

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”

20th of March 2009

Contents

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
use

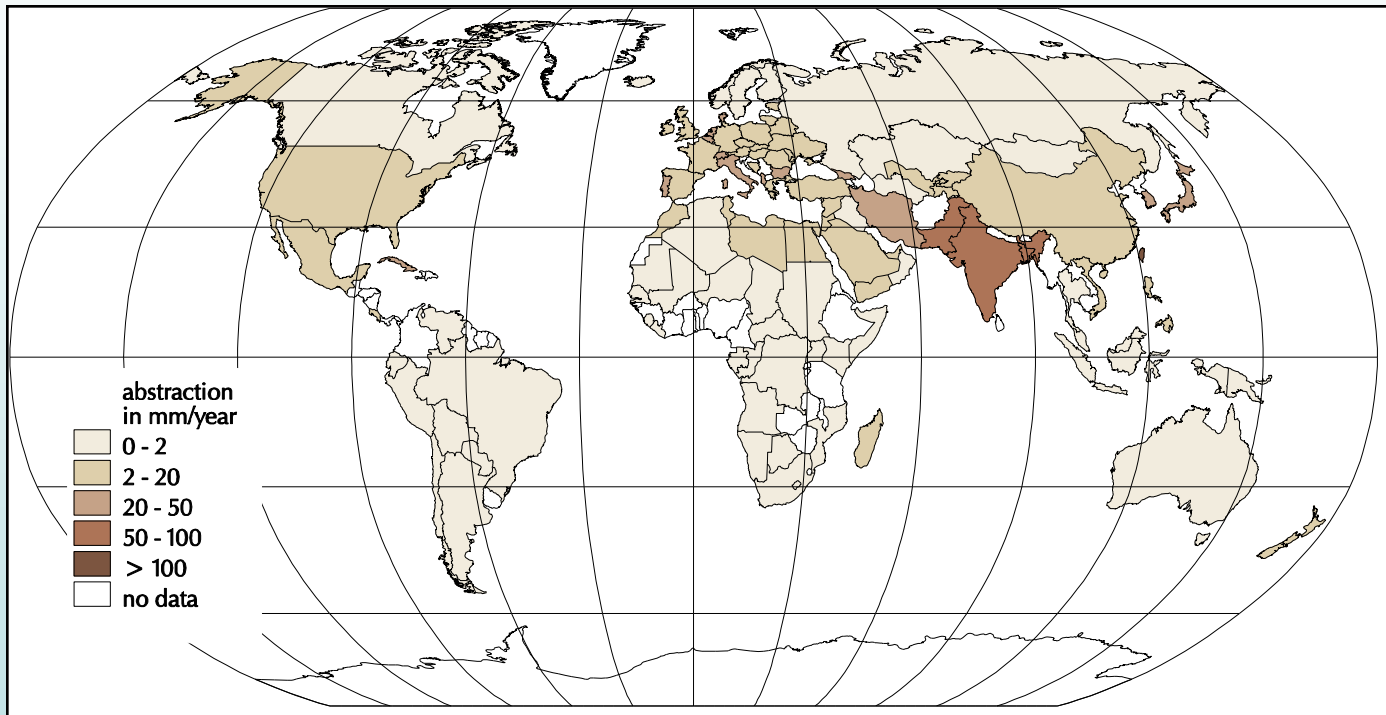
Any groundwater use associated
with intensive abstraction/
development of groundwater?

How to interpret "intensive"?
- *In absolute terms [volume/time]*
- *In relative terms (in relation to
something/somebody/society)*

Where does it occur?
*Intensive groundwater use in a
geographic context*

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has been
established
for
documentin
g the world's
groundwater
systems

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 km ³ /a
USA	115 km ³ /a
China	97 km ³ /a
Subtotal:	402 km³/a

50 % of global total

Global total:

At least 800 km³/a

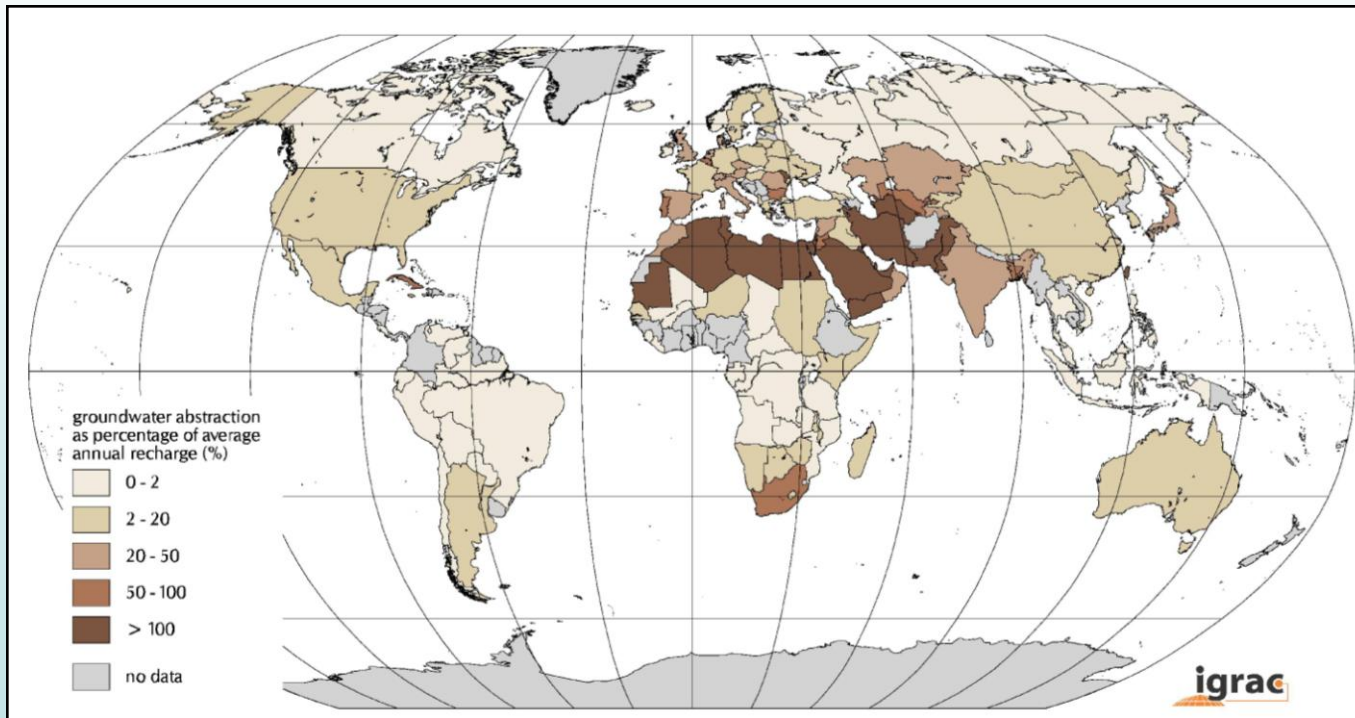
Top-10 countries:

India	190 km ³ /a
USA	115 km ³ /a
China	97 km ³ /a
Pakistan	55 km ³ /a
Iran	53 km ³ /a
Mexico	38 km ³ /a
Saudi Arabia	21 km ³ /a
Indonesia	12.5 km ³ /a
Russia	11.6 km ³ /a
Japan	10.9 km ³ /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

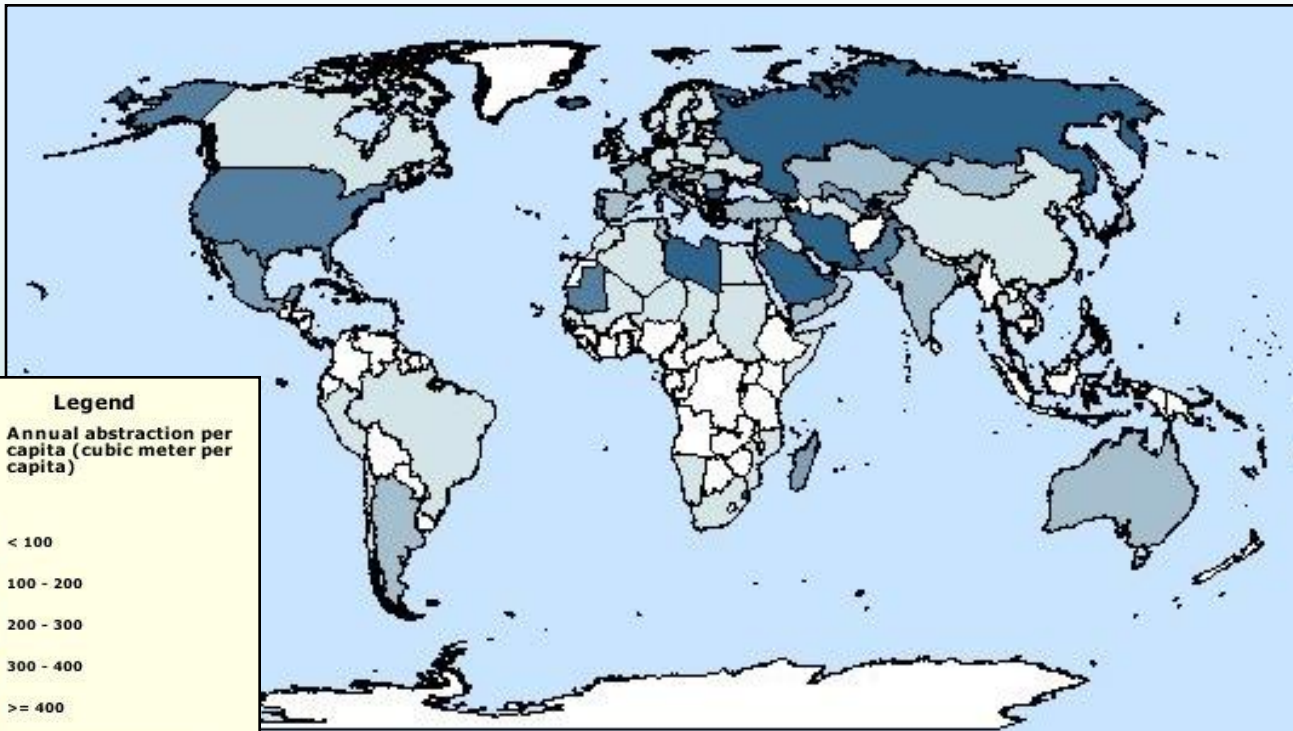
Data of variable quality and low spatial resolution

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.

