

Water Saving Technologies

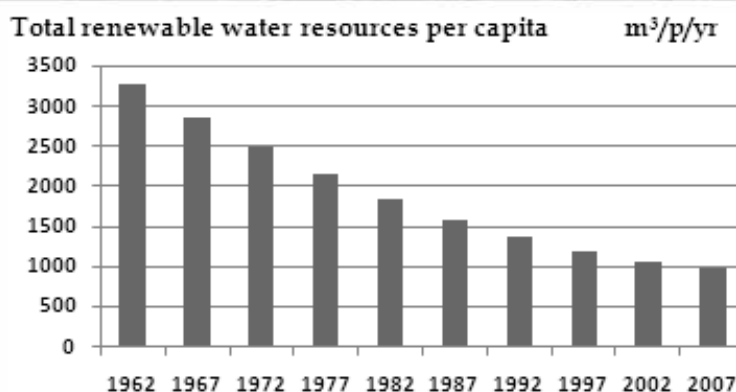
EGM on Promotion of South-South Cooperation in Technology Transfer, April 20-21, 2011, Amman, Jordan



George J. Nasr, Dr. Eng.
UN-ESCWA SDPD-WRS

? Why Water Saving?

Rank	Environmental problem
1	Water pollution
2	Fresh water shortages
3	Depletion of natural resources**
4	Air pollution
5	Loss of animal/plant species
6	Climate change / global warming
7	Automobile emissions



Water Saving

1. Conserve
2. Reuse
3. Know How
4. Manage

Source:

<http://www.circleofblue.org/waternews/waterviews/>

ESCWA; 2008: **Water Resources in the ESCWA Region: Country Fact Sheet**, ESCWA, Beirut, Lebanon

Apr. 20, 2011

Water Saving Technologies



Outline

The Context

The Water Cycle

Technology

Water Conservation Tech

Water Saving

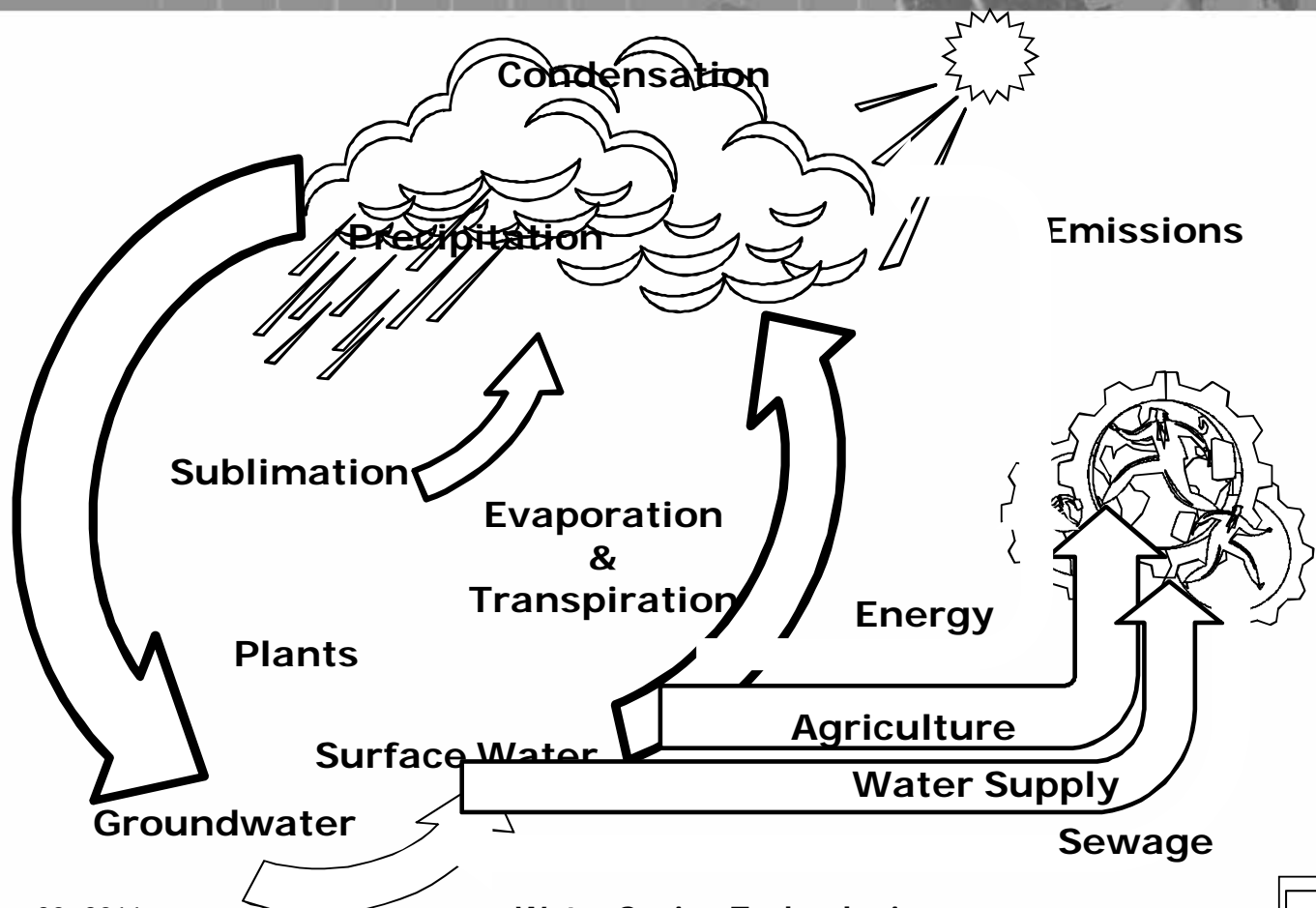
1. Conserve
2. Reuse
3. Monitor
4. Manage

Future Outlook

EGM on Promotion of South-South Cooperation in Technology Transfer,
April 20-21, 2011, Amman, Jordan

Session 1: Water Saving Technologies

Socio-Economic Water Cycle: Energy



C The Context: Technology



Two Types of Technology:

– **Hard:** Tools

- Equipment; Pumps, filters...
- Systems; Waste water plants, desalination...

