



FINAL REPORT

**Activities, results, and outputs of Mendel University
in Brno in the STREAM project**

Mendel University in Brno

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in Brno in the STREAM project**

Prepared by

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May 2024

Project

This report was prepared by experts from Mendel University in Brno as part of the Sustainable Resilient Ecosystem and Agriculture Management in Mongolia (STREAM) project. The STREAM project, co-financed by the European Union and the German Federal Ministry for Economic Cooperation and Development, is being implemented by the Mongolian Ministry of Environment and Tourism with the support of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Food and Agriculture Organization of the United Nations (FAO).



Mendel University in Brno heads a consortium of twelve educational and research institutions that collaborate on the forestry component of the project led by the GIZ.

More information about the project: <https://www.giz.de/en/worldwide/128246.html>

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1 INTRODUCTION

Mendel University in Brno (MENDELU) and the University Consortium joined the STREAM project on January 1, 2022. The main role of the Consortium led by MENDELU was to cover the research, educational and management aspects in forests (European Commission, 2021). MENDELU ensured the design and implementation of site-specific sustainable forest management comprising i) evaluation of environmental and economic aspects of demonstration plots, ii) forest inventory, iii) design and field implementation of site-specific forest management measures, and iv) planting and seasonal inventory of planted trees. The purpose of forest and landscape management interventions was to increase wood quality, economic profitability and forest resilience and stability in different types of habitats.

MENDELU and the University Consortium proposed a research and monitoring system regarding practical sustainable forest management. Against the backdrop of climate change, the data-based sustainable forest management is essential for creating the resilient forests that can face the dramatically changing environment. There is currently a critical lack of environmental data for practical use in Mongolia. The MENDELU and University Consortium scientific team ensures i) long-term climate monitoring, ii) long-term soil moisture and temperature monitoring, iii) soil survey, iv) mycorrhiza survey, v) pedoanthracology survey, vi) botany survey, and vi) insect survey. Results of the research and monitoring are presented in several outputs.

Further, MENDELU and the University Consortium ensured the multilevel educational activities consisting of field training and educational materials preparation. MENDELU cooperates with all the local universities providing environmental education, namely NUM, MULS, Mongolian University of Science and Technology (MUST) and GMIT. University students and academics were an integral part of the project.

For the practice and application sphere, MENDELU ensured i) education and practical field trainings and workshops for local foresters and government officers, ii) damage-free tree climbing training, and iii) a study tour to the Czech Republic. In addition, MENDELU brought and implemented the innovative forest pedagogy approach to forestry and environmental education for children and Mongolian public along with a short guide with newly developed games on forest functions and wooden educational and memory games.

MENDELU and selected consortium members prepared a practical handbook for Mongolian foresters and a “textbook” of forest ecology and practice for university students.

To increase the impact and dissemination of the STREAM project, MENDELU prepared a documentary movie connecting the hot topics of the Mongolian environment with the activities of the STREAM project. In addition, three educational and instructional videos were prepared.

MENDELU's forestry expertise also focused on the functioning of forest nurseries in Mongolia. A report was written on this topic summarizing common shortcomings and errors and presenting possible solutions.

MENDELU experts developed mobile application Forest Marketplace and provided it for pilot testing. The application has the practical economic and educational purpose. It connects supply and demand in the Mongolian forestry sector and provides useful information related to sustainable forestry management.

2 SUMMARY OF MENDELU AND CONSORTIUM ONLINE OUTPUTS

MENDELU with the contribution of the Consortium and the GIZ prepared 15 comprehensive research and educational outputs. The outputs are available at:

<https://forest4mongolia.mendelu.cz/en/outputs>



Report – Sustainable forest management measures realized within the STREAM project

- Authors: Václav Pecina (MENDELU), Aleš Škoda (MENDELU), Martin Smola (MENDELU), Antonín Kusbach (MENDELU), David Juříčka (MENDELU) and Jan Šebesta (MENDELU)

Report – Environmental research, monitoring and evaluation: Results of the STREAM project

- Editors: Václav Pecina (MENDELU) and Antonín Kusbach (MENDELU)
- Authors: David Juříčka (MENDELU), Martin Valtera (MENDELU), Burenjargal Otgonsuren (MULS), Pavel Peška (MENDELU), Jan Novák (CU), Jan Šebesta (MENDELU), Vladimír Hula (MENDELU)

Graphical abstract – Impact of grazing on Mongolian steppe river valley

- Authors: Václav Pecina (MENDELU), David Juříčka (MENDELU) and Martin Valtera (MENDELU)

Graphical abstract – Mountain permafrost degradation

- Authors: David Juříčka (MENDELU), Václav Pecina (MENDELU) and Martina Machalová (MENDELU)

Graphical abstract – Wood-related carbon (C) cycling

- Authors: Jan Parobek (TUZVO), Václav Pecina (MENDELU), Martin Valtera (MENDELU) and Martina Machalová (MENDELU)

Graphical abstract – Root system of seedlings: The key to successful reforestation 1

- Authors: Václav Pecina (MENDELU) and Martina Machalová (MENDELU)

Graphical abstract – Root system of seedlings: The key to successful reforestation 2

- Authors: Václav Pecina (MENDELU) and Martina Machalová (MENDELU)

Book – Sustainable forest management silviculture basics: Forest regeneration, protection and tending in Mongolian light taiga forests

- Authors: Aleš Škoda (MENDELU) and Václav Pecina (MENDELU)

Book – Basics of forest ecology and management: To sustainable forest management in Mongolia

- Editors: Antonín Kusbach (MENDELU) and Václav Pecina (MENDELU)
- Authors: Václav Pecina (MENDELU), Paul C. Rogers (USU), Khishigjargal Mookhor (MULS), Jan Šebesta (MENDELU), František Máliš (TUZVO), Jan Novák (CU), David Juříčka (MENDELU), Martin Valtera (MENDELU), Douglas L. Godbold (MENDELU), Burenjargal Otgonsuren (MULS), Enkhtuya Batkhuu (MENDELU, GMIT), Antonín Kusbach (MENDELU), Pavel Peška (MENDELU), Martin Smola (MENDELU), Aleš Škoda (MENDELU, Czech Forestry Academy Trutnov), Tomáš Zemánek (MENDELU), Petr Lukeš (Global Change Research Institute CAS), Ján Parobek (TUZVO)

Report – Forest nurseries in Mongolia: Recommendations for increasing the quality and quantity of seedling production

- Authors: Aleš Škoda (MENDELU) and Václav Pecina (MENDELU)

Guide – How to implement education on forest functions in Mongolia through experiential pedagogy: A short workshop guide

- Authors: Petra Packová (MENDELU) and Václav Pecina (MENDELU)

Documentary movie – STREAM for the green Mongolian landscape

- Authors: Antonín Kusbach (MENDELU), Václav Pecina (MENDELU), Jan Šebesta (MENDELU) and Ladislav Moulis

Instructional videos

- Authors: Richard Slabý (MENDELU) and Jan Šebesta (MENDELU)

Educational forest games

- Authors: Lesní svět (external company) and Václav Pecina (MENDELU)

Marketplace application

- Authors: Robert Blaha (MENDELU), Václav Pecina (MENDELU) and Jan Šebesta (MENDELU)

3 IMPLEMENTATION OF SUSTAINABLE FOREST MANAGEMENT

Responsible person: Václav Pecina

Description: MENDELU experts prepared the specific design of management measures for each STREAM pilot site (Figure 1, Figure 2, Figure 3, Figure 4, Figure 5, Figure 6, Figure 7, Figure 8). The site-specific design of management measures respects the local natural conditions and economic utilization of local forests. MENDELU together with the Mongolian Universities and GIZ contribution put into practice the management measures in the field between 2022 and 2023. In 2022, a total of 98 forest/landscape management plots were established. These included 16 exclosures with planting or underplanting, 10 plots with soil scarification, partially in combination with planting and individual tree protection (repellent), 12 training thinning plots, 28 thinning and pruning plots, 15 plots with planting, underplanting or natural regeneration with individual protection of seedling (repellent, individual fencing) and 17 reference plots for all types of the management interventions. Composition of management measures is unique for each pilot site. Six new plots (two exclosures, pruning, control to thinning, training thinning and thinning) beyond the original design were realized in the summer of 2023. In total, MENDELU and the consortium with partners designed and implemented 104 forest/landscape management measure plots. Forty-three of them were intended for forest tending (thinning, training thinning and pruning). Tree species for planting were selected for individual sites and plots with regard to their potential for the given habitat and natural occurrence in the area. Planting activities were done according to a precise design allowing periodic evaluation of seedling survival rate and seedling damage rate (Figure 9). The design of planting and seedling numbers were updated after the planting based on the real situation in the field. In 2022, a total of 2,161 seedlings were planted of which there were 538 *Larix sibirica*, 844 *Pinus sylvestris*, 242 *Salix* sp., 212 *Populus* sp., 113 *Hippophae rhamnoides*, 68 *Crataegus sanguinea* and 144 *Ulmus pumila*. In the fall of 2023, repair planting of seedlings (instead of those that died) took place in exclosures, where the seedlings were sufficiently protected from browsing. In addition, two more plots in Javkhlant were established with extensive planting. During the implementation of the project, a total of 3,203 seedlings of 8 woody species were planted according to MENDELU's design.

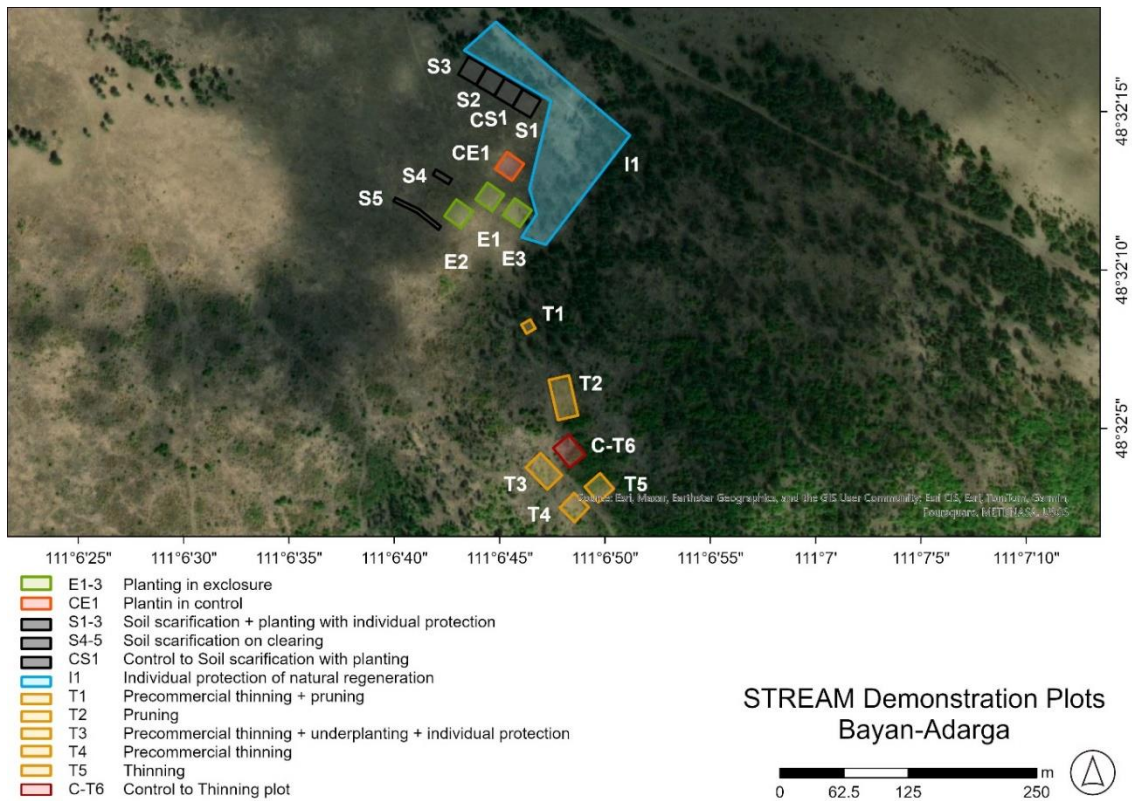


Figure 1. Forest management measures at the Bayan-Adarga pilot site.

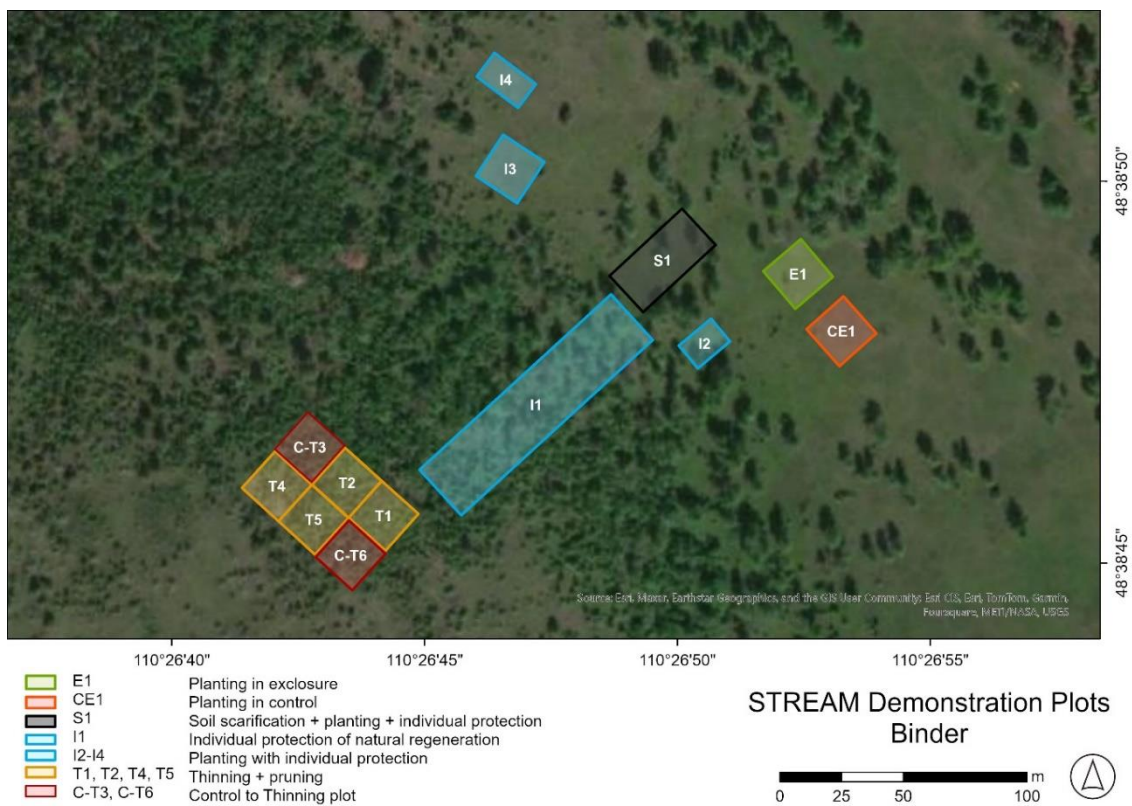


Figure 2. Forest management measures at the Binder pilot site.



Figure 3. Forest management measures at the Binder pilot site (pine corridor).

