
AI translation · View original & related papers at
chinaxiv.org/items/chinaxiv-202308.00165

Governing a Large Country: Strategic Choices and Future Vision for Desertification Control in China (Postprint)

Authors: Cui Guipeng, Xiao Chunlei, Lei Jiaqiang, Li Xiaosong, Bao Yingshuang, Lu Qi

Date: 2023-08-12T00:00:00+00:00

Abstract

Over the past 70-plus years, China's sustained desertification control efforts have achieved tremendous accomplishments. Currently, China's desertification control has entered a new stage, still confronting challenges such as a large base of sandy land and high governance difficulty, necessitating comprehensive fulfillment of national strategic demands including ecological construction, rural revitalization, and the development and utilization of wind power and photovoltaics in sandy, Gobi, and desert areas. The strategic choice for China's desertification control in the new era is overall improvement with key breakthroughs, with the strategic core being comprehensive governance, innovation-driven development, and technology integration. The institutional arrangement for classified policy implementation is the comprehensive implementation of the "one desert, four systems" (conservation, prevention, treatment, utilization), vigorously fighting and winning the "three major iconic campaigns" of the "Three-North" defensive battle, prioritizing the layout of a batch of key demonstration projects, accelerating policy updates, and creating a new technological engine to help improve the quality and efficiency of desertification control, blueprint a beautiful vision of Chinese-style modernization featuring the integration of "three lives" and harmonious coexistence between humans and sand, and promote the "China solution" for desertification control to go global and benefit the world.

Full Text

Preamble

Special Issue: Comprehensively Preventing and Controlling Desertification to Win the "Three-North" Battle

On June 6, 2023, President Xi Jinping inspected Bayannur City in Inner Mongolia Autonomous Region and presided over a symposium on strengthening comprehensive desertification prevention and control and advancing key ecological projects such as the “Three-North” shelterbelt program, where he delivered an important speech. He emphasized that strengthening comprehensive desertification prevention and control and deepening the construction of key ecological projects like the “Three-North” initiative concerns China’s ecological security, its development as a great nation, and the sustainable development of the Chinese nation—a noble undertaking that benefits both contemporary and future generations. Over the past 45 years, China has achieved remarkable success in desertification control and “Three-North” project construction: forest coverage in the project area has increased from 5.05% to 13.84%, more than 45% of manageable sandy land has been initially treated, 61% of soil erosion areas have been effectively controlled, and 450 million mu of farmland is now protected by shelterbelt networks. China has forged a distinctive path of sand prevention and control with Chinese characteristics. While past achievements have been tremendous, future tasks remain arduous. Over the next decade, China urgently needs new scientific and technological engines to fight the “Three-North” project battle. Based on outputs from multiple scientific and technological programs—including the National Science and Technology Basic Resources Survey Special Project, the National Natural Science Foundation of China, and the Chinese Academy of Engineering’s Strategy and Consulting Project—the *Bulletin of Chinese Academy of Sciences* has organized this special issue on “Comprehensively Preventing and Controlling Desertification to Win the ‘Three-North’ Battle.” This issue presents China’s strategic choices and future vision for desertification prevention and control, as well as implementation pathways and strategic planning for the new phase of “Three-North” project construction. It aims to help create new miracles in sand prevention and control with Chinese characteristics and provide new momentum for the “Three-North” battle. This special issue was jointly guided and advanced by Chief Scientist Lu Qi from the Chinese Academy of Forestry and Researcher Lei Jiaqiang from the Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences.

Citation Format: Cui G P, Xiao C L, Lei J Q, et al. China’s governance: Strategy choice and future vision for combating desertification. *Bulletin of Chinese Academy of Sciences*, 2023, 38(7): 943-955

Abstract

China has achieved tremendous success in combating desertification over the past 70-plus years of continuous efforts. Currently, China’s desertification control has entered a new stage, yet it still faces challenges such as a large base of sandy land and high difficulty in treatment. It must comprehensively meet national strategic needs including ecological construction, rural revitalization, and the development and utilization of wind and solar power in desert, Gobi,

and wasteland areas. The strategic choice for China's desertification control in the new era is overall improvement with key breakthroughs. The core of the strategy lies in whole-area governance, innovation-driven development, and technology integration. The institutional arrangement of classified policies is to fully implement the "one desert, four systems" approach (cultivation, prevention, combating, and utilization), vigorously fight the "three iconic battles" of the "Three-North" project, prioritize the deployment of key demonstration projects, accelerate policy updates, and build new technological engines. These efforts will help improve the quality and efficiency of desertification control, create a beautiful vision of Chinese-style modernization featuring the integration of production, life, and ecology with harmony between humans and sand, and promote China's desertification control solutions to the world for global benefit.

