Importance and Challenges of IWRM for Managing the Quality of the Nile System in Egypt

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The Country Context - Egypt

- about 1 million km^2
- population was 2.5 million in 1800
- population increased from 38 million in 1977 to about 84 million today

Population distribution

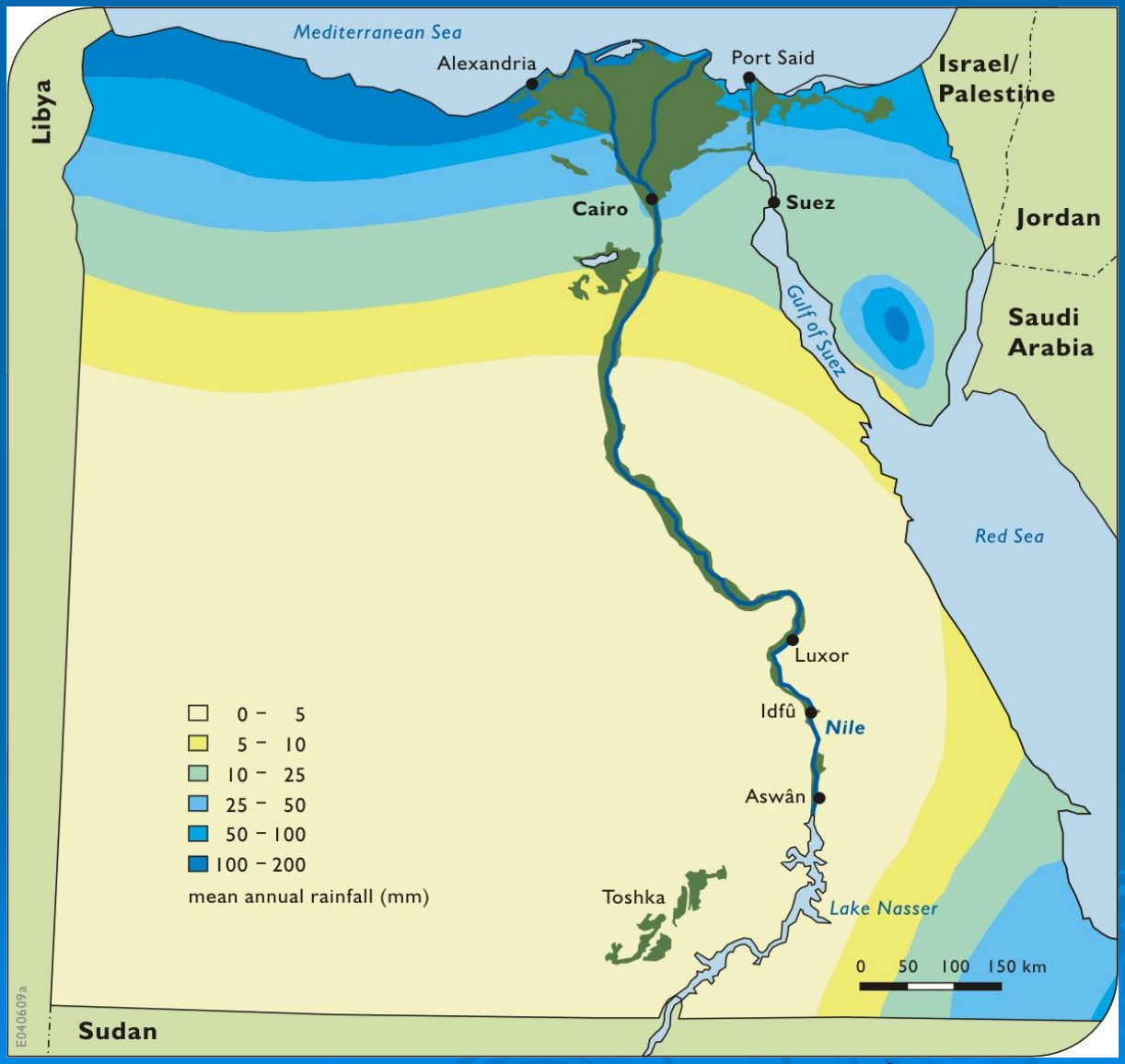
- 97% of the population lives on 4% of the land

