Differentiating Water Scarcity and Drought

A key to proceed in the development of effective drought management practices

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Differentiating Water Scarcity and Drought

- While "drought" means a temporary decrease in water availability due for instance to rainfall deficiency, "water scarcity" means that water demand exceeds the water resources exploitable under sustainable conditions.
- It is important to differentiate both terms carefully as they are related to different causes and require different measures

COM(2007) 414 final, COMMUNICATION FROM THE COMMISSION OF THE EUROPEAN PARLIAMENT AND THE COUNCIL: Addressing the challenge of water scarcity and droughts in the European Union

Differentiating Water Scarcity and Drought

- Why are they named in one breath often and frequently mixed up in discussing sustainable watershed management?
  - The socio-economic and environmental aim to satisfy the requested water demands is affected by both
  - During water scarcity an occuring drought impose additional hardship
  - Water scarcity is reducing the buffer capacity and resilience of a system to anticipate future droughts

- Under conditions of water scarcity
  - measures to reduce structural overconsumption are a pre-requisite to increase the buffer capacity
  - drought management cannot be substituted by water scarcity management and require its own recognition
  - the role of storages in GW and SW is critical and need to be addressed

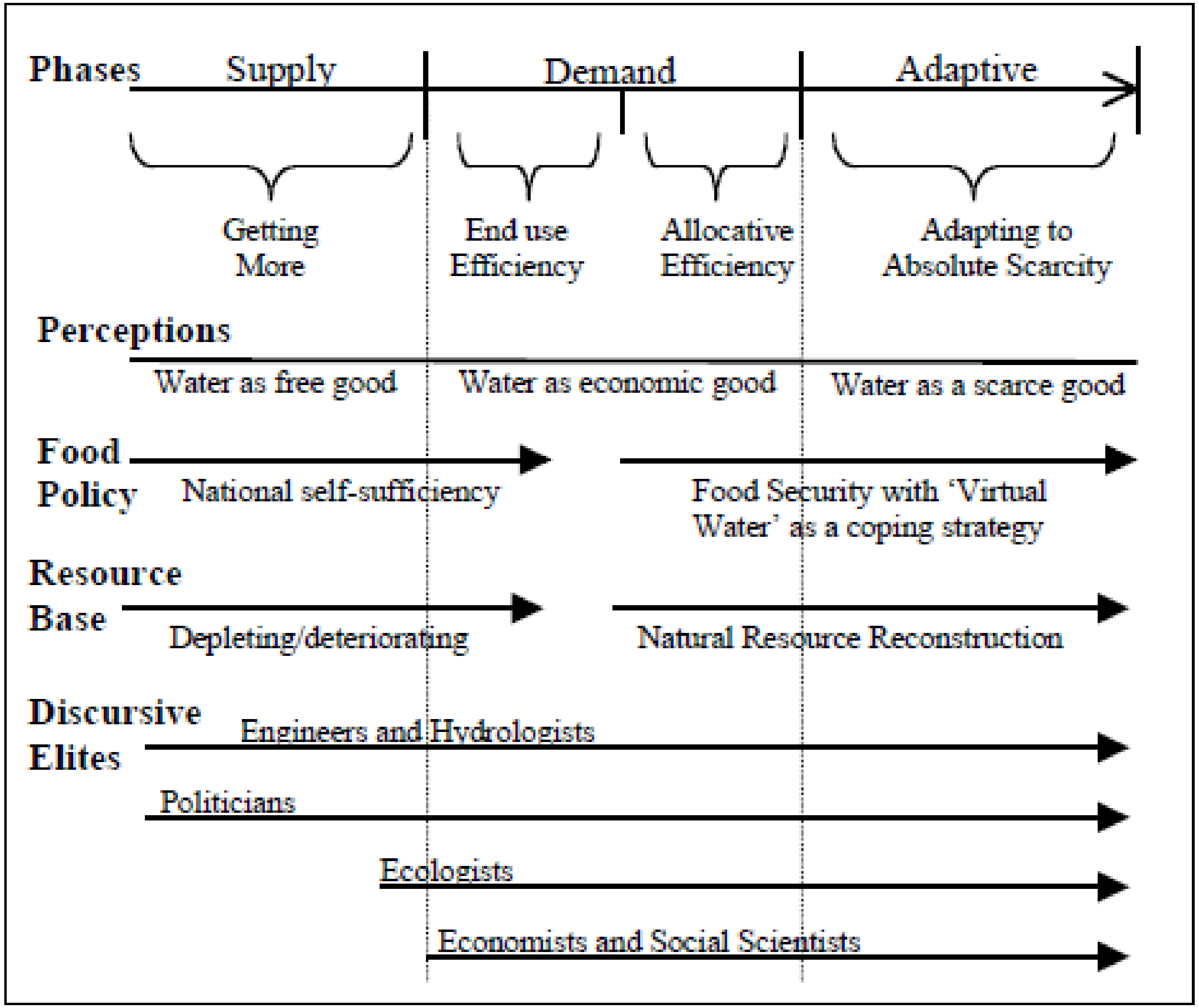
Differentiating Water Scarcity and Drought