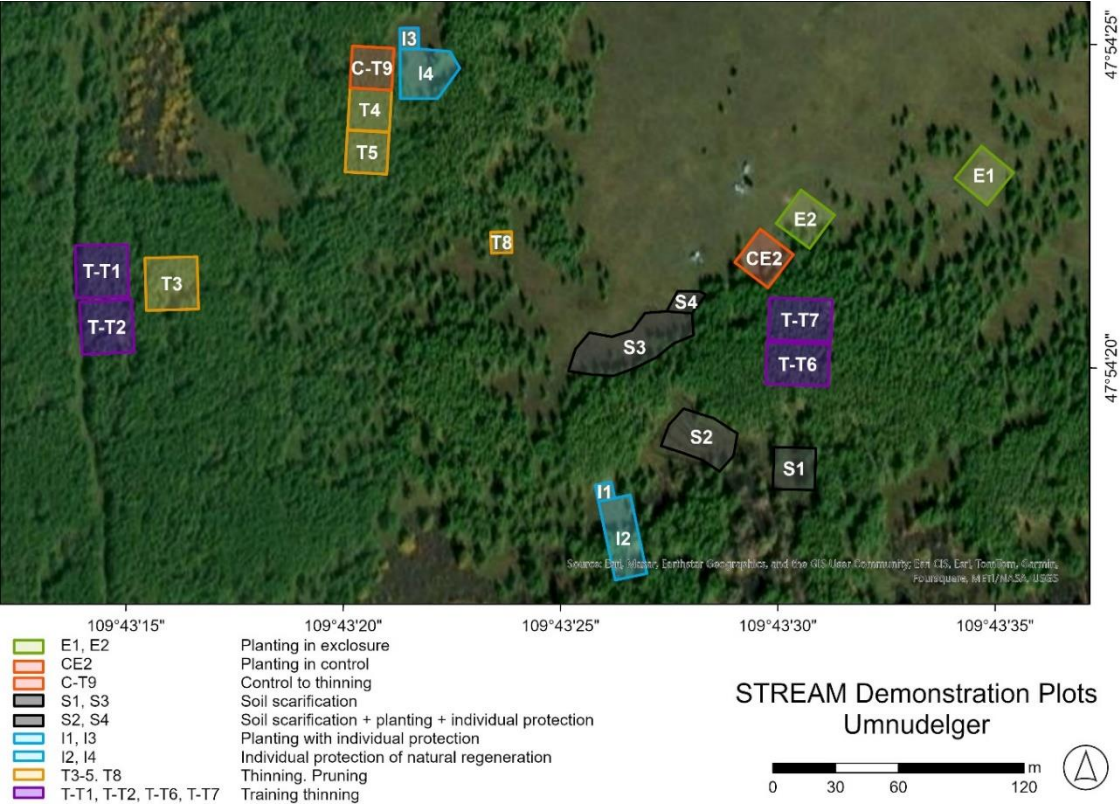


Figure 4. Forest management measures at the Umnudelger pilot site.

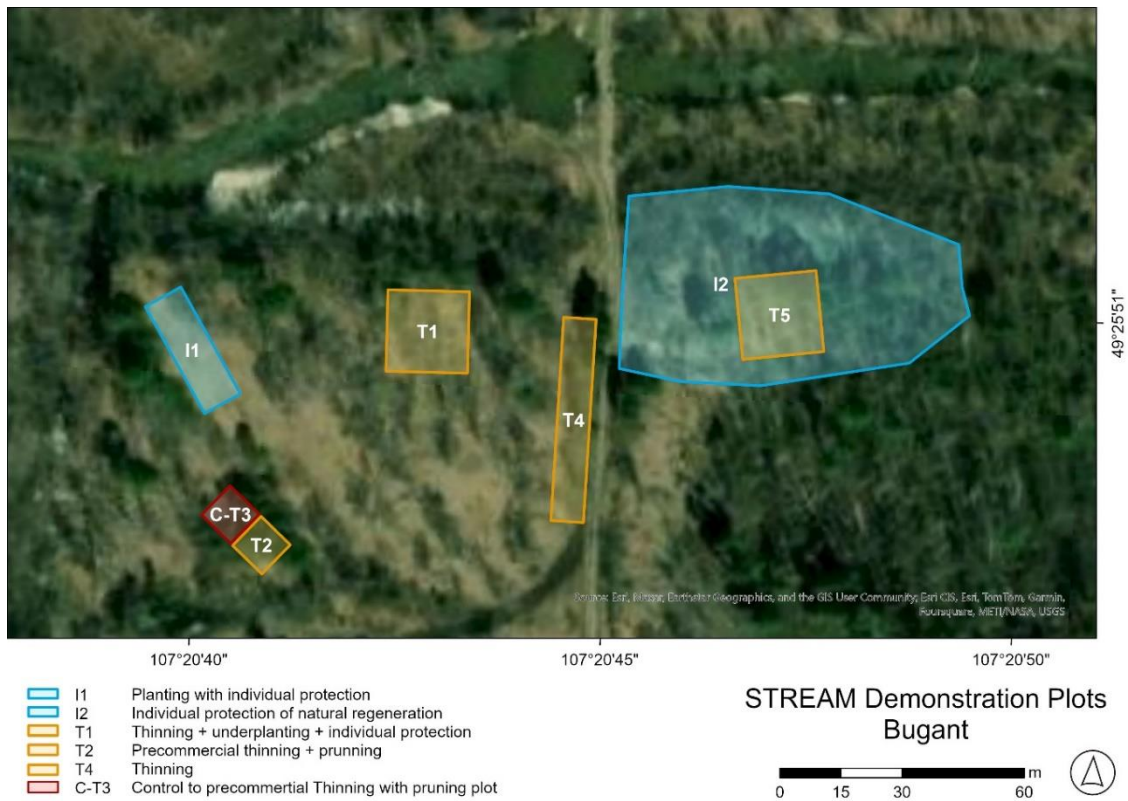


Figure 5. Forest management measures at the Bugant pilot site.

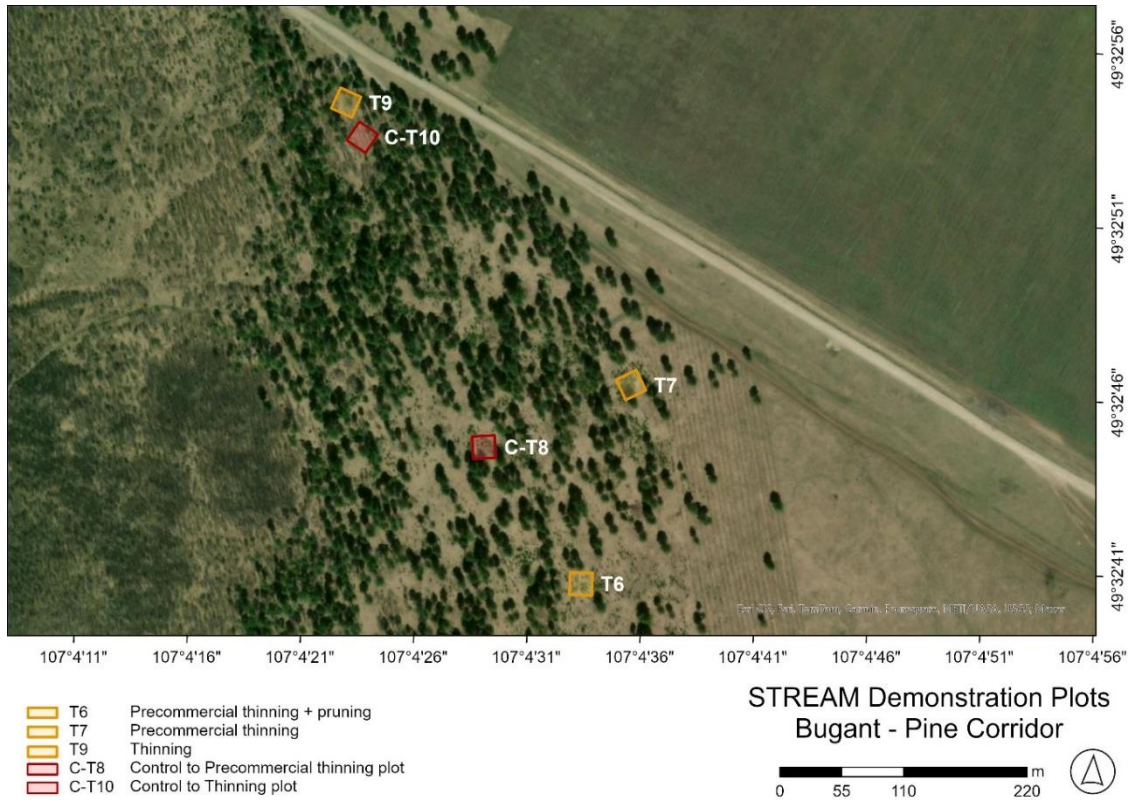


Figure 6. Forest management measures at the Bugant pilot site (pine corridor).

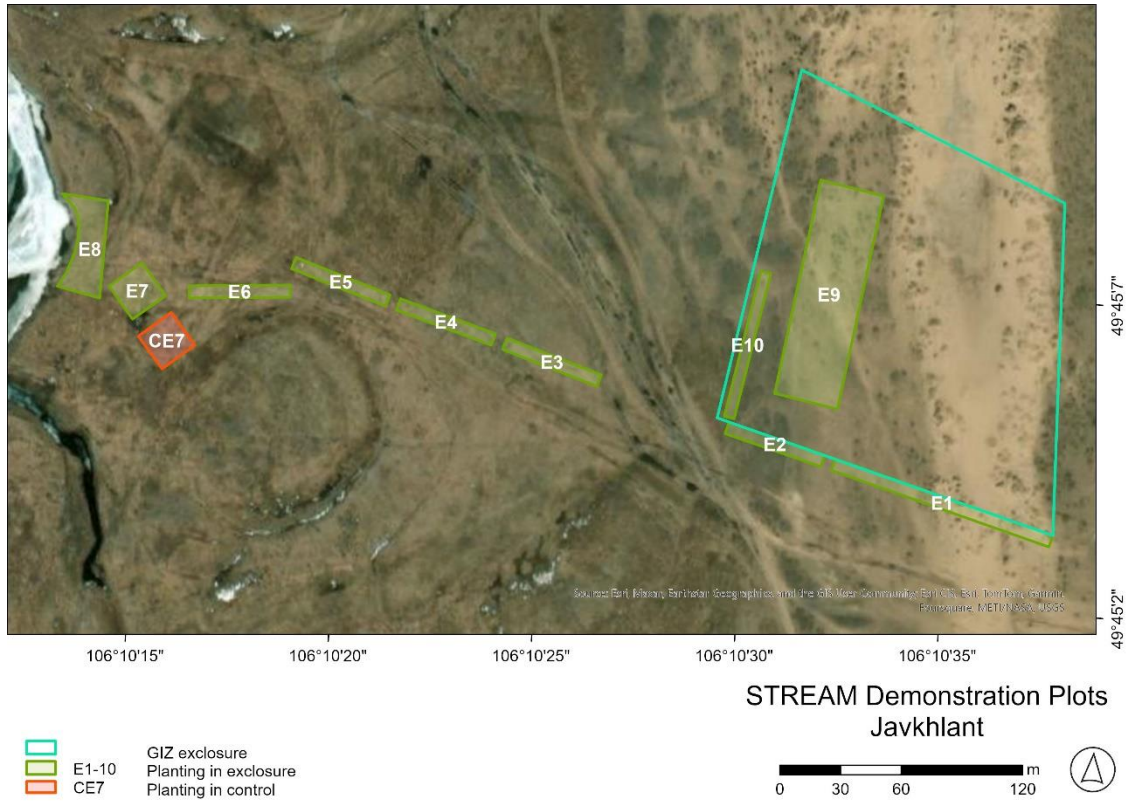


Figure 7. Forest/landscape management measures at the Javkhant pilot site.

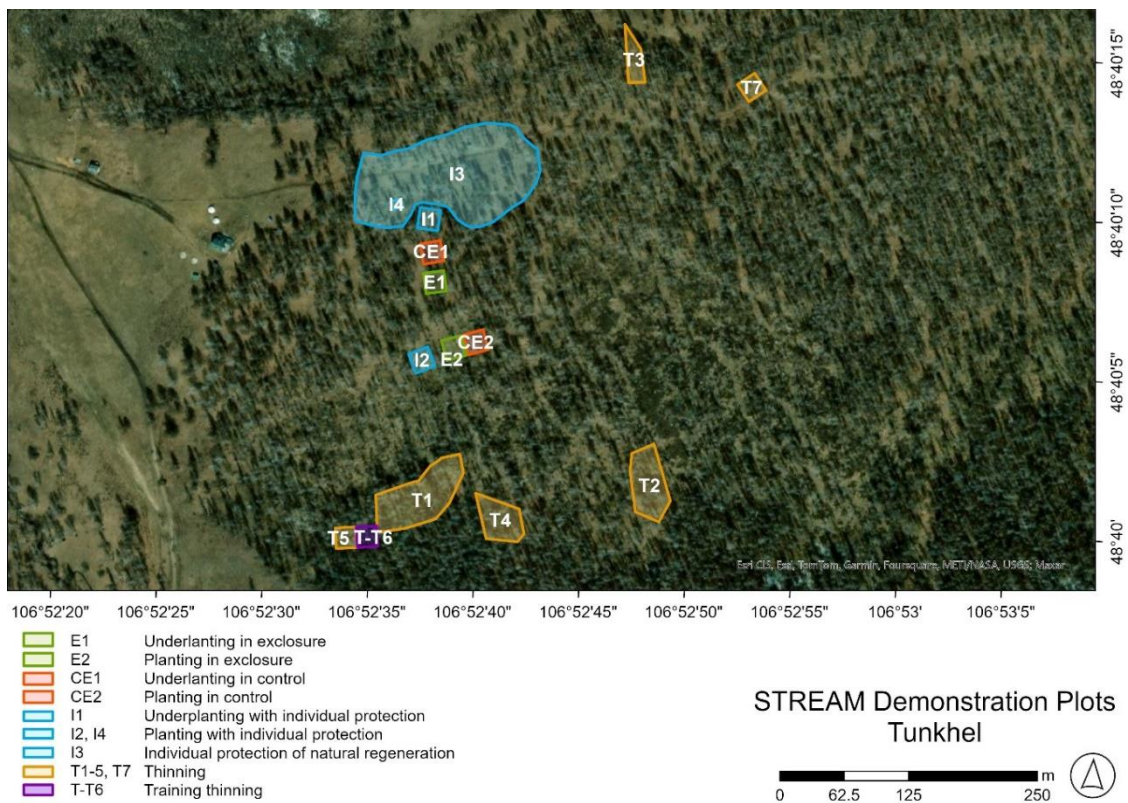


Figure 8. Forest management measures at the Tunkhel pilot site.

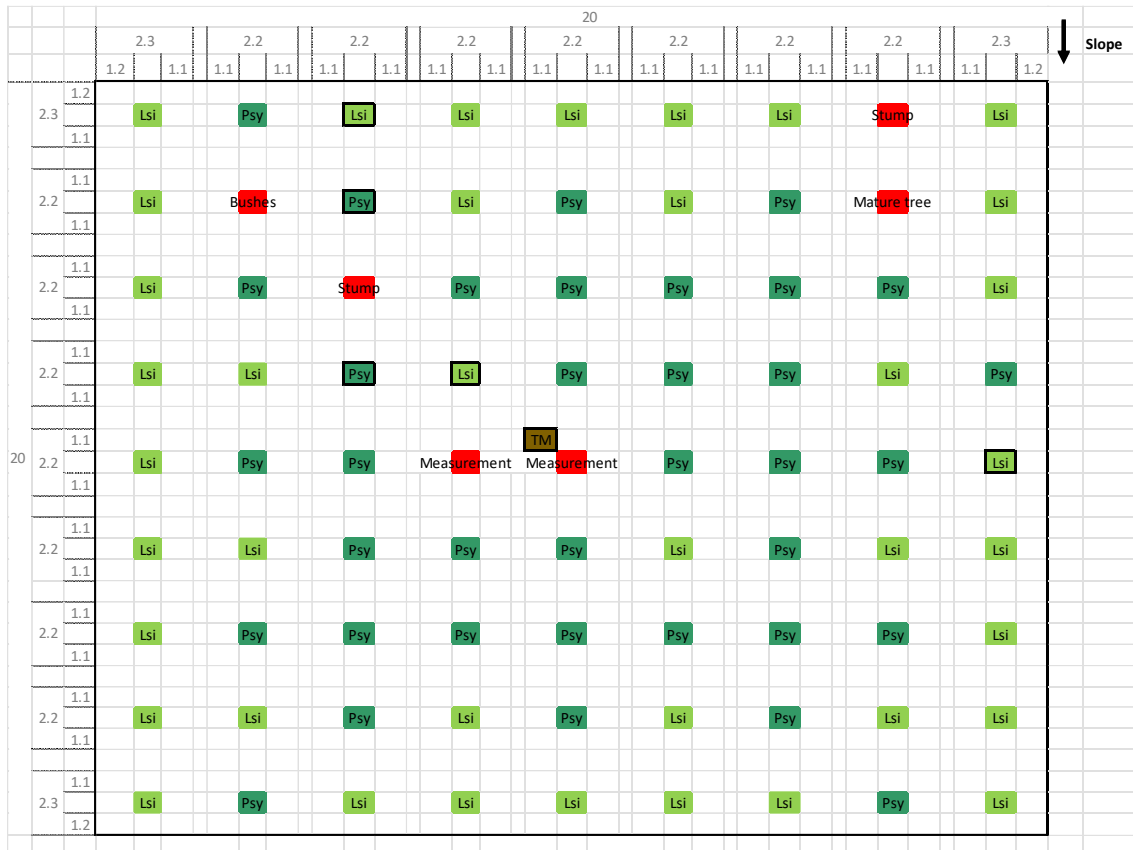


Figure 9. Example: planting design in the control plot (Bi CE1) at the Binder demonstration site.