– **Soft:** Knowledge

- Management,
- Integrated Management,
- Information Technologies

– Putting it together:

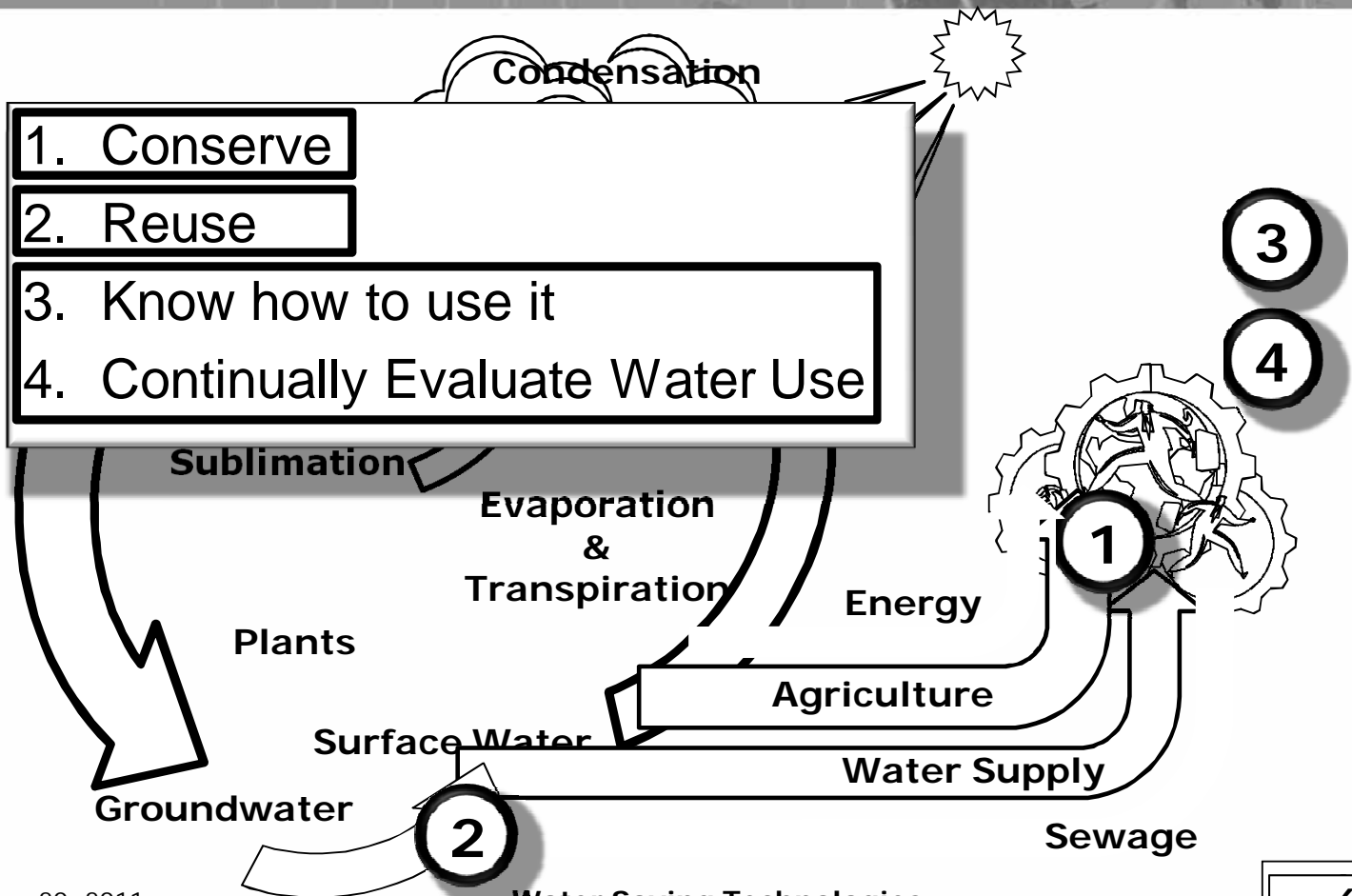
- Cogeneration.

Apr. 20, 2011

Water Saving Technologies

5

Water Conservation Principles



Apr. 20, 2011

Water Saving Technologies

6

The Context: Water Saving Tech



1. Conserve:

- Demand Side
- Supply Side

Water
Conservation

2. Reuse:

- Recover
- Recycle

3. Know how to use it

- Management

4. Continually Evaluate Water Use

- Monitoring
- Faster with Information Technology

**Water
Saving
Technology**

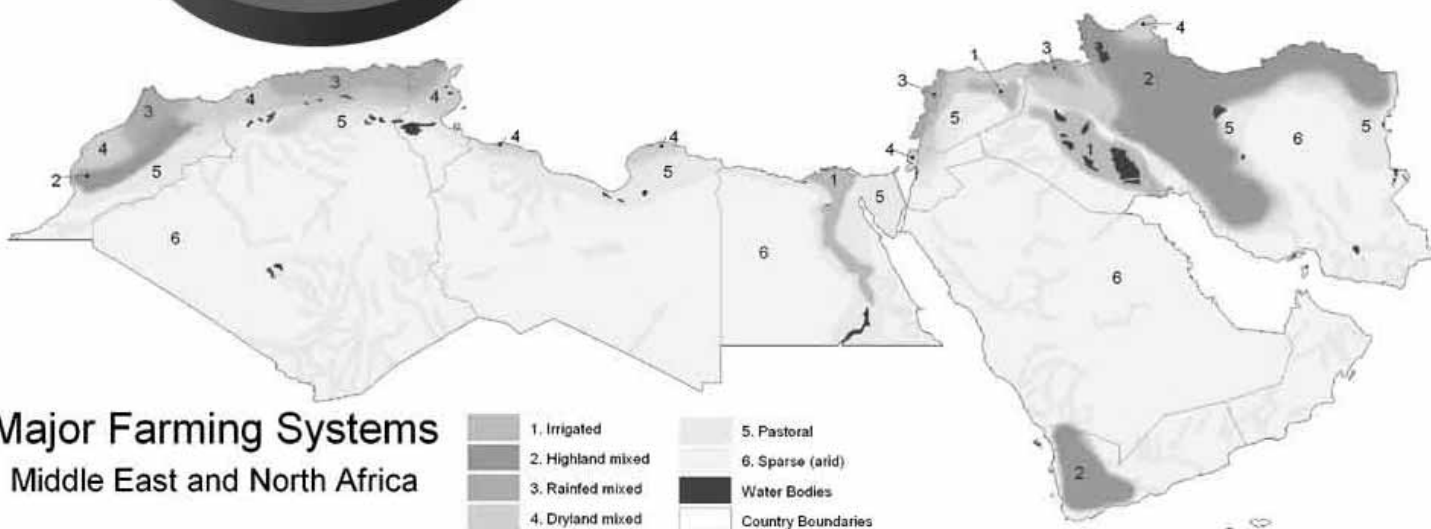
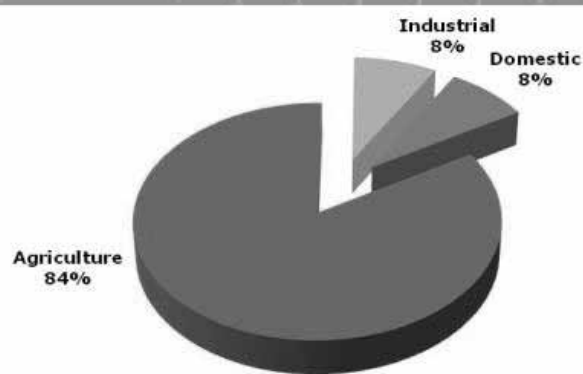
Technology

