Applying organic residues to denuded areas (Iceland)

Restoration with organic residuals

**DESCRIPTION**

Applying organic residues to denuded areas

The rangelands in question are severely degraded, and parts of them have lost their topsoil layer entirely. Nevertheless, in many cases some remnant vegetation patches are still in place and can serve as seed banks during the restoration process. In order to stabilize the surface (i.e., to reduce the effects of freeze-thaw processes), to provide nutrients to the system, increase water availability and facilitate the spread of native species within the degraded areas, tractors are used to spread manure or hay over the denuded areas. All implementation is based on the methods and tools used in ecological restoration, aiming at re-activating environmental and ecological processes, and increasing the resilience of the ecosystems undergoing restoration. Denuded patches, preferably close to the remaining vegetation “islands”, are covered with organic matter in order to stabilize the surface, facilitate seed production and dispersal and provide safe sites for germination.

Purpose of the Technology: The purpose of the technology is to halt further land degradation and facilitate natural succession within the area undergoing restoration. In the long-term, it should substantially reduce wind and water erosion. It should also lead to increased biodiversity, enhanced water availability and accelerated carbon sequestration (in both soil and vegetation). The overall restoration task is to increase the resilience of the ecosystems to natural hazards, including volcanic activity.

Establishment / maintenance activities and inputs: In the year after the areas are addressed, they are commonly treated with a low level of inorganic fertilizer to provide readily available nutrients to the seeds, and seedlings that have already germinated, within the area. The fertilizer treatment is repeated twice a year for 4-8 years on average.

Natural / human environment: In the long-term, the technology is expected to substantially increase biomass production, re-build soil qualities, accelerate carbon sequestration and secure water availability within the rangeland and the adjacent ecosystems. The areas still grazed are assumed to be more suitable for grazing and the protected areas are expected to be of better recreational and aesthetic value. The increased vegetation cover will reduce, and even halt, the sand drift that still creates challenges for inhabitants in adjacent villages, on farmsteads and within the summerhouse clusters scattered around the area. As the degraded rangeland is in the vicinity of an active volcano (Mt Hekla) the technology is also expected to increase ecosystem resilience against natural hazards like ash and pumice drift and reduce potential offsite damage caused by these materials.

**LOCATION**

<table>
<thead>
<tr>
<th>Location</th>
<th>Rangarvellir, Rangarthig Ytra, Iceland</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Technology sites analysed:</td>
<td>n.a.</td>
</tr>
<tr>
<td>Geo-reference of selected sites</td>
<td>n.a.</td>
</tr>
<tr>
<td>Spread of the Technology:</td>
<td>No</td>
</tr>
<tr>
<td>In a permanently protected area?:</td>
<td>No</td>
</tr>
<tr>
<td>Date of implementation:</td>
<td>more than 50 years ago (traditional)</td>
</tr>
<tr>
<td>Type of introduction</td>
<td>through land users' innovation</td>
</tr>
<tr>
<td>as part of a traditional system (&gt; 50 years)</td>
<td>✓</td>
</tr>
<tr>
<td>during experiments/ research through projects/ external interventions</td>
<td></td>
</tr>
</tbody>
</table>
Old hay used to stabilize the surface, bring in nutrients and make safe microsites for seed germination (Thorunn Petursdottir)

### Classification of the Technology

#### Main Purpose
- ✓ improve production
- ✓ reduce, prevent, restore land degradation
- ✓ conserve ecosystem
- ✓ protect a watershed/ downstream areas – in combination with other Technologies
- ✓ preserve/ improve biodiversity
- ✓ reduce risk of disasters
- adapt to climate change/ extremes and its impacts
- mitigate climate change and its impacts
- ✓ create beneficial economic impact
- ✓ create beneficial social impact

#### Land Use

- **Grazing land**
  - Extensive grazing
  - Animal type: horses, sheep
  - Products and services: meat, whool

- **Unproductive land** - Specify: Wastelands, deserts, glaciers, swamps, recreation areas, etc

#### Water Supply

- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

#### Purpose Related to Land Degradation

- ✓ prevent land degradation
- ✓ reduce land degradation
- ✓ restore/ rehabilitate severely degraded land
- ✓ adapt to land degradation
- not applicable

#### Degradation Addressed

- **Soil erosion by water** - Wt: loss of topsoil/ surface erosion, Wo: offsite degradation effects

- **Soil erosion by wind** - Et: loss of topsoil, Eo: offsite degradation effects

- **Biological degradation** - Bc: reduction of vegetation cover, Bq: quantity/ biomass decline, Bs: quality and species composition/ diversity decline

