



Trench with recently planted pine seedlings (*Pinus sylvestris*) in Saralanj community (Kirchmeir, H.)

High-altitude afforestation for erosion control (Armênia)

DESCRIÇÃO

Afforestation is a key technologies to protect soil against erosion and provide a wide range of ecosystem services. In this case, afforestation at high altitudes, which is particularly challenging, with the primary purpose of erosion control were planted in small patches with different methods. They form the basis for future community forests in Armenia.

Forests are - in terms of biomass accumulation and stability - the most successful ecosystems in the world. Natural forest ecosystems offer multiple ecosystem services, such as timber and fuel wood provision, water purification, carbon sequestration. In mountainous landscapes, forests have an additional protective function against erosion and natural hazards (e.g., avalanches, landslides, debris flows or rock falls). In the South Caucasus, two natural limits restrict forest expansion: at 2.300-2.600m a.s.l. the upper tree line is visible, whereas steppe and semi-desert ecosystems form the lower tree line.

Socio-economic and geo-physical living conditions:

The intervention area is located at the northern to eastern slopes of Mount Aragats (4013m). The villages are located at 1600 to 1800 m above sea level where the slope meets a plain with stepic soils and crop production while the slopes of the mountains are used for livestock grazing (sheep and cattle).

Purpose of afforestation:

By means of afforestation of degraded pastures, mountainous areas that suffer from erosion and overgrazing should be rehabilitated and erosion protection capacity enhanced. At the same time, the afforestation sites should form the basis for future community forests providing a wide range of ecosystem services, a concept that has not yet been established in Armenia.

Implementation

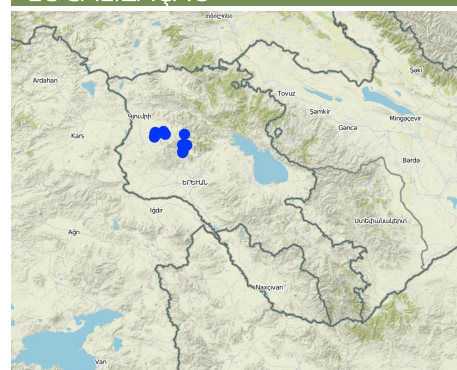
Between 2014 and 2017 more than 200 hectares were fenced for afforestation, 145 ha were actively afforested in 10 different communities around Mount Aragats in Armenia. The average size of the 20 plots is 10 ha (35 ha being the largest site, 1 ha the smallest one). The afforestation included different species combinations, planting schemes and methods to determine most cost-efficient afforestation methods for Armenian conditions. All afforestation took place at elevations between 1900 and 2300 m.a.s.l.. The afforestation included fencing of the area to protect the afforestation site against grazing, the preparation of the planting sites according to fixed planting schemes, the actual planting in lines with trenches, single plant holes and group plantings. For some sites, additional irrigation was established for the first years. Particular attention was paid to the species selection which explicitly included fruit trees and shrubs to ensure local economic returns.

Practical experiences

A wide range species was tested. Within the given climate context, pine (*Pinus sylvestris*), the main non-native species as well as native maple (*Acer trautvetteri*), Persian Oak (*Quercus macranthera*) and birch (*Betula litwinowii*) showed the best results. Particular attention was paid to adapted species to create resilient forest-shrubland with a large number of tree species. In general, planting in trenches shows highest survival rates. Bare root system and containerized seedlings were used for planting. Containerized seedlings definitely provide better survival rate in comparison with bare root system seedlings. Additionally, mulch cover was provided to protect seedlings and keep soil humidity. The main maintenance measures are repeated mulching and weed control and irrigation during the first 3 years. Furthermore, some replanting is continuously taking place as the sites are facing tough environmental conditions (hot summers, drought, short vegetation period).

The plantation was organised and supervised by local NGO's (ATP Armenian Tree Project, ESAC Environmental Sustainability Assistance Center) in close cooperation with the local village population. In a Memorandum of Understanding between the Armenian Ministry of Territorial Administration and Development, the local village administration and GIZ the share of paid labour and own contribution was fixed beforehand.

