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Original Article

CHINA'S ENVIRONMENTAL SUSTAINABILITY CONCEPTS FOR REHABILITATING DESERTS IN LINE WITH THE ARABIAN DESERT

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ABSTRACT
China seeks for idea of desert rehabilitating especially at Mongolia desert. This environmental sustainability concept has strategies for desert reconstruction via wild planting projects. It scopes on modifying climatic changes to optimum standard levels by idea of planting. This review compares as well the status of Arabian hot desert by using Saudi Arabia as an example. It gives such solutions to solve our environmental problems especially at desert area.

Keywords: Elm Tree, Harsh Environment, Water Footprint, CO2 Equivalent, Microflora

INTRODUCTION

In China, there is a rapid desertification due to factors such as rapid population growth and overgrazing. At the end of 2050, China's government will exert all its best to cover more than 26% of all lands with planted afforestation. Mongolia desert is aimed to be a target by 2030 with tree plantation as part of its commitments to the United Nations Sustainable Development Goals ElNesr et al. (2010) Figure 1.

Figure 1

Figure 1 Location of Mongolia Desert

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CHINA PROJECT ESTABLISHMENT

They started planted specific type of wild tree like Pinus tabulaeformis L. and Elm tree (Ulmus procera L.) that are resistant to drought, cold weather and low nutrients with very small holding of water capacity. Volunteers added the seedlings in appropriate biodegrable bags with sufficient nutrient soils and amount of water to help the seedling within the first period of growth to overcome and adapt the harsh environment Alshehddi and Bokhari (2020) Figure 2, Figure 3.

Figure 2

Figure 2 Volunteers Planted the Seedling

Figure 3

Figure 3 (a) Pinus Tabulaeformis L., (b) Elm tree

They are obeyed the ecological water parameters that are determined by IPCC (Intergovernmental Panel on Climate Change); an intergovernmental body of the United Nations. Its job is to advance scientific knowledge about climate change caused by human activities Abd El-Maboud (2016).

DETERMINATION OF ECOLOGICAL WATER PARAMETERS

These parameters are:

1) Water Footprint (WF)

It measures the amount of water used to produce such healthy surviving trees Scerri (2018).

2) Ecological Water Deficit (EWD)

It refers to the situation where the model underestimates the amount of water in the soil early in the season and slightly overestimates it later in the season, particularly for well-watered treatments Zhou et al. (2023)

3) Water stress index

It is used to indicate the ratio of water consumed that deprives other users in the same watershed area. These water parameters can provide better IPCC scenario for conserving the best percentage of CO2 level at atmosphere. The green curve refers to best outcome that serves global temperature Chen et al. (2023) Figure 4.

Figure 4

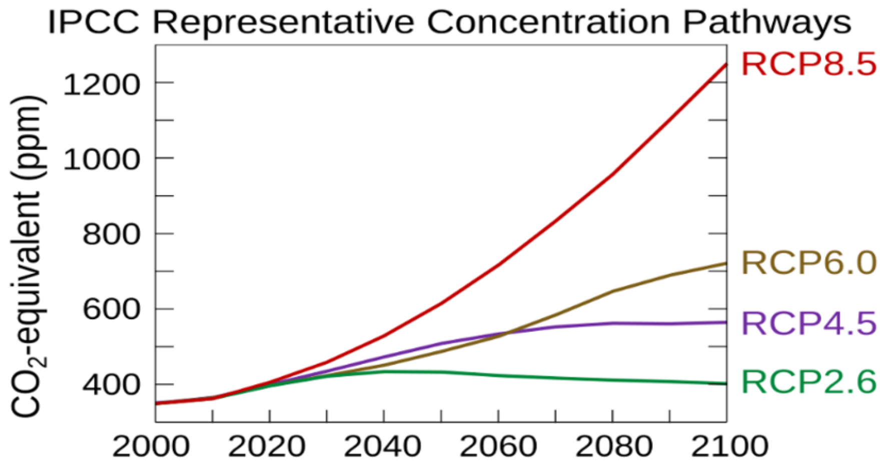

Figure 4 Suggested IPCC Scenarios Will Influence Global Temperature

These pathways (or trajectories) describe future greenhouse gas concentrations and have been formally adopted by the IPCC. The pathways describe different climate change scenarios, all of which were considered possible depending on the amount of greenhouse gases (GHG) emitted in the years to come Zhengyi (2021)

