The Yemen Experience on Water Harvesting

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Photo: www.adslgate.com

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YEMEN ASSOCIATION FOR WATER, ENVIRONMENT & ENERGY

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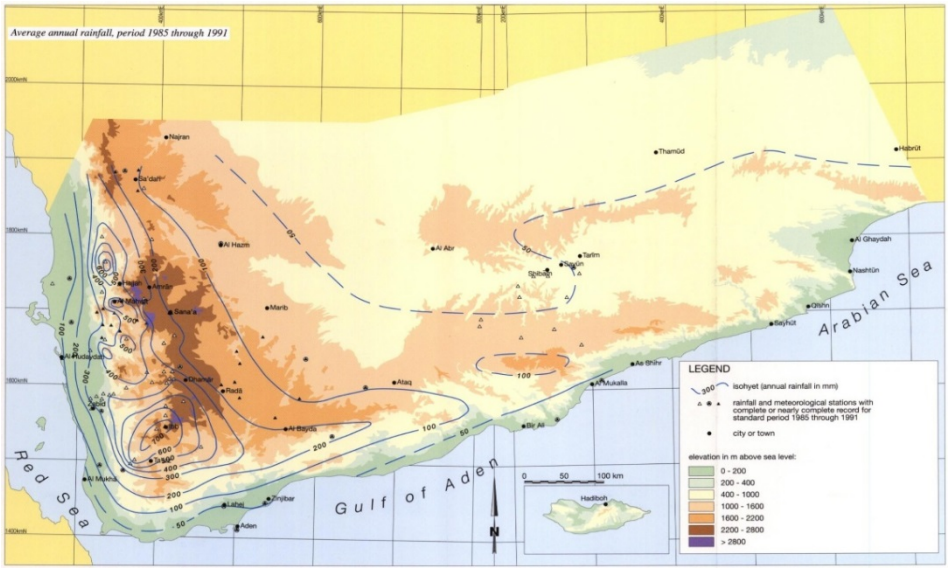
Sana'a University

Outline

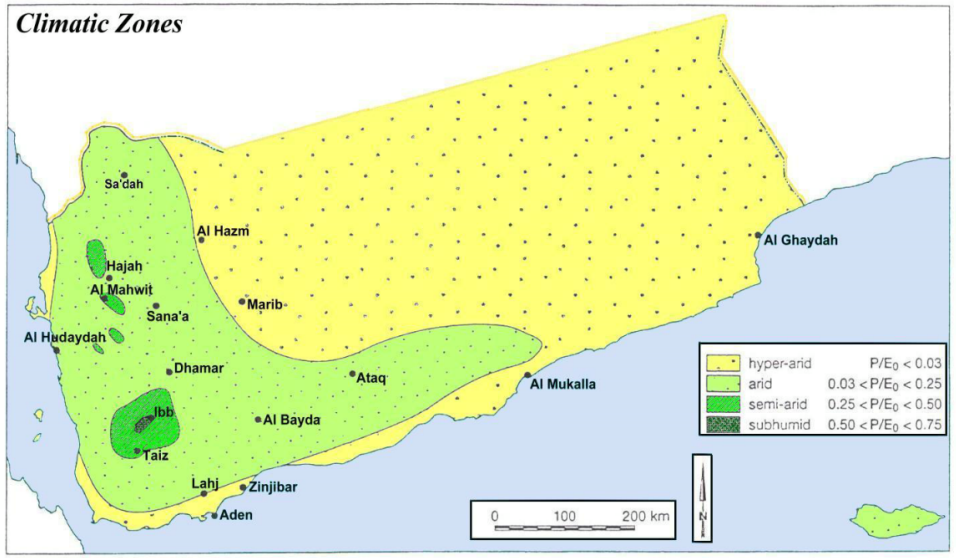
- Yemen water scarcity
- Importance of RWH in Yemen
- Challenges
- Techniques
- Impacts
- Conclusions

