Adapting to water scarcity for Yemen's vulnerability communities: The case studies of Sana’a, Sadah and Aden

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BACKGROUND

- This research is funded through (NCAP)
- Administered through ETC International
- Executing Agency is Environmental Protection Authority (EPA) Yemen.
- Case studies under this project conducted by WEC in Sana’a university
- International technical backstopping is provided by SEI
Background

- Water scarcity is the main environmental problem in Yemen.
- Varied climate and variable annual rainfall (less than 50mm to near 600 mm).
- Groundwater is the main source for domestic uses & for the growing irrigated farming which uses more than 90% of the annual abstraction.
- This problem is getting worse due to climate changes resulting in less rainfall and increase temperature.
Concentration of population in Yemen and Rainfall distribution
Time change of cultivated areas in different farming systems

Time change of cultivated areas in different farming systems

- Rain fed
- Flood’s
- Spring’s
- Groundwater

Year:
- 1975
- 1983
- 1990
- 1995
- 2000

Percentage:
- 0
- 20
- 40
- 60
- 80
- 100

Legend:
- Rain fed
- Flood’s
- Spring’s
- Groundwater
Objectives

- Evaluation of current and future vulnerability of water resources to climate change,
- Identification of a comprehensive set of adaptation strategies that address water scarcity in vulnerable communities,
- Revise the proposed set of adaptation strategies based on stakeholder consultations
- Implement one adaptation measure identified in the analysis at the pilot scale within the case study area
- Identify a comprehensive set of changes to existing policies and laws to facilitate adaptation to climate change-induced water scarcity
Approaches and Methodology

- Data collection from different authorities and related ministries
- Rapid appraisal for participatory assessments among stakeholders.
- WEAP water modeling to evaluate water needs and scarcity among all sectors under a range of potential climate change scenarios.
- Multi Criteria Analysis (MCA) to identify a set of adaptation measures
Case studies locations

Three case study areas were selected based on:
- representing a different ecological zone
- Water scarcity problems

Case study 1 (highly urban area, Sana'a)
Case study 2 (coastal urban area, Aden)
Case study 3 (rural highland area, Sadah)
Case study 1 (Sana'a Basin)
Heritage signification
Urban area expansion in Sana’a basin
Results:

- rapidly depleting aquifers and more frequent water conflicts due to growing competition for water.
Rainfall trend

Sana'a Airport

Rainfall (mm)

years
The schematic view of the Sana’a basin application in WEAP. There are 22 sub basins represented and 6 aquifer nodes. Each sub basin’s demand nodes link to the appropriate groundwater node.
Sub-structure of each sub-basin...
The headflow/rainfed catchment nodes...
The irrigated area catchment nodes…
Simulation of hydrologic processes in the catchments...
The reference scenarios is not able to create sustainable use of the all demand sites.
Scenarios explore 6 different adaptation strategies…
Replacing Qat with wheat production....
Qat (Cathula edulis) has become a very large part of the economy - some estimate as much as 25% of GDP, 16% of employment and 30% of water use.
Differences in crop coefficients are the driver of this scenario.

In this scenario, the monthly crop coefficient values for wheat versus qat are the key variables that drive the difference in water demand.
Yearly water demand for Qat versus wheat in Wadi A Sir....
Replacing Qat with wheat results in less GW drawdown....
Any one of the strategies alone is not enough to create sustainable use of the Central Plains aquifer....
.....and for all aquifers
But when the effects of scenarios are added via ‘inheritance’....
Adding effects of strategies approaches sustainability for Central Plains aquifer....
Possible future climate scenarios also analyzed....

‘OSU Core’ climate scenario is expected climate change: +2 degrees C
And +5% rainfall by 2050

‘UKHI dry’ climate scenario is worst case climate change: +2 degrees C
And -20% rainfall by 2050
Hydrology model in WEAP explicitly simulates climate effects on crop water demands....
Climate has only small effect on groundwater volume....
Consultations with Farmers and Decisions makers

The main aim was to discuss their concerns regarding issues of water scarcity as well as to assess their willingness to participate and be committed in implementing the project activities (adapted strategy).
Consultations with Farmers and stakeholders meetings

All Information collected through interview will entered, processed and analyzed by MCA program in accordance with the objectives specified.
Meeting with decision makers
Identify a set of adaptation measures using MCA

Module 6: Ranking of Adaptation Initiatives by central scores

<table>
<thead>
<tr>
<th>Initiative \ Score</th>
<th>Total central score</th>
</tr>
</thead>
<tbody>
<tr>
<td>improving indigenous method for irrigation</td>
<td>79</td>
</tr>
<tr>
<td>Shift crop production from Qat to Wheat</td>
<td>45</td>
</tr>
<tr>
<td>Improve irrigation efficiency</td>
<td>28</td>
</tr>
<tr>
<td>Lower population growth in Sana’a</td>
<td>26</td>
</tr>
<tr>
<td>Waste water reused and inject to GW</td>
<td>23</td>
</tr>
<tr>
<td>Improve urban efficiency</td>
<td>23</td>
</tr>
</tbody>
</table>
Implement one adaptation measure

proposed location of check dam in Wadi Asser
Adaptation (Traditional Water Harvesting Techniques)

- Terraces
- Cisterns
Terraces after the rainfall
Traditional ponds and cisterns
Traditional Cisterns

greater capacity
upward and easy access,
Local material
sediment trap
Traditional subsurface cisterns in rural areas

Source: SFD
Underground reservoir in mountainous area

Source: SFD
Conclusion

- Increase knowledge and information on the vulnerability of the water resources
- The need to emphasize awareness among stakeholders and decision makers
- Mainstreaming Climate Change in all governmental development plans and programs
- Special program on the issues of Climate Change in various governmental offices
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