LOCALIZAÇÃO



Localização: Lusagyugh, Saralanj, Harich, Aray, Quchak, Hnaberd, Mets Manatash, Pokr Mantash, Nahapetavan, Shirak and Aragatsotn Marzes, Armênia

Nº de sites de tecnologia analisados: 10-100 locais

Geo-referência de locais selecionados

- 44.03408, 40.60734
- 44.15521, 40.61765
- 44.38562, 40.61728
- 44.03523, 40.63233
- 44.13295, 40.64011
- 44.05501, 40.61872
- 44.02974, 40.61975
- 44.36409, 40.44722
- 44.371, 40.45878
- 44.41472, 40.51481
- 44.02905, 40.59833
- 44.0215, 40.59193
- 44.36129, 40.5197
- 44.36186, 40.45786

Difusão da tecnologia: Uniformemente difundida numa área (approx. < 0,1 km2 (10 ha))

Data da implementação: menos de 10 anos atrás (recentemente)

Tipo de introdução

- através de inovação dos usuários da terra
- Como parte do sistema tradicional (>50 anos)
- durante experiências/ pesquisa

Impacts and perception

After the first years already first successes are becoming visible contributing to increased vegetation cover, increased biomass and improved soil protection. The communities are proud to be amongst the first in Armenia with a community forest. However, slow growth will require continuous commitment and care on behalf of the community.

✓ através de projetos/intervenções externas



Planting of different tree seedlings in trenches in Arayi, Armenia (Kirchmeir, H.)



Oak (*Quercus macranthera*) planted in a hole to protect seedling (Kirchmeir, H.)

CLASSIFICAÇÃO DA TECNOLOGIA

Objetivo principal

- ☐ Melhora a produção
- ✓ Reduz, previne, recupera a degradação do solo
- ✓ Preserva ecossistema
- ☐ Protege uma bacia/zonas a jusante – em combinação com outra tecnologia
- ✓ Preservar/melhorar a biodiversidade
- ☐ Reduzir riscos de desastre
- ☐ Adaptar a mudanças climáticas/extremos e seus impactos
- ✓ Atenuar a mudanças climáticas e seus impactos
- ☐ Criar impacto econômico benéfico
- ☐ Criar impacto social benéfico

Uso da terra



Pastagem - Pastagem extensiva:

Seminomadismo/pastoralismo

Principais espécies animais e produtos: Cattle and sheep



Floresta/bosques - Plantação de árvores, reflorestamento:

Variedades mistas

Produtos e serviços: Lenha, Frutas e nozes,

Pastagem/Alimentação de folhas e brotos, Proteção contra desastres naturais

Abastecimento de água

- ☐ Precipitação natural
- ✓ Misto de precipitação natural-irrigado
- ☐ Irrigação completa

Número de estações de cultivo por ano: 1

Uso do solo antes da implementação da Tecnologia: The afforestation sites were previously used as (partly overgrazed) pastures for grazing of mainly cattle. Thus, this technology included a land-use change from grassland/pasture to forest/shrubland.

Densidade pecuária: 1-2/ha

Objetivo relacionado à degradação da terra

- ✓ Prevenir degradação do solo
- ✓ Reduzir a degradação do solo
- ☐ Recuperar/reabilitar solo severamente degradado
- ☐ Adaptar à degradação do solo
- ☐ Não aplicável

Degradação abordada



Erosão do solo pela água - Wt: Perda do solo

superficial/erosão de superfície, Wg: Erosão por ravinas/ravinamento



Degradação biológica - Bc: redução da cobertura vegetal, Bs:

Qualidade e composição de espécies/declínio de diversidade

Grupo de GST

- Gestão natural e seminatural de floresta
- Reserva (suspensão do uso, apoio à recuperação)
- Redução de riscos de desastre baseada no ecossistema

