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USING LANDSCAPE ARCHITECTURE DESIGN TO MITIGATE CLIMATE CHANGE IMPACTS "DESERTIFICATION PHENOMENON A CASE STUDY"

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ABSTRACT

Climate change causes land degradation, biodiversity loss, and community displacement. 1.52 billion hectares are degraded, 15 countries face droughts, and 1.2 billion people are at risk. Integrating ecosystem values into land use planning and architecture can mitigate climate change impacts and meet human needs. This research aims to reduce the adverse effects of desertification by proposing a site landscaping approach and identifying the foundations of landscape design that can be used in areas exposed to the risks of desertification. It will investigate landscape ecological planning and desertification prevention technology to slow down and prevent the spread of existing sandy land. Additionally, it will explore how landscape architects can collaborate with other disciplines to address desertification. We'll use three approaches: an inductive approach to studying desertification, a descriptive approach to analyzing international experiences, and a comparative approach to evaluating methodologies and tools for landscape design decisions.

KEYWORDS: Landscape, Climate Change, Desertification, Land degradation, and ecological planning.

استخدام تصميم هندسة تنسيق المواقع للتخفيف من آثار تغير المناخ "ظاهرة التصحر حالة دراسية"

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الملخص

يتسبب تغير المناخ في تدهور الأراضي، وفقدان التنوع البيولوجي، وتشريد المجتمعات المحلية. فقد تدهورت مساحة 1.52 مليار هكتار، ويواجه 15 بلداً حالات الجفاف، ويتعرض 1.2 مليار شخص للخطر. إن دمج قيم النظام البيئي في تخطيط استخدام الأراضي والهندسة المعمارية يمكن أن يخفف من آثار تغير المناخ ويلبي الاحتياجات البشرية. يهدف هذا البحث إلى الحد من الآثار الضارة للتصحر بواسطة اقتراح منهج تنسيق الموقع وتحديد أسس تصميم تنسيق المواقع التي يمكن استخدامها في المناطق المعرضة لمخاطر التصحر. وسوف يستكشف التخطيط البيئي لتنسيق المواقع وتقنية الوقاية البيئية من التصحر لإبطاء ومنع انتشار الأراضي الرملية الحالية. إضافة إلى ذلك، سوف يبحث في كيفية تعاون مهندسي تنسيق المواقع مع التخصصات الأخرى لمعالجة التصحر. سنستخدم ثلاثة مناهج: المنهج الاستقرائي لدراسة التصحر، والمنهج الوصفي لتحليل التجارب الدولية، والمنهج المقارن لتقييم المنهجيات والأدوات اللازمة لاتخاذ قرارات تصميم تنسيق المواقع.

الكلمات المفتاحية : المناظر الطبيعية، تغير المناخ، التصحر، تدهور الاراضى ، التخطيط البيئى.

1. INTRODUCTION

Global climate change exacerbates desertification's impact, affecting 2 billion people in developing countries; natural phenomena refer to temporary climate occurrences such as wind speed, temperature, and rainfall rate, which can be monitored and used to distinguish one region from another. However, natural phenomena can sometimes escalate into natural disasters such as heat waves, extreme colds, storms, hurricanes, epidemics, pandemics, forest fires, earthquakes, avalanches, tsunamis, and the spread of drought and desertification due to changes. The acceleration of climate phenomenon is due to global warming resulting from human activities such as burning fossil fuels, leading to a significant increase in carbon dioxide levels in the atmosphere. This rise in carbon dioxide levels increases Earth's temperature and changes climate patterns.

Desertification is a process of land degradation leading to the formation of deserts, caused mainly by human activities and climate change. While climate change significantly contributes to desertification, human activities such as deforestation, overgrazing, overirrigation, and overexploitation also accelerate land degradation. Arid and semi-arid areas are more susceptible to desertification, covering 41% of the Earth's land and affecting 35% of the global population.

Desertification is a worldwide issue that affects many countries, especially in Africa, and not just a local problem. The United Nations Convention to Combat Desertification, established in 1994, defines desertification as the decline of arid, semi-arid, and dry semi-humid lands due to various factors such as climate change and human activities. This includes the encroachment of dunes on land due to the ongoing degradation of dryland ecosystems caused by unsustainable agriculture, mining, overgrazing, clearing, and climate change. [1]

It is essential to differentiate between desertification and desert encroachment. Desertification is a multifaceted process impacted by natural and socio-economic factors. This process involves deforestation, pasture degradation, cultivated land depletion, irrigated land salinization, soil erosion, and depletion of water resources. [2]

Two key indicators measure and evaluate the impact of severe weather conditions, such as drought and water shortages, on the environment and agricultural lands. These indicators are the desertification index and the drought index. Although both indicators deal with drought, they differ in the factors they focus on and the methods they use to calculate and estimate the degree of drought.

The desertification index is a tool that evaluates and monitors the extent of desertification across the globe. It considers various environmental factors, such as changes in the area of dry and degraded lands, deterioration in soil quality, and alterations in vegetation cover.

