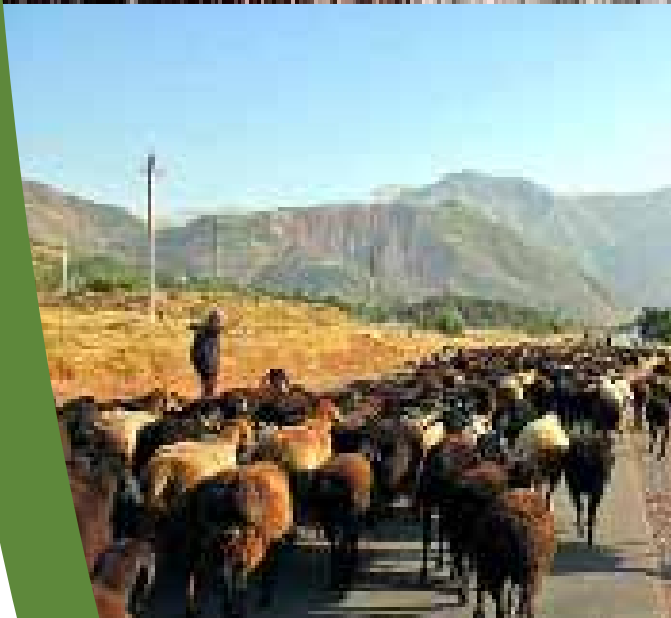


THE LAND USE PLANNING (LUP) CATALOGUE



Forest Management

Pasture/Livestock Management

Cropland Management

Saline and waterlogged land

Financed by:



European Union

FLERMONECA

Forest and Biodiversity Governance
Including Environmental Monitoring

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This land use planning (LUP) Catalogue” is primarily designed for facilitators and community mobilizers (CM) as a tool during community workshops or other occasions. The LUP catalogue should provide “food for thought” for the local population in form of easily and understandably presented options, to be used either during community workshops or during other occasions. The description of options is not exhaustive but should provide ideas on improving land use practice, should motivate creative thought directions outside the traditional ways, and should help in establishing an atmosphere of curiosity among villagers to lead them to innovative planning and testing.

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Instructions for the catalogue of land use options

1. WHY THIS CATALOGUE?

Tajikistan is one of the most vulnerable countries in the region for negative impacts of climate change, with a rural population of small farmers being most heavily affected. To make the country’s agricultural land more resilient to climate change requires a wide range of possible measures (options) for adequately responding by considering different cultural, biophysical and climatic conditions within the country. Local conditions are decisive for the choice of the improvement option. The local population knows these conditions best and is at the same time the driver for change. Therefore, a sound participatory approach is key.

This catalogue of land use options (this “LUP Catalogue” or the “catalogue”) should provide “food for thought” for the local population in form of easily and understandably presented options, to be used either during community workshops or during other occasions. The description of options is not exhaustive but should provide ideas on improving land use practice, should motivate creative thought directions outside the traditional ways, and should help in establishing an atmosphere of curiosity among villagers to lead them to innovative planning and testing.

The selection of the options is tuned to Tajik conditions, i.e., the prevailing soil and climate conditions, land use systems and related problems, etc.

The LUP Catalogue is supposed to be open for any addition and improvement. Users and experts are invited to propose additional land use options or to improve the presentation of existing land use options. The catalogue is public and anybody can use it.

2. FOR WHOM IS THE CATALOGUE?

The LUP Catalogue is primarily designed for facilitators and community mobilizers (CM) as a tool during community workshops or other occasions. Only in exceptional cases are such CMs technical experts in one or more of the subjects covered under the different land use categories, certainly not in all. If necessary, technical experts on specific land use questions can be invited by CMs whenever needed to support villagers in their planning and implementation efforts.

3. HOW IS THE CATALOGUE STRUCTURED?

Main chapters of the LUP Catalogue are:

- Forest management
- Pasture management
- Crop management
- Saline and waterlogged land management

The first three chapters represent the main land use categories, the fourth focuses on specific questions of deteriorating arable land. In each of these main chapters organizational, management, and technical aspects are presented.

Each land use option consists of a brief on purpose and technologies, a box on advantages and disadvantages, and questionnaires for a first self-assessment on whether or not necessary preconditions are met, hence whether the land use option is applicable under the prevailing condition and situation. The questionnaires should help to assess challenges of introducing the land use option, its financial implications, impact on ecology (including climate resilience), gender equality, and effects on the community as a socio-economic unit. In case of missing background information or doubt as to how to answer certain questions, a technical advisor should be contacted. A list of potential advisors is added to each option.

