Webinar on Transitioning to Climate-Resilient Pathways
March 4, 2022
Seoul, ROK

Sharing the experience of the Republic of Korea in nature-based solutions approaches: Enhancing resilience for the sustainable development goals

Gaeun Kim • Yowhan Son

Korea University

Empowered lives.
Resilient nations.

Sustainability

Nature-based solutions (NbS)

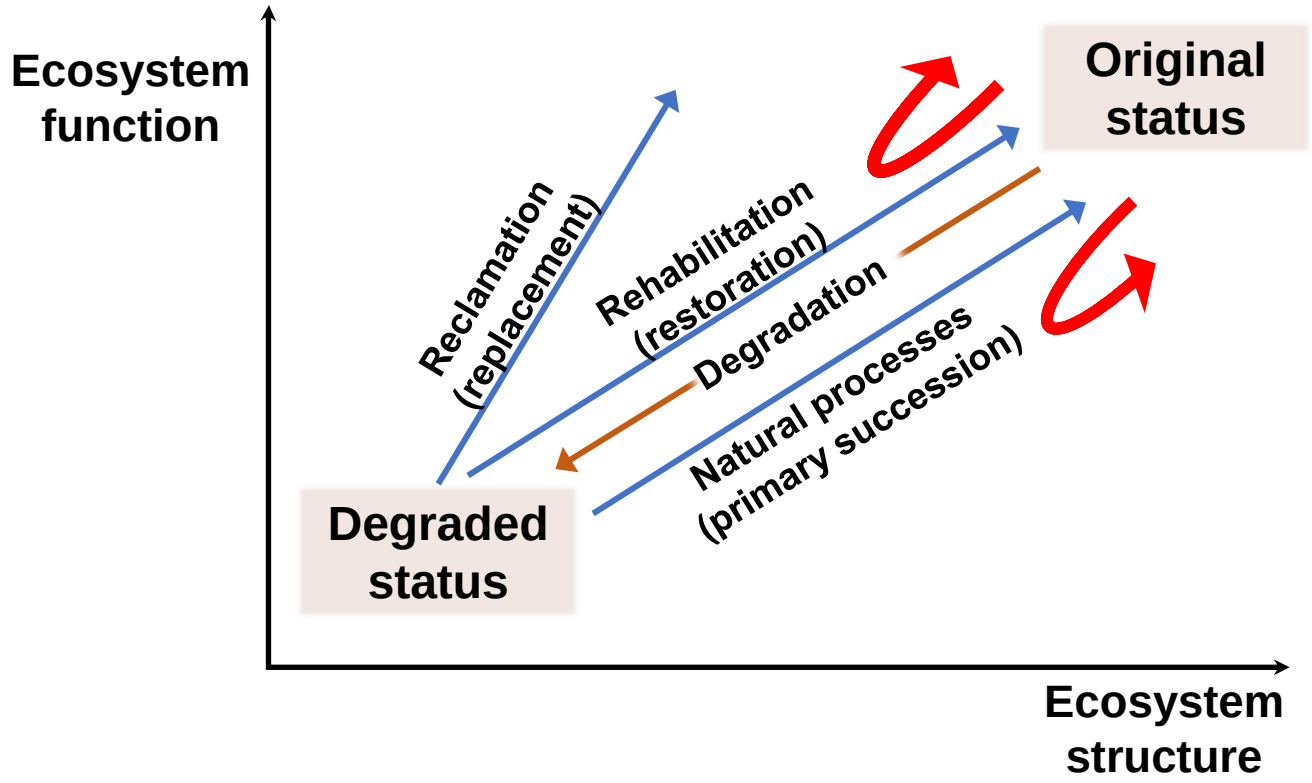
NbS: actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.

In July 2020, IUCN launched the **IUCN Global Standard for Nature-based Solutions**, a tool that helps plan, analyze, and evaluate NbS projects (IUCN, 2020)

	Summary of the guidelines
Criterion 1	**NbS effectively address societal challenges**: NbS are designed as a response to societal challenge identified as a priority.
Criterion 2	**Design of NbS is informed by scale**: NbS are designed responding to the scale of the issue. Scale refers to geographic, economic, ecological, and societal aspects of the landscape.
Criterion 3	**NbS result in a net gain to biodiversity and ecosystem integrity**: NbS are designed to enhance the ecosystem's sustainability.
Criterion 4	**NbS are economically viable**: NbS sufficiently consider the return on investment, the efficiency of the NbS intervention, and equity in the distribution of benefits and costs.
Criterion 5	**NbS are based on inclusive, transparent and empowering governance processes**: NbS are socially equitable; they acknowledge and involve a variety of stakeholders.
Criterion 6	**NbS equitably balance trade-offs between achievement of their primary goal(s) and the continued provisi on of multiple benefits**: NbS balance choices that need to be made to achieve short and long-term gains, and ensure transparent, eq uitable, and inclusive process to determine such trade-offs.
Criterion 7	**NbS are managed adaptively, based on evidence**: NbS adapt and evolve according to the continuous learning about system-wide processes in order to minimi ze risks and effectively harness ecosystem resilience.
Criterion 8	**NbS are sustainable and mainstreamed within an appropriate jurisdictional context**: NbS embed the concept and actions into policy or regulatory frameworks as well as linking to national targe ts or international commitments.