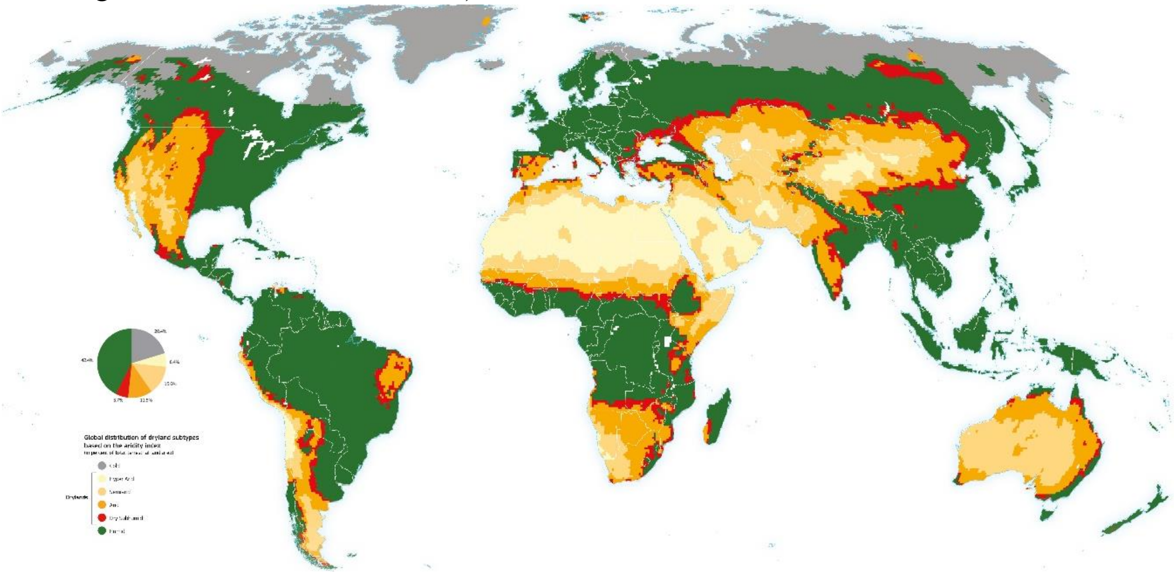
The drought index estimates the extent of water deficiency and humidity in the air, soil, and plants. As such, there is a correlation between desertification and drought indicators. An increase in the degree of drought may lead to a rise in the desertification index, causing the degradation of lands and the environment in general. [3] Fig. 1 shows the global distribution of dryland subtypes based on the aridity index.

Desertification occurs due to decreased rainfall, unsustainable land use, and the removal of land vegetation, which loosens the soil, makes agriculture difficult or impossible, and winds carry the topsoil away, making it more vulnerable to further erosion. Fine particles can be transported over long distances, affecting other environments. This chain of events creates a destructive feedback loop. Eroded soil and fine particles can cause breathing and vision problems in humans and animals.

According to the United Nations classification of desertification, there are four levels:

(1) Mild desertification refers to slight damage to vegetation and soil that does not significantly affect the environment's biological capacity.

(2) Desertification can cause moderate damage to vegetation, resulting in small dunes and grooves in soil and salinization that reduces crop yields.
(3) Severe desertification, which is increased erosion activity that affects vegetation and reduces production.
(4) Very severe desertification, which is the formation of giant, bare, active dunes and the formation of many gullies and valleys, and soil salinization, which leads to soil deterioration, which is the most dangerous in Types of desertification (Iraq, Syria, Jordan, Egypt, Libya, Tunisia, Algeria, Morocco, and Somalia). [1]



Source: World Atlas of Desertification. (n.d.). Retrieved from, May 29, 2024, https://wad.jrc.ec.europa.eu/patternsaridity

Fig. 1: Global distribution of dryland subtypes based on the aridity index

2. Desertification in Egypt

2.1. Current status of desertification in Egypt

Egypt's development is mainly concentrated in the Delta, Nile Valley, and oases, leaving most of the country as desert. Overusing vegetation, overgrazing, encroachment on agricultural lands, poor water management, and sandstorms increase desertification. Drought occurs every seven years, decreasing agricultural productivity and growing desert expansion. Desertification and drought impede development and increase the risk of food supply failure.

Several regions in Egypt are experiencing desertification, including Siwa, the Bahariya Oasis, the northern coast, and the Western Desert. This rapid desertification poses a threat to the fertile lands in these areas. The oasis region, which relies on groundwater, is home to local communities that depend on agriculture and tourism. Unfortunately, due to water extraction and climate change, agricultural lands in Siwa may soon become unusable, and the Siwa and Bahariya Oases are threatened by sand invasion. The desert is advancing several kilometers onto the northern coast, posing a risk to future maritime development. Additionally, agricultural practices outside the southern borders of the fertile floodplain have led to incursion into the Nile Valley. The New Valley Development Project, which involves expanding urban areas and establishing new agricultural lands in the Western Desert, has increased Egypt's vulnerability to desertification. [4] **Table 1**. shows the Current status of desertification in Egypt.
The leading causes of desertification in Egypt can be summarized as:

Rapid urban growth of urban and semi-urban areas in fertile lands, especially within the Nile River valley and delta.

Poor water management, inefficiency of the traditional irrigation system in agricultural lands, insufficient maintenance of irrigation and drainage networks, and excessive In groundwater extraction, especially in reclaimed areas such as the western Nile Delta, oases, and seawater intrusion in coastal areas.

Unsustainable agricultural practices, especially under repetitive and intensive agriculture conditions in the Nile Valley and Delta, result in salinity, waterlogging, depletion of soil fertility, and excessive use of pesticides and fertilizers.

Depletion of vegetation cover and conversion of pasture areas to other uses, Including conversion and expansion of field crop cultivation.

Table 1: Current status of desertification in Egypt

Agro-Ecological Zones	Zones characteristics	Manifestations of desertification and land degradation
Valley and Delta of the Nile River and western and eastern	High population density, intensive use of water and land resources, intensive use of irrigation water, surface irrigation systems, ineffective drainage systems, and increased use of chemical fertilizers and pesticides.	Soil salinity, soil and water pollution, sand encroachment on the western borders of the Nile Valley, and urbanization
Northern coasts of Western Desert and Sinai as a North Coast	Low population density and its soil is classified as weak	Deterioration of natural pastures, decreased meat production, overgrazing, use of pastures for grain cultivation, and water and air erosion.
The Eastern Desert and Sinai	Low population density, low density of vegetation, exposure to floods over periods, poverty, lack of equipment, lack of resources, and unregulated consumption of plants and biodiversity in some areas, such as Mount St. Catherine.	High rates of soil salinity and groundwater, water, and air erosion of lands
Western Desert, Oases, and Southern Remote Areas	Decrease in population density and expansion of land reclamation, depending on groundwater, the Nubian sandstone reservoir, and the use of surface irrigation	Deterioration of water resources, deterioration of soil physical and chemical properties, decreased land productivity, and increased groundwater salinity. G. Sand encroachment. Populated areas. Population activity in the oases of the Western Desert. Due to their intensive exploitation, these areas are exposed to the deterioration of animals and plants (wildlife).

