RETHINKING LANDSCAPES

Nico Berdellé on how the desert can be transformed into a life supporting system

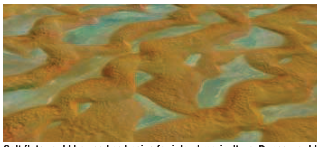
EVERY LANDSCAPE PROVIDES UNIQUE water services. Landscape architecture in the MENA region could fulfil the purpose of recreating water services according to natural models. In combination with other scientific disciplines like geological and hydrological engineering and also mechanical and civil engineering, the art of landscaping could be reconsidered for the installation of Life Support Systems (LSS).

In a region with dying agriculture, no forestry and very little wildlife, there is much to gain and little to lose by rethinking the landscape.

The Arabian subcontinent offers unlimited space and diversity of eco-topes to choose from. Vast regions are only a few metres above sea level making them ideal for seawater farming. Others regions are largely mountainous, with little vegetation, constituting extensive watersheds. The Rub Al Khali desert has countless salt flats that are primed basins for inland mariculture (seawater farming). The surface groundwater makes them waterproof at the bottom. Further, the mixing of hyper saline groundwater with the seawater will not matter because the seawater available in the Gulf is metahaline, having reached 47ppt salinity and still rising (brine is considered to start at 50ppt). In general, soils in Arabia are rich in minerals.

Most important, solar irradiation is an untapped treasure which could enable generation of freshwater with low temperature desalination (LTD). Even without further technology, like boiling point reduction, an annual water column of 1,800 – 3,600mm could be gained by evaporation, which is the simplest form of desalination and the solution that planet earth operates on. The numbers are derived from daily evaporation rates of five to 10mm.

The accrued water vapour can used in two different ways: first, inside a greenhouse, which is small scale but comes equipped with closed cycles offering unlimited water supply. The humid air is squeezed out, like a sponge, to gain the fresh water and to start the cycle. Second, it could serve open air as by-product of large scale inland mariculture, which would result in a more temperate micro climate. The water vapour will not be available for reuse in this version unless one is thinking in terms of Terraforming, which is a real process, but on a four-dimensional scale and of a size which could be a disincentive to investors.



Salt flats could be used as basins for inland mariculture. Dunes would be "locked down" with waterworks greenhouses

Of course there are several challenges to such architectural landscaping projects. First, salinity levels of seawater rise when deployed for seawater farming. The conduct of the water in open canals and the very large size of the farming areas cause a long exposure to the sun, which binds the endeavour to the shore. Our calculations show that a maximum of 20% of the water transported 100 kilometres inland evaporates under worst conditions.

If the recipient greenhouse or mariculture is further inland, the water must be pumped. The energy for it is not significant, especially coming from the Arabian Gulf, because the ascending slope inland is low. But building pipelines, especially huge ones required for mariculture in the salt flats, is all the more expensive. Open canals are more demanding when it comes to maintenance, unless they are inside the greenhouse utilities.

Salinity levels of the two Gulfs are too high to permit increase in discharge of brine. If the aim is ecological and long-term economic development, the saltwater must be evaporated entirely (open pond evaporation). This demands a large area, which pushes the operation further inland and brings us back again, to the cost of laying pipelines.

The next challenge is the construction of a greenhouse, or superstructure. It must be able to withstand strong winds and take care of sand deposits, some of which can get very heavy. At the same time, the opacity of the structure must be averted to keep sufficient solar energy coming in. The greenhouse must not only cover an acre or two, but an entire landscape. Only the most economic type of construction can be the solution.

In the case of seawater farming, there are also various parameters in the fields of fish breeding, fish food growing and breeding, climate, hydrology, technology and logistics that have to be taken care of.

These are but a few areas of interest that were solved in a process of Multi-disciplinary engineering (MDE) covering 145 scientific areas. All are part of the finished set of models

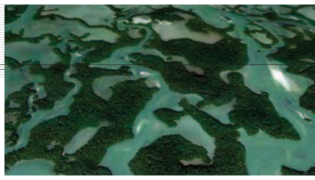
developed by TS Prototype Creation. The 'brick wall' of location, pipeline building and pumping cost could be solved through the strategy of subdividing into functional elements, mixing with different solution and reassembling to a flexible and adaptable strategy.

Systems integration

The entire concept relies on a series of inventions that emerged out of the broad linkage of the divergent areas of science and technology modelled for the IBTS (Integrated Biotectural System). At the same time, these ideas do not add up if considered from a single perspective. For the architect, building a greenhouse (in the desert) may not make sense. For the developmental planner, it is a book with Seven Seals because the master plan relies on natural sciences, technology and new probabilities in construction engineering. The mechanical engineer will not get the idea of a machine that works with water, soil, the climate and other natural assets.

Neither modern faculties nor the experiences collected during professional careers 'inside the system' produce generic scientists equipped to understand the polystructure of such concepts.

