ECOSYSTEM-BASED ADAPTATION THROUGH SHOUTH-SOUTH COOPERATION

GOOD PRACTICE CASE STUDY

The Green Wall in the heart of the Takalamakan Desert

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Over a period of more than 2,500 years, China constructed and maintained its Great Wall to repel invasions and control its borders. Despite stretching over more than 21,000 km, this wall was often unsuccessful in holding back northern attackers. More recently, China has built a more successful wall, a 'Green Wall' comprising a dense plantation of indigenous desert plant species adjacent to the highway cutting through the Taklamakan desert, which protects the road infrastructure from being covered in sand.

Key lessons

- The Green Wall of the Taklamakan Desert shows how human ingenuity and science can overcome tremendous environmental barriers to develop new, green ecosystems that provide adaptation services such as protection of infrastructure, as well as an increase of biodiversity
- EBA is cost effective: the total cost of investment on the Green Wall is significantly lower than the estimated total cost of removing sand from the road
- Long-term ecological research is of fundamental importance for EBA implementation
- Applied research should be conducted in collaboration with both the private and public sectors to trigger up-scaling of EBA interventions
- EBA good practices and technologies can be shared and transferred to Africa, in particular in support to its Great Green Wall of the Sahara and the Sahel

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GOOD PRACTICE DESCRIPTION

LOCATION: Taklamakan Desert, Xinjiang Uygur Autonomous Region in northwest China

IMPLEMENTATION PERIOD: 1991-2006

ESTIMATED INVESTMENT COSTS: $10,000 per hectare, with total maintenance cost of $4.7 million per year

Background information and climate change vulnerabilities

The Taklamakan Desert covers 337,000 square kilometers and is the world's second largest desert after the Sahara. The desert is dissected from north to south by the Tarim Desert Highway, constructed to transport oil and gas from the centre of the desert. The blowing of sand is a serious problem in this extremely dry area. As a result of climate change, the air temperature of the Taklamakan Desert is increasing. Future climate change impacts on the desert ecosystem and water regimes are still poorly understood, but it is anticipated that, as a result of warming, sands will become increasingly mobile.

Intervention technologies

Applied research was undertaken to determine which plant species could tolerate the extremely saline groundwater of the Taklamakan Desert. The Taklimakan Desert Research Station (TDRS) of the Xinjiang Institute of Ecology and Geography (XIEG), Chinese Academy of Sciences, tested the growth of 173 species of plants under desert climate and irrigation with saline water. Of these, only 88 species were able to grow well under these harsh environmental conditions. Three plant genera from the 88 species were selected as having optimal characteristics for the construction of a Green Wall, namely *Calligonum*, *Haloxylon* and *Tamarix*. These characteristics include extreme drought tolerance, rapid growth, capacity to withstand damage from wind-blown sand and capacity to grow using saline water.

Description of the results

The Green Wall, which stretches for 436 km through the heart of the Taklamakan Desert, was constructed over a period of 16 years from 1991 to 2006. *Calligonum*, *Haloxylon* and *Tamarix* are planted in rows, alongside drip irrigation pipes, in belts of 72-78 meters wide on each side of the road. This creates a barrier that protects the road infrastructure from being covered in sand.

The success of the Green Wall has catalyzed public sector expenditure to reclaim the desert and develop highly productive agricultural landscapes in the Hotan prefecture, situated on the southern border of the Taklamakan Desert. Drip irrigation systems, using groundwater, are being installed into the desert over thousands of hectares and new agriculturally productive landscapes are being created.

GOOD PRACTICE ANALYSIS*

Knowledge building

How has the project built upon or applied the findings of specific research projects? How has the project actively contributed to international understanding on Ecosystem-based Adaptation?

The Green Wall in the Takalamakan desert builds on 50 years of scientific research conducted by the Xinjiang Institute of Ecology and Geography (XIEG) within the Chinese Academy of Sciences (CAS). This research, driven by the demands of communities and industry, has been conducted by numerous research stations, including those from the Chinese Ecosystem Research Network (CERN). Two important players in the EBA interventions in and around the Green Wall are the Turpan Botanical Gardens, which function as a research base for conserving the germplasm of many Chinese desert plant species, and the Cele National Field Research Station (CNFRS), located 100 kilometers from Hotan City, which develops technologies to control desertification and movement of sand dunes into urban and agricultural areas.