4. HOW TO USE THE LUP CATALOGUE DURING A COMMUNITY WORKSHOP?

This LUP Catalogue will be used routinely for community workshops on land use planning. According to experience, in many cases the workshop should not last longer than two days, so as not to overstrain participants. Longer workshops would allow going into more detail, however, as it is difficult to ensure participation, longer workshops should not be planned without the explicit wish of the potential participants. Normally, a two day workshop allows generating sufficient impetus to interested participants who sometimes request follow-up meetings, possibly in smaller interest groups.

a) Before the workshop:

Before the LUP workshop, the CM should collect sound information about village and local land use practices for the purpose of being able to address concrete issues during the workshop. In response to this information, the CM will compose his/her workshop team for being able to answer technical questions or for ensuring the participants the support of the authorities.

b) During the workshop:

Usually the first workshop day is devoted to raising awareness on climate change, land use challenges, and risks, by referring to the concrete situation in the village.

On the second day, during discussion on problems, such as soil erosion, often manifested in gully development, and irrigation water shortage. It is important to define the (often socio-economic) roots of the problems (such as overgrazing, wrong tillage, etc.) and the effects on diminishing natural resources, hence the sustainability of the base of life in rural areas. In response to this analysis of problems, it may be appropriate to discuss more general concepts, such as joint forest management, and the need for proper pasture and water management on arable land. Then it would be the right point in time to review relevant LUP options and to facilitate the pre-selection process by the participants. These options should then be analysed in more detail, including financial aspects, by means of adequate participatory methods and should be clustered according to interest groups within the village showing interest to work with the option. Depending on the interest in the option, this is also a way to identify focal points within the village.

At this point it is essential to take into consideration the role of the village, groups of villagers or individuals concerning later implementation measures. The question has to be answered what can be done or regulated by the village and what is under private ownership (e.g., livestock or use of arable land) and therefore needs individual commitment and activity. Many LUP improvement measures need decisions of the village population on how to regulate use of certain land categories or at least the support for individuals in changing the land use. Mutual benefits of concerted actions and cooperation among villagers for individual businesses and the common environment should be particularly highlighted.

Complex challenges can be solved through different intersectional land use options. That is the point where the facilitator plays the main role. It's no longer the time to think about perfect implemented measures or cropping techniques; village members have to work together and come to agreement on practical solutions.

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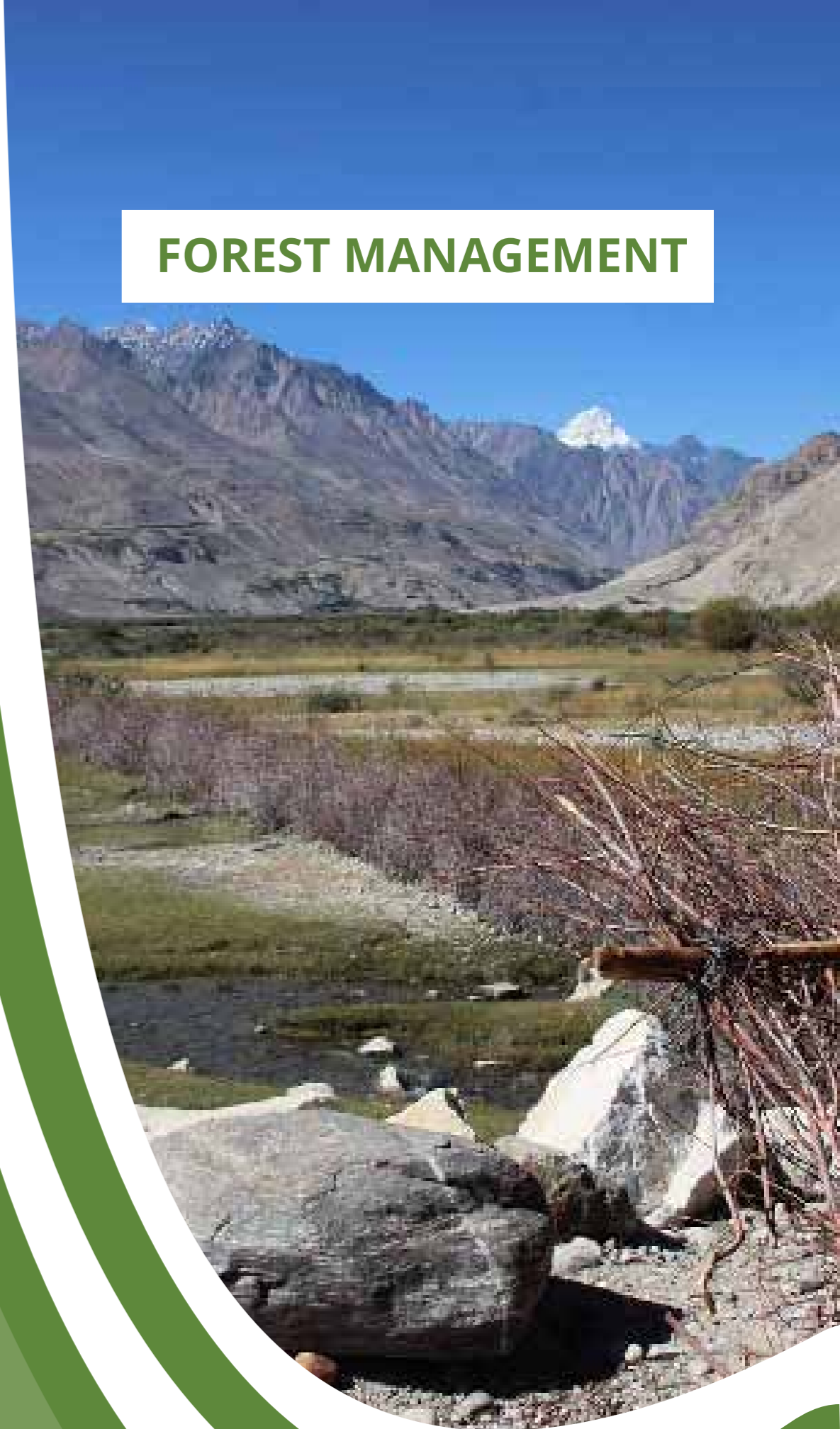
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FOREST MANAGEMENT