3.1 Outputs

3.1.1 Sustainable forest management measures realized within the STREAM project

Authors: Václav Pecina, Aleš Škoda, Martin Smola, Antonín Kusbach, David Juříčka and Jan Šebesta

Description: Based on the sustainable forest management measures implemented in the field and related work, MENDELU prepared a report presenting i) description of environmental conditions at the sites, ii) detailed description and design of the management measures (Figure 10), iii) management recommendations, iv) reforestation and afforestation data including survival rate evaluation, v) forest inventory at the managed plots, and vi) generalized recommendations for sustainable forest management in Mongolia. Thinning is one of the most important measures to improve timber quality and forest health status. In addition, thinning is considered a suitable approach to improving the growth response of remaining trees in forest

stand after treatment in both conifers and broadleaves. Additionally, the first valuable timber and potential profit can be generated by thinning. Thus, a detailed inventory and evaluation of thinning plots was done in relation to the thinning interventions. The specific purpose of each thinning intervention, results and recommendations were mentioned in the output. The report contains 170 images and 34 tables accompanying the texts and has a total of 198 pages. Four site-specific sustainable forest management models defined and recommended for forestry practice in Mongolia are an important part of it.

Available at: <https://forest4mongolia.mendelu.cz/en/outputs>

STREAM report on SFM measures prepared by Mendel University in Brno (2022–2024)



*Figure 139. Fencing protecting planted *Populus* seedlings from browsing in the burned forest area (E2) with several individuals of *Pinus* forming a protective group of trees (in the background).*



*Figure 140. Fencing protecting planted *Populus* seedlings from browsing in the burned forest area (E3) with a protective mature *Populus* forest stand (in the background).*

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Figure 10. *An example of a page from the report with the realized exclosures and their description.*

4 ENVIRONMENTAL RESEARCH, MONITORING AND EVALUATION

Responsible person: David Juříčka

Description: Investigation and evaluation of natural conditions is an essential part of sustainable forest management. Knowledge of landscape natural limits is a fundamental assumption to balance the production and non-production forest function. The evaluation of the selected natural conditions was used to prepare the design of forest management measures.

Available at: <https://forest4mongolia.mendelu.cz/en/outputs>

4.1 Outputs

4.1.1 Environmental research, monitoring and evaluation: Results of the STREAM project

Editors: David Juříčka and Václav Pecina

Authors: David Juříčka, Martin Valtera, Burenjargal Otgonsuren, Pavel Peška, Jan Šebesta, Vladimír Hula

Description: MENDELU prepared the report containing five chapters regarding the fields of research in demonstration plots including identification of environmental threats and management recommendations. The report contains i) long-term monitoring (Figure 11, Figure 12) of selected climatic and soil conditions: rainfall (Figure 13), air temperature (Figure 14), soil temperature (Figure 15) and dry period evaluation (Figure 16), ii) soil classification and evaluation (Figure 17, Figure 18, Figure 19), iii) pedoanthracological survey (Figure 20), iv) botany survey and v) lepidoptera survey (Figure 21). Selected topics and scientific investigations were presented to the public through graphical abstracts.

Available at: <https://forest4mongolia.mendelu.cz/en/outputs>

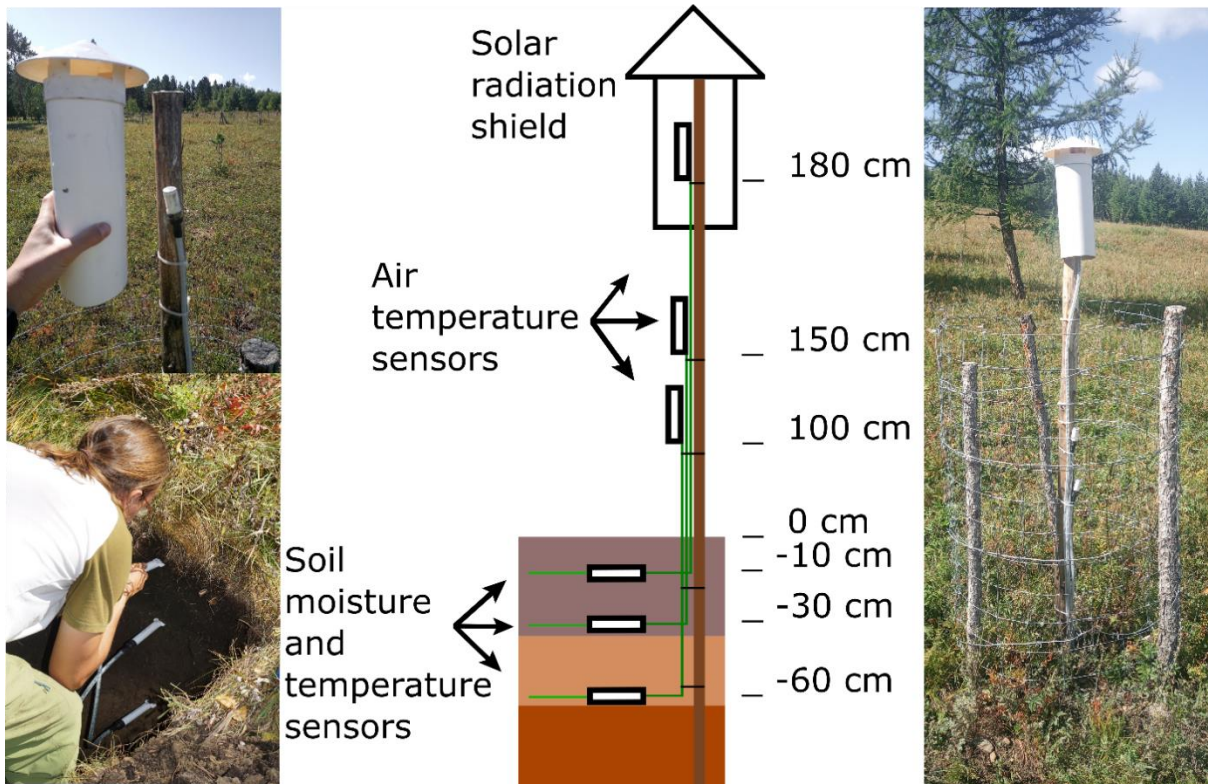


Figure 11. Visualization of installation and placement of TOMST TMS4 soil sensors in the field.



Figure 12. a = Pronamic Pro rain gauge (EMS Brno, 2024), b = rain gauge placement in the Tunkhel demonstration plot.

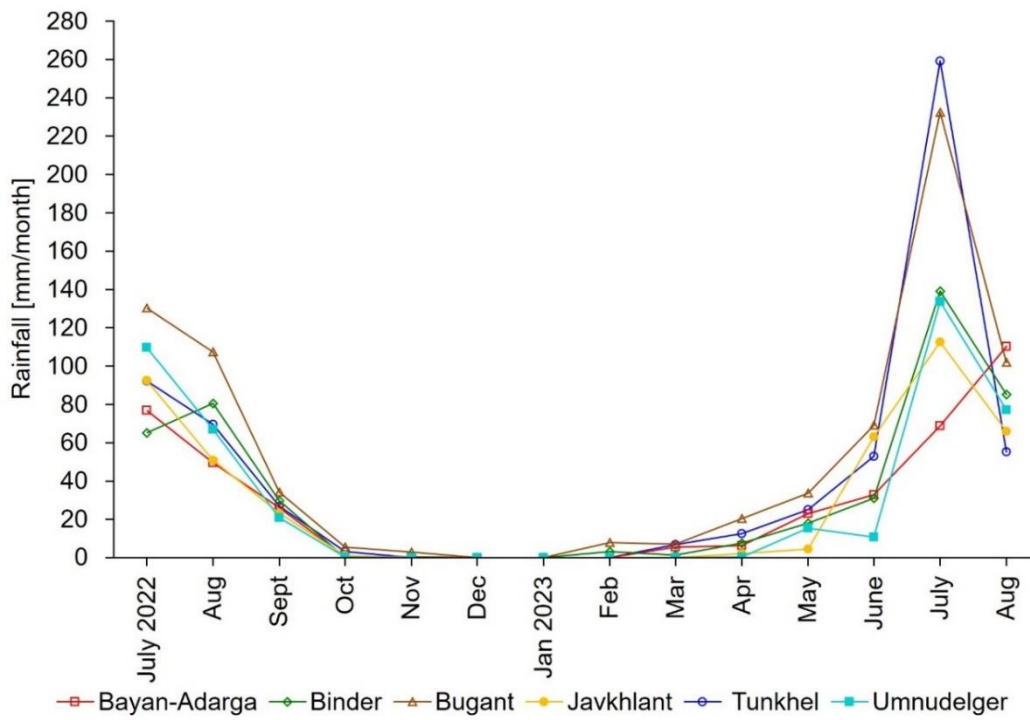


Figure 13. Monthly rainfall totals at the demonstration sites.

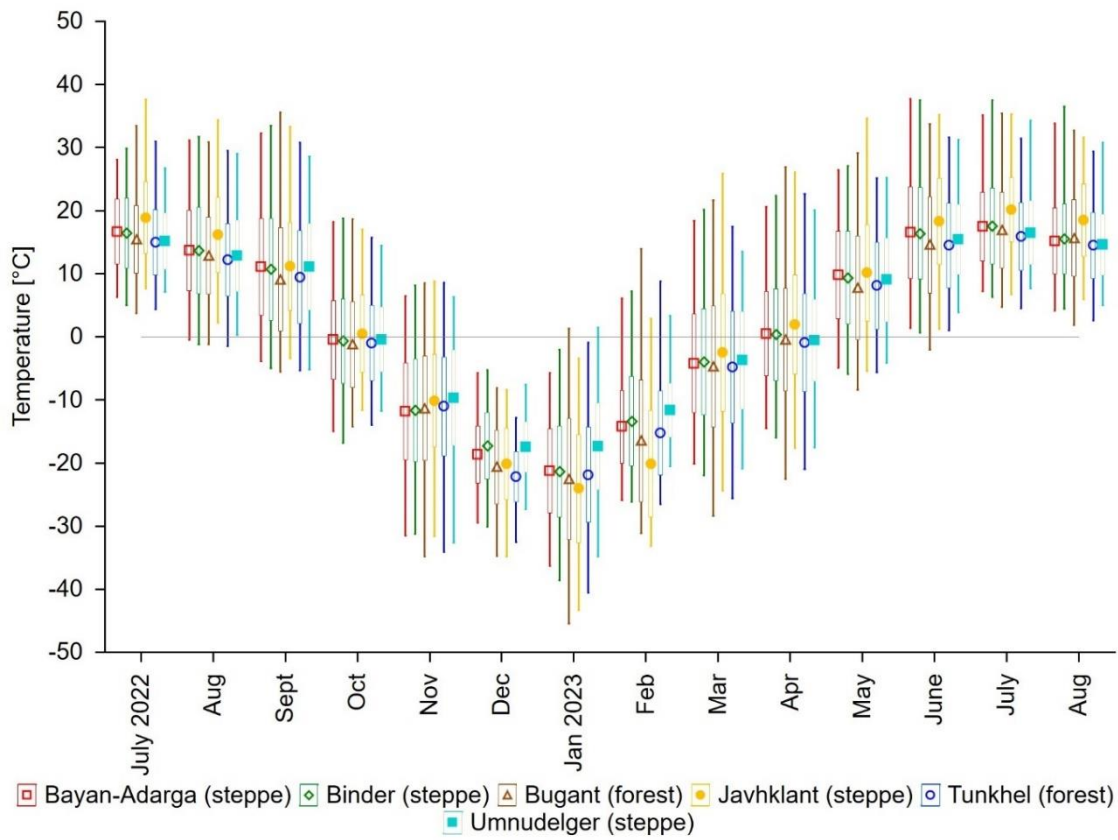


Figure 14. Monthly air temperature at the demonstration sites.

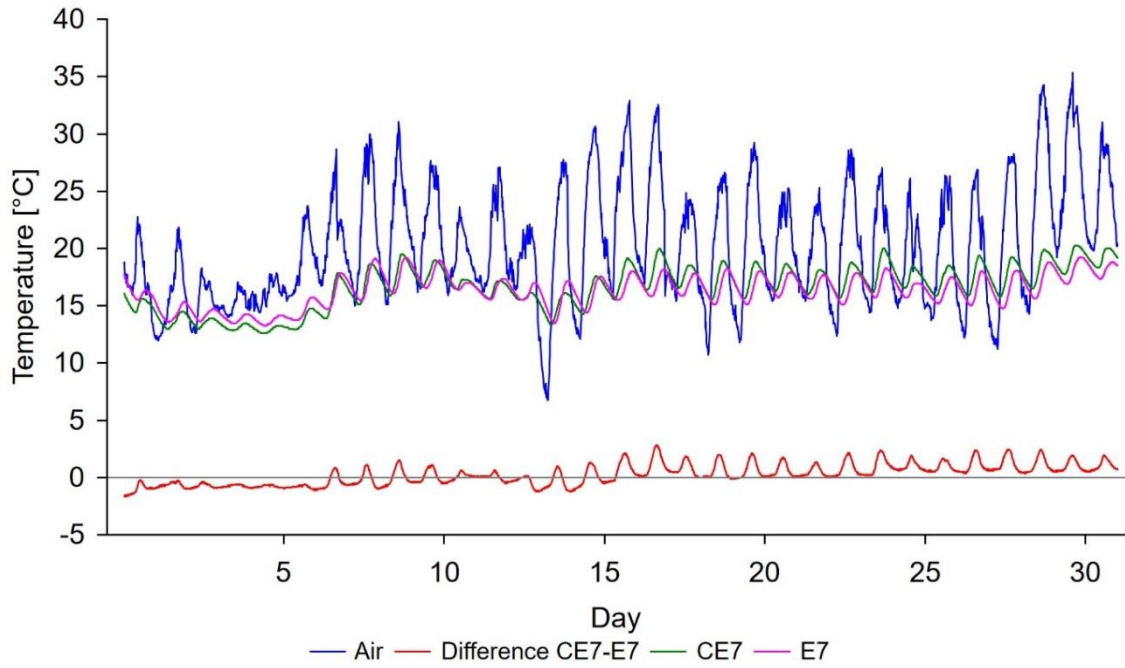


Figure 15. Soil temperature in 10 cm and difference between the exclosure (E7) and the control plot (CE7) in the Javkhlant demonstration plot. The plus value of the Difference means a higher temperature and higher potential evaporation in the control plot.

