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Original Article

Feasibility Study for Forest Cooperation Project Between the Republic of Korea and Turkmenistan

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ABSTRACT

Turkmenistan has sparse forested areas, which cover only 8.8% of its entire territory. Increasing climate aridity and anthropogenic desertification hinder the survival and growth of plants. In response, Turkmenistan has carried out several afforestation projects toward sustainable forest management and requested a forest cooperation project with the Republic of Korea, which consists of six detailed projects: (1) afforestation with salt-tolerant species, (2) afforestation with pistachio, (3) building of seedling nurseries, (4) establishing a training center, (5) introducing a forest fire control system, and (6) strengthening the forest research foundation. The purpose of this study was to evaluate the feasibility of the requested project by reviewing relevant documentation. The evaluation criteria—relevance, readiness, and sustainability—were modified from those given by the Development Assistance Committee of Economic Cooperation and Development. All six detailed projects were feasible to proceed since they satisfy all evaluation criteria. However, more concrete strategies are required to secure the sustainability of the last three projects, and further discussions between partner countries may contribute to favorable relationship and more reasonable projects. Consequently, this study will serve as a reference guideline when various countries and international organizations plan forest cooperation with Turkmenistan or other countries under similar conditions.

Keywords: Afforestation, desertification, international forest cooperation, official development assistance, Turkmenistan

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Introduction

Turkmenistan, which became independent from the Soviet Union in 1991, is an official member of the Commonwealth of Independent States (Konończuk, 2007). Turkmenistan is located in the southwestern region of the Central Asia, and the total area of the country is 48.8 million ha (UNECE, 2019b). Due to high ambient temperatures and low mean annual precipitation in Turkmenistan, which varies from 80 mm in deserts to 300–400 mm in mountainous regions, 80% of its land is covered by deserts (GIZ, 2020; Lioubimtseva et al., 2012). Forest area, mostly represented by desert shrubland vegetation, accounts for 8.8% of the territory (FAO, 2020b; Yin et al., 2017). Additionally, the average growing stock is 3.5 $m^3 ha^{-1}$, which is much lower than the global average of 137.1 $m^3 ha^{-1}$ (FAO, 2020a, 2020b).

The desert soil surface is prone to erosion because of scarce vegetation and periodically occurring dust storms (Orlovsky et al., 2005; Saigal, 2003). In addition, excessive irrigation for agricultural activities and desiccation of the nearby Aral Sea have caused the occurrence of saline dust storms and accelerated the soil salinization in Turkmenistan (Annaklycheva, 2002; Lal et al., 2007). For example, the Dashoguz Province, which is located in the northern part of the country, is adjacent to the Aral Sea, and 200–800 kg ha^{-1} of salt dust settles annually (Esenov, 2013; Turkmenistan, 2012a). Under the influence of the soil salinization, desertification is worsened, thereby decreasing the growth rate and productivity of crops and causing the respiratory illness among residents due to saline dust (Micklin, 2007; Saigal, 2003; World Bank Group & Asian Development Bank, 2021). The soil salinization and desertification in Turkmenistan are expected to intensify with increasing temperatures and more frequent droughts under various climate change scenarios (Lioubimtseva et al., 2012; World Bank Group & Asian Development Bank, 2021).

The government of Turkmenistan has devised measures to mitigate climate change by enhancing the sustainability of ecosystems. These measures included the development of a national forest program (Turkmenistan,

2012b). In 2012, the 2013–2020 National Forest Programme of Turkmenistan (NFP) was announced to protect, conserve, and rationally manage the forests (Turkmenistan, 2012a). The main objectives of the NFP are listed in Table 1.

In 2020, Turkmenistan requested a forest official development assistance (ODA) project from the Republic of Korea (ROK). The ROK lost most of its forests immediately after the Korean War in the 1950s. However, it succeeded in restoration through national reforestation projects implemented since 1973, by increasing the growing stock from 8.2 m^3 ha^{-1} in 1954 to 150.0 m^3 ha^{-1} in 2015 (Kim et al., 2019). With accumulated experiences and skills in the forest sector, the ROK has participated in international forest cooperation as a donor country and collaborated with several countries, including Mongolia and Uzbekistan (Islamov & Islamova, 2021; Lee & Ahn, 2016).