Medidas de GST

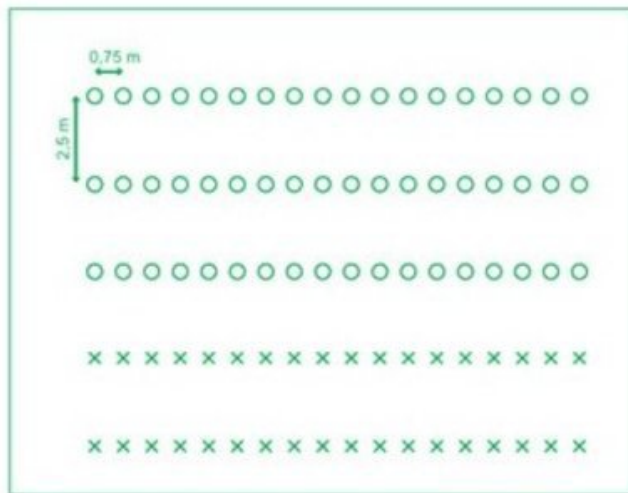


Medidas vegetativas - V1: cobertura de árvores/arbustos

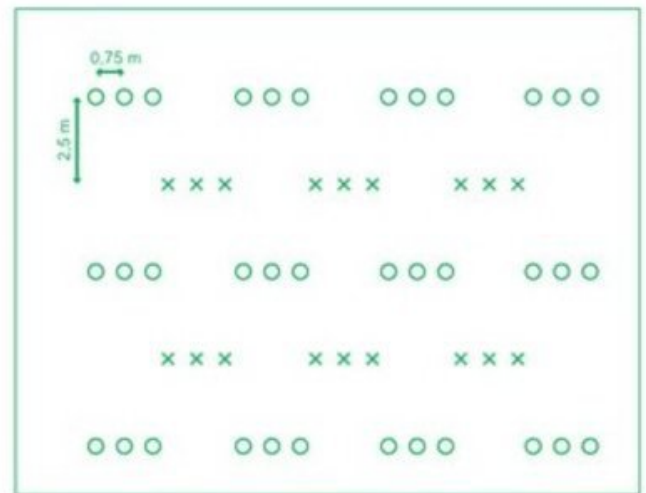


Medidas de gestão - M1: Mudança no tipo de uso da terra

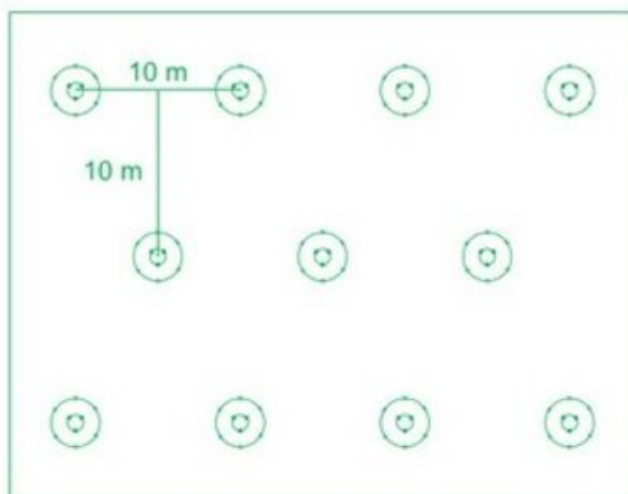
DESENHO TÉCNICO



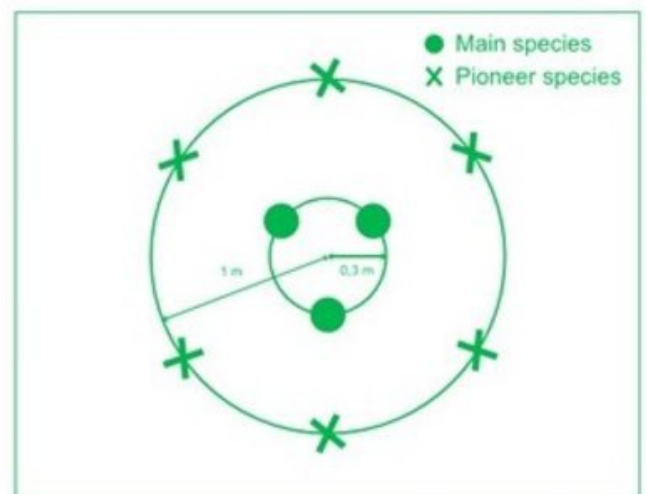
A. Line planting scheme



B. Chess pattern planting scheme



C. Overview of group plantation scheme



D. Example of planted group with different main and pioneer species

Autor: GIZ IBiS

Needed resources for 1 ha afforestation:

- 2.000-5.000 seedlings
- 10-50 t water (for initial irrigation)
- 40 – 100 working days
- Shuffles or soil driller
- Means of transport

Selection of species

It is recommended to use different local tree species for any afforestation activity, as they can cope best with the given environmental conditions and, therefore, are more resilient towards pests and climatic variations. Most suitable species for afforestation:

- Trautvetters maple (*Acer trautvetteri*)
- Birch (*Betula letwinowii*)
- Wild Oriental Apple (*Malus orientalis*)
- Scott's Pine (*Pinus sylvestris* var. *hamata*)
- Persian Oak (*Quercus macranthera*)
- Raspberry (*Rubus idaeus*)
- Mountain ash (*Sorbus aucuparia*)

For selecting suitable species, screening of the wider project area is essential in order to prepare a list of species, which would naturally grow under the given ecological conditions

Planting scheme

The technical drawings describe different potential planting schemes. A further figure describes the advantages and disadvantages of each scheme.

