INSTITUTO CERVANTES DE ESPAÑA

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THE SCIENTIFIC AND TECHNOLOGICAL ADVANCES TO SOLVE WORLD WATER CRISIS

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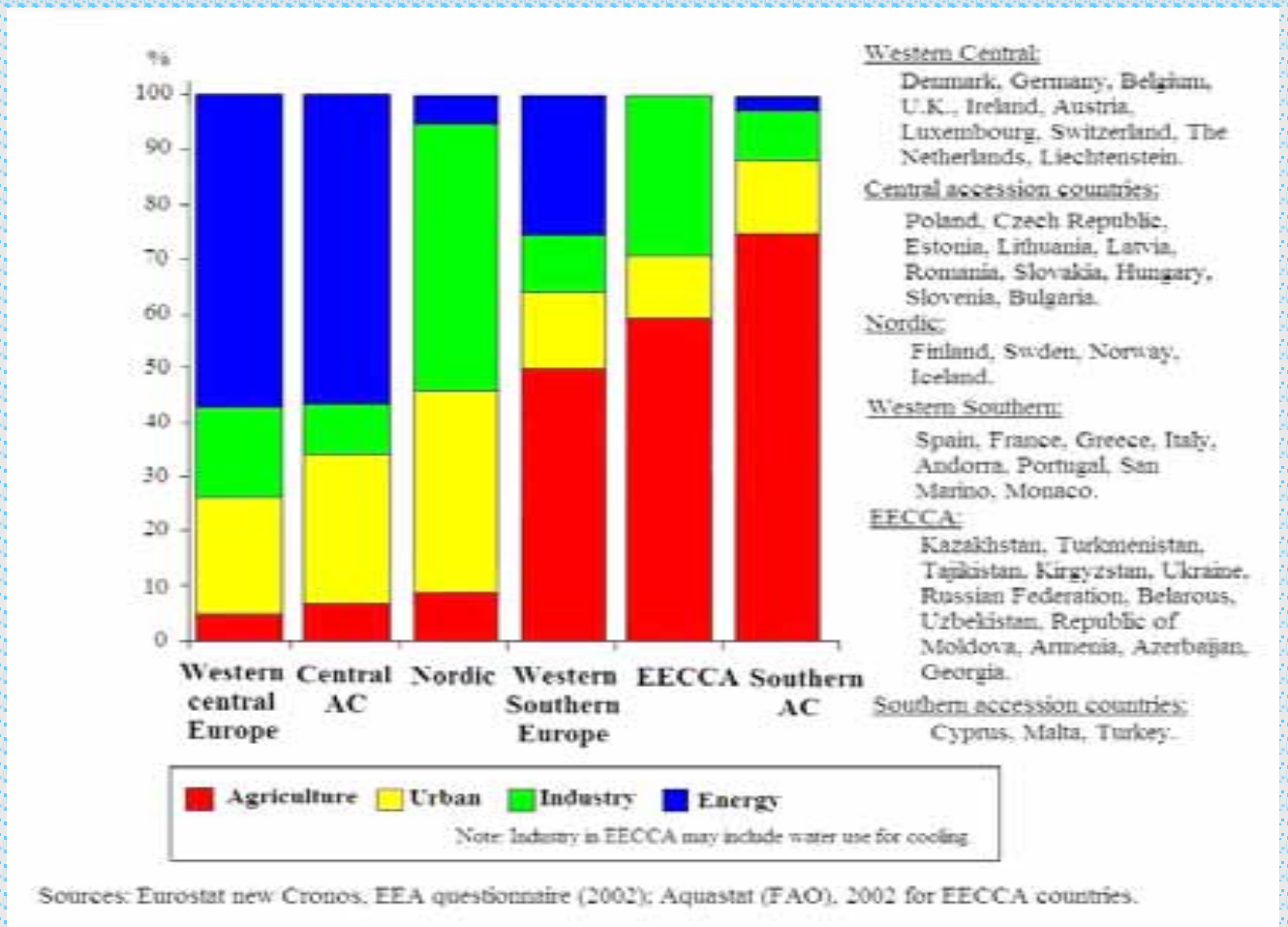
1. INTRODUCTION (I)