CLIMATE SCIENTISTS' HYPOTHESES

Climate scientists claim that native and other climate resilient tree species with low water needs, can reduce sand storms, avert wind erosion, and contribute to carbon sinks, improving micro-climates, soil nutrients and water retention. So that China's project started as successive stages to obtain the yields, assess the procedures and predict the incoming results Kwak (2017) Figure 5, Figure 6.

Figure 5

Figure 5 Plant Stages of China's Project

Figure 6

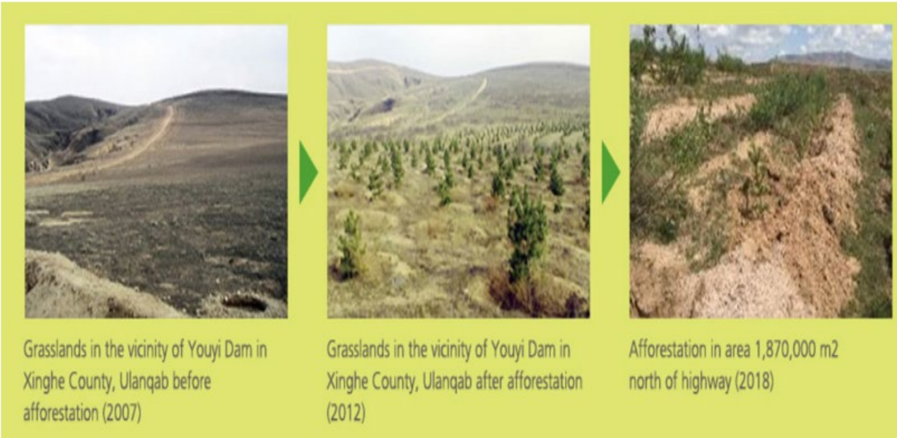

Figure 6 Plant Progress at Mongolia Desert

The project initiated from 2000 to 2006 by planting approximately 80,000 trees on 300 hectares. It encouraged on increasing the plantation as phase 1 by planting 700,000 tress from 2008 to 2012 after reaching 94.72% survival rate on 467 hectares. After that, the second phase started from 2013 to 2017 by planting 700,000 tress at the same number of hectares after reaching to 96.94% survival rate. Finally, from 2018 to 2022, it was the third phase including other 700,000 trees on the same number of hectares at 85% survival rate Maurice (2024)

Table 1

Table 1 China's Project Details

	Phase 1 (2008–2012)	Phase 2 (2013–2017)	Phase 3 (2018–2022)
Number of participating companies	14 companies	16 companies	16 companies
Expenditure for the project	10 million RMB	20 million RMB	20 million RMB
Tree planting area	Vicinity of Youye Dam 467 hectares	Area along National Road 110 467 hectares	North of highway 467 hectares
Tree species	Pinus tabulaeformis(59%) Pinus sylvestris (22%)	Pinus tabulaeformis(31%) Pinus sylvestris (54%)	Pinus tabulaeformis (50%) Pinus sylvestris (50%)
Survival rate of the year	**2008**: 96.60 % **2009**: 97.40 % **2010**: 95.60 % **2011**: 91.90 % **2012**: 92.10 %	**2013**: 96.10 % **2014**: 94.10 % **2015**: 98.00 % **2016**: 97.70 % **2017**: 98.80 %	**2018**: **98.40 %** **2019**: 98.90 % **2020**: 98.30 % **2021**: 99.20 % **2022**: –
Average survival rate	94.72%	96.94%	Target survival rate: 85% and above (Government standard)

The plantation included Pinus tabulaeformis and Pinus sylvestris with different percent by assistance of 14 to 16 companies with cost of nearly 50 million RMB at three phases. The survival rate per each year was more than 90% so it reflected the successful mission throughout long period of time Erick (2021) Table 1.