The Water Resources System

Renewable water resources

- Nile water: 55.5 billion m^3/yr
- Rainfall: about 1.3 billion m^3/yr

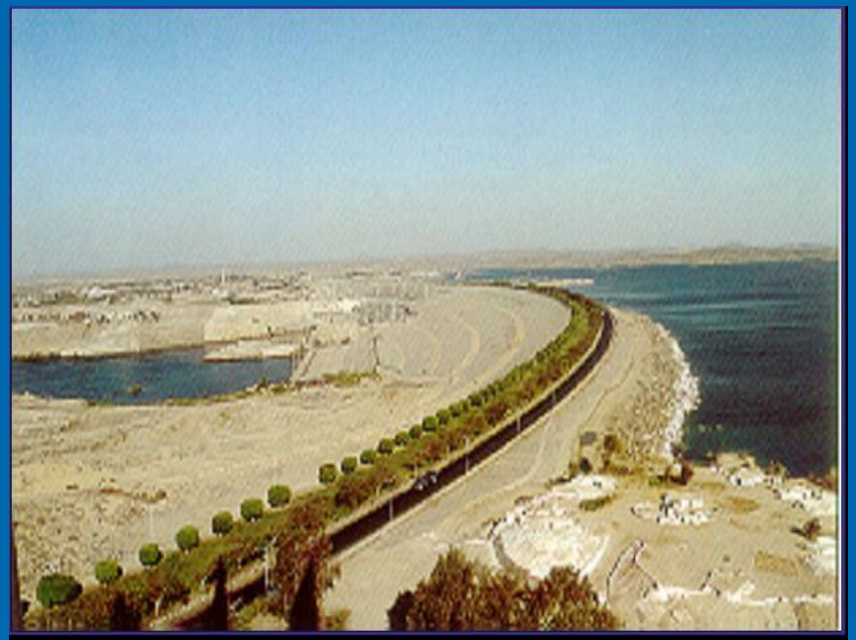
Average annual rainfall in Egypt



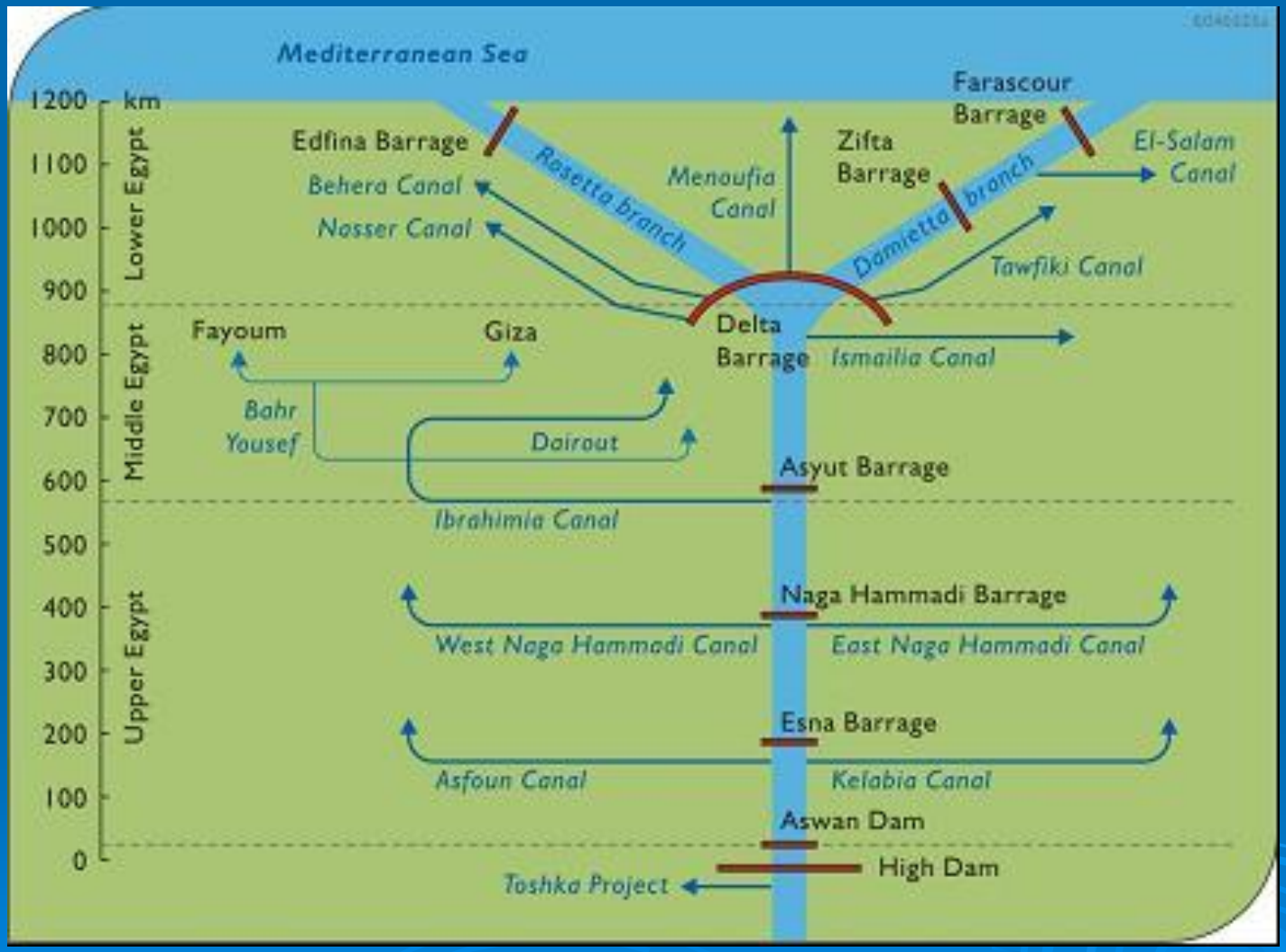
Major water-related infrastructure

Dams and Barrages

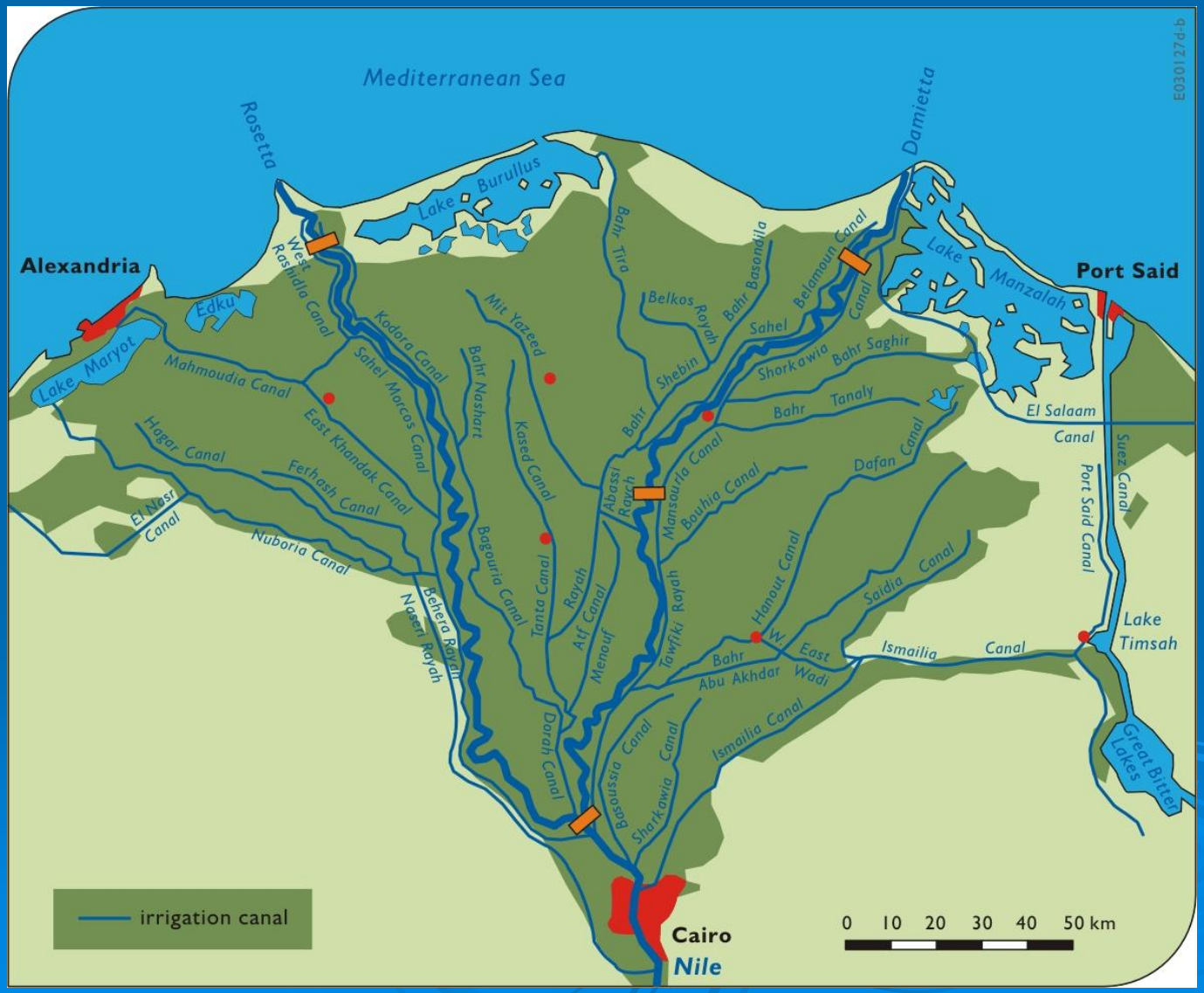
- Old Aswan Dam (1902) - 1 BCM
- High Aswan Dam (1964) - 168.9 BCM



High Dam at Aswan


Mediterranean Sea
1200
km
1100
1000
900
800
700
600
500
400
300
200
100
0
Lower Egypt
Middle Egypt
Upper Egypt
Edfina Barrage
Rosetta branch
Farascour Barrage
Zifta Barrage
El-Salam Canal
Damietta branch
Menoufia Canal
Behera Canal
Nasser Canal
Tawfiki Canal
Delta Barrage
Ismailia Canal
Fayoum
Giza
Bahr Yousef
Dairout
Asyut Barrage
Ibrahimia Canal
Naga Hammadi Barrage
West Naga Hammadi Canal
East Naga Hammadi Canal
Esna Barrage
Asfoun Canal
Kelabia Canal
Aswan Dam
High Dam
Toshka Project