Keywords: desertification control, sand prevention and fixation, ecological governance, strategic choice, future vision

1. State-Led, Strategy Upgrade

Over the past 40 years, China has implemented a series of major ecological projects, including the "Three-North" Project, Beijing-Tianjin Sand Source Control Project, Natural Forest Protection Project, Grain for Green and Grass for Animal Husbandry Project, and the integrated protection and restoration of mountains, rivers, forests, fields, lakes, grasslands, and deserts. These initiatives have improved the ecological environment in northern China. China has initially established a nature protected area system with national parks as the main component, incorporating large areas of natural deserts into protected status. Through six phases of desertification and sandy land monitoring, China has gained a clear understanding of its sand "conditions" and established a long-term observation and research network in desert regions. Currently, the relationship between scientific desert management and the development of desertified land has been largely rationalized compared to 40 years ago, achieving basic harmony among production, life, and ecology in some areas. The concepts of whole-area governance and systematic management have been scientifically developed, making ecological security, coordination, integration, and high-quality green development the priority choices for regional development.

1.1 Whole-Area Governance, Combined "Skin" and "Fur" Treatment

China has creatively developed and enriched the new ecological construction concept of integrated protection and restoration of "mountains, rivers, forests, fields, lakes, grasslands, and deserts." Based on the differences among these seven elements, this can be summarized as a "skin and fur" combined treatment system (Figure 1). Here, "mountains, rivers, lakes, and deserts" constitute the "skin," representing the carrying capacity attribute of land, while "forests, fields, and grasslands" constitute the "fur," representing the productivity at-

tribute. The “skin” includes the ground and subsurface parts—the matrix for “fur” growth—requiring attention to ecological land planning and allocation in ecological construction. The “fur” includes plants growing above ground, representing vegetation construction based on the “skin.” In ecological construction, scientific planning of forest and grass vegetation and agricultural production should be based on the natural endowment conditions of the “skin.”

The “skin and fur” combined treatment represents a simple summary of whole-area, comprehensive, and systematic governance, containing multiple levels of understanding. Within the “skin,” ecological security must be ensured internally, such as preventing wind-blown sand from the Ulan Buh Desert from entering the Yellow River, restoring mines in the Helan Mountains, and managing the ecology of West Lake in Dunhuang. Within the “fur,” high-quality integrated development must be achieved among forestry, grassland, and agriculture industries, such as in the Grain for Green and Grass for Animal Husbandry Project and restoration of degraded grasslands in farming-pastoral ecotones. The relationship between “skin” and “fur” requires optimizing vegetation productivity allocation based on land carrying capacity, such as constructing farmland/oasis shelterbelts and comprehensive management of the Horqin Sandy Land.

In northwestern arid and semi-arid regions where desertification control tasks are heavy, “mountains, rivers, forests, fields, lakes, grasslands, and deserts” often present superimposed elements and hazards. Taking the Yellow River’s “Ji Zi Bend” as an example, this area lies in the Yellow River basin and the northern sand prevention belt, containing all seven elements (Yinshan and Helan mountains, the Yellow River, ten major tributaries, windbreak and sand-fixing forests, the Hetao Plain grain base, Ulan Suhai Lake, Urad grassland, and Ulan Buh Desert). It faces superimposed “three hazards” of water disasters (suspended Yellow River), sand disasters (wind-sand hazards, coarse sand entering the Yellow River), and salt disasters (salinization), with prominent contradictions among production, life, and ecology (ecological water use, ecological land use). These issues highly overlap regionally and require consistent problem-solving, necessitating comprehensive whole-area governance solutions. In arid oasis areas, contradictions among water, sand, and fields are prominent, with high risks of salinization threatening food security. Therefore, in desertification control, especially in ecological construction spatial layout, scientific planning of forest and grass vegetation construction and agricultural production should be based on the natural endowment differences of the “skin.”