Climate scientists extended to claim that after new investment of tree planation, we can be able to plant other shrubs or subshrubs under huge trees increasing more environmental sustainability with promotion of soil microflora communities interacting with plants to an increase in the water regime in natural ecosystems Wang (2023) Figure 7.

Figure 7

Figure 7 Improvement of Environment After Growth of Huge Trees

SUGGESTED PLANATION OF SHRUB AT CHINA'S PROJECT

Hippophae rhamnoides L. (Sea buckthorn) (Elaeagnaceae) is a drought-resistant shrub species with a well-developed root system, adapted to very dry land. The roots can reach to depths of 4-5 m due to very long main root exceeded of 2 m besides many lateral roots so that this plant can withstand and adapt for living below 2% water content. This new environmental adaptation will encourage new living organisms to invade with enhancement soil properties, water collections and climate change Figure 8. This combination between trees and shrubs create better environment capturing more animals and birds besides increasing fertility of soil. All of them will improve water potential at the soil by plants from one side and other biotic factors from another side Wang (2023).

Figure 8

Figure 8 Real Photo from Mongolia Desert

It is suggested to increase water supply in Mongolia desert after decades with completely changeable adapted environments. More rehabilitations may occur not only from living organisms but also human beings Erick (2021) Figure 9.

Figure 9

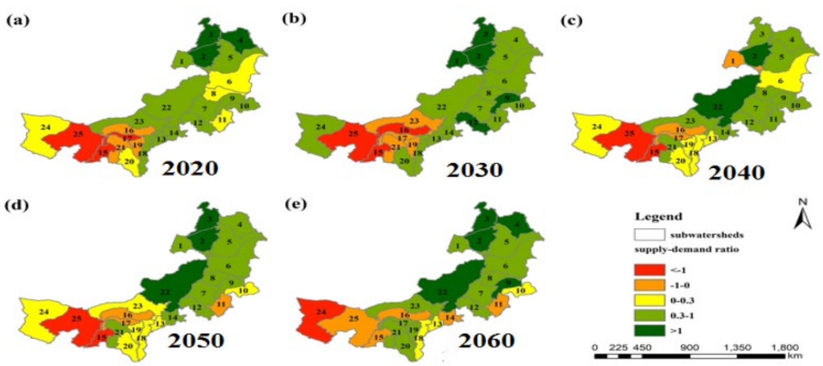

Figure 9 Suggested Assessing Fresh Water Supply at Mongolia Desert (2020-2060)

COMPARISON BETWEEN MONGOLIA AND SAUDI DESERTS

Mongolia desert is regarded as cold desert while Saudi deserts are hot ones. Fluctuation of rain precipitations is almost the same between two deserts. Moreover, tunnels of water supply beneath underground are more distributed with interwoven networks on the contrary; the underground water resources at Mongolia desert are limited at the northern direction beneath mountains. The average temperature through the year is almost the same between two regions Maurice (2024) Figure 10, Figure 11, Figure 12, Figure 13 .