Apr. 20, 2011

Water Saving Technologies

7

1 At Consumer: Users of Water



Source:

<http://www.fao.org/docrep/003/y1860e/y1860e08.jpg>
Apr. 20, 2011

Water Saving Technologies

8

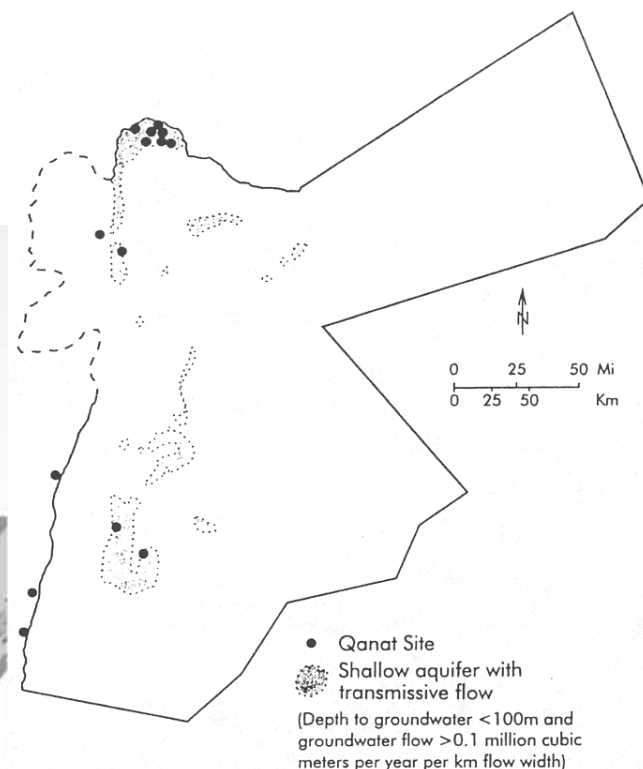
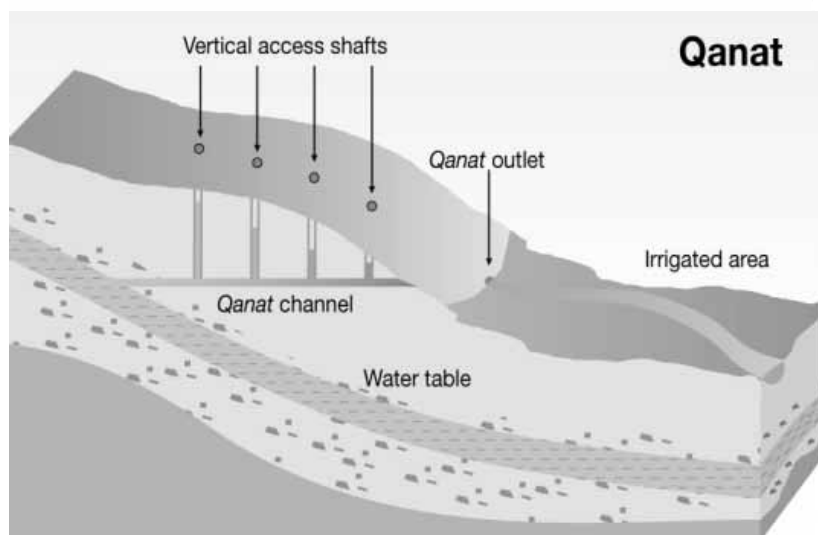
- Agriculture;
 - Efficient Water Use: Drip Irrigation, Sprinklers,
- Industrial;
 - Fogging nozzles for cooling, controls on system overflows,
- Domestic;
 - High-pressure, low-volume nozzles, high-efficiency toilets, chemical toilets

Apr. 20, 2011

Water Saving Technologies

9

Traditional Knowledge



Source:

<http://www.waterhistory.org/histories/jordan/>
<http://maps.grida.no/go/graphic/qanat>

