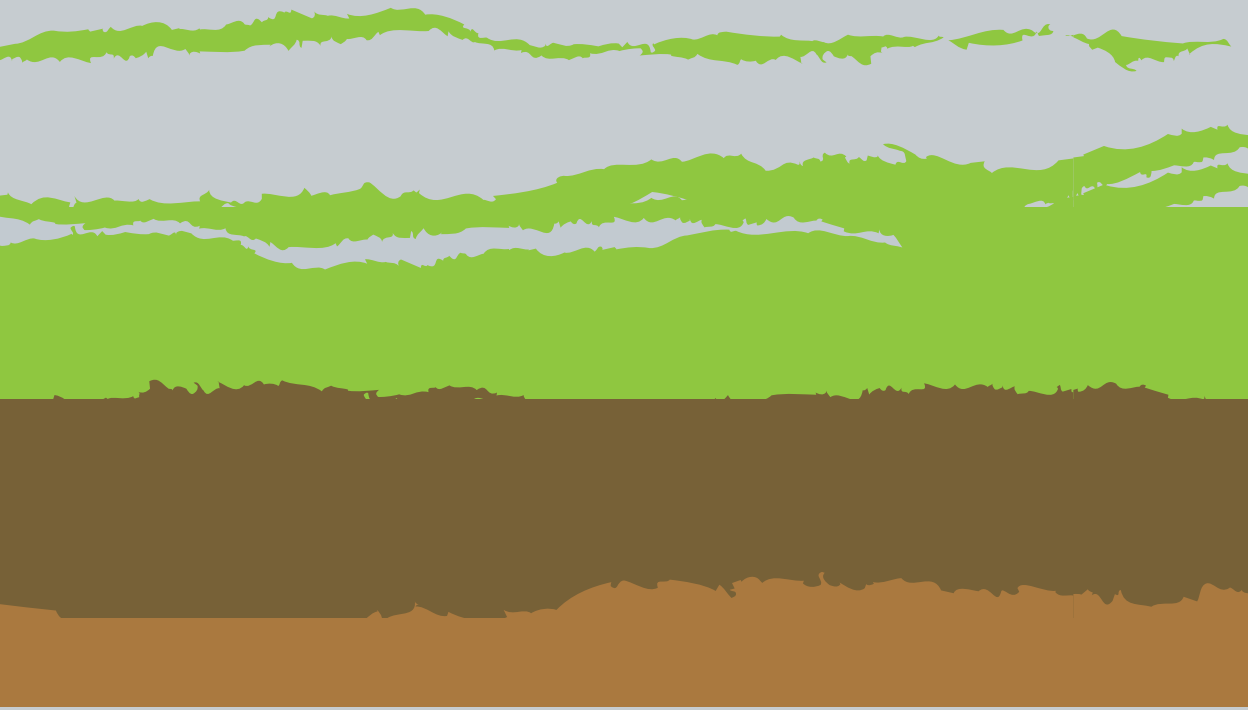
Soil management practices in the Alps

A selection of good practices - Case Study 8



Edited by · Andreja Nève Repe · Aleš Poljanec · Borut Vrščaj

Interreg Alpine Space
EUROPEAN UNION
Links4Soils
EUROPEAN REGIONAL DEVELOPMENT FUND

Excerpt from
SOIL MANAGEMENT PRACTICES IN THE ALPS
A selection of good practices for the sustainable soil management in the Alps

Project and funding
Links4Soils project (ASP399);
EU Interreg Alpine Space

WP, Deliverable
WPT3 (D.T3.5.3)

WP Lead / Publisher
Slovenia Forest Service
(Zavod za gozdove Slovenije)

Editors
Dr. Andreja Nève Repe, Dr. Aleš Poljanec,
Dr. Borut Vrščaj

Reviewers
Dr. Aleš Poljanec, Elena Cocuzza,
Sašo Gorjanc, Elisabeth Schaber,
Dr. Borut Vrščaj, Jurka Lesjak,
Dr. Michele Freppaz, Dr. Silvia Stanchi,
Dr. Andreja Nève Repe

Slovenia Forest Service, Office of the Tyrolean Regional Government, Agricultural Institute of Slovenia, University of Innsbruck, Institute of Geography, University of Torino, Department of Agricultural, Forest and Food Sciences

English review
Miha Odar

Acknowledgments
Special thanks to Mr Thomas Peham, a Links4Soils project partner and member of the EUSALP Action Group 6, who provided several best-case practices.

