# Intensive Groundwater Use: Silent Revolution

## Some comments and additional views

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**Side event WWF5**

**"THE ROLE OF GROUNDWATER SILENT REVOLUTION IN ACHIEVING THE MOTTO MORE CASH AND NATURE PER DROP"**

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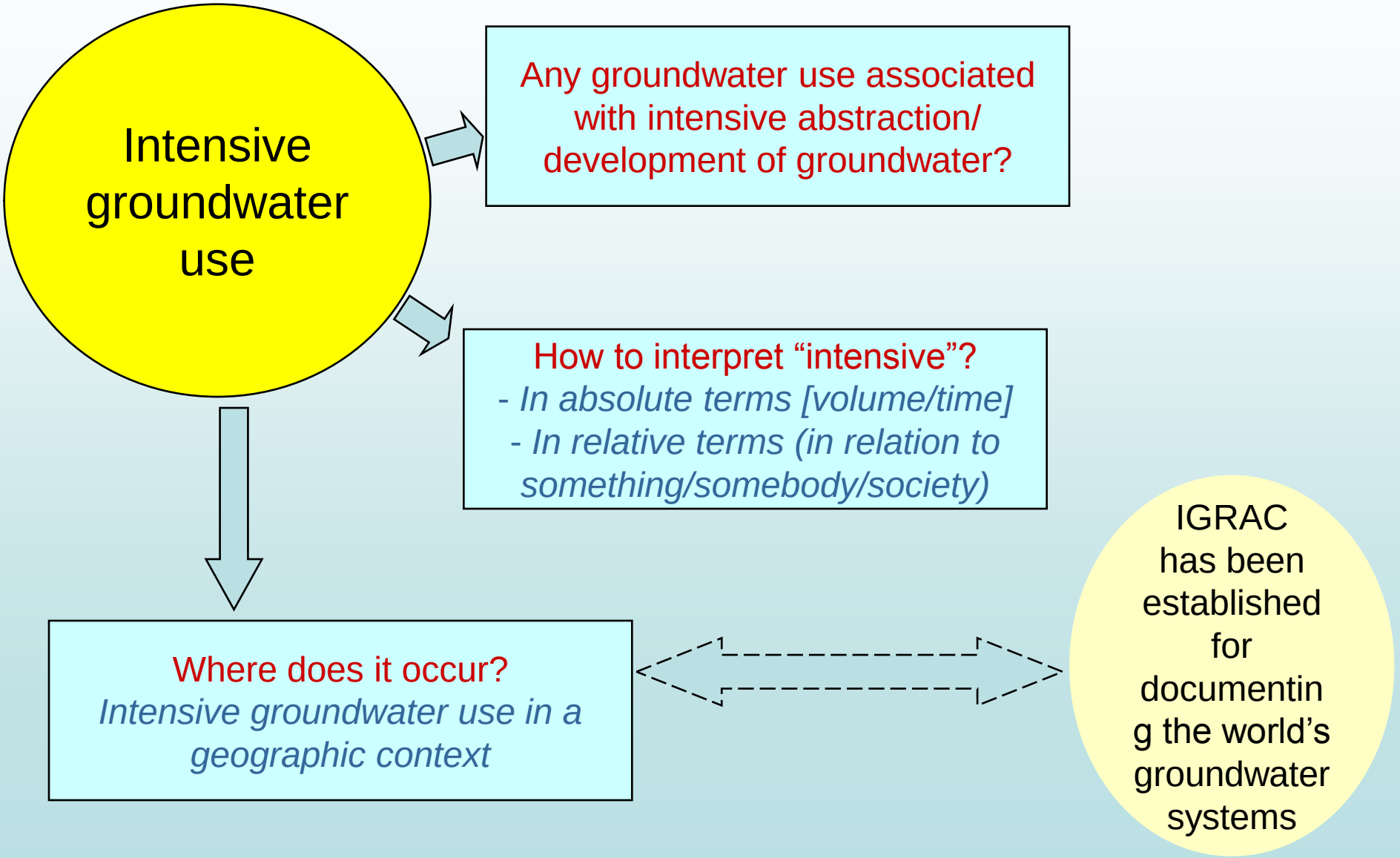
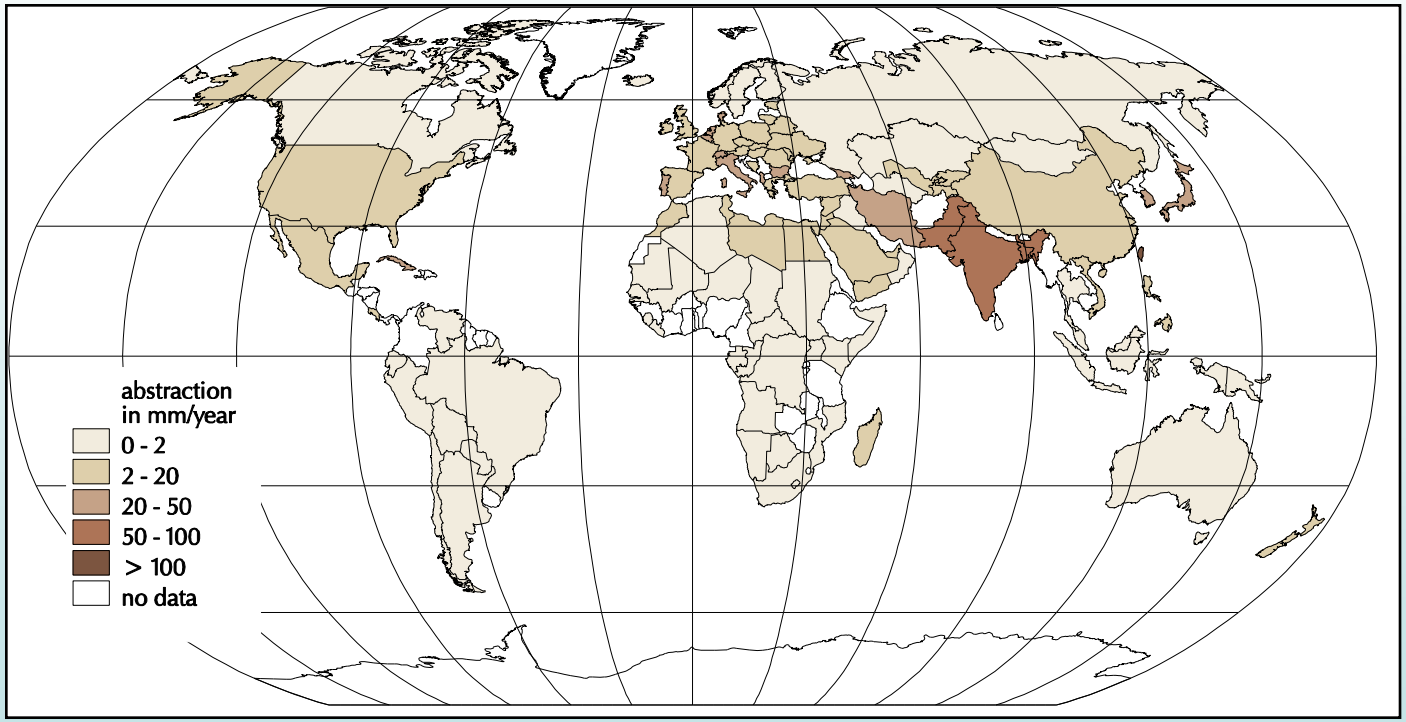
1. Interpretations of “intensive use”
2. Where does intensive groundwater use occur?
3. Benefits & negative impacts of intensive use