The ROK and Turkmenistan have no prior cooperation experience in the forest sector. In addition, Turkmenistan have fewer referable cases of international forest cooperation compared to other Central Asia countries in respect of the variety of cooperation partners and the number of previous cooperation cases (UNECE, 2012, 2019a). Thus, preliminary evaluation is essential to ensure the feasibility of the first forest cooperation project between the two countries.

Generally, feasibility studies are conducted to evaluate the potential of realizing a project and to identify the most successful way of implementing the project in planning phase (Brockhouse & Wadsworth, 2010; McLeod, 2021). The definitions and evaluation criteria of feasibility studies are diverse depending on sectors and purposes of target projects. However, the guidelines for forest sector projects are insufficient (Hopfensperger et al., 2007; JICA, 2012; McLeod, 2021). Hence, novel criteria for the feasibility evaluation of the forest cooperation project were developed in this study using the criteria of the original ODA evaluation guideline from the Development Assistance Committee of Economic Cooperation and Development (OECD/DAC).

According to the project proposal document, the forest ODA project comprises six detailed projects: (1) afforestation with salt-tolerant species, (2) afforestation with pistachio, (3) building of seedling nurseries, (4) establishing a training center, (5) introducing a forest fire control system, and (6) strengthening the foundation of the forest research. However, the project plans have not been fixed, and discussion on the details is ongoing. Therefore, it is noteworthy that this feasibility study represents a qualitative evaluation and focuses on reviewing and analyzing the six detailed projects based on the status, policy, and national goals in the forest sector of Turkmenistan. This study aimed to (1) evaluate the feasibility of the requested forest cooperation based on the novel criteria, which were modified from the ones of OECD/DAC and (2) provide suggestions for the proposed projects, which is in planning phase.

Methods

The study was conducted for 10 months, from February 2021 to December 2021, and proceeded through the following three stages: (1) data collection, (2) evaluation criteria establishment, and (3) evaluation.

Data Collection

The access to national statistical information of Turkmenistan is limited (Timur, 2006). In addition, because of the coronavirus disease 2019 (COVID-19) pandemic, on-site surveys and workshops were not practicable. Therefore, the basis of the evaluation was mainly prepared by reviewing the related literature.

The unpublished NFP report "National programme of Turkmenistan on forestry" was provided from the government of Turkmenistan and served as the primary material for identifying relevance between the requested project and the national forest strategies (Turkmenistan, 2012a). The research reports and literature collection were mostly carried out by the internet search from September 2021 to December 2021. Especially, the research reports from international organizations such as United Nations Economic Commission for Europe (UNECE) and Food and Agriculture Organization (FAO) were obtainable from their online libraries. The collected materials are summarized in Table 2.

Evaluation Criteria Establishment

The OECD/DAC provides evaluation criteria for assessing development assistance projects before, during, or after the execution of cooperation projects (OECD, 2021). For example, Lee and Ahn (2016) conducted mid-term evaluation for the "Greenbelt plantation project in Mongolia" based on the criteria. According to OECD (2021), the six criteria—relevance, coherence, effectiveness, efficiency, impact, and sustainability—can be modified depending on the data availability, resource constraints, and the stage of target project. Therefore, the six criteria were redefined and simplified into three criteria, considering characteristic of the project and current constraints.

First, two criteria—coherence and impact—were incorporated into relevance criterion because they could be assessed by the importance of the project, which was evaluated based on their relations to the NFP and

Table 1.
Main Objectives of the NFP

No.	Objectives
1	Introducing promising technologies to develop a forest management system for the maintenance of national large-scale afforestation projects
2	Afforestation of salinized land affected by the Aral Sea desertification
3	Establishing Awaza national tourism zone by planting trees
4	Planting in desert areas to stabilize soil and prevent desertification
5	Planting forests on agricultural land to improve the quality and quantity of crop yields and protect them from climate change impact
6	Planting ornamental plants to improve the environment and landscape of villages
7	Advancing forest inventory system to sustainably manage and develop forests

Note: NFP = 2013–2020 National Forest Programme of Turkmenistan.
Source: Turkmenistan (2012a).