Resilience (socio-economic & environmental)

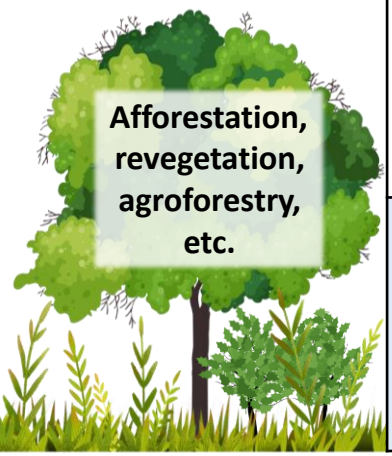
Enhancing resilience of society and environment through NbS



(Modified from Dobson et al., 1997)

NbS and sustanability

Nature-based solutions → **Resilience** → **Sustainability** → **Global agenda**



	Resilience	Sustainability	Global agenda
Socio-economic aspects	- Yellow Dust ▼ - Ecosystem Service ▲ - Cultivation techniques ▲ - Employment rate▲ - Local income ▲	- Local community stability - Local self-reliance	- Health (SDG 3) - Economic growth (SDG 8) - Infrastructure (SDG 9) - Inequality (SDG 10) - Partnership (SDG 17) - HDI, PHDI
Environmental aspects	- Greenhouse gas ▼ - Soil fertility ▲ - Biodiversity ▲	- Global warming mitigation - Ecosystem sustainability	- Climate action (SDG 13) - Life on land (SDG 15)

NbS related projects of Korea

1. **Domestic reforestation projects**
2. **International afforestation projects (ODA)**

   - China, Mongolia, and Kazakhstan

Why Republic of Korea,

Why forestry sector?

Brief history of the Korean forests

1910 – 1945 Japanese colonial period

1950 – 1953 Korean War

1973 – 1997 Forest rehabilitation period

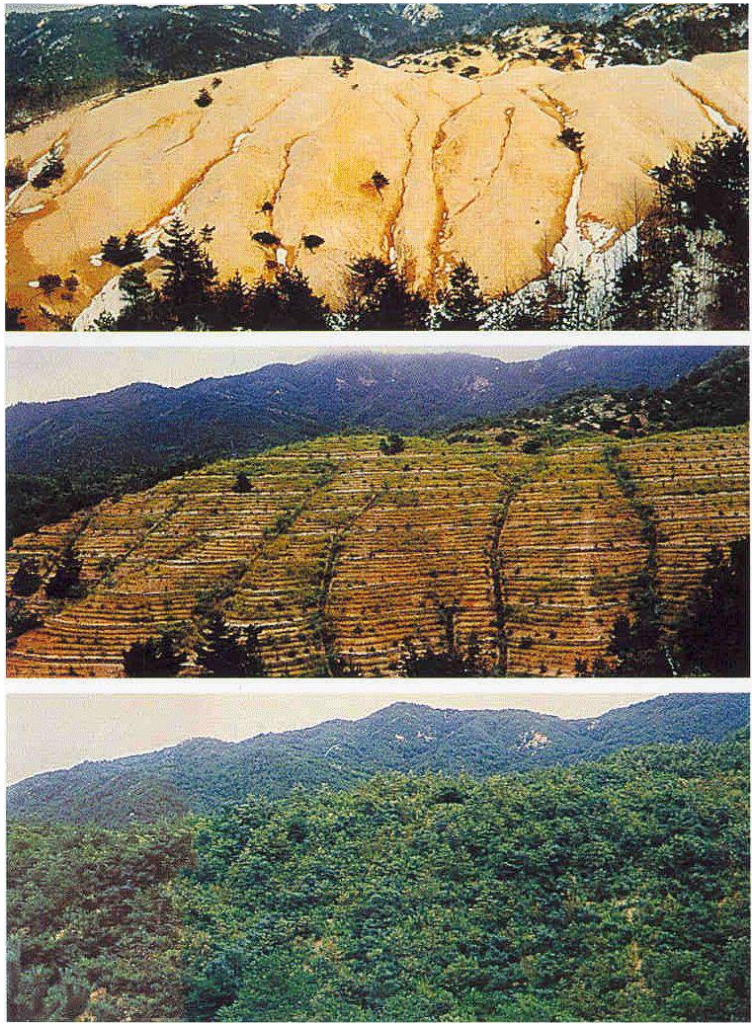
2000 – 2022 Forestry sector ODA with

Mongolia, China, Indonesia, Cambodia, Vietnam, Kazakhstan, Tajikistan

Growing stock (m^3)