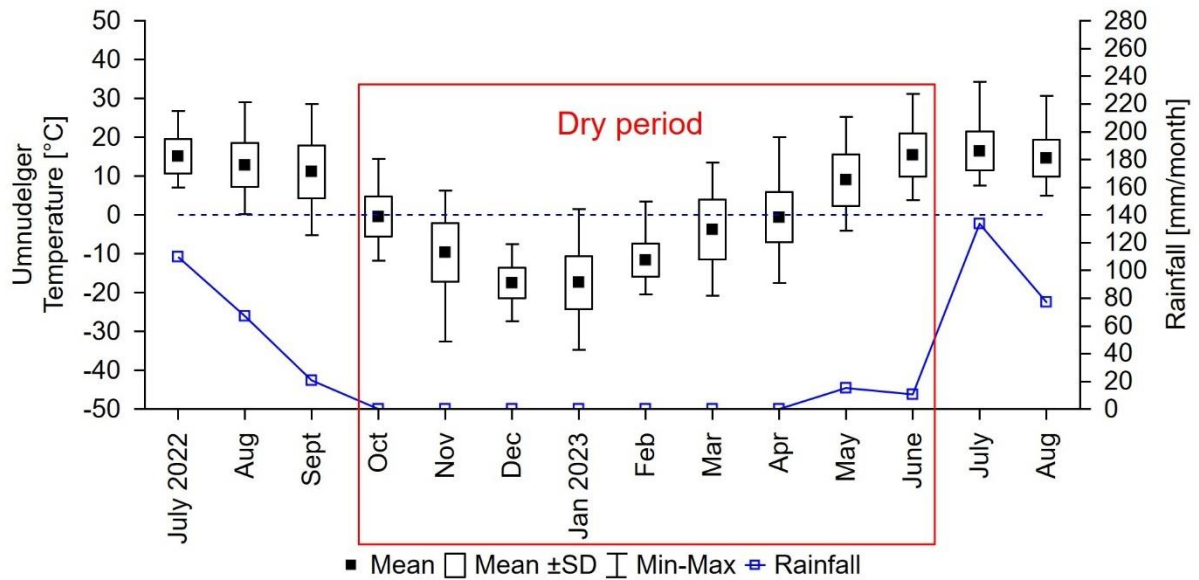


Figure 16. Dry period at the Umnudelger demonstration site.



Figure 17. Mycorrhiza sampling in Umnudelger (a) and Binder (b) demonstration sites.



Figure 18. Soil survey in Umnudelger (a), soil sampling in Javkhlant (b), and the extracted mineral soil 0–30 cm core sample (c).



Figure 19. Cambic Phaeozem (Loamic) in Tunkhel (a), Fluvic Phaeozem (Loamic) in Bugant (b), and Stagnic Fluvic Phaeozem (Arenic, Turbic) in Javkhlant (c).

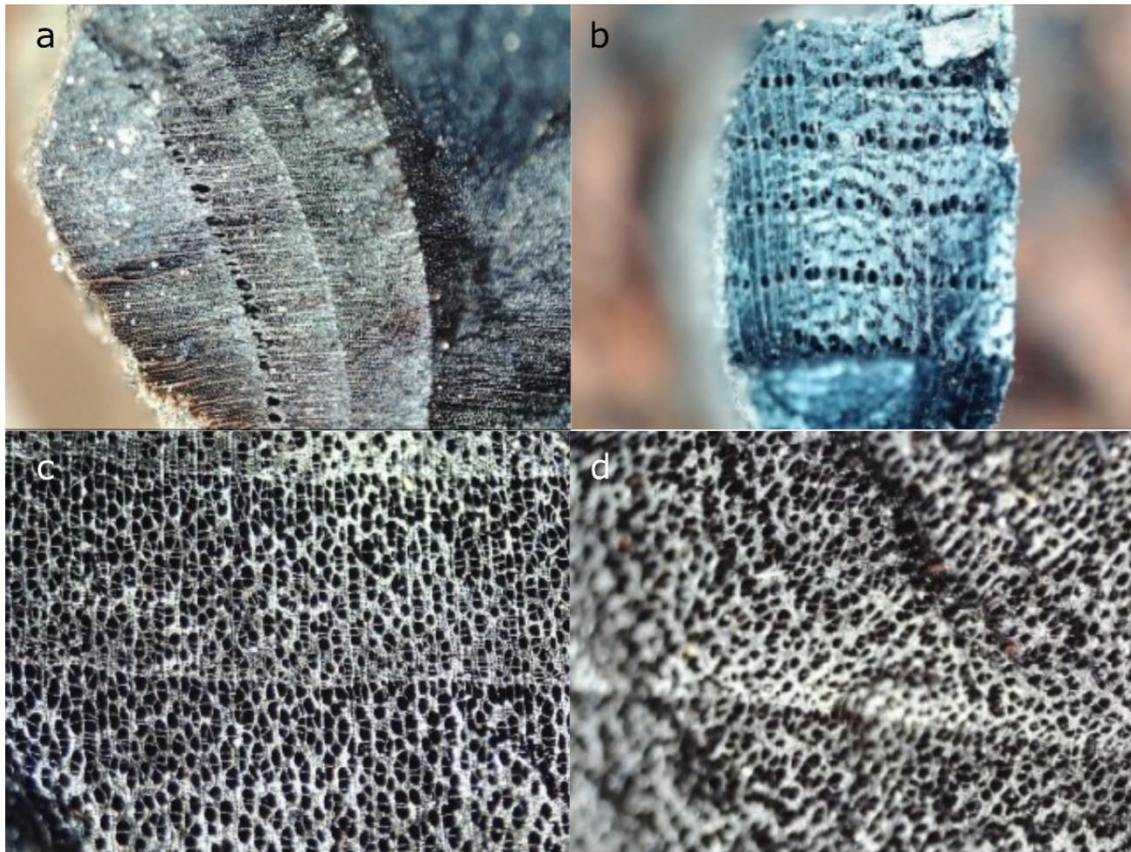


Figure 20. Final charcoal samples for laboratory determination. *a* = *Pinus sylvestris*, *b* = *Ulmus pumila*, *c* = *Populus tremula*, *d* = *Salix* spp.



Figure 21. *a* = Collecting insects with a butterfly net and *b* = *Lasionycta orientalis*.

5 GRAPHICAL ABSTRACTS

Responsible person: Václav Pecina

Description: Graphical abstracts present the results of our research and experience from forestry practice in a simplified form with the aim of reaching the Mongolian public in a simple image form. The outputs were created based on the data collected at the demonstration plots.

Available at: <https://forest4mongolia.mendelu.cz/en/outputs>

5.1 Impact of grazing on Mongolian steppe river valley

Authors: Václav Pecina, David Juříčka and Martin Valtera

Description: The graphical abstract (Figure 22) shows the landscape degradation caused by overgrazing. Overgrazing is one of the most serious problems accelerating the large-scale landscape degradation in Mongolia. The output was prepared based on the data from long-term environmental conditions monitoring.

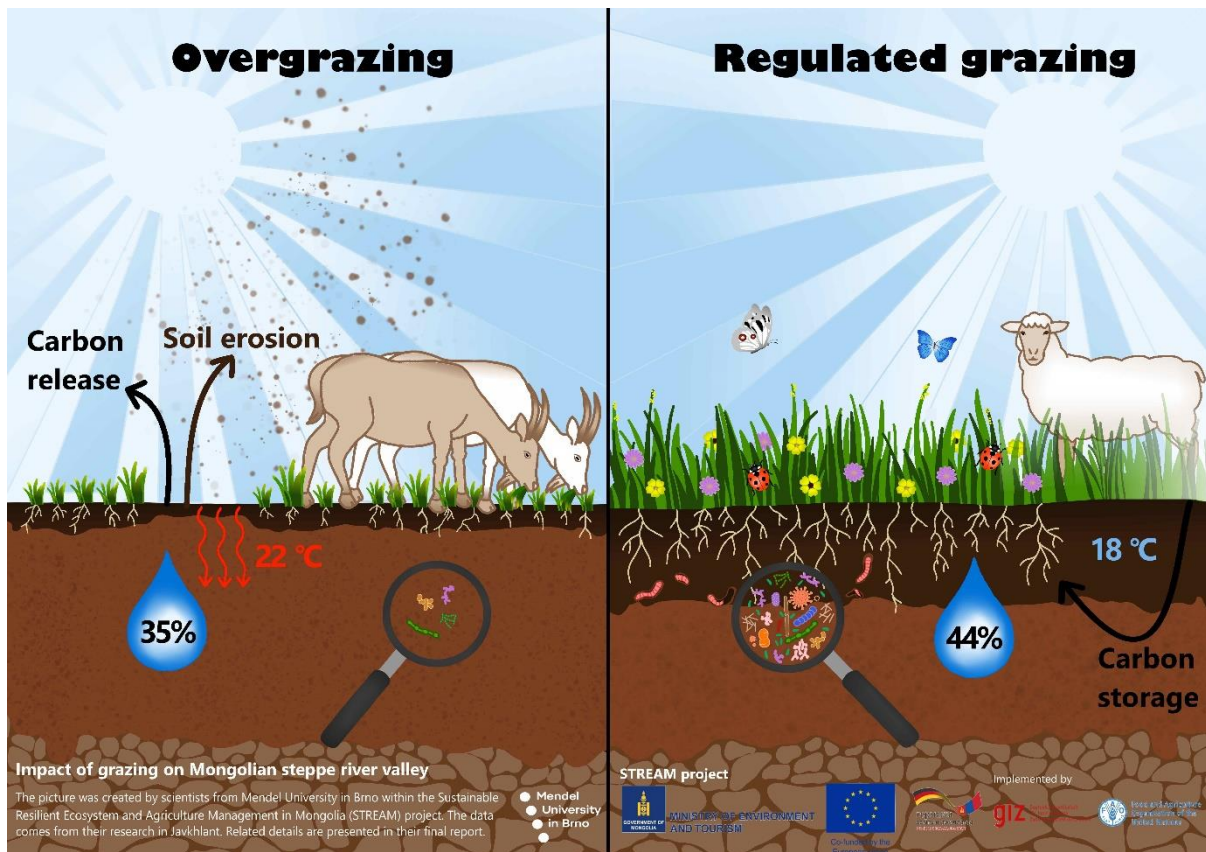


Figure 22. Graphical abstract – Overgrazing.

5.2 Mountain permafrost degradation

Authors: David Juříčka, Václav Pecina and Martina Machalová

Description: Permafrost is one of the most important sources of water in Mongolia. The graphical abstract (Figure 23) shows the serious topic of permafrost degradation and water loss from the Mongolian landscape. The output was prepared based on the data from long-term environmental conditions monitoring.

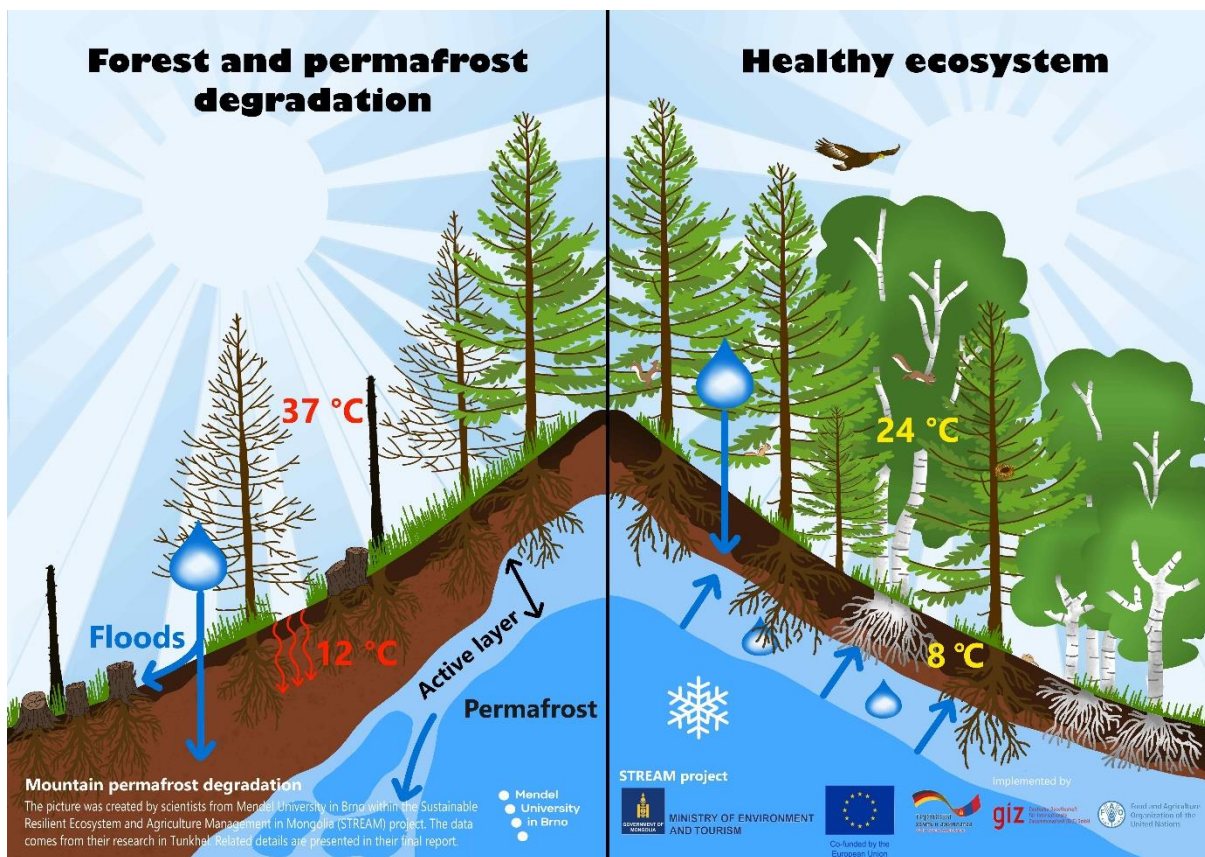


Figure 23. Graphical abstract – Permafrost degradation and water loss from landscape.

5.3 Wood related carbon (C) cycling

Authors: Jan Parobek, Václav Pecina, Martin Valtera and Martina Machalová

Description: Against the backdrop of ongoing climate change, the climate-neutral and low-carbon economy is a global issue. The graphical abstract (Figure 24) shows comprehensively wood related carbon fluxes in the Mongolian landscape and the important role of forest in

carbon cycling. Unfortunately, most of the timber is burned in Mongolia. Therefore, the authors highlighted the importance of timber processing and wood product carbon sequestration.

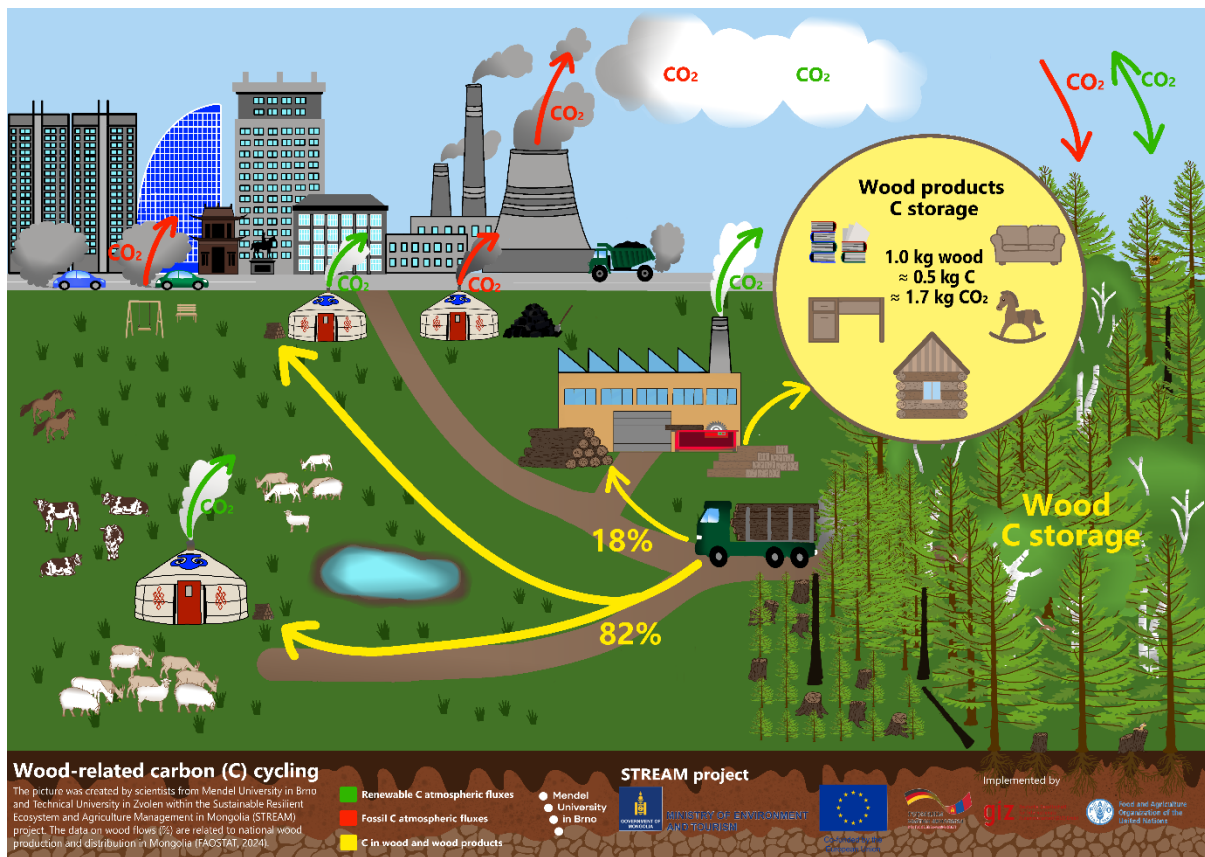


Figure 24. Graphical abstract – Wood related carbon cycling.