Table 2.
Summary of Collected Materials

No.	Sources	Main Contents	Data Usage
1	National programme of Turkmenistan on forestry (NFP report)	–Current situation –National forest strategy –Forest code and policy –Ongoing forest R&D or projects	–Examine the relevance of the requested project –Assess capacity for conducting collaborative task –Evaluate project sustainability
2	Research reports from international organizations	–Current forest sector status of Turkmenistan –Previous forest sector projects in Turkmenistan	–Review forestry status of Turkmenistan –Review past cooperative projects in the forest sector
3	Other literature	–General environment of Turkmenistan –Forest sector status of Turkmenistan	–Identify the necessity of afforestation project in Turkmenistan –Review the forest status of Turkmenistan

Note: NFP = 2013–2020 National Forest Programme of Turkmenistan; R&D = research and development.

Sustainable Development Goals (SDGs). Second, readiness criterion was added to assess whether the proposed project will be implemented favorably and cooperatively. Third, effectiveness criterion, which is to evaluate the extent to which a project attains objectives sustainably, was integrated into sustainability criterion (OECD, 2021). Last, efficiency criterion, which represents economic feasibility, was excluded because data for the evaluation were not available. The modified evaluation criteria are listed in Table 3.

Evaluation

A three-point rating system was introduced to evaluate the feasibility of each detailed project. All criteria include three respective indicators (Table 3). Based on the collected data and materials, each criterion was rated up to three points according to the number of satisfied indicators (1 = low, 2 = middle, 3 = high). When two or more indicators were satisfied, the criterion was rated three points. When one or no indicator was satisfied, the criterion was rated two points or one point, respectively. The combined points of the three criteria are the total points for each project. The project was determined feasible when the total points were six or higher, and simultaneously all three criteria were rated two points or higher .

Results

Project 1: Afforestation with Salt-Tolerant Species

This project aims to plant drought- and salt-tolerant tree species in the Dashoguz Province to alleviate the damage caused by the salt dust and sand deposition, especially from the dried Aral Sea. The candidate species are saxaul (*Haloxylon* spp.), kandym (*Calligonum* spp.), and cherkez (*Salsola* spp.), all of which grow naturally in deserts of Turkmenistan owing to their both halophytic and xerophytic characteristics. This project directly corresponds to the second and fourth objectives of the NFP (Table 1). Additionally, SDG 13 (Climate Action) and SDG 15 (Life on Land) would be achieved through this project (Sachs et al., 2021). Therefore, the project satisfied all indicators of relevance, which corresponds with three points (Table 5).

With respect to readiness and sustainability, Turkmenistan has been executing afforestation projects domestically or with international institutions for over a decade. Continuous international afforestation projects with Turkey, Germany, and the United Nations Development Programme (UNDP) indicate strong willingness of cooperation and accumulated capacity of related organizations for carrying out the project (GIZ, 2020; UNECE, 2019b). The planned project site is near Uzbekistan, which has carried out afforestation projects in the desiccated Aral Sea basin for over 20 years and utilized black saxaul (*Haloxylon aphyllum*) as one of the main species for semi-desert and desert afforestation (Botman, 2009). The procurement of seedlings from the neighboring country contributes to efficient afforestation and sustainable management of the project site after completion (Choi et al., 2020). Hence, readiness and sustainability were rated three points (Table 5).