1967	2018
63,746,337	995,079,158

X 15.6



(Korea Forest Service)

1. Domestic reforestation projects

Purpose of the projects: Restoration of devasted national territory and revitalize the economy

1st 10-Year Forest Rehabilitation Plan	2nd 10-Year Forest Rehabilitation Plan	3rd 10-Year Forest Resource Plan
1973-1978	1979-1987	1988-1997
Reforested 1,079,773 ha with 2,960,000 trees Major goals 1) Rapid greening through nursery and erosion contr 2) Promoting national reforestation movements that all citizens can participate in 3) Creation of new economic forestry areas by linking reforestation with income growth 4) Slash-and-burn fields reorganization	Reforested 1,060,000 ha with 1,915,000 trees Major goals 3) Developing post-reforestation management for fire and disease prevention, weeding and thinning	Reforested 323,960 ha with 837,000 trees Major goals Developing income streams for mountain villages Improve the forests' public service function 3) Fostering and supplying good quality timber resources

Planting → Tending

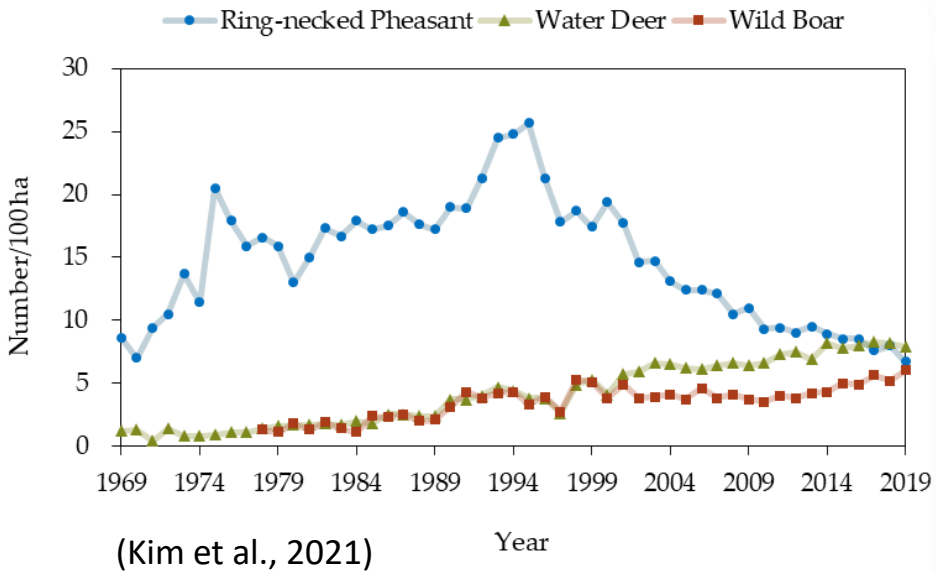
1. Domestic reforestation projects

Resilience analysis: Environmental resilience

Mean growing stock (m^3/ha) : **5.7** (1953) → **161.5** (2019)

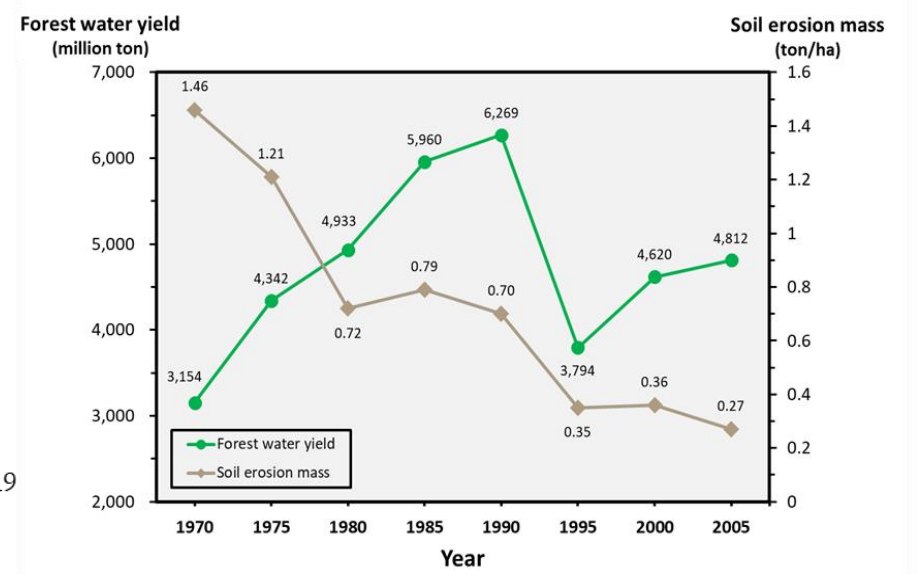
Carbon accumulation (Tg C) : **422.4** (1954) → **903.5** (2012)