1.2 Conceptual Innovation, Learning from Nature

China’s desertification control concepts have evolved through three stages: the initial stage of mobilizing the entire population to march toward the desert with mass participation; the development stage driven by national will and major projects; and the new stage of whole-area, comprehensive, and systematic governance. The most prominent challenges differed in each historical stage, requiring different priorities. In the new era, China has implemented a series

of conceptual innovations in desertification control, emphasizing learning from nature. Currently, mainstream global ecological governance concepts such as sustainable development and Nature-based Solutions (NbS) are all reflected in traditional Chinese culture. For example, the *Book of Zhou · Daju* states: “In Yu’s prohibition, during spring’s three months, no axes enter the mountains and forests to allow grass and trees to grow; during summer’s three months, no nets enter the rivers and marshes to allow fish and turtles to grow,” corresponding to sustainable development. The *Strategies of the Warring States · Qi Ce IV* concept of “returning to simplicity” and the *Tao Te Ching* principle of “Man follows Earth, Earth follows Heaven, Heaven follows the Dao, and Dao follows nature” correspond to NbS.

New concepts require updating scientific management of deserts and scientific prevention of desertification. Ecological construction in sandy areas must strengthen coordination with regional high-quality integrated green development, ensuring both ecological security and regional green development. It must address ecological problems while also solving livelihood issues and promoting green development. Mine ecological restoration, desert pollution control, and protection and restoration of lakes and wetlands must be organically connected and highly integrated with desertification control work. Phase 6 of the “Three-North” Project will launch 20 county-level scientific afforestation pilots, scientifically planning county-scale optimal allocation of forest and grass resources based on water resource constraints according to different site conditions.

1.3 Desertification Control “Prescriptions,” Complete Technology

For over 70 years, China has maintained state leadership in desertification control, encouraging active participation from all industries (forestry and grassland, science and technology, agriculture, water conservancy, finance, environmental protection, etc.) and all social levels (desertification control enterprises, models, forest farm construction, teaching and science popularization, etc.), leveraging scientific and technological support, local characteristics, and public wisdom. This has established multiple types of desertification control models and technical systems for different bioclimatic zones. Drawing on traditional Chinese medicine concepts, desertification control technologies can be categorized into “single prescriptions, proven prescriptions, and secret prescriptions,” plus a “wonder prescription” for building new cities in deserts.

Single Prescriptions refer to using individual technologies to quickly control sand hazards. For example, the “straw checkerboard” mechanical sand barrier technology, known as the “Chinese Magic Cube,” was introduced from Soviet expert Petrov in the 1950s and improved in China, demonstrating excellent sand-fixing effects and remaining widely used in sandy areas today. Other examples include afforestation projects initiated by civil society organizations such as “Ant Forest” and “100 Million Haloxylon.”

Proven Prescriptions are integrated sand control technologies that have proven effective in practice through years of verification. These represent assembly and matching of individual technologies, achieving technological integration and innovation in sand hazard control. Typical examples include the railway and highway sand control system of “mainly fixation with combined fixation and blocking” based on research of sand transport characteristics (such as the comprehensive sand control system for the Baotou-Lanzhou Railway at Shapotou section and the Tarim Desert Highway), and the “low-coverage sand control technology system” that achieves water-determined greening. China’s sand hazard prevention models and applications for major transportation lines have reached internationally leading levels.

Secret Prescriptions are tailored solutions developed according to different local climates, soil types, and ecological-economic needs for different eco-geographical regions. Currently, China has developed various sand prevention and control models: for extremely arid regions, the “Hotan Model,” “Aksu Model,” “Dunhuang Model,” and “Ejin Model”; for arid regions, the “Linze Model,” “Minqin Model,” “Shapotou Model,” “Dengkou Model,” “Kubuqi Model,” and “Eren Model”; for semi-arid regions, the “Yulin Model,” “Youyu Model,” “Chifeng Model,” “Saihanba Model,” and “Zhanggutai Model”; and for alpine special habitats, the “Gonghe Shazhuyu Model,” “Guinan Huangshatou Model,” “Maqu Model,” and “Ruo’ergai Model.”

Wonder Prescription for Building New Cities in Deserts. Cities such as Aral, Golmud, Kangbashi, Wuhai, Bayanhot, and Shapotou District have been built in deserts. The Xinjiang Production and Construction Corps has shifted from “reclaiming and garrisoning border areas” to “building cities and garrisoning border areas,” developing towns and oases such as Aral City and Huyanghe City, all under the jurisdiction of the Corps and directly administered by the autonomous region.