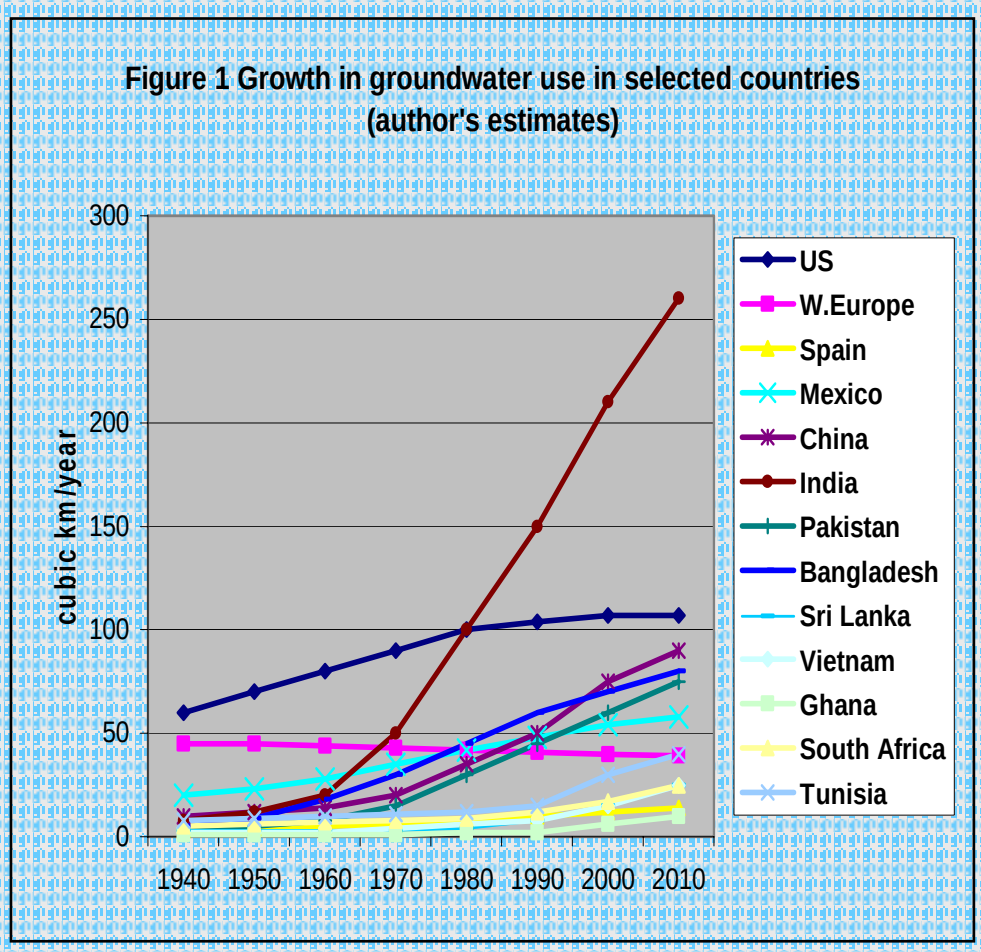
- Cheap transport, Membrane Technology and Intensive groundwater use are a relatively new phenomena.
- Should a water crisis occur, it will be felt mostly in irrigation in arid and semi-arid regions.
  - Though important, urban water supply only amounts to 10% of worldwide consumptive use.

1. INTRODUCTION (II)



Sectorial uses of water in Europe (EEA, 2003)

1. INTRODUCTION (III)



Source: Shah (2004)

2. VIRTUAL WATER, HYDROLOGICAL FOOTPRINT AND FOOD SECURITY (I)

Virtual water is the amount of water necessary to produce a good o services.

1 kgr wheat ..... 1.000 kgr water

1 kgr beef ..... 20.000 kgr water

2. VIRTUAL WATER, HYDROLOGICAL FOOTPRINT AND FOOD SECURITY (II)

Hydrological footprint means the amount of water (blue and green) that a human being requires for all her/his needs (about 90% for food).

vegetarian diet	~800 m^3/year
read meat diet	~ 1.500 m^3/year

2. VIRTUAL WATER, HYDROLOGICAL FOOTPRINT AND FOOD SECURITY (III)

Total Water resources 110.000 km^3/year
Green Water 70.000 km^3/year
Blue Water 40.000 km^3/year

Human needs

diet	population	km^3/year (blue + green)
Vegetarian	$7.000.10^6$	~6.000
Readmeat	$7.000.10^6$	~12.000
Vegetarian	$10.000.10^6$	~8.000
Readmeat	$10.000.10^6$	~15.000

betwen 5-13% of Total Water Resources

2. VIRTUAL WATER, HYDROLOGICAL FOOTPRINT AND FOOD SECURITY (IV)

Food security is today more related to economic capacity than to water scarcity.