Wild animal population increase



(Kim et al., 2021)

Soil quality improvement



1. Domestic reforestation projects

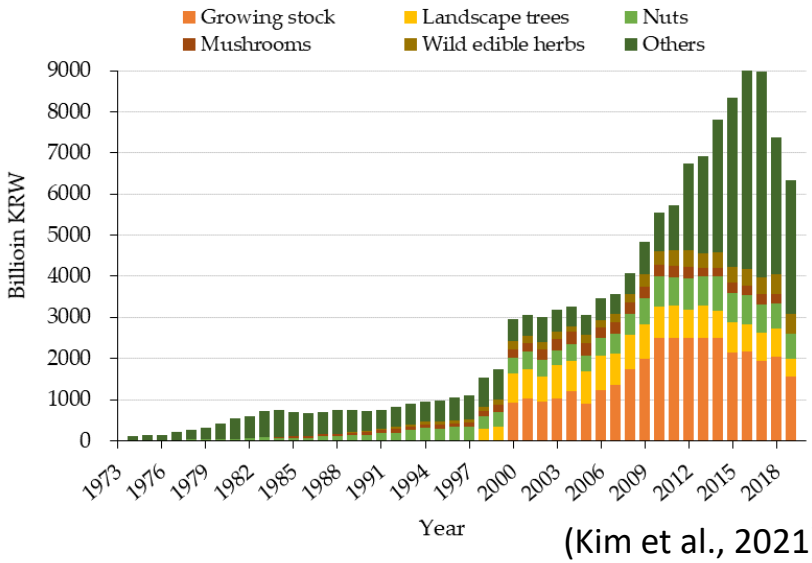
Resilience analysis: Socio-economic resilience

Public education and training :

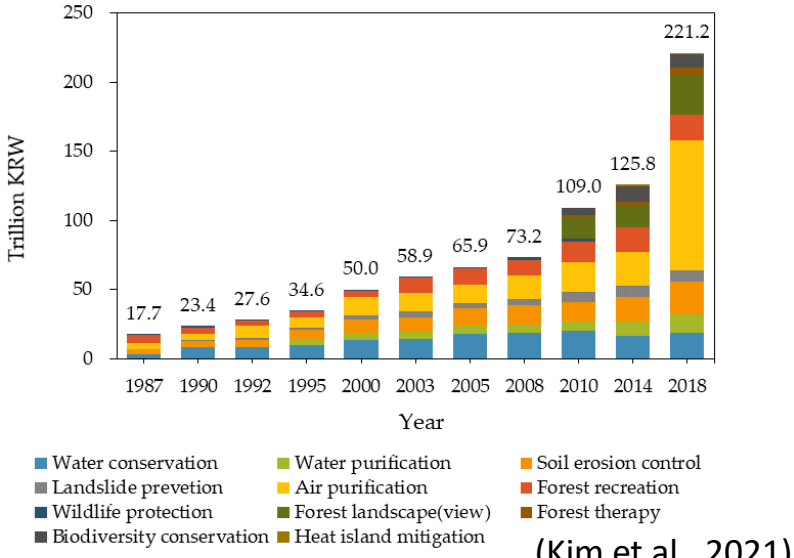
- **Arbor Period** (21 March–20 April) was designated as a national event that involved several million participants from the military, administrative agencies, schools, villages, and private organizations.

(National Archives of Korea)

Increase in forest resources production and public



(Kim et al., 2021)



(Kim et al., 2021)

2. International afforestation projects of Korea

(https://ontheworldmap.com/asia/)

2. International afforestation projects - China

Purpose of the projects: Building a green wall across the desert to mitigate yellow dust

Duration of the project: 35 years (2006–2041)
Project site location: Kubuqi Desert, a part of Dalad Banner, Ordos City, China

Yellow dust issue is caused by the sand, dust, and pollutants that originate from the deserts in Northwest Asia.

12 million *Populus* and *Salix* trees were planted over a total area of 4,741 ha on both sides of the Jiechai Road, which crosses the easternmost part of the Kubuqi Desert in the north-south direction.