1.4 Desert “Scenery,” Major Opportunities

In October 2021, President Xi Jinping proposed at the 15th Conference of the Parties (COP15) to the UN Convention on Biological Diversity that China would launch large-scale wind and photovoltaic construction in desert, Gobi, and wasteland areas. In January 2022, the National Development and Reform Commission and the National Energy Administration jointly released the *Layout Plan for Large-scale Wind and Photovoltaic Bases Focusing on Desert, Gobi, and Wasteland Areas* and *Opinions on Improving Institutional Mechanisms and Policy Measures for Green and Low-Carbon Energy Transition*, proposing a series of policy measures to promote wind and photovoltaic development in sandy areas. In March 2023, the General Office of the Ministry of Natural Resources, the General Office of the National Forestry and Grassland Administration, and the General Department of the National Energy Administration jointly issued the *Notice on Supporting the Development of Photovoltaic Power Generation Industry and Regulating Land Use Management*, standardizing land use issues

for photovoltaic industry development in deserts, Gobi, and wasteland areas. Under the premise of strict ecological protection and regulated land and water use, wind and photovoltaic construction in these regions will bring opportunities for “prevention, control, and utilization” in desertification areas.

The wind and photovoltaic industry has become a major feature of future collaborative development between desertification control and local areas. China is exploring the establishment of integrated solutions such as “photovoltaic + desertification control” and social capital access mechanisms, accelerating the development of corresponding ecological protection technology systems. Desert wind and photovoltaic development will provide large amounts of clean energy. Besides most electricity being transmitted externally for increased revenue, a small portion can be used for local industrial development, providing new momentum for high-quality development of new green industries in desert and desertification areas represented by plant factories, photosynthetic engineering, and facility agriculture.

2. Overall Improvement, Key Breakthroughs

Desertification control concerns ecological construction, regional development, rural revitalization, and people’s well-being in vast desert and desertification areas. The strategic choices for desertification control have three starting points: ensuring the health of desert ecosystems, strengthening desertification prevention, control, and assessment with preferential policy support, and actively connecting with major national strategies to contribute to integrated governance of “mountains, rivers, forests, fields, lakes, grasslands, and deserts.” China’s desertification control strategy must fully align with national strategies, meet international commitments, and respond to global initiatives. Following the governance approach of “coordinated comprehensive management of mountains, rivers, forests, fields, lakes, grasslands, and deserts” and “promoting green development to foster harmony between humans and nature,” the strategy should focus on connecting with the “dual” planning approach, 抓好 the construction of national comprehensive desertification control demonstration zones, build a solid northern ecological security barrier, achieve the “dual beauty” goals (building a beautiful China and meeting people’s needs for a better life), align with the “dual carbon” goals, respond to the “dual convention” goals (SDGs and UNCCD’s Land Degradation Neutrality target “LDN”), and build a community with a shared future for arid regions.

2.1 One Desert, Four “Systems,” Regular Assessment

For various types of desertification areas and different regions of desert ecosystems, China proposes a four-character policy of “cultivation, prevention, combating, and utilization,” establishing a strategic framework of “one desert, four systems” (plus one “assessment”) (Figure 2 [Figure 2: see original paper]).

1. “**Cultivation**” targets natural ecosystems such as primary deserts, sandy

lands, and Gobi, planning key “cultivation” (protection) areas. Four major types of cultivation (management) in desert ecosystems include national parks, nature reserves, desert nature parks, and protected closure areas.

2. **“Prevention”** targets “sub-healthy” areas to prevent potential desertification and sandification, mainly including marginal zones of existing desertified and sandy lands prone to land degradation and areas with obvious desertification trends, requiring key prevention and scientific management.
3. **“Combating”** targets “diseased” areas, scientifically promoting key desertification control to slow deterioration and enable artificial restoration. According to the *Major Ecological Protection and Restoration Project Construction Plan for the Northern Sand Prevention Belt (2021-2035)*, various types and key prevention areas of sandy land in China should be treated through classified, concentrated, and contiguous governance.
4. **“Utilization”** targets developable and utilizable areas, adhering to the principle of “high input, high output, high efficiency, and high benefit” to manage and make good use of limited resources in sandy areas. On the basis of continuing to promote planting and breeding industries in sandy areas, cultivating green food and biopharmaceutical industries, developing and utilizing sand-based materials, and developing sandy area eco-tourism, efforts should be intensified to develop “four high” industries, launching a series of projects such as wind and photovoltaic power, factory-based facility agriculture, plant factories, and photosynthetic engineering that meet the “four high” characteristics. Management of land and water resources in sandy areas should be strengthened to promote efficient and intensive development and utilization.
5. **“Assessment”** targets desert and desertification areas, conducting regular assessments of desert ecosystem quality, function, and services. Key monitoring and assessment indicators reflecting desert ecological quality and ecosystem health should be established, making full use of integrated “satellite-air-ground” monitoring technology to continuously monitor ecological functions of desert ecosystems at both “point” and “area” scales, and conduct assessments of desert ecosystem quality, health, function, and services.