There exist some problems:

a) WTO – hidden monopolies
b) Threat of political embargo
c) Domestic social changes required

3. DESALINIZATION. MEMBRANE TECHNOLOGY (I)

The energy cost to desalinize one cubic meter of sea water has decrease from almost 20 kwh/m^3 to less than 4 kwh/m^3.

The most common technology today is **REVERSE OSMOSIS (RO)** (Membrane technology).

3. MEMBRANE TECHNOLOGY (II)

The current total cost for RO is between US $ /0.5-0.6/m^3, with full time operation and large plants.

Smaller for (subterranean) brackish water (US $ 0.10 – 0.20).

3. MEMBRANE TECHNOLOGY (III)

Currently in Spain about 7% of the population drinks (desalinated) sea water.

The cost of desalination is affordable in most cases for urban water supply for cities near the coast.

3. MEMBRANE TECHNOLOGY (IV)

Theoretically it can to be used for irrigation of high value crops (greenhouse).

Value of crop 60.000 €/ha/yr

Cost of Water (5.000 m^3 x US \$0.6/$m^{3)}$ 3.000 €

Cost of water < 5% of crop value

However, as long as groundwater is cheaper its use in agruculture is minimum. This is the Spanish current debate.

4. THE “SILENT REVOLUTION” AND ITS CAUSES (I)

- It has been carried out by million of modest individual farmers.
- Water decision makers have seldom paid attention to this phenomenon.
- It has produced great socio-economic benefits, as well as some problems (mainly environmental).
- Documented problems to date are often irrelevant due to the enormous groundwater storage capacity of most aquifers.

4. THE “SILENT REVOLUTION” AND ITS CAUSES (II)

- Wide availability of cheap well drilling technologies.
- Invention and commercialization of the submersible pump.
- Hydrogeology has become a solid body of science.

HOWEVER, THE SILENT REVOLUTION IS MAINLY MARKET DRIVEN, EXCEPT IN VERY POOR COUNTRIES

4. THE “SILENT REVOLUTION” AND ITS CAUSES (III).

From the dug-well to the deep borehole.

From the water wheel to the pump.

From the water-witches to Hydrogeology.

5. BENEFITS AND COSTS OF THE SILENT REVOLUTION (I)

- Cheap, quick and secure source of drinking water for people (poor and not-so-poor).
- Allows for “small” irrigation (e.g. India).

5. BENEFITS AND COSTS OF THE SILENT REVOLUTION (II)

- Low abstraction cost (even without "perverse" energy subsidies).