5.4 Root system of seedlings: The key to successful reforestation 1

Authors: Václav Pecina and Martina Machalová

Summary: Poor quality of seedlings was one of the most determining factors for low seedling survival rate at the demonstration plots. Seedlings with a poor and undeveloped root system are sensitive to drought and have little chance to survive a dry period from autumn to summer or even the planting and related change of environment. The graphical abstract (Figure 25) highlights the importance of pine seedling quality for successful reforestation.

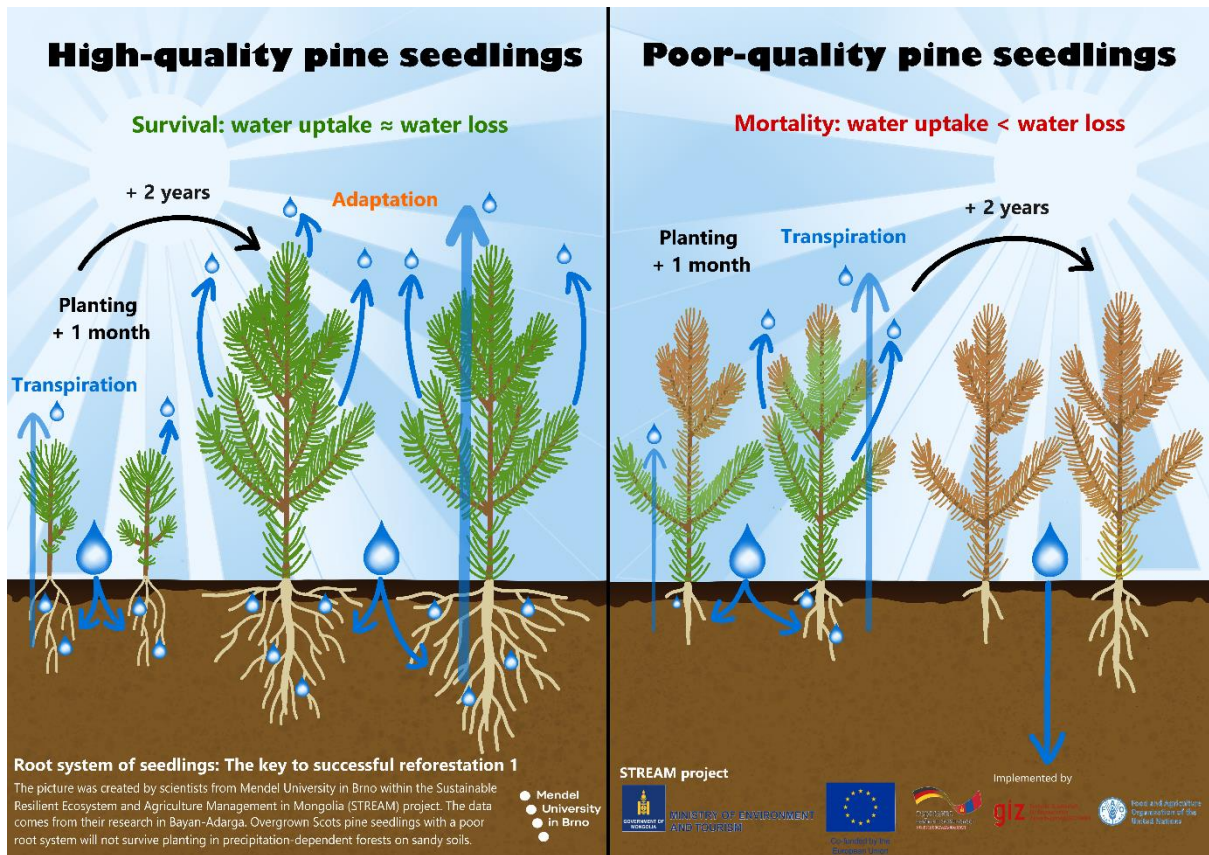


Figure 25. Graphical abstract – Mortality of pine seedlings.

5.5 Root system of seedlings: The key to successful reforestation 2

Authors: Václav Pecina and Martina Machalová

Summary: Poor quality of seedlings was one of the most determining factors for low seedling survival rate at the demonstration plots. Seedlings with a poor and undeveloped root system are sensitive to drought and have little chance to survive a dry period from autumn to summer or even the planting and related change of environment. The graphical abstract (Figure 26) highlights the importance of larch seedling quality for successful reforestation.

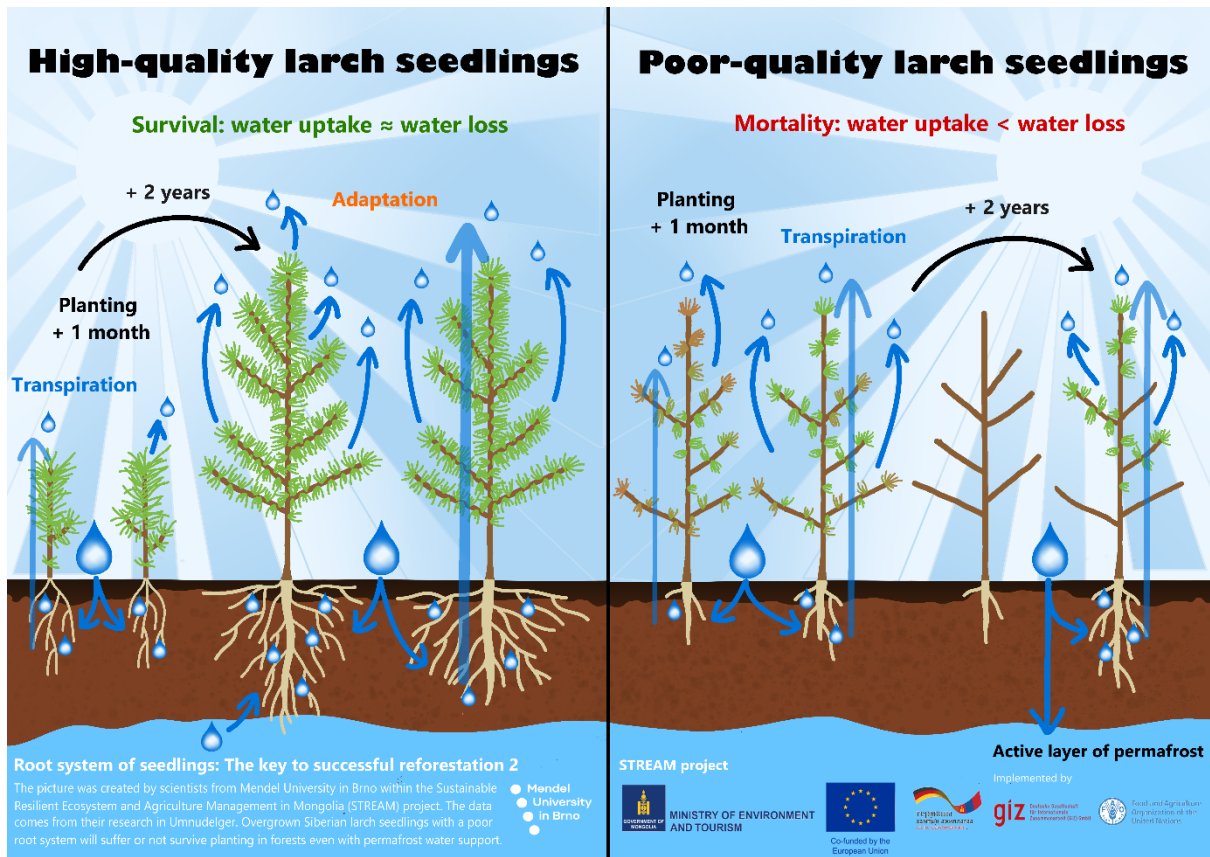


Figure 26. Graphical abstract – Mortality of larch seedlings.

6 RESEARCH EXPERIMENTS

6.1 Soil additives

Responsible persons: David Juříčka and Enkhtuya Batkhuu

Description: A planting experiment in the steppe and sand dune transition zone was carried out by MENDELU at the Javkhlant site in September 2023. We intend to compare the effect of different types of additives on the survival rate and success of *Ulmus pumila* seedlings. *Ulmus pumila* is adapted to dry and sandy soils and it can survive in extreme conditions. We compared charcoal, hydrogel, wool pellets, mycorrhiza with a fertilizer, and no additive treatment (control). Tree seedlings were planted in a rectangular design with a regular spacing 3×2 m (Figure 27, Figure 28), each row containing a specific treatment (Figure 29). In summary, each treatment affects 105 seedlings, which is 525 seedlings in total in the experiment. The height of the seedlings was measured to evaluate their growth dynamic in the future. MENDELU will measure sap flow and differences between the treatments on an anatomical level by the summer of 2024. The evaluation of the experiment will have an impact on the recommendations for plantations in extreme habitats affected by drought and desertification.

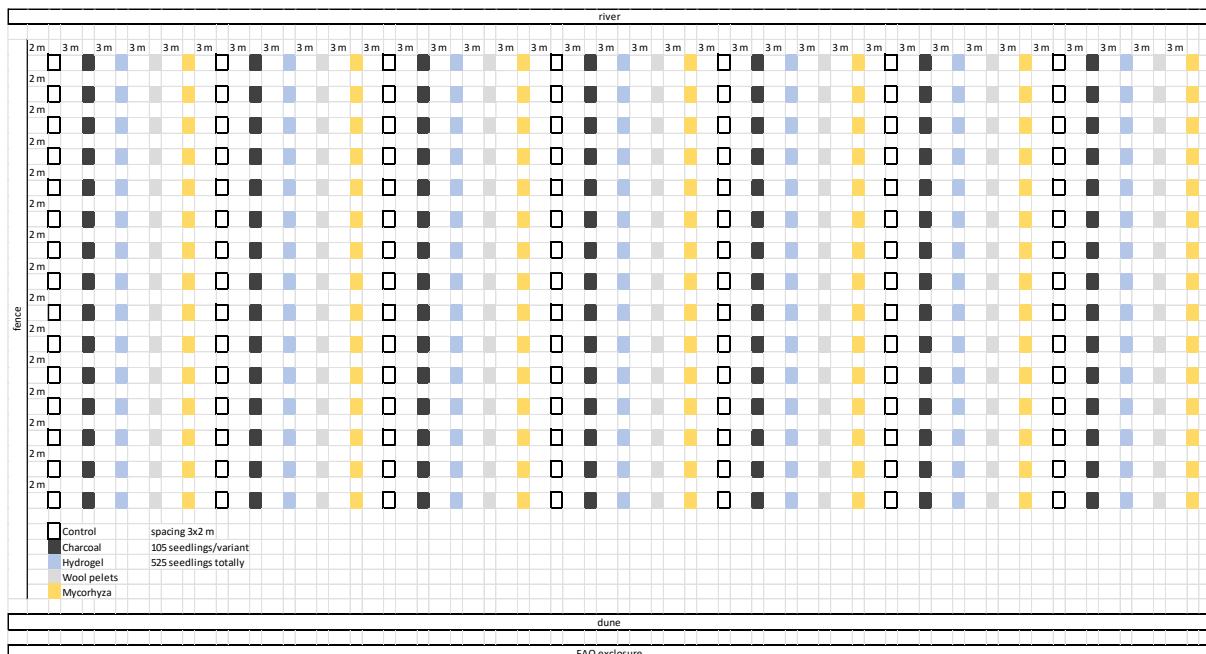


Figure 27. Planting design of the experiment. The colours represent the treatments – charcoal (black), hydrogel (blue), wool pellets (grey), mycorrhiza (orange), and control (hollow).



Figure 28. *Planting at the Javkhlant demonstration site.*



Figure 29. *a = wool pellets from ElfSystems company and b = mycorrhiza with a fertilizer from Grown company.*

7 EDUCATION AND TRAINING

Responsible persons: Jan Šebesta and David Juříčka

Description: One of the pillars of the MENDELU team within the STREAM project was knowledge transfer to experts and professionals in the field of forestry as well as the education and training of future forestry experts. Within this section, it is possible to divide our activities into several content units, which we present below.

7.1 Field training for foresters

Description: In 2022, several discussions were held with local foresters and officials when establishing demonstration plots at individual STREAM sites. Based on this, MENDELU organized (with an organizational contribution from GIZ) and led three workshops for Mongolian forestry professionals in 2023 (Figure 30). The events took place on August 29 (Binder), September 11 (Bugant) and September 15 (Tunkhel). The main aim of the workshops was the transfer of knowledge in sustainable forest management, forest tending (thinning; with practical training), forest ecology, capacity development, and awareness-raising in the modern concept of sustainable forest management and wood processing. Besides, we highlighted the importance of the ecological background for sustainable forest management. We discussed the issues connected to sustainable forest management in the fields of soil science, climatology, botany, entomology, forest policy, forest classification, and landscape ecology. The Consortium ensured the quality of the training and Mongolian experts put the expertise in the framework of the Mongolian environment. Moreover, harmless methods of tree climbing and seed collection were introduced. We also presented the basics of forest pedagogy and the possibilities of developing work with children and teenagers. The participants gained experience with the field reality and implemented management exercises related to sustainable forestry. They have been exposed to several topics and taken to a variety of sites, which demonstrate a range of natural and managed forests, and a range of sustainability issues. Mongolian participants were the employees and heads of the Inter-Soum Forest Units, National Forest Agency, Civil Society Organisation, and STREAM project staff.

More information at: <https://www.facebook.com/share/p/bWTsiQvSt45i13Ha/>;
<https://www.facebook.com/share/p/MbHojNzkUKmKEoRK/>



Figure 30. Workshops for foresters in Binder (*a = thinning marking training, b = tree climbing training, c = nurseries in forest nursery*), Bugant (*d = presentation of precommercial thinning*) and Tunkhel (*e = forest pedagogy in practice, f = presentation of the enclosure*).

7.2 Tree climbing training

Description: MENDELU organized and led (with an organizational contribution from the GIZ) two workshops in tree climbing for experienced people and bought two sets for tree climbing (Figure 31). The main trainer was Karel Kejla (MENDELU), who is a professional climber and designed one of the climbing methods (Figure 32). MENDELU's student of arboriculture Michal Uhrich assisted Karel and the other participants. The translation to Mongolian was

provided by Alena Bežiaková (MENDELU). A total of 16 participants took part in the course. The workshops took place in Tunkhel, each lasting one week. Basic emphasis was placed on safety during the training. There are two most popular tree climbing techniques for professionals: a stationary rope system and a moving rope system. We used and taught an advanced moving rope system where the climber starts by creating a tie-in point by installing a climbing line through a friction saver in a tree, causing the rope to “double” over itself. Karel Kejla compiled a detailed manual for participants and potential users, the publication was translated into Mongolian (Figure 33). Successful participants received a certificate, and they will manage seed collection in their area.