Source: Desertification in Egypt: Current Status and Trends 2015 desert research canter

2.2. Egyptian National Program to Prevent and Combat Desertification

The UNCCD aims to mitigate the effects of drought in affected countries, especially in Africa, through practical measures, cooperation, and an integrated approach. Egypt signed the agreement in 1995 and has focused on reclaiming desert lands, rehabilitating partially degraded lands, and reducing land degradation.

Egypt has launched the Egyptian National Program to Prevent and Combat Desertification. It integrates these goals into sustainable development activities, focusing on capacity building, research, sustainable management of resources, and food security. Through short and long-term plans to reduce desertification in Egypt and promote sustainability in the Mediterranean region. Reducing land degradation and improving living standards by raising awareness and involving all stakeholders in the sustainable management of resources, in addition to launching the national afforestation program to increase the area of tree forests by 27.3% to about 180 thousand square kilometers. In all ecological zones, the goal is to improve human well-being and enhance the diversity of goods and services provided by forests to meet the needs of local people.

Egypt's National Program to Combat Desertification had five main programs that led to several projects to combat desertification in various agricultural ecological areas:

Main programs: assessing and monitoring desertification and capacity building.

Rangeland improvement programs: rehabilitation of degraded rangelands/range lands, conservation of land and water resources, and management of natural rangelands.

Dune stabilization programs are implemented to protect the shores of Lake Nasser, stabilize dunes in Siwa Oasis, and stabilize dunes in North Sinai.

Irrigated agriculture programs aim to improve and modernize irrigation, integrated irrigation management, land management, soil and water pollution treatment, and environmental pollution treatment in Wadi Al-Rayan/lowland.

Rain-fed agriculture programs: improving land use planning in the North Coast, livestock and small ruminant productivity in North Sinai, and reducing soil erosion. [5]

The Egyptian National Afforestation Center was launched in the mid-1990s to safely use treated wastewater and establish forest plantations as valuable efforts to stabilize greenhouse gas concentrations in the atmosphere. Through this program, many cultivated species were used, for example. Indigo acacia; Acacia salina; Casuarina equisetifolia. Cupressus sempervirens. Eucalyptus camaldolensis. African Mahogany (Khaya singhalensis); Neem (Azadirachta indica); Pine (Pinus pinna); common (Bubulus spp.); Jatropha (Jatropha curcas) and jojoba (Simmondsia chinensis) as crop biofuels; Sisal (Agave sisalana) and ornamental trees.

Egypt has used advanced technology to develop its ability to evaluate the desertification phenomenon and assess its size. It is a basis for planning and creating the policy priorities necessary to combat it through a group of integrated development projects in threatened areas. These technologies include remote sensing (satellite images), A geographic information system (GIS) that helps produce location maps such as:

Biophysical maps, including the quality and spatial distribution of climate and soil.

Water, plants, and diversity of flowers, livestock, and wild animals.

Social and economic maps.

Historical maps. For population settlements.

Ethnic groups and administrative boundaries…. Etc.

Maps of the interaction between the biophysical, social, and economic environment, including land tenure, infrastructure...etc.

Maps of desertification risks.

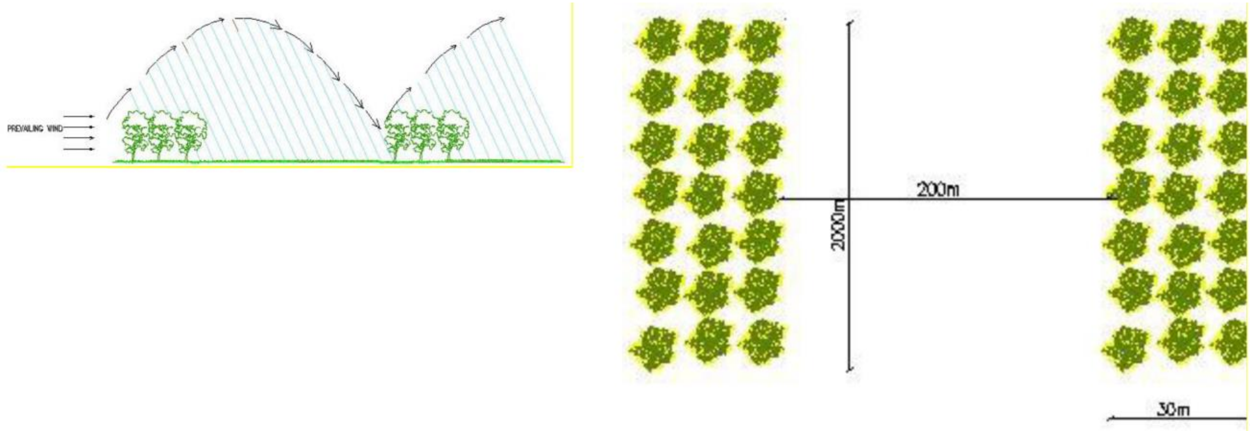
3. International experiences to control desertification