- The most widely used measure is the Falkenmark indicator or “water stress index” (Falkenmark et al., 1989). They proposed
  - 1700 m3 per capita per year: water stress
  - 1000 m3 per capita per year: water scarcity
  - < 500 m3 per capita per year: absolute scarcity

… but

- **water scarcity should be a relative criteria, as situation, water demand and vulnerability differs locally**

Drought management



Different phases in water scarcity management (Turton, 1999)

water stress problems

complexity (region, time)
uncertainty

handle **seasonal water supply deficits**

handle **man-made scarcity**

anticipate on water stress in **intensively used agricultural lands**

handle **meteorological droughts & dry spells**

anticipate on **future climate variability**

coping with natural rainfall variability

supply management

large scale irrigation development

demand management

minimise pollution, **increase usable water resources**, closed systems (agroparks)

create **strategic reserves**

combine rain fed and irrigation systems

adapt system operations

increase water productivity of rain fed and irrigated agriculture

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Case study Nile Delta, Egypt

- Egypt completely depends on its annual share of Nile water:
- 1959 Nile Waters Agreement between Egypt and Sudan, Egypt's share of the Nile flow is 55.5 km3/yr. The agreement was based on the average flow of the Nile during the 1900-1959 period, which was 84 km3/yr at Aswan.
- Average annual evaporation and other losses from the Aswan High Dam and reservoir (Lake Nasser) were estimated at 10 km3/yr
- Net usable flow of 74 km3/yr, of which **18.5 km3/yr was allocated to Sudan** and **55.5 km3/yr to Egypt**.
- Rainfall on the northern coast of 1.3 BCM annually comparable neglible

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Case study Nile Delta, Egypt

- Egypt's population 73.4 million (2004), FAO, is growing at a fast rate and the uncertainty in the future size of the population is large.
- Projections of future population growth differ, based on different scenario assumptions:
- According IPCC and Millennium Ecosystem Assessment (MA):
  - Maximum prediction

    150 million in 2050

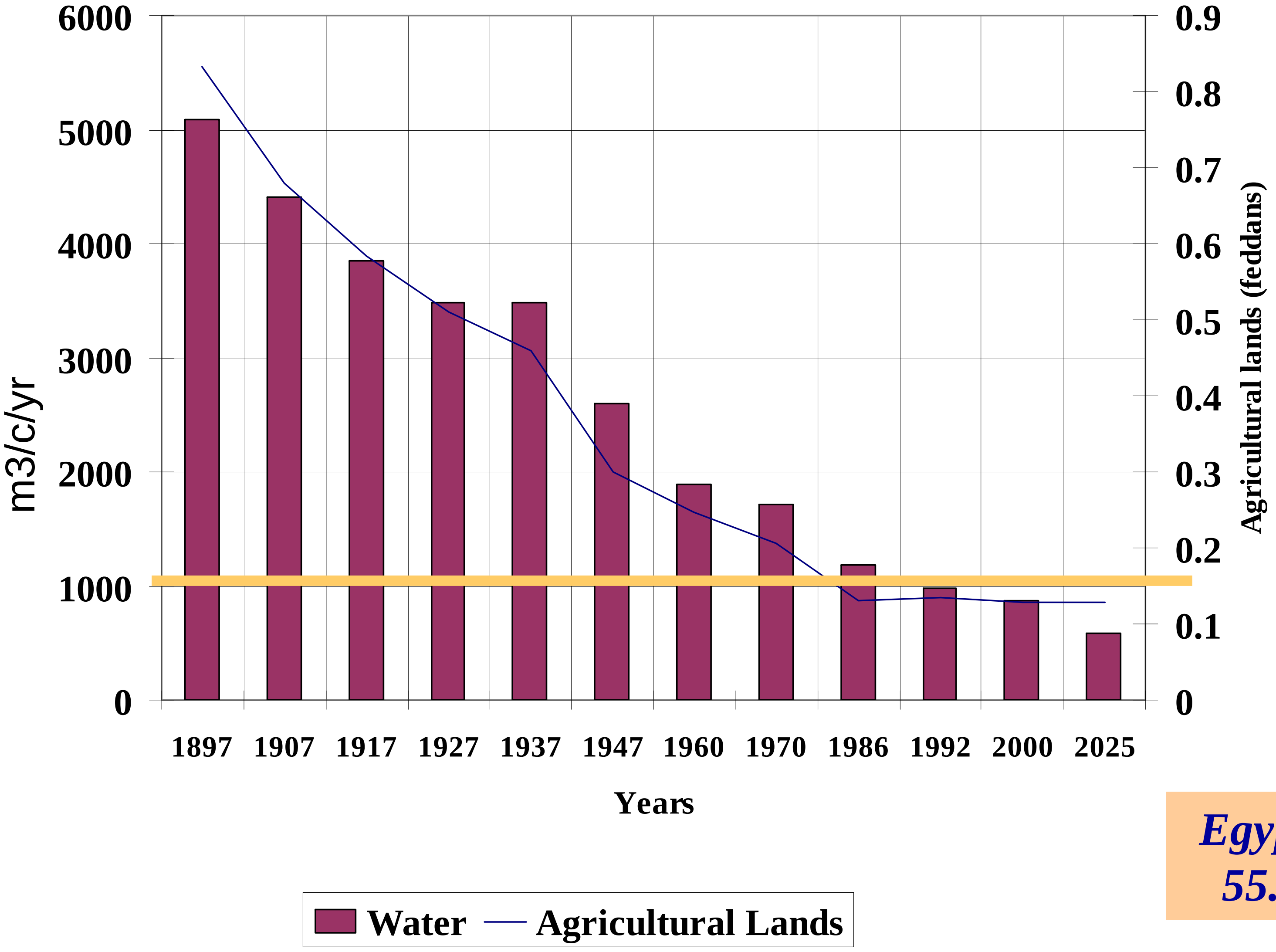
    190 million in the year 2100.

