Greening Drylands with Seawater Easily and Naturally

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The sun and sea are inexhaustible sources of energy and water that could be used to transform drylands into more viable ecosystems. A sustainable and cost-effective approach is proposed for greening drylands and restoring wildlife and biodiversity in deserts using seawater desert-houses (or movable seawater ponds) that could offer important environmental advantages.

Solar Desert-Houses (or Movable Seawater Ponds)

In an attempt to green the desert and revive its dry niches, I propose a simple and cost-effective approach that could be developed using artificial and movable solar stills in the form of greenhouses, which we can call “solar desert-houses” or “artificial seawater ponds” (Figure 1). Based on the same principle as rain formation, these structures could distill seawater naturally and sustainably to provide small, but permanent, amounts of freshwater to satisfy water requirements for many desert species. Thus, large and movable water-tanks or containers could be manufactured in rectangular or circular forms to be either fixed above the ground or buried in the soil (see Box 1 for some design criteria). Seawater could then be supplied into these assemblies and left under natural conditions. Given that the sun shines most of the time in drylands, with average temperatures up to 40–50°C, seawater will evaporate and condense on the inner side of the roof as freshwater droplets. These droplets could be collected, stored, and conducted outside the desert-house via small grooves at the bottom-lateral edges, which would be connected to perforated hoses or tubes that would deliver the freshwater into the soil (similarly to inground irrigation systems). As such, a permanent and miniaturized replication of the rain system would be created naturally with valuable benefits for nomadic peoples, and plant and animal species in drylands.

Major Advantages

The suggested approach is simple, accessible, cheap, and environmentally friendly. Solar desert-houses could be built anywhere in drylands or wastelands, including remote continental arid zones where the sun shines, and seawater could be brought through ducts or tubes. Another advantage is that the seawater ponds could be transferred to new locations, removed, or stopped at any moment. Given that the seawater is kept in containers and salts could be recovered from them, there would be no soil salinization risk associated with this system. In fact, there would be a double benefit: on the one hand, it would produce freshwater for desert vegetation and, on the other, it would produce, as a byproduct, salts, which could be used for human consumption or industrial applications. Given that there is little equipment required for this approach, maintenance operations would be easy and minimal, limited to turning the seawater provision system on and off and recovering accumulated salts from the containers. Finally, buried tubes offer an important advantage to minimize the evaporation risk of the freshwater itself by delivering the freshwater droplets...
directly inside the soil close to the root areas so that plants would benefit from accumulating freshwater droplets more efficiently. However, if freshwater-collecting tubes were designed to be buried, regular controls might be needed to ensure that the tube perforations did not become blocked by the soil; alternatively, the tubes should be semipermeable so that the freshwater water would leak from them into the soil. Finally, the outlined approach might also be used to treat or evaporate sewage or wastewater in sunny drylands, and the resulting solid wastes could be used as solid organic fertilizers.

**Minor Disadvantages**

Although the yield of the freshwater produced this way may be low per units of time and space, the process is sustainable and scalable; therefore, the overall volume of freshwater produced over time could be enough to meet the minimal needs of many desert plant species whose needs are intrinsically low. As a result, many desert plant species would be able to prosper and populate the surfaces surrounding the established seawater ponds to form small oases in the heart of the desert (Figure 1). However, given that the evaporation process would be continuous, salts would accumulate in the containers, reducing the volume of evaporable seawater. To prevent this, the supply of seawater could be stopped periodically to recover the accumulated salts and allow the system to function optimally.

While the efficiency in producing freshwater will depend on the ambient conditions and materials used in capturing sunlight, the outlined approach could help to exploit arable lands more intelligently if the system were built at a high density on lands that only need a little freshwater to offer full agricultural potential. In fact, many desert plant species can grow and thrive in extremely dry conditions with only traces of moisture in the soil or in the atmosphere (dew); therefore, the amount of freshwater produced via the proposed approach could be enough to meet their needs and allow them to grow successfully. Another potential minor hurdle is the risk of the produced freshwater evaporating before the soil absorbs it, particularly if the freshwater droplets are poured on the soil surface rather than inside it. To mitigate this hazard, the freshwater-collecting tubes could be half-buried or completely

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**Figure 1. A Streamlined Illustration of Simple, Reusable, and Cost-Effective ‘Solar Desert-Houses’ (or ‘Artificial Seawater Ponds’).** In contrast to traditional greenhouses, solar desert-houses are not intended to grow plants inside, but to be filled up with seawater, which, under hot dry conditions, would evaporate and condense into freshwater droplets that could satisfy the needs of some crops or plant species growing in the desert (e.g., xerophyte and halophyte species). Artificial seawater ponds would help to form artificial oases in the desert, while offering a valuable food source for desert animals, such as camels, horses, or wild birds. When the accumulated salts reach a given threshold at which the evaporation efficiency is reduced, the salts could be recovered by discharging the accumulated salts from the container so that it can be reused again and again. The desert-houses should be made from materials adapted to harsh climate conditions (i.e., extreme temperatures and high salt concentrations) to minimize maintenance operations. New technologies could help optimize the proposed system by, for example, full automation of all the processes, from seawater pumping to salt discharging; although such automation would increase the overall cost, it would also improve the system substantially. Any excess of seawater brought to the desert-houses could be returned to the sea in a cyclic and sustainable system.
buried in the soil so that the freshwater droplets would be injected inside the soil as soon as they are produced. Another potential enhancement is to design the seawater ponds to stock freshwater produced during the day in lateral reservoirs and to deliver it during the night, when it is cooler, so that the evaporation risk would be significantly minimized. This could be achieved by using, for example, light sensors or mechanical adapters that could control the delivery of freshwater only during the dark (i.e., a control by light or optical sensors) or when the accumulated freshwater reaches a certain volume or weight (a mechanical control or a control by weight).

Concluding Remarks
Purifying seawater from its impurities and salts could be attempted naturally in sunny regions using ‘solar desert-houses’ or ‘artificial seawater ponds’ on a large scale to produce freshwater for desert vegetation at low cost. The approach is inexpensive and easy to implement to benefit many people and native animal and plant species in large drylands in the world without any particular hurdles. Solar desert-houses could be placed anywhere that sun and saltwater are both available. By adopting and optimizing such a system, many plant species could grow successfully and provide food sources for desert animals and, indirectly, for humans. The proposed approach could also contribute to protecting the soil as a result of plant growth, thus reducing the intensities and frequencies of dust storms in these regions. Developing solar desert-houses would also help improve the quality of life for many people and desert species and offers a potentially useful solution to the issues of water shortage and desertification in large drylands worldwide.

References

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http://dx.doi.org/10.1016/j.tibtech.2016.09.005