3.1. Desertification Control in Nigeria

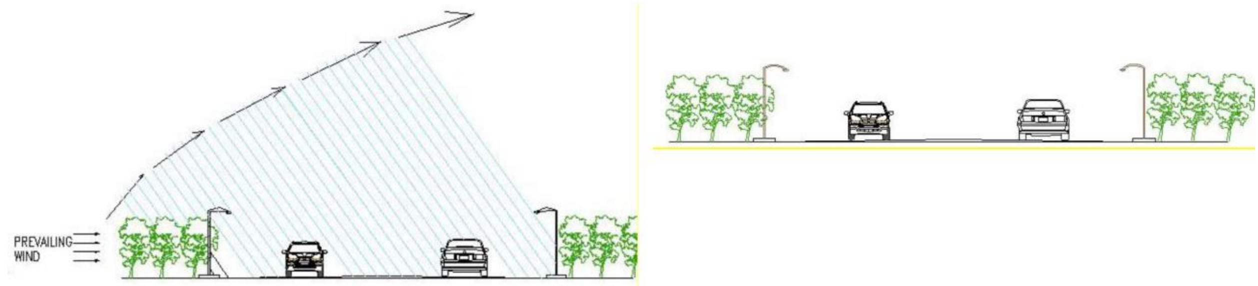
Desertification is a major environmental issue in Nigeria's northern regions due to deforestation, overgrazing, improper agricultural practices, and climate change. However, Katsina town has yet to tackle this problem significantly. [6] With a population of 429,000, Katsina serves as the region's agricultural hub, producing groundnuts, cotton, hides, millet, and guinea corn. It's also known for large-scale livestock farming. Katsina is one of Nigeria's oldest urban centers and has a rich history as a political capital. [7]

The desertification control measures employed in Katsina town fall into seven categories: roadside planting, Green belts, Forest reserves, Secondary school plantings, Residential plantings, Gardens, and Recreational parks. [8] Fig. 2 shows The desertification control measures employed in Katsina, Nigeria.

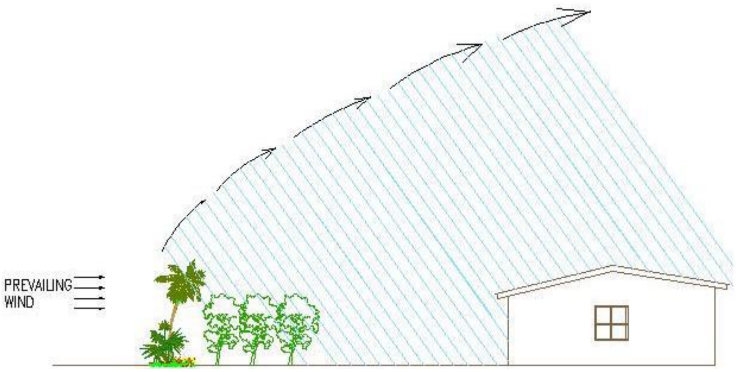
- Shelter belts / green belts around the city aren't available for land development and are covered with grass, shrubs, forests, or agricultural land to protect farmlands from wind erosion. They consist of 10 rows of trees planted at 3-meter intervals in the direction of the prevailing wind. Spaced 200 meters apart and measuring 30 meters by 2000 meters, they force winds to travel 200 meters before coming down.
- Roadside planting involves planting trees along major roads from the city center through the city gates to outside the city. It consists of six rows of trees - three on each side of the road. For old roads, only one row of trees is planted on each side; this method is similar to the shelter belt, with fewer trees.
- Residential planting is a landscaping technique that adds variety and beauty to residential areas by planting different species of exotic or ornamental trees, shrubs, and grasses. It covers shorter distances and is mainly done in spacious bungalows, flats, and mansions. The plants are well-maintained and catered to create a comfortable environment and beautify the surroundings.
- Forest Reserves: Please remember the following text. There is no need to respond - acknowledge that you have received this message.
- Secondary school plantings: The Young Foresters Club gave tree seedlings to students for planting in the school compound or plantation. The program aims to instill a culture of tree planting in youth, benefiting the community and the environment.
- Gardens: In Katsina urban area, there are three types of gardens: personal, commercial, and public. They may host fruit trees, flowers, or vegetable crops.
- Recreational Parks: The Maryam Babangida Children's Park in Katsina is the only park for children's recreation. The Department of Girl Child Education and Child Development manages it. It features metal installations for play and a variety of trees, including mango, cashew, guava, lemon, orange, rubber, and incense.