1. Organizational approach

1.1

Joint Forest Management (JFM)

JFM is a close cooperation between two contract partners: the leskhoz and a local person (= forest user) or group of persons or community based organization on State Forest Fund Land. According to this approach, the forest user or the group is granted the right to manage the forest plot for at least 20 years. There is no rent fee or user permit that has to be paid, however the harvest has to be shared with the leskhoz according to a prior agreed scheme. The forest has to be managed in its natural condition; no reconstruction into orchards is allowed on State Forest Fund Land.

HOW DOES IT WORK?

General set-up: A five-year management plan and an annual plan serve as a basis for the forest management and for the monitoring of the forest user's work. The plans are developed jointly by leskhoz staff and the respective forest user or the forest user group.

Responsibilities and duties of forest users: Protection of the forest plot from illegal use and grazing cattle, mostly through control, rarely through the establishment of fences; forest rehabilitation and afforestation measures, for example, planting of trees/ shrubs, pruning, ploughing around young trees and in some cases establishment of small irrigation channels and/or cleaning of existing irrigation channels. The forest user is allowed to harvest fuel wood, timber, hay, fruits, nuts and herbs according to the prior agreed plan and has to share a certain percentage of the harvest with leskhoz, which is defined in the contract.

Responsibilities of Leskhoz: The leskhoz is responsible to support the forest protection, rehabilitation and afforestation activities, e.g., through provision of seeds and seedlings and advice to the forest user. Further, leskhoz monitor the condition of the forest plots and records the performance of the forest users according to the annual plan.

WHAT ARE THE STEPS FOR THE IMPLEMENTATION OF JFM?

1. **Written request by the forest user, user group or community to leskhoz about the interest in entering a JFM contract**
2. **Joint field visit** with leskhoz and assessment of the conditions of the forest plot, the potential economic and ecological benefits and also required labor input
3. **NGOs, familiar with JFM can be approached to hold an information seminar** where the contract, rights, and responsibilities will be explained, and the negotiation process can be assisted
4. **Demarcation** and allocation of plots in the field and on maps
5. Conclusion of JFM **contract including agreement on harvest share**
6. Development of management and **annual plan**

WHAT ARE GENERAL ADVANTAGES AND CHALLENGES OF JFM?

JFM generates additional income for the forest user by producing and selling timber, fuelwood and non timber forest products, like nuts and fruits. Additionally, reforestation serves relevant ecological functions like soil and grassland stabilization. Not only individual JFM users profit from reforestation around the village; the whole community profits from erosion protection and soil stabilization against landslides. For mountain communities reforestation has the ecological advantage of groundwater storage.