According to differences in natural endowment, especially water conditions, representative key areas should be selected for demonstration: extremely arid regions such as the Dunhuang basin; areas around the Taklimakan Desert spanning extremely arid to arid regions; the Yellow River’s “Ji Zi Bend” region in arid areas; and the Horqin Sandy Land and Hunshandake Sandy Land in semi-arid regions.

2.2 Priority Layout, Key Demonstrations

In future strategic tasks of China's desertification control, five priority actions should be deployed in important and urgently needed areas.

1. **Priority Protection Action for Desert Ecosystems:** Mainly including comprehensively promoting the establishment of desert-type national parks, conducting inventory and science popularization of China's deserts, sandy lands, and Gobi, and increasing interaction with media and society.
2. **Sustainable Development Action for Deserts:** Mainly including strengthening disaster prevention and mitigation, forecasting and early warning, curbing coarse sand entering the Yellow River in the middle and upper reaches, and managing the increasingly serious trend of "suspended river" moving upstream in the Hetao irrigation area (the Yellow River's suspended river problem has a trend of moving from downstream to mid-upstream).
3. **High-Quality Development Action for Deserts:** Mainly including promoting the construction of large-scale wind and photovoltaic new energy bases in desert, sandy land, and Gobi areas, and accelerating the establishment of a financial support system for green industries in desert ecosystems.
4. **Desert "Dual Carbon" Action:** Mainly developing quality and efficiency improvement technologies for carbon sequestration by sand-fixing vegetation based on water resource carrying capacity.
5. **International Exchange and Technology Export of China's Desert Management "Solution":** Introducing China's experience and measures in combating desertification to the world, contributing Chinese wisdom, and providing Chinese solutions, with priority support for the "Great Green Wall" construction in Pan-Africa, assisting Africa in developing agroforestry operations, and promoting photovoltaic industry development in Africa's power-deficient and powerless areas with concentrated populations.

2.3 Legislation and Regulation, Institution First

1. **Initiate the revision process of the *Law of the People's Republic of China on Prevention and Control of Desertification*.** The revised law should better adapt to new-era national ecological governance concepts and relevant national strategic requirements, connect well with other environmental protection and natural resource laws, and lay a legal foundation for sustainable development of desert ecosystems.
2. **Strengthen implementation of relevant plans.** Mainly including the "dual" planning approach, national desertification prevention and control planning, forestry and grassland protection and development planning,

soil and water conservation planning, agricultural sustainable development planning, and national desert park development planning.

3. **Continue to promote and improve the target responsibility system for desertification prevention and control.** Explore the establishment of a desert area ecological damage accountability system, clarifying circumstances, forms, and procedures for accountability.
4. **Establish a desert ecosystem protection system.** Mainly including establishing a sandy land closure protection system, implementing a basic grassland protection system, clarifying natural resource asset property rights in sandy areas, improving grassland contract management systems, and perfecting supervision systems for resource development and utilization in sandy areas.
5. **Establish a desert ecosystem protection compensation mechanism.** Based on existing forestry subsidies, grassland ecological protection subsidies, sandy land closure protection subsidies, and tax incentives in sandy areas, establish an ecological compensation mechanism for desert ecosystems. Actively explore and pilot diversified compensation methods, establish a two-way mechanism of compensation and punishment, and accelerate the improvement of supporting systems for desert ecological compensation.
6. **Firmly fulfill commitment to conventions.** Continue to implement the *United Nations Convention to Combat Desertification* (UNCCD), *Convention on Biological Diversity* (CBD), and *United Nations Framework Convention on Climate Change* (UNFCCC) (collectively the “Rio Three Conventions”). Through these platforms, establish cooperation mechanisms with the international community to bring Chinese technology, experience, and solutions to the world, especially developing countries, contributing Chinese wisdom to global desertification control. Promote global achievement of SDG 15.3 (land degradation neutrality) and actively respond to the G20 initiative to halve land degradation by 2040.