# What is intensive groundwater use?



# Intensive groundwater development in an absolute sense




| Top-10 countries: | |
|---|---|
| Bahrain | 286 mm/a |
| Taiwan | 197 mm/a |
| Barbados | 185 mm/a |
| Mauritius | 111 mm/a |
| Malta | 79 mm/a |
| Pakistan | 75 mm/a |
| Bangladesh | 74 mm/a |
| India | 58 mm/a |
| Israel | 58 mm/a |
| Italy | 46 mm/a |

Global mean: 6 mm/a

*GGIS, 2005*

Groundwater abstraction intensity,

in mm/a averaged over entire countries.

High intensities in large part of Southern Asia

*(India+Pakistan+Bangladesh+N.China: half of global GW abstraction)*

Data of variable quality and low spatial resolution

# Countries with largest groundwater abstraction

*Margat, 2008*

Groundwater abstraction in km3/a summed over entire countries.

Synchronization of data is poor (data from 1990 to 2004)

Top-3 countries:

| | |
|---|---|
| India | 190 km3/a |
| USA | 115 km3/a |
| China | 97 km3/a |
| *Subtotal:* | *402 km3/a* |

50 % of global total

Global total:
At least 800 km3/a

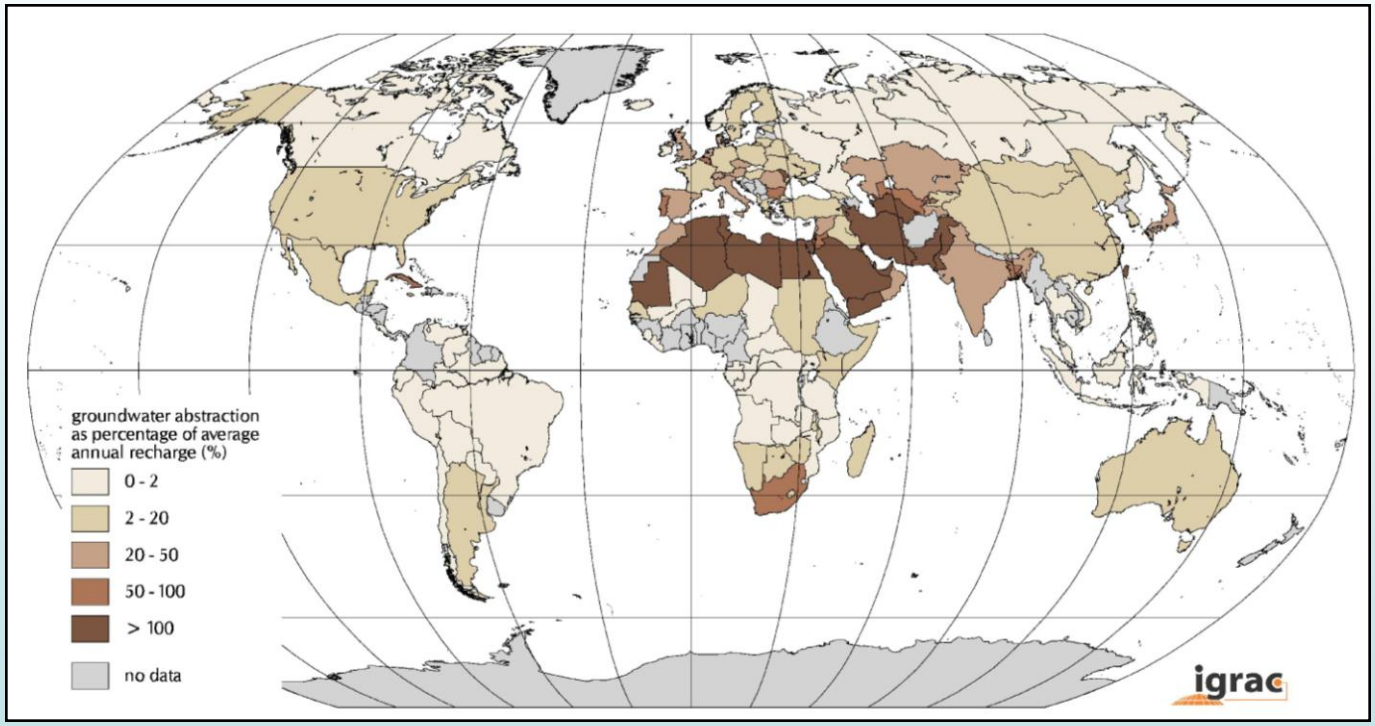
Top-10 countries:

| | |
|---|---|
| India | 190 km3/a |
| USA | 115 km3/a |
| China | 97 km3/a |
| Pakistan | 55 km3/a |
| Iran | 53 km3/a |
| Mexico | 38 km3/a |
| Saudi Arabia | 21 km3/a |
| Indonesia | 12.5 km3/a |
| Russia | 11.6 km3/a |
| Japan | 10.9 km3/a |
| *Subtotal:* | *604 km3/a* |

75 % of global total

Data of variable quality and poor synchronization

# Intensive groundwater development in a relative sense (1)




| Top-10 countries: | |
|---|---|
| Saudi Arabia | 1520% |
| UAE | 330% |
| Libyan A.R. | 529% |
| Egypt | 408% |
| Qatar | 373% |
| Mauritania | 293% |
| Israel | 240% |
| Algeria | 171% |
| Bahrain | 169% |
| Moldova | 150% |