Apr. 20, 2011

Water Saving Technologies

10

Conserve : Land Use / Qanats

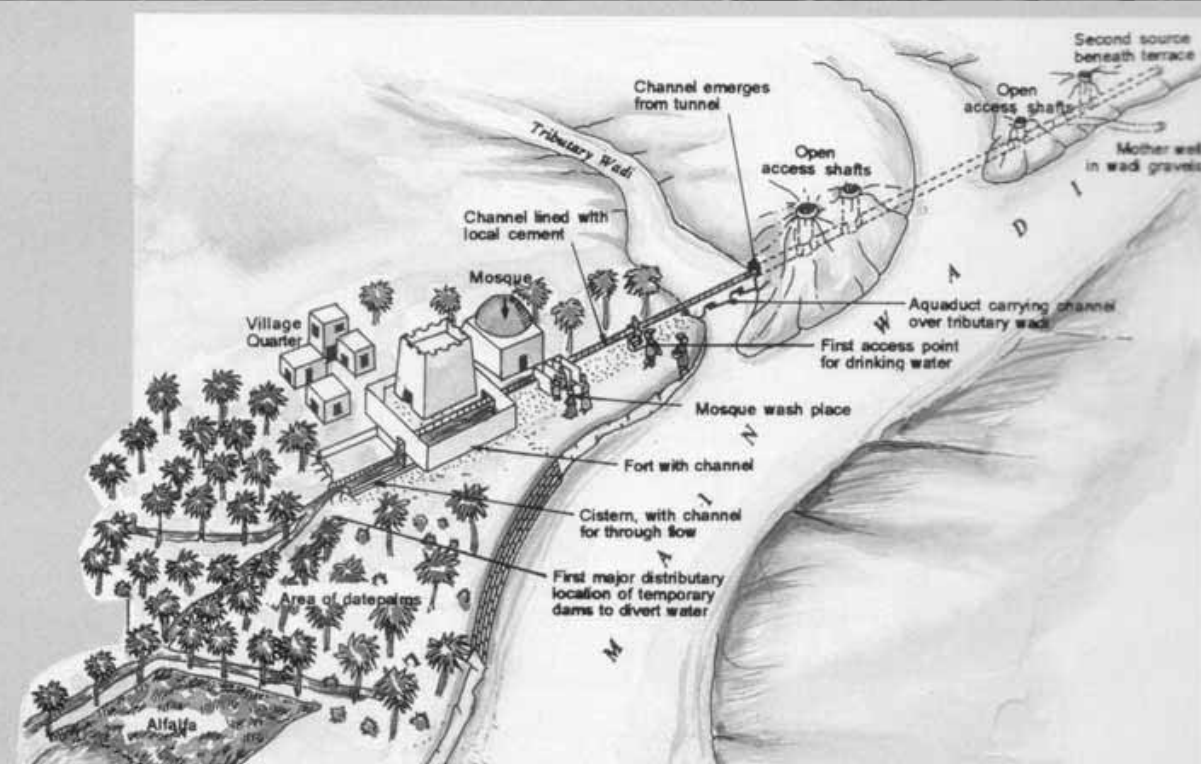


Figure 80 The falaj and the community: the water serves different purposes as it flows through the village.

Source:

<http://www.newsbriefsoman.info/item/2006/08/world-heritage-site---the-aflaj-of-oman/catid/13>

Apr. 20, 2011

EGM Session 1: Water Saving Technologies

11

1 Conserve : Rainwater Harvesting

Traditional Knowledge



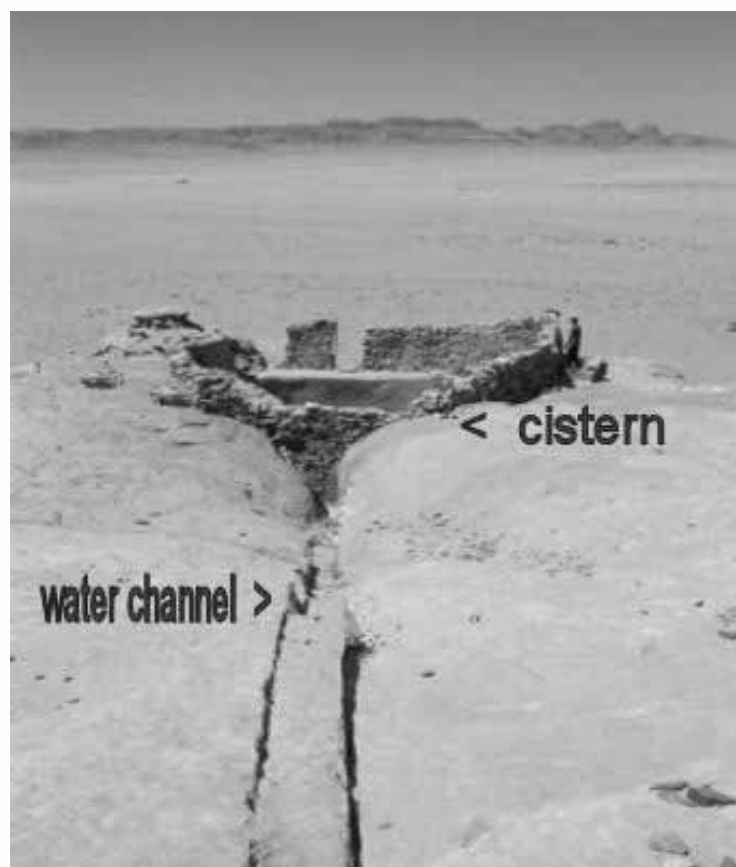
Source:

http://www.a4we.org/Alternative_Water_Sources_Intro.aspx

<http://enperublog.com/2009/12/07/four-ceremonial-fountains-discovered-at-machu-picchu/>

Apr. 20, 2011

Water Saving Technologies

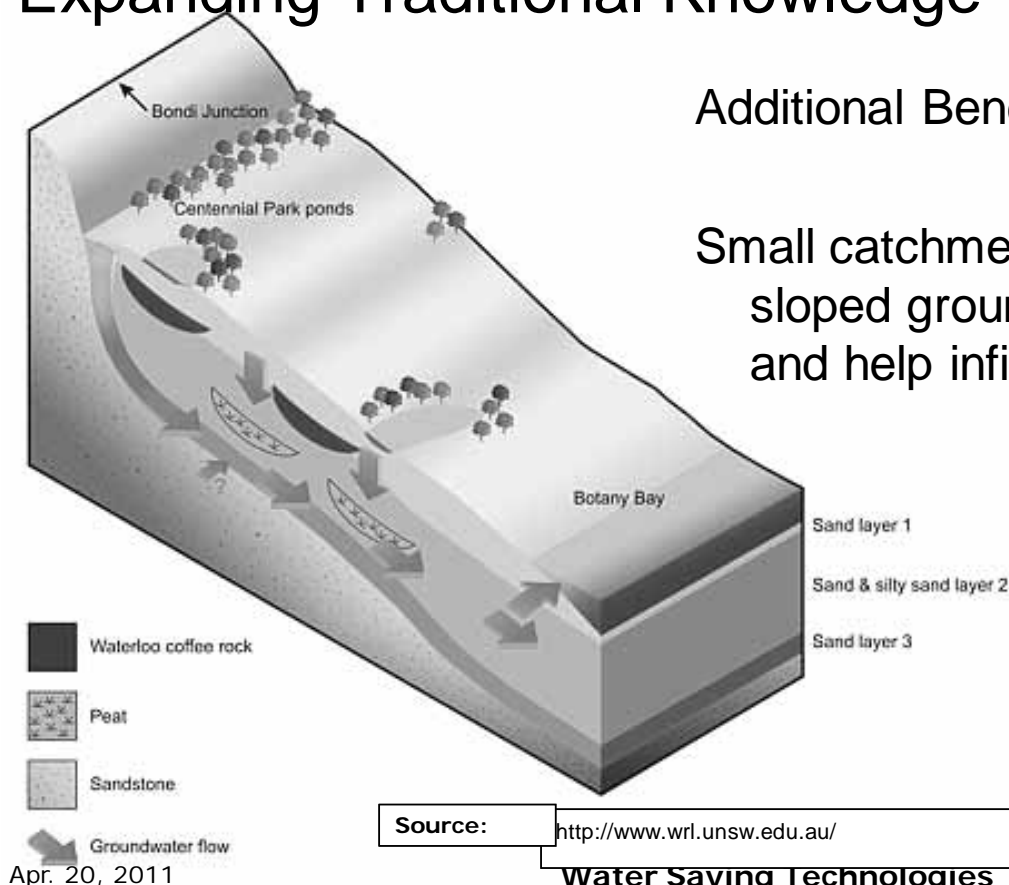


12

Expanding Traditional Knowledge

Additional Benefit:

Small catchment ponds along sloped ground to collect runoff and help infiltration.