Climate

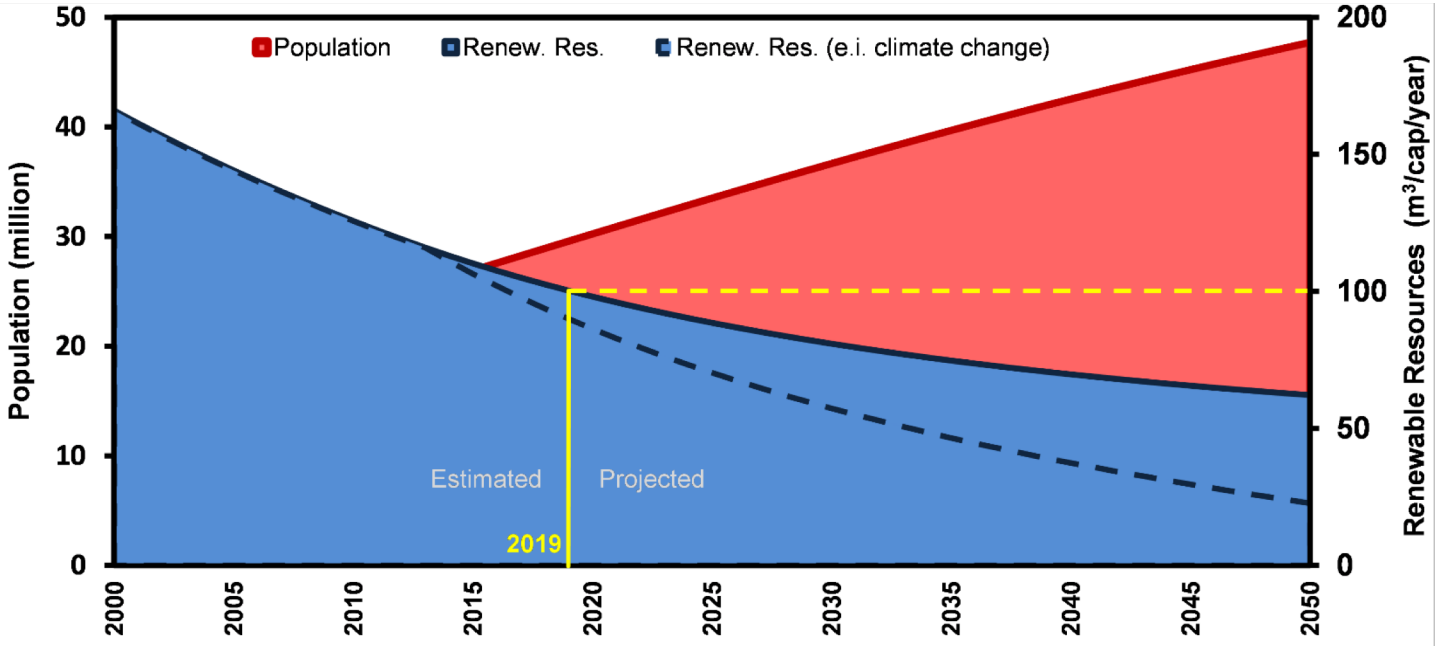
- Climate: varied, annual rainfall (50 - 800 mm).



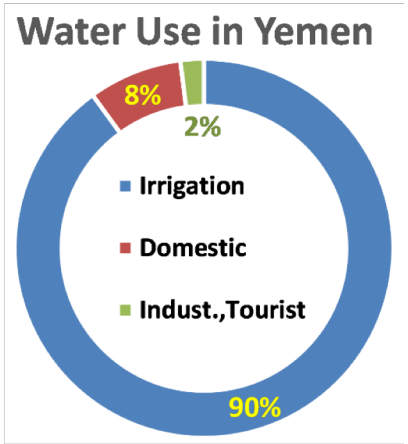
- Mainly arid and hyper-arid country
  - UNESCO aridity index (P/E)



Water scarcity



- Renewable resources are limited.
- 100 m^3/cap/year for 2019, keeps decreasing
- Groundwater is the main source for domestic uses & for the growing irrigated farming which uses 90% of the annual abstraction.



Importance of RWH in Yemen

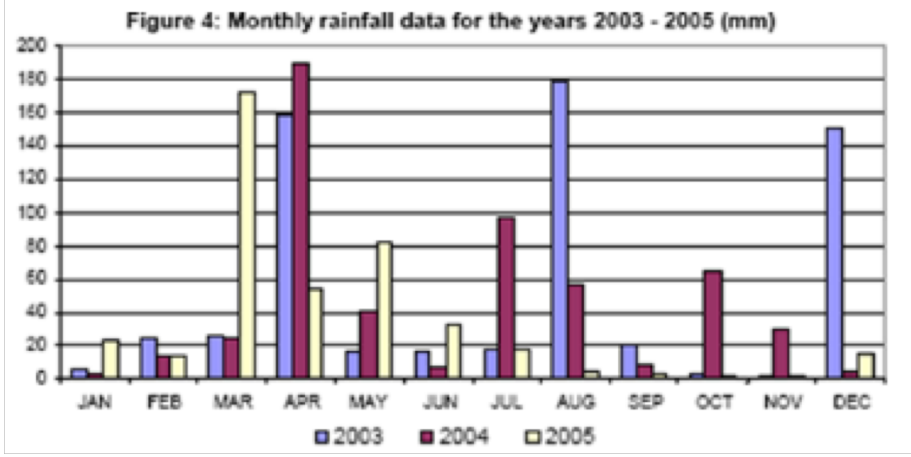
- A solution to water security problems in the mountain areas in Yemen (77% of the population)
- Rural communities depend mainly on agricultural production from the terraces
- Effective alternative access to water in massive scattered settlements with difficult topographical conditions
- Heritage significance

Heritage signification

Water access difficulties

Challenges of the RWH in Yemen

- Lack of data/information,
- Conflict between upstream and downstream users
- Lack of investment in RWH techniques.
- High Variability and non-uniform distribution of rainfall



Traditional RWH Techniques in Yemen

- Terraces
- Cisterns
- Roof WH

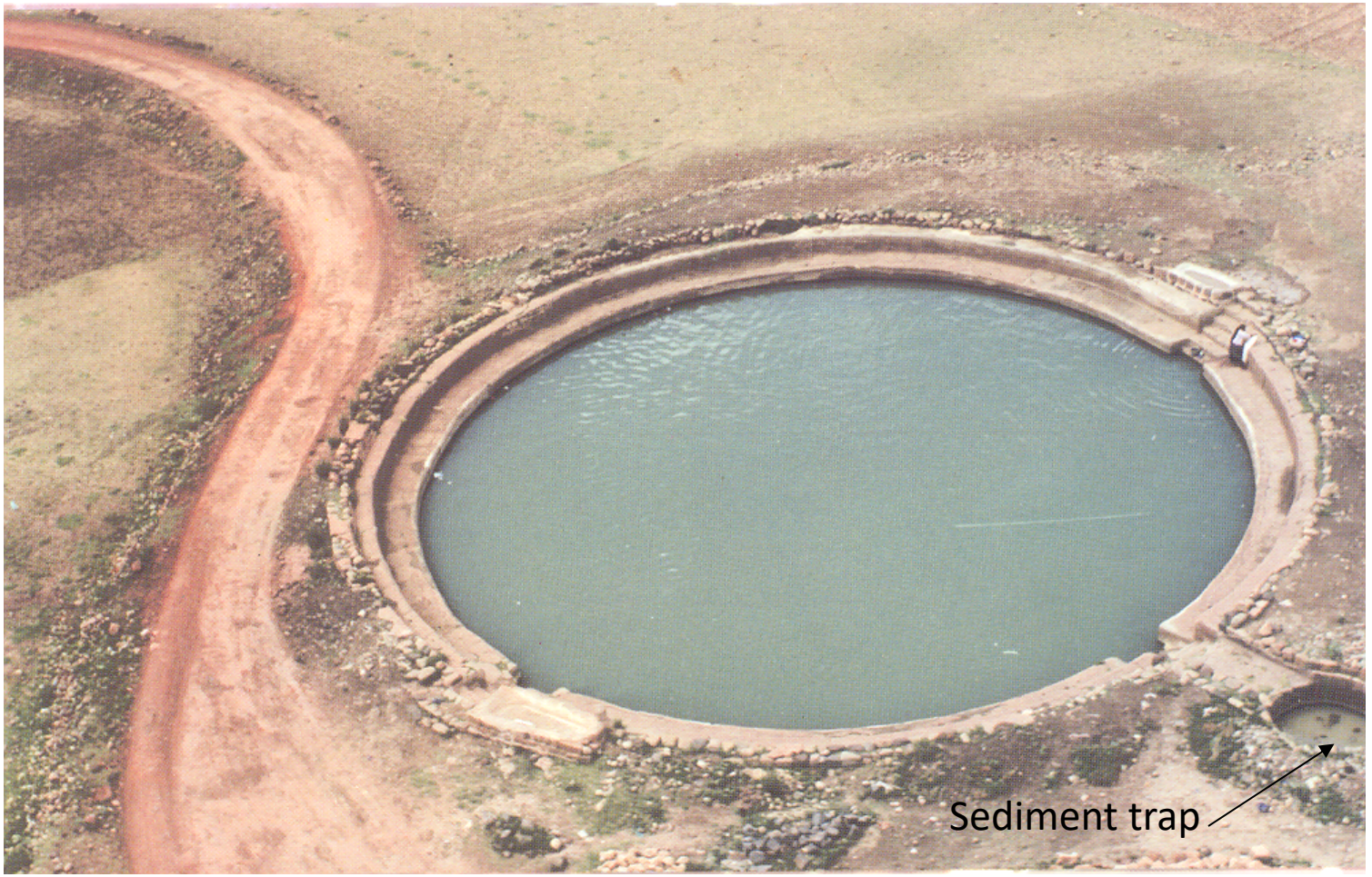
1. Terraces

1. Terraces

- Thousands of terraced fields have been constructed on steep, rugged mountain slops and began simple, highly effective methods of harvesting rainwater
- RW is collected in the terraces and soaks into the shallow soil
- Small walls at the edge of the terraces prevent runoff form flowing down to the next terrace
- Allow the passage of runoff through sheet flow, which prevents damage to the terraces from runoff concentrating at certain points

1. Terraces

2. Cisterns

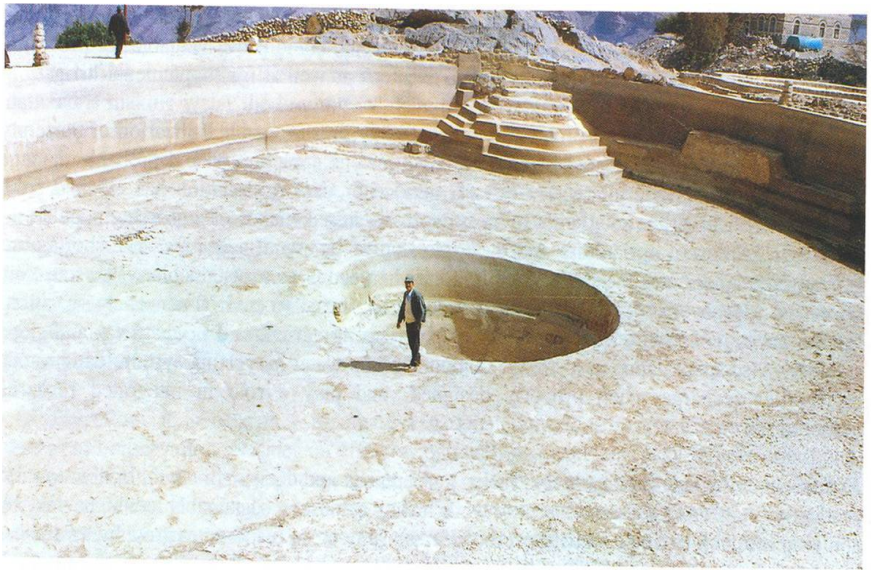


2. Cisterns

- Cistern building is a very old technique and is employed in Yemen for hundreds of years,
- Traditional cistern, ponds buildings (catchment & rooftop WH) was neglected till the end of the 20 century, when the overexploitation of aquifers became evident

2. Cisterns

2. Cisterns



- greater capacity upward and easy access
- Local material
- sediment trap

Photos Credit: SFD

2. Cisterns

Albearak Alasadiah

Al mouajil

Aljeroof

Al-Kohoof

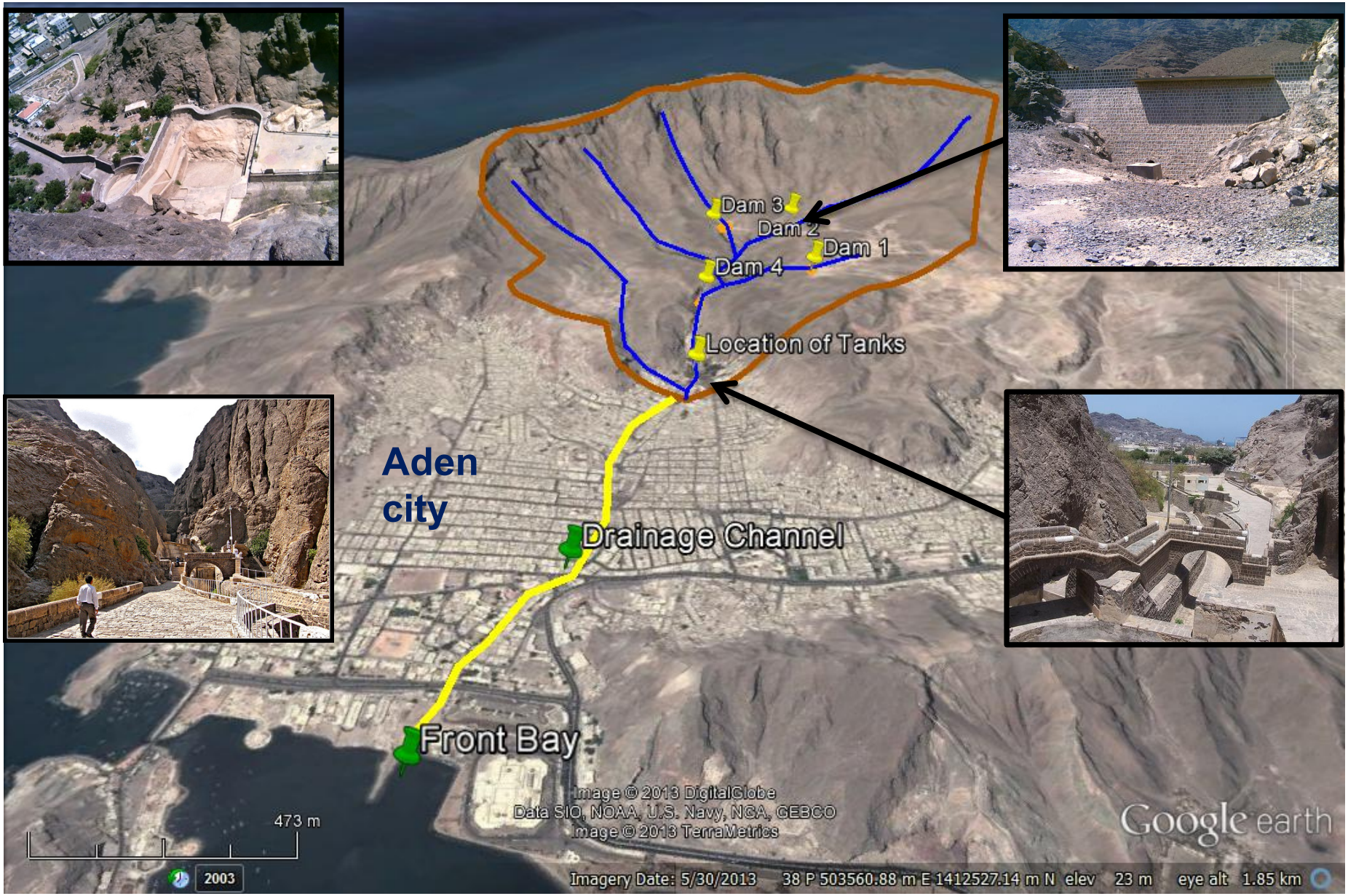
Traditional subsurface cisterns

Aden Cisterns

- Dating 1500 BC
- Rediscovered and refurbished in 1854

Aden Cisterns

- One of the most prominent archaeological and tourist sites in Aden city because of their advanced technological system and their position as an icon of an ancient civilization.
- Serves as flood detention and rain water harvesting facility with capacity of 20 million gallons.
- Helps ensuring safe disposal of the combined storm flow from the large barren rock upper Tawila catchment and the storm water flow from the urban area in the lower drainage sub-basin through the Tawila drainage Channel.
- Provides reserve storage of drinking water used for irrigation and entertainment requirements of the Tawila Garden Park located in the Cisterns site and in emergency cases


Dam 3
Dam 2
Dam 1
Dam 4
Location of Tanks
Aden city
Drainage Channel
Front Bay
Image © 2013 DigitalGlobe
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2013 TerraMetrics
473 m
2003
Google earth
Imagery Date: 5/30/2013 38 P 503560.88 m E 1412527.14 m N elev 23 m eye alt 1.85 km

3. Roof Water Harvesting

3. Roof Water Harvesting

- Low cost, relatively simple in design, less laborious and saves time, allocated water rights
- More appropriate in mountainous areas
  - no ground water sources
  - Rainwater is the only feasible means of providing a water supply
  - Centralized water supply schemes proved to be very expensive in terms of implementation, operation and maintenance.
- The quality of water is good compared to other water sources in the rural areas
- Rooftops can be much easier kept clean than a hillside catchment area

Roof rainwater Harvesting (Dr. Taha's house)

Roof Water Harvesting in old Sana'a

Ancient urban food gardens In old Sana'a

Low cost RWH: Ferro-Cement Tanks in Schools (SFD, 2007)

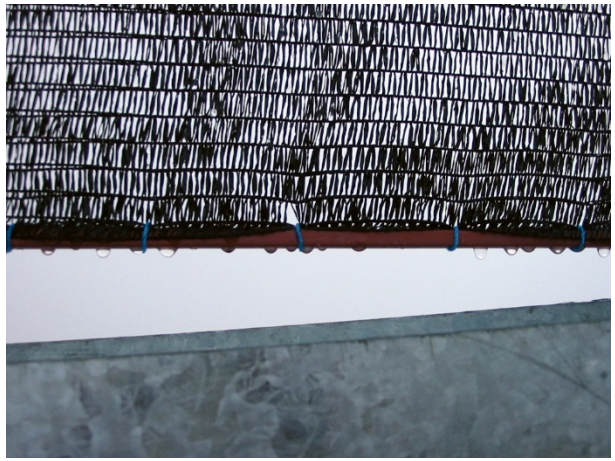
Construction 50 m³ Ferro-Cement Tank, Ikhwan Thabit School

Non-Traditional Water Harvesting

- Fog water Harvesting in Manakhah and Hajjah pilot project

Standard fog collectors

- The collectors are simple, flat, rectangular nets (mesh) of nylon (area 1m2)
- Constructed with locally available materials and local workmanship
- Feasible when captures > 4L/day
- Water collected on the net, the droplets join to form larger drops, falling into a channel, conveyed to a storage tank

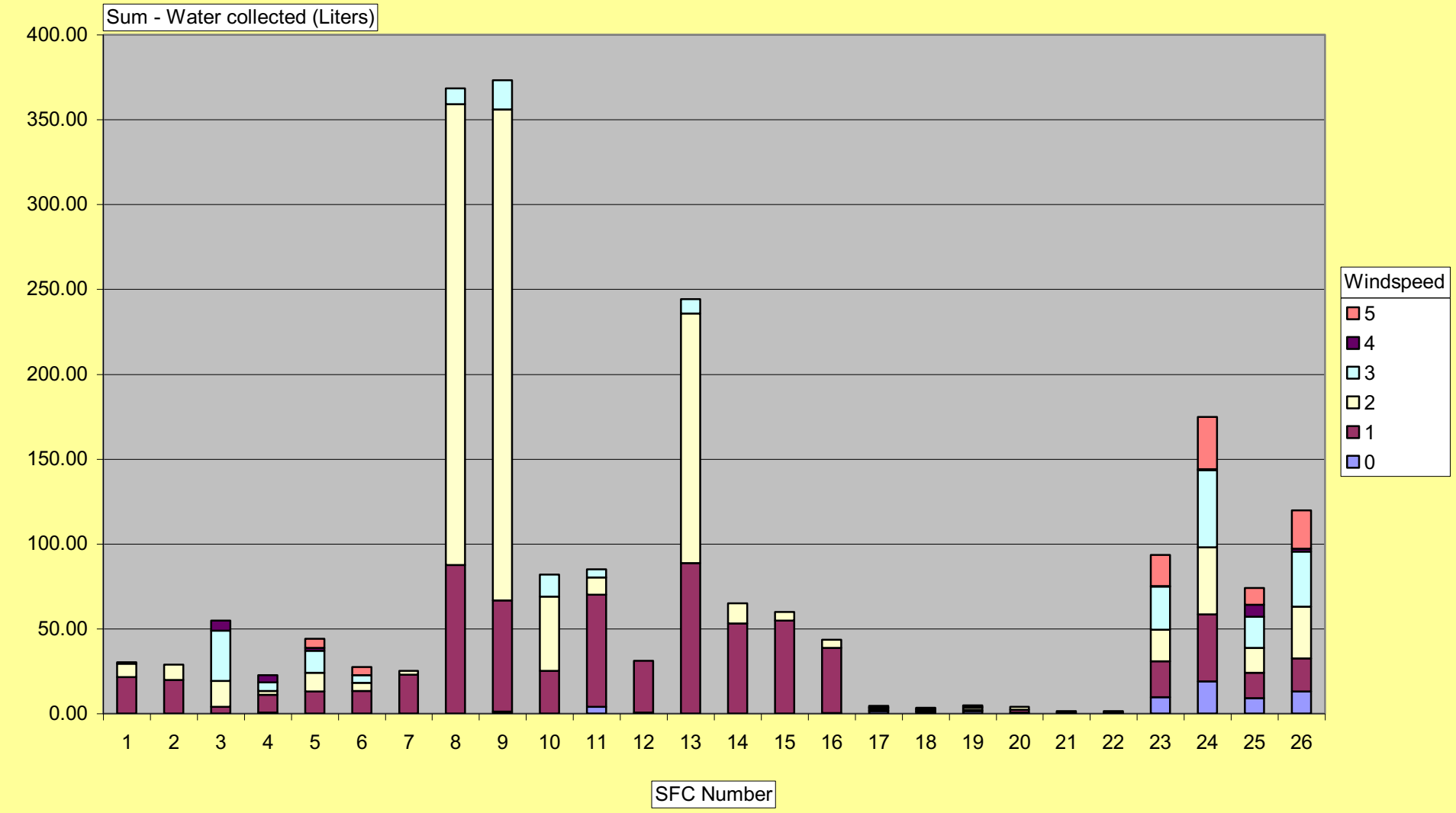


Installing standard fog collectors

Large fog collectors (2 X 5m)

Associated with capacity building

Results


Sum - Water collected (Liters)
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
SFC Number
Windspeed
5
4
3
2
1
0

Water Harvesting Impacts

RWH Impacts

Environmental

- Little effect to annual runoff - estimated to be reduced only by 0.3~0.4%
- Alleviates the pressure on the groundwater resources, also recharge
- Improve development of cash crops and fruit trees
- More trees and vegetation contribute to ecosystem recovery

Economic

- Income and livelihoods of farmers

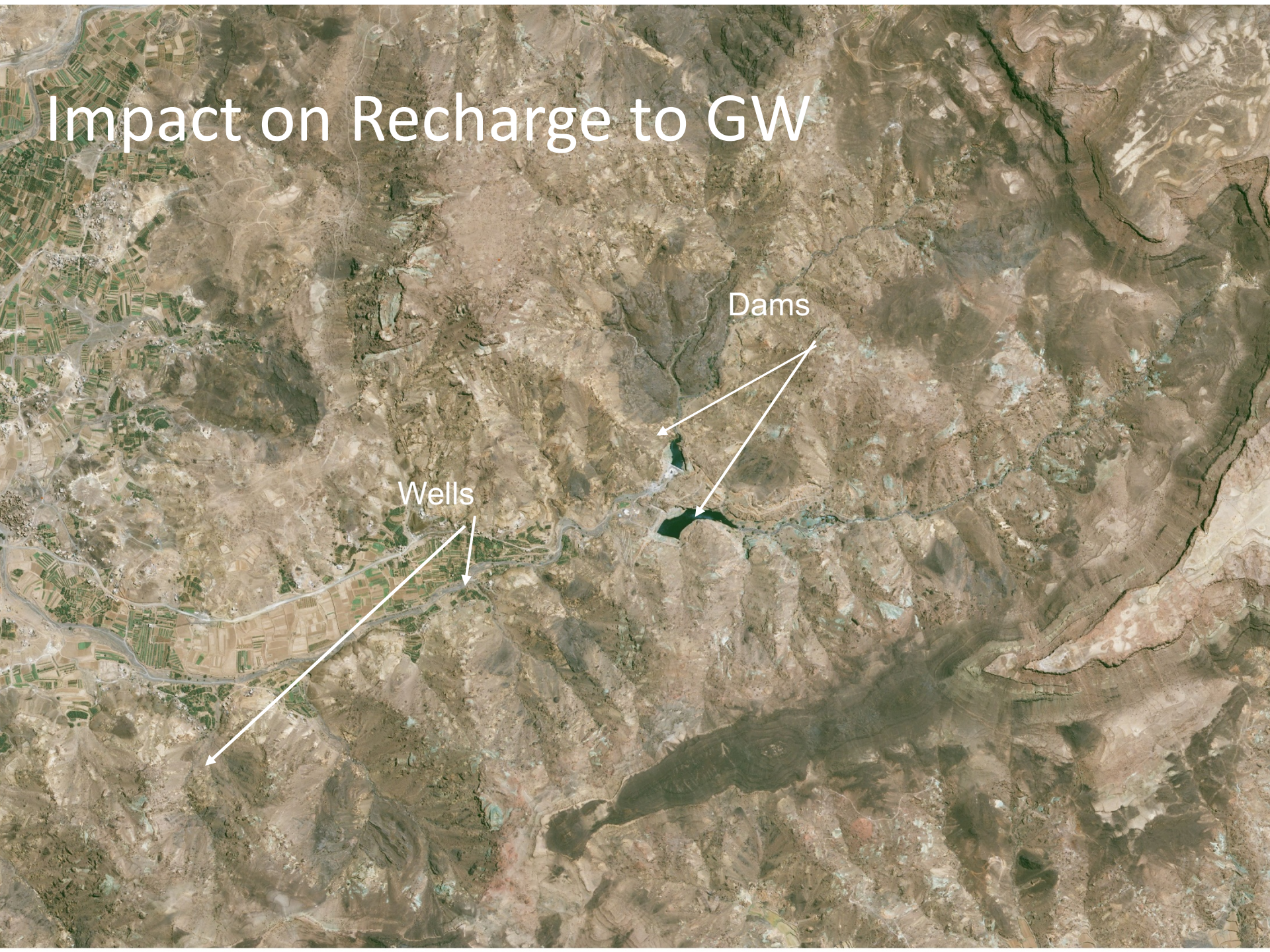
Public Health

- Improves the quality drinking water and enhancing recharge

Other

- Historical and tourist sites
- Flood mitigation
- Improve hygiene for schools and girls education
- Research and higher education in water management

Impact on Recharge to GW



Conclusions

Conclusions (1)

- Attention must be given to social and economic aspects: water rights, gender, land tenure etc..
- Public awareness has an important role. Education and training are needed to encourage people to consider importance and quality of collected water.
- A means of augmenting the amount of water available. In old Sana'a, the harvested water from the roofs covers 17.5% of the demand.

Conclusions (2) – on fog harvesting

- RWH is more feasible than fog harvesting in all areas and aspects. However, fog harvesting can serve as a supplementary, spare and resilience technology at household level, especially in crises or disease outbreaks.
- Fog water collection rate varies in time, altitude, and wind direction. Feasible when harvests > 4 L/day.
- For Yemen, south-west winds direction are the most productive
- 50% of the water collection occurred when the wind speed was around 2 m/s
- Elevations from 2000-2500 above sea level are good sites for fog harvesting

Thank You!

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