- **Water degradation** - Hs: change in quantity of surface water, Hg: change in groundwater/aquifer level

#### SLM Group

- ✓ improved ground/ vegetation cover
- ✓ ecosystem-based disaster risk reduction

#### SLM Measures

- **Agronomic measures** - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility

### Technical Drawing

Technical specifications

An example of how old hay can effectively be distributed on denuded areas with the right equipment

Technical knowledge required for field staff / advisors: low

Technical knowledge required for land users: low

No vegetation --> old hay spread over area --> with machinery to spread
ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated:
  - Currency used for cost calculation: ISK
  - Exchange rate (to USD): 1 USD = 138.0 ISK
  - Average wage cost of hired labour per day: n.a

Most important factors affecting the costs
The most determinate factors affecting the cost are: 1) the machinery needed and 2) the distance of the eroded areas from the farmsteads

Establishment activities
1. Spreading organic residuals (Timing/ frequency: spring time and summer)

Establishment inputs and costs

<table>
<thead>
<tr>
<th>Specify input</th>
<th>Unit</th>
<th>Quantity</th>
<th>Costs per Unit (ISK)</th>
<th>Total costs per input (ISK)</th>
<th>% of costs borne by land users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>ha</td>
<td>1.0</td>
<td>126400.0</td>
<td>126400.0</td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>ha</td>
<td>1.0</td>
<td>72000.0</td>
<td>72000.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Fertilizers and biocides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compost/manure (hay cost probably higher)</td>
<td>ha</td>
<td>1.0</td>
<td>10000.0</td>
<td>10000.0</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>ha</td>
<td>1.0</td>
<td>10000.0</td>
<td>10000.0</td>
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<tr>
<td>Total costs for establishment of the Technology</td>
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<td>218'400.0</td>
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<td></td>
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<tr>
<td>Total costs for establishment of the Technology in USD</td>
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<td></td>
<td>1'582.61</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Maintenance activities
n.a.

NATURAL ENVIRONMENT

Average annual rainfall
- < 250 mm
- 251-500 mm
- 501-750 mm
- 751-1,000 mm
- 1,001-1,500 mm
- 1,501-2,000 mm
- 2,001-3,000 mm
- 3,001-4,000 mm
- > 4,000 mm

Agro-climatic zone
- humid
- sub-humid
- semi-arid
- arid

Specifications on climate
Thermal climate class: boreal

Slope
- flat (0-2%)
- gentle (3-5%)
- moderate (6-10%)
- rolling (11-15%)
- hilly (16-30%)
- steep (31-60%)
- very steep (>60%)

Landforms
- plateau/plains
- ridges
- mountain slopes
- hill slopes
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- 501-1,000 m a.s.l.
- 1,001-1,500 m a.s.l.
- 1,501-2,000 m a.s.l.
- 2,001-2,500 m a.s.l.
- 2,501-3,000 m a.s.l.
- 3,001-4,000 m a.s.l.
- > 4,000 m a.s.l.

Technology is applied in
- convex situations
- concave situations
- not relevant
### Soil depth
- **Very shallow (0-20 cm)**
- **Shallow (21-50 cm)**
- **Moderate deep (51-80 cm)**
- **Deep (81-120 cm)**
- **Very deep (> 120 cm)**

### Soil texture (topsoil)
- **Coarse/ light (sandy)**
- **Medium (loamy, silty)**
- **Fine/ heavy (clay)**

### Soil texture (> 20 cm below surface)
- **Coarse/ light (sandy)**
- **Medium (loamy, silty)**
- **Fine/ heavy (clay)**

### Topsoil organic matter content
- **High (>3%)**
- **Medium (1-3%)**
- **Low (<1%)**

### Groundwater table
- **On surface**
- **< 5 m**
- **5-50 m**
- **> 50 m**

### Availability of surface water
- **Excess**
- **Good**
- **Medium**
- **Poor/ none**

### Water quality (untreated)
- **Poor drinking water**
- **Good drinking water**
- **Treatment required**
- **Irrigation**
- **Unusable**

### Is salinity a problem?
- **Yes**
- **No**

### Occurrence of flooding
- **Yes**
- **No**

### Species diversity
- **High**
- **Medium**
- **Low**

### Habitat diversity
- **High**
- **Medium**
- **Low**

### CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

#### Market orientation
- **Subsistence (self-supply)**
- **Mixed (subsistence/commercial)**
- **Commercial/ market**

#### Off-farm income
- **Less than 10% of all income**
- **10-50% of all income**
- **> 50% of all income**

#### Relative level of wealth
- **Very poor**
- **Poor**
- **Average**
- **Rich**
- **Very rich**

#### Level of mechanization
- **Manual work**
- **Animal traction**
- **Mechanized/ motorized**

#### Sedentary or nomadic
- **Sedentary**
- **Semi-nomadic**
- **Nomadic**

#### Individuals or groups
- **Individual/ household**
- **Groups/ community**
- **Cooperative**
- **Employee (company, government)**