Figure 10

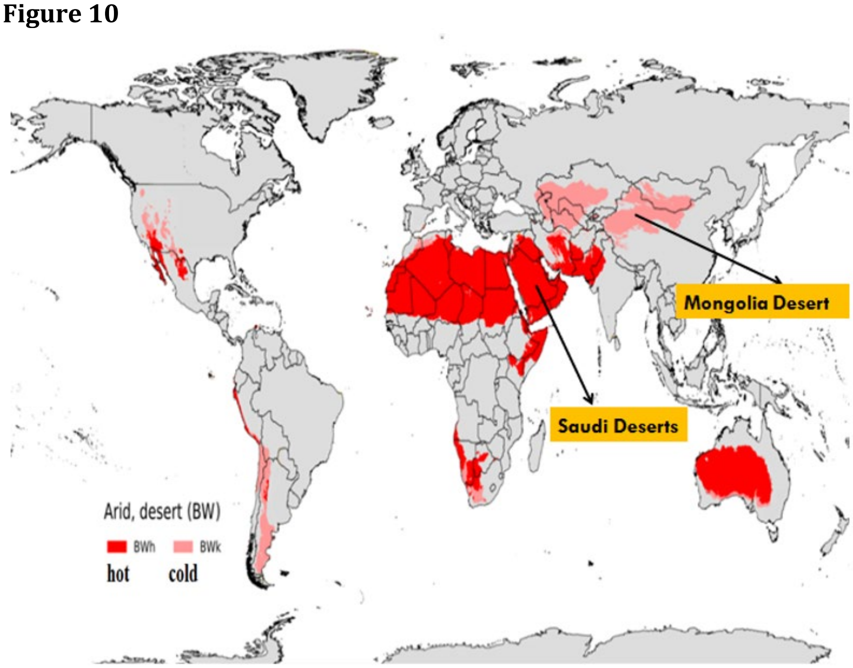

Figure 10 Distribution of Hot and Cold Deserts All Over the World Including Mongolia and Saudi Deserts

Figure 11

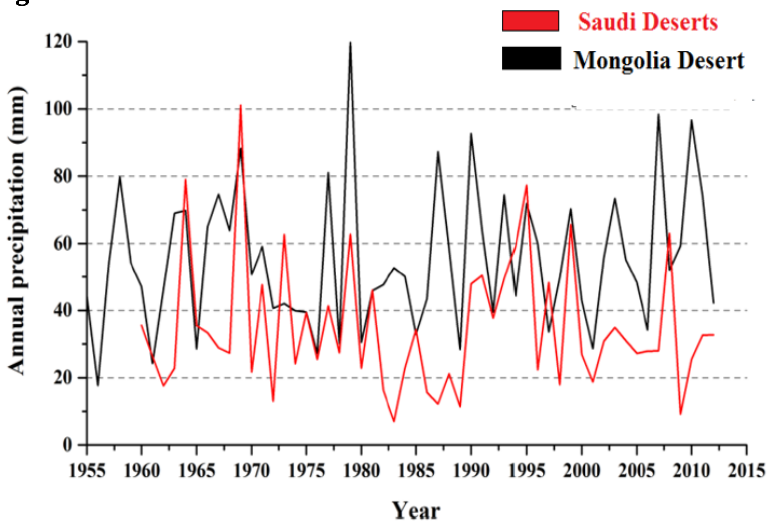

Figure 11 Annual Percepitation Fluctuations Between Mongolia and Saudi Deserts

Figure 12

Figure 12 Traces of Water Resources Within (a) Mongolia Desert, (b) Saudi Deserts