Water Saving Technologies

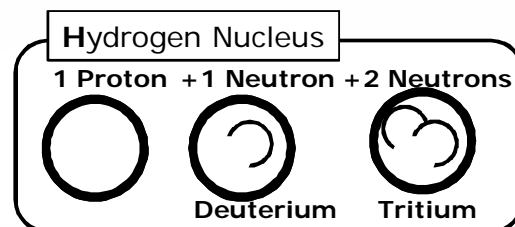
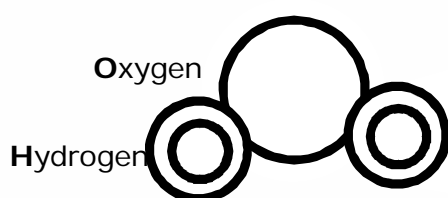
13

- Depends on tolerable TDS levels:

1. Domestic
2. Agriculture
3. Industry
4. Managed Aquifer Recharge
5. Waste to Landfills

- Metering:
 - Incentive for water conservation,
 - Detect water leaks in distribution networks:
 - Reduction of “non-revenue” water;
- Tracking isotopes ratios:
 - Origin, age and renewal rate of groundwater,
 - Risk of salt water intrusions or contamination.
 - Rapid and reliable mapping of groundwater resources

“Can save decades of hydrological data collection”



Source:

http://www-naweb.iaea.org/napc/ih/IHS_role.html

Apr. 20, 2011

Water Saving Technologies

15

- Optimized Farming Practices:
 - Organic materials used as soil amendments:
 - livestock waste, foods scraps collected through municipalities, food processing wastes, industrial organic wastes,
 - Cover crops,
 - Manage crop residues / other biomass,
 - Conservation tillage
- Restored Habitat
 - Conservation buffers,
 - Restored wetlands

Apr. 20, 2011

Water Saving Technologies

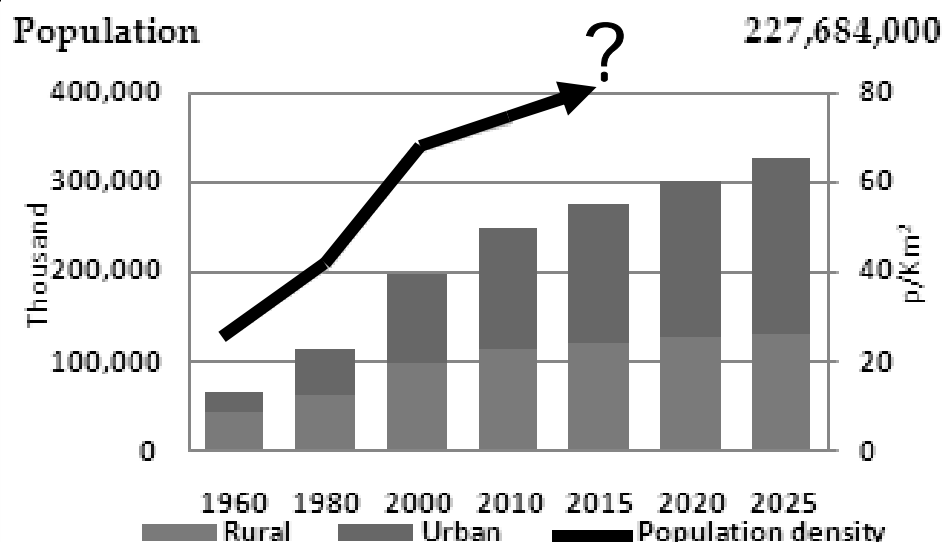
16

Outline

The Context Water Saving

Future Outlook

1. Conserve
2. Reuse
3. Monitor
4. Manage
5. Water & Energy Nexus



Source:

ESCWA; 2008: **Water Resources in the ESCWA Region: Country Fact Sheet**, ESCWA, Beirut, Lebanon
EGM on Promotion of South-South Cooperation in Technology Transfer, April 20-21, 2011, Amman, Jordan



**WATER FOR CITIES:
RESPONDING TO THE
URBAN CHALLENGE**

Session 1: Water Saving Technologies

1 Conserve: New Agriculture Tech

- Leverage Traditional Knowledge with New Tech
 - New crop varieties
 - Drought resistant crops,
 - Adapted crop varieties
 - Adapted Farming Practices
 - “food close to fork”
- Adapted and **Appropriate** Technologies
 - Take into account regional specificities...

Source:

Jiao, DM; 2008: **Redesigning C 4 rice from limited C 4 photosynthesis**, in Sheehy, J.E.; (ed.); Charting new pathways to C4 rice, <http://beta.irri.org/news/index.php/press-releases/new-higher-yielding-rice-plant-could-ease-threat-of-hunger-for-poor.html>

- Drip Irrigation
 - Nanotech: Inhibit root intrusion into emitters. Instead of trifluralin, nanometer-sized inert, inorganic particles
- Sprinklers

Apr. 20, 2011

Water Saving Technologies

19

- New Breeds of plants
- Re-introducing adapted plants:
 - No need for additional energy/water,
 - Enhanced food security & sustainable livelihoods;
 - virtual water/foreign exchange
 - income/employment generation



Groundwater	350 m depth (pumping)
Flow rate	70 m3/hour
Diesel use	40 liters/hour
Diesel needs	0.58 liters of diesel/m3 water
Price of Diesel (Aug 2009)	\$0.58/liter (\$1.29/l Summer 2008 peak)
Irrigation Needs	600 m3 for 1 dunum zaatar (dunum=1,000 m3 land)
Zaatar Output	600-1000 kg/dunum
Zaatar Revenue	\$3,400 - \$5,667/dunnum
Diesel costs (fixed)	\$202/year/dunnum
Share in Revenue	6% - 3.6% (intermittency problem)
Irrigation	\$23.50/dunnum for electricity
Energy/Electricity	6.6% - 4% of revenues



Source: Chouchani-Cherfane, C; 2009: **Water and Energy for Development**, Paper presented for ESCWA at the Seminar on Water and Energy Linkages in the Middle East, 18 August 2009, Stockholm, Sweden.