More information at: <https://www.montsame.mn/mn/read/326272>



Figure 31. *a = a common method of seed harvesting is hammering, which damages trees, we want to prevent that b = thorough harmless methods of tree climbing.*



Figure 32. *Tree climbing lecturing in Tunkhel. Safety principles are the most important part of the training.*

Ажлыг хэлбэрээр оруулав, Др. Б. Эгэев

2. Тоног хэрэгсэллүүд

Шаардлагатай хувийн хамгаалах хэрэгсэл (XXX)-ийн жагсаалт ба товч тайлбар.

- ВЭРТЭКС ВЭНТ - VERTEX VENT** ажлын шар хамгаалалтын малгай
- ФАЛКОН АСПЭНТ - FALCON ASCENT** ажлын уяа
- КОУРАНТ БАНДИТ - COURANT BANDIT 11 мм** -ийн өгсөх, аюулгүйн, давхар бэхлэгээний оос, урт 5 м, цагаан өнгөтэй, төгсгөл нь оюултой. Энэхүү ажлын журмын тайлбар хэсэгт энэхүү оосоо "ажлын оос" гэж нэрлэнэ.
- КОРДЭ ПОУР ГРИЛЛОН ЛАНЯРД - CORDE POUR GRILLON LANYARD** өгсөх болон аюулгүй байдлыг хангах зориулалттай оосор, урт 5м, оёмол нэг холбох төгсгөлтэй, цагаан өнгөтэй. Энэхүү ажлын журмын тайлбар хэсэгт эдгээр оосорыг "Өгсөх оосор" эсвэл "зүүн эсвэл баруун өгсөх оосор" гэж нэрлэнэ.
- ЛАНЯРД ЖАНЭ I - LANYARD JANE I** холболт, аюулгүй байдлын нэмэлт оосор, урт 1,5 м, хар өнгөтэй. Энэхүү ажлын журмын тайлбар хэсэгт энэ оосорыг "холболтын оосор" гэж нэрлэнэ.
- ГРИЛЛОН ХҮК - GRILLON HOOK** ажлын аюулгүй байдлын байрлал тохируулгатай их биеийн оосор, урт 4м. Энэхүү ажлын журмын тайлбар хэсэгт энэ оосорыг "их биеийн оосор" гэж нэрлэнэ.
- РИГ - RIG** өөрөө тоормостой буух төхөөрөмж
- РЭСКУКЭНДЭР - RESCUCENDER** онгойлгох боломжтой оос хавчигч. Энэхүү ажлын журмын тайлбар хэсэгт энэ түүнийг "зүүн эсвэл баруун дээш өргөх оосор" гэж нэрлэдэг.
- ОМНИ ТРИАКТ ЛОК - OMNI TRIACT LOCK** Гурвалсан үйлдэлтэй аюулгүйн түгжих систем бүхий холбогч (карабин). Энэхүү карабиныг **ФАЛКОН АСПЭНТ** -ийн ажлын уяаны бэхлэгэнд ашигладаг. Мөн түүнийг ажлын байрлалын төв холбох цэг болгон ашигладаг.
- ОК ТРИАКТ ЛОК - OK TRIACT LOCK** холбогч (карабин) нь гурвалсан үйлдэлтэй аюулгүй түгжих системтэй ба хамгаалалтын болон байрлалын бэхлэгээний төхөөрөмжийг холбоход хэрэглэгддэг.
- АМД СКРЭВ ЛОК - AMD SCREW LOCK** Гараар аюулгүй түгжих систем бүхий холбогч (карабин) нь хамгаалалтын болон байрлалын бэхлэгээний төхөөрөмжийг холбоход хэрэглэгддэг.
- СИННИНГ РОК СКРЭВ ЛОК - SINGING ROCK SCREW LOCK** ган холбогч (карабин) нь аюулгүйн түгжээтэй хамгаалалтын болон байрлал тогтоогчийг холбоход хэрэглэгддэг.
- АНХНЫ ТУСЛАМЖИЙН ИЖ БҮРДЭЛ - FIRST AID KIT** нь ажлын талбарт

3. Модонд авирах арга техникийн зааварчилгаа

Мөчиргүй их биед авирах техник

Ажилтан нь модонд авирах бүрдээ дараахь журмыг заавал мөрдөнө:

1. Хөдөлмөр Хамгаалалтын ажлын багаж Хэрэгсэл (даашид XXX гэх) зааварчилгааны хамт бүрэн бүтэн байгаа эсэхийг хянаж шалгах.
2. XXX бүрэн бүтэн, ажил явуулхад хангалттай, эвдэрч хэмхрээгүй эсэхийг хянаж шалгах.
3. Аврах ажлын бэлтгэл эхэлнэ.
4. Ашиглах зааврын дагуу **ВЭРТЭКС ВЭНТ** хамгаалалтын малгайг өмсөх.
5. Зааврын дагуу **ФАЛКОН АСПЭНТ** хамгаалалтын уяаг зүүнэ. Уяануудыг бэхлэхэд **ОМНИ ТРИАКТ ЛОК** - карабиныг ашиглана.
6. Энэхүү карабин **ОМНИ ТРИАКТ ЛОК** нь мөн суудлын бэхлэгээний төв холбох цэг юм. Хоёр **РЭСКУКЭНДЭР** оос хавчигчыг холбоход ашиглана. (1-р зургийг үз).



Зур. 1

Figure 33. An example from the manual for tree climbers.

7.3 Field training for university students

7.3.1 Mongolian students

Description: Teaching and knowledge transfer to Mongolian students is one of the pillars of the MENDELU team within the STREAM project. Our concept consists of the presentation of all levels of the environment and ecosystem, we emphasize a comprehensive approach and support mutual discussion. Effective transmission of knowledge with field examples and cooperation in data sampling seems crucial for Mongolian students.

The first field trip was performed during June-July 2022 (Figure 34). Thirteen students from MULS, NUM and GMIT participated in geological, soil and botanical surveys and forest inventories. Other activities carried out together in the field included the construction of enclosures, forest cleaning, tree climbing, and planning and marking forestry interventions involving forest tending. The lectures included topics of environmental protection, forest

protection, forest ecology, silviculture, environmental geochemistry, forest management and marketing, forest nurseries, forest planning, and forestry mechanization.

Summary of the summer field trip (June 16–July 7) in 2022:

- 13 students were trained, and 2 academics (NUM and MULS) participated,
- soil sampling,
- research activities, 4 students work at pilot sites for the final thesis,
- practical forestry work in the field,
- landscape analysis and joint discussions.

The second field trip took place during August-September 2022 (Figure 34). The trip was attended by 7 students who had already participated in the first trip. The students were pre-selected based on their skills and interest in continuing. New seasonal (autumn) topics, in which the students could be educated, were taught. The activities carried out in the field included continuing forest inventories and planning and marking of forestry interventions involving forest tending. In addition to planning, the implementation itself was carried out. Therefore, pruning and cutting (precommercial or commercial thinning) were done partly by students. As part of silviculture lessons, soil scarification as a method of promoting the success of natural regeneration, the correct procedure for the planting of seedlings, and the protection of seedlings using a repellent coating of the terminals were taught. Thanks to the meeting of the representatives of the university consortium with several experts in their fields, the students also had an opportunity to discuss new specific topics such as European forestry economy and policy, arboriculture, dendrology, or aspen ecology. Cooperation with the students continued even after the end of the field trips.

Summary of the autumn field trip (August 29–September 29), 2022:

- 7 students were trained,
- experts from the consortium participated,
- soil sampling and permafrost mapping
- research activities,
- practical forestry work in the field.



Figure 34. Field training for Mongolian students in 2022: *a = enclosure construction, b = soil survey, c = tree climbing, d = thinning intervention marking, e = pruning realization, f = tree planting, g = tree planting within an event for public and h = forest inventory. a–d = summer field trip and e–h = autumn field trip.*

The third and fourth field trips: During the MENDELU field missions to Khentii and Selenge in June 16–July 8 and August 28–September 19, 2023 (Figure 35), eleven students from four Mongolian universities (MULS, NUM, GMIT and MUST) participated. The students cooperated with the MENDELU team within the STREAM project, they were trained in the field and collected data for their final theses. The students were engaged in data collection in the fields of soil science, climatology, botany, entomology, forest policy, forest classification, landscape ecology and forest management. The experts from MENDELU and the Consortium ensured the quality of the training and the Mongolian experts put the expertise in the framework of the Mongolian environment. For example, Paul Rogers (USU) explained the importance of aspen in the dry environment of Mongolia; Byambagerel Suran (NUM) explained the background of fire ecology and regime in pine and larch forests; Douglas Godbold (MENDELU) described the significance of mycorrhiza for tree water management, Jan Parobek (TUZVO) illustrated the aspects of global market and challenges in the Mongolian forestry sector; Jan Novák (CU) explained the long-term history and successions of forests based on charcoal analyses; Lucian Curtu (UNITBV) highlighted the importance of genetic resources for forest stability; Václav Bažant (CZU) trained the principles of seed collection and tree climbing, etc. Besides the transfer of know-how, the students assisted experts in data collection and lab work. They actively participated in designing experiments and implementing forest management interventions in the field. Some of the Mongolian and Czech students do their bachelor and master theses on the STREAM demonstration sites. Furthermore, the connection of Mongolian and Czech students has also enabled a horizontal transfer of knowledge. Altogether, students have gained valuable experience in the research areas, and they can share their acquired knowledge with other colleagues. We assume that such subsequent knowledge-sharing will spread the acquired knowledge among a number of students. In addition, trained students are likely to become future authorities and decision-makers on important issues in forestry and landscape policy.

Summary of the spring field trip (June 16–July 8), 2023:

- 11 students were trained,
- 4 academic staff members from the Mongolian HEIs participated,
- experts from the university consortium participated,
- soil sampling, research activities, ecosystem approach,

- forest nurseries and practical forestry work in the field.

Summary of the autumn field trip (August 28–September 19), 2023:

- forest pedagogy,
- events for the public and professionals (workshops),
- practical forestry work in the field.



Figure 35. Field training for Mongolian students in 2023: *a* = soil survey, *b* = forest inventory, *c* = forest inventory team, *d* = seedling description and planting, *e* = tree planting, *f* = forest pedagogy realization. *a–c* = summer field trip and *d–f* = autumn field trip.

Mongolian students in the Czech Republic: Thanks to the Czech exchange program for international students, Mongolian forestry students applied to study in the Czech Republic for 6 months. The Czech Embassy in Mongolia announced the programme, and 3 out of 7 applicants were supported, after being chosen in the selection process in February and March 2023. The MULS's students Duulal Erdene, Namuunaa Shinebayar, and Angarag Zorigtbayar studied at MENDELU in Brno from September 2023 to February 2024. They successfully studied and received the credits that are fully accepted at MULS. MENDELU pardons their tuition fees and facilitates their study at the Faculty of Forestry and Wood Technology. Moreover, the students were rewarded for their work in the laboratory. They analysed soil samples collected in the demonstration plots. The studies were in English, and the students were part of an international group of students.

More information at: <https://www.facebook.com/share/p/74eARV3sDGFwjji/>

7.3.2 Czech students

Description: During the MENDELU field missions to Khentii and Selenge on June 16 to July 8 and August 28 to September 19, 2023, five students from MENDELU (Michal Mičulek, Marian Vrba, Benjamin Vrbovský, Matěj Nejeschleba, Michal Uhrich) and one from CZU (Tomáš Hornig), who spent 1 month in Mongolia, cooperated with the STREAM team and Mongolian students (Figure 35a,d,f; Figure 36). They were trained in the field and collected data for their final theses. The students were engaged in data collection in the fields of soil science, climatology, botany, entomology, forest policy, forest classification, landscape ecology and forest management.



Figure 36. Czech students in Mongolia: a = data downloading and b

7.4 Study tour to the Czech Republic

7.4.1 Study tour for Mongolian academics

Description: MENDELU organized and guided a study tour in the Czech Republic for Mongolian academics collaborating on the STREAM project from 2nd to 14th April 2023 (Figure 37). The participants were Burenjargal Otgonsuren (MULS), Byambagerel Suran (NUM), Enkhjargal Sodnomdarjaa (GMIT) and Enkh TUYA BatkhUU (GMIT). The aim of the study tour was know-how transfer and capacity building in higher education. The specific objectives were i) wood processing technologies, ii) field exhibition of sustainable forest management and forestry technologies and operations, iii) concept of independent and prosperous forest enterprise and iv) know-how transfer in forestry education at university and high school. The participants gave a series of lectures for international and local MENDELU students on hot topics of Mongolian forests and forestry sector.

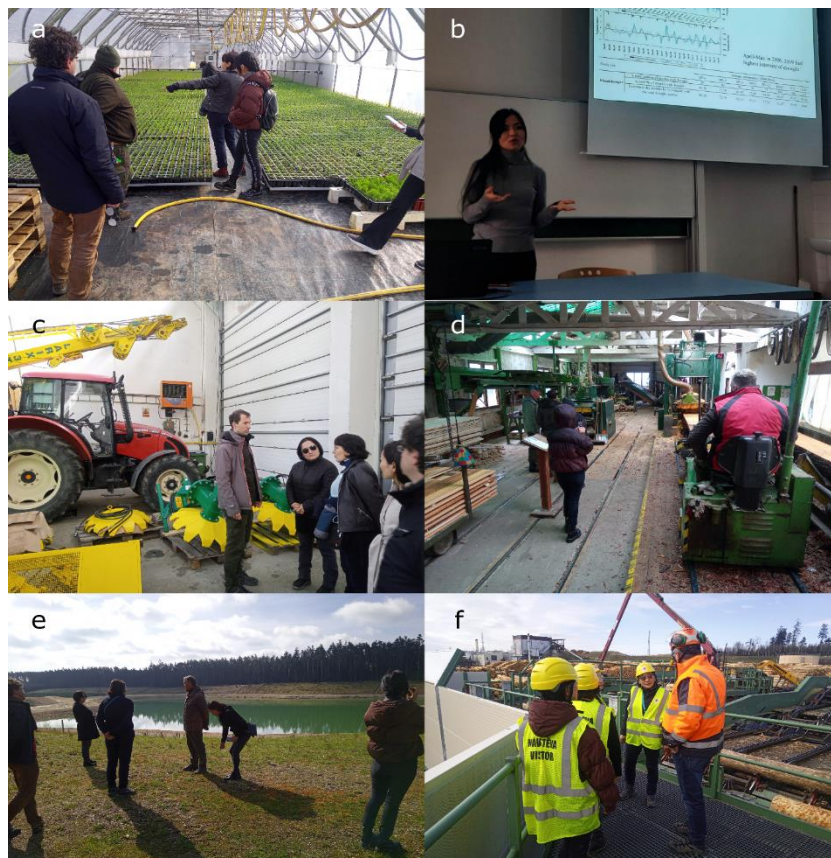


Figure 37. *a = Forest nursery of the University enterprise Masaryk Forest in Křtiny, b = lecturing at MENDELU, c = forestry technologies, d = small scale forest sawmill, e = Urban forests Hradec Králové, f = sawmill Stora Enso Wood Products Ždírec s.r.o.*

7.4.2 Study tour for Mongolian professionals

Description: MENDELU organized and guided a study tour for Mongolian forestry professionals in the Czech Republic from 21st May to 2nd June 2023. The main aim of the study tour was capacity development and awareness-raising in modern forest management and wood processing. The Mongolian participants were heads of the Inter-Soum Forest Units, National Forest Agency, Civil Society Organisation, and STREAM project staff. MENDELU adapted the programme for the participating organizations and Mongolia's forestry sector in general. The GIZ facilitated the organisation of the study tour and covered the costs related to transportation of participants from Mongolia to the Czech Republic and the accommodation of the participants. Thanks to the STREAM project, MENDELU covered the costs related to the local transport (bus) and accommodation of both the participants from Mongolia and from MENDELU. The Mongolian foresters visited 14 companies and institutions in five main topic packages: i) Wood-Processing Technologies (Figure 38), ii) Tree Nursery and Planting Technologies, iii) Environment-Friendly Technologies and Innovations, iv) Sustainable Forest Management (Figure 39), v) Forestry and Wood-Processing Education, and vi) Forest Service for Society and the Public. The forest companies were selected based on the prior personal experience of MENDELU experts. There were demonstrations of both large-scale industries and small-scale family forest and wood processing companies. Demonstrations of both intensive and extensive sustainable forest management were also provided. Forestry education was presented from the level of vocational schools to university education. The participants are expected to use and disseminate the acquired knowledge and know-how in practice and share it with professional colleagues. Activities and detailed descriptions of individual topic packages are presented below:

More information at: <https://www.facebook.com/share/p/Y5vKKYQRGbxr3vMq/>;

<https://www.facebook.com/share/p/cyw1rXM6QEaej2L/>;

<https://ldf.mendelu.cz/mongolsti-lesnici-na-ldf-mendelu/>;

<https://www.facebook.com/share/p/RPD9NeDgMcfbqm68/>;

<https://ekolist.cz/cz/publicistika/priroda/co-se-mohou-mongolsti-lesnici-priucit-od-lesniku-ceskych>



Figure 38. Excursion to Stora Enso Wood Products Ždírec s.r.o.