  - Lowest estimate

    120 million inhabitants in 2075

    115 million in 2100.

Case study Nile Delta, Egypt



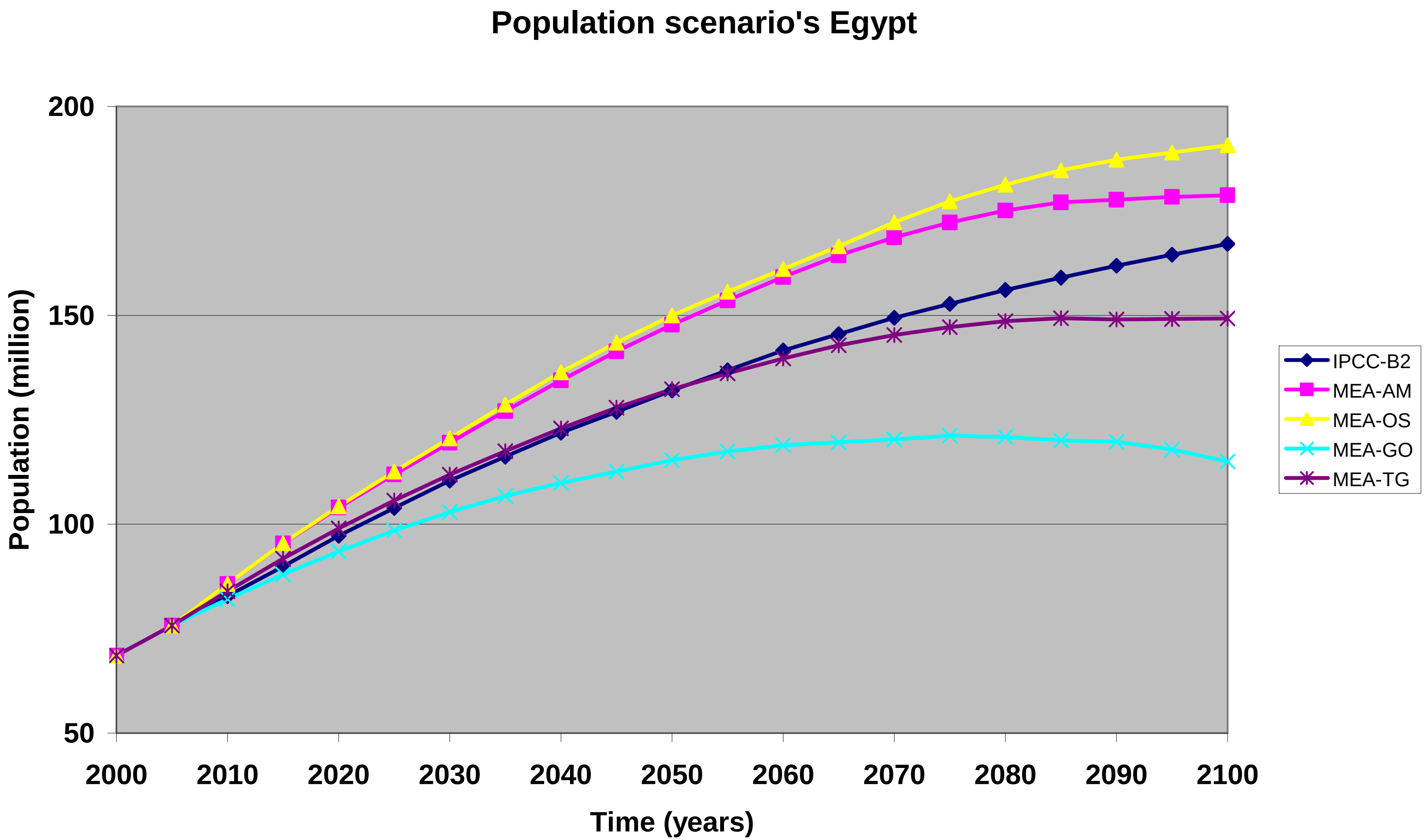
Egypt Quota
55.5 ***BCM***

El-Atfy, 2009

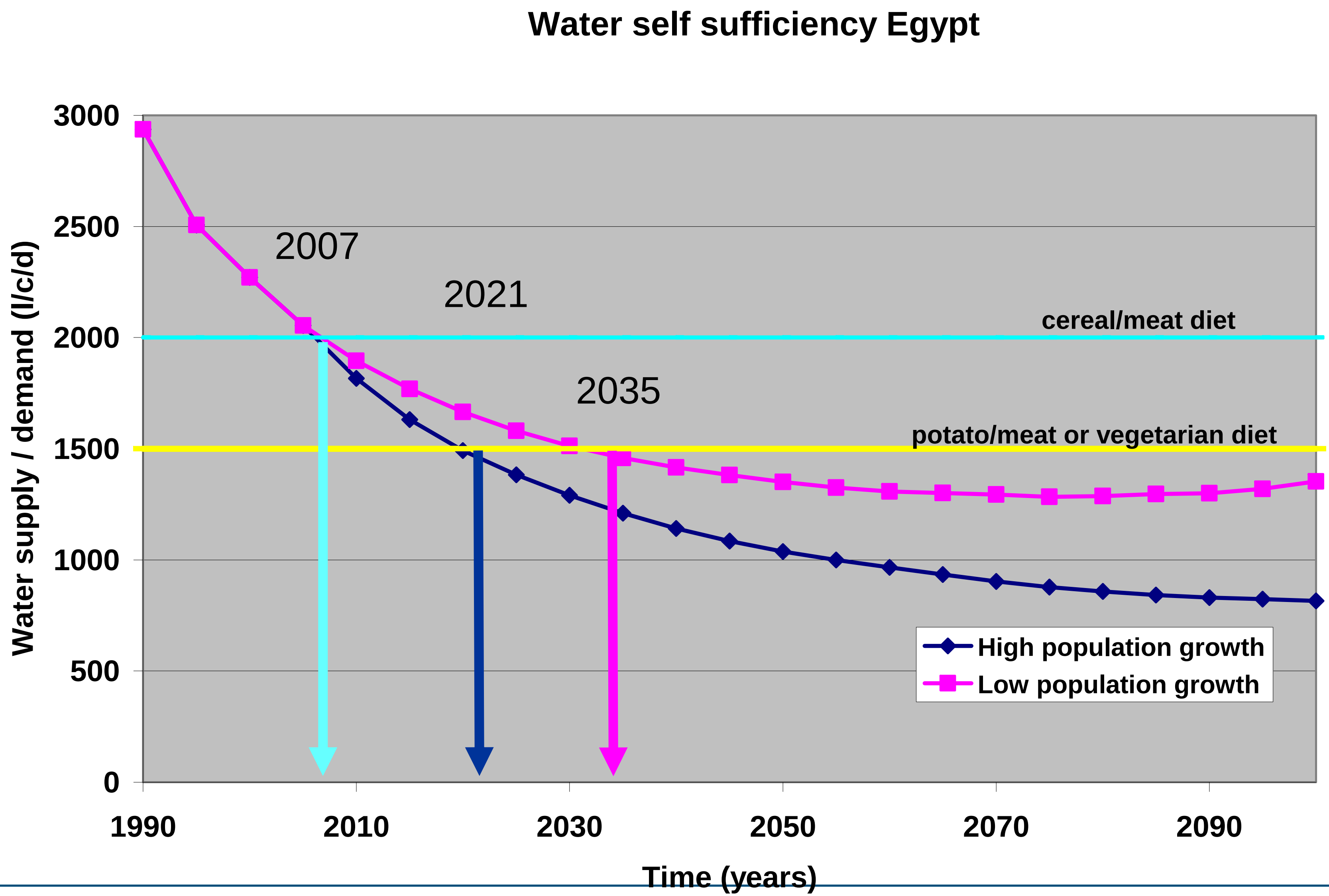
Case study Nile Delta, Egypt

- Water use
  - Water use for drinking, cooking, bathing and flushing:
    100 - 300 l/c/d
  - Consumptive use for food production depends on agricultural productivity and on diet: 1400 - 1700 l/c/d
  - Water needed per inhabitant: 1500 and 2000 l/c/d
- Water Scarcity in Egypt:
  - cereal/meat diet: today (2010)
  - potato/meat or vegetarian diet between 2020 and 2030
- The situation is more severe since no account is made of the water needs for the industrial sector or for the environment!