Apr. 20, 2011

Water Saving Technologies

20

1 Conserve: Rooftop Farming



Modern Terraces



Apr. 20, 2011

Water Saving Technologies

21

1 Conserve: “Old” Agriculture Tech

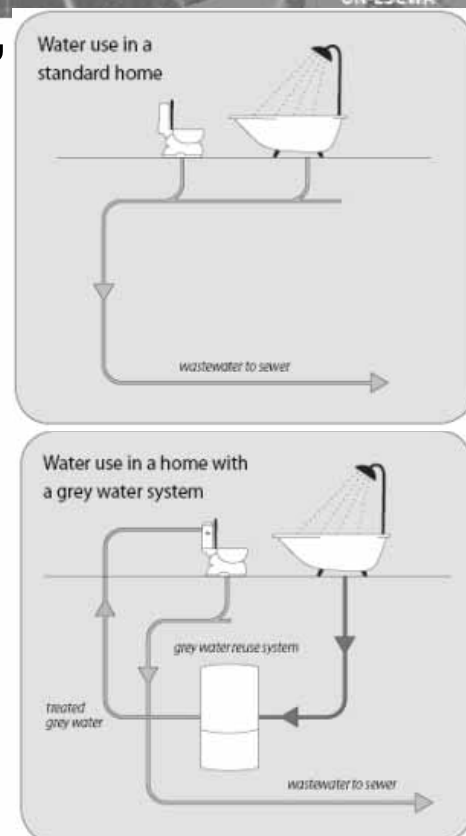
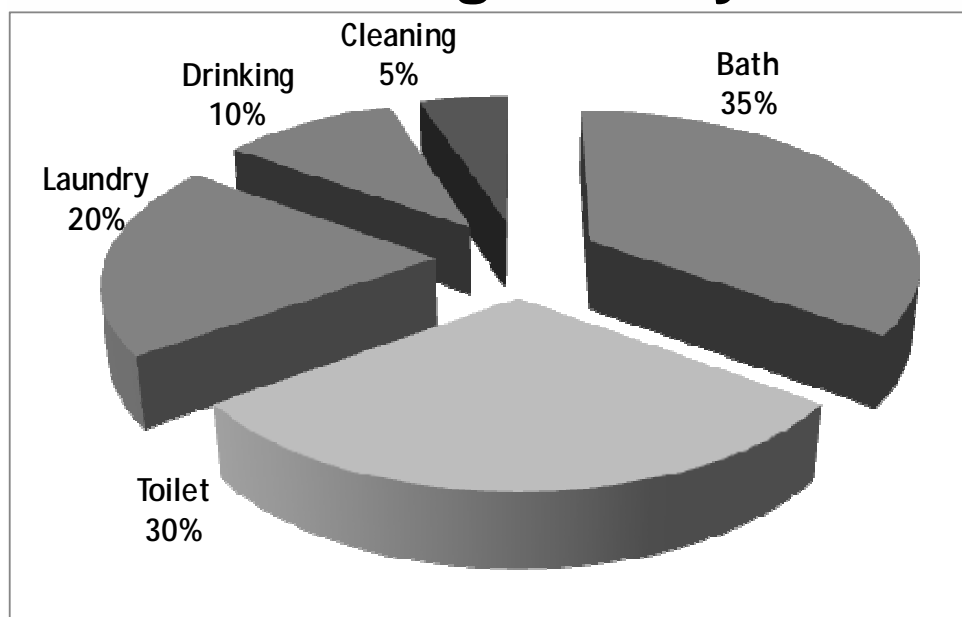


- Hydroponic Farming
 - 1/20th the Amount as a regular farm:
most water is recycled,
 - Lower nutrient cost / Lower pollution,

2 Reuse: Domestic “Grey Water”



Green Buildings: “Grey Water”



Source:

Surendran, S.; 1998: **Grey-Water Reclamation for Non-Potable Re-Use**, Water and Environment Journal

<http://guelph.ca/>

Jefferson, B., Palmer, A., Jeffrey, P.; 2004: **Grey water characterization and its impact on the selection and operation of technologies for urban reuse**, Water Science and Technology Vol 50 No 4

Apr. 20, 2011

Water Saving Technologies

23

2 Reuse: Wastewater Treatment



- Depends on tolerable TDS levels:
 1. Domestic
 2. Agriculture
 3. Industry
 4. Groundwater recharge
 5. Waste to Landfills

2 Reuse: Reclaimed Water



- Aquaba Water:
 - 5 MCM/yr
 - 25% of Total Water Supply.
 - Agricultural: partially treated,
 - Industrial: mechanically treated,



Source:
Aqaba Water, Jordan
Apr. 20, 2011

EGM Session 1: Water Saving Technologies

25

3 Monitor: Information & Communication Technology



Pre-Cultivation

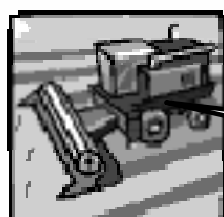
Crop selection
Land selection
Calendar definition
Access to credit

Cultivation & Harvesting

Land preparation
Sowing
Irrigation
Fertilization

Post Harvest

Marketing
Transportation
Packaging
Food processing



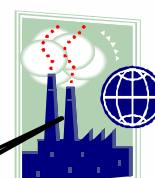
Work Units



Farm



Climate Data

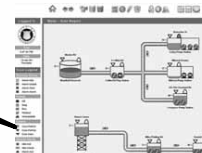


Industry

Field Data



ICT



Water Network

- Integrated Water Management
 1. Pollution prevention, "*Primum non nocere*";
 2. Shared understanding of risks,
 3. On site solutions whenever possible,
 4. Reuse and recycle should have priority.