Planting season

The climate in the South Caucasus region shows low precipitation rates in the summer period. As seedlings have a small root system, young trees are more sensitive to drought. The best time for planting is either autumn or early spring as during autumn, winter and spring, more

moisture is available that helps the seedlings to develop deeper root systems to survive during summer droughts.

Fencing

In many cases, afforestation sites are located on pasture land. To protect the planted seedlings from browsing by livestock or wild game, it is recommended to fence the afforestation site before starting the plantation of the seedlings.

Planting

The planting process is specified in one of the technical drawings. With a hole driller planting of one tree takes 2-4 minutes, planting by hand 8-10 min. Each seedling is waterered with an intial 5-10 l of water.

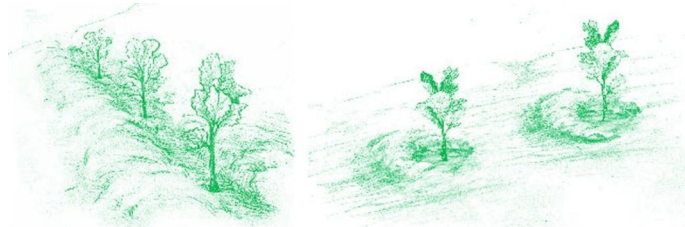


Fig. 7A: Oak seedlings in a trench plantation

Fig. 7B: Oaks planted in plant holes

Autor: GIZ IBIS

Planting

Description	Working step
- Water the containerized seedlings 24 hours before transport. - Package the bare rooted seedlings in plastic bags. - Store the seedlings for max. 4 days at a cool protected place.	 Transport of seedlings
- Use a spade or a soil driller for excavating a hole for the seedling: 30-40cm deep, 25cm diameter, min. 1m spacing between holes. - If the site is not too stony or too steep, prepare trenches with a single-plough: 30cm deep, 2m spacing between the rows.	 Excavate a hole or plough trenches
- Place the seedling 5-10cm lower than the upper ground. - Keep some space between the roots and the ground. - Fill the hole up with soil and slightly press it down.	 Planting
Apply 5-10 l water to each seedling immediately after planting.	 Watering
Cover the ground around the seedlings with organic material to reduce the need for irrigation and weed control.	 Mulching

Maintenance

- Irrigate young seedlings at least 2-4 times per year with 5-10 l each (during the first 2 years).
- Protect the area from wild fires, e.g. by preparing fire protection trenches around the site.
- Prevent overgrowth of vegetation, e.g. by mowing the grass 1-2 times per year.
- Renew the layer of mulch on an annual basis (after hay harvest in late summer).

Autor: GIZ IBIS

ESTABELECIMENTO E MANUTENÇÃO: ATIVIDADES, INSUMOS E CUSTOS

Cálculo de insumos e custos

- Os custos são calculados: por área de tecnologia (tamanho e unidade de área: **1 ha**)
- Moeda utilizada para o cálculo de custos: **Dólares norte-americanos**
- Taxa de câmbio (para USD): 1 USD = n.a
- Custo salarial médio da mão-de-obra contratada por dia: n.a

Fatores mais importantes que afetam os custos

With costs of approximately 5,700 USD/ha including fencing (30%), planting (30%) and seedlings (40%) afforestation is very intensive in financial resources. It is very likely that these high costs will limit the upscaling of the afforestation process. There are some options to reduce costs: •Fence large areas and try to have sites in square or circle shape •Increase number of seedlings planted by person by using soil-drillers •Use cheaper fencing material (e.g. game protection fence, poles without concrete) •Reduce seedling number to 2000-3000 seedlings/ha •Using seeds (e.g. oak) instead of seedlings •Regrow seeds in local low-cost nurseries (e.g. Lusagyugh)

Atividades de implantação

- Selection of afforestation site, plantation scheme and species (Periodicidade/frequência: anytime)
- Fencing of the area (if area is being grazed or wild game is browsing seedlings (Periodicidade/frequência: before planting)
- Prepare and transfer seedlings to the site (Periodicidade/frequência: before planting)
- Excavate whole for the seedling (30-40cm deep, 25 cm diameter, 1m spacing between wholes) (Periodicidade/frequência: autumn, early spring)
- Place the seedling and fill hole with soil (Periodicidade/frequência: autumn, early spring)
- Apply 5-10 l of water immediately after planting (Periodicidade/frequência: after planting)
- Cover soil around seedling with mulch and organic material (Periodicidade/frequência: after planting)

