached up to 22 billion cubic meters.*

Why does conventional approach contribute to more consumptive use of water and degradation of ecosystems?

- Water "saved" with conventional approach is not all lost: much of it returns to the aquifers below and keeps dynamic balance of groundwater storage;
- If "saved" water is used to irrigate more land or supplied to other water users, the consumptive use of water will greatly increase, which would result in more serious groundwater overdraft and ecosystem degradation;
- The field investigation showed wherever the conventional approach was used to save water in physical water scarcity areas, there must have been a serious over-exploitation of water resources and a serious degradation of ecosystems.

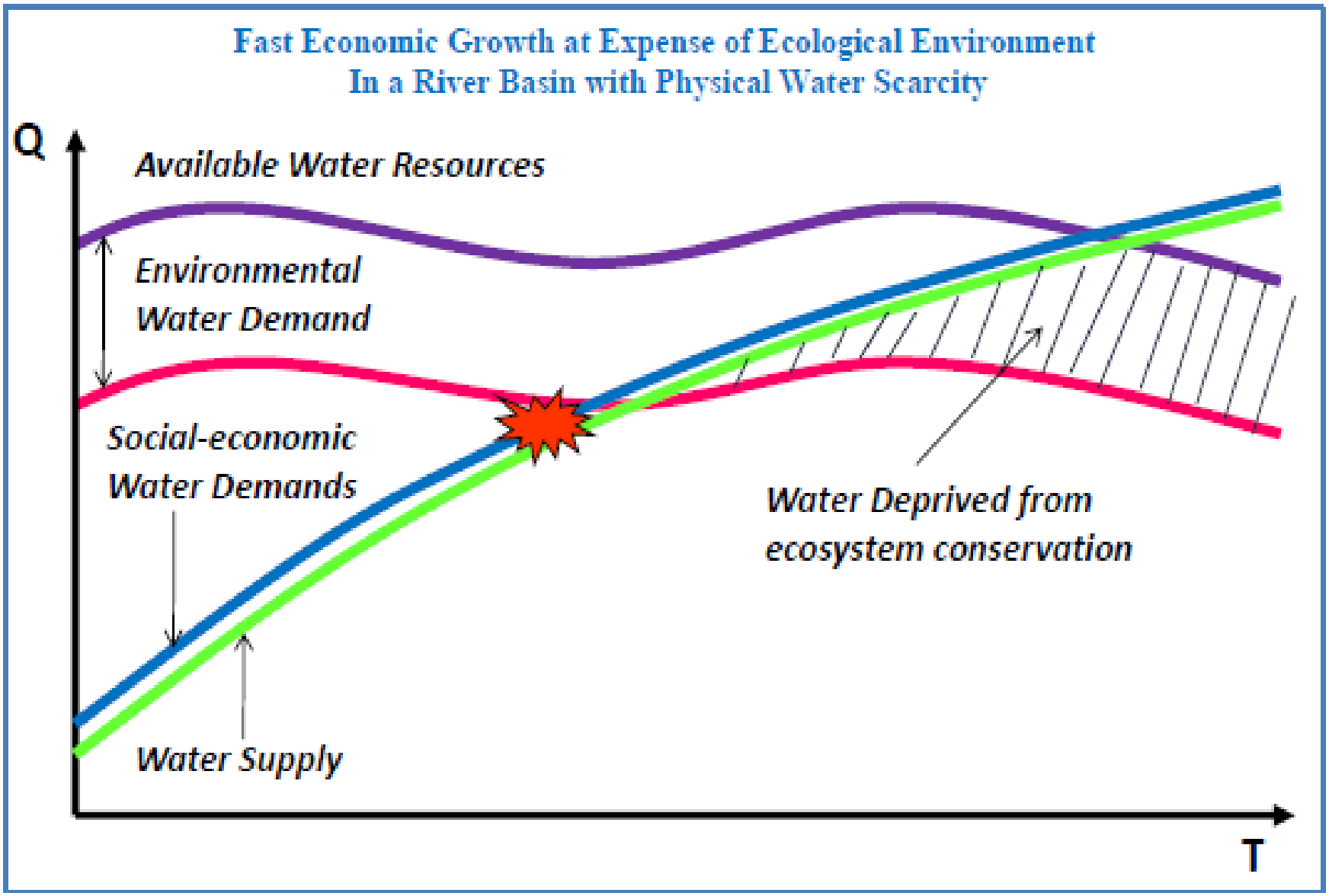
China's Strictest Water Resources Management