However, if looked at in the right context, it is not difficult. If we look at the efficiency of tropical rainforest biomes, as an example, the highest degree of efficiency is achieved by the integration of cycles and their functions. Viewing a simple leaf as energy provider will not convince the energy expert because photosynthesis operates on low efficiencies of around three to six per cent of total solar radiation. But looking at the cooling effect, so powerful that entire landscapes receive temperatures 20°C lower as well as the evaporated fresh water that amounts up to 4000mm of rain in the Amazonian rainforest, things looks different. In addition, the leaves provide oxygen, shade, beauty, nutrition, fodder and medicine.



Mangroves in the Everglades thrive on saline water with up to 60ppt (1). Black and white mangroves still grow above 90ppt (2)

This way of integration is superior to the high-tech or modern methods that are a misuse of nature. Employing the patterns of nature without falling for pointless mimicry is a challenging task.

The elements

A suitable, bionic water management for desert regions includes water preservation, seawater use (not only for seawater farming), solar desalination, atmospheric water generation (AWG), storage and controlling the flows of virtual water. All of these can be covered by an MDE landscaping process:

First and foremost, a paradigm shift between provision and preservation has to be traversed. There is sufficient water anywhere in the MENA region because any household, factory, or greenhouse can be equipped with closed water cycles or the more simple open water cycles that show no deficit in the inflow/outflow balance. Just like the Amazon rain forest, which generates its own rain and rivers, we have, on a micro scale, the Biosphere 2. The required water for operation is introduced in the form of a onetime charge. If evaporative desalination is the charging process and complete evaporation is achieved, then the landscaping development will not hit any physical or natural limit.

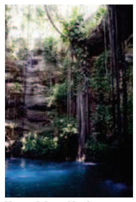
Furthermore, engineered desert-reclamation or desert-greening will gain momentum during its growth in contrast to common urban, industrial, or agricultural reclamation efforts that literally dry up after flourishing for some time. The reason for this acceleration is simple population dynamics. The growth of a population is dependent on its ability to harness and use the available resources. The concept applies for economics just as well. More than anything, unlimited resources from sustainable (water) cycles can aid the economic growth of the Arabian countries.

Seawater farming is a term used by the Seawater Foundation. The more exact name would be Integrated Multi trophic mariculture (IMTM). The name describes the joint cultivation of different seawater plant and animal species in a food chain system that makes profit out of waste. Salt loving plant species like Mangrove, Salicornia, Microalgae and Zooplankton (fish food) are fertilised by the excrement of fish or domestic effluent. Besides the yield in fish, the plants can serve as fodder for goats, cattle and poultry.

Atmospheric water generation can start outside of a greenhouse with plantations harvesting the morning mist. Certain plants have the ability to internalise and use this water before it evaporates again. The dew provides sustenance for many insects like honey bees. The moist foliage can be used as fodder reducing the requirement for other potable water sources for the animal husbandry.

Inside the greenhouse a dense atmosphere of elevated temperature and water vapour allows for economic water generation. Different condensation technologies, depending on coastal distance, topography, pumping technology, physics and the containment itself offer exciting solutions for low-energy condensation.

(Below) soil is a water storage which can take in and release water in a controllable manner! The upper few 100 metres of the earth's crust can host static or moving water masses in very different forms. In the tropical rainforest of the Yucatan peninsula, an underground system of rivers exists which is directly connected to the biosphere by very long roots of different key species.



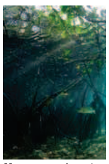
Karst sinkpool in the Yucatan peninsula. Areal roots reach into the aquifer.

The topsoil's surface must be designed to minimise evaporation in agricultural applications. For greenhouse applications, the soil will contribute to the required evaporation to saturate the air.

It is necessary to control the flow of virtual water embedded in food production. Arab nations will not lose much profit or technological advancement if they stop exporting agricultural goods. The production of technology and machines, which requires even more virtual water per service unit (pertaining to the MIPS concept or Material Input per Service Unit) would make sense abroad, but that is a much bigger topic than the local ecology.

Turning the landscape into a water machine, including large scale solar desalination in a greenhouse complex, is one of the main features offered by the Integrated Biotectural System. The IBTS is a flexible master plan concept comprising of modules the size of residential properties. It can be installed instantaneously because the Construction Site Setup (CSS) is already a fully functional version of the IBTS. The consistent biomimicry of an entire rainforest biome brings unprecedented efficiency rates in reach, like the generation of freshwater from brine with only 1.8 kWh of electrical energy input (3). Considering that the IBTS is a broadband developmental solution, integrating the functions of power plants, desalination plants, agriculture, animal husbandry and aquaculture farms, forestry and desert-greening requires minimal financial investment. This in turn results in a low-risk and stable project implementation.

The Excess yielding Service Cycles, adapted to the Physical Environment (ESCAPE), provide utilities within the cycles of the IBTS but also Excess Services for the environment it is part of like communities in the vicinity. What more could be expected?



Mangrove underwater

Mangrove canal with little evaporation

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