Irrigation Canals in the Delta



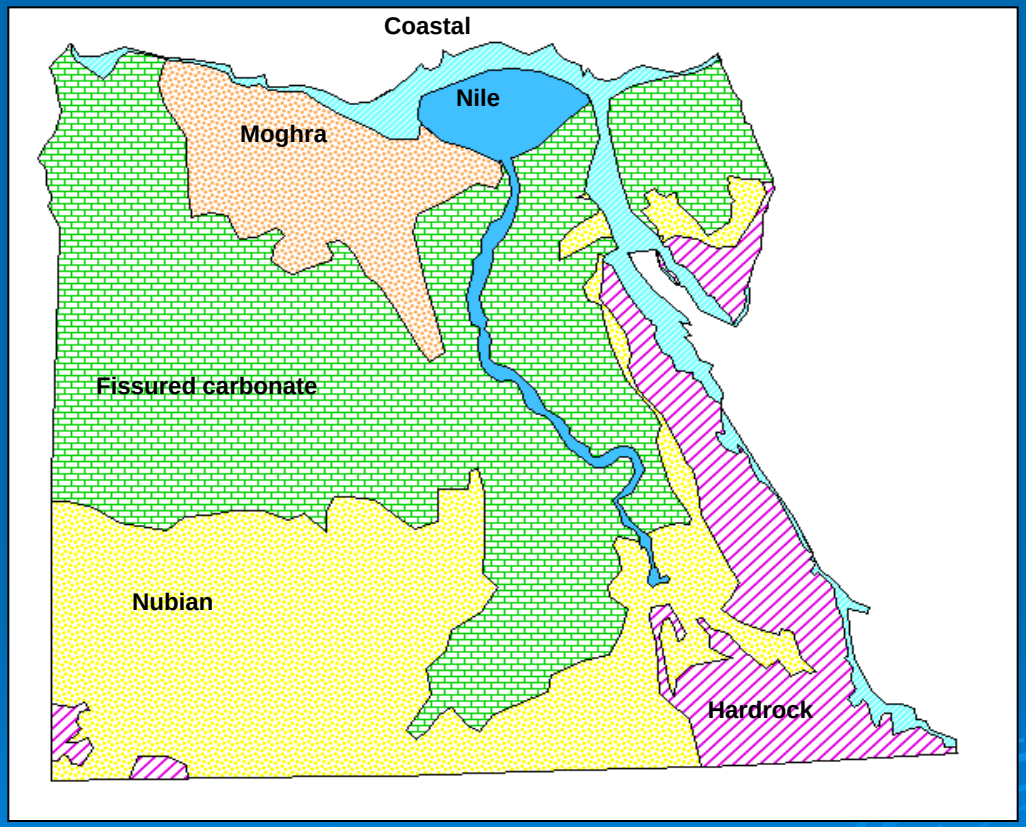
The Drainage System

- Field (open & covered) - collector - main
- Flow either back to Nile or to Canals or to (coastal or inland) lakes or to the sea
- effluents from agriculture but increasingly also from municipalities & industries

Groundwater

- Nile aquifer (ca 87% of total abstraction)
- Nubian sandstone aquifer (2 Mil. Km2)
- Fissured carbonate aquifer (on top of NSS)
- Moghra aquifer (Western Desert)
- Coastal aquifer (recharged by rainfall in winter)