2.4 Scientific Support, Innovation-Driven

1. **Strengthen basic research and key technology development for desertification control.** Relying on research institutes, public-private enterprises, and technology extension units in desertification control and the “Three-North” project field, form a government-enterprise-academia-research cooperation mechanism, conduct joint research, encourage innovation, and strive to achieve breakthroughs in basic scientific research, control technology development, and new product manufacturing and application.
2. **Strengthen promotion and application of desertification control technology achievements.** Continue to improve existing national,

provincial, and county-level technology extension networks, fully utilize various agricultural, forestry, animal husbandry, and water conservancy extension channels, and establish a technology and information sharing platform for sustainable desert ecosystem development.

3. **Improve the desertification monitoring, early warning, and observation research network system.** Establish a monitoring system with national, regional, and provincial monitoring centers as the backbone and positioning monitoring stations and fixed monitoring sample lines as the support, forming a long-term observation and research network integrating “observation-research-demonstration-extension.”
4. **Improve the desertification control technical standard system.** Accelerate the formulation and revision of standards for desert ecosystem protection and desertification control, especially for sandstorms, drought, strong winds, and other disaster emergency response. Actively participate in international standard formulation for desertification control and promote the internationalization of technical standards.
5. **Establish a diversified financing system for desertification control.** Stabilize financial investment, encourage local and private investment in sand prevention and control, establish a mechanism for realizing the value of desert ecological products, and give full play to the ecological value of desert ecological products in tourism. Encourage social and private funds to actively participate in national and local desertification control project investment and expand financing channels.
6. **Strengthen basic surveys and clarify the resource base.** Actively plan the second national desert scientific expedition and cross-border Gobi resource surveys; promote international cooperation in desertification control, establish a China-Mongolia desertification control cooperation center, prepare for a China-Arab international research center on drought, desertification, and land degradation, support scientific and technological support projects for the Pan-Africa “Great Green Wall” construction, jointly carry out the Aral Sea ecological restoration project in Central Asia, and strive to participate in Saudi Arabia’s “10 Billion Trees Initiative” and other major international, regional, and foreign desertification and sand hazard control projects.

3. Future Vision

3.1 China’s Desertification Control Goals for 2035

By 2035, China’s desertification control is expected to achieve decisive progress. The modernization of the governance system and capabilities in desert and desertification areas will be basically realized, with significantly enhanced sustainable, high-quality, and green development capabilities. The area of manageable desertified and sandy land will continue to decrease, the degree of sandifica-

tion will be significantly reduced, vegetation coverage in sandy areas will be basically stable, and the ecological environment in sandy areas will gradually improve. The ecological conditions in key areas such as the four major sandy lands, desert oases, the Qinghai-Tibet Plateau, the Yellow River basin, and the Beijing-Tianjin-Hebei region will be significantly improved, with the initial realization of the goal of building a solid northern ecological security barrier. The national desert park construction system will be gradually complete, the supporting capacity of green industries in sandy areas will be significantly enhanced, and a relatively complete green industry system will be established. While better serving national ecological civilization construction needs, it will also better support international convention implementation needs and promote global achievement of SDG 15.3 (land degradation neutrality).

According to regional differences in China's natural endowment conditions, future desertification control priorities and tasks for different regions should be planned. China's terrain is traditionally divided into three major steps. This paper adds specific consideration for marine blue territory and coastal zones (coastal dune distribution areas), proposing a new "four terraces" approach that separates blue territory and coastal zones as the "fourth terrace." Based on this new four-terrace zoning, corresponding desertification control priorities and tasks should be planned (Figure 3 [Figure 3: see original paper]).

First Terrace: The first step of China's three terrestrial steps, including the Qinghai-Tibet Plateau region—a high-altitude, alpine area. The core task is to control grassland degradation and desertification in the Three-River-Source region and manage freeze-thaw desertification to ensure ecological security of the "Asian Water Tower."

Second Terrace: The second step, including northwestern inland areas, Inner Mongolia Plateau, Loess Plateau, Sichuan Basin, and Yunnan-Guizhou Plateau. This is the main distribution area of China's arid and semi-arid regions and the main battlefield for desertification control and the "Three-North" project's "three major battles." The core tasks are to win the Yellow River "Ji Zi Bend" battle, focusing on sand control along the Yellow River banks and photovoltaic sand control to ensure Yellow River safety and maintain ecological security of the grain base; win the Hexi Corridor-Taklimakan Desert edge battle, focusing on wind-sand pass control and heritage site protection to maintain ecological security of important nodes along the "Belt and Road"; strengthen ecological management in sand source areas and sand passage areas to ensure ecological security of China's northern sand prevention belt and improve farmland ecosystem stability.