Project 2: Afforestation with Pistachio

This project aims to improve the socioeconomic conditions of local population by planting nut-bearing tree species. It is reported that 75,000 ha of pistachio (*Pistacia vera*) forest exists in the Ahal Province, where the planned site for the project is located (Padulosi & Hadj-Hassan, 1998). Turkmenistan has commonly utilized pistachio as

Table 3.
Modified Evaluation Criteria for the ROK and Turkmenistan Forest Cooperation Project

OECD/DAC Evaluation Criteria	Modified Evaluation Criteria	Evaluation Indicators
Relevance Coherence	Relevance	–Relevance with the current forest status –Connection with the NFP –Connectivity with SDGs
Impact Effectiveness	Readiness	–Presence of related organizations –Experiences of implementing similar projects –Willingness to cooperate
Sustainability Efficiency	Sustainability	–Capacity of related organizations –Willingness of local community to participate –Further cooperation possibility with third party

Note: NFP = 2013–2020 National Forest Programme of Turkmenistan; ROK = Republic of Korea; OECD/DAC = Development Assistance Committee of Economic Cooperation and Development; SDGs = Sustainable Development Goals

afforestation tree species, and its nut is one of the most representative nontimber forest products (APFNet, 2018). Additionally, planting pistachio is expected to help stabilize slopes and alleviate land degradation due to their complex root structures (Arpaci et al., 2009). Therefore, this project has scored three points of relevance corresponding with the fourth main objective of the NFP and several SDGs: SDG 2 (Rural Development), SDG 8 (Decent Work and Economic Growth), SDG 13, and SDG 15 (Tables 1 and 5).

Based on the NFP, local government agencies are obligated to plant 1.5 million trees per year and should ensure that 20% of the planted trees consist of nut- or fruit-bearing trees. Additionally, the government of Turkmenistan planned to grow seedlings of ten main species for afforestation projects between 2013 to 2020, and pistachio accounted for 15% of the total amounts (Turkmenistan, 2012a). The Ministry of Protection of Nature in Turkmenistan cooperated with the Turkish International Cooperation and Development Agency (TIKA) for imporving the capacity of growing pistachio (Arpaci et al., 2009). Even though, similar afforestation cases have not been identified, the NFP and related efforts indicate the willingness of utilizing pistachio. Thus, readiness was rated three points as two indicators were satisfied (Table 5). The overall continuum of pistachio nursery management, seedling planting, cultivation, harvest, and utilization can generate local income and is expected to promote active participation of the locals. Pistachio is one of the most prominent species for afforestation in Central Asia, which increases the possibility of further cooperation (Choi et al., 2020; UNECE, 2019a). Hence, sustainability was rated three points (Table 5).

Project 3: Building of Seedling Nurseries

The third project is proposed to establish greenhouses and seedling nurseries equipped with the modern technologies to advance seedling production capacities (APFNet, 2018). This project is essential for producing high-quality seedlings and for meeting the required quantity of seedlings for afforestation. By planting seedlings, which were grown in nurseries near the afforestation sites, the growth and survival rates of the seedlings are expected to advance because the seedlings can better adapt to the microclimate and other environmental factors of the sites. Turkmenistan is willing to conduct joint projects to broaden vegetated territories and portfolio of candidate species in nurseries (Turkmenistan, 2012a). This project contributes to the achievement of the first, second, and fourth main objectives of the NFP and has connection with the SDG 8, 13, and 15 by supporting the two afforestation projects (Table 1). Thus, relevance was rated three points (Table 5).

The Turkmenistan government has strived to secure seedlings to carry out the NFP and develop high-end technology of growing seedlings for plantation. For example, seedlings of another common species in Turkmenistan, juniper (*Juniperus turcomanica* and *J. zeravschanica*), were grown in the containers to guarantee higher survival rate and growth compared with bare-root seedlings (Turkmenistan, 2012a). Moreover, through the international project "Improving the pistachio growing in Turkmenistan and Uzbekistan," Turkish International Cooperation and Development Agency (TIKA) shared skills regarding seedling production and orchard management (Arpaci et al., 2009). Creating jobs to manage nurseries is a means to encourage active participation of local villagers, and the site proximity to Uzbekistan and Kazakhstan may promote the exchange of skills and experiences for the seedling production and nursery management (Choi et al., 2020). For these reasons, both readiness and sustainability were rated three points (Table 5).

