

# Safeguarding the water reserves of Laizhou Bay

Water management is a growing issue in Laizhou Bay in China. Based on an analysis of the water supply issues and the legal and policy framework in Laizhou Bay, partners in the EU H2020 project '**SUBSOL – bringing coastal SUBsurface water SOLutions to the market**' have developed a set of recommendations to safeguard the future supply of freshwater.

## RECOMMENDATIONS

- Subsurface Water Solutions (SWS) are capable of addressing the water management issues of Laizhou Bay. Moreover, they are low-cost, low-tech and can be adapted to the local institutional capacity.
- The local authorities in Laizhou Bay are aware of the urgency of the issue and positive towards SWS schemes. A pilot project is however needed to demonstrate the benefits and potential of a full scale implementation of SWS technologies.
- To ensure implementation of SWS technology, further clarification is needed on the legal framework regarding groundwater management. Additionally, the institutional organization of groundwater management needs to be clearer.
- In order to ensure an efficient and legitimate process with local support and cooperation and a solution that is adjusted to local needs and resources, dialogue with all stakeholders and authorities prior to decision making and implementation is core



## WATER SUPPLY CHALLENGES IN LAIZHOU BAY

The Laizhou Bay area suffers from the most severe saltwater intrusion in China. Salinity is caused by both saltwater intrusion, as well as upwelling of ancient brine deposits. Saltwater intrusion has worsened over the last decades mainly as a result of population growth and steady economic development. This puts available water resources even more under pressure because of higher water demand and over-abstraction of groundwater.

In the North and East of China, salinization of groundwater affects around 38 million people. Additionally, climate change is beginning to show an impact. In the upper reaches of the Yellow River Basin, rainfall is predicted to fall by up to 15%, and more intense local rainfall alternating with longer dry spells is expected. Climate change will also increase the occurrence of extreme weather events, e.g. storm surges which increases saltwater intrusion, and increase temperature and precipitation uncertainties.

The issue of saltwater intrusion in the Laizhou Bay area has been recognized by authorities for about forty years. Local economies are considerably constrained by salinized groundwater and a lot of effort has been devoted to mitigate this issue (e.g. several subsurface barriers and enhancement of riverbed infiltration).

The water resources management strategy established by the Chinese government in 2009 recognised "the importance of water for China's future sustainable development as well as prosperity". The Chinese government seems keen to try and implement innovative technologies if they are perceived as having a high potential. Concerns about over-abstraction mean that new wells and boreholes for agriculture and industry will not be permitted in aquifers that are deemed to be fully exploited. Deep groundwater aquifers will be held as strategic reserves as well as for emergencies."<sup>2</sup>

## SUBSURFACE WATER SOLUTIONS

Subsurface Water Solutions (SWS) offer a series of solutions to freshwater resources problems in coastal areas by means of advanced groundwater management (pumping, infiltrating, controlling) which enables protection, enlargement and sustainable utilization of fresh water resources.

Combinations of wells extracting brackish water and infiltration (ponds) or injection (wells) of fresh water are used to control the position of the interface between fresh and brackish water, thereby creating a barrier against further saltwater intrusion and securing the freshwater wells inwards. Moreover, it enables storage of large volumes of run-off or recycled water in the underground in order to ensure a stable water supply year-round, irrespective of seasons and shifting levels of exploitation, e.g. from agriculture and tourism.

SWS systems address all of the main water issues of Laizhou Bay and the wider region. Moreover, while SWS systems work by stimulating natural infiltration to secure the availability of clean water during the dry season, and as they require little energy to run compared to e.g. desalination technologies, they provide environmentally sustainable and low-cost alternatives for water management. Finally, as SWS systems require little operation and maintenance, they can be easily implemented with the existing institutional and economic capacities of authorities in Laizhou Bay.