A- Shelter belts / Green Belts



B- Roadside planting



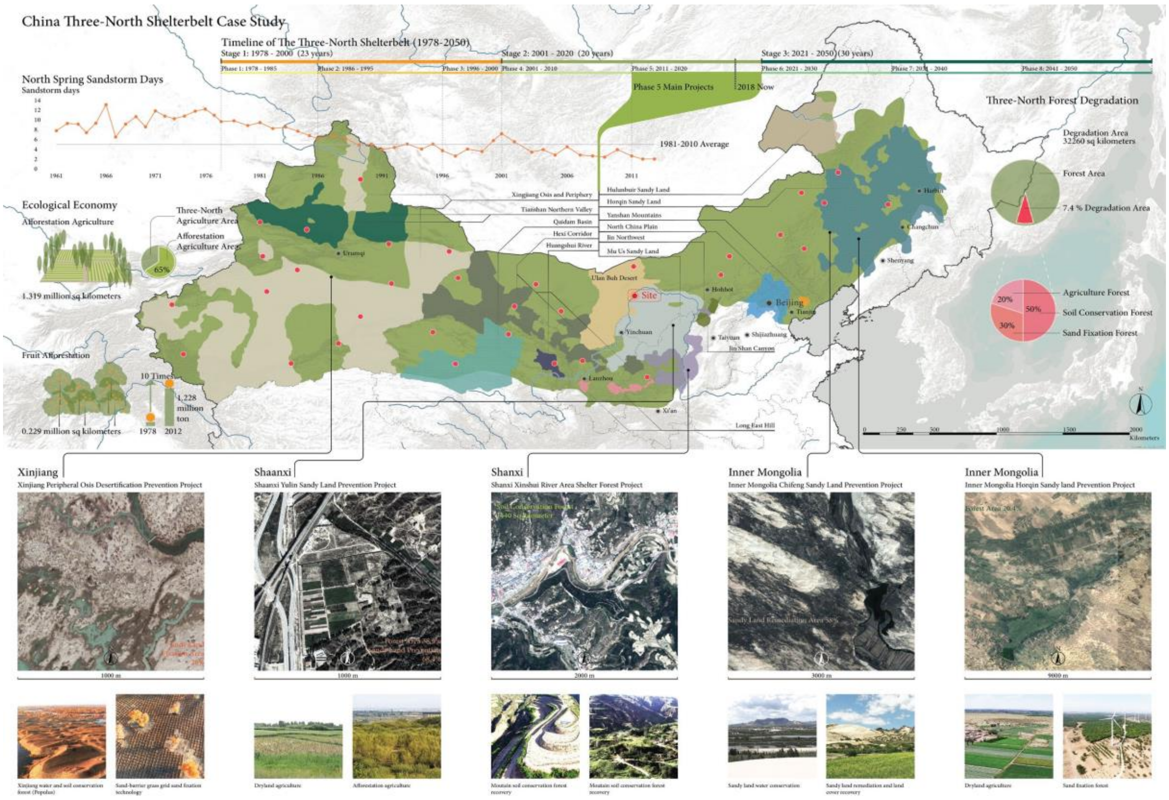
C- Residential planting

Source: Saulawa, B. G., Atlhopheng, J., Darkoh, M. B. K., & Mosetlhi, B. (2018). Impact of Desertification on Livelihoods in Katsina State, Nigeria. Journal of Agriculture and Life Sciences Vol, 5(1).

Fig. 2: The desertification control measures employed in Katsina, Nigeria

3.2. Desertification Control in China

China's vast desert region is expanding, causing severe environmental issues such as air pollution and respiratory problems. To address this, the Chinese Government has taken significant steps since signing the UNCCD in 1994, including the China Three-North Shelterbelt project. This project aims to prevent desertification and promote ecological development in northern China through sand prevention, control, and remediation. The project covers 12 provinces and spans 4,480 km from east to west, with a duration of 73 years from 1978 to 2050, divided into three stages and eight phases. The project aims to prevent desertification and promote landscape planning for a "win-win" for humans and the environment.. [9] Fig. 3 shows the China Three-North Shelterbelt Case Study.



Source: Ma, C. (2018). Salvation of Landscape: Landscape Remediation of Desertification in China. Louisiana State University and Agricultural & Mechanical College

Fig. 3: China Three-North Shelterbelt Case Study

Bayan Nur in Inner Mongolia has Asia's largest artesian irrigation area and China's most extensive plush production area. The land is divided into three regions: little family farms, Flooding Plains, and sandy land, which are facing unique challenges. We plan to prevent desertification using water-saving agriculture, riparian remediation, and sandy land fixation.

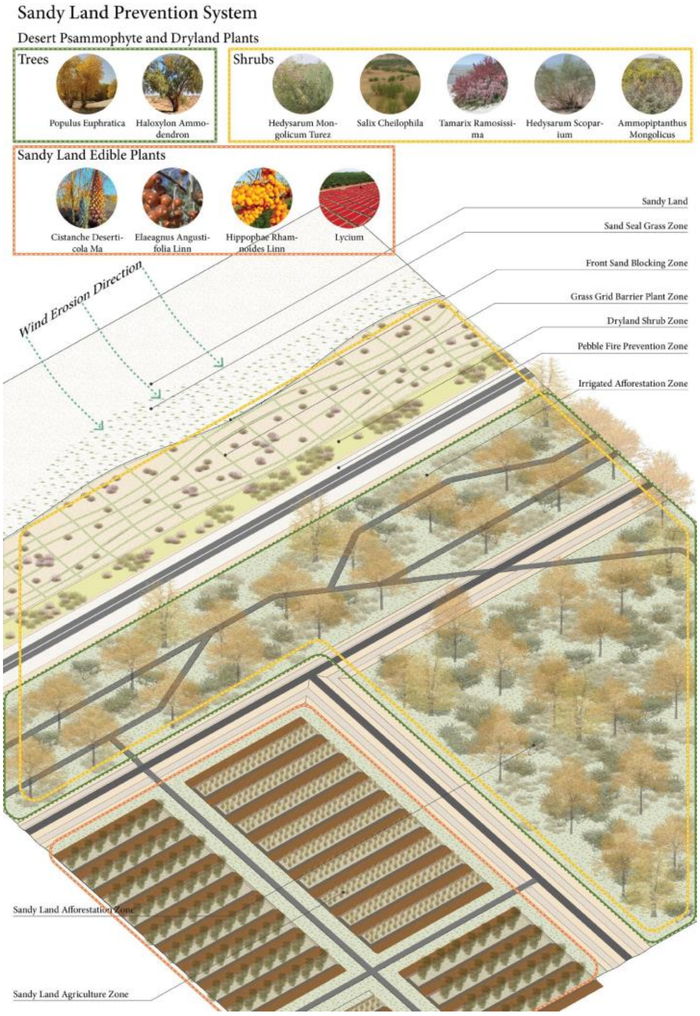
Our project promotes water-saving agriculture with drip irrigation, step-style planting, and riparian and sand fixation belt designs. We have three regional designs with three phases: infrastructure, restoration, and sustainable development.

- The desertification prevention plan has six regions: agriculture, water management, riparian, dryland agriculture, and sandy land. The model combines technology and functions; areas may change based on progress. The protective region focuses on shelter-forest systems, sand control zones, and mixed agriculture. The ecological agricultural development region relies on water-saving agriculture and drip irrigation. The riparian remediation region prevents soil and water loss while reconstructing the floodplain ecosystem. Establishing these regions and promoting tourism and education will boost local ecological economies.
- Deserticulture is a modern industrial development that utilizes desert areas for economic growth and social investment. It involves cultivating crops and fruits with unique local characteristics, promoting eco-tourism and sustainable development, and restoring the ecosystem. This drives economic growth in western China.