Estabelecer insumos e custos (per 1 ha)

Especifique a entrada	Unidade	Quantidade	Custos por unidade (Dólares)	Custos totais por entrada (Dólares)	% dos custos arcados pelos

			norte-americanos)	norte-americanos)	usuários da terra
Mão-de-obra					
Local workers for plantation of trees	seedlings	2500,0	0,27	675,0	10,0
Installation of fence and posts	person day	191,0	12,3	2349,3	
Equipamento					
Equipment (hammer, driller, etc.)	set	1,0	141,8	141,8	30,0
Material vegetal					
Tree seedlings	pieces	2500,0	0,31	775,0	
Mulching	kg	1250,0	0,03	37,5	
Material de construção					
Fencing (permanent mesh wire fence)	meter	317,0	1,35	427,95	10,0
Irrigation system	set	1,0	889,0	889,0	15,0
Metal posts for fence (1.8m)	pieces	106,0	2,97	314,82	
sand	kg	3444,0	0,012	41,33	
Other material(electrode, wire armature, metal disc)	set	1,0	386,9	386,9	20,0
Cement	kg	1148,0	0,12	137,76	
Outros					
Transporation of mulch	time	1,0	102,8	102,8	
Transporation of construction materials	time	5,0	92,5	462,5	
Transporation of workers to the field	time	15,0	30,2	453,0	
Transporation of seedlings	time	1,0	51,4	51,4	
Custos totais para a implantação da tecnologia				7'246.06	

Atividades de manutenção

1. Irrigation of young seedlings with 5-10 l (Periodicidade/frequência: 2-4 times per year for the first two years)
2. Preparation of fire protection trenches (Periodicidade/frequência: if needed)
3. Mowing to prevent overgrowth of seedlings (Periodicidade/frequência: 1-2 times per year)
4. Renew mulch layer (Periodicidade/frequência: annually after hay harvest in summer)
5. Replanting of seedlings (10% each year) (Periodicidade/frequência: annually to be done for the first 5 years)

Insumos e custos de manutenção (per 1 ha)

Especifique a entrada	Unidade	Quantidade	Custos por unidade (Dólares norte-americanos)	Custos totais por entrada (Dólares norte-americanos)	% dos custos arcados pelos usuários da terra
Mão-de-obra					
Irrigation of young seedlings with 5-10 l	Man/day	1,0	10,0	10,0	100,0
Preparation of fire protection trenches	rm	150,0	0,34	51,0	100,0
Mowing to prevent overgrowth of seedlings	Man/day	4,0	10,0	40,0	50,0
Renew mulch layer (including mulch value)	Man/day	5,0	10,0	50,0	50,0
Material vegetal					
Seedlings for replantation (including labour)	seedlings	1200,0	0,51	612,0	50,0
Outros					
Petrol for irrigation	liter	7,0	0,8	5,6	
Custos totais para a manutenção da tecnologia				768.6	

AMBIENTE NATURAL

Média pluviométrica anual

- ☐ <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

Zona agroclimática

- ☐ úmido
- ☐ Subúmido
- ☒ Semiárido
- ☐ Árido

Especificações sobre o clima

Pluviosidade média anual em mm: 521.0
Precipitation peak between May and June.
Nome da estação meteorológica: Aparan, Aragatsotn Marz, Armenia
According to Köppen and Geiger, the climate is classified as Dfb (Cold/continental, no dry season, warm summers). Annual mean temperature is 5.2. °C. The warmest month of the year is August, with an average temperature of 16.4 °C. January has the lowest average temperature of the year with -6.9 °C.
based on data from the following source:
<https://www.arcgis.com/home/webmap/viewer.html?layers=3ac478a468c245ef9bfd5533f7edbf93>

Inclinação

- ☐ Plano (0-2%)
- ☒ Suave ondulado (3-5%)
- ☒ Ondulado (6-10%)
- ☐ Moderadamente ondulado (11-15%)

Formas de relevo

- ☐ Planalto/planície
- ☐ Cumes
- ☒ Encosta de serra
- ☐ Encosta de morro
- ☒ Sopés

Altitude

- ☐ 0-100 m s.n.m.
- ☐ 101-500 m s.n.m.
- ☐ 501-1.000 m s.n.m.
- ☐ 1.001-1.500 m s.n.m.
- ☒ 1.501-2.000 m s.n.m.