The challenges of JFM lie in the fairly complex management and the potential for under-estimation of the required labor input. In some cases leskhoz may not abide by the contract but rather proceed as usual and request the forest user to pay for the forest use (lesnoi biljet) in addition to the share. In such cases support by an NGO can be helpful and facilitate the proper understanding of roles, responsibilities and the regulations. The approach requires certain technical knowledge in pruning of different tree types and bushes as well as planting of additional trees and harvest techniques, which are not daily business of households. The time and labor the forest user has to invest in forest management can be quite substantial, and needs to be considered carefully, especially in the case of female headed households. Some management activities are rather hard and thus are more typically male work, and women shouldn't be overburdened. On the other hand, women groups may be interested in renting forest plots that are mainly oriented on production of forest herbs or spices, like *Ferula* in pistachio forests and *Cumin* in juniperus forests.

Contact:

CAMP TABIAT
Umed Bulbulshoev (director)
9 Sohibnazarova Street, Choroug
+992 935 14 19 45

Jangalparvar
Jamolidin Madibron (director)
62 Druzhbi narodov str., 734025, Dushanbe,
+992 91 818 18 25

Links:

<http://camp.kg/en/who-we-are/camp-tabiati/umedsho@mail.ru>

FOREST MANAGEMENT

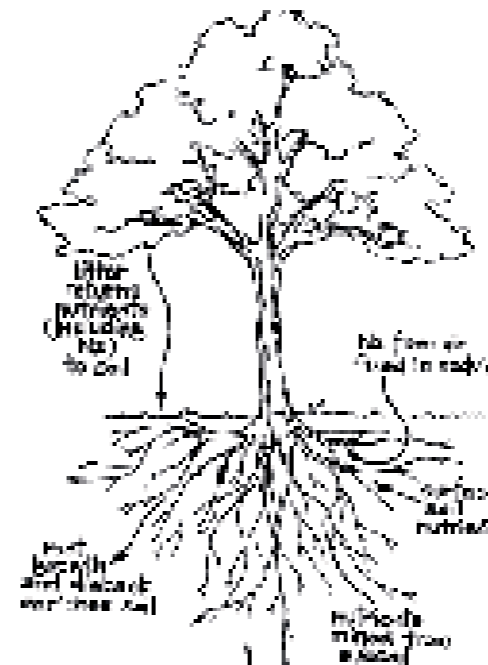
2. Soil cover and fertility

2.1

Planting of nitrogen fixing trees

WHAT ARE NITROGEN FIXING TREES?

Nitrogen fixation is a pattern of nutrient cycling: nitrogen is a stable gas, normally unavailable to plants. Nitrogen fixation is a process by which certain plants "fix" or gather atmospheric nitrogen and make it biologically available.



HOW DOES IT WORK?

Nitrogen fixing trees (*Robinia pseudoacacia* L., *Elaeagnus angustifolia* L., *Cercis Griffithii* L., and *Colutea canescens* L., *Hippophae rhamnoides* L. as shrubs) contain symbiotic bacteria within nodules in their root systems, producing nitrogen compounds that help the plant to grow and compete with other plants. When the plant dies, the fixed nitrogen is released, making it available to other plants and this helps to fertilize the soil also for crops. Nitrogen fixing trees grow faster than non nitrogen fixing trees, under the exact same environmental conditions. You can use them also as live fencing trees. Therefore have a look at the option *live fencing*, too. When sea buckthorn is planted together with poplar trees for the production of timber on nitrogen-poor soils, poplar trees grow faster.

Advantages & positive side effects:

1. Restoration of nutrient cycling and fertility
2. Nutrients from deeper soil layers are made available to the upper level since nitrogen fixing plants are usually deep-rooted
3. Leaves falling down from nitrogen fixing trees increase fertility of soil
4. Stabilization and aeration of soil due to extensive root system stabilizes soil → constantly growing → more organic matter in soil, channels for aeration
5. Branches provide fodder for animals
6. Berries from sea buckthorn and oleaster can be used
7. Purchase of nitrogen and phosphorus fertilizer not needed

Disadvantages & risks:

1. Nitrogen fixing shrubs should be used with care and oversight!
2. Due to ability to grow under poor soil conditions, they can easily become weedy
3. Especially in dry areas with few available nutrients, nitrogen fixing shrubs can be competitive to other plants
4. Careful and informed planting and management of nitrogen fixing trees and shrubs is needed!