Layout
Alenka Šubic

Place and date
Ljubljana, April 2020

URL
https://www.alpine-space.eu/projects/links4soils/en/

Free copy

Kataložni zapis o publikaciji (CIP) pripravili v Narodni in univerzitetni knjižnici v Ljubljani

COBISS.SI-ID=305185024

ISBN 978-961-6605-41-0 (pdf)

Interreg Alpine Space
EUROPEAN UNION
Links4 Soils
ZAVOD za GOZDOVE SLOVENIJE
Slovenia Forest Service

CS8.

Revegetation of degraded areas in the French Alps

INRAE, French National Research Institute for Agriculture, Food and Environment:
Alice Dupré la Tour
Thomas Spiegelberger
Contact:
Alice Dupré la Tour
alice.duprelatour@inrae.fr

Thomas Spiegelberger
thomas.spiegelberger@inrae.fr

Country, Region:	*France, Auvergne Rhône Alpes*
Organisation:	*INRAE, French National Research Institute for Agriculture, Food and Environment*
Sector:	*ski resorts, tourism*
Land uses:	*pasture, ski slopes*
Main soil threat:	*erosion*
Key soil ecosystem services:	*erosion, tourism, production (agropastoralism)*
Summary:	*Following the degradation that comes with infrastructure development, ecological restoration initiatives often utilise non-native seed mixtures resulting in hybridisation, and competition with local flora. This project aimed to develop and test a more efficient reseeding method by utilising the so-called "fresh hay transfer" method, which calls for the use of species adapted to the local biotope. The method was successful estimating a 70–80% recovery within the next years.*
Keywords:	*erosion, hay transfer technique, revegetation, local seeds*

Background and description of the problem

The restoration of degraded land at high altitude is strongly linked to the creation of infrastructure (tourist buildings, roads, ski slopes, pastoral and forestry use, power lines, protection against natural hazards, etc.) and requires compensatory works to mitigate the negative consequences of the construction works. In general, the purpose of ecological restoration is to block or slow down the degradation of natural environments and the loss of biodiversity. Thus, the revegetation is practically systematic when structure of the ground is modified.

In Courchevel, as part of development work for the resort, major surfaces were redesigned in 2017 in the Moriond sector (coordinates: 45°24'48'' N, 6°36'54'' E – altitude: 2000 m). Machine-graded ski run constructions had an impact on the environment and soil in particular. Thus, actions have been taken to mitigate the negative consequences of the construction. Société des 3 Vallées (S3V – the company in charge of ski resort operations) in conjunction with the MDP (landscape planner) and the farmer-operator have initiated revegetation operations in the area affected by the development. The main reason mentioned by S3V was to mitigate the erosion process. A soil that is left bare is exposed to high risk of erosion and, at such altitude, the vegetation has difficulties growing due to climate and soil characteristics, all the more because of soil compaction due to the use of construction machinery. The revegetation is also needed to minimise the project impact on landscape. Finally, the vegetation provides a protection of the snowpack that is valuable for ski slopes. From another point of view, the benefit of revegetation is also to ensure a plant cover to allow agropastoral activity during the summer season.

However, the seed mixtures that are usually used for the revegetation of high-altitude areas in the French Alps are very rarely of Alpine origin and often result in low altitude multiplication and little diversity in species. Of the plant species most frequently used for planting, three are mainly cultivated outside the European Union (Achillea millefolium in New Zealand, Bromus erectus in the United States and Trifolium subterraneum in Australia).

The use of these commercial mixtures can have several negative consequences on the vegetation growing at high altitudes:

- low durability of planted cover crops with high risk of erosion of poorly protected soils,
- need to bring large numbers of seedlings and doses of fertilisers,
- risk of hybridisation and competition with local flora inducing a modification of plant communities and landscapes.

This case study aimed to develop and test a more efficient reseeding method. The so-called "fresh hay transfer" method is based on the use of local species adapted to the local biotope. Société des 3 Vallées aimed at reseeding a pilot plot in Ariondaz at an altitude of 2000 meters.

Duration of the project: The project took place in august 2017

The cost of the project for an area of 4,000 m² was €2,350 of which the farmer received a total of: €850 and compensation for the hay totalling: €300. These costs do not include the time spent for the negotiations, organisation, and coordination of the construction works.

Contribution to better soil management

As a preamble, we remind you that this project took place in a specific ecosystem of ski resorts. This ecosystem is strongly impacted by the presence of snow and in particular artificial snow, involving the destruction of soil and the use of fertilizers.

This project was an opportunity to present the feasibility of an alternative method compared to the usual one that is used to vegetate ski slopes. Indeed, earth-moving companies use practices that are harmful to soil preservation. During the operations, the soil should be stripped, stored and reinstalled horizon by horizon.