Case study Nile Delta, Egypt



Case study Nile Delta, Egypt



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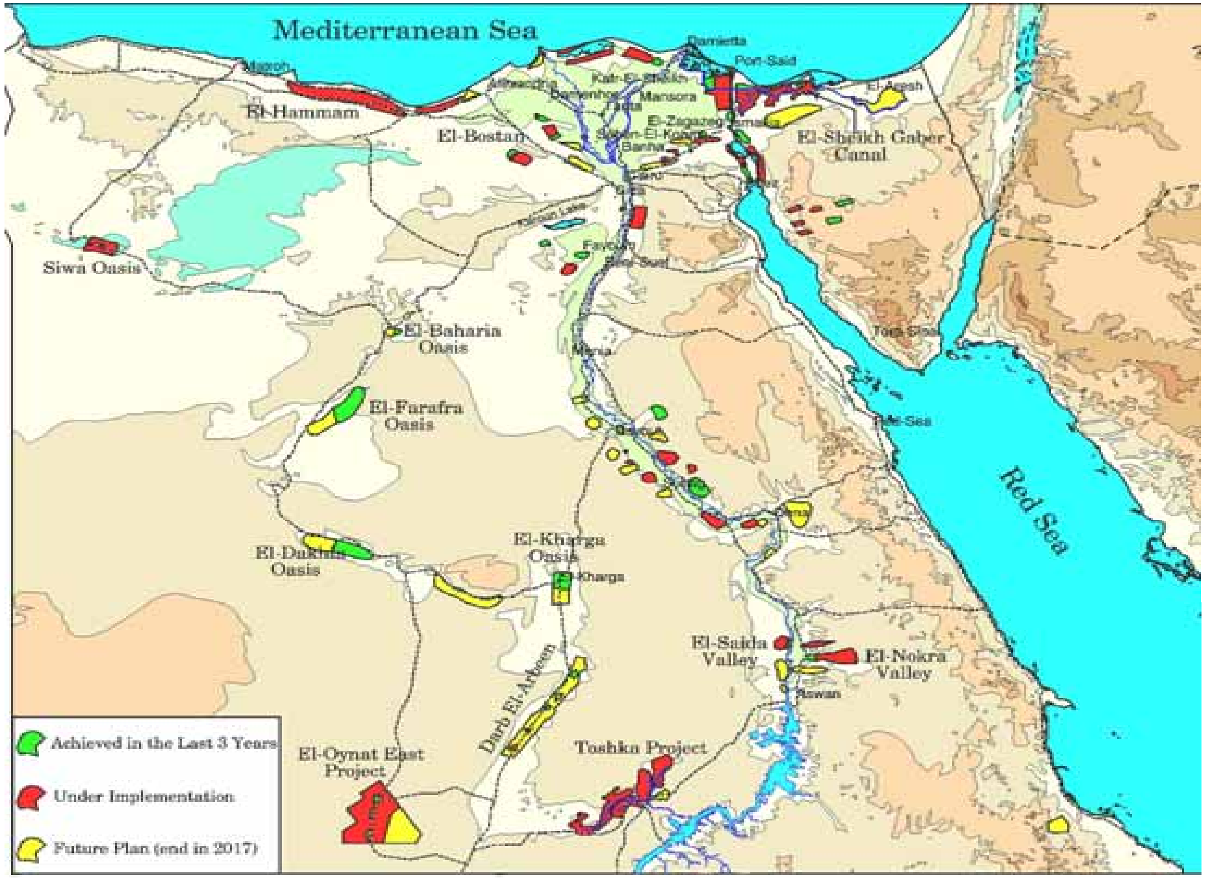
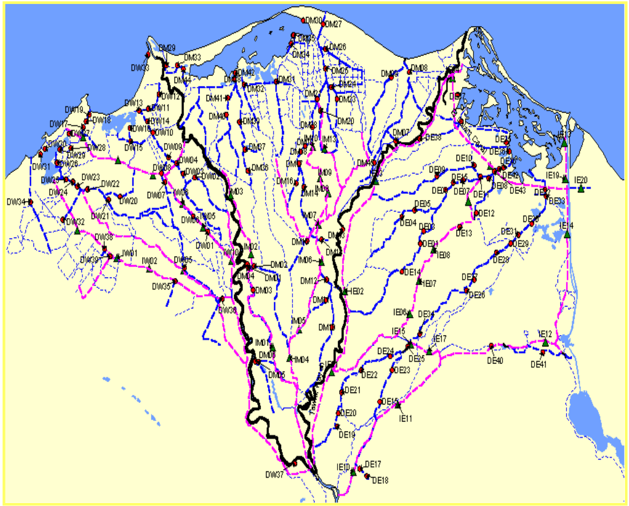


Needs for Managing Water Scarcity

- Agriculture in Egypt is (almost) completely dependent on the Nile water supply
- Egypt is expanding its agricultural area
- Large (mega) projects are being developed in the Egyptian desert

Case study Nile Delta, Egypt

- Existing (subsistence) agriculture in the Nile valley and Delta **has to cope with less water in the future**. The irrigation system in the old lands excels in its simplicity.
- Water is supplied through **open canals through a system of rotation to farmers**. Farmers themselves are responsible for lifting water from these ditches to the agricultural fields.
- Investments in infrastructure will be required **to prevent that farmers at the beginning of canals to use all water**, leaving the canal tail-ends dry.