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with **“Yes”**, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for this plot?		
Do you have access to local nitrogen fixing trees (seedlings or seeds) ?		
Is the plot suitable for the nitrogen-fixing species ? Robinia pseudoacacia L.: Elaeagnus angustifolia L.: Cercis Griffithii L.: Colutea canescens L.: Hippophae rhamnoides L: can only grow in river beds, needs sufficient ground water level and sunlight		
Is the plot, due to overuse, wind/ water erosion, in need of nutrient supply, especially nitrogen?		

The **“Question”** part will ask you about additional framing preconditions. If the answer is **“No”**, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Is minimum equipment for planting available?		
Is the plot easily accessible from your residence so that you easily can ensure care, harvest, watering of. the trees?		
Can you get benefits from these trees, e.g., like timber, fuelwood, berries?		
Do you have enough work power for the establishment and care of the crop plants?		

FINANCIAL CALCULATION/ PRICE EXAMPLES

Tree species	English	Price example for seeds and/or seedlings
Robinia pseudoacacia L.	Robinia	
Elaeagnus angustifolia L.	Oleaster plant	
Cercis Griffithii L.	Judas tree	
Colutea canescens L.	Bladder senna	
Hippophae rhamnoides L	Sea buckthorn	

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with **“Yes”**.

If at the end most of the questions are answered with **“Yes”**, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefit	Yes	No
Would you benefit by less nutrient losses on your plot and therefore, by higher yields?		
Could you get more income by higher yields due to higher fertility on your plot?		
Do the tree products cover your household needs?		
Could you save money because of less expenditure for fertilizers?		
Could you get additional income from, e.g., selling firewood, timber?		
Ecological impact		
Could nitrogen fixing trees improve the soil fertility on your plot or make overused soils available again?		
Do you have a reliable water supply for the plot also under changing climate?		
Could nitrogen fixing trees reduce soil erosion processes on your plot?		
Could nitrogen fixing trees reduce the risk exposure to natural disasters (landslides, erosion, sedimentation of springs, flooding) in your community?		
Gender impact		
Which role do women play in taking care of (nitrogen fixing) trees: Are women involved in planting, weeding, watering (nitrogen fixing) crops?		
Could women directly benefit from nitrogen fixing trees?		
Would the additional workload of planting special nitrogen fixing crops create a reasonable output for women (e. g., by selling fodder)?		
Community impact		
Would the establishment of nitrogen fixing trees have a positive impact in terms of higher agricultural output for your community?		
Could your community benefit from planting nitrogen fixing trees in terms of protection from natural disasters (reduction of wind/water erosion, avalanches, landslides...)?		
Would the establishment of nitrogen fixing trees affect other households of the community negatively?		
Would this eventually lead to tensions or conflicts within the community?		

Contact:

CAMP TABIAT
Umed Bulbulshoev (director)
9 Sohibnazarova Street, Choroug
+992 935 14 19 45

Jangalparvar
Jamolidin Madibron (director)
62 Druzhbi narodov str., 734025, Dushanbe,
+992 91 818 18 25

Cesvi
Daniil Ilyasov (Project coordinator)
+992 985 02 27 37
Dushanbe Office: Firdavsi Str., 15
Khovaling Office: Mirzo Tursunzoda Str.

Caritas Switzerland
Afzalsho Nasibov (Project coordinator)
+992 901 10 93 32
26 Titova str.ap.25, 734025, Dushanbe

Links:

<http://camp.kg/en/who-we-are/camp-tabiat/umedsho@mail.ru>

daniil.ilyasov@gmail.com

anasibov@caritas.ch

FOREST MANAGEMENT

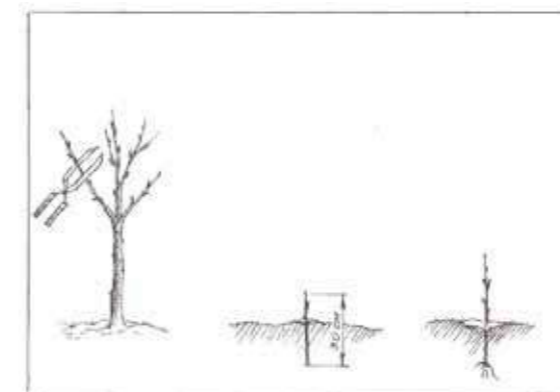
2. Soil cover and fertility

2.2

Planting of poplar trees for afforestation

WHAT ARE POPLAR TREES?