(Future Forest)

2. International afforestation projects - China

Resilience analysis: Environmental resilience

Increase in vegetation cover

- Enhanced Vegetation Index: **0.07** (2006) → **0.12** (2016), natural green area: **0.17**

Soil surface stability

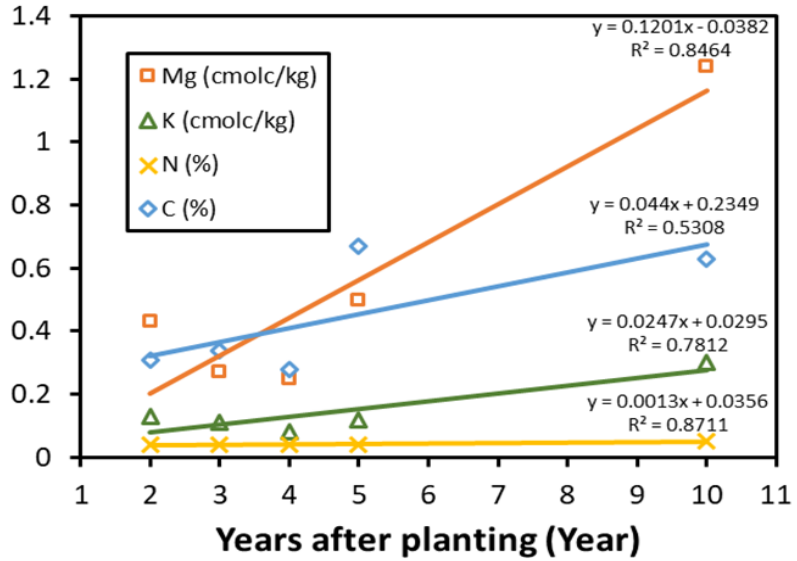
- The **amount of moving sand at the planting site was 1-5% of the desert sites.**

Biodiversity changes

- In 2015, over **35 species of living creatures**, and **20 other plant species** are growing together with the artificially planted trees.

Physicochemical improvement of the soil ▶

(IYDCD)



2. International afforestation projects - China

Resilience analysis: Socio-economic resilience

Mitigation of sandstorms

- During a survey study conducted in 2015, **68.3%** of respondents answered that the **air quality had improved by the afforestation**.

Increase in job opportunities for locals

- Due to the project residents are returning to rural areas and **the population is increasing**.

Cultivation of afforestation techniques

- Based on the same survey, **82%** of the respondents answered that the **local government and residents are able to continue the afforestation project** after the foreign assistance ended.

2. International afforestation projects - Mongolia

Purpose of the projects: Prevent desertification and secure community stability, mitigation of yellow dust

Over 40% of Mongolia is regarded as a desert or steppe, approximately 90% is at risk of desertification.

Green Asia Network's afforestation project

Duration of the project: 22 years (ongoing, 2000–)
Project site location: Bayannuur, Bagannuur, Ogginuur etc. Mongolia

Total of 770,000 trees were planted in 680ha. Major tree species are poplar, elm, willow, and sea buckthorn. This project highlights the importance on local community's self reliance; education, training, agroforestry, and community fund establishment are main activities alongside the afforestation.

2. International afforestation projects - Mongolia

Resilience analysis: Environmental resilience

Increase in soil fertility

- **Formation of root nodules in the project site's soils** indicate the interaction between tree roots and soil fauna.

Increase in soil surface stability

- In Bayannuur, where 120ha of forests were established, local **sand storms which occurred more than 50 times a year have disappeared**.

Grassland ecosystem has developed in the project sites.

(Green Asia Network)

2. International afforestation projects - Mongolia

Resilience analysis: Socio-economic resilience

Economic assistance through diversification of livelihoods

- The project recruited residents, low-income individuals and eco-refugees. As of 2018, **168 local people are working in eight locations**.
- In 2018, **12 kinds of vegetable (3,000kg) and sea buckthorn (1,113kg) were produced** in the agroforestry farms.

Creation of community-level activities

- **A cooperative** has been established to gather opinions from the community members, and for the further joint investments, **a community fund** has been made.


(Green Asia Network)


(Green Asia Network)


(Green Asia Network)

2. International afforestation projects - Mongolia

Resilience analysis: Socio-economic resilience

Education and training

- Knowledge and skills for orcharding, agriculture, afforestation, and overall project operation were shared to the maximum of **2,800 residents**.

Partnership with national government and volunteers worldwide

- **Green Asia Network assists Mongolian government agencies to generate land management policies**.
- **Annual eco-tour program** allow volunteers from various countries visit afforestation sites and promote public awareness and a sense of community among the residents.

2. International afforestation projects - Kazakhstan

Purpose of the projects: Desalt and ameliorate the exposed substrate of the Aral Sea

Duration of the project: 2 years (2017–2018)
Project site location: Kyzylorda, Kazakhstan

The desiccated seafloor has become a source of salt, sand, and dust transfer to the adjacent regions, negatively affecting human health and the environment by inhibiting the survival and growth of the vegetation.

In response, to stabilize the saline sand blowing from the Aral seabed, multiple domestic and international efforts have been performed to establish vegetation cover, majorly with indigenous trees of Saxaul.

In this project, **3,750,000 trees were planted in 10,800ha** of dried Aral Seabed.