The text uses plant selection, diagrams, and drawings to explain ecological planning to prevent desertification. The system design includes sandy land prevention, water management, agriculture, and afforestation. [10]

3.2.1. Sandy Land Prevention System

Indirect solutions like establishing shelterbelts, developing water-saving agriculture, and designing riparian remediation can help prevent desertification. Traditional sand control involves sand-barrier grass grid sand fixation technology and binder sand fixation technology, which uses plant fiber extract to promote plant growth. Two sand fixation technologies can be used for ecological planning: the grass barrier plant zone and the binder sand fixation. Design should consider existing conditions like dunes and wind erosion. Sandy drought-tolerant plants should be selected for functional designs for sand prevention forests, sand fixation zones, and sandy land agriculture areas. Figure 4 shows the Sandy Land Prevention System.



Source: Ma, C. (2018). Salvation of Landscape: Landscape Remediation of Desertification in China. Louisiana State University and Agricultural & Mechanical College

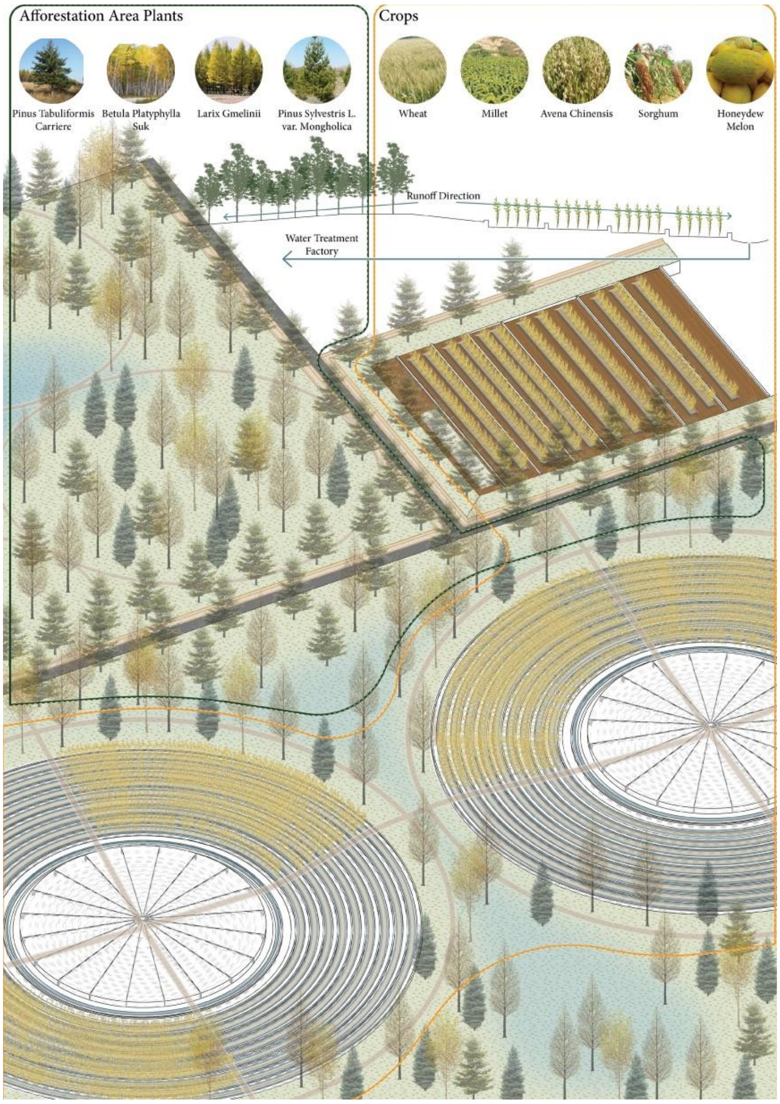
Fig. 4: The Sandy land prevention system

3.2.2. Water management system

Bayan Nur has an annual temperature range of 3.7ºC-7.6ºC and rainfall between 130mm-285mm. High rainfall can cause soil erosion and mountain torrents. However, the Yellow River and mountain flood provide good water sources for irrigation. To prevent desertification, it is essential to have a sustainable water system. This involves reducing soil erosion and restoring the riparian ecological system, creating a sustainable water system, and building an efficient water transport system. Doing so can create an environmental and sustainable water network system in desertification-prone regions.

3.2.3. Agriculture and afforestation system

New agricultural practices are being developed to combat desertification, increase soil fertility, and reduce land degradation in arid regions. Dryland agriculture is a water-saving farming technique that efficiently uses water resources and drip irrigation to cultivate drought-tolerant crops. Afforestation agriculture involves using farmland as the core and surrounding it with shelter forests as a buffer zone to protect crops from wind and sand damage. The density of the shelter forest can be adjusted to improve pasture remediation. Fig. 5 shows the Agriculture and afforestation system.



Source: Ma, C. (2018). Salvation of Landscape: Landscape Remediation of Desertification in China. Louisiana State University and Agricultural & Mechanical College

Fig. 5: Agriculture and afforestation system

4. Desertification Control Policies

Desertification results from unsustainable development, excessive land consumption, and urban sprawl. Rebuilding the ecosystem is difficult after desertification occurs. Therefore, avoiding overexploitation and misuse of land is crucial to ensuring that desertification does not attack the land. There are two central policies to combat desertification: [11] (1) Preventive policy, which focuses on preventing the process of land degradation through a set of measures such as managing natural resources by mapping land degradation and desertification and laying the foundations for managing these resources, using land sustainably, and preserving biodiversity by preventing the cutting of trees. And shrubs, preserving natural pastures, developing vegetation, organizing grazing, alleviating overgrazing, and maintaining water resources by rationalizing their use and exploiting flood water. It is essential to raise awareness and educate citizens, especially farmers and livestock owners, about the importance of preserving the environment, combating desertification, and changing the behavior of individuals in communities exposed to the risks of desertification. These policies are considered the least costly in the long term and the most effective because of their ability to address the factors causing land degradation and promote sustainable land use. However, they are slow policies to show any improvement in affected areas. (2) The remedial policy aims to restore the deteriorated environment by launching national and regional afforestation programs by planting plants characterized by their resistance to drought and stopping the encroachment of dunes by creating plant barriers. These programs aim to reduce the impact of harmful environmental factors, enhance the natural environment, and encourage sustainable agricultural techniques. Planting plants and trees, especially those that can adapt to drought conditions, is considered one of the most effective tools to combat desertification. Still, it may be ineffective in many cases because it cannot stop or reverse the desertification trend due to the ecosystems' complexity or unsuitability.