The core of the strictest water resources management system is to implement the "three red lines" established for water resources management:

1. ***The first red line is to control total amount of water use or withdrawal from rivers and groundwater aquifers without exceeding planned targets.***
2. ***The second red line is to increase water use efficiency to resolutely restrain waste of water; and***
3. ***The third red line is to strictly control the total amount of pollutant discharge into rivers, lakes or other water bodies, which should be determined by the assimilative capacity in water bodies to be consistent with the water function zone targets.***

Two Major Types of Water Scarcity in China

- ***Economic water scarcity area - where there are relatively abundant water resources and water scarcity occurs when there is a lack of investment in water infrastructure or a lack of human, institutional or financial capacity to satisfy demand; and***
- ***Physical water scarcity area - where surface and groundwater resources have already been overused and water scarcity occurs when there are insufficient water resources available to meet all water demands.***
- ***Question: What are strategies to ensure that food security is sustainable?***


Fast Economic Growth at Expense of Ecological Environment
In a River Basin with Physical Water Scarcity
Q
Available Water Resources
Environmental
Water Demand
Social-economic
Water Demands
Water Deprived from
ecosystem conservation
Water Supply
T

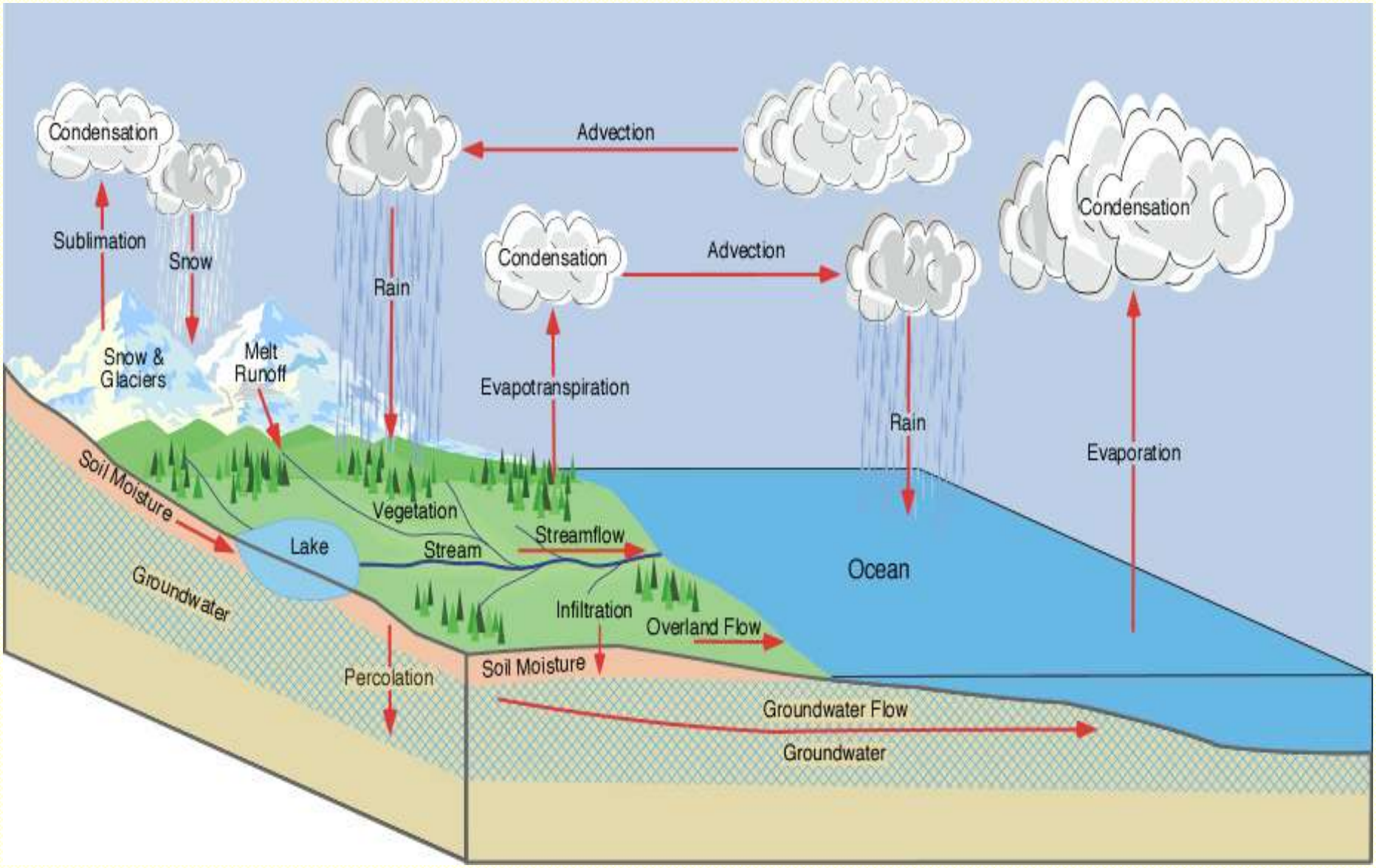
Different Strategies for Sustainable Food Security