- "On-Farm" Energy :
 - Solar, wind power
 - Second Generation Biofuels
 - Recycled farm waste products

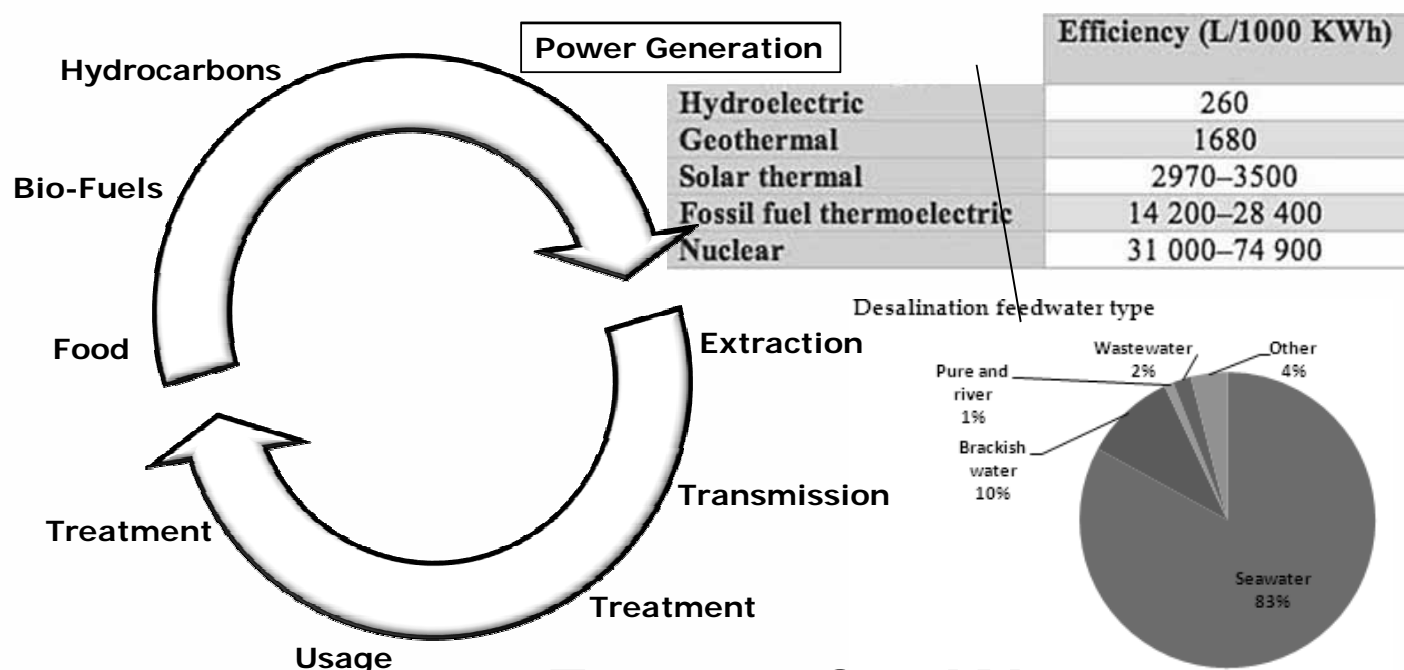
Source:

Apr. 20, 2011

Water Saving Technologies

27

Water for Energy



Energy for Water

Source:

Younos, T.; Hill, R.; Poole, H.; 2009: **Water Dependency of Energy Production and Power Generation Systems**, July 2009, Virginia Water Resources Research Center (VWRRC), VWRRC Special Report No. SR46-2009.

ESCWA; 2008: **Water Resources in the ESCWA Region: Country Fact Sheet**, ESCWA, Beirut, Lebanon

Apr. 20, 2011

Water Saving Technologies

28

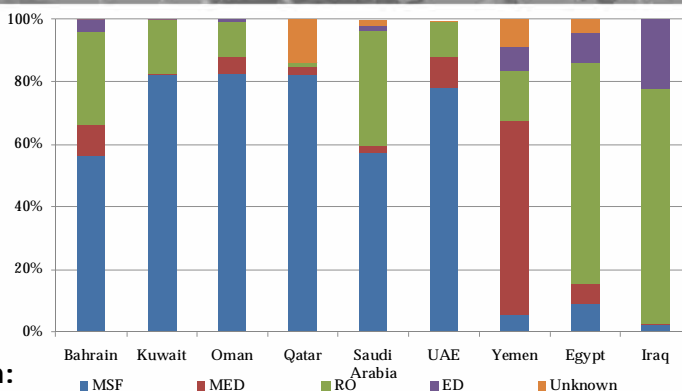
5 Energy for Water: Desalination



Renewable Energy for Desalinization:

- Solar:
 - Thermal energy for steam generation; Abu Dhabi, UAE
 - Increase temperature through solar heating and thus reduce energy needs
- Wind:
 - Electrical energy; Libya

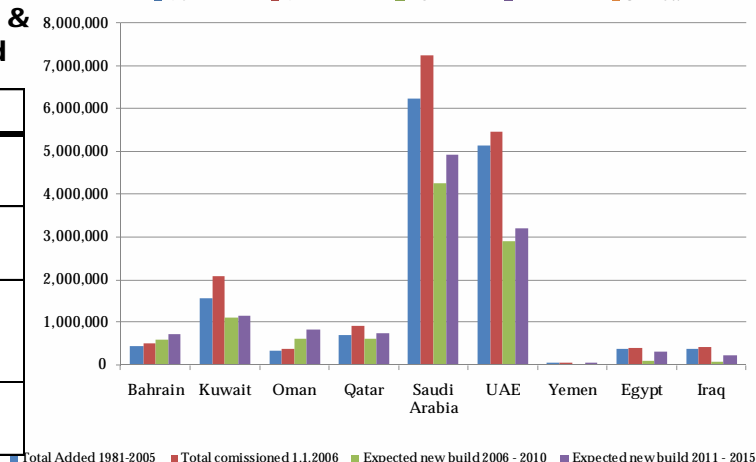
Desalination by Type



Energy Needed by Type:

	MSF	MED	RO
Operating Temperature	below 120°C	below 70°C	Ambient
Main energy source	Steam (heat)	Steam (heat)	Electrical Energy
Thermal energy demand	12 kWh/m ³	6 kWh/m ³	None
Electrical energy demand	3.5 kWh/m ³	1.5 kWh/m ³	4–7 kWh/m ³

Desalination: Current & Planned



Source: Chouchani-Cherfane, C; 2009: **Water and Energy for Development**, Paper presented for ESCWA at the Seminar on Water and Energy Linkages in the Middle East, 18 August 2009, Stockholm, Sweden.