Intensive groundwater development in a relative sense (2)



Top-10 countries:

Iran	835 m ³ /a
Iceland	712 m ³ /a
Libyan A.R.	673 m ³ /a
Bulgaria	663 m ³ /a
UAE	644 m ³ /a
Georgia	608 m ³ /a
Saudi Arabia	594 m ³ /a
Swaziland	568 m ³ /a
Russian Fed.	533 m ³ /a
Pakistan	398 m ³ /a

Legend

Annual abstraction per capita (cubic meter per capita)

- < 100
- 100 - 200
- 200 - 300
- 300 - 400
- >= 400
- No information available
- Countries

GGIS, 2005

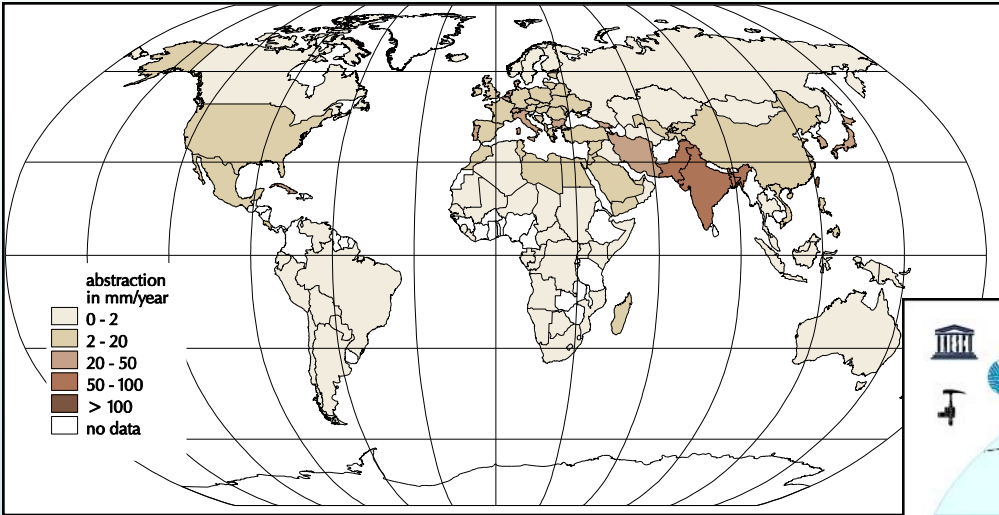
Groundwater abstraction per capita
(related to *dependency* on groundwater)

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



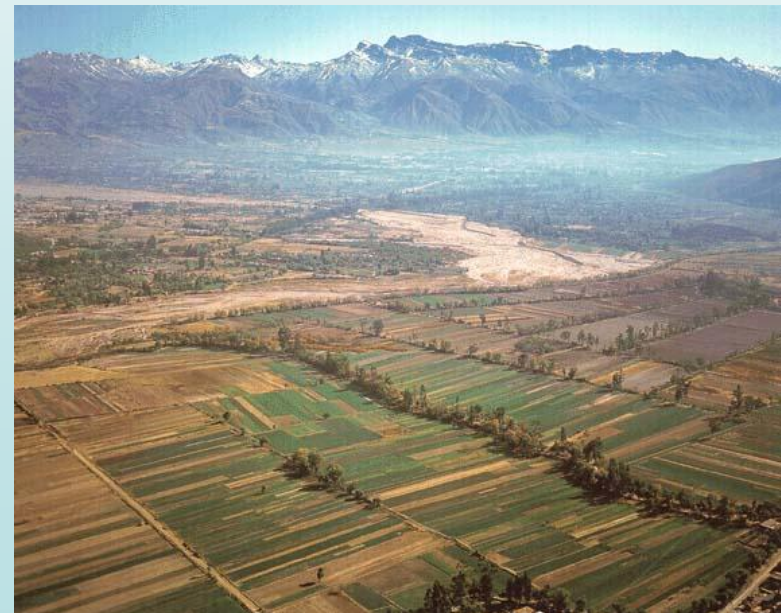
Zones with large stored volumes of groundwater (blue zones on WHYMAP) are for shorter or longer time resilient to intensive groundwater abstraction, zones without significant storage (brown zones) are extremely vulnerable to drought and depletion.



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*).

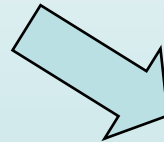
INDIA	1970/1973	1990/1993
Agricultural output (billion US\$/a)	28.3	49.9
Contribution SW	15.5%	13.9%
Contribution GW	4.4%	14.5%



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



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Scientific and Cultural Organization



World Meteorological
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Government of
The Netherlands



Deltares