- ***Strategy for economic water scarcity - to increase irrigation efficiency and expand irrigated areas for higher agricultural production, together with other measures.***
- ***Strategy for physical water scarcity - to increase water productivity for higher agricultural value per unit of evapotranspiration (ET), together with other measures.***
- ***Difference of strategies - the former is to consume more water for higher yield; the latter is to consume less water for higher productivity.***

Keys of the Strategy in Physical Scarcity Areas

- ***The only water truly lost in a hydrologic system is through Evapotranspiration or ET, which is water evaporated from water surface or transpired from plant leaves into the atmosphere;***
- ***ET is the real consumptive use of water since no one can make further use of it once it is in the atmosphere; and***
- ***Increase of irrigation efficiency in order to grow more crops over a wider irrigated area or to increase cropping intensity in the same irrigation area would raise the level of ET !***

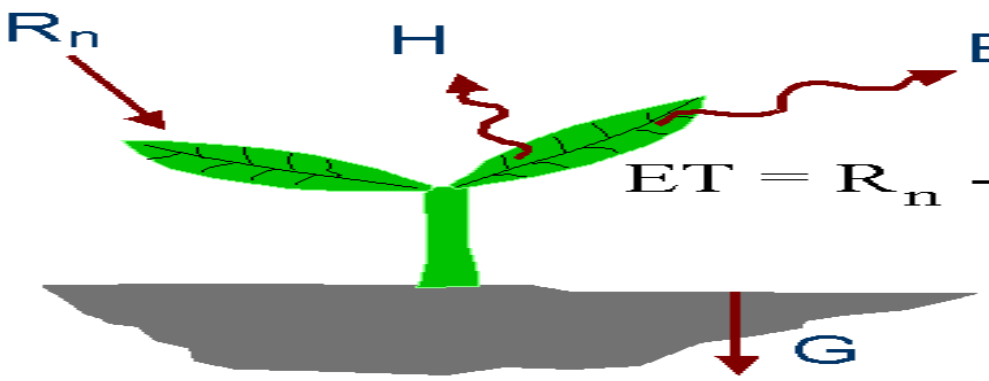
ET is the Only Water Truly Lost in a Hydrologic System !



How can we measure and monitor ET ?

- By the Latest Remote Sensing (RS) Technology, which is being developed very fast in China !
- Remote sensing by satellites can now provide ET readings for pixels of 30 by 30 meters with a good accuracy. This tells farmers how much water they can consume without adversely affecting the ecosystems around them.

