Sheep manure used to stabilize the surface and bring in nutrients (Thorunn Petursdottir)

Applying organic residues to denuded areas (Iceland)

Restoration with organic residuals

DESCRIPTION

Applying organic residues to denuded ares

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

Location: Rangarvellir, Rangarthig Ytra, Iceland

No. of Technology sites analysed:

Geo-reference of selected sites

- n.a.

Spread of the Technology:

In a permanently protected area?: No

Date of implementation: more than 50 years ago (traditional)

Type of introduction

- [ ] through land users' innovation
- [x] as part of a traditional system (> 50 years)
- [ ] during experiments/ research
- [ ] through projects/ external interventions

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

Author: Sveinn Runólfsson

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

Specify input	Unit	Quantity	Costs per Unit (ISK)	Total costs per input (ISK)	% of costs borne by land users
Labour					
drivers on the tractor	ha	1.0	126400.0	126400.0	
Equipment					
Machine use (2 tractors needed)	ha	1.0	72000.0	72000.0	100.0
Fertilizers and biocides					
Compost/manure (hay cost probably higher)	ha	1.0	10000.0	10000.0	
Other					
transport of the hay (depend how far away)	ha	1.0	10000.0	10000.0	
Total costs for establishment of the Technology				**218'400.0**	
Total costs for establishment of the Technology in USD				*1'582.61*	

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
- [x] very shallow (0-20 cm)
- [ ] shallow (21-50 cm)
- [ ] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [ ] very deep (> 120 cm)

Soil texture (topsoil)
- [x] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- [x] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Topsoil organic matter content
- [ ] high (>3%)
- [ ] medium (1-3%)
- [x] low (<1%)

Groundwater table
- [ ] on surface
- [x] < 5 m
- [ ] 5-50 m
- [ ] > 50 m

Availability of surface water
- [ ] excess
- [ ] good
- [ ] medium
- [x] poor/ none

Water quality (untreated)
- [x] good drinking water
- [ ] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

Water quality refers to: ground water

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

Species diversity
- [ ] high
- [ ] medium
- [x] low

Habitat diversity
- [ ] high
- [ ] medium
- [x] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [ ] mixed (subsistence/ commercial)
- [x] commercial/ market

Off-farm income
- [ ] less than 10% of all income
- [x] 10-50% of all income
- [ ] > 50% of all income

Relative level of wealth
- [ ] very poor
- [ ] poor
- [x] average
- [ ] rich
- [ ] very rich

Level of mechanization
- [ ] manual work
- [ ] animal traction
- [x] mechanized/ motorized

Sedentary or nomadic
- [x] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

Individuals or groups
- [ ] individual/ household
- [x] groups/ community
- [ ] cooperative
- [ ] employee (company, government)

Gender
- [x] women
- [x] men

Age
- [ ] children
- [ ] youth
- [x] middle-aged
- [ ] elderly

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [x] 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
- [x] small-scale
- [ ] medium-scale
- [ ] large-scale

Land ownership
- [x] state
- [ ] company
- [ ] communal/ village
- [ ] group
- [ ] individual, not titled
- [ ] individual, titled

Land use rights
- [ ] open access (unorganized)
- [x] communal (organized)
- [ ] leased
- [ ] individual

Water use rights
- [x] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [ ] individual

Access to services and infrastructure

health	poor		✓	good
education	poor		✓	good
technical assistance	poor		✓	good
employment (e.g. off-farm)	poor		✓	good
markets	poor		✓	good
energy	poor		✓	good
roads and transport	poor	✓		good
drinking water and sanitation	poor		✓	good
financial services	poor		✓	good

IMPACTS

Socio-economic impacts

water availability for livestock	decreased		✓	increased
expenses on agricultural inputs	increased		✓	decreased

Socio-cultural impacts

food security/ self-sufficiency	reduced		✓	improved
health situation	worsened		✓	improved
national institutions	weakened		✓	strengthened
SLM/ land degradation knowledge	reduced		✓	improved

reduce dust in the air --> air better for breathing

Ecological impacts

water quantity	decreased		✓	increased

surface runoff	increased	✓	decreased
evaporation	increased	✓	decreased
soil moisture	decreased	✓	increased
soil cover	reduced	✓	improved
soil loss	increased	✓	decreased
nutrient cycling/ recharge	decreased	✓	increased
soil organic matter/ below ground C	decreased	✓	increased
vegetation cover	decreased	✓	increased
biomass/ above ground C	decreased	✓	increased
emission of carbon and greenhouse gases	increased	✓	decreased
wind velocity	increased	✓	decreased

Off-site impacts

wind transported sediments	increased	✓	reduced
damage on neighbours' fields	increased	✓	reduced
damage on public/ private infrastructure	increased	✓	reduced
impact of greenhouse gases	increased	✓	reduced

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%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- ✓ 0-10%
- 11-50%
- 51-90%
- 91-100%

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 accesable 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
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Date of documentation: June 2, 2015

Last update: July 5, 2020

Resource persons
Thorunn Petursdottir - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_1761/

Linked SLM data
n.a.

Documentation was faciliated 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/