Project 4: Establishing a Training Center

This project aims to build an educational facility and scientific research center of the forest sector to train the local workforce and foster professionals. The majority of forest sector professionals are educated at the Turkmen Agricultural University, and short-term professional training and courses are also offered (APFNet, 2018). However, the employment index of the forest sector, which is represented as full-time equivalent per 1000 ha, is only 0.3 (UNECE, 2019a). This value is significantly lower compared to other Central Asian countries (Tajikistan, 4.9; Kazakhstan, 3.3; Uzbekistan, 3.1; and Kyrgyzstan, 2.3) (UNECE, 2019b). Professional knowledge and skills are essential to sustainably address the main objectives of the NFP, and the government of Turkmenistan (2012a) has emphasized the importance of training specialists and improving forest management systems. Additionally, this project has the potential to achieve the SDG 2, 4 (Education), 8, and 15. Thus, both relevance and readiness were rated three points (Table 5).

Through this project, both local villagers and forest specialists will be trained to acquire skills in growing seedlings, grafting, and pollination, which could promote active participation of local community. However, the overall forest sector workforce in Turkmenistan is insufficient, jeopardizing the capacity of related organizations to maintain the educational center (UNECE, 2012). Therefore, sustainability of this project satisfies only the second indicator and was rated two points (Table 5).

Project 5: Introducing a Forest Fire Control System

This project aims to establish pilot systems for managing and monitoring forest fires in the pistachio afforestation site, Ahal Province, which is one of the regions particularly vulnerable to fire (Yin et al., 2021). In Turkmenistan, forest fires occur mainly due to anthropogenic factors in combination with extremely hot and dry weather (APFNet, 2018). As forest fire outbreaks are positively related to air temperature and dryness, the frequency and intensity of forest fires have presumably been increasing with climate change (Zong et al., 2020). In a similar vein, the forest area affected by fires in Turkmenistan showed an increasing trend from 20 to 100 ha from 2006 to 2010 (FAO, 2020b).

Increasing forest fires are considered one of the major threats to the forest sector of Turkmenistan (UNECE, 2019b). Forest fires devastate natural forests and plantations, and the related organization—Committee on Environment Protection and Land Resources of Turkmenistan—aims to take urgent actions to prevent fires (APFNet, 2018). Additionally, establishing a firefighting system is required to guarantee the sustainability of afforestation projects. This project contributes to achieving the SDG 13 and SDG 15. Accordingly, both relevance and readiness were rated three points (Table 5). In respect of sustainability, further cooperation with third party was determined as possible based on the increasing interests toward forest fire management in Central Asia and outbreak of forest fires in Turkmenistan (FAO, 2020b; Yin et al., 2021). However, infrastructure related to information and communication technology is insufficient in Turkmenistan; therefore, sustainability was rated two points (Table 5).

Project 6: Strengthening the Forest Research Foundation

This project aims to secure the sustainability of afforestation projects and strengthen the professionality of the forest sector by developing inventory system and research and development programs. The latest forest inventory investigation was conducted in 1988–1989, and the government of Turkmenistan recognized the need to renew basic forest inventory data and introduce advanced forest management skills (APFNet, 2018). This project corresponds to SDG 13 and contributes to achieving another objective of the NFP, which is "advancing forest

Table 4.
List of Research Topics Planned for the NFP

No.	Research Topics	Cooperating Institutions	Period
1	Planting fruit-bearing trees and desert plants along the drainage channels of Lake Ashgabat	Turkmen Agriculture University	2013–2015
2	Cultivating salt-tolerant plants to restore pasture and enhance feed resources	Scientific Research Institute on Livestock and Veterinary	2013–2015
3	Developing methods to control rodents and other pests of forest and desert plants	–	2014–2016
4	Developing technologies to prepare and grow juniper seedlings	–	2014–2017

Note: NFP = 2013–2020 National Forest Programme of Turkmenistan.
Source: Turkmenistan (2012a).

inventory system in order to sustainably manage and develop forest"; therefore, relevance is rated three points (Table 5).