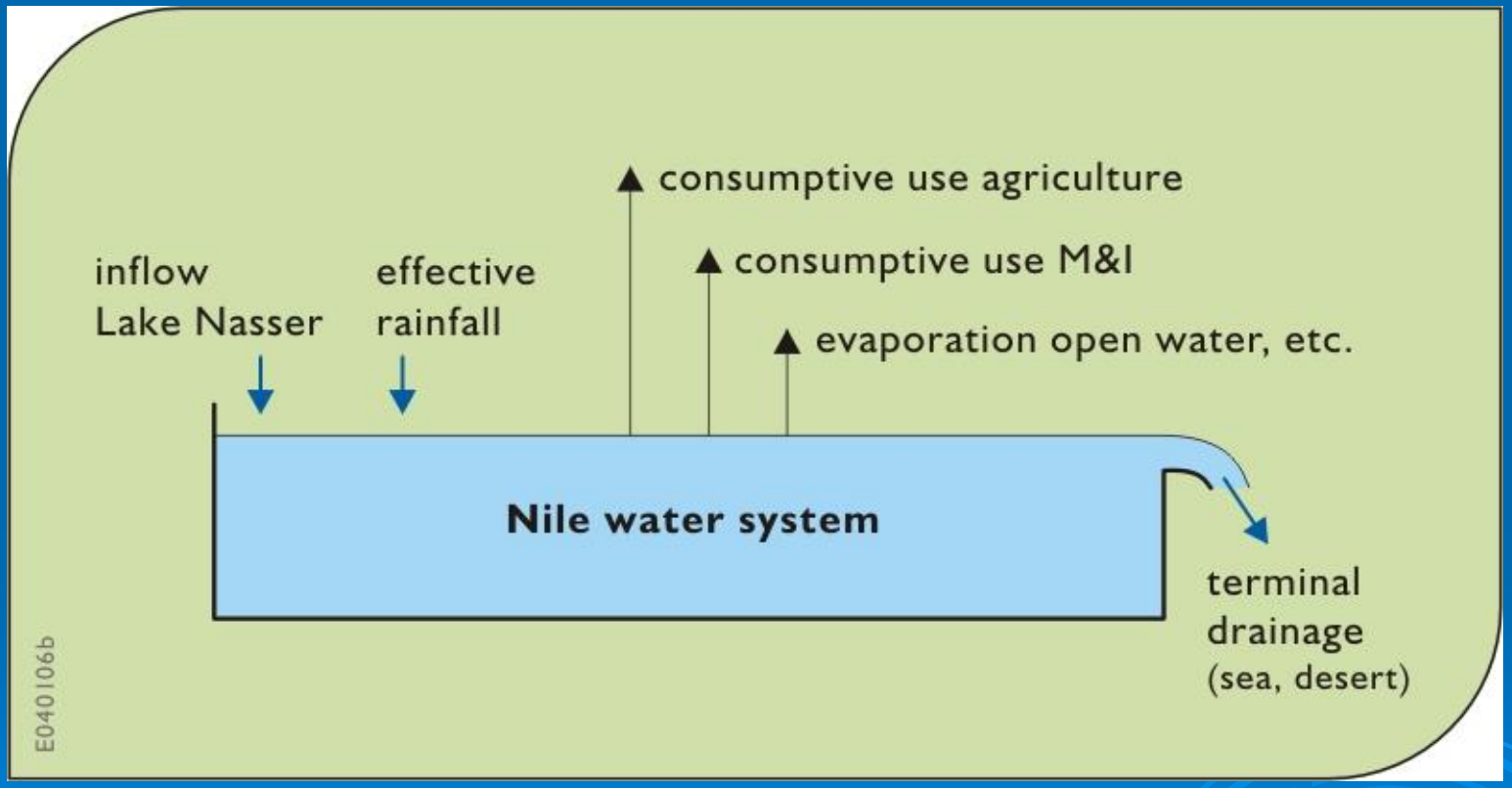
Major aquifer systems in Egypt



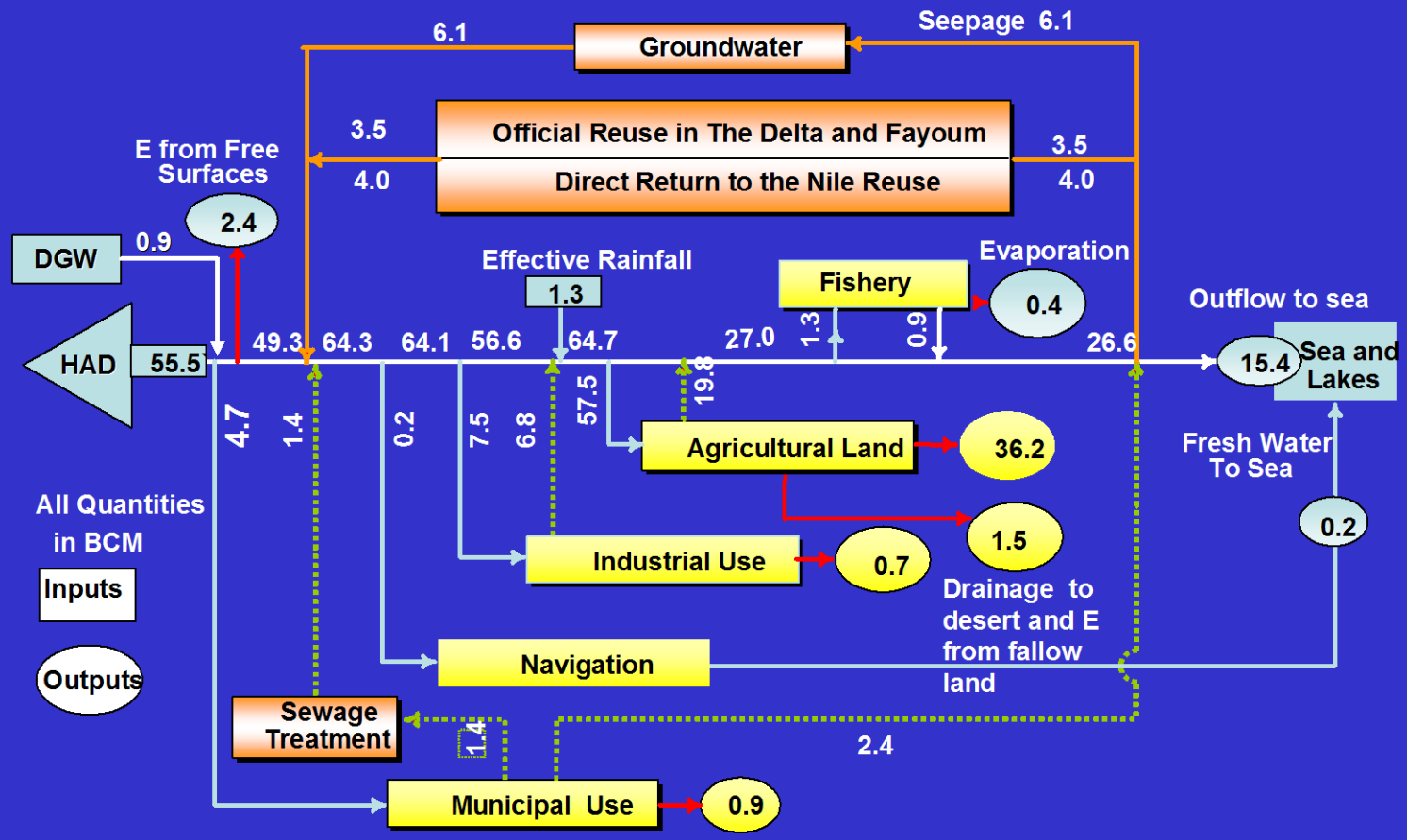
Other Water Resources

- Flash flood harvesting
- Rainfall harvesting
- Desalination

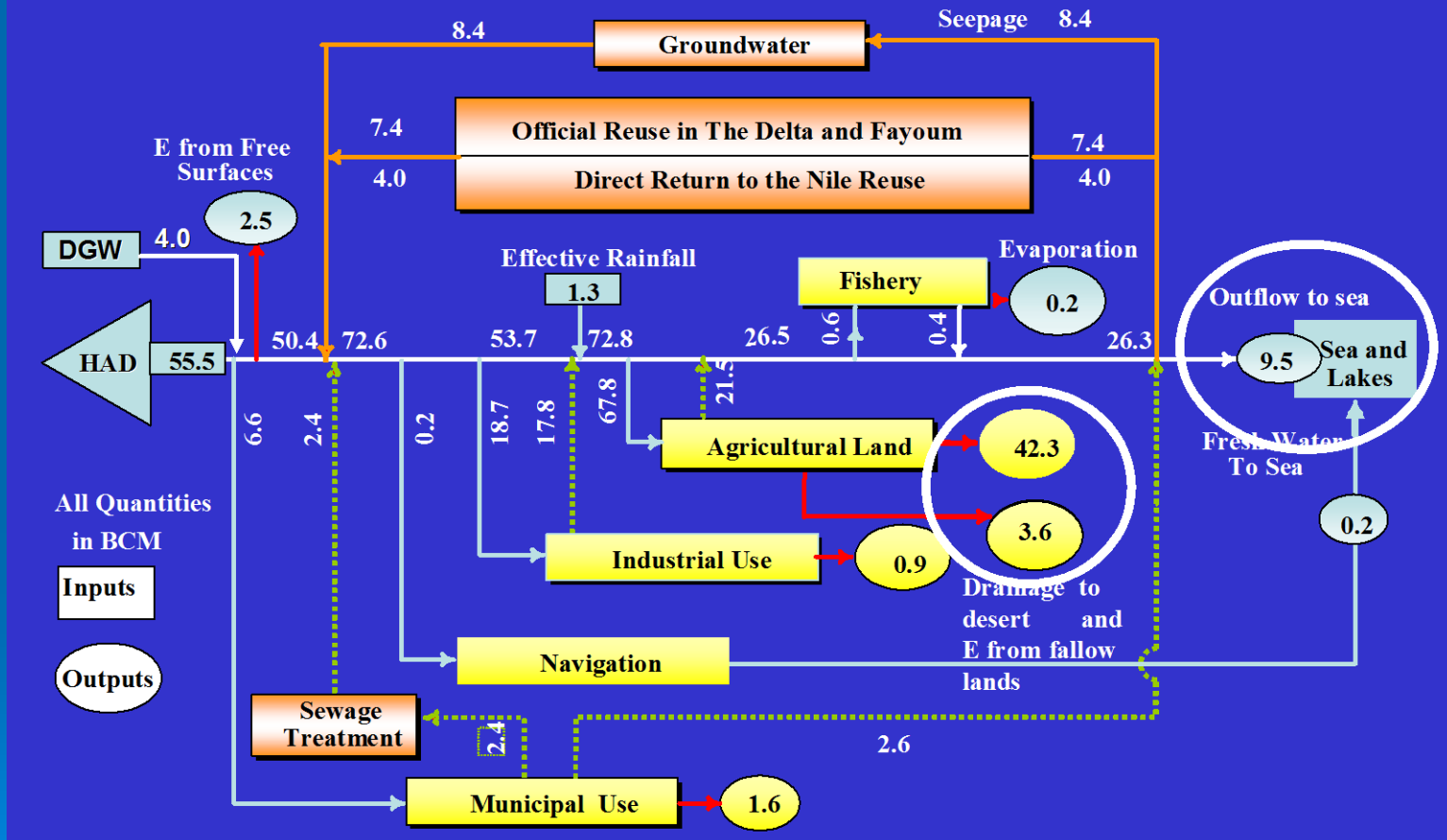
The water balance of Egypt



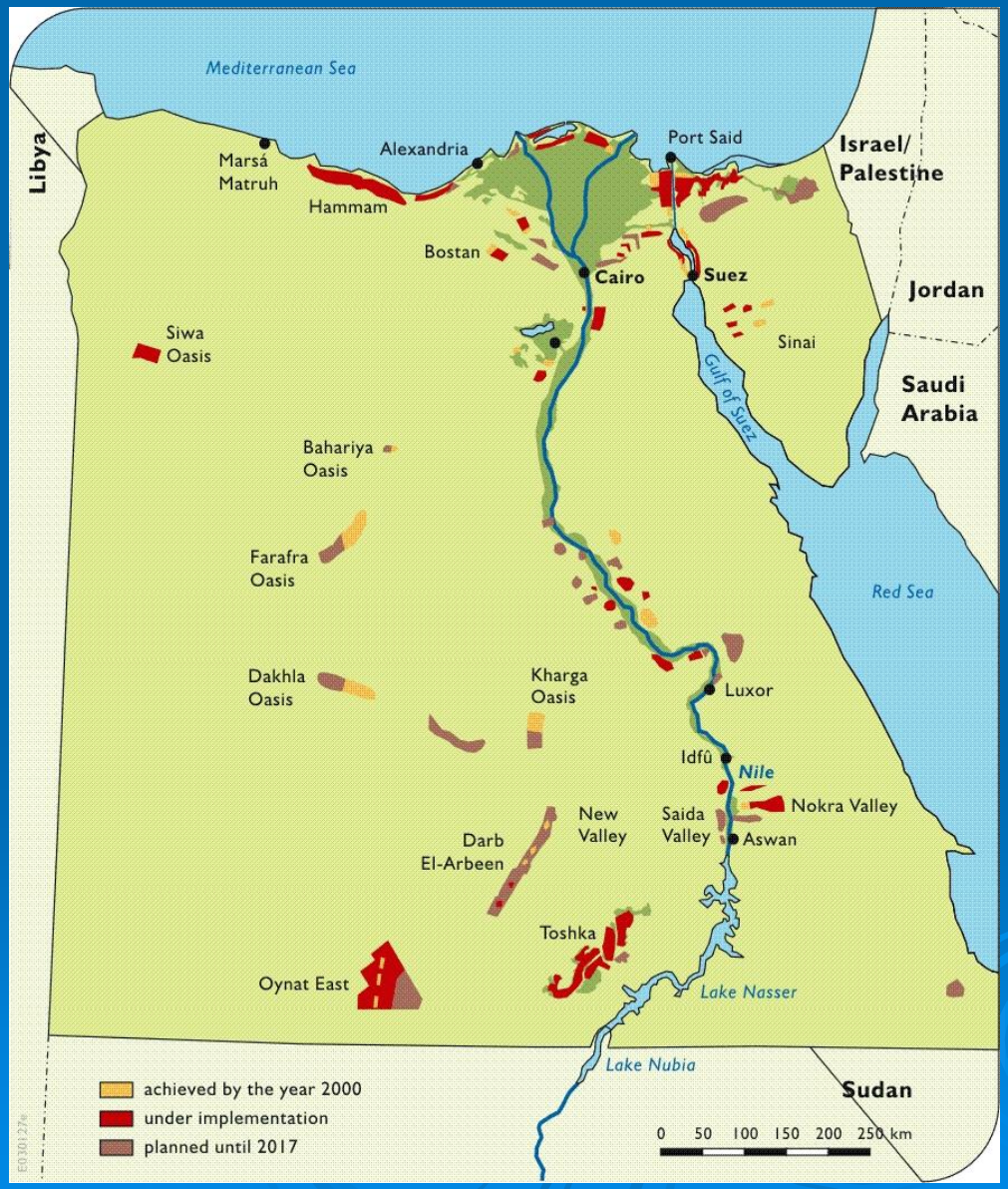
Water Balance 1997



Water Balance 2017



Horizontal expansion projects



Previous Water Policies

- Water Policy 1975
- Water Master Plan 1980
- Water policy 1982

} Supply Management

- Water Policy 1997

→ Supply&Demand Management

- National Water Resources Plan 2005

→ IWRM

What is expected by 2017

- Population increase by 30%
- Increase in standard of living
- Agricultural lands increase from 7.9 to 10.3 M feddan (43%)
- Municipal use increases from 4.7 to 6.6 BCM (40%)