Figure 13

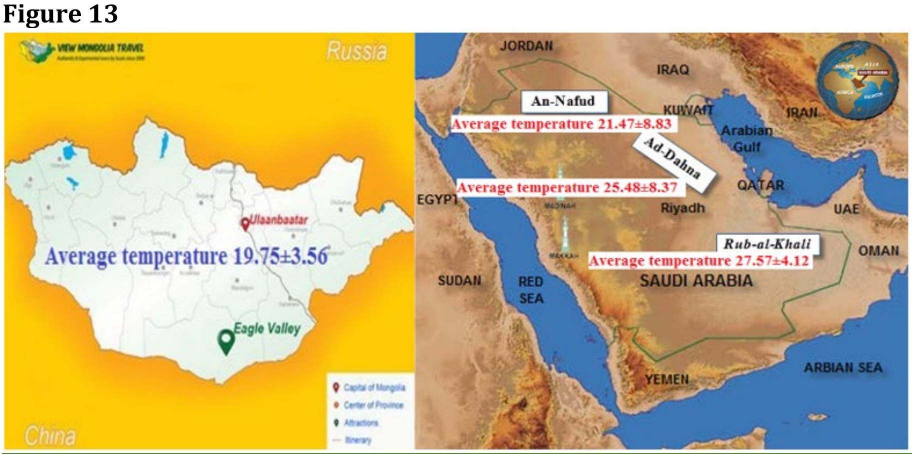

Figure 13 Ambient Temperature at Both Studied Deserts, (a) Mongolia Desert, (b) Saudi Deserts

SUGGESTED WILD TREES PLANTED AT SAUDI DESERTS

There are some suggested trees which can be planted at Saudi desert following all ecological and water efficiency. All of suggested trees have large canopies which can fulfill the sustainability and adaptational requirements for planting project. Celtis africana Burm.f. (Cannabaceae) is easy to grow and is fast-growing. It is fairly drought resistant and can withstand little water. Dobera glabra (Forssk.) Juss. ex Poir. (Salvadoraceae) is one such typical drought indicator. At dry season, the shoot systems undergo to grown new ones enhancing also with flowers, fruits and seeds in absence of rains or even with low precipitation. Mimusops laurifolia (Forssk.) Friis (Sapotaceae) is an evergreen tree containing the leathery leaves bunched at the branches of the peaks. It has a slow growth adapting to drought habitats. Salix mucronata Thunb. (Salicaceae) is a fairly fast grower and the tree is hardy, able to withstand frost and drought conditions. Terminalia brownii Fresen.(Combretaceae) is the drought resistant species occurs in the arid and semi-arid regions but can also be found in the sub-humid areas. Trema orientale (L.) Blume (Cannabaceae) is very fast-growing and has an extensive root system that enables it to survive drought conditions. Ziziphus spina-christi (L.) Desf. (Rhamnaceae) is drought hardy, very resistant to heat and can be found in desert areas. The tree is frost tender, can withstand water logging for up to 2 months and 8-10 months of dry season Kwak (2017), Wang (2020) Figure 14.

Figure 14

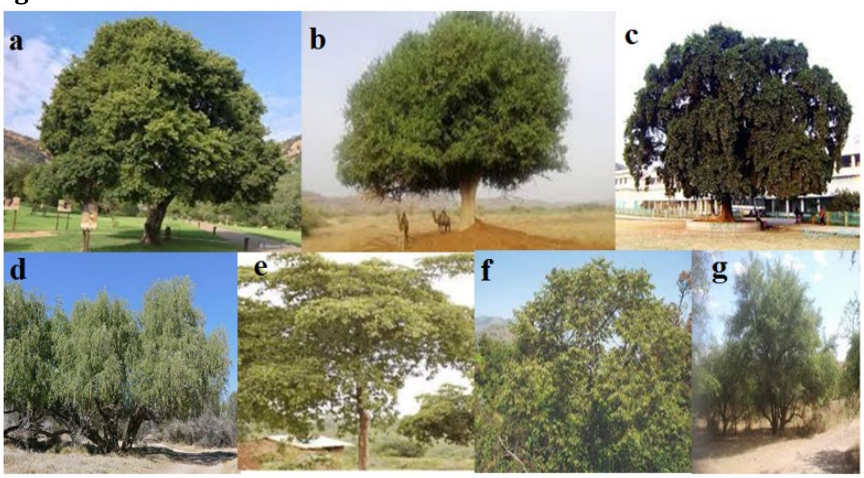

Figure 14 Suggested wild Trees Planted at Saudi Deserts; a: Celtis Africana, b: Dobera Glabra, c: Mimusops Laurifolia, d: Salix Mucronata, e: Terminalia Brownie, f: Trema Orientale, g: Ziziphus Spina-Christi