Third Terrace: The third step, including the Northeast Plain, North China Plain, East China, and South China—main distribution areas of semi-arid, semi-humid, and humid regions. The core task is to win the battle of annihilation in the Horqin-Hunshandake Sandy Lands, focusing on high-quality forest and grass construction to restore traditional grassland landscapes (such as sparse elm grasslands in the two sandy lands) and effectively control sand sources invading

the Beijing-Tianjin region; implement the Beijing-Tianjin Sand Source Control and Northeast Black Soil Management Projects.

Fourth Terrace: Blue territory and coastal zones—coastal sandy land and marine distribution areas. The core task is to prevent and control coastal sandy land desertification and sandification to ensure ecological security of national blue territory.

While each of the four terraces has its own priority tasks, all will contribute to national ecological construction and integrate into the national ecological governance framework, building a strategic plan for coordinated land-sea governance.

3.2 New Mission for China's Desertification Control in the New Era

Facing the future, China's desertification control will achieve a major strategic transformation from sand prevention, control, and utilization to sand understanding, cultivation, and protection, extending from desert development and desertification control to ecological governance, whole-area governance, comprehensive governance, and public governance. The future vision for China's desertification control mainly includes four aspects (Figure 4 [Figure 4: see original paper]).

3.2.1 Integration of “Three Lives,” Integrated Development Ecological land will achieve scientific planning. In the future, priority should be given to exploring substantive legislation and land classification management for ecological land. Based on future-oriented land ecological function attributes, ecological land in desertification control areas should be divided into three categories: permanent ecological land (natural), basic ecological land (artificial), and reserve ecological land (polluted and abandoned). Ecological land will implement classified management for sustainable use: for permanent ecological land, focus on “protection” with strengthened closure protection; for basic ecological land, focus on “management” to ensure ecological, production, and living functions, implementing ecological projects and ecological management; for reserve ecological land, strengthen land management and restoration, balancing “management” and “utilization” to reserve land “increment” for future development.

Ecological water use will achieve scientific efficiency. Ecological water use for desertification control will realize water-determined greening and production, scientifically optimizing forest and grass resource allocation based on vegetation ecological water demand. In areas with relatively serious ecological damage and poor site conditions, active artificial intervention and ecological reconstruction will be implemented mainly through major national ecological projects, strengthening ecological water supply; in areas with relatively minor ecological damage and better site conditions, ecological restoration will be achieved mainly through near-natural restoration and closure protection, with strict control of ecological water supply.

Desertification control and regional integrated high-quality development will be

coordinated and advanced in tandem. Desertification control must be closely coordinated with national and local development strategies, especially accelerating green transformation of industries in western regions, realizing modernization and intelligence of agricultural production in sandy areas, encouraging high integration of sandy area agriculture with photovoltaic and wind power industries, promoting conservation tillage (no-tillage), and developing organic agricultural production to form new green, low-carbon, and environmentally friendly agricultural production models in sandy areas.

3.2.2 Whole-Area Sand Control, Real-Time Monitoring Multi-dimensional whole-area sand control will be achieved. Spatially, coverage will extend to “whole watershed, whole mountain area, and whole sandy area,” coordinating mountain-alluvial fan/alluvial gully-oasis transition zone-desert chain management, focusing on “whole oasis upstream and downstream” sand control at desert edge oasis transition zones. Temporally, coverage will extend to “whole process, whole duration, and whole cycle,” implementing classified measures according to different time scales required for ecological reconstruction (geological time scale, ecosystem succession scale, and human ecological construction scale), realizing the principle of “whoever destroys, restores; whoever pollutes, manages; whoever benefits, pays.” When necessary, national ecological projects will still be deployed to promote desertification control, especially in severely desertified areas. Academically, coverage will extend to “whole discipline, whole direction, and whole field,” using the opportunity to elevate soil and water conservation and desertification control to first-level disciplines, incorporating natural science forces such as forestry, ecology, geology, geography, environmental science, biology, and water conservancy science into desertification control work, strengthening international cooperation, fulfilling convention commitments, emphasizing strategy and policy formulation, and encouraging research on sand industries and desert economics.

Real-time dynamic monitoring of desert(ification) will be achieved. Currently, national forestry and grassland authorities conduct national desertification and sandification monitoring every five years. In the future, annual and eventually real-time dynamic monitoring capabilities for desert ecosystems and desertification will be gradually achieved. Annual assessments of desert ecosystem quality, health, function, services, and ecological assets will be realized. China will explore accounting for ecological benefit contributions of desertification control and implement annual assessments.