1 GWP (2015).

2 GWP (2015).

3 Wang et al. (2007).

4 Water Law of the People's Republic of China: [http://www.npc.gov.cn/englishnpc/Law/2007-12/12/content\\_1383920.htm](http://www.npc.gov.cn/englishnpc/Law/2007-12/12/content_1383920.htm)

5 Wang et al. (2007).

6 Bin and Speed (2009).

## PERSPECTIVES FOR THE UPTAKE OF SWS SYSTEMS

All contacted stakeholders unanimously confirm that saltwater intrusion is a huge issue in the Laizhou Bay area and agree that additional remediation measures must be initiated. Many resources have been devoted to alternative measures to deal with saltwater intrusion in the area. In contrast to large centralised measures to counter saltwater intrusion, SWSs hold potential to empower specific end-users, e.g. in agriculture and horticulture to participate in the groundwater resources management and exercise more control and ownership, in order to promote more sustainable agribusinesses along the Chinese coast. SWSs offer a decentralised and environmentally-friendly solution for the end-users in coastal regions that are affected by salinization.

Water resources are owned by the state. Hence, all property rights to groundwater resources belong to the state, meaning that “the right to use, sell and/or charge for water ultimately rests with the government”<sup>3</sup>. Water abstractors must pay a water resource fee, which varies between regions depending on local water resources and economic conditions. The 2002 Water Law is China’s key water legislation and includes provisions on water abstraction rights (Article 7), stating that: “the law does not allow groundwater extraction if pumping is harmful to the long run sustainability of groundwater use”<sup>5</sup>.

The Ministry of Water Resources has the main responsibility for water resources management, and more specifically for the management of abstraction permits<sup>6</sup>. Other ministries involved to manage water-related issues include the Ministry of Land and Resources, the Ministry of Environmental Protection and the Ministry of Housing, Urban and Rural Development:

The recommendations for exploring and implementing SWS solutions in the Laizhou Bay area involve three main issues:

### Clarification of legal framework for SWS implementation

There is a lack of official laws and policy measures specific to groundwater management, and the legal framework for implementation of SWSs remains unclear. At the national level, there is not one water regulation that is specifically focused on groundwater management. This results in laws not always being enforced, which also highlights the need for including local authorities in the decision-making process to strengthen their abilities to enforce existing legislation.

### A pilot SWS project

In order to provide the needed documentation for the technical, economic and sanitary feasibility of artificial recharge with SWS schemes, and to test the ability of the aquifer to clean recharged water, an important first step would be to allow for a pilot study. A SUBSOL pilot project could possibly be developed in the Laizhou Bay area under the auspices of the Water Resources Research Institute of Shandong Province (WRISD). Private companies may be prospective end-users if the financial viability of SWS technologies, ideally in conjunction with rainwater harvesting, can be demonstrated.

Local stakeholders proposed the following cities as potential sites for SWS technology implementation: Longkou, Laizhou, Changyi, Shouguang, Binhai as well as near-coast areas in the south of Laizhou Bay. Furthermore, the entire Yantai peninsula may hold favourable conditions for the implementation of SWSs, with the project possibly being developed under the auspices of the Yantai Institute of Coastal Zone Research.

### Proper process

As water supply is a major issue for households as well as for industry and environment, there are many stakes involved. For example, any attempt to ensure a more stable supply of clean water will require investments, better enforcement of regulation and eventually fees. In order to ensure an efficient and legitimate process with local support and cooperation, and in order to ensure that the solution and particular details of implementation address the actual local needs, resources and institutional framework, it is vital to have a proper, inclusive process prior to decision making and implementation.

## The SUBSOL project

SUBSOL targets a market breakthrough of SWS as robust answers to freshwater resources challenges in coastal areas, by demonstration, market replication, standardization and commercialization. The route to market includes business cases, market scans, capacity building and adaptive solution development in selected regions in Europe (Mediterranean, Northwestern Europe) and worldwide (USA, Brazil, China, Vietnam). SUBSOL will share experiences and outcomes with stakeholder groups through an online platform which will be linked to existing networks, including EIP on Water.

The SUBSOL consortium combines knowledge providers, technology SMEs, consultants, and end-users from across Europe. Our ambition is to introduce a new way of thinking in terms of water resources management, promoting the sustainable development of coastal areas worldwide. This will stimulate economic growth by ensuring a safe and cost efficient water supply.

## Credits and disclaimer

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