#### Gender
- **Women**
- **Men**

#### Age
- **Children**
- **Youth**
- **Middle-aged**
- **Elderly**

#### Area used per household
- **< 0.5 ha**
- **0.5-1 ha**
- **1-2 ha**
- **2-5 ha**
- **5-15 ha**
- **15-50 ha**
- **50-100 ha**
- **100-500 ha**
- **500-1,000 ha**
- **1,000-10,000 ha**
- **> 10,000 ha**

#### Scale
- **Small-scale**
- **Medium-scale**
- **Large-scale**

#### Land ownership
- **State**
- **Company**
- **Communal/ village**
- **Group**
- **Individual, not titled**
- **Individual, titled**

#### Land use rights
- **Open access (unorganized)**
- **Leased**
- **Individual**
- **Communal (organized)**

### IMPACTS

#### Socio-economic impacts
- **Water availability for livestock expenses on agricultural inputs**
- **Increased**
- **Decreased**

#### Socio-cultural impacts
- **Food security/ self-sufficiency**
- **Improved**
- **Worsened**

#### Ecological impacts
- **Water quantity**
- **Improved**
- **Worsened**

- **Reduce dust in the air**
- **Air better for breathing**
### Surface Runoff
- Increased
- Decreased

### Evaporation
- Increased
- Decreased

### Soil Moisture
- Increased
- Decreased

### Soil Cover
- Reduced
- Improved

### Soil Loss
- Increased
- Decreased

### Nutrient Cycling / Recharge
- Increased

### Soil Organic Matter / Below Ground C
- Decreased
- Increased

### Vegetation Cover
- Decreased
- Increased

### Biomass / Above Ground C
- Increased

### Emission of Carbon and Greenhouse Gases
- Increased
- Decreased

### Wind Velocity
- Increased
- Decreased

### Off-site Impacts
- Wind transported sediments
  - Increased
  - Decreased
- Damage on neighbours’ fields
  - Increased
  - Decreased
- Damage on public / private infrastructure
  - Increased
  - Decreased
- Impact of greenhouse gases
  - Increased
  - Decreased

#### Cost-Benefit Analysis

**Benefits compared with establishment costs**

- **Short-term returns**
  - Very negative
  - Very positive

- **Long-term returns**
  - Very negative
  - Very positive

**Benefits compared with maintenance costs**

- **Short-term returns**
  - Very negative
  - Very positive

- **Long-term returns**
  - Very negative
  - Very positive

#### Climate Change

- **Adoption and Adaptation**

  **Percentage of land users in the area who have adopted the Technology**
  - Single cases / experimental
    - 1-10%
    - 11-50%
    - > 50%

  **Number of households and / or area covered**
  - For the hay single cases ; manure more often 11-50%

  **Has the Technology been modified recently to adapt to changing conditions?**
  - Yes
  - No

  **To which changing conditions?**
  - Climatic change / extremes
  - Changing markets
  - Labour availability (e.g. due to migration)

#### Conclusions and Lessons Learnt

**Strengths: land user’s view**
- It increases the vegetation cover and stops wind erosion.

**Strengths: compiler’s or other key resource person’s view**
- Same view as land user.

**Weaknesses / disadvantages / risks: land user’s view**
- How to overcome
- This technology is dependence on surface and accessibility (must be accessible for machinery and not far away from farms).
- Specialized machinery is needed (only 3 machines in Iceland).
- Hay is needed to feed the animals and is therefore limited and if available expensive.

**Weaknesses / disadvantages / risks: compiler’s or other key resource person’s view**
- How to overcome
- Same view as land user.

#### References

**Compiler**
Thorunn Petursdottir

**Reviewer**
Hanspeter Liniger
Jan Reichert

**Date of documentation**: June 2, 2015

**Last update**: July 5, 2020
Resource persons
Thorunn Petursdottir - SLM specialist

Full description in the WOCAT database

Linked SLM data
n.a.

Documentation was facilitated by
Institution
• Soil Conservation Service of Iceland (Soil Conservation Service of Iceland) - Iceland
Project
• Preventing and Remediating degradation of soils in Europe through Land Care (EU-RECARE)

Links to relevant information which is available online
• Webpage Soil Conservation Service of Iceland: https://land.is/english/