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INITIATIVE "DONSATI PROGRAM" OF TECHNOLOGY AND INNOVATION FOR REFORESTATION AND UTILIZATION OF DEGRADED FORESTS IN MONGOLIA

ABSTRACT. *In this study, we presented the results of a comprehensive technology and innovation program to rehabilitate degraded forests and put dead trees into economic circulation, and to study its scientific basis, feasibility, management, and methodological basis. The main factors contributing to Mongolia's forest degradation are forest fires, pest infestations, unsustainable logging, and tree aging. As of 2020, 13% or 1.8 million hectares of forest area in Mongolia have been degraded. The degraded forests have 44.2 million cubic meters of standing dead trees, 20.0 million cubic meters of fallen dead trees, and a total of 64.2 million cubic meters of dead trees resources that need to be removed. The dead trees of the forests create conditions for forest fires and pests and become a too big problem to forest natural regeneration and plantation. The concept of dead natural trees refers to fallen and standing dead trees that have stopped growing due to forest fire, defoliating insects, disease, aging, strong wind, and snowfall. At "DONSATI program" initiative, we are proposing the development of technologies and innovations for the deep processing of dead trees by industrial methods and the production of new technological materials and products. As a result, it will not only have social and economic benefits,*

such as job creation and support for small and medium-sized forest enterprises in rural areas but will also make a real contribution to increasing the competitiveness of the forestry sector. Deforestation and deforestation are ecologically important to reduce the risk of forest fires, their spread, pest infestation, and outbreaks, as well as to protect, rehabilitate, and improve forest resources.
Keywords: *Dead trees, forest degradation, standing dead tree, falling dead tree, advanced technology, innovation, new material*

INTRODUCTION

The total forest area of Mongolia is 18,454.4 thousand hectares or 11.8% of the territory, and the total forest stock of Mongolia is 1,316.3 million m3, respectively [1]. The total forest area is divided into two protected and industrial (utilization) forest areas. Potentially available for wood production is an area of approximately 9.7 million hectares of natural forests, out of which 2.7 million ha (19.5% of total) can be classified as "utilization area" (all measures possible) and 7.0 million ha as "protected area" (only silvicultural activities possible) [2]. The forests provide Mongolians with resources such as lumber and fuelwood as well as ecosystem services such as water purification and retention, soil sediment protection, and biodiversity [3]. These factors indicate that the forestry sector is an independent, ecologically, socially, and economically important sector.

As a result of multipurpose national forest inventory, Mongolian forests have been aging. An assessment, also within the framework of the NFI, concluded that most forests are over-aged (76.4%). On the other hand, the statistic indicates that 21.3% of the forest area is over 200 years of age, 64.7% is between 50 and 200 years old, and the remaining 14% is below 50 years of age [4]. The aged trees are weak and increasing risk of forest fires and pest infestation. On the other hand, the main factors contributing to forest degradation are forest fire, unsustainable logging, and damage from pest outbreaks. In recent years, 13% or 1.8 million hectares of Mongolia's forest area have been degraded due to the main factors. [1]. Forest fires reduce the viability of trees, increase the risk of disease transmission, and create a favorable environment for pests to live and spread. Logging is one of the important parts of sustainable forest management, but sustainable logging and thinning are currently inadequate in Mongolia. Most logging practices in Mongolia are unsustainable and consequently lead to long-term forest degradation. Logging companies do not follow best practices for sustainable forest management and reduced impact logging is not practiced. Continued degradation is the most common reason for deforestation [5]. The long-term compounded effect of the several above factors of forest degradation leads to deforestation. Several studies have confirmed the deterioration of the

quality of forests since the 1990s, with the rapid progression of forest degradation [6, 7].

As of 2020, 13% or 1.8 million hectares of forest area in Mongolia have been degraded (Table 1). The degraded forests have 44.2 million cubic meters of standing dead trees, 20.0 million cubic meters of fallen dead trees, and a total of 64.2 million cubic meters of dead trees resources that need to be removed. The dead trees of the forests create conditions for forest fires and pests and become a too big problem to forest natural regeneration and plantation.