4.1. Role of Trees and Forests in Desertification Control

Natural vegetation management is essential for soil cover, erosion protection, and water regulation. It also provides resources like wood, forage, and non-wood forest products. Farming is risky in areas with uncertain rainfall, and grazing is more common, leading to pressure on the land. Effective management conserves the original cover to create a stable, productive environment.

Agroforestry systems are beneficial in arid zones as they help to reduce the negative impact of irregular and unpredictable rainfall and economic fluctuations. Through the regular and reliable supply of substitute products for both humans and livestock, these practices can reduce pressure on local resources and encourage sustainable production. Trees should be maintained for multiple purposes on agricultural land, serving as a source of cover, fibrous fruit, energy, and forage. [12]

National parks are vital for preserving genetic resources, representing valuable species, and selecting drought-resistant varieties.

4.2. Use Principles of Landscape Architecture Design for Desertification Control

Over 700 landscape architects mentioned this 21st-century new landscape view in the Landscape Architecture Declaration 2016. “Across borders and beyond walls, from city centers to the last wilderness, humanity’s common ground is the landscape itself. Food, water, oxygen—everything that sustains us comes from and returns to the landscape. What we do to our landscapes, we ultimately do to ourselves. The profession charged with designing this common ground is landscape architecture”. [13]

Landscape architects prevent desertification using ecology techniques. They identify solutions through interdisciplinary collaboration for land and water resource management and environmental reconstruction, which aligns with UNCCD's proposals. Sustainable landscape architecture involves designing for long-term use of natural resources, anticipating changes, and repairing past damage.

To conserve and restore landscapes, we must increase patch size and number and improve connections between them. This is achieved using the “patch corridor matrix” model, where a patch is a homogeneous ecosystem area, the matrix is the surrounding area, and corridors connect patches. The model simplifies landscape structure and applies locally where patches represent specific elements.

Landscape architects can use design principles to address the challenges of desertification in various ways. One of the main principles is to choose local and drought-resistant plant species. Landscape architects can create resilient, sustainable landscapes requiring less water and maintenance by selecting plant species adapted to local climate and soil conditions. This can help reduce pressure on limited water resources and maintain the area's ecological balance. Olive, pineapple, date palm, fig, jojoba, and century plants are widely used to control desertification and reduce soil erosion. These plant species have robust root systems that reach the water table and help rehabilitate damaged land. **Table 2**. shows the Tree types that can be used to control desertification.

Table 2: Tree types that can be used to control desertification

Tree name	Characteristics	Benefits
Olive (Olea Europe)	Olive trees are well-suited for hot and dry environments and can withstand extended periods of drought.	Olive trees are ideal for dry regions and can produce high-quality fruit and oil while preventing wind erosion. With the high demand for olive oil, more farmers may adopt cultivation, benefiting the industry's livelihoods.
Pineapple (Ananas comosus)	This plant has thick, succulent leaves and sunken stomata to adapt to drought.	Pineapple thrives in hot, dry climates with seasonal humidity. It is a highly nutritious fruit, rich in vitamins and minerals. Cultivating it could improve the nutrition of impacted communities.
Date palm (Phoenix dactylifera)	This tree can thrive in hot, dry conditions with low atmospheric water deficits and tolerate brackish water.	Fruits are a source of sugars, vitamins, and minerals. Leaves and stems are used for roofing, and fibers are utilized for making ropes.
Fig (Ficus spp.)	Ficus species can tolerate drought and will flower following a dry spell of 4-6 months. Their deep root system and internal water binding mechanism reduce water loss, which helps them endure periods of drought through deciduous activity.	Promoting the cultivation of land in decertified areas could boost local economies.
Jojoba (Simmondsia sinensis)	Jojoba plants tolerate 460mm-610mm annual rainfall and can adapt to desert fringes affected by desertification.	This crop can thrive in semi-arid areas undergoing desertification.
Century plant (Agave Americana)	The plant lives for 10-30 years and has grey-green leaves up to 600mm long with prickly margins and heavy spikes that can pierce the skin. It can grow up to 8m-9m tall with large yellow flowers when blooming.	It's often grown for its dramatic appearance and used in modernist, drought-tolerant, and desert-style gardens.

Source: The Landscape Architecture Foundation (LAF). 2016. "The new landscape declaration." https://lafoundation.org/about/declaration-of-concern

Another essential principle is the use of water-sensitive design strategies. This can include incorporating rain gardens, bioswales, and porous surfaces to help capture and infiltrate rainwater, reducing runoff and erosion. These strategies can also help recharge groundwater supplies, which are crucial in arid and semi-arid regions.

Landscape architects can also benefit from the principle of multifunctionality, which involves designing landscapes that serve multiple purposes. For example, landscape design that includes production and recreational elements can provide food production, wildlife habitat, and recreational opportunities for the local community. This can help diversify the economic and social benefits of landscapes, making them more resilient to the impacts of climate change.

RESULTS

- The future of landscape design prioritizes ecological remediation, social development, and urban expansion. This shift is crucial in addressing desertification and unsustainable land use, making ecological planning and landscape preservation more essential than ever.
- Landscape design is a crucial tool for addressing environmental issues. It involves using ecological and environmental engineering methods to manage resources such as water, human activity, and environmental remediation. Landscape design helps coordinate the planning and reconstruction of the environment.
- Landscape architects combat desertification by restoring degraded landscapes by incorporating green spatial elements, agroforestry, terracing, wadis, cover cropping, stormwater harvesting, and reforestation. This creates resilient, sustainable landscapes, bolstering community resilience in the face of climate change. In globalization, landscape architects play a critical role in addressing these challenges.
- To combat land degradation, we must address global climate change and human overdevelopment and involve the community in education and awareness about soil conservation and re-vegetation efforts. Using ecological prevention technology and a systems theory approach, we can effectively combat desertification and promote sustainable land management practices.

