Sahara Forest Project

Re-vegetation and creation of green jobs through food, freshwater, biofuel and electricity production

Status | Project | Contact
Ongoing | Restorative growth | Sahara Forest Project

The production of key resources, such as clean water, clean energy and a sustainable production of food represents some of our time's greatest challenges. These challenges are closely intertwined and therefore require integrated approaches. With nature as an inspiration, the Sahara Forest Project uses a technological system where the waste product from one technology is used as a resource for another. This integrated technological system allows for harvesting beneficial synergies and increased efficiencies of the individual technologies. In such a way, the Sahara Forest Project advocates a restorative growth approach that is good for the environment, good for people and provides long term economic viability. The Sahara Forest Project has introduced a new environmental solution to create re-vegetation and green jobs through profitable production of food, water, clean electricity and biomass in desert areas. The first Sahara Forest Project realisation is a pilot facility in Qatar, built in 2012. Work to build the first stage of a test and demonstration centre in Jordan started in 2014.

The issue

Case background/context

By 2050 the world population is expected to exceed 9 billion people. Currently we are facing intertwined challenges food, water and energy security, within the context of climate change and desertification; challenges that will only be exacerbated by our growing population. The challenges that we face are not without solutions, but solutions for one challenge cannot be taken at the expense of another. These challenges are an interlinked nexus and so the same must be true for their solutions.

Today, about 70% of freshwater consumption is by agriculture. According to FAO estimates, global food production will have to increase by 70% from 2009 to 2050, however but this must be achieved within a context of increasing water demand, due to the growing and developing population. Additionally, expansion of agricultural output should not cause large negative effects on energy consumption, CO_2 emissions, or desertification.

Sahara Forest Project (SFP) is established as two entities. A foundation is set up to promote the concept of Restorative Growth and to be a creative playground for early-stage concepts and launching of new initiatives. The SFP has also set up as a Norwegian private limited liability company with the purpose of creating profitable innovation and environmental solutions within the food, water and energy sector. The company's activities deliver on a triple bottom-line: The activities will

be good for the environment, good for social development and provide long-term economic benefits to investors.

The response

The main objective of the case

Current models of production and single-focus technology solutions neglect and/or waste many resources that can be utilised to achieve restorative growth. In this context The Sahara Forest Project (SFP) developed an innovative solution designed to utilise what we have enough of (using deserts, saltwater and CO_2) to produce what we need more of (food, water, and clean energy). This was done by combining already existing and proven environmental technological components, including saltwater-cooled greenhouses, solar power technologies and technologies for desert re-vegetation around a saltwater infrastructure. The synergies arising from integrating the technologies improve the performance and economics of the system compared to those of the individual components.

The SFP set out to establish groups of interconnected economic activities in different low lying desert areas around the world. The simple core of the concept is an infrastructure for bringing saltwater inland. Through this infrastructure The SFP aims to make electricity generation from solar power more efficient, operate energy- and water-efficient saltwater-cooled greenhouses for growing high value crops in the desert, produce freshwater for irrigation or drinking, safely manage brine and harvest useful compounds from the resulting salt, grow biomass for energy purposes without competing with food cultivation, and re-vegetate desert lands.

From 2009 the concept has been developed with an initial focus on implementation in Qatar and Jordan. A fully functional SFP Pilot Facility was built in Qatar through a partnership between Yara International ASA, Qatar Fertilizer Company (Qafco) and The SFP.

The pilot facility involved a purpose built greenhouse. At one end of the greenhouse seawater is run down a surface whilst fans blow desert air over it. The evaporation of the seawater results in cool and humid air within the greenhouse, thus lowering the temperature. The condensation of moist air, using pipes cooled with the seawater, results in a fresh water source for irrigation. The energy produced for the operation of the greenhouse is generated within a concentrated solar power plant within which solar energy is used to create steam and drive turbines.

The results

Outcomes

The Pilot Facility in Qatar has provided a unique research platform and the first demonstration of the technologies at scale and hosted a multidisciplinary programme of technology verification and optimisation.

Some of the key findings from Qatar were:

- Greenhouse uses 2.3 L/plant/day water, and produces up to 25 kg/m^2/crop, indicating yields at 75 kg/m^2/year baby cucumbers. The yields obtained in the pilot stage in Qatar are competitive with leading European greenhouse operations.
- Use of seawater for evaporation in greenhouse pad and fan cooling system reduces total water use of the system by more than 50% compared to traditional freshwater systems.
- Vegetable production possible in greenhouse 12 months of the year despite summer heat.
- Cooling for Concentrated Solar Power using seawater infrastructure provides near 100% of theoretical max wet cooling efficiency.
- 19 desert plants and vegetable and grain crops successfully cultivated outdoors throughout the year in areas with saltwater based evaporative hedges.
- The system also provides climate benefits by sequestering CO_2 in the facility's plants and soils, and by pushing back the accelerating process of desertification through the re-vegetation of deserts.

Findings from Qatar will help prepare for the next steps; a test and demonstration centre providing the first commercial-scale of the full SFP value chain. The value chain consists of all the core technological components (saltwater-cooled greenhouse, solar power and evaporative hedges and outdoor vegetation) in a synergetic set-up coupled with facilities for training and innovation. An important part of the Test and Demonstration Center will be to further optimise the technologies based on the results from the Qatar Pilot Facility to achieve optimal resource use. By bringing together local and international entrepreneurs, scientists, business and other key players in green innovation, The SFP Test and Demonstration Center will be a platform for research, innovation and training for sustainable solutions to the food, water and energy challenges. Like the pilot facility in Qatar, additional activities will include using the seawater for cultivating algae and halophytes for biomass, and salt extracting by evaporation.

The successful operation of technologies identified by SFP indicates the effectiveness and competitiveness of the concept in challenging conditions. Findings prove that there are significant comparative advantages using saltwater for the integration of food production, re-vegetation and renewable processes.

References

Sahara Forest Project .(2013). Results from the pilot facility in Qatar.
http://saharaforestproject.com/fileadmin/uploads/sfp_qatar_results_folder_2013.pdf.

Science Magazine. (2013). Desert Farming Experiment Yields First Results.
http://news.sciencemag.org/asiapacific/2013/11/desert-farming-experiment-yields-first-results.