Table 1. Degraded forest area

Provenance	Degraded forest area (ha)				%
	Degraded by forest fire	Degraded by unsustainable logging	Degraded by insect	Total	
Khentii	391152	3411	2638	397201	22.6
Khuvsgul	352659	11333	30670	394662	9.8
Selenge	226260	31717	331	258308	13.3
Bulgan	212214	26244	20625	259083	13.5
Tuv	148517	7048	5645	161210	11.6
Zavkhan	133102	10522	1148	144772	19.7
Dornod	114864	1461	-	116325	47.7
Arkhangai	61518	24102	27902	113522	10.7
Uvurkhangai	1698	4587	6748	13033	7.4
Ulaanbaatar	959	5756	3685	10400	8.9
Uvs	2042	1971	26	4039	1.7
Darkhan-Uul	716	301	15	1032	1.3
Orkhon	161	478	78	717	3.9
Bayankhongor	327	-	-	327	1.0
Bayan-Ulgii	96	125	-	221	0.2
Total	1646285	129056	99511	1874852	13.5

Damaged and dead trees of the degraded forests are a valuable resource in Mongolia, and their harvest and use must be promoted to prevent the negative effects by forest pests and pests. Therefore, in 2014, the Government of Mongolia approved and started implementing the “Forest Cleaning” program. According to provision 3.1.15 of the Mongolian Law on Forest such ‘Forest Cleaning’ consists of the removal of dead trees, fallen twigs, and trees that have died due to forest fire, defoliating insects, disease, strong wind, and snowfall. In an international context, salvage cutting is usually understood to remove dead or severely damaged trees to recover the economic value that would otherwise be lost (redd). Harvesting of dead trees is more active than of living trees in Mongolia. An ongoing governmental program for forest cleaning targets covering 315,000 ha and 1.4m m3 of timber and fuelwood every year until 2020, primarily in the forest-rich

provinces [1]. Recently, several researchers have tried to clarify the wood properties of living trees naturally grown in Mongolia [8, 9]. However, studies on the use of dead trees for industrial purposes are very limited, and it is used only for fuelwood purposes. On the other hand, Mongolia's forestry sector needs a broad development program to promote the sustainable management of its forests such as the Rehabilitation of degraded forests and the use of dead trees.

The purpose of this study is to help achieve sustainable forest management of living trees by effectively utilizing currently accumulated dead trees. introduce effective management of scientific and industrial cooperation to rehabilitate degraded forests, dead trees of degraded forests put into economic circulation, and create innovative activities to ensure the development of technologies to produce import-substituting products and new materials. Deep processing of dead trees and production of new materials and products will have social and economic benefits, such as job creation and support for small and medium enterprises in rural areas, as well as a real contribution to increasing the competitiveness of the sector.

MATERIALS

Resources of dead trees

Dead tree (deadwood) was defined in the multipurpose national forest inventory as all non-living woody biomass including fallen dead trees on the ground (fallen parts of, or whole, trees lying on the ground and stumps) (Figure 1) and standing dead trees that larger than or equal to 5 cm in diameter (Figure 2).

Figure 1. Fallen dead trees

Figure 2. Standing dead trees

In the Mongolian boreal forest exist on average 46.5 m^3 of dead trees per ha, of which 18.7 m^3/ha (40%) are standing dead trees, 25.8 m^3/ha (56%) are fallen dead trees, and 2.0 m^3/ha (4%) are stumps (Table 2). Most of the standing dead trees volume is found in the larger diameter of a tree, >30 cm, with an average of 10 m^3/ha (Table 3) (MNFI 2016).

Table 2. Dead trees volume (m^3/ha)

Types of dead trees	Volume (m^3/ha)	Percentage (%)
Standing dead trees	18.7	40
Fallen dead trees	25.8	56
Stumps	2.0	4
Total	46.5	100

Table 3. Standing dead trees volume (m^3/ha)

Class of tree diameter (cm)	Steam volume (m^3/ha)
6 to15	2.5
15 to 30	6.2
30 < above	10.0
Total	18.7

Siberian Larch (*Larix sibirica*) represented most of the standing dead trees volume, with an average of 15.4 m3/ha of the total 18.7 m3 dead trees per hectare. According to official data, an average of 729,000 m3 of trees was harvesting annually between 2011 and 2020 in Mongolia. From the total, 9.1% were harvested from industrial harvest cutting, 4.6% from thinning 86.3% from forest cleaning and sanitation cutting. In addition, 18.8% of the total harvest is used for industrial purposes and the remaining 81.2% is used for fuelwood [4]. Therefore, we are purposing the “DONSATI Program” initiative to develop technologies and innovations for the rehabilitation and

use of the degraded forest by making full use of dead trees from degraded forests and increasing its economic efficiency.