**Storage depletion**

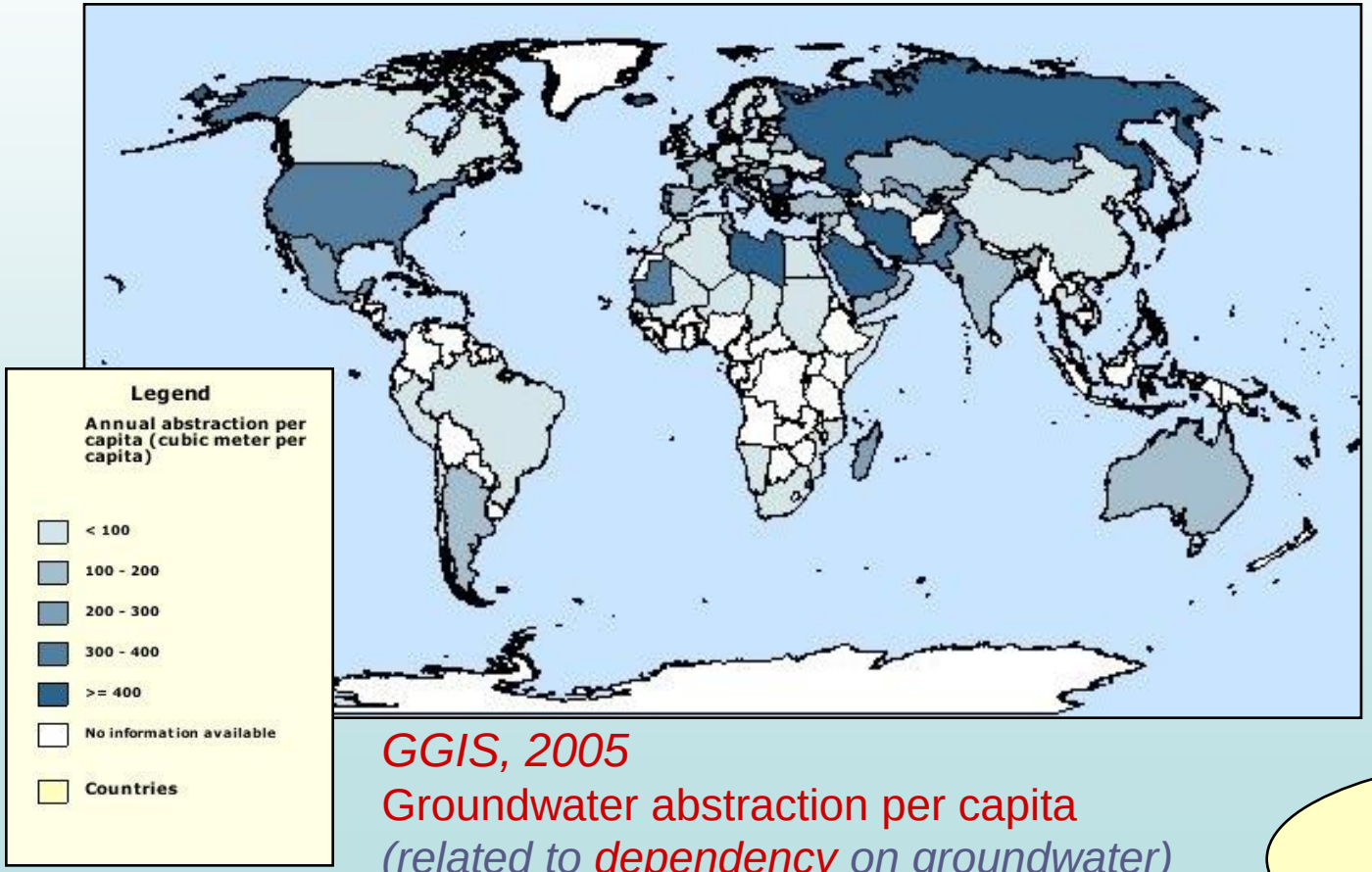
*GGIS, 2005*

Groundwater development indicator: abstraction as a percentage of present-day mean recharge.

Significantly modified groundwater balances in N-Africa, Middle-East & other arid regions.