- Industrial use increases from 7.5 to 18.7 (150%)
- Increase in pollution loads

Assumptions

- Agricultural water consumption per feddan decreases by 27%
- Yet drainage water reuse increases from 7.5 to 11.4 BCM (52%)
- Groundwater recharge/withdrawal increases from 6.1 to 8.4 BCM (

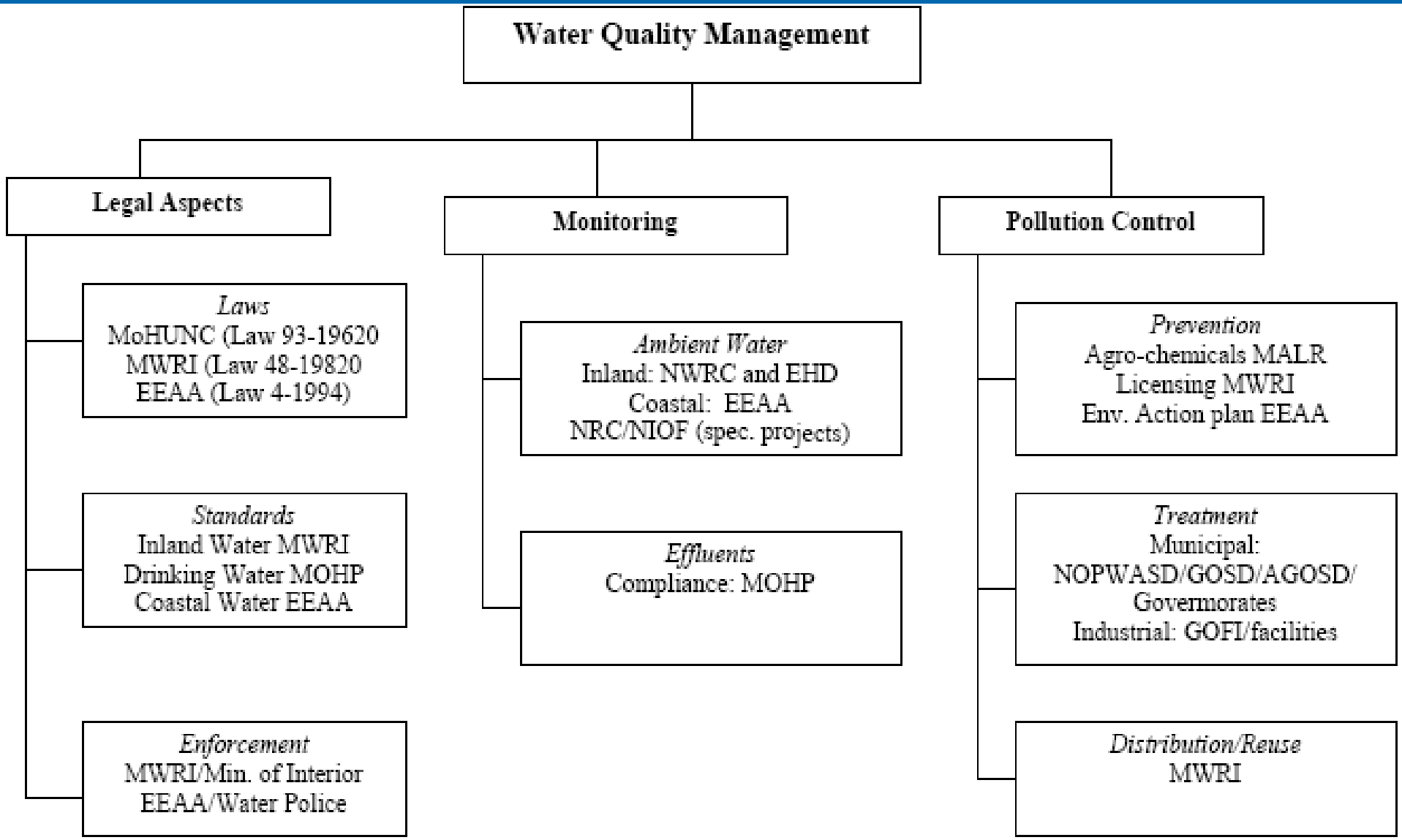
The main issues: Water quantity

- how can the efficiency of the various uses be increased?
- how can the agricultural expansion policies of the government be supported and what are the priorities and limitations in this expansion, given existing water resources, optimum efficiency and priority for drinking and industrial water use?
- how should Egypt manage its water resources system under variable supply conditions?