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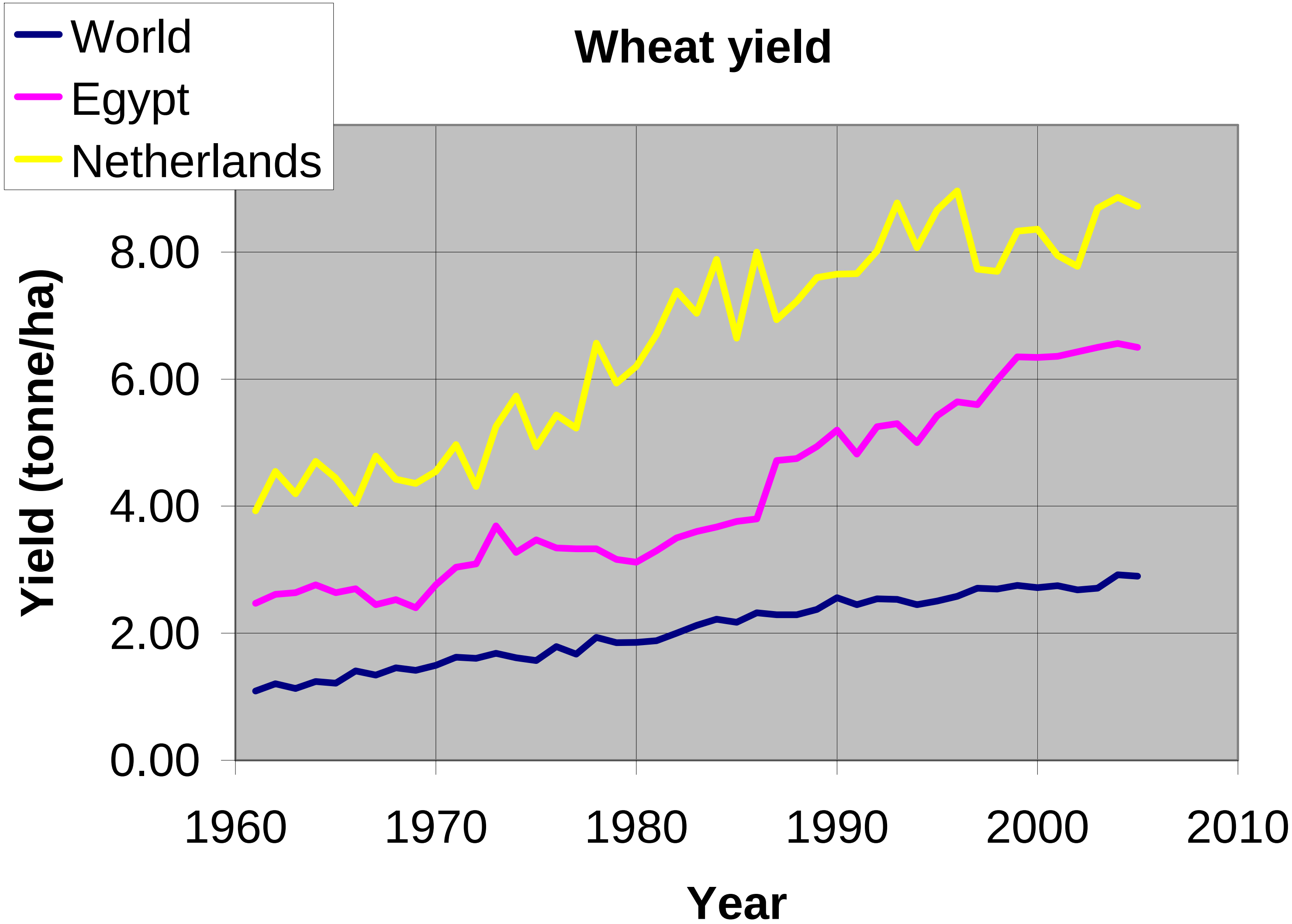
- Since the 1960's the Aswan High Dam enables storing the flood water for more than one growing season and has made it possible for Egyptian farmers **to change from one crop per year to a double cropping system**.
- Today, the cropping **intensity has increased to 210%,** crop yields in Egypt are **among the highest** in the world.
- Yet, the average farmer of today with an area of < 1 ha obtains only 40% of his income from the farm. The other **60% originates from other non-farming activities**.

Case study Nile Delta, Egypt



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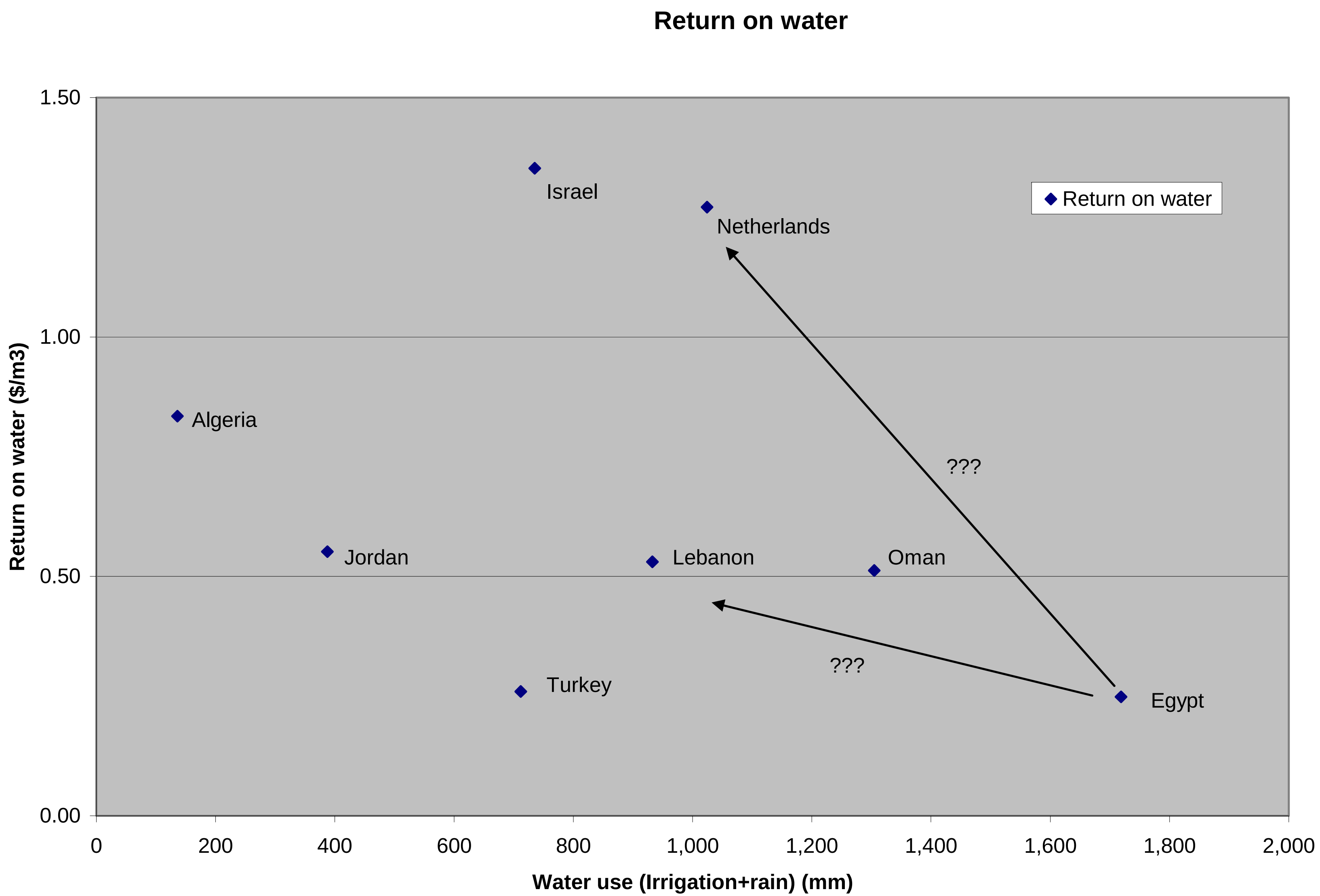