Data of variable quality and low spatial resolution

# Intensive groundwater development in a relative sense (2)




| Top-10 countries: | |
|---|---|
| Iran | 835 m3/a |
| Iceland | 712 m3/a |
| Libyan A.R. | 673 m3/a |
| Bulgaria | 663 m3/a |
| UAE | 644 m3/a |
| Georgia | 608 m3/a |
| Saudi Arabia | 594 m3/a |
| Swaziland | 568 m3/a |
| Russian Fed. | 533 m3/a |
| Pakistan | 398 m3/a |

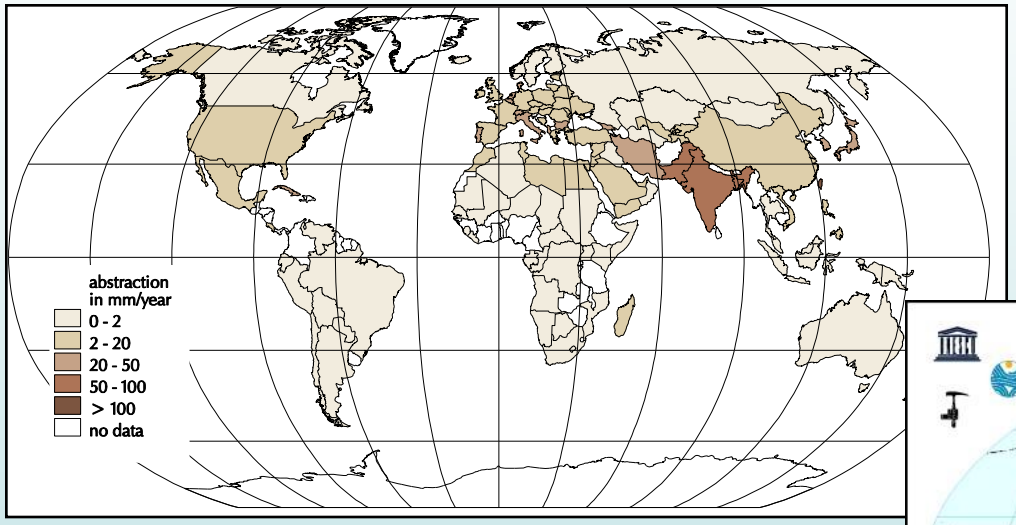
*GGIS, 2005*

Groundwater abstraction per capita

*(related to dependency on groundwater)*

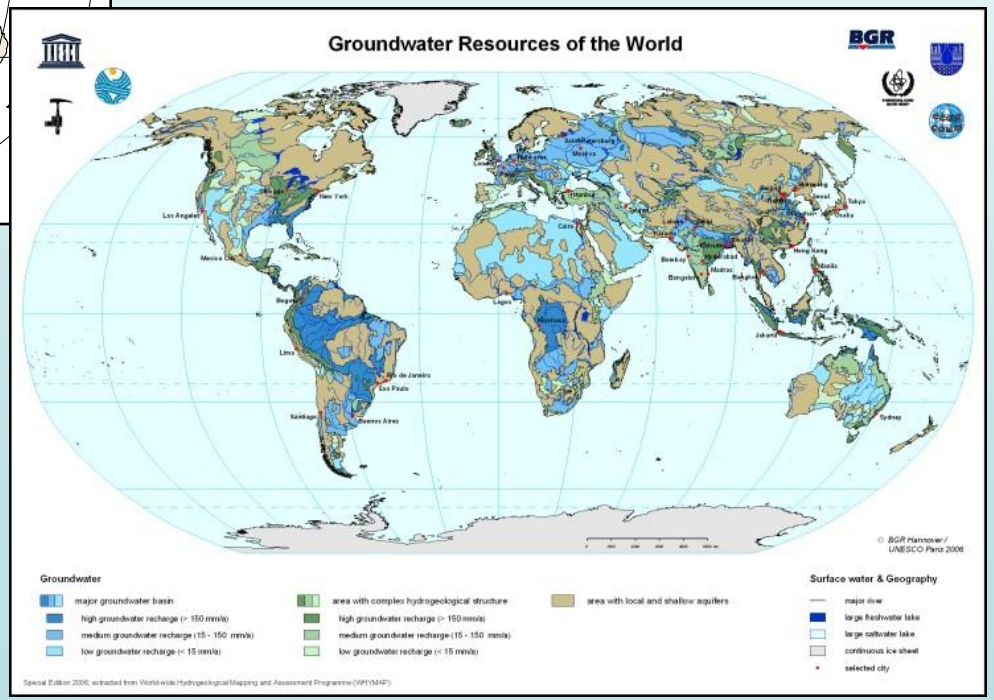
Data of variable quality and low spatial resolution