Figure 39. Harvester exhibition in the Kinský Family's Forest.

8 FOREST PEDAGOGY

Responsible persons: Václav Pecina and Petra Packová

Description: We perceive the need to increase the attractiveness of forestry and environmental engineering for the public. Therefore, we introduced the innovative approach of forest pedagogy. There is a long-term tradition of forest pedagogy in Central Europe, but this approach has never been applied in Mongolia. Hence, we implemented forest pedagogy for the August–September mission in 2023 and prepared a program and games for children. Events for children, such as “A Day with a Forester” and “Forest Games”, focused on the issues of the area of interest related to local forests. MENDELU organised and led (with an organizational contribution from the GIZ) eight events at the STREAM pilot sites (except Tunkhel) and even in other localities (Yeröö, Mandal and Ulaanbaatar) (Figure 40). Dr. Petra Packová (MENDELU), a forest pedagogy expert, was included in the Czech STREAM team for these activities. Czech and Mongolian students helped her with the implementation, for whom it was a form of education for the implementation of similar activities in the future. In a playful way of experiential learning (games), children received information about the work of foresters, forest ecosystems, forest functions and visible forest-affecting threats at the sites (Figure 41, Figure 42). The involvement of children and teachers aimed to increase the dissemination and increasing their knowledge. Approximately 250 children participated in the activities. MENDELU provided refreshments and presents (e.g. design wooden rulers and several forest-related games) for the children and their teachers. Forest pedagogy was also practiced during two professional workshops for Mongolian foresters. To ensure further dissemination, MENDELU participated in a workshop for Mongolian teachers of natural sciences and leaders of eco clubs. The workshop organized by GIZ in 2024 aimed at possible new ways of environmental education and included this approach. Special wooden games were also used during the events. These are described in more detail in the next chapter.

More information at: <https://www.facebook.com/share/p/iwxYAUZUZBq8YrAJ/>;

<https://mendelu.cz/mendelu-rozsirila-aktivita-v-mongolsku-o-lesni-pedagogiku/>;

<https://www.facebook.com/share/p/RnuYUuVQh2fy6rvv/>;

<https://www.facebook.com/share/p/EdC6WASadLR5k8uZ/>;

<https://www.facebook.com/share/p/EdC6WASadLR5k8uZ/>;

<https://www.facebook.com/share/p/hnKbWW1EAuCfBNsK/>



Figure 40. Forest pedagogy groups: a Bayan-Adarga (August 30), b Binder (September 2), c Umnudelger (September 3), d Javkhlant (September 8), e Yeröö (September 9), f Bugant (September 10), g Mandal (September 12) and h Ulaanbaatar (September 17).



Figure 41. *Forest pedagogy implementation.*



Figure 42. *Forest pedagogy implementation (tree climbing) in Bayan-Adarga.*

9 EDUCATIONAL FOREST GAMES

Responsible person: Václav Pecina

Description: MENDELU implemented the innovative concept of educational forest games into the public and primary school children education. The main purpose of the forest educational games is to increase the interest of Mongolians in forest topics. The multi-age and multi-level education is a key to improving the level of general understanding of the irreplaceable role of forests in the Mongolian landscape (Figure 43). As far as we know, this approach has never been applied in Mongolia. Educational forest games are an integral part of the forest pedagogy concept. MENDELU in cooperation with Lesní Svět company (<https://www.lesnisvet.cz/>) designed and created commercial products suitable for the Mongolian environment. A strictly native Mongolian animal and plant species were used as a basis for the originally Czech memory game Pexeso (Figure 44, Figure 45) and Rotating discs (Figure 46, Figure 47). Pexeso memory games were prepared in small board, bag and large board versions combining animal, plant, and tree species in Mongolian and English or Latin. The games were used on Europe Day in 2023, during the events for the public and kids (A Day with a Forester) in 2023, during the experiential pedagogy workshop in 2024 and several games were donated to Mongolian schools. Part of them was donated by MENDELU and part by GIZ.

Available at: <https://www.lesnisvet.cz/>



Figure 43. Presentation of educational forest games on “Europe Day” event in Ulaanbaatar on May 14, 2023.

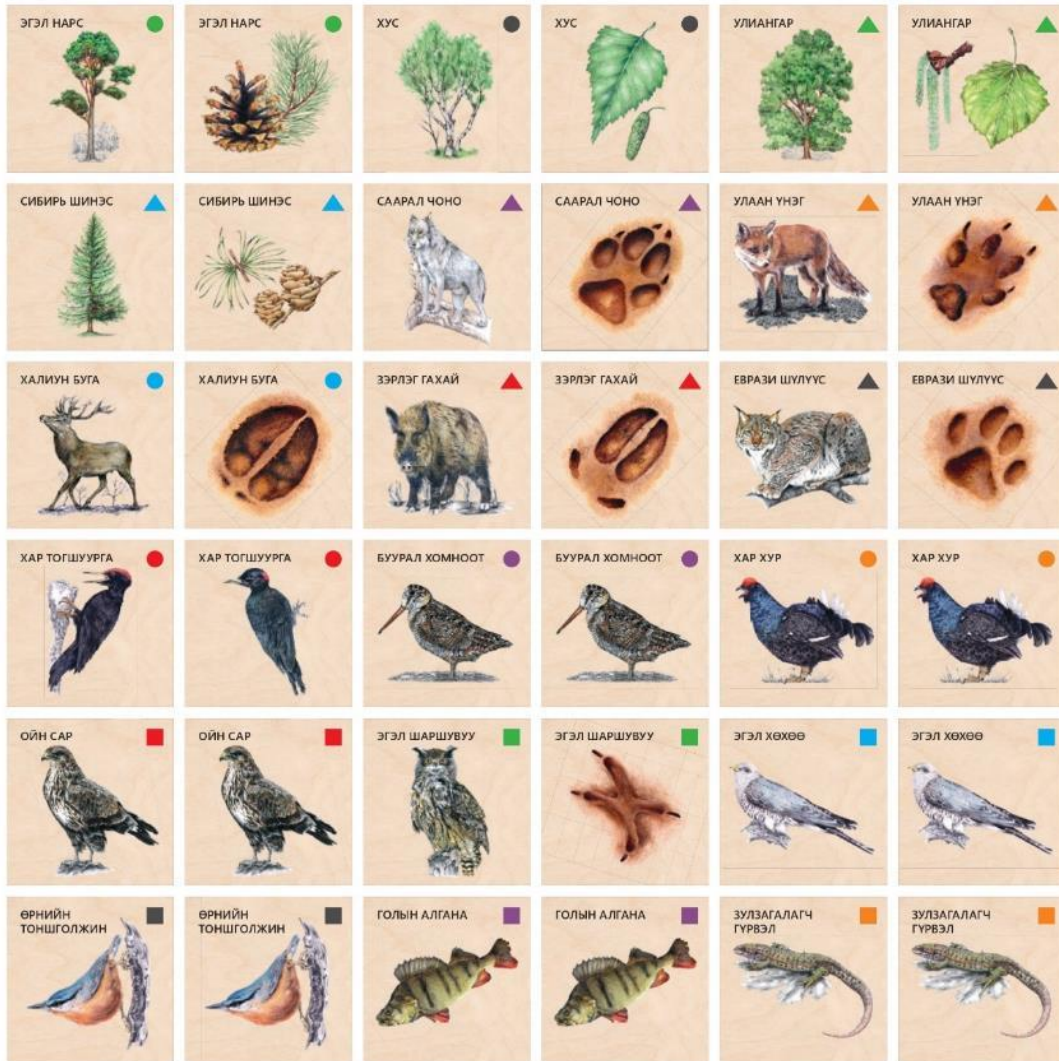


Figure 44. Design of a Pexeso memory game with animal, plant, and tree species in Mongolian.

GRAFICKÝ NÁVRH

Pexeso (36) 100 × 100 mm

Náš les 2



zadní strana
pexesa

Tiskárna není možno kopírovat ani užívat k jakýmkoli komerčním či nekomerčním účelům. Jejich použití je chráněno autorským zákonem a podléhá veškerým autorským právům.

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Figure 45. Design of a Pexeso memory game with animal and tree species in Mongolian.



Figure 46. Design of a Rotation disc with tree species, including the whole tree, leaves/needles and cones in Mongolian and Latin.

GRAFICKÝ NÁVRH

Otočné kolo – lesní ptáci



Ilustrace není možno kopírovat ani užívat k jakýmkoli komerčním či nekomerčním účelům. Jejich použití je chráněno autorským zákonem a podléhají veškerým autorským právům.

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Figure 47. Design of a Rotation disc with Mongolian bird species in Mongolian and Latin.

10 FORESTS AND FORESTRY BOOKS FOR CURRENT AND FUTURE MONGOLIAN PROFESSIONALS

Responsible person: Václav Pecina

Description: MENDELU prepared various types of educational materials especially for university students and forestry practitioners. The materials were prepared and designed based on the specific needs of each group of users. One of the books focuses on illustrative examples of the work of a forester, mainly in the form of pictorial documentation, the other theoretically describes topics important to the work of a forester. The contents of the books are based on specific conditions in Mongolia. The materials are freely accessible on-line.

Available at: <https://forest4mongolia.mendelu.cz/en/outputs>

10.1 Outputs

10.1.1 Basics of forest ecology and management: To sustainable forest management in Mongolia

Editors: Antonín Kusbach and Václav Pecina

Authors: Václav Pecina, Paul C. Rogers, Khishigjargal Mookhor, Jan Šebesta, František Máliš, Jan Novák, David Juříčka, Martin Valtera, Douglas L. Godbold, Burenjargal Otgonsuren, Enkhtuya Batkhuu, Antonín Kusbach, Pavel Peška, Martin Smola, Aleš Škoda, Tomáš Zemánek, Petr Lukeš, Ján Parobek

Description: The “textbook” for Mongolian university students (Figure 48) provides comprehensively and clearly the most important information from the fields of i) forest environment, ii) forest disturbances, iii) forest management, iv) forest technology, and v) forest economy. The main purpose of the book is to fill the gap in the Mongolian forest ecology and sustainable forest management literature for today’s practitioners, as well as provide solid educational tools based on modern forestry practices for education of forestry students and professionals. The book has 199 pages and is in English.

Available at: <https://doi.org/10.11118/978-80-7509-986-0>

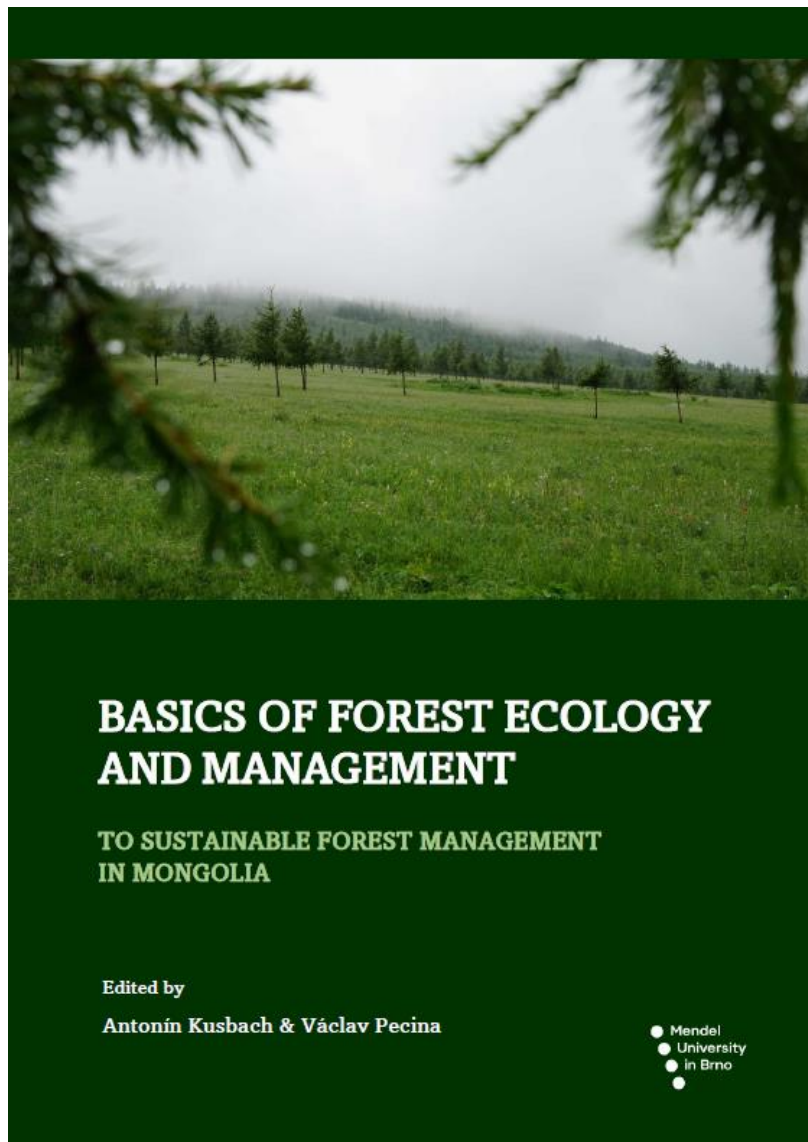


Figure 48. *Title page of the book.*

10.1.2 Sustainable forest management silviculture basics: Forest regeneration, protection and tending in Mongolian light taiga forests

Authors: Aleš Škoda and Václav Pecina

Description: The handbook is intended for forest managers – foresters – who are looking for inspiration on how to manage forests better. The goal is to present topics related to forest cultivation (silviculture) adapted to Mongolian conditions in a simple and illustrative form. This is not a textbook that would comprehensively explain the issue of silviculture together with theory. It is a tool with which a forester can learn directly in the forest what to do there – how to make the forest stronger, healthier and more productive, and how to become more

efficient at work and reduce costs and increase revenues. In particular, the handbook describes activities related to sustainable forest management, about which foresters need to know more. Silviculture is presented here in a broader context starting from seed collection, cultivation of seedlings in nurseries, reforestation, taking care of plants in forests until they are mature enough to be tended (Figure 49) and harvested. Emphasis is placed on increasing the quality and efficiency of the processes, in particular on forest protection and related activities. The content was prepared on the basis of the experience of Czech foresters with Mongolian forests in cooperation with Mongolian foresters. The book has 50 pages and is both in English and Mongolian.

Available at: <https://doi.org/10.11118/978-80-7509-972-3>

WHAT FOREST CARE IS NEEDED ACCORDING TO ITS STAGE OF DEVELOPMENT

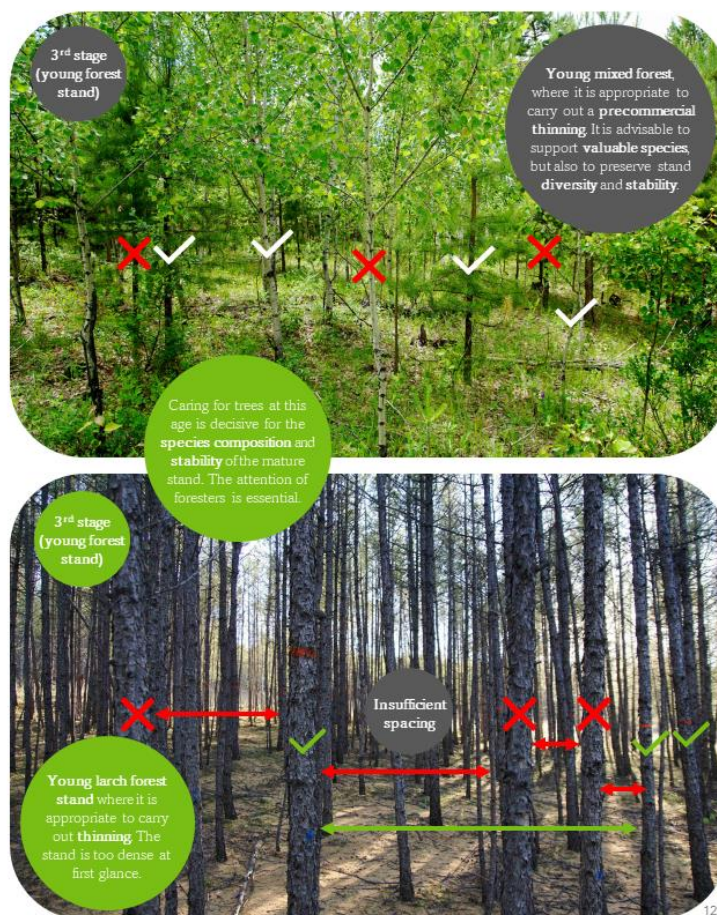


Figure 49. An example of a page from the book.

11 FOREST NURSERIES SURVEY AND EVALUATION

Responsible persons: Aleš Škoda and Jan Šebesta

Description: High quality seedlings are essential for successful artificial forest regeneration. Although we prefer natural regeneration and artificial measures to promote and support it, in some cases it is necessary to plant pre-grown seedlings. A forest nursery is a place where trees and other woody plants are grown for the purpose of reforestation, afforestation, or landscaping. Forest nurseries may specialize in a particular type of tree, such as conifers, deciduous trees, or fruit trees, or they may offer a wide variety of species for sale. Hence, several forest nurseries in Selenge and Khentii aimags were evaluated as part of the inspection of experts from MENDELU together with their colleagues from the GIZ. Based on the experiences from those nurseries, we prepared a report including a list of suggestions and measures that can effectively improve the quality and quantity of seedling production and operational efficiency of forest nurseries in Mongolia. The expertise considered the given environmental and socio-economic conditions.

11.1 Output

11.1.1 Forest nurseries in Mongolia: Recommendations for increasing the quality and quantity of seedling production

Authors: Aleš Škoda and Václav Pecina

Description: The report containing a list of suggestions and measures that can effectively improve the quality and quantity of seedling production and operational efficiency of forest nurseries in Mongolia was prepared. The expertise considered the given environmental and socio-economic conditions. To write the report, 13 forest nurseries were visited and 22 generalized recommendations were written based on their condition. Forest nursery in Binder was evaluated in detail (Figure 50, Figure 51). The report has a total of 47 pages. The document is both in English and Mongolian.

Available at: <https://forest4mongolia.mendelu.cz/en/outputs>



Figure 50. *New greenhouse (2023) in Binder nursery. In the future, the occupancy of the greenhouse with seedlings and the preparation of the soil horizon should be improved.*



Figure 51. *Example of poor (uneven) sowing in Binder nursery, where some places are empty, and others are too densely sown.*

12 EDUCATIONAL VIDEOS ABOUT FORESTS AND FORESTRY

Responsible persons: Antonín Kusbach and Jan Šebesta

Description: MENDELU prepared various types of educational video materials for public and forestry practitioners. The materials were prepared and designed based on the specific needs of each group of users. The materials are freely accessible on-line.

Available at: <https://forest4mongolia.mendelu.cz/en/outputs>

12.1 Outputs

12.1.1 Forest documentary movie – STREAM for the Green Mongolian Landscape

Responsible persons: Antonín Kusbach and Ladislav Moulis

Description: MENDELU contributed to the dissemination of project results by the preparation of an educational documentary film. MENDELU hired professional cameraman Ladislav Moulis (Figure 52), who was responsible for the technical part of the documentary preparation. The main aim of the documentary is to raise awareness of the importance of Mongolian forests and the threats they face. The message of the documentary is primarily aimed at a wider Mongolian audience, focusing on two main topics related to forests in Mongolia: i) the path of water and ii) the path of wood/timber (forest management). Both topics are closely related to climate change and threats to the local forests. Filming took place mainly around Bugant and Javkhlant, but areas of Binder, Bayan-Adarga, Umnudelger, Terelj and Ulaanbaatar are also included. Interviews are made with people from across the forestry sector (Figure 53), environmental researchers, students of forestry-oriented fields and representatives of the political sector. The documentary is intended for i) the wider public of all ages, ii) professionals and iii) students of elementary, primary, high schools and universities with potential for international reach. The documentary is going to be offered to Mongolian Public Television and Czech Public Television and distributed to a wide range of institutions, including, for example, schools, universities and forest user groups in Mongolia. The documentary is expected to reach thousands of people not only in Mongolia as it is provided in three language versions: English, Mongolian and Czech.

The full version (27 minutes) is available at: <https://forest4mongolia.mendelu.cz/en/outputs>

A short trailer (3:40 minutes) is available at: <https://forest4mongolia.mendelu.cz/en/outputs>



Figure 52. *Ladislav Moulis (on the left) and Antonín Kusbach (on the right) during drone filming in Gorkhi Terelj National Park.*



Figure 53. *Ladislav Moulis filming an experienced employee of a forest nursery in Bugant.*

12.1.2 Educational videos for forestry practice: 1) Reforestation, 2) Seed collection, and 3) Tree logging

Responsible person: Jan Šebesta

Authors: Richard Slabý and Jan Šebesta

Description: MENDELU produced three educational videos. The topics of 1) reforestation, 2) seed collection and 3) tree logging were covered by the videos. The reforestation video lasts 5:30 minutes and describes the procedures in forest nurseries: how to seed the seedlings, what types of seedlings should be chosen for replanting, the distance of seedlings, how to protect the seedlings and how to plant the seedlings in the field. The risks associated with planting and key recommendations were described: drying, browsing, and trampling. Several technologies for planting and plant protection were introduced. We also emphasized the support of natural regeneration. The expected target group should be workers in forest nurseries and students. The seed collection video lasts 6:40 minutes and there is a summary of the main principles of tree climbing, technologies, and safety. The video primarily serves as additional material for the participants of the tree climbing course. The main emphasis is on work safety. The participant and lecturer demonstrate all the steps and techniques for tying into the climbing set. Subsequently, they demonstrate harmless climbing and collecting of cones and seeds on the treetops. A technology and process for how to obtain the seed from the cones is introduced as well. The logging video lasts 6:30 minutes and describes the basic principles, benefits and challenges of thinning. The procedure for tree cutting in the specified direction is also shown in detail, including where to place the notches into the trunk. There is also the introduction of methods and technologies how to move the trunks and products from the forest stand. The processing and storing of the wood in a suitable place are also integral parts of the video. Besides, the expert demonstrated how to collect and clean the chainsaw. Finally, the basic of chain grinding is also introduced.

Available at: <https://forest4mongolia.mendelu.cz/en/outputs>

13 MARKETPLACE APPLICATION

Responsible persons: Jan Šebesta and Václav Pecina

Authors: Robert Blaha, Václav Pecina, Jan Šebesta

Description: MENDELU prepared a pilot version of the web application including the catalogue of services and products in the field of forestry and wood processing on the Mongolian market (Figure 54). The application is a kind of online marketplace where it will be possible to find and trade products and services in real time with the possibility of bidding on the price and closing the entire deal. The task for the period of the STREAM project was to design and create the pilot version so that interest in a similar application could be verified in real operation. The application contains three main sections. The first two sections provide the sorts of services and products offered by local providers. Application users can find out the necessary information about the service provider especially the contact details and a range of services and products provided. The items in the catalogue are tree organized. The application shows the distance between the user and the provider based on the current location of the user. The last section of the application is informative/educational. This section allows its user to search for appropriate management measures for each development phase of the forest and provides the sort of service for each necessary kind of management interventions. It is assumed that the list of service providers will be centrally managed (Figure 55). A service provider who wants to be included in the catalogue submits a request for registration which will be carried out by an authorized administrator. Before registration the administrator verifies the data on the service provider and the goods he offered.

Technical solutions: The application is divided into two parts - administrative and public/user. The administrative part is used to manage categories and service providers. The public one then provides an interface for end users. The server part of the application is created in the Python programming language using the Django framework. This made it possible to use the administration interface of this framework and thus obtain, with only minor modifications, a full-fledged administration tool. This framework also provides data and background for the user part of the application. In this version, it is created only with a basic tabular appearance using the Bootstrap library. The open-source PostgreSQL database is used for data storage. The application enables the translation of all data and user interface elements. English was primarily used for development, and translation tools are available.

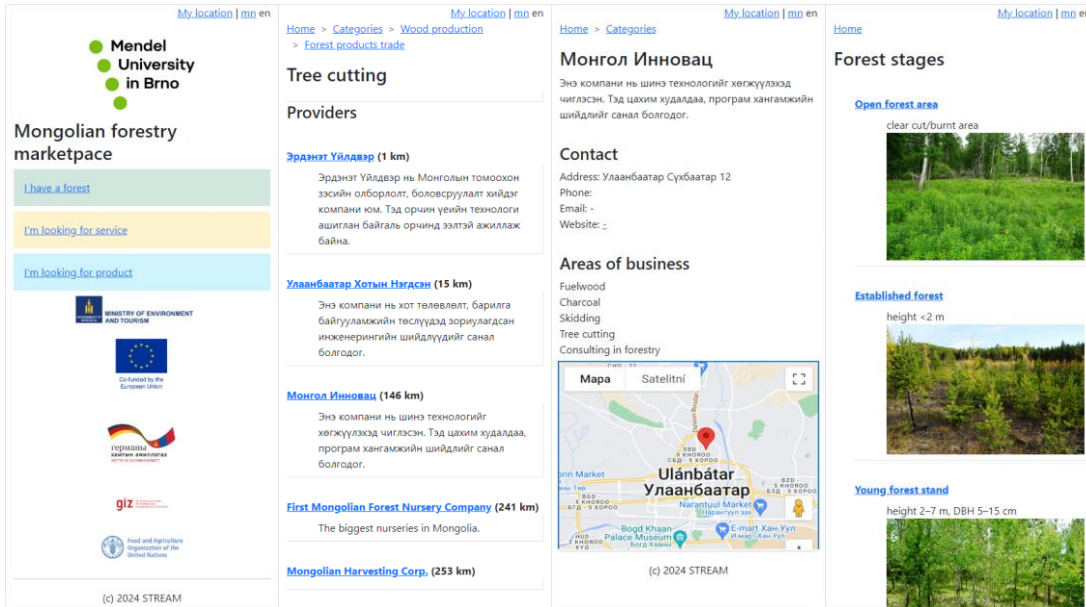


Figure 54. Marketplace application.

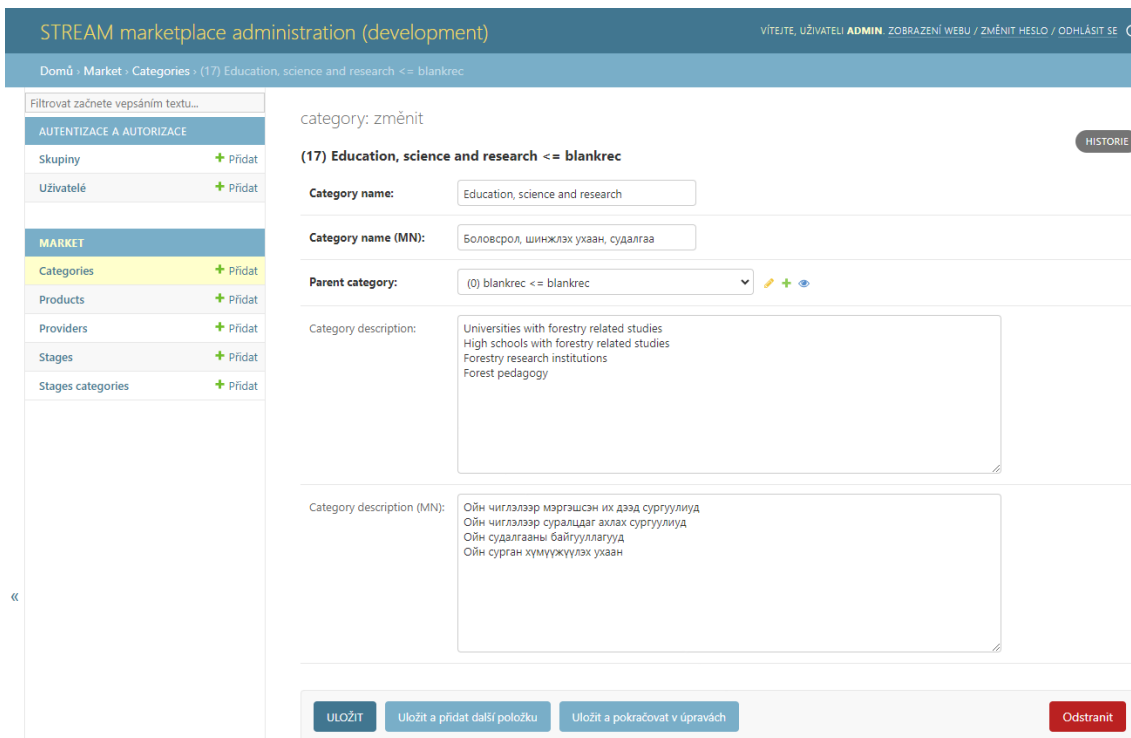


Figure 55. Example of creating catalogue services.

14 INTERNATIONAL UNIVERSITY CONSORTIUM

The participation of the Consortium in the STREAM project followed the EU internationalization strategy. The consortium team members were selected to deal with the specific topics of the Mongolian environment. Holistic approach is the key to understanding the natural processes and human interaction and finding the solution to current challenges in forestry and landscape engineering in Mongolia. The role of the Consortium in the STREAM project was to contribute to science and education and observing. The Consortium members visited Mongolia two times (in 2022 and 2023). They were an integral part of lecturing students and some of the workshops for foresters and local authorities (Figure 56). The international Consortium enriched the field of lecturing and training with different educational approaches and methods. They participated in the current research activities and established their own experiments and contributed to some of the project outputs (e.g. chapters in the textbook for university students).



Figure 56. Consortium members participating in the policy discussion at Binder.

15 CHALLENGES: KEY MESSAGES

1

With the current issue of climate change, with dramatically changing environment and critical impacts on society in Mongolia, **sustainable forest management cannot be done without research**. It is essential to follow the potential of natural conditions, empiric data and predictions.

2

Environmental conditions and transport accessibility enable forest management focused primarily on wood production in a very limited number of areas. These areas should primarily be selected and managed for the needs of the **development of the forestry sector and the wood processing industry in the coming years**. Model examples with the introduction of new technologies are essential.

3

In order to maintain, develop and protect forests, there is a need to change the approach at the national level. This requires consistent education. **There is a lack of professionals in the forestry sector, they need to be trained**. Cooperation between universities and practice and forestry education at secondary school level is essential.

16 AFTERWORD

An enormous amount of work in the field was done and many interesting outputs were produced during the short period of the STREAM project. However, it is just the beginning. It is necessary to continue the current activities in the demonstration plots together with local people and to promote the implementation of management measures in practice. Against the backdrop of climate change it is necessary to continue the long-term monitoring of natural conditions which is essential for scientific-based sustainable forest management. For MENDELU, Mongolia is one of the priority countries for international cooperation. Together with the strong international scientific team including local universities (Figure 57), MENDELU is going to upscale the research, education, and development activities in Mongolia.



Figure 57. *Strong team for strong Mongolian forests.*

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