The soil should not be smoothed with a power shovel but rather scratched perpendicular to the line of greatest slope to obtain a roughness which limits erosion phenomena and to ensure sufficient decompaction of the topsoil.

This project also highlighted the limitations of the contractual conditions under which the work is carried out. Earth-moving companies are contractually committed to ensure vegetation recovery rate a few months after seeding. For this reason, they use fertilisers. With the hay transfer technique we can demonstrate to earth-moving companies that the use of local seeds adapted to the specific conditions of high mountainous areas (climate and poor substrate) and careful soil preparation can garner comparable if not better result.

Stakeholders and target groups

This project of revegetation concerns a large public of practitioners involved in the mountain area management: ski resort managers, engineering offices, managers of natural areas, seed producers, public administrations, pastoral services, and public research centres.

The revegetation project of Courchevel was carried out by:

Société des Trois Vallées (S3V)
La Croisette
73120 Courchevel
+33 (0) 4 79 08 04 09
contact@s3v.com

MDP Consulting
5A chemin de la Dhuy
38240 Meylan
+ 33 (0)4 76 90 20 60
cecile.baudot@consultingbymdp.com

INRAE, French National Research Institute for Agriculture, Food and Environment:
2 Rue de la Papeterie
38402 Saint-Martin-d'Hères
+ 33 (0)4 76 76 27 27

The case study was funded within the project of SEM'LES ALPES, S3V and the departmental board of Haute Savoie.

Data and methods

The site is located in Courchevel (France). The vegetated area corresponds to an area of 4,000 m². According to the EUNIS habitat classification, the natural habitat of the site is classified as E2.3, which corresponds to a hay meadow. The hay was harvested on an area of 17,500 m².

The procedure followed is broken down into several steps as follows:

1. Protection of the harvesting area

The area to be mowed is to be protected as soon as the snow melts on 1 to 2 hectares. A harvesting area of 2 hectares for every 1 hectare to be replanted will provide a safety margin in the implementation of the hay transfer if the mowing period or method results in a loss of seed.

2. Placement of the substrate on the plot to be restored

The successful completion of this step is critical to the success of revegetation. The topsoil must be identified with the prime contractor, stripped and stored separately. After the reconstitution of the mineral horizons, the topsoil is to be spread just before sowing in a fairly thick layer without large clods, and very slightly compacted. The objective is to have a loose substrate on the surface at the time of sowing. Otherwise, the soil must be de-compacted just before sowing with a harrow passage or the power shovel bucket.

If the topsoil is rich, there is no need to spread manure. If the choice is made to add manure, it can be spread just after the topsoil, or, when there is lack of it, it can be mixed in. The amount of manure must be reasonable so as not to have a substrate that is too fertile, which would limit the germination of certain species.

3. Hay harvesting at the sampling site

The optimal mowing date corresponds to the beginning of the maturation of the seeds of the main grasses of the prairie at the soft pasty stage, i.e. 5–6 days before maturity. Adjusting the date according to the observed phenological stages is recommanded. It is preferable to mow at low speed at about 5–7 cm cutting height in cool to wet conditions, with morning dew, to prevent seeds from falling out.

4. Transport of fresh hay

Mowed hay should be picked up soon after cutting if possible, during the day. If work is not completed on the areas to be revegetated, hay can be left on site for up to one week, even if it rains, or loaded on a tarpaulin and covered with it and stored for up to 2–3 days. Several options are available for pick-up:

– Swathing and collecting with a fork, which is labour-intensive but significantly reduces seed loss. For forklifting, you should plan a day with 5 -10 people per hectare.

– Swathing and baling the hay into bales, which results in a significant loss of seed, but limits the amount of labour required. Small rectangular bales hold more seed than round bales. Large rectangular bales are to be avoided. When pressing, be careful not to overtighten the bales.

– If a loader is available, bulk pick-up can be carried out more quickly. Bulk hay or unpacked bales can be put directly into the manure spreader, or stored in a semi-trailer with a tarpaulin spread at the bottom to recover falling seed.

5. Spreading fresh hay

On the site to be replanted, spread the hay 2 cm thick. If necessary, recover the seeds that have fallen on the tarpaulin in the semi-trailer and sow them.

6. Protection of the restored area

If livestock pass nearby, set up an area enclosed by an electric fence and put up signage for at least 2 years following the completion of works.

Activities

Before main construction activities, the topsoil has been removed with an excavator and stored next to the site. Below the same area, an ecologically similar plot of grassland has been identified and allocated as a source area for obtaining natural seeds.

Once the modifications have been done, the topsoil has been repositioned. Then, the soil has been superficially scratched in the direction perpendicular to the line of maximum gradient to mitigate potential erosion due to rain and snow melting. The soil has not been amended to avoid a perturbation of the natural species mixture, i.e. favouring of one species over another.