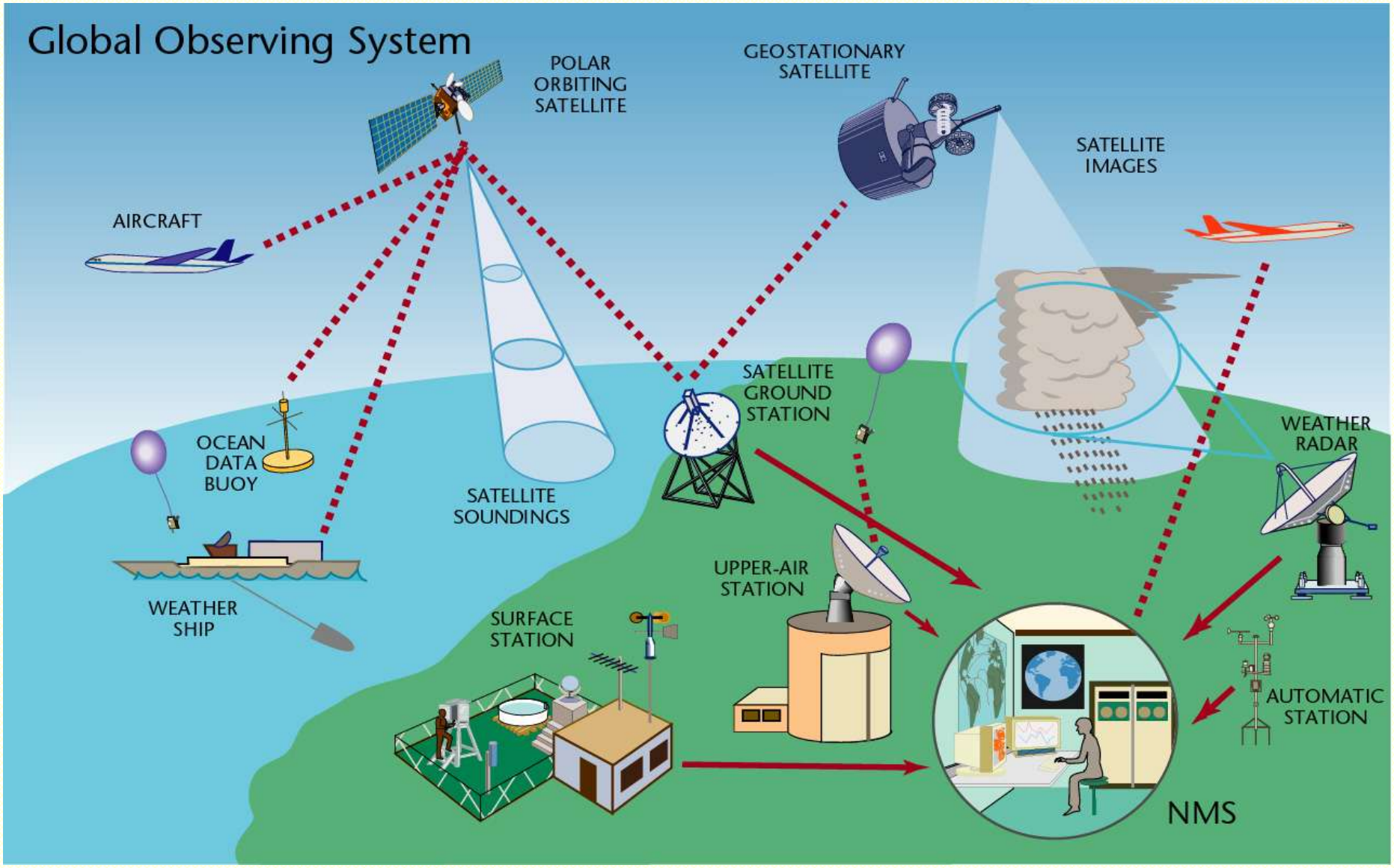
ET is calculated as a "residual" of the energy balance