# Intensive groundwater development in a relative sense (3)




Large differences between aquifers in resilience to intensive abstraction, drought and climate change

WHYMAP

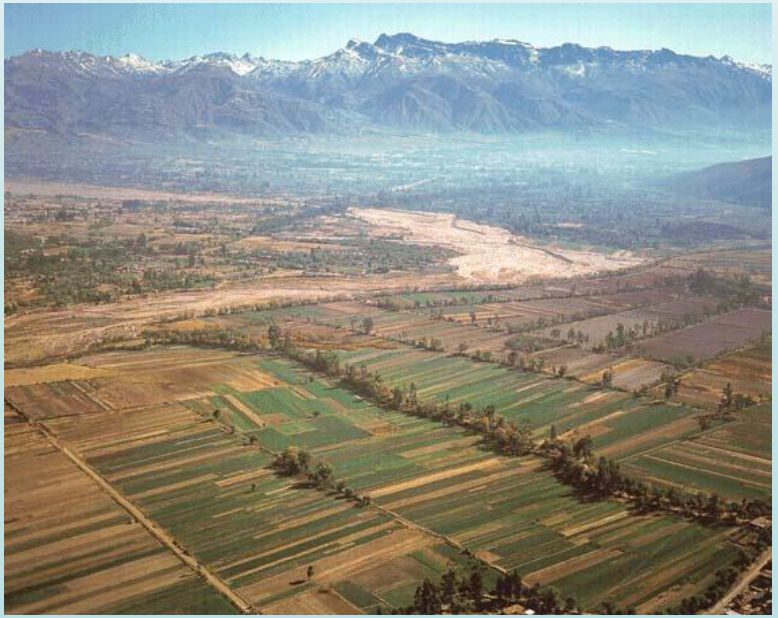



Zones with large stored volumes of groundwater *(blue zones on WHYMAP)* are for shorter or longer time resilient to intensive groundwater abstraction, zones without significant storage *(brown zones)* are extremely vulnerable to drought and depletion.

# Silent Revolution: benefits

- Spectacular improvement of food production, farmers' income and local economy in many regions of the world (India, Pakistan, Yemen, etc…)
- Opportunities for making land and labour more productive and reducing water shortage risk in agricultural production
- Increased numbers of more or less drought-prone domestic water supplies (particularly in rural areas of developing countries)
- Reduced risk of famines and other food shortages
- Improved access to water for many people (GW is "democratic resource" - *Shah*).

| **INDIA** | 1970/1973 | 1990/1993 |
|---|---|---|
| Agricultural output (billion US$/a ) | 28.3 | 49.9 |
| Contribution SW | 15.5% | 13.9% |
| Contribution GW | 4.4% | 14.5% |



# Silent Revolution: negative impacts

## Physical impacts:

- Progressive depletion of groundwater storage in many aquifers (particularly in arid and semi-arid countries)
- Increasing groundwater salinity problems, especially in coastal zones
- More groundwater pollution
- Damage to wet ecosystems
- Reduced baseflows/ spring flows, water level declines
- Land subsidence, …. etc.


## Socio-economic impacts:

- Loss of livelihoods
- Declining rural economies
- Threat of water and food shortages
- Degenerating environment
- Uncertain future
- Conflicts, …… etc.

# Conclusions

- Intensive exploitation and use of groundwater can be viewed from different angles of view. All of them contribute to better understanding of the phenomenon and its impacts.
- It is remarkable that a very limited number of countries only is pumping the lion's share of groundwater abstraction in the world.
- Worth noting as well is that intensive groundwater abstraction often occurs in regions of limited rate of groundwater renewal.
- The "Silent Revolution" has produced very significant benefits, especially in semi-arid and arid zones of developing countries.
- However, it is producing negative impacts as well, aggravated by climate change, to the extent that experts predict the evolution of groundwater use to end in a final phase of "social conflict" (Llamas, 2008) or "decline of socio-ecology" (Shah, 2007). This underlines the need for adequate groundwater resources management. Can these fatalistic predictions be challenged?

# Thank you for your attention


International Groundwater Resources Assessment Centre

www.igrac.net

United Nations Educational, Scientific and Cultural Organization

World Meteorological Organization

Government of The Netherlands

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