On the pilot site, two different plots were identified, on which to apply two different seeding methods. The first method consists of spreading the fresh hay on the ground. The second consists of seeding non local seeds mixtures to allow an accurate evaluation of the "fresh hay transfer" method.

The source plot was mown in early August when the seeds of the main species were reaching maturity. After the reconstitution of a topsoil horizon over the area to be restored, the harvested hay was spread by hand at a thickness of 2 cm providing mixed seeds, and mulching favourable to germination.

Results and success of the project

The "fresh hay" method on all the sites has been successful: it makes it possible to obtain remarkable plant cover rates over the first two years of monitoring and a specific composition that over time resembles that of the reference environment. The vegetation cover percentages that were observed in the plots that were seeded using the "fresh hay" method suggest that vegetation can be expected to recover over the next few years, and will most likely reach values of 70 to 80% for sufficient protection against mountain erosion (Krautzer et al. 2006; Dupin et al. 2014). The return of the vegetation cover on the entire surface may take time, but the results of this study show a more accurate fast and efficient recovery on plots reseeded using the fresh hay transfer method.

Detailed results in French can be found on the website of the "Sem Les Alpes" Project http://www.cbn-alpin.fr/actualites/poia/semlesalpes.html

Transferability and applicability to better soil management practice

The implementation of the "fresh hay transfer" method has the advantage of being replicable in various contexts. To be successful, it requires special attention from the landscape contractors with regards to the location of source grasslands and planning.

The first important step is to identify a source grassland where the first mowing can be delayed to build a seed stock, and then to plan the service with the farmer of the plot. The ratio between the area to be harvested and that to be restored depends on the environment. The second important step is the operation schedule that has

to be adapted both to the progress of development projects and to the maturity periods of the seeds.

Environmental and climate change impact

The case study has focused on developing the use of locally sourced seeds in restoration work in Alpine mountain areas. The actions carried out have been reasonable in such a way as to positively impact biodiversity, preserving genetic, specific, and ecosystem-based heritage. The impacts in terms of greenhouse gas (GHG) emissions were not the main purpose of the project but were taken into account throughout its implementation.

Firstly, the restoration of open habitats with local seeds, which consists of restoration of sustainable and autonomous plant covers, has the effect of storing carbon in vegetation and soil. Indeed, the permanent grasslands are carbon sinks, the storage of which has been evaluated in Europe at 2.7 t eCO_2/ha/year (or 0.7 t C/ha/ year), a value comparable to that of temperate forests. The intensity of carbon storage in permanent grasslands depends on many factors, such as management practices, which cannot be reported here for a quantitative assessment of GHGs stored during the performance of restoration work.

The use of locally sourced seeds in these ecological restoration works also has direct impact on GHG. Firstly, the transport of seed stocks is minimised, whether the mixtures come from direct harvests in natural environments or from multiplication. In the case of harvests in the natural environment, the source sites must be bioclimatically similar to the areas to be restored. The geographic information system tool for identifying potential harvest areas has been designed with this in mind, which also meets the feasibility criteria. Secondly, as locally sourced seeds are adapted to the poor soils of mountainous and subalpine areas, they do not require fertilisation, unlike non local seeds generally used by landscape contractors. However, chemical or organic fertilisation of soils, directly and indirectly, generates emissions of nitrous oxide, a gas with a very high global warming potential. In addition, as exogenous seeds are unsuitable for mountain bioclimatic conditions, their recovery is weak, requiring over-seeding and over-fertilisation in the years following restoration.

Finally, sowing non local mixtures generates plant cover with some species disappearing in the mid-term, which does not allow grasslands to fulfil their role as carbon sinks. On the other hand, sowing local mixtures makes it possible to obtain autonomous herbaceous cover crops, whose carbon storage function is stabilised.

Photos / illustrations / maps

Figure 30: Soil preparation

Figure 31: Spreading of fresh hay.

References and further reading

Dupin B., Malaval S., Couëron G., Cambecedes J., Largier G. (2014)
Comment reconstituer la flore en montagne pyrénéenne. Conservatoire botanique national des Pyrénées et de Midi-Pyrénées, Bagnères de Bigorre, 72-73.

Krautzer B., Wittmann H., Peratoner G., Graiss W., Partl C., Parente G., Venerus S., Rixen C., Streit M (2006)
Site-specific high zone restoration in the Alpine region: the current technological development. Federal Research and Education Centre Raumberg-Gumpenstein, Irdning, 97-130.

Caring for Soils
- Where Our Roots Grow