3.2.3 Harmony Between Human and Sand, Greening and Carbon Sequestration Priority Protection of Primary Deserts. The ecological value provided by desert ecosystems will steadily increase, ecological products will gradually become more abundant, and biodiversity in sandy areas will continue to improve. Under the combined effects of natural conditions and ecological projects, long-term greening and carbon sequestration will be achieved in sandy areas, with desert ecological carbon sink capacity scientifically recognized

and steadily improved. Natural deserts, sandy lands, and Gobi will be strictly protected through closure, preserving primary desert landscapes for future generations.

Benefit-Hazard Balance, Prevention According to Hazard. By 2035, the ecological conditions in key areas such as the Yellow River basin and Beijing-Tianjin-Hebei region will gradually improve, with effective control of coarse sand entering the Yellow River and irrigation area salinization. The ecological conditions in domestic sand source areas will significantly improve (indirectly reducing the frequency and harm of sandstorms in northern China), and the northern ecological security barrier will become effective, healthy, and sustainable.

Efficient Utilization, Livelihood Improvement. On desertified land with production functions or that has been controlled, a batch of ecological industries will develop rapidly, including modern ecological agriculture (vigorously promoting conservation tillage, plant factories, and photosynthetic engineering), characteristic Chinese herbal medicine cultivation (near-natural habitat simulation planting to improve genuine medicinal material quality), renewable energy development and utilization (wind, photovoltaic, and biomass energy), and characteristic eco-tourism (relying on the nature protected area system with national parks as the main component, such as desert parks). The rapid development of wind and photovoltaic industries in desert areas, leading internationally, will see a portion of electricity used locally through modern ecological agriculture methods, helping develop ecological industries and revitalize sandy areas, achieving high-quality green development transformation.

3.2.4 “Chinese Prescription,” Global Win-Win Technology transfer, collaborative innovation, and mutual benefit. In the future, China’s desertification control experience, technology, and new materials will support Africa’s “Great Green Wall” construction. China’s nearly 40 years of desertification control experience (especially the “Three-North” Project known as the “Green Great Wall”) can directly support Africa, contributing Chinese wisdom and providing Chinese solutions for Pan-Africa’s “Great Green Wall” construction. Technology transfer in agroforestry operations, where China has rich experience and mature models, and photovoltaic industries, particularly suitable for Africa’s populous and power-deficient regions, will be prioritized. It is expected that future Chinese desertification control wisdom and technology will contribute to global desertification governance in the Mongolian Plateau, Central Asian Aral Sea region, and African region, promoting early achievement of global land degradation neutrality.

Promoting Cross-Border Whole-Area Governance. At the end of 2022, China proposed initiatives to explore the establishment of a China-Mongolia Desertification Control Cooperation Center and a China-Arab International Research Center on Drought, Desertification, and Land Degradation, making substantive contributions to cross-border whole-area governance and jointly ensuring the well-being of people in desertification areas along the “Belt and Road.”

Based on long-term international cooperation in desertification control technology and models, future cooperation mechanisms through these two centers will enable China to actively participate in cross-border governance, providing scientific support, decision-making support, and think tank services for global desertification control. Facing deteriorating ecological trends in overseas sand source areas, future efforts should include detailed surveys of cross-border Gobi and desert sand sources and promoting China's solutions, wisdom, and contributions for "great nation sand control" and even "great nation governance" to sand source countries. Support should be provided for Pan-Africa's "Great Green Wall" construction, the Great Central Asian Aral Sea ecological restoration plan, Mongolia's 10 billion trees plan, and Saudi Arabia's 100 billion trees initiative through international cooperation and technical support at national and social levels, effectively promoting ecological security and people's well-being in desertification areas along the "Belt and Road."

Author Information:

Cui Guipeng is an Assistant Professor at the Institute of Ecological Conservation and Restoration and Institute of Desertification Studies, Chinese Academy of Forestry. His research focuses on desert ecological protection and restoration, desertification control strategies and policies, and desert environmental evolution. E-mail: cuigp@caf.ac.cn

Lu Qi is Chief Scientist and Professor at the Institute of Ecological Conservation and Restoration and Institute of Desertification Studies, Chinese Academy of Forestry. He has long been engaged in research on desertification control, ecosystem management in arid zones, and related strategies and policies. E-mail: luqi@caf.ac.cn

Corresponding author

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv — Machine translation. Verify with original.