PURPOSE AND OBJECTIVES OF THE "DONSATI program" INITIATIVE

The purpose of this program is to rehabilitate degraded forests, dead trees of the degraded forests put into economic circulation, ensure the development of technologies to produce import-substituting products and new materials, and establish effective management of scientific and industrial cooperation to create innovation activities.
The purpose of the "DONSATI Program" initiative will be implemented within the following objectives. These include:

- Development of technologies and innovations for rehabilitation of degraded forest;
- To determine the level of quality of dead trees and develop technology and innovation for the production of value-added products and materials;
- Researchers and researchers in the field of forestry and timber shall cooperate in the technology and innovation activities of rehabilitating degraded forests and putting deciduous trees into economic circulation, transforming new knowledge and intellectual creations into consumer products and resources, and sharing research laboratories and material resources;
- The mutually beneficial and creative collaboration of stakeholders (policymakers, local governments, researchers, producers, forestry organizations, forest communities, professional associations, non-governmental organizations, local people, and consumers) in the technology and innovation activities of the "DONSATI Program" initiative to intensify operations, introduce green and advanced technologies, and establish effective cooperation for the development of cluster systems

MAIN ACTIVITIES OF THE "DONSATI PROGRAM" INITIATIVE

1. Technology development and establish a plantation of larch forest for industrial purpose in degraded forest areas;
2. Fundamental research to determine the technological characteristics and degradation rate of dead trees;

3. Technology and innovative development, and study to produce dead trees for deep processing and production of forest bio-products (biochar, biofuels, wood alcohol, etc.);
4. Development of technology for deep processing of dead trees and production of new materials for furniture;
5. Development of technology for deep processing of dead trees to produce new construction materials;
6. Semi-automated slice production technology testing and refinement;
7. Development of technology for heat and power generation using forest biomass and dead trees;
8. Other forest production technology development projects that stakeholders consider necessary

The implementation of the "DONSATI program" will have the following impact on the environment, social and economic development. These include:

Environmental impact:

- Contribute to the improvement of Mongolia's forest ecology.
- An innovation cluster system with environmentally friendly technologies and equipment will be created
- The use of green technology in the forestry and wood industry sector will increase
- Eco-production, product range, and quantity will increase.

Impact on social development:

- The competitiveness of the forestry and wood industry sector will increase.
- With the support of customs, tax, and credit policies related to the introduction of innovations in the forestry sector, the quality, and accessibility of innovative products, services and products will increase.
- The development of advanced technologies will create new opportunities for the forest-based economy, increase employment in the sector, and make small and medium-sized forest enterprises one of the areas of rural development.
- The economy and investment will improve, new jobs will be created, the income of forest-dependent people will increase, and their livelihoods will improve.

Impact on economic development:

- Increasing the quality, availability, and variety of products and products in the forestry sector will increase economic capacity and efficiency.
- Public and private investment in the forestry sector will increase.
- The cooperation and capacity of universities and research institutes in the sector will be enhanced.
- Conditions will be created for the introduction and introduction of highly efficient advanced green technologies in the forestry sector.

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Ti- и Zr- СОДЕРЖАЩИЕ КОНВЕРСИОННЫЕ ПОКРЫТИЯ НА ОЦИНКОВАННОЙ СТАЛИ С ПРОПИТКОЙ ВОДОРАСТВОРИМЫМ ПОЛИМЕРНЫМ СОСТАВОМ

Аннотация. *Работа посвящена проблеме формирования бесхромовых конверсионных покрытий на оцинкованной стали. Исследовано влияние дополнительной обработки конверсионных покрытий полимерным «силером» на защитно-декоративные свойства покрытий.*

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TI- AND ZR- CONTAINING CONVERSION COATINGS ON GALVANIZED STEEL IMPREGNATED WITH WATER-SOLUBLE POLYMER COMPOSITION

Abstract. *The work is devoted to the problem of the formation of chromium-free conversion coatings on galvanized steel. The effect of additional processing of conversion coatings with a polymer "sealer" on the protective and decorative properties of coatings has been investigated.*

Цинкование стальных деталей с целью защиты их от коррозии является одним из самых распространённых процессов в гальванотехнике. Устойчивость к коррозии самих покрытий определяет длительность защиты покрываемых изделий от коррозионного разрушения. Для повышения коррозионной стойкости цинковых покрытий их подвергают пассивации, в результате которой на поверхности оцинкованной стали формируются конверсионные