In terms of readiness, the presence of forest research organization such as National Institute of Deserts, Flora and Fauna (NIDFF) under the Ministry of Agriculture and Environment Protection of Turkmenistan was identified. In addition, Turkmenistan committed to reducing greenhouse gas emissions at the United Nations Framework Convention on Climate Change meeting, which was considered as strong willingness of the government to develop the forest inventory system for estimating carbon dynamics. In terms of sustainability, several research activities by NIDFF were planned under the NFP, though the capacity of related organization could not be assessed owing to the absence of actual performances or results (Table 4). Further cooperation with third party could be realized by referring prior cases of research projects conducted by international scientific institution such as Center for International Forestry Research (Kanowski, 2020). As a result, readiness and sustainability were rated three and two points, respectively (Table 5).

The results of the three-point rating show that all detailed projects were rated least two points across all criteria, which indicates that all of them were evaluated as feasible (Table 5). In terms of relevance and readiness, all of the detailed projects were given three points, which indicates that they are highly relevant to the forest status and are coherent with the NFP or global agenda (SDGs). On the other hand, sustainability of the last three projects were rated two points, which, in turn, differentiated their total points from the ones of other projects. Considering the total points, three projects, including salt-tolerant species and pistachio afforestation and building of seedling nurseries, are considered more feasible projects than the other three projects: establishing a training center, introducing a forest fire control system, and strengthening the forest sector capability (Table 5).

Discussion

One of the purposes of the feasibility study was to improve the results of the projects by examining their inherent limitations during the planning phase. This can be supplemented in two ways. First, all detailed projects should be implemented with the integrative approach to support each other. Three detailed projects, which were rated nine points in total, can provide tangible outcomes—the number of newly produced or planted seedlings—in short period. On the other hand, other projects were difficult to bring the outcome in the early phase and could be easily neglected. However, those projects are essential to ensure the sustainability of afforestation or nursery management and the self-reliant development of the recipient country. For example, SDG target 17.9 (Enhancing International Support for Capacity Building) emphasizes the importance of establishing knowledge and technical foundations

Table 5.
Rating Result of the Detailed Projects

Evaluation Criteria	Evaluation Indicators	Project 1	Project 2	Project 3	Project 4	Project 5	Project 6
Relevance	–Relevance with the current forest status	○	○	○	○	○	○
	–Connection with the NFP	○	○	○	○		○
	–Connectivity with SDGs	○	○	○	○	○	○
Readiness	–Presence of related organizations	○	○		○	○	○
	–Experiences of implementing similar projects	○		○			
	–Willingness to cooperate	○	○	○	○	○	○
Sustainability	–Capacity of related organizations	○					
	–Willingness of local community to participate		○	○	○		
	–Further cooperation possibility with the third party	○	○	○		○	○
	Total points	9	9	9	8	8	8

to achieve long-term sustainability of the project (Bloomfield et al., 2018; Gabay & Ilcan, 2017; Hacker et al., 2012). Therefore, sustainability of the project can be improved by developing the synergetic strategies between two sorts of the detailed projects.

Second, building links between ODA donor and recipient countries is of paramount importance for achieving the project goals. The feasibility evaluation of the project proposal through this study was constrained by the COVID-19 pandemic restrictions, the lack of communication with the government during the evaluation period, and limited access to the information. Thus, the willingness to implement the proposed project could not be ensured. Efforts to strengthen international relationships and improve communication are required such as through official online or offline forums and academic exchange programs. Last, further cooperation with the forest sector in neighboring Uzbekistan and Kazakhstan is encouraged, considering the shared history of development, similarities in ecological settings, and their experience of previous forest cooperation projects conducted with the ROK (Choi et al., 2020; OECD, 2019; UNDP, 2009).

Conclusion and Recommendations

This feasibility study was carried out through the literature review applying the novel criteria, which were modified from the internationally recognized evaluation criteria, to provide guidelines for the comprehensive evaluation. As a result, the necessity of sustainably managing forests and the importance of the forest cooperation project in Turkmenistan were demonstrated according to the national priority and the global agenda. This study is expected to serve as a referable case study, which can be utilized when various countries and organization plan forest cooperation projects in Turkmenistan and other countries that require advancement in the forest sector. Meanwhile, the evaluation system of the study was simplified and confined to the qualitative criteria due to the difficulties of collecting sufficient data, therefore, further research should devise evaluation systems for the forest-related projects based on more quantitative evaluation criteria.

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