Photo by Sunggil Lee

2. International afforestation projects - Kazakhstan

Resilience analysis: Environmental resilience

Changes in soil quality

- The **soil quality represented by soil organic materials, water, and nutrient (K^+ and Mg^{2+}) content has been improved by the afforestation**.
- Soil microbial activity is also observed to be activated**.** This indicates the relative efficacy of afforestation and hence aids in justifying afforestation investments.

Flora and fauna diversity

- Plant species were evaluated from the sites afforested from 1991 to 2017. **Stand density and species richness were the highest in the 1991 plantation site** among all sites.

Increase in carbon sequestration

- The carbon storage of saxaul in afforested areas is estimated to be **9.70 C g/m^2**

2. International afforestation projects - Kazakhstan

Resilience analysis: Socio-economic resilience (expected)

Reduction of blowing salty dusts

- **Vegetation acts as a windbreak**, and plant roots stabilize the soil surface by physically trapping the substrates.

Securing forest products

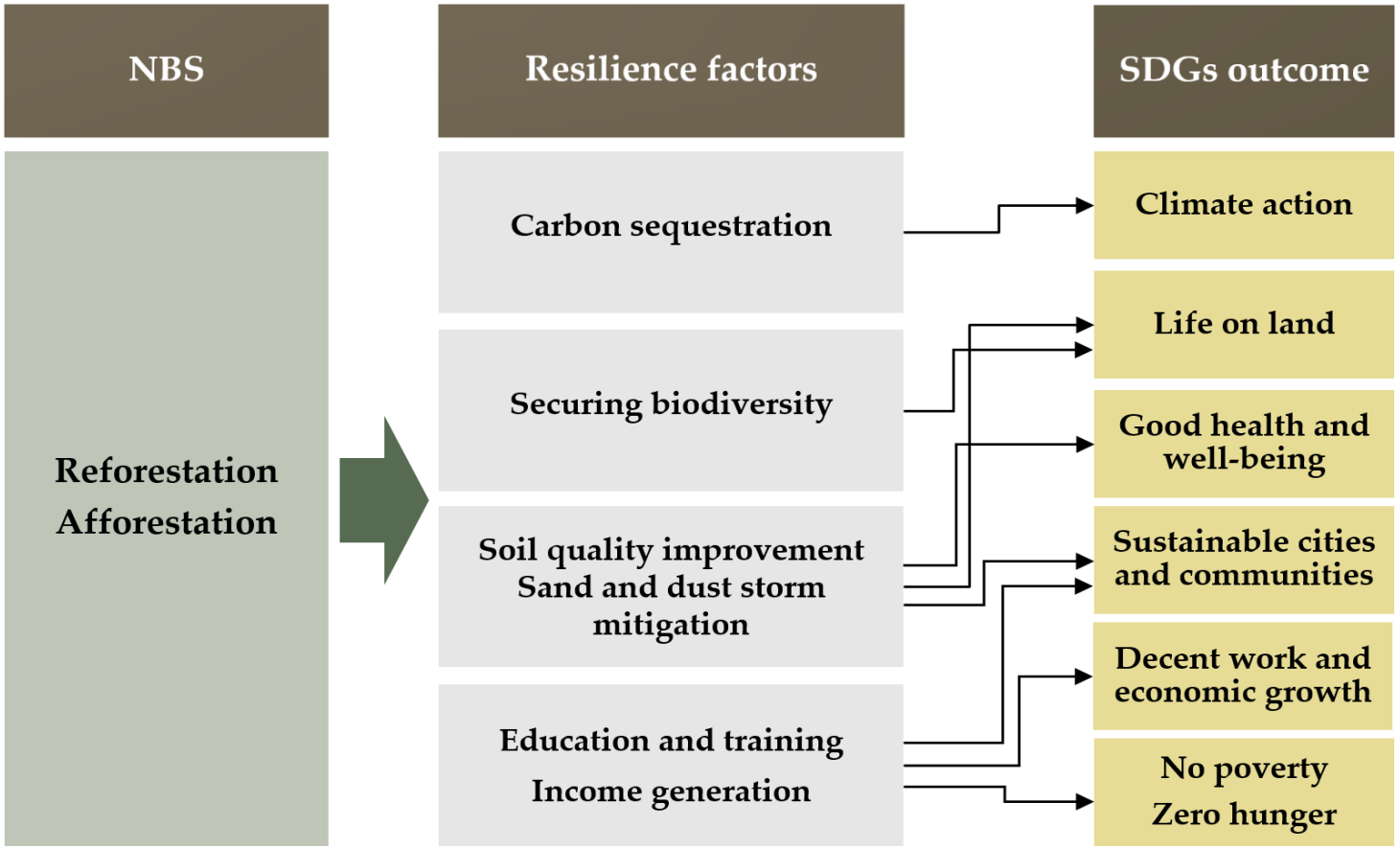
- **Forest products through afforestation can support residents with acquired resources.**