  Abstraction cost usually between 0.02 – 0.20 US$/$m^3$

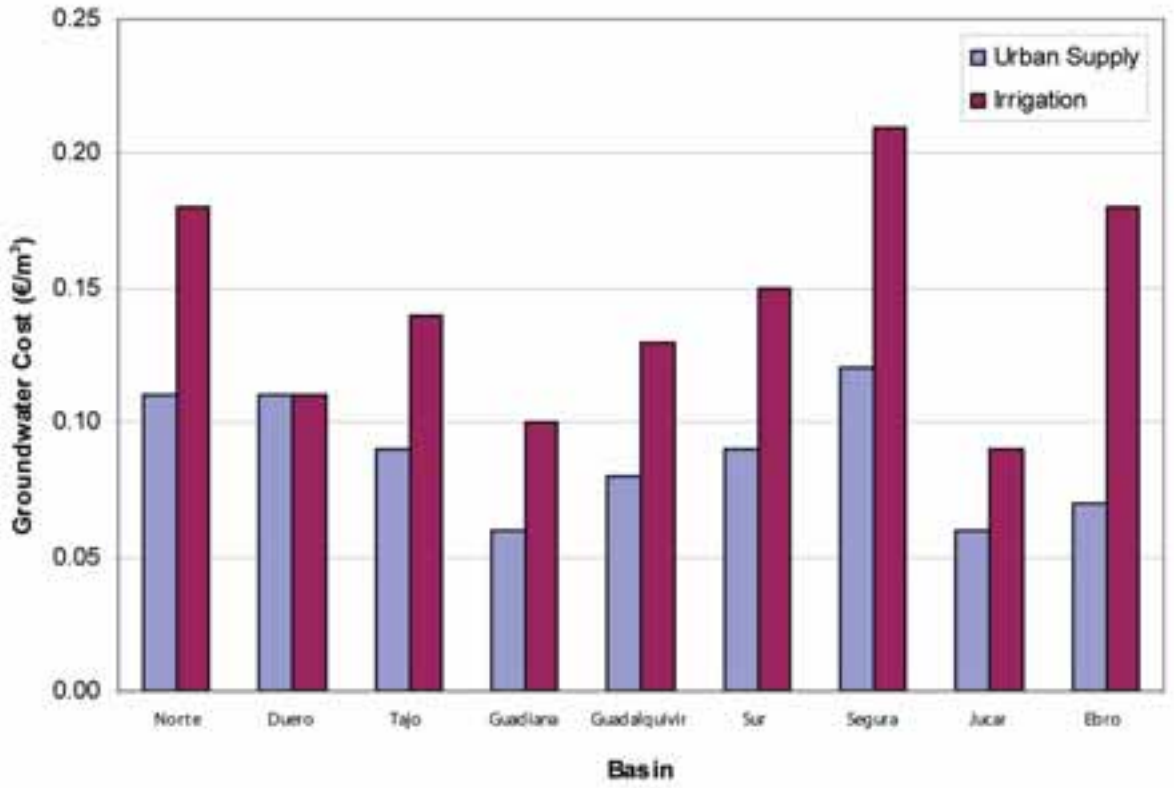
  Irrigation cost dependent on crop type: 50 – 1000 US$/ha

- Significantly **"more crops and jobs per drop"** than in surface water irrigation systems.

- In Industrial countries this motto is changing **"more cash and nature per drop"**

5. BENEFITS AND COSTS OF THE SILENT REVOLUTION (III)

Groundwater unit volume cost in Spain



Source: DGOH (2003)

5. BENEFITS AND COSTS OF THE SILENT REVOLUTION (IV).

- Negative effects may appear:
  - Groundwater level depletion (often irrelevant, although the most frequently referred to).
  - Groundwater quality degradation is usually the most important. It also may be due to poor land-use planning (e.g.Netherlands; Murray-Darling Basin, Australia).
  - Land subsidence (Mexico, Osaka, Bangkok...)
  - Ecological impacts on surface water courses and wetlands (irrelevant wherever poverty is the main ecological problem).

6. MOST PERVASIVE HYDROMYTHS ON GROUNDWATER

- Paraphrasing Hamlet:

  "FRAILTY, FRAILTY, THY NAME IS GROUNDWATER"
- "EVERY WATER WELL BECOMES DRY OR BRACKISH"

- Groundwater development is a "PILLAR OF SAND", prone to collapse:

DOCUMENTED CASES OF SOCIO-ECONOMIC HAVOC CAUSED BY INTENSIVE GROUNDWATER USE ARE STILL PRACTICALLY UNKNOWN

7. SILENT REVOLUTION IMPACT ON WATER RESOURCES POLICY (I)

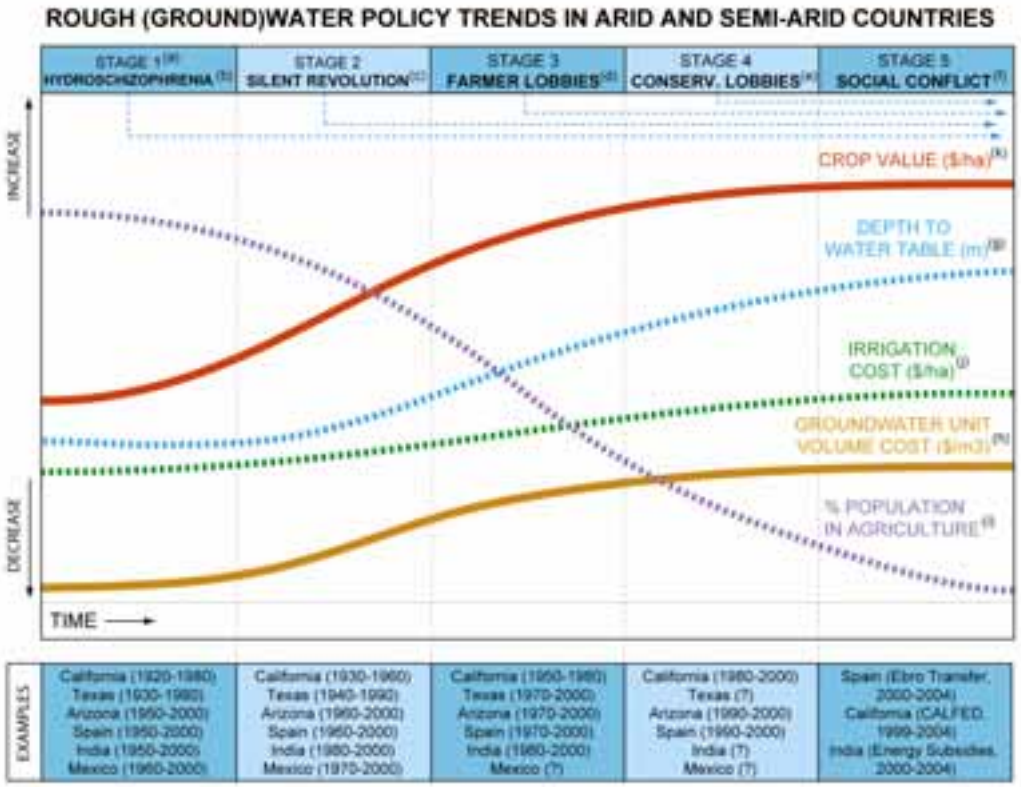
SARAGOSSA, Oct 2002

BRUSSELS, Sep 2001

VALENCIA, May 2003

CLAMOROUS SOCIAL CONFLICTS IN SPAIN

7. SILENT REVOLUTION IMPACT ON WATER RESOURCE POLICY IN W.R. (II)



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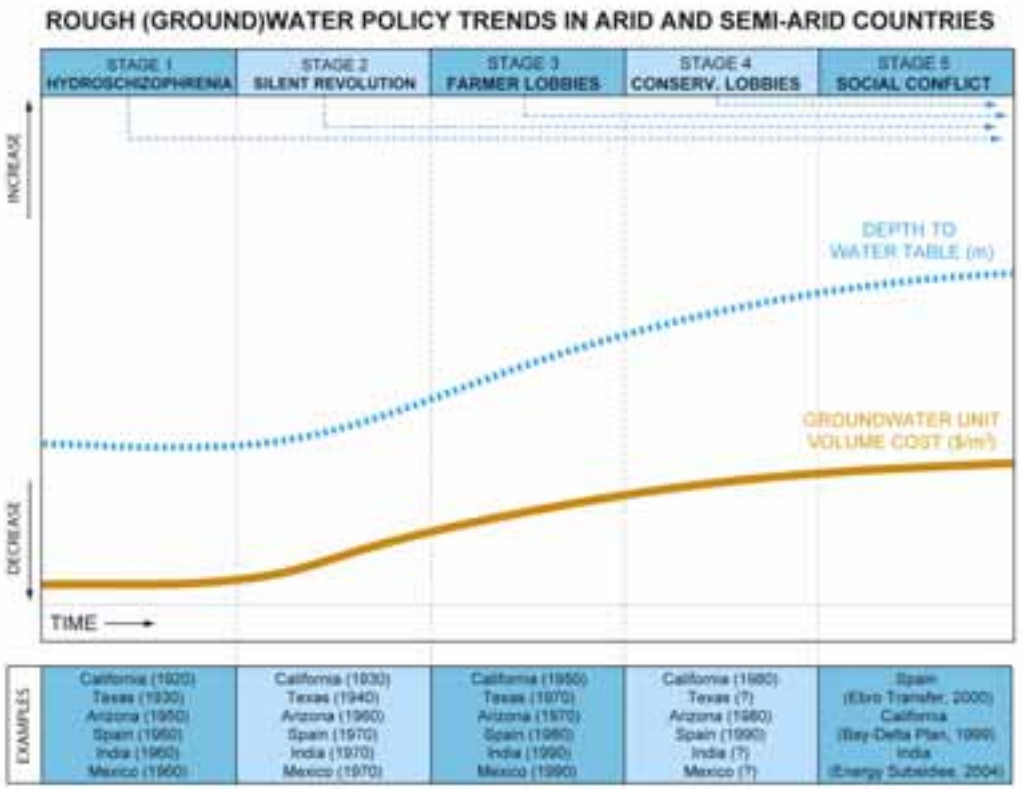