Case study Nile Delta, Egypt

- Increasing yields / m3 not more an option.
- To anticipate pressing water scarcity and to stabilize economic development in the Nile Delta **fundamental paradigm shifts** are required.
- Major Question for the Delta **not only how to have a higher return, but how to maintain crop yields AND financial return with LESS WATER.**

Case study Nile Delta, Egypt

Field scale: do we do the things right under reduced water availability?

- Do we apply proper crop management (fertilizer and agrochemicals at the right place and time)?
- Do we supply sufficient water at the right moment and in the right quantities?;
- How can we improve crop yields (and crop quality) within the existing boundary conditions (input markets, water supply, soil and weather, etc.).

Farm level: Do we do the right things?

- Innovations in agronomy of crops commonly grown is expected to have limited effects.
- The farming system itself needs innovations, which can be triggered by water shortage. Such innovations have to come from farmers themselves.
- Farmers can be stimulated, though, by providing knowledge, economic incentives and by relaxing presently restricting rules which may hamper innovations.

Community level: Can we do better by cooperating together?

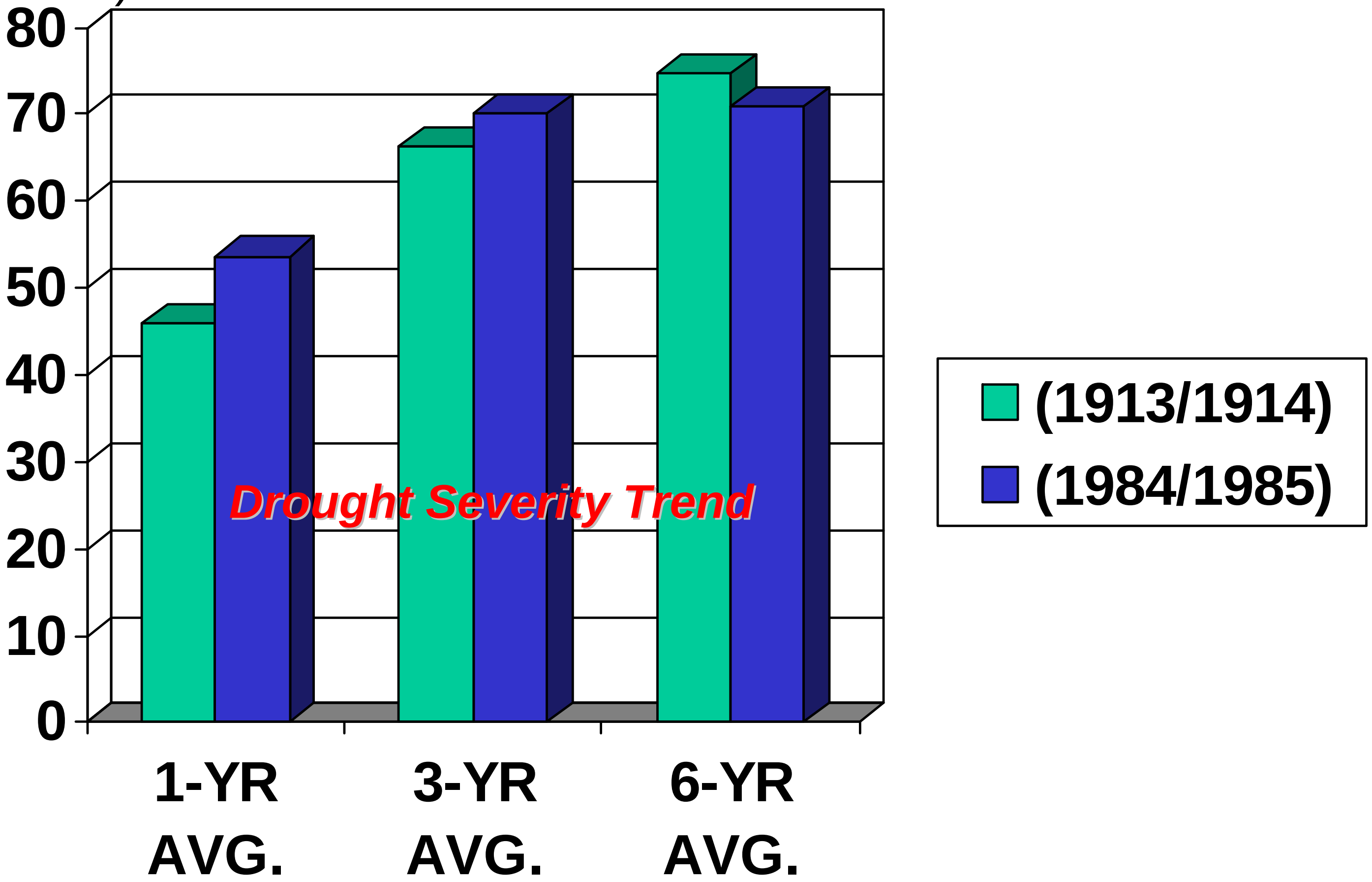
- Innovations at community level can relate
  - to market access,
  - to synergy between different farms (using each others rest products),
  - storing water to improve water security,
  - trading water rights,
  - possibly by using rest products from villages such as wastewater and manure, etc.

