YEMEN

Challenges of Maintaining the Terraces in the Highlands
Current Status of Water Resources

Extremely Scarce
Average annual water consumption
  YEMEN: 125 m³/person/year
  MENA Average: 1,250 m³/person/year
  World Average: 7,500 m³/person/year
  WHO Minimum Requirement for Healthy and Hygiene Living: 500 m³/person/year

Rapid Depletion of Groundwater
Sana’a 4 - 7 m/year (water use - 270 million m³/year, Recharge - 50 million m³/year); Amran 3 m/year; Sada’ah 5 – 6 m/year; Rada’a 5 m/year; Dhamar 2.5 – 3.5 m/year; Taiz 1.5 - 2 m/year; Tihama 1 – 3 m/year; Hadramout 1.5 – 2.0 m/year; Tuban-Abyan 0.2 – 1 m/year
Current Availability of Water

1. Supply – 5.1 billion m³
   (renewable: 2.5 billion m³)
   - Rainfall (93%)
   - Surface water (5%)
   - Groundwater (2%)

2. Demand - 3.5 billion m³ in 2007
   13 billion m³ in 2020
   - Agriculture (95%)
   - Household (3%)
   - Industries (2%)
Water and Agriculture

Total area: 53 million ha
Cultivable Land: 4 million ha (7.5%)
Cultivated Land: 2 million ha (3.8%)
Irrigated Land: 400,000 ha (0.7 %)
Qat Cultivation: 124,000 ha
(30 % of the irrigated land)
REPUBLIC OF YEMEN

(Soil Conservation Project & groundwater)

(IDA Credit No. 3860-YEM)
Project Objective

To assist the Government in promoting groundwater conservation in farming areas and increasing surface and groundwater availability through:

(i) improving irrigation water use efficiency;

(ii) improving recharge and protection of watersheds and; and

(iii) supporting the groundwater management framework and water institutions.
New Simple Technology for Water Purification
Groundwater and Soil Conservation Project

Rehabilitation and Maintenance of Terraces
1. Beneficiaries Demand & Participation

>> Pilot activities under LWCP identified large demand for rehabilitation of abandoned Terraces.

>> Self help and cost sharing arrangements with the beneficiaries under GSCP.

>> Technical assistance from GSCP and material from the beneficiaries to carry out these works through small contracts with the beneficiaries or with a small local contractor from amongst the beneficiaries.
2. Impacts of Terraces Degradation
Extensive degradation of the terraces - over 50 % of the rainfed areas, causing serious impacts:
(i) economic,
(ii) ecological,
(iii) environmental and
(iv) social impacts.
<table>
<thead>
<tr>
<th>Systems of Irrigation</th>
<th>Unit</th>
<th>Situation in 1970</th>
<th>Situation in 2005</th>
<th>(+)/(-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cultivate Areas</td>
<td>Ha</td>
<td>1,290,000</td>
<td>1,200,000</td>
<td>Marginally less</td>
</tr>
<tr>
<td>Groundwater Irrigated Areas</td>
<td>Ha</td>
<td>37,000</td>
<td>393,080</td>
<td>(+) 11 times</td>
</tr>
<tr>
<td>Spate Irrigated Areas</td>
<td>Ha</td>
<td>120,000</td>
<td>137,163</td>
<td>(+) Marginally</td>
</tr>
<tr>
<td>Rain-fed Areas</td>
<td>Ha</td>
<td>1,200,000</td>
<td>608,525</td>
<td>(-) Nearly half</td>
</tr>
<tr>
<td>Spring Irrigated Areas</td>
<td>Ha</td>
<td>73,000</td>
<td>34,301</td>
<td>(-) Nearly half</td>
</tr>
<tr>
<td>Qat Areas</td>
<td>Ha</td>
<td>8,000</td>
<td>124,000</td>
<td>(+) 16 times</td>
</tr>
<tr>
<td>Areas under Cereals Crops</td>
<td>Ha</td>
<td>1,082,000</td>
<td>726,000</td>
<td>(-) 2/3 rd</td>
</tr>
<tr>
<td>Areas under Irrigated Fruits &amp; Vegetables</td>
<td>Ha</td>
<td>39,000</td>
<td>157,000</td>
<td>(+) Four times</td>
</tr>
<tr>
<td>Fodder Crops</td>
<td>Ha</td>
<td>40,000</td>
<td>123,000</td>
<td>(+) 2.5 times</td>
</tr>
<tr>
<td>Qat Crop</td>
<td>Ha</td>
<td>8,000</td>
<td>124,000</td>
<td>(+) 16 times</td>
</tr>
</tbody>
</table>
3. Cause, effect, and interventions

- Changes in rainfall-runoff relationships induce erosion and deposit.
- Removal of trees and vegetation for fuel and by overgrazing accelerates erosion on the steel slope of rugged hillsides in Yemen.
- One degraded terrace affects both the upper and lower terraces.
- Declining land production capability trigger an exodus of people, which further accelerate degradation of terraces.
- Realistic, simple, and participatory type interventions focusing on a priority program which triggering a chain reaction is acceptable to the people and replicable by the local communities.
4. Rehabilitation of Terraces under the GSCP:

>> A total of 193,500 m of terrace walls is to be rehabilitated in 6 governorates as traditional walls with a width of 0.40 m at almost vertical angle according to the local practice.

>> The average cost of the walls rehabilitation is around US$6-8 per meter or US$ 1,163/ha.

>> The beneficiaries contribute 20% of the rehabilitation cost in the form of labor and sometimes material, while the project finances 80 % of the cost.
<table>
<thead>
<tr>
<th>Field Units</th>
<th>Total</th>
<th>Al-Daleh</th>
<th>Hajja</th>
<th>Lahej</th>
<th>Taiz</th>
<th>Dhamar</th>
<th>Northern</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20,655</td>
<td>25,550</td>
<td></td>
<td>83,174</td>
<td>12,284</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>193,535</td>
<td>20,655</td>
<td>25,550</td>
<td>83,174</td>
<td>12,284</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>1,107</td>
<td>288</td>
<td>288</td>
<td>288</td>
<td>288</td>
<td>288</td>
<td>288</td>
</tr>
<tr>
<td>US$ million</td>
<td>3,876</td>
<td>2,167</td>
<td>190</td>
<td>786</td>
<td>164</td>
<td>402</td>
<td>166</td>
</tr>
<tr>
<td>Farm size/family</td>
<td>6.6</td>
<td>8.20</td>
<td>4.74</td>
<td>6.9</td>
<td>17.01</td>
<td>15.24</td>
<td>4.53</td>
</tr>
<tr>
<td>Unit Items</td>
<td>M</td>
<td>Ha</td>
<td>Ha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total length to be rehabilitated</td>
<td>45,247</td>
<td>12,284</td>
<td>12,284</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are likely to be benefited</td>
<td>406</td>
<td>154</td>
<td>154</td>
<td>406</td>
<td>406</td>
<td>406</td>
<td>306</td>
</tr>
<tr>
<td>Incremental area</td>
<td>0.313</td>
<td>0.209</td>
<td>0.101</td>
<td>0.101</td>
<td>0.101</td>
<td>0.101</td>
<td>0.101</td>
</tr>
<tr>
<td>Estimated cost</td>
<td>2.4</td>
<td>0.38</td>
<td>0.57</td>
<td>0.57</td>
<td>0.57</td>
<td>0.57</td>
<td>0.57</td>
</tr>
<tr>
<td>Families benefited</td>
<td>166</td>
<td>402</td>
<td>164</td>
<td>786</td>
<td>15.24</td>
<td>6.9</td>
<td>17.01</td>
</tr>
<tr>
<td>Unit cost of rehabilitation/m</td>
<td>6.9</td>
<td>2,520</td>
<td>8.20</td>
<td>8.20</td>
<td>8.20</td>
<td>8.20</td>
<td>8.20</td>
</tr>
<tr>
<td>Unit cost of rehabilitation/ha</td>
<td>771</td>
<td>38.5</td>
<td>73</td>
<td>116</td>
<td>116</td>
<td>116</td>
<td>116</td>
</tr>
<tr>
<td>Annual Maintenance (%)</td>
<td>58</td>
<td>28</td>
<td>127</td>
<td>127</td>
<td>127</td>
<td>127</td>
<td>127</td>
</tr>
</tbody>
</table>
5. Private and Social Benefits

>> Net income from terrace cultivation of two main crops: Sorghum - YR 54,000/ha and Maize - 72,300/ha

>> Average maintenance cost - YR 11,600/ha.

>> Additional income from water retention by terraces: increase in crop productivity - 10 % (YR 5,400-7,230/ha)

>> Opportunity cost of labor in the rural areas is close to zero.
6. Terrace Maintenance

>> Individual farmers are responsible for maintenance,

>> Establishment of WUGs induces community participation and strengthens community traditional mechanism. GSCP has established 373 WUGs for terrace rehabilitation, comprising 3,778 members.

>> The main causes of neglect of terrace maintenance: low rainfall and low productivity. (where Qat is grown, the terraces are well maintained.)

>> Beneficiary farmers pay 20 % as contribution. (10 % of the contribution is retained in a separate account for maintenance).

>> Technological inputs, including improved seeds, fertilizers, extension etc. will increase the productivity and hence the private incentives to maintenance.
7. Groundwater Recharge from Terraces

>> In sloping areas, the runoff from the upstream tract of land (catchment's area) that are not cultivated is collected/conveyed to the terraced cultivated fields.

>> The fields are ridged and the terrace wall contains a ridge to enable the water to accumulate on the terraces and to infiltrate into the soil.

>> When the terrace is saturated by water, the excess water is conveyed to a lower terrace.

>> The amount of runoff water available for water harvesting varies from area to area and depends on the catchment's area upstream of the field.
8. Soil Conservation and Erosion Control

>> The structural measures: (i) check dykes (loose rock or gabion walls into cultivated riparian farms, reinforced by vegetative measures; and (ii) wadi bank protection by gabion walls or loose stone walls and spurs; and (iii) rehabilitation of terraces.

>> A terraces can store about 100 mm of water between the ridges. When the soil profile is saturated (the terrace can store about 200 mm), additional water will permeate into deep layers.

>> The terraces will control sediment, capture run-off, improve farming production systems which will increase farmers’ income, and facilitate groundwater recharge.

>> As a result, these will reduce flood velocities, erosion, and sedimentation, increase retention time of run-off thus increasing soil wetting and groundwater recharge, in addition to providing protection for existing wadi bank terraces and cultivation.
9. On-farm Water Storage Facility

>> Abandonment of Terraces in the Uplands has led to drying-up of natural springs resulting in an acute scarcity of drinking water for human and animal consumption in the villages in the uplands.

>> Rehabilitation of Terraces is likely to revive these Springs.

>> Tanks were built in the past to collect Spring water. However, lack of maintenance of the tanks has resulted in shortage of water due to leakages from the tanks.

>> As part of Water Harvesting measures GSCP provides for new on-farm water storage tanks for human, animal and crop consumption with beneficiary contribution of 20%.
Conclusion

1. Water deficit (1 billion $M^3$) of Yemen has been compensated by overexploiting GW, which is not sustainable.

2. As a result, significant declining GW tables have been observed in many parts of the country.

3. GSCP is addressing this issue by improving irrigation water use efficiency, improving recharge and protection of watershed.

4. Rehabilitation of terraces is costly (about $1,200/ha) and may not be sustainable without Government subsidy since the net income from water retention by terraces is between $270/ha and $360/ha.

5. To justify Government subsidy, external benefits of terraces rehabilitation should be considered including GW recharge, soil erosion protection to avoid land slides, flood reduction by reducing run-off, reduction of migration to cities, value of tourism, etc.

6. Agriculture rainwater management should be carried out by combing various water harvesting methods including terracing in order to maximize its impact in Yemen.
THANK YOU