Apr. 20, 2011

EGM Session 1: Water Saving Technologies

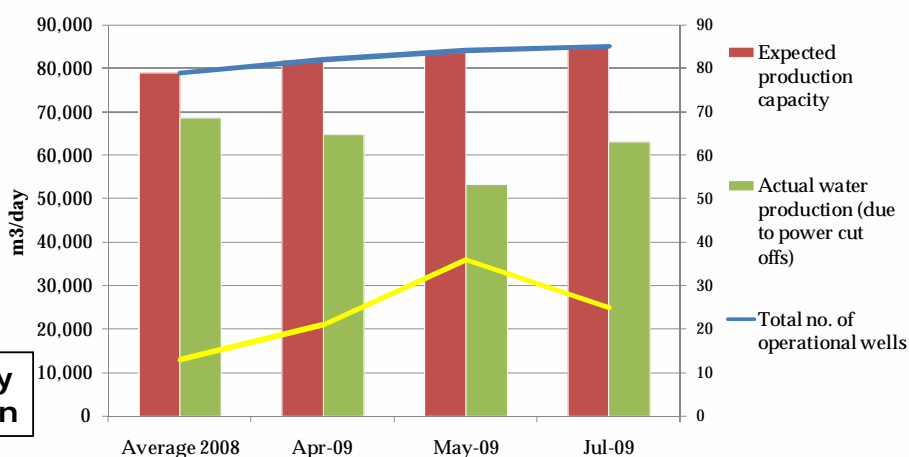
29

5 Energy for Water: Supply



Dependence on reliable energy source for:

- Performance & service delivery:
- Maintaining water quality:
 - Fluctuating pressure / Loss of pressure in pipes: increases cracks and leakages, suction effects that draw in outside contaminants
- Cost recovery



Supply Service Delivery
Sana'a, Yemen

Source: Chouchani-Cherfane, C; 2009: **Water and Energy for Development**, Paper presented for ESCWA at the Seminar on Water and Energy Linkages in the Middle East, 18 August 2009, Stockholm, Sweden.

Apr. 20, 2011

EGM Session 1: Water Saving Technologies

30

Water for Energy: New Energy

Fuel Source	Efficiency (liters per 1000 kilowatt-hours)
Natural gas	38
Synfuel: coal gasification	144–340
Tar sands	190–490
Oil shale	260–640
Synfuel: Fisher-Tropsch	530–775
Coal	530–2100
Hydrogen	1850–3100
Liquid natural gas	1875
Petroleum/oil-electric sector	15 500–31 200
Fuel ethanol	32 400–375 900
Biodiesel (First Generation)	180 900–969 000

Source:

Younos, T.; Hill, R.; Poole, H.; 2009: **Water Dependency of Energy Production and Power Generation Systems**, July 2009, Virginia Water Resources Research Center (VWRRC), VWRRC Special Report No. SR46-2009.

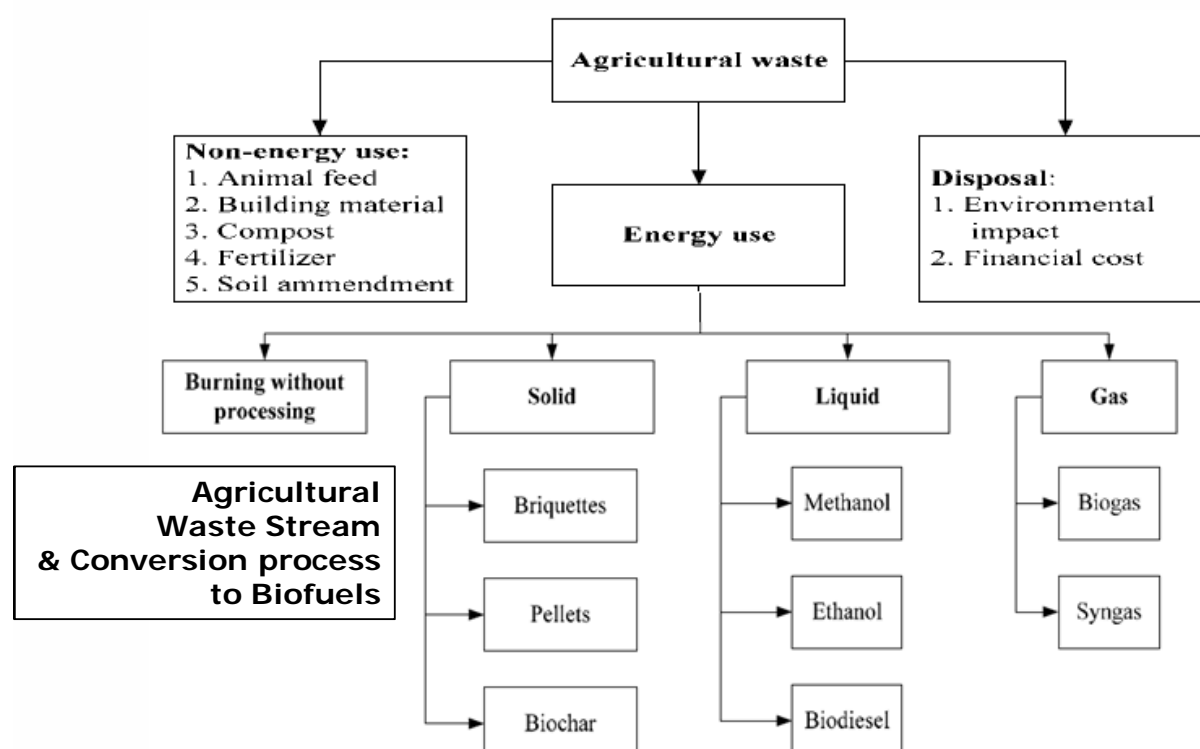
Apr. 20, 2011

Water Saving Technologies

31

Water for Energy: Second-Gen Biofuel

- Derived from agricultural waste.



Source: ESCWA, 2009: Increasing the Competitiveness of Small and Medium-sized Enterprises through the Use Of Environmentally Sound Technologies, Report E/ESCWA/SDPD/2009/5, November 12, 2009, ESCWA, Beirut, Lebanon.

Apr. 20, 2011

EGM Session 1: Water Saving Technologies

32



Thank you



Traditional & Current

Water
Conservation

1. Conserve
2. Reuse
3. Monitor
4. Management



Technology

Going Forward...

5. The Water Energy Nexus.
Energy & Water