SUGGESTED WILD SHRUBS AND SUBSHRUBS PLANTED AT SAUDI DESERTS

Calligonum comosum L'Hér. (Polygonaceae) is hardy shrub grows in arid, sandy ecosystems where the annual rainfall does not exceed 100 mm. It thrives on sandy soils, often stabilizing the surrounding sand in large hummocks and reaching the water- table with its long taproots. Cornulaca monacantha Delile (Amaranthaceae) is a desert plant, woody shrub, richly branched, usually with long internodes. This plant can adapt with dry condition as less than 2% water content. Haloxylon persicum Bunge (Amaranthaceae) is typical desert plants, show strong drought tolerance and environmental adaptability due to well-efficient root system against scarce water. Lycium shawii Roem. and Schult. (Solanaceae) is drought-deciduous thorn plant. It is completely leafless in the summer and stems take over the photosynthesis process to slowdown the rate of metabolism. Rhanterium epapposum Oliv. It consists of bushy of branches with sharp thorns that are scattered within leaves and branches besides presence of shiny yellow flowers. It is a very bushy shrub approximately 80 cm height Zhengyi (2021), Chen et al. (2023) Figure 15.

Figure 15

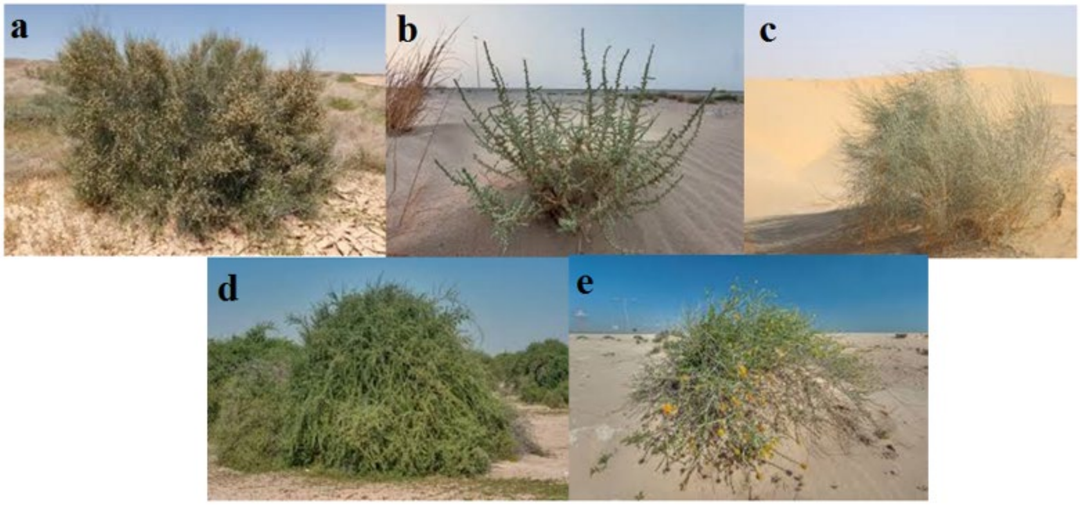

Figure 15 Suggested Wild Shrubsand Subshrubs Planted at Saudi deserts; a: Calligonum Comosum, b: Cornulaca Monacantha, c: Haloxylon Persicum, d: Lycium Shawii, e: Rhanterium Epapposum

CONCLUSION

The huge environmental project needs more interest and brave decision to take place for best lives for future generations. The sustainability is the main core that all scientists focus nowadays to save our planet for us from one side and all incoming children from another side. Safe global earth with all natural resources is the most attention towards to all countries either developing or developed countries.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

DATA AVAILABILITY STATEMENT

All datasets were achieved, used and analyzed in the current study. They were included within this manuscript.

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