Provision of income

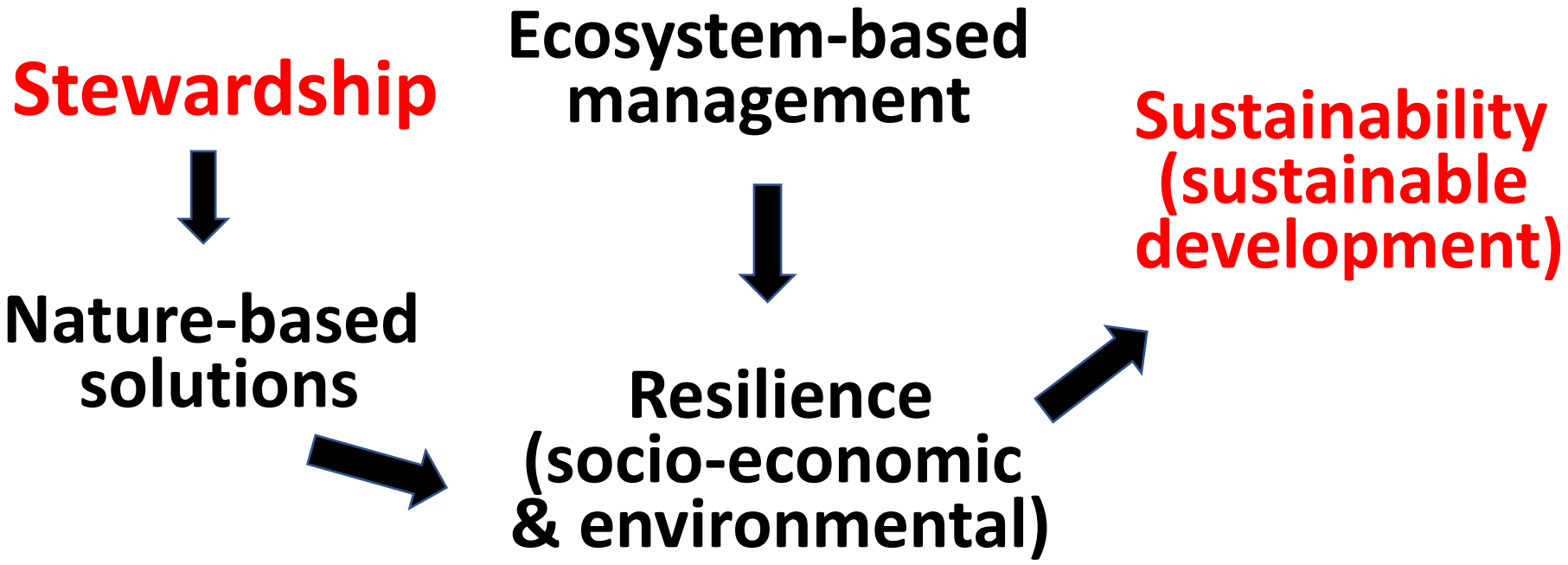
- Several stages of afforestation, including seed collection and processing, seeding, seedling excavation, and planting in the project areas, **require the labor provided by residents**.
- Herbaceous plants that grow with trees are a food source for livestock. **Afforestation can provide another means of livelihood – herding – to the locals**.

NbS – Resilience – Sustainability (SDGs)

Common elements of the NbS, resilience factors, and SDG outcomes from the reforestation and afforestation projects conducted by Korea



(Kim et al., 2021)


Stewardship
Nature-based solutions
Ecosystem-based management
Resilience (socio-economic & environmental)
Sustainability (sustainable development)

Conclusions

Lessons from the NbS related projects

First, reforestation/afforestation can be highly beneficial for both the environment and for community development.

Second, successful forest restoration can be accomplished through careful management after reforestation/afforestation activities.

Third, to formulate sustainable and long-term restoration projects, it is important to **reflect the needs of the local community and enable them to be self-reliant**.

Sharing the Experience of the Republic of Korea in Nature-based Solutions Approaches:

Enhancing Resilience for the Sustainable Development Goals

Sustainable Development Goals Policy Brief Series No.11

sustainability

MDPI

Article

How Do Nature-Based Solutions Improve Environmental and Socio-Economic Resilience to Achieve the Sustainable Development Goals? Reforestation and Afforestation Cases from the Republic of Korea

Gaeun Kim [1], Jiwon Kim [1], Youngjin Ko [1], Olebogeng Thelma G. Eyman [1], Sarwat Chowdhury [2], Julie Adiwal [2], Wookyun Lee [1] and Yowhan Son [1,*]

[1] Department of Environmental Science and Ecological Engineering, Korea University, Seoul 02841, Korea; marine1031@korea.ac.kr (G.K.); jiwonandonly@korea.ac.kr (J.K.); ko871004@gmail.com (Y.K.); 2020021591@korea.ac.kr (O.T.G.E.); leewk@korea.ac.kr (W.L.)