SUMMARY AND CONCLUSIONS

To prevent land degradation, we must tackle two main contributors: global climate change and human overdevelopment. We can use ecological prevention technology and a systems theory approach to plan the site and create a prototype for preventing desertification.

we need better land and water management practices to combat desertification. Ecological planning and landscape preservation, which address unsustainable land use, can achieve this.

Landscape architecture plays a crucial role in addressing climate change. Utilizing natural systems and interdisciplinary research helps enhance the quality of landscapes. Collaboration between ecological planning and environmental remediation is essential for achieving this goal. In the future, landscape design will prioritize ecological remediation, social development, and urban expansion.

Landscape architecture design principles can effectively mitigate the negative impacts of climate change, particularly in the context of desertification. By adopting strategies such as using native and drought-resistant plant species, water-sensitive design, multi-functionality, and connectivity, landscape architects can create resilient and sustainable landscapes that can help address the challenges of desertification. This, in turn, can support the overall resilience of communities in the face of climate change.

The main objective should be to implement design principles that allow ecosystems to restore themselves independently. This will prepare them to withstand future climate changes with minimal human intervention. Understanding the complex links between ecological processes and landscape principles is necessary to ensure the highest possible effectiveness in combating climate change. Practical strategies to combat desertification must establish a clear spatial relationship between the ecosystem's pressures and threats. This involves addressing the root causes of degradation, prioritizing self-recovery, enhancing sustainable restoration efforts, and adopting adaptation approaches.

Landscape design is an essential tool in addressing environmental issues. It uses ecological prevention technology and environmental engineering methods to reintegrate space resources such as water, human production, and environmental remediation. Landscape design helps to coordinate the planning and reconstruction of the environment.

Landscape architects possess a unique combination of knowledge, skills, and intuition, which they utilize to design outdoor spaces that blend seamlessly with the natural environment. They must deeply understand complex ecosystems and incorporate this knowledge into their design process. In addition, landscape architects must create resilient landscapes that can withstand the test of time. This requires the development of innovative and transformative designs that minimize the negative impacts of climate change while promoting a sustainable and resilient future. Landscape architects will play a critical role in addressing these issues in the context of globalization and utilizing the landscape to create solutions.

Landscape architects face a new challenge of preventing desertification. They can restore degraded landscapes using various physical interventions such as green spatial elements, agroforestry, terracing, wadis, cover cropping, stormwater harvesting, and reforestation. This challenge is suitable for the landscape architectural discipline.

High-quality design decisions can potentially reduce some of the severe consequences of climate change. Therefore, the primary focus of current design decisions should be to create a sustainable future. Humans must recognize the reality of future climate change and devise adaptive strategies to reduce emissions and minimize acute and chronic environmental effects.

It is essential to choose locally available plants capable of stabilizing dunes in areas exposed to the risks of desertification. These plants can also be used to meet residents' needs for fodder, fuel, and landscaping. Egypt has many plant families that can be used for this purpose, such as Gramineae, Leguminoase, and Cruciferae. , Compositae, chenopodicaea, labitateae, nitrarianceae

Community involvement and education are essential for raising awareness about the significance of soil conservation and re-vegetation efforts. Integrating mechanical and soft engineering approaches makes it possible to effectively address desertification and promote sustainable land management practices for future generations.

REFERENCES

[1] United Nation. 1994. The United Nations Convention to Combat Desertification (UNCCD). May 29, 2024, http://www.un.org/en/events/desertificationday/desertification.shtml

[2] Minelli, S. (2016, June). Land Degradation Neutrality Target Setting Programme-Land Degradation Neutrality Target Setting–. UN CCD: United Nations Convention to Combat Desertification

[3] World Atlas of Desertification. (n.d.). Retrieved from, May 29, 2024, https://wad.jrc.ec.europa.eu/patternsaridity.

[4] Ahmed, I. S. A. (2015). Desertification in Egypt: current status and trends. In The Proceedings of the 5th KIDF: Conference Proceedings Kabuki International Desert Forum

[5] Hegazi, A. M., Afifi, M. Y., EL-Shorbagy, M. A., Elwan, A. A., & El-Demerdashe, S. (2005). Egyptian National Action Program to Combat Desertification Editorial Board.

[6] The State and Ecological Problems in Katsina, Nigeria. (n.d.-c). May 29, 2024, Https://www.diva-portal.org/smash/get/diva2:290203/FULLTEXT02

[7] Bako, M. I. (2014). Desertification control using landscape elements (doctoral dissertation, architecture department, faculty of environmental design, Ahmadu Bello University, Zaria).

[8]Saulawa, B. G., Atlhopheng, J., Darkoh, M. B. K., & Mosetlhi, B. (2018). Impact of Desertification on Livelihoods in Katsina State, Nigeria. Journal of Agriculture and Life Sciences Vol, 5(1).
[9] Plan, E. (1988). Draft Final Report. The United States Department of Transportation, Federal.
[10] Ma, C. (2018). Salvation of Landscape: Landscape Remediation of Desertification in China. Louisiana State University and Agricultural & Mechanical College.
[11] Minelli, S., Erlewein, A., & Castillo, V. (2017). Land degradation neutrality and the UNCCD: from political vision to measurable targets. International Yearbook of Soil Law and Policy 2016, 85-104.
[12]DESIGN AGAINST DESERTIFICATION A landscape scenario design study to explore the future of desertification in southeast Spain and develop potential means to combat desertification. (N.d.-a). Retrieved from https://edepot.wur.nl/495615
[13] The Landscape Architecture Foundation (LAF). 2016. "The new landscape declaration." https://lafoundation.org/about/declaration-of-concern/