The main issues: Water quality

- what is the best mix of prevention, treatment and protection measures that results in a water quality that complies with reasonable standards?
- what is the level of investment needed to provide all people with safe drinking water and adequate sanitation facilities?
- what institutional mechanisms should be developed that can best cope with the increased pressure on the water resources in the country?

Responsibilities in Water Quality Management



Recommended Measures/Actions
Water Quantity Management Measures

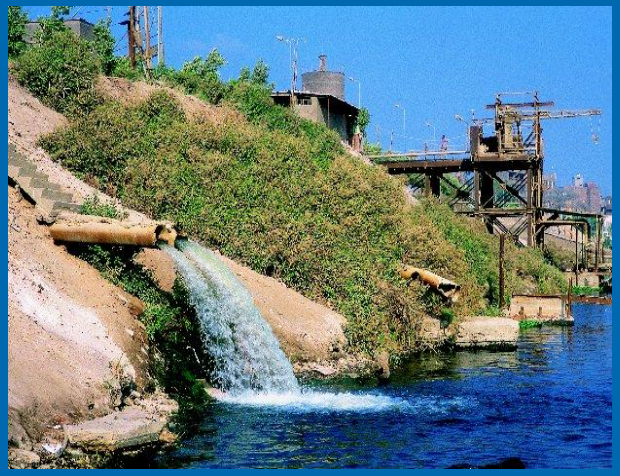
			Stakeholders															
			Nat. Water Council / MWRI	Min.of Water Res.& Irrig.	Min.of Agric.& Land Recl.	Ministry of Industry	Ministry of Environment	Ministry of Housing	Ministry of Health	Ministry of Electricity	Min. of Transportation	Ministry of Planning	Min. of Local Developm.	Ministry of Tourism	NGOs, etc.	WUAs / Water Boards	Directorates/Decentr.Org.	Private Sector
Develop more resources	Nile	Continue co-operation with the Nile countries	O	●														
	Groundwater	Groundwater development Western Desert		●	O													X
		Groundw.developm. Sinai and Eastern Desert		●	O													X
		Development brackish groundwater for agriculture and aquaculture		●	O													X
		Increase management of shallow groundwater		●	O		X	X								X		X
	Rainfall/ flash fl.	Stimulate rainfall harvesting / *groundwater infiltration* along Northern coast		●	O								O					X
		Stimulate *on-farm* rainfall harvesting along Northern coast		O	●								O					
		Flash floods harvesting in Sinai and Eastern Desert		●									O					X
	Desal.	Increase brackish / salt water desalination		O										O				●
	Horiz. exp.	Continue planned horizontal expansion projects (postponing Middle Sinai development and making further development dependent on availability)		●	O							X						O
	Irrigation efficiency Nile system	Prioritise efficiency measures in effective areas		●	O											O	O	
		Continue IIP in prioritised areas / IIIMP		●	O											O		X
		Strengthen Irrigation Advisory Service		●	O											O	O	X
		Apply canal lining in effective stretches		●												O		
		Apply land-leveling with laser techniques		O	●											O		O
		Introduce controlled drainage during rice cultivation		●	O											O		O
		Improve drainage conditions (EPADP)		●	O											O		
		Apply modern irrigation techniques in new areas		●	O													O
		Gradually introduce modern irrigation techniques in oases		●	O													O
		Control well discharges in desert areas		●														X
		Reduce irrigation supply after rainfall		●												O		

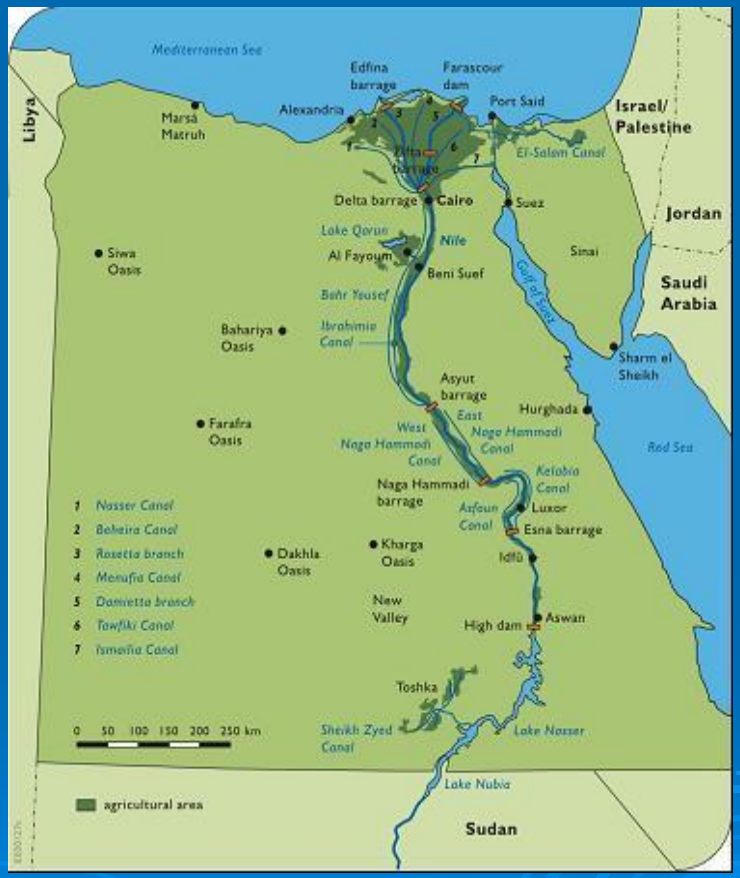
Recommended Measures/Actions Water Quality and Institutional Reform

		Stakeholders															
		National Water Council / MWRI	Ministry of Water Resources and Irrigation	Ministry of Agriculture and Land Reclamatio	Ministry of Industry	Ministry of Environment	Ministry of Housing	Ministry of Health	Ministry of Electricity	Ministry of Transportation	Ministry of Planning	Ministry of Local Development	Ministry of Tourism	NGOs/ Community Based Organisation	Water Users Associations/Water Boards	Directorates/Decentral Organisations	Private Sector and Investor Groups
r Quality Management Measures – Prevention	Introduce financial incentives to promote clean industrial products		x		●	O		O									O
	Start public disclosure pollution control program for industries				O	●		O						O			O
	Introduce compliance action agreements for industries				O	●		O									O
	Initiate public awareness campaigns for clean industrial production				O	●		x						O			O
	Initiate water quality awareness campaings		O		O	●						O		O			
	Phase out and relocate polluting industries along vital waters		x		●	O		x									O
	Introduce load based discharge levies		●		O	O											
	Strengthen institutions controlling and monitoring industrial pollution		O		O	●		O									
	Encourage use of environmentally friendly agricultural methods			●		O											
	Control the production and import of agrochemicals			●	O	O											
	Control the use of organic fertilisers			●		O								O			
Treatment	Increase municipal sewerage and wastewater treatment		O				●	O				O					
	Increase drinking water treatment capacities		O				●	O				O					
	Initiate cost recovery for urban and rural sanitary services						O					●					
	Start local action plans on domestic sanitation in rural areas						O					●		O		O	
	Encourage treatment or pre-treatment of industrial wastewater by industries		O		O	●		x									O
	Collect and/or pre-treat industrial wastewater separately		O		●	O											O

Water C	separately		o		●	o											o
	Control	Define functions of waterways	o	●	o		o	o	o		o						o	
		Define water quality standards based on receiving water		o			o	o	●								o	
		Include reduction of human contact with polluted water in local action plans		o					o				●		o			
		Divert pollution from Northern Lakes		●			o		x					x				
		Protect groundwater from pollution in particular around wells		●					o						o			
		Select proper sources for public water supply		o				●	o				o		x		o	
		Provide sewage disposal systems in unconnected areas		x			o	o					●		o			
	Institutional	Enhance water quality monitoring and information dissemination		●			o		o						o		o	
		Train MWRI and WB staff on pollution and water quality		●												o	o	
Institutional Reform	Institutional r	Restructure the role of MWRI		●												o	o	
		Restructure MWRI - establish integrated water management districts		●												o	o	
	Fin./priv.	Stimulate Private Sector participation in infrastructure and O&M		●													x	o
		Implement systems of cost sharing and cost recovery for all water users		●													o	o
	Planning / co-operation	Continue water sector planning as a rolling exercise	●	o	o	x	o	o	o	x	o	x	o	x	x	o	o	x
		Enhance data exchange among different authorities	●	o	o	x	o	o	o	x	o	x	o	x	x	o	o	x
		Co-ordinate investments on the regional and national levels	o	o	o	o	o	o	o			●	o				o	o
		Establish permanent inter-misterial High Committee on IWRM (NWC)	●	o	o	o	o	o	o	x	o	o	o	x			x	
		Enhance role of NGO's and Civil Society (e.g. in local action plans)	●	o									o		o		o	

Water quality





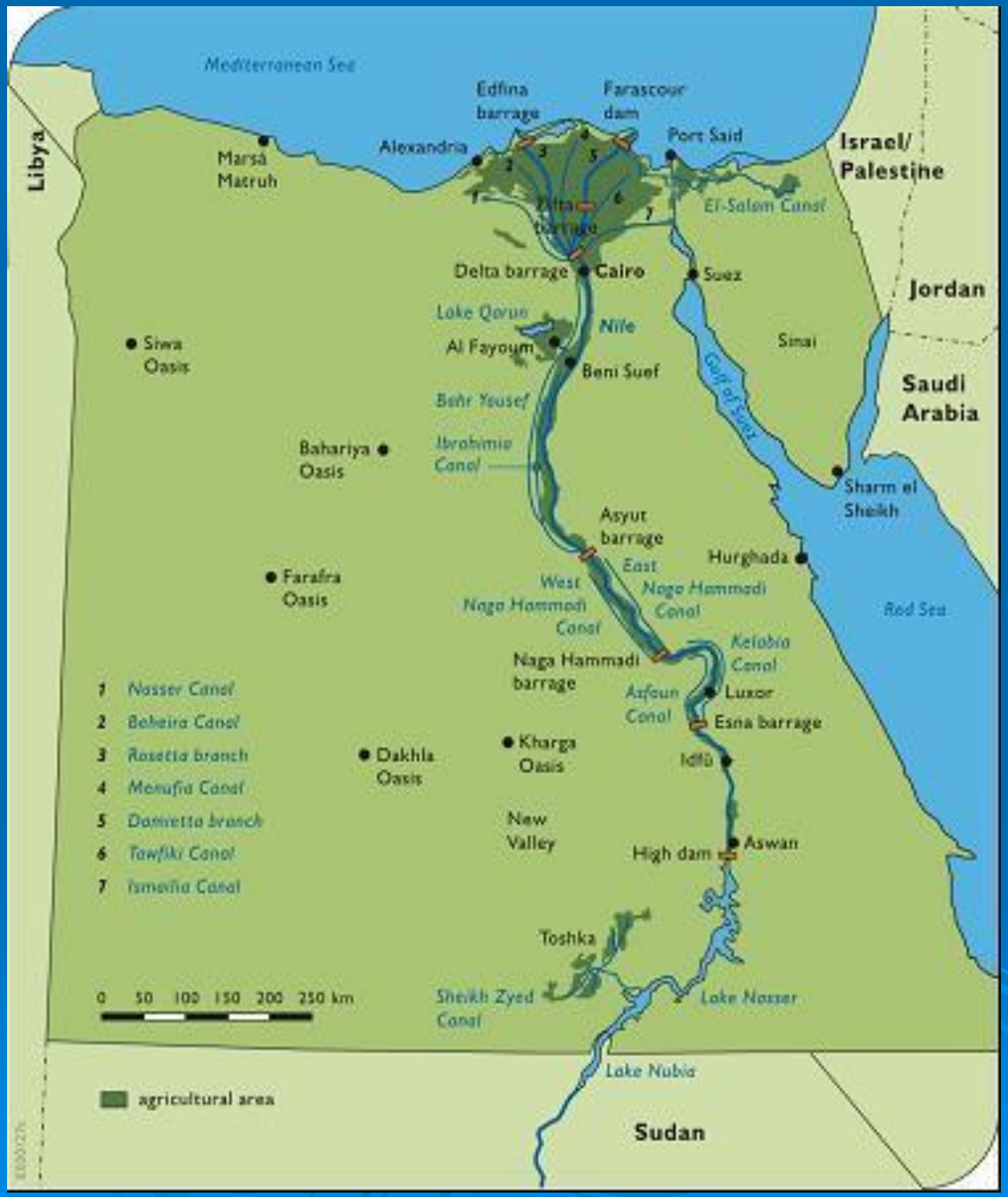
Issues related to water quality

- Drainage water reuse
  - 64 major drains discharge drainage water to the Nile between Aswan Dam and Delta Barrage
  - In the Delta reuse pump stations pump drainage water from major drains to major canals (22 constructed, 8 stopped due to excessive pollution, 14 in operation)
  - Agricultural drainage water is receiving increasing amounts of (largely untreated) domestic and industrial wastewater, as well as solid wastes
  - The use of drainage water in fish farms leads to the production of polluted fish

Water supply and sanitation

- More than 95% drinking water coverage
- Quality of drinking water
- Sanitation coverage only 50% urban and 10% rural areas
- Traditionally septic tanks in villages
- Problems of septic tanks
- Construction of wastewater collection systems by locals discharging directly to drains

Drinking/ Industrial Water Supply



Drinking Water Coverage in Egypt

Source of drinking water	Total Urban	Total Rural	Urban govern'tes	Lower Egypt			Upper Egypt			Frontier govern'tes	Weighted average
				total	urban	rural	total	urban	rural		
Piped Water	96.6	69.5	99.0	85.9	98.3	79.8	68.0	90.9	55.7	50.4	83.3
Into residence	92.5	53.3	94.7	71.6	94.5	60.2	58.8	86.7	43.8	49.5	73.2
Public tap	4.1	16.2	4.3	14.3	3.8	19.6	9.2	4.2	11.9	0.9	10.1
Well water	1.1	25.5	0.1	11.2	0.5	16.5	26.2	4.0	38.1	4.3	13.1
In residence	0.7	13.3	0.1	6.8	0.3	10.0	12.6	2.7	18.0	1.3	6.9
Public	0.4	12.2	-	4.4	0.2	6.5	13.6	1.3	20.1	3.0	6.2
Nile/canal	-	0.3	-	0.1	-	0.1	0.3	-	0.5	0.1	0.1
Other	2.3	4.7	0.9	2.8	1.2	3.6	5.5	5.1	5.7	45.2	3.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: El-Zanaty, 1996: Demographic and Health Survey, 1995

There is a nationwide need for (additional) treatment at household level

Issues related to sanitation

- Stringent discharge standards (limiting use of low-cost technologies)
- Construction of new treatment plants without sufficient attention to treatment efficiency of existing plants
- Not enough public interest to treat
- Limited land in densely populated villages
- Other wastes

Some efforts

- Piloting low-cost sanitation
  - Locations (Fayoum and Sharquia)
  - Institutional issues
  - Cost issues
  - Reuse issues
    - Methodologies for irrigation in Egypt
      - In Delta: flood irrigation – hazard
      - In fringes: drip irrigation – clogging
        sprinkler irrigation – hazard
      - What crops fit climate, land, and needs?