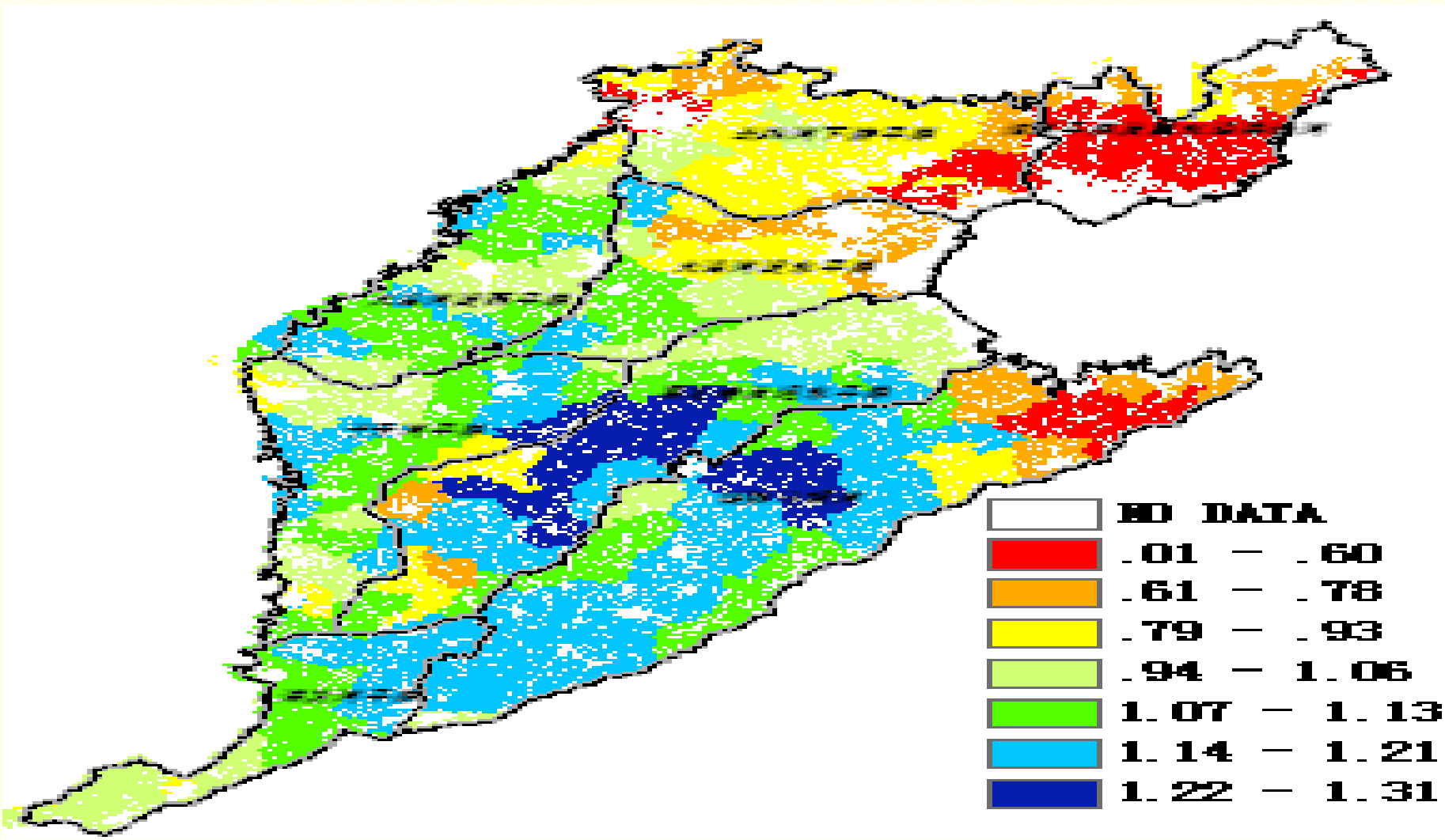
$$ET = R_n - G - H$$

The energy balance includes all major sources (R_n) and consumers (ET, G, H) of energy

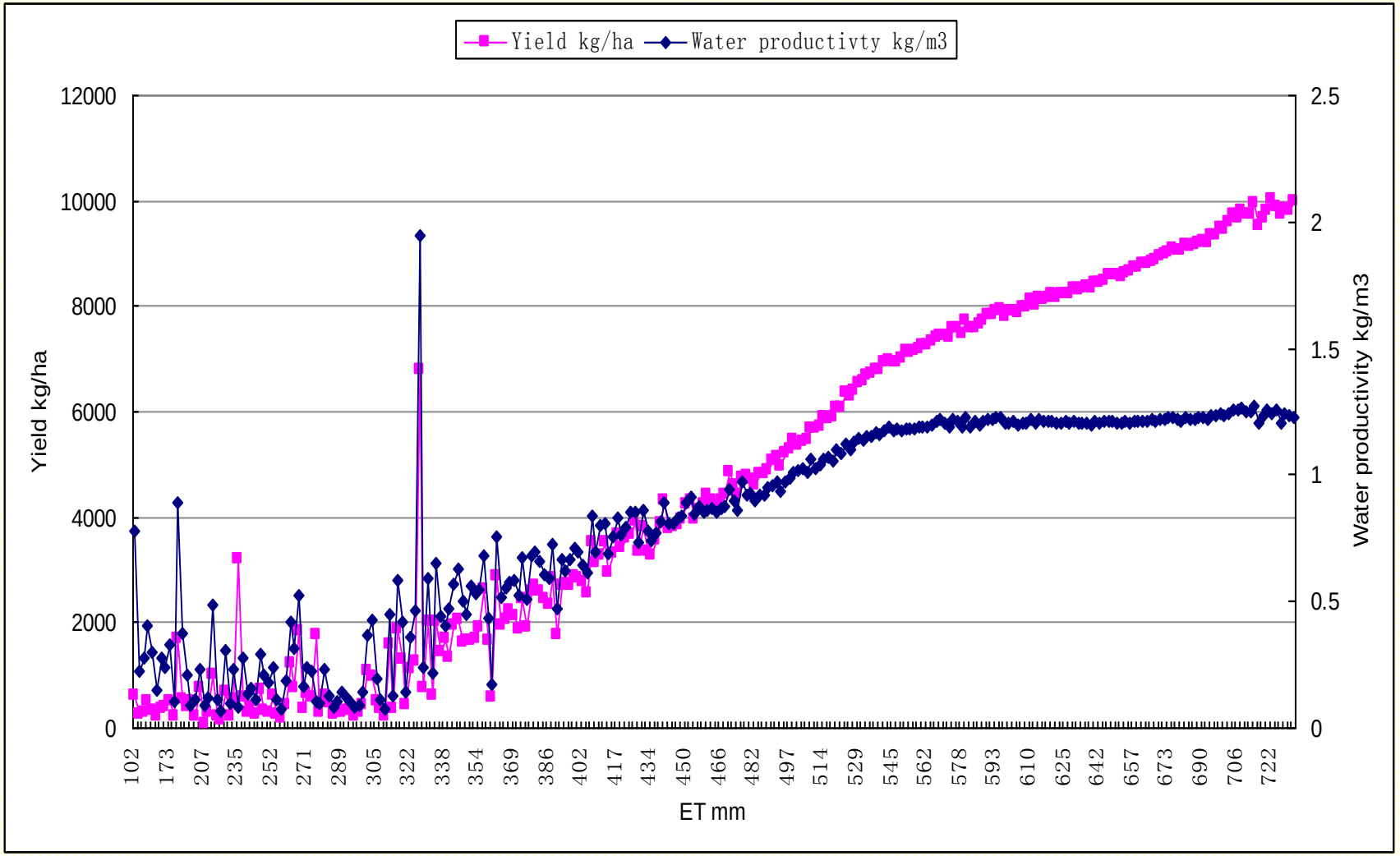
The Latest RS-based ET Measuring Technology



There has been potential to increase water productivity in the Hai Basin



Water productivity in Hai Basin – One of Key Grain Production Areas in China



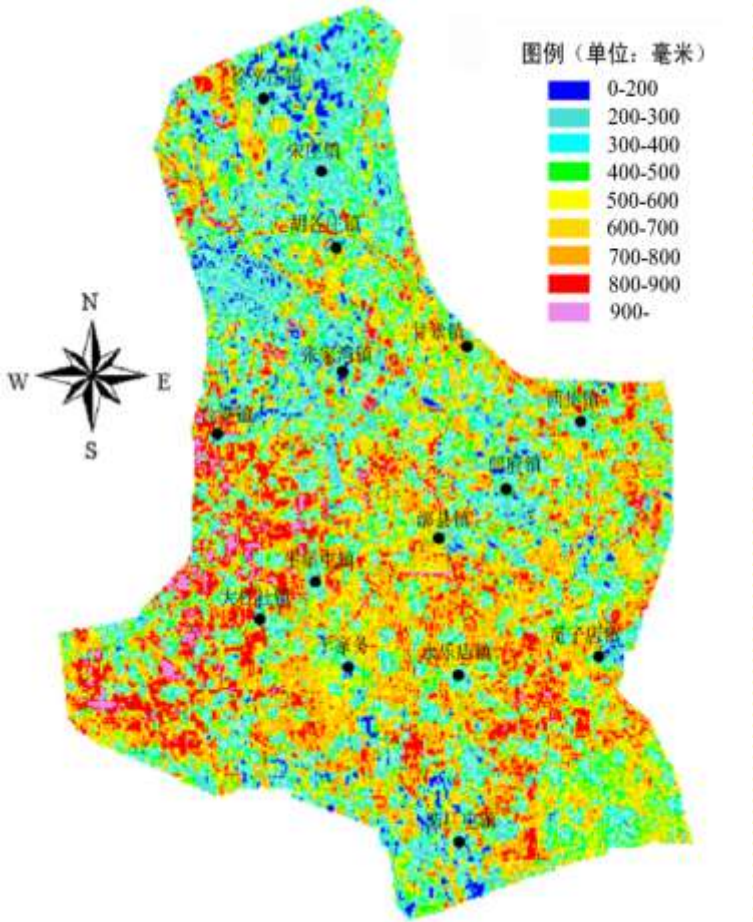
Case study on Water Conservation Project (2000-2006) in Physical Water Scarcity Areas

- The farmers' per capita income increased by 193 percent, while consumptive use of water or ET over the irrigated areas fell by 27 percent; and
- Water productivity was increased from 0.85 kg/m^3 to 1.20 kg/m^3 for wheat and from 1.30 kg/m^3 to 2.2 kg/m^3 for maize with integration of engineering, agronomic and irrigation management measures.

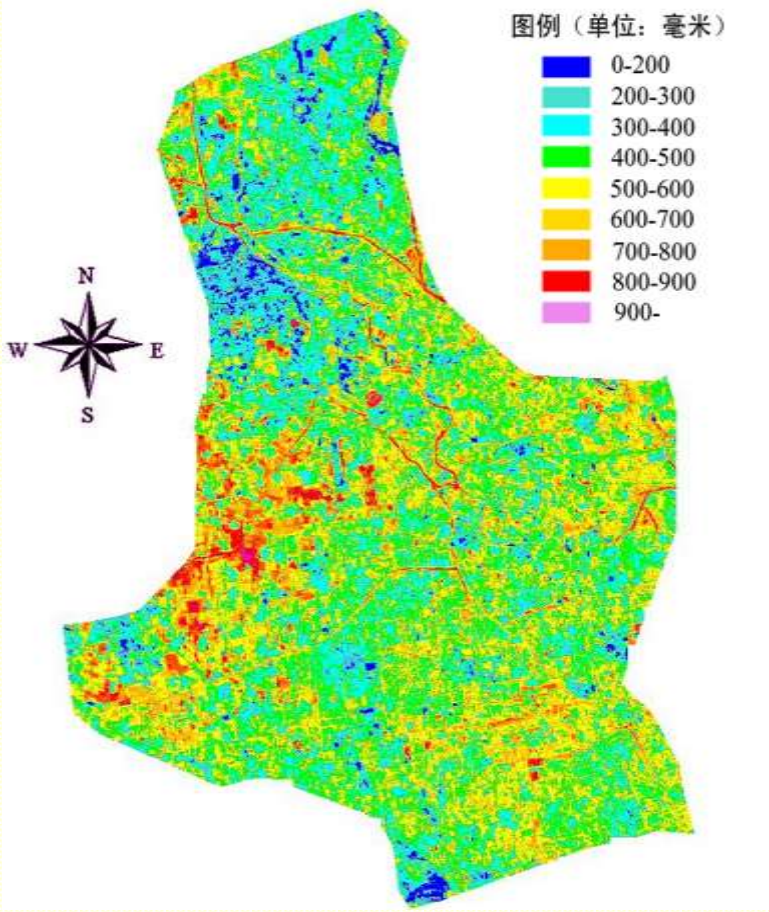
Farmers Learn How to Operate ET Management !

ET Reduction in TongZhou District of Beijing, China

Before Project



After Project



Concluding Remarks

- ***Different strategies should be taken in different water scarcity areas to ensure sustainable food security;***
- ***In physical water scarcity areas, increase of water productivity or reduction of consumptive use of water or ET is the way to ensure sustainable food security, rather than increase of irrigation efficiency to expand irrigated areas;***
- ***Remote Sensing technology can be used to monitor the actual ET or water productivity and to identify areas for improvements; and***
- ***The case study in Water Conservation Project in China shows good outcomes of adopting the strategy proposed for physical water scarcity areas.***

Thanks
Welcome Questions