A tecnologia é aplicada em

- ☐ Posições convexas
- ☐ Posições côncavas
- ☒ Não relevante

☐ Forte ondulado (16-30%) ☐ Montanhoso (31-60%) ☐ Escarpado (>60%)	☐ Fundos de vale	☒ 2.001-2.500 m s.n.m. ☐ 2.501-3.000 m s.n.m. ☐ 3.001-4.000 m s.n.m. ☐ > 4.000 m s.n.m.	
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Profundidade do solo ☐ Muito raso (0-20 cm) ☒ Raso (21-50 cm) ☐ Moderadamente profundo (51-80 cm) ☐ Profundo (81-120 cm) ☐ Muito profundo (>120 cm)	Textura do solo (superficial) ☐ Grosso/fino (arenoso) ☒ Médio (limoso, siltoso) ☐ Fino/pesado (argila)	Textura do solo (>20 cm abaixo da superfície) ☐ Grosso/fino (arenoso) ☒ Médio (limoso, siltoso) ☐ Fino/pesado (argila)	Teor de matéria orgânica do solo superior ☐ Alto (>3%) ☒ Médio (1-3%) ☐ Baixo (<1%)
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Lençol freático ☐ Na superfície < 5 m ☒ 5-50 m ☐ > 50 m	Disponibilidade de água de superfície ☐ Excesso ☐ Bom ☒ Médio ☐ Precário/nenhum	Qualidade da água (não tratada) ☐ Água potável boa ☒ Água potável precária (tratamento necessário) ☐ apenas para uso agrícola (irrigação) ☐ Inutilizável	A salinidade é um problema? ☐ Sim ☒ Não Ocorrência de enchentes ☐ Sim ☒ Não
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Diversidade de espécies ☐ Alto ☒ Médio ☐ Baixo	Diversidade de habitat ☐ Alto ☐ Médio ☒ Baixo		
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CARACTERÍSTICAS DOS USUÁRIOS DA TERRA QUE UTILIZAM A TECNOLOGIA

Orientação de mercado ☐ Subsistência (autoabastecimento) ☒ Misto (subsistência/comercial) ☐ Comercial/mercado	Rendimento não agrícola ☐ Menos de 10% de toda renda ☒ 10-50% de toda renda ☐ >50% de toda renda	Nível relativo de riqueza ☐ Muito pobre ☒ Pobre ☒ Média ☐ Rico ☐ Muito rico	Nível de mecanização ☒ Trabalho manual ☐ Tração animal ☒ Mecanizado/motorizado
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Sedentário ou nômade ☒ Sedentário ☐ Semi-nômade ☐ Nômade	Indivíduos ou grupos ☐ Indivíduo/unidade familiar ☒ Grupos/comunidade ☒ Cooperativa ☐ Empregado (empresa, governo)	Gênero ☒ Mulheres ☒ Homens	Idade ☐ Crianças ☐ Jovens ☒ meia-idade ☒ idosos
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Área utilizada por residência ☐ < 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	Escala ☒ Pequena escala ☐ Média escala ☐ Grande escala	Propriedade da terra ☐ Estado ☐ Empresa ☒ Comunitário/rural ☐ Grupo ☐ Indivíduo, não intitulado ☐ Indivíduo, intitulado	Direitos do uso da terra ☐ Acesso livre (não organizado) ☒ Comunitário (organizado) ☐ Arrendado ☐ Indivíduo Direitos do uso da água ☐ Acesso livre (não organizado) ☒ Comunitário (organizado) ☐ Arrendado ☐ Indivíduo
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Acesso a serviços e infraestrutura Saúde Educação Assistência técnica Emprego (p. ex. não agrícola) Mercados Energia Vias e transporte Água potável e saneamento Serviços financeiros	<table border="0"> <tr> <td>Pobre</td> <td>☒</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>Bom</td> </tr> <tr> <td>Pobre</td> <td>☐</td> <td>☒</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>Bom</td> </tr> <tr> <td>Pobre</td> <td>☐</td> <td>☐</td> <td>☒</td> <td>☐</td> <td>☐</td> <td>Bom</td> </tr> <tr> <td>Pobre</td> <td>☒</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>Bom</td> </tr> <tr> <td>Pobre</td> <td>☒</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>Bom</td> </tr> <tr> <td>Pobre</td> <td>☒</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>Bom</td> </tr> <tr> <td>Pobre</td> <td>☐</td> <td>☒</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>Bom</td> </tr> <tr> <td>Pobre</td> <td>☐</td> <td>☐</td> <td>☒</td> <td>☐</td> <td>☐</td> <td>Bom</td> </tr> <tr> <td>Pobre</td> <td>☒</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>Bom</td> </tr> </table>	Pobre	☒	☐	☐	☐	☐	Bom	Pobre	☐	☒	☐	☐	☐	Bom	Pobre	☐	☐	☒	☐	☐	Bom	Pobre	☒	☐	☐	☐	☐	Bom	Pobre	☒	☐	☐	☐	☐	Bom	Pobre	☒	☐	☐	☐	☐	Bom	Pobre	☐	☒	☐	☐	☐	Bom	Pobre	☐	☐	☒	☐	☐	Bom	Pobre	☒	☐	☐	☐	☐	Bom
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IMPACTOS

Impactos socioeconômicos

Produção de forragens

diminuído ☐ ☐ ☐ ☒ ☐ ☐ aumentado

Within the fenced afforestation site, the grass could be cut and used as hay. The protection from grazing helps biomass development which leads to better protection from Surface water Erosion and this lead to soil-regeneration and increase of productivity.

Qualidade da floresta/do bosque

diminuído ☐ ☐ ☐ ☐ ☒ ☐ aumentado

The natural forest was removed for the purpose of grazing

Produção florestal não madeireira

diminuído  aumentado

and the forest cover will be now re-established on the afforestation sites.

Diversidade de produtos

diminuído  aumentado

We mixed shrub species like raspberries and fruit-trees (wilde plumb) between the main tree species to create short time Benefit for the village people.

Área de produção (nova terra sob cultivo/uso)

diminuído  aumentado

In addition to the wide spread grazing land use now the hay production in the fenced afforestation site is increased for the first 1-2 decades (until the canopy is too dense) and the collection of berries and fruits give additional income opportunities. In the Long terme fuel wood production can be expected from the forested land.

Carga de trabalho

aumentado  diminuído

The grazing range is limited by the fenced afforestation site. This is relevant in the first couple of years before hay or fruit/berry productivity is able to fully compensate the loss of grazing range.

The maintenance of the afforestation site lead to increase of workload especially in the first 2-4 years when hay cutting and Irrigation is needed until the tree seedlings are well established.

Impactos socioculturais

Oportunidades de lazer

Reduzido  Melhorado

As there is almost no forest near to the villages every woodland is very attractive for recreational purpose, but it will Need 2-3 decades until this function will be fulfilled by the afforestation site.

Conhecimento de GST/ degradação da terra

Reduzido  Melhorado

The local stakeholders got hands on training on fencing, afforestation and maintenance of afforestation sites.

Impactos ecológicos

Escoamento superficial

aumentado  diminuído

The fencing of the afforestation site immediately stops the heavy grazing Impact which leads to fast recovery of the Vegetation. The improved Vegetation cover and better development of the root System reduce Surface water run of Speed and increase water Infiltration.

Evaporação

aumentado  diminuído

An increase of vegetation and the leaf area index will lead to an increase of evaporation.

Perda de solo

aumentado  diminuído

Increase of vegetation cover and reduction of water runoff will lead to decrease of soil loss.

Matéria orgânica do solo/carbono abaixo do solo

diminuído  aumentado

The increase of vegetation leads to an increase of root development. Additionally, the increase of vegetation produces more litter, as no grazing is applied. The increase in litter leads to an increase of an humus layer and therefore to more below ground carbon.

Cobertura vegetal

diminuído  aumentado

Especially the fencing leads to fast increase of vegetation cover.

Biomassa/carbono acima do solo

diminuído  aumentado

The local stakeholders got hands on training on fencing, afforestation and maintenance of afforestation sites.

Diversidade vegetal

diminuído  aumentado

The stop of grazing and the new micro-habitats created by the shadow of the tree seedlings have let to an increase in plant diversity. This process might be reverse when the tree canopy is closed and less light is available for the herb-layer, but this will take several decades.

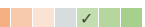
Diversidade de habitat

diminuído  aumentado

The plain grasslands habitats are diversified by patches of forest.

Impactos fora do local

Capacidade de
tamponamento/filtragem (pelo solo,
vegetação, zonas úmidas)

Reduzido  Melhorado

The decrease of water run off increase the water capacity of the habitat and the afforested area will provide increase buffer capacity in the case of intensive rainfalls.

Sedimentos transportados pelo
vento

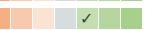
aumentado  Reduzido

The high grass and trees reduce wind speed at ground level.

ANÁLISE DO CUSTO-BENEFÍCIO

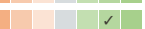
Benefícios em relação aos custos de estabelecimento

Retornos a curto prazo muito negativo  muito positivo

Retornos a longo prazo muito negativo  muito positivo

Benefícios em relação aos custos de manutenção

Retornos a curto prazo muito negativo  muito positivo

Retornos a longo prazo muito negativo  muito positivo

In the first decade the efforts on maintenance are high and it can be expected that the return of natural resources (hay, berries, fruits) is significantly lower than the maintenance efforts. As soon as the trees are established and larger than 1.3 the root system is well established and the trees are resistant to droughts, no vegetation cutting is needed and even game or cattle browsing will not necessarily lead to lethal damage.

MUDANÇA CLIMÁTICA

Extremos (desastres) relacionados ao clima

Trovoada local não bem em absoluto  muito bem

Tempestade de granizo local não bem em absoluto  muito bem

Tempestade de neve local não bem em absoluto  muito bem

Infestação de insetos/vermes não bem em absoluto  muito bem

Outras consequências relacionadas ao clima

Período de crescimento alongado não bem em absoluto  muito bem

ADOÇÃO E ADAPTAÇÃO

Porcentagem de usuários de terras na área que adotaram a Tecnologia

- ☒ casos isolados/experimental
- ☐ 1-10%
- ☐ 10-50%
- ☐ mais que 50%

De todos aqueles que adotaram a Tecnologia, quantos o fizeram sem receber incentivos materiais?

- ☒ 0-10%
- ☐ 10-50%
- ☐ 50-90%
- ☐ 90-100%

A tecnologia foi recentemente modificada para adaptar-se as condições variáveis?

- ☒ Sim
- ☐ Não

drought-adapted species, adaptation of planting schemes

A quais condições de mudança?

- ☒ Mudança climática/extremo
- ☐ Mercados dinâmicos
- ☐ Disponibilidade de mão-de-obra (p. ex. devido à migração)

CONCLUSÕES E EXPERIÊNCIAS ADQUIRIDAS

Pontos fortes: visão do usuário de terra

- Extension of forest cover of communities, new habitat for wild creators, forest will be a fire wood and non timber products source for local inhabitants, attraction of tourists into the communities, increased water regulating function, improved soil quality, increased vegetation, microclimate formation function, wind velocity reduction, reduced land degradation, nice view of the area due to afforestation, increased fodder for cattle
- empowerment of the local capacities on sustainable land management
- successful demonstration of erosion control measures

Pontos fortes: a visão do/a compilador/a ou de outra pessoa capacitada

- Diversification of land use options for local stakeholders. Future options for sustainable firewood supply, non-timber forests products (berries) and recreation
- Option to use grass from cutting in between as fodder/hay production
- side-effect of fencing is increase in biodiversity of grassland species due to exclusion from grazing.

Pontos fracos/desvantagens/riscos: visão do usuário de terra como superar

- Reduces pasture land of community, which was converted into a forest Villagers/farmers need to increase the amount of hay from their homestead gardens using irrigation

Pontos fracos/desvantagens/riscos: a visão do/a compilador/a ou de outra pessoa capacitada como superar

- strong need for care taking in the first years community commitment, strong ownership
- Expensive due to high costs for fencing Consider alternative, cheaper fencing methods (e.g. wildlife protection fence)
- Complicated decision making processes by the project More mandate given to the implementing NGOs

REFERÊNCIAS

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Descrição completa no banco de dados do WOCAT

https://qcat.wocat.net/pt/wocat/technologies/view/technologies_4101/

Dados GST vinculados

Approaches: Afforestation/Tree planting https://qcat.wocat.net/pt/wocat/approaches/view/approaches_2587/
Approaches: Sustainable managements on pasture and forest lands based on natural regeneration by electrified fences
https://qcat.wocat.net/pt/wocat/approaches/view/approaches_2451/

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Referências-chave

- Handbook on Integrated Erosion Control A Practical Guide for Planning and Implementing Integrated Erosion Control Measures in Armenia, GIZ (ed.), 2018, ISBN 978-9939-1-0721-9: GIZ Armenia

Links para informação relevante que está disponível online

- Project website of the GIZ program: <http://biodivers-southcaucasus.org/>

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