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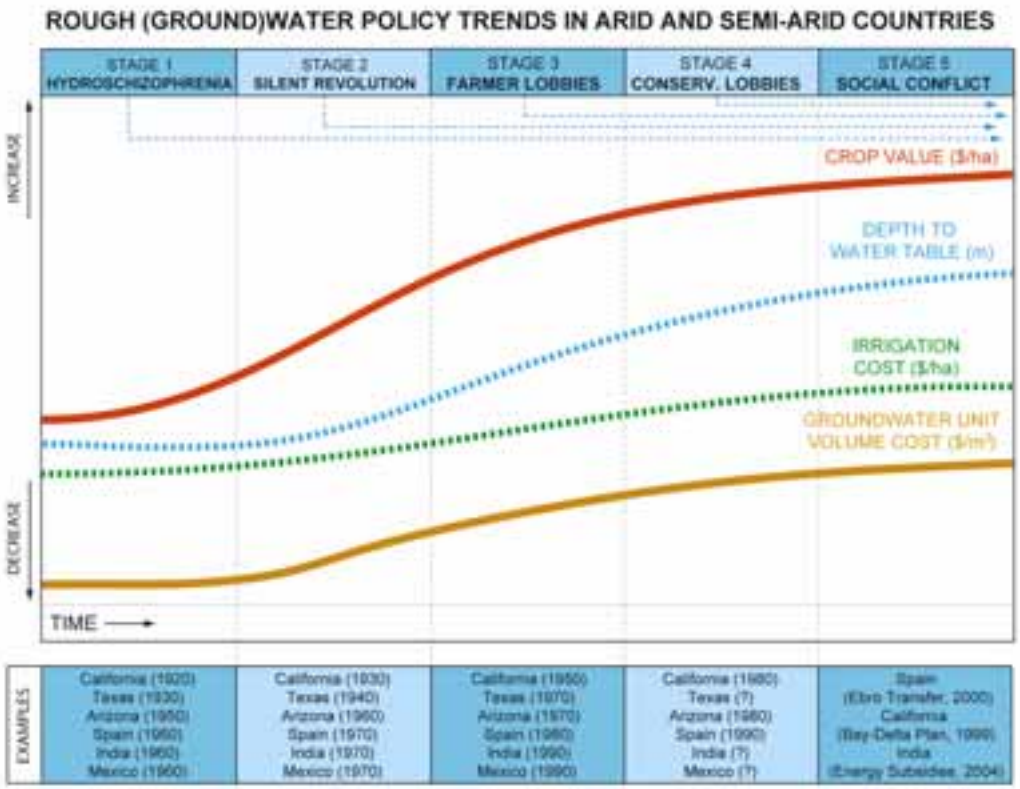
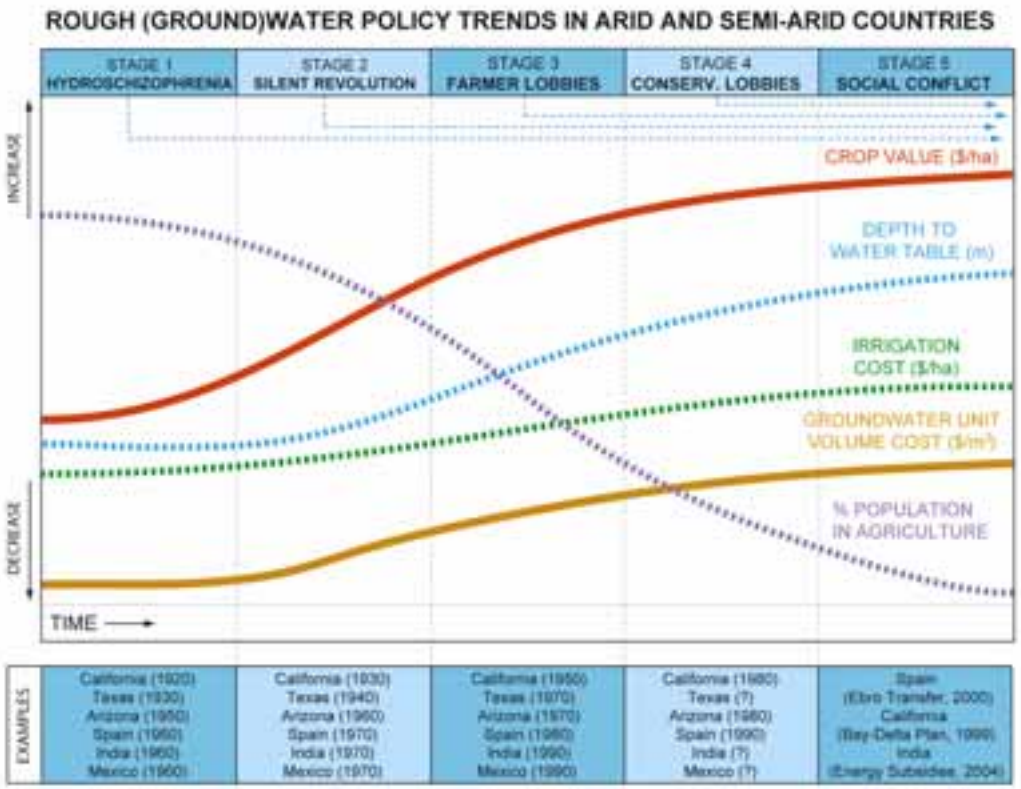