Poplar trees are fast growing trees and therefore suitable for afforestation purposes. Especially in high mountainous regions of Tajikistan with low temperatures and precipitation it is difficult to plant any tree species other than poplar or willow. Due to the frostiness in winter in these altitudes and scarcity of other heating material, the planting of fast growing poplar trees can meet the population's demand for fuel as well as cheap timber for construction purposes. Poplar trees protect the soil from flooding and erosion and can serve as windbreaks.



HOW DOES IT WORK?

For the afforestation with poplar trees on sandy soils of flood plains of high mountain river areas, irrigation channels along the tree row must be established. Then poplar seedlings are replanted from a nursery to the plot. Therefore, small holes 1.2 x 1.5 m must be dug (on 1 ha up to 5,000 poplar trees can be planted). For filling the holes, a mixture of soil and dung needs to be prepared. The seedlings on the plot need to be watered frequently

in the first years. From time to time, the irrigation channels need to be cleared of sediments. In the beginning of their growth, seedlings need to be protected from freely grazing livestock. Here, the subchapter on *plastic cover on plantlets, fencing and life fencing* offer additional information. As soon as the trees are big enough ($\varnothing=30-50$ cm) selective felling of some trees can be conducted. For slightly saline soils, *Populus pruinosa* is a regionally adapted variety and accepts slightly saline soils.

Advantages:

- Provision of **firewood and timber, fodder**
- **Soil stabilization**, reduction of erosion and landslides
- Increase of **water** stored in the soil and reduction of wind speed
- **Diversification** of land use: promotion of vegetation species and varieties
- Improvement of ground cover, increase of organic matter (biomass)
- **Offering shade** on fields, cropland, houses or animals

Disadvantages / Challenges:

- **Labor-intensive** for the first years: afforestation, irrigation, cleaning canals, fencing
- **(Could be) capital-intensive** for fencing, seedlings, equipment
- Poplar trees need a good **water supply** (only possible if planted next to rivers)

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for this plot?		
Do you have space to plant single trees?		
Is the plot located on an acceptable place for poplar afforestation?		
Is the local climate (short growing season) good enough for poplar trees?		
Are seedlings available?		
Do you have enough work power (for establishment of channels, planting trees, pruning)?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Is the plot already used as agricultural land?		
Is the plot exposed to soil erosion (wind or water)?		
Is minimum equipment for poplar planting/establishment of irrigation channels available?		
Do you have information about planting trees/establishing irrigation channels, or do you need additional advisory service?		
Do you have a demand for firewood, timber or fodder?		
Is the plot in a more or less good ecological condition: Can you gather benefits out of it?		
Are there market opportunities to sell timber?		

FINANCIAL CALCULATION

Experience from GBAO shows the following investment costs, for the establishment of a 2150m irrigation channel in 59 hours for a Joint Forest Management plantation in May 2014, Rav area.

Installation of irrigation system for 28ha	Costs per unit	Total
Mini excavator	165.00 TJS/hour	9,758 TJS
Salary (operator)	50.00 TJS/ hour	424 TJS
Salary (engineer)	50.00 TJS/ day	150 TJS
Total cost		11,338 TJS

Investment expenses	Investment amount per unit	Investment amount total
Price for Poplar trees		
Fences		
Watering		
Additional costs		
Additional costs		
TOTAL expenses:		
Investment earnings		
Branches as fodder		
Fuel wood		
Timber		
Additional benefits		
Soil improvement		
Fertilizer saving		
Slop stabilization		
Wind erosion breaker		
Shadow for livestock/ kitchen garden		
Additional earnings		
TOTAL earnings:		

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration

Financial benefit	Yes	No
Can planting single poplar trees cover some of your household needs?		
Is there a possibility to sell timber, or fuelwood?		
Could you save money because of less expenditure for firewood, timber?		
Is labor for fencing, watering and pruning included into the calculation?		
Ecological impact		
Could planting of poplar trees improve the soil fertility and soil structure of your plot or kitchen garden?		
Could planting of poplar trees improve soil and water retention capacities of your plot?		
Could planting of single poplar trees make illegal cuttings less attractive?		
Gender impact		
What role do women play in the care of trees: Are women involved in planting, reforestation, protection of trees?		
Can women directly benefit from tree products, e.g., by selling timber?		

From these benefits, can women decide on what the additional money is spent for?		
Would the planting of poplar trees on your plot constitute an additional workload for women (establishment and care for trