Limiting abstraction from shallow aquifers

Challenge: Sea level rise **Adaptation response:** Limiting saltwater intrusion

Description

The increased demographic and economic pressure on coastal areas has raised the demand for freshwater, causing over extraction in many areas and saltwater intrusion is a global problem affecting coastal aquifers. These pressures are increasing and may further be aggravated from the impact of climate change. It is required to establish a sustainable water extraction regime from coastal aquifers that do not exceed the natural (and artificial) recharge. One key to controlling saltwater intrusion is to maintain the proper balance between water being pumped from an aquifer and the amount of water recharging it. Constant monitoring of the salt-water interface is necessary in determining the proper management technique.

Means of reducing abstraction of freshwater to sustainable levels through improved ground water management include the following elements:

- Scientific monitoring, scientific assessment
- Improvements in water use efficiency/regulation
- Improved and coordinated well operation
- Alternative water sources.

Implementation

Implementation can take several forms and can include targeted actions across following domains:

Scientific monitoring, scientific assessment:

- Elevated salt content within a well does not necessarily reflect intrusion; rather, active saltwater intrusion (characterized by a prolonged shift in the saltwater-freshwater interface) can be definitively identified only with numerous samples over a longer period of time (Barlow 2003). Such monitoring and assessment is required for a thorough understanding of existing conditions in coastal aquifers and constitutes a necessary first step in determining both the severity of any saltwater intrusion and the best approach(es) in adapting to the impacts of climate change (Linzei 2011).
- Modelling helps identify the different factors (such as recharge) that influence groundwater movement. Models can be further enhanced to incorporate the effect of water density (e.g., salinity) on groundwater flow, and they can be adapted to identify conditions under which groundwater availability is optimized and saltwater intrusion is limited (Barlow and Reichard 2010). Specifically, these optimization models can assist in calculating favourable groundwater yields by identifying the pumping rates, well locations, and human interventions (such as artificial recharge) that are most efficient (Darnault and Godinez 2008; Ferreira da Silva and Haie 2007, cited in Linzei 2011).

Improvements in water use efficiency/regulation

- Develop and implement policies securing adequate groundwater supply by optimising locations and rates of withdrawal and by controlling land use and development around coastal aquifers. Such policies may lead to reduced pumping rates and development of alternative sources.
- Develop and implement policies focusing on limiting or reducing demand for groundwater. This could include water pricing and water quotas or pursuance of more efficient water use systems for example through incentives. Other policies could appeal to behavioural changes with respect to water conservation, use efficiency and reuse through awareness raising and public education (Linzei 2011)

Improved and coordinated well operation:

- Discontinue use of wells impacted by saltwater intrusion
- Manage pump regime according to water levels
- Coordinate well management/pumping to minimise impact
- Manage volume and frequency of pumping to minimize drawdown
- Improvements in water use efficiency

Alternative water resources:

- Relocate wells further inland
- Desalination

Environmental Benefits

- Reducing pressure on groundwater resources.
- Promotes efficient and sustainable water use including safeguarding ecosystem needs.
- Reduces groundwater pollution risks.

Socioeconomic Benefits

- Improved and sustained access to freshwater of adequate quality for domestic purposes.
- Improved health and safety conditions.
- Improved and sustained access to freshwater of adequate quality for livelihood activities.

Opportunities and Barriers

Opportunities:

- Identification of alternative water resources
- Reducing water imprint.

Barriers:

- Technically advanced modelling requirements
- Institutional capacity is required to supervise monitoring and assessments and to enforce regulations and control pumping schemes in vulnerable coastal aquifers.

Implementation considerations*

Technological maturity:	3-5
Initial investment:	3-5

Operational costs:	3-5
Implementation timeframe:	2-4

* This adaptation technology brief includes a general assessment of four dimensions relating to implementation of the technology. It represents an indicative assessment scale of 1-5 as follows:
Technological maturity: 1 - in early stages of research and development, to 5 – fully mature and widely used
Initial investment: 1 – very low cost, to 5 – very high cost investment needed to implement technology
Operational costs: 1 – very low/no cost, to 5 – very high costs of operation and maintenance
Implementation timeframe: 1 – very quick to implement and reach desired capacity, to 5 – significant time investments needed to establish and/or reach full capacity
This assessment is to be used as an indication only and is to be seen as relative to the other technologies included in this guide. More specific costs and timelines are to be identified as relevant for the specific technology and geography.

Sources and further information

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Ferreira da Silva, Julio F., and N. Haie. 2007. Optimal locations of groundwater extractions in coastal aquifers. Water Resource Management 21: 1299–1311.

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