7. SILENT REVOLUTION IMPACT ON WATER RESOURCE POLICY IN W.R. (V)



8. ETHICAL ISSUES (MAINLY IN RELATION TO THE SILENT REVOLUTION)

- In most cases, there exists a blend of:
  - Ignorance: Hidrogeology being a rather “new” science.
  - Arrogance: Professional “clicks” and/or bias.
  - Institutional inertia.
  - Corruption: the main obstacle to attain adequate water management.

Groundwater development is less prone to corruption:

a) Smaller investment required

b) Shorter implementation time

9. RELEVANCE OF REMOTE SENSING AND GIS TO ACHIEVE A BETTER WATER POLICY

- The data on water uses (mainly on irrigated land) and the inventary of water wells and water rights are crucial needs for an acceptable water management.
- The accuracy of such data and their availability to the general public are usually very deficient.
- The usual excuse for this failure is the relevance of the transition costs.
- The current remote sensing technology and GIS allow to obtain these important data in a way fast, cheep and efficient.

10. CONCLUSIONS (I)

VIRTUAL WATER AND FOOD SECURITY

Virtual water trade is facilitating the food security of water poor countries.

Some political obstacles remain in relation to the World Trade Organization.

10. CONCLUSIONS (II)

Membrane Technology (RO) is already allowing to solve urban water supply in coastal areas.

In the near future it will allow also the irrigation of high value crops.

10. CONCLUSIONS (III)

- In the last decades, a spectacular in groundwater irrigation has taken place in many arid and semi-arid countris.
- This is a Silent Revolution, carried out millions of farmers, and it is market driven.

10. CONCLUSIONS (IV)

- Groundwater irrigation can achieve the “more crops and jobs per drop” motto.
- A worlwide assessment on the relative socio-economic efficiency of surface/groundwater is required.
- Groundwater is not the panacea. If the current situation of anarchy persists, serious problems may appear.

10. CONCLUSIONS (V)

- Groundwater governance requires a participatory approach of all stakeholders.
- Groundwater development is less prone to corruption that surface water projects.
- Most governments can afford the investment of putting their groundwater resources to good use.

A willingness is needed to fight ignorance, negligence, arrogance and corruption.