Industrial pollution prevention

- New legal framework for prevention and control. Its centerpiece is the Load-based Discharge Fee (LDF). This system:
  - links discharge fees to impact of pollution (the polluter pays principle);
  - specifies (categories of) industries and polluters to be subject to the LDF system;
  - uses suitable parameters for expressing pollution loads, with internationally applied discharge standards adjusted for local conditions;
  - bases fees on the cost of treatment in the different industries using best locally available technologies.
  - uses a surcharge on discharge fees to encourage treatment;
  - allows alternative methods to determine pollution loads (analysis of actual waste-water samples or international reference data for waste load coefficients based on water consumption);

LDF Fee Calculation Sheet (I)

I. DISCHARGE FEE CALCULATION FOR ORGANIC POLLUTERS

General input information

1	Name Company			
2		Unique identification number for the company		
3		ISIC main code	Industrial Sector	
4		ISIC sub-code (1)	Process Description	
		ISIC sub-code (2)	Process Description	
		ISIC sub-code (3)	Process Description	
5		Annual production in production units		
6		Annual water intake in m^3/year (from design or metering)		
7		Annual wastewater discharge (from metering or 90% from # 6)		
8		Applied wastewater treatment technology:		

1 Calculation Formula for normative fee calculation

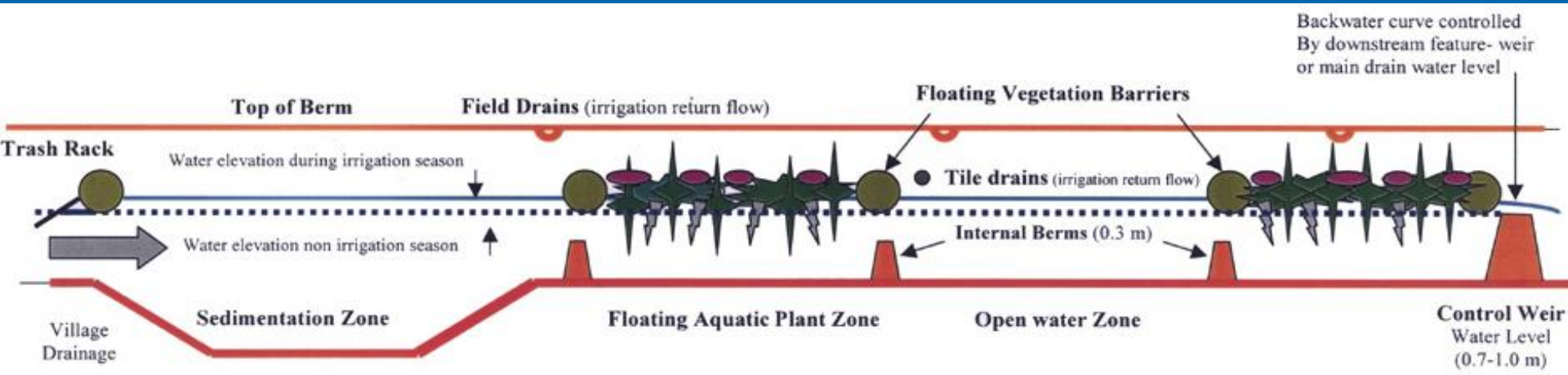
LDF = A * B * C * D * E [formula 1]

Input data for normative calculation:

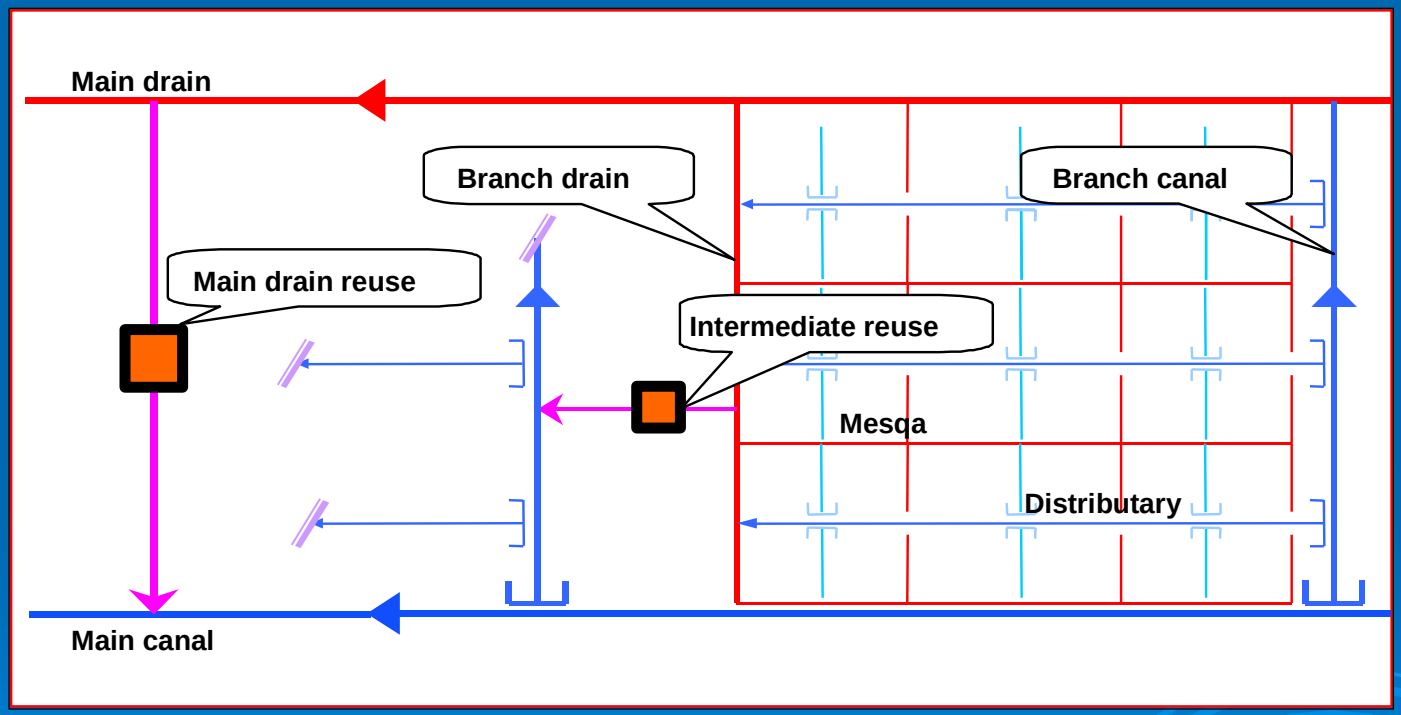
A	0	Annual production in production units (PU) from #5 above
B		Emission factor in kg oxygen demand per production unit from the database
C		Reduction factor for applied treatment technology from the database
D		Fee unit rate per kg oxygen demand from the database
E		Applied non-compliance surcharge (arbitrary set at 1.3)

Other efforts to minimize impact of pollution

- In-stream constructed wetland treatment
- In-stream packing media
- Reuse outside instead of discharge to drain
- Intermediate drainage water reuse



Drainage water reuse options



What is needed?

- Raising awareness at all levels
- Research and development
- Improved institutional and legislative setting and allocation of tasks
- Continuous monitoring
- Integrated management of all resources (water, land, energy, people)
- Resort to non-conventional methodologies
- Regard wastes as resources
- Design win-win solutions