This knowledge can be used and shared to manage climate change risks, such as increasing temperatures and more intense and frequent droughts, that China and the entire world face.

Political ownership, collaboration and approval

How has the project secured support from political-level stakeholders and aligned its activities with wider development agendas to trigger further collaboration opportunities?

This experience has shown that applied research should be conducted in collaboration with both the private and public sectors to ensure that appropriate up-scaling of EBA interventions is triggered. For example, research on appropriate EBA interventions started at a plot scale in the Turpan Botanical Garden and then reached thousands of hectares through the collaboration with the industrial sector on the Green Wall, and finally, after influencing public policy, it has been up-scaled in the Hotan prefecture, where thousands of hectares of desert are being reclaimed to yield verdant agricultural fields.

Financial sustainability

How has the project secured financing for sustaining and/or expanding its impacts?

Twenty million plants were planted over a 2 year period to form this green infrastructure, at a cost of ~$10000 per hectare, with total maintenance cost of ~$4.7 million per year. The investment has been deemed very cost-effective because the cost of removing sand manually from the road on a daily basis is estimated at $15 million per year. The total cost of investment – including establishment and maintenance – of the Green Wall over a 20 year period is estimated to be ~$125 million. By comparison the total cost of removing sand from the road – including all expenditure on equipment – has been estimated to be more than double this cost (~$300 million).

The Green Wall is also expected to generate an income stream, based on research by the Taklimakan Desert Research Station (TDRS) into the production of a medicinal plant, the desert

* This analysis is based on the "principles of good practice" developed by the EU/FP7-funded project AfriCAN Climate (2011-2014). These principles represent critical cross cutting issues shared by the majority of climate change projects, regardless of focus, scope and scale. They are intended to encourage critical reflection and help project developers and decision-makers draw out relevant lessons. Source: http://africanclimate.net/en/good-practice/8-principles-good-practice

ginseng (*Cistanche deserticola* and *Cistanche tubulosa*). These plants are root parasites that live off the shrubs of the Green Wall. Their roots are chipped, dried and then sold into the large domestic market across China. TDRS is conducting trials on the desert ginseng to determine how to maximize the income from this agricultural production. The research has shown that it is feasible to produce desert ginseng across the entire Green Wall and this up-scaling is in the process of being rolled out. It is anticipated that between $1500 and $7500 per hectare per annum will be generated through sales of the desert ginseng once it is in full production across the Green Wall.

Achieving co-benefits and balancing trade-offs

How were the costs and benefits external to the project taken into consideration, e.g. on employment, environment, health, poverty levels, food security etc?

The benefits of the Green Wall go beyond merely stopping sand from moving onto the road. For example, there has been an increase in indigenous biodiversity, including mammals and birds.

In new desert reclamation projects in the Hotan prefecture, drip irrigated *Tamarix* plantations used to control movement of sand from the desert are also used to produce roots of the valuable medicinal plant, *Cistanche*, for export. The production of *Cistanche* is undertaken by local villagers, providing them with a new income stream that is boosting the local economy.

Transferability

How has the project ensured that its activities can be transferred beyond the specific contexts in which they were implemented?

The development of the Green Wall has triggered many other green infrastructural developments, and numerous lessons have been learned through the XIEG's long-term, applied research.

Indeed, an EBA approach using green infrastructure designed by XIEG has already started in the Hotan prefecture.

The XIEG is now sharing expertise with developing countries across Africa and Asia. The Great Green Wall of the Sahara and the Sahel (GGS) is one pertinent example of how XIEG's research knowledge could be applied to great effect. This green wall was initiated by the African Union and the Community of Sahel-Saharan States to address the detrimental social, economic and environmental impacts of land degradation and desertification in the Sahel and the Sahara. The lessons learned by XIEG during the construction of China's Green Wall through the Taklamakan Desert and the transformation of thousands of hectares of desert into productive agricultural landscapes in the Hotan prefecture are likely to be of great benefit to the GGS developers. This is because Africa's green wall will also go far beyond simple tree planting. It will be exploring ways to generate income, adapt to climate change, develop new livelihoods, establish new value chains and provide food security for vulnerable local communities. There are consequently considerable synergies between the two green walls in China and Africa.