[2] United Nations Development Programme Seoul Policy Centre, Seoul 02841, Korea; sarwat.chowdhury@undp.org (S.C.); julie.adiwal@undp.org (J.A.)

* Correspondence: yson@korea.ac.kr; Tel.: +82-02-3290-3015

check for updates

Citation: Kim, G.; Kim, J.; Ko, Y.; Eyman, O.T.G.; Chowdhury, S.; Adiwal, J.; Lee, W.; Son, Y. How Do Nature-Based Solutions Improve Environmental and Socio-Economic Resilience to Achieve the Sustainable Development Goals? Reforestation and Afforestation Cases from the Republic of Korea. *Sustainability* **2021**, *13*, 12171. https://doi.org/10.3390/su132112171

Academic Editors: Raúl Romero-Calcerrada, Javier Cabello, Manuel Pacheco-Romero and Koldo Trapaga Monchet

Received: 1 October 2021
Accepted: 2 November 2021
Published: 4 November 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

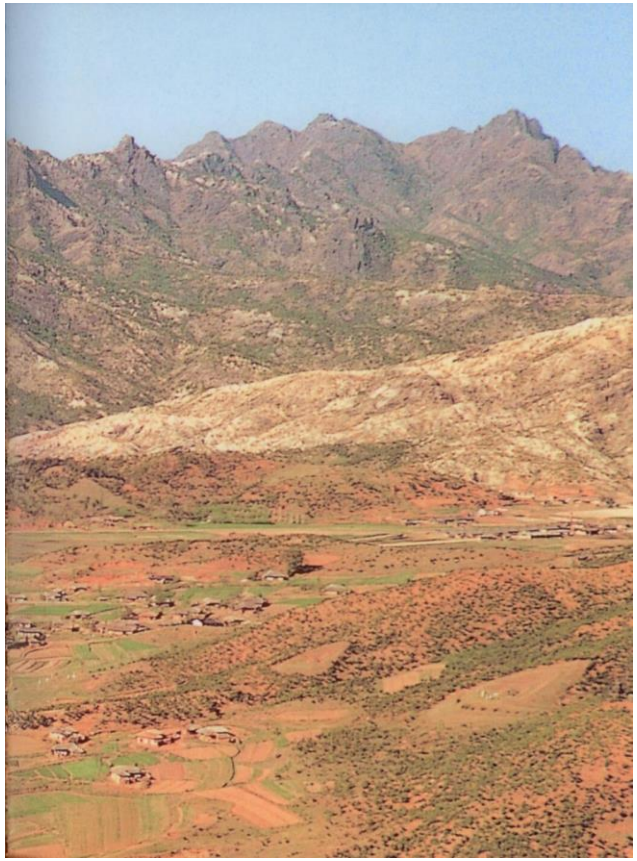
Abstract: Industrial and technological development have contributed significantly to causing environmental crises, such as climate change and land degradation. To address these environmental challenges, nature-based solutions (NBS) have gained increased attention over conventional technical responses. This study derived conceptual linkages from NBS application to resilience promotion, and subsequently, to the achievement of sustainable development goals (SDGs). The study was conducted to reveal that NBS activities are an essential approach that determines the balance between human development and nature conservation. In this paper, we compare four case studies, one domestic reforestation project and three international afforestation projects, all of which had forest-related NBS experiences and were conducted by the Republic of Korea. All four projects were found to have an impact on environmental and socio-economic resilience. These impacts were qualitatively assessed through resilience indicator evaluations. Subsequently, the resilience indicators were matched with the targets of the SDGs. NBS initiatives designed to include various natural and social elements promoted the resilience of ecosystems and society and address a broader spectrum of SDGs. Further efforts to establish region-specific promotional models, identify resilience indicators, and collect scientific data are recommended for quantitatively assessing the NBS initiatives.

Keywords: nature-based solutions; resilience; sustainable development goals; afforestation; reforestation; climate change; desertification; land degradation

1. Introduction

Rapid industrialization has caused a global environmental crisis, which in turn has produced rebound effects by threatening human society. The expansion of arid areas and degraded lands has not only caused an environmental crisis but also brought about social and economic crises that demand immediate solutions to harmonize human development and nature conservation and look further than the conventional technological innovations used to address these issues [1]. The need for fundamental prevention and mitigation of these problems has encouraged us to go beyond technological responses. For instance, desertification can be prevented by creating an ecosystem in arid regions, and such preventive measures eliminate the need for technical solutions. The concept of nature-based solutions (NBS) has emerged in this context. While there are always debates on the issues of the trade-off between NBS and other technical solutions, however, this paper focuses on NBS instead of other solutions to derive the implications of NBS. According to the International Union for Conservation of Nature (IUCN), NBS is described as "actions to

Thank you for your attention



Korea Forestry News 2011.

The current study was supported by the UNDP Seoul Policy Centre.