Case study Nile Delta, Egypt

Impact of water scrarcity on drought resilience

Case study Nile Delta, Egypt

- When AHD storage slipped below 60 Billion m3, MWRI applied a sliding scale to reduce total water releases below 55.5 Billion m3 (annual Egypt's share from the Nile).



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Measures Implemented to manage 1980's drought

- Demand-based water releases in all canals.
- Time-restricted scheduling of navigational demands.
- Optimization of hydropower generation.
- Extensive reuse of drainage water.
- Increased, but stressed use of groundwater.
- Minimization of water disposed to the Mediterranean Sea and Northern Lakes.
- Transparency with stakeholders and media.
- Rapid assessment studies conducted in the course of drought management.

Principal Conclusion

- Appropriate preparedness is critical
- Availability and maintenance of reserves is critical
- Prioritization of water uses need to be adressed
- Risk management including the determination of irreversible damages is needed

Drought management

Priority list for water use (Example from NL

Category 1 safety and prevention of irreversible damage	**Category 2** Public utilities	**Category 3** small-scale use with high added value	**Category 4** Other uses (economic considerations, also for nature)
1. stability of dikes 2. soil compaction (peat) 3. nature (connected to soil characteristics)	1. drinking water 2. energy production	• temporary sprinkling of capital-intensive crops • process water	• shipping • agriculture • nature (as long as no irreversible damage is done) • industry • recreation • fishery
precedes →	precedes →	precedes →	

Drought management

Country	High priority → → → Low priority	Source
Cyprus	Domestic → permanent crops + greenhouses → other agriculture	Iglesias et al, 2007
Italy	→ Permanent crops → other agriculture	Iglesias et al, 2007
Egypt	Drinking water → industrial supply → agriculture → hydropower	NWRP, 2005
Morocco	Potable water → livestock water →	Iglesias et al, 2007
Spain	Urban Water → irrigation → hydro-power → industry → fish farming → recreation → navigation	EC, 2007
Netherlands	Safety + Irrecoverable Damage → drinking water + energy (cooling) → process water + high value crops → all other uses	Min V&W website

Linking water scarcity and drought management

Phase	Step	Responsible
Prepardness	Awareness	National Governments - RBA
	Determine Damage to accept	National Governments Regional details to be given by RBA
	Prioritization	National Governments - RBA
Pre-Drought "action"	Water scarcity management	National Government, RBA and users
	Increase of buffer capacity	National Government, RBA, WUA, WU
	Adaptive capacity	RBA
During Drought "action"	Pre-alert	RBA
	Alert	RBA
	Emergency	RBA
Post Drought "action"	Drought recovery / Restoration	RBA – National Governments

Conclusions

- Water scarcity is a structural deficit, and need to be tackled during the non-drought periods. This have to go along with paradigm changes in particular in the agricultural sector.
- New innovation cycles should be stimulated to motivate the farmers to produce differently with less water.
- Groundwater storage provide if aquifers are available the most effective reservoir to mitigate water shortages during droughts.
- There is a need for an active regeneration of GW storage during the wet periods with similar restrictions in overuse as sometimes met during the drought.
- Indicator systems are required to allow for a differentiation of drought as a irregular phenomen and water scarcity as a man made problem.
- Water quality management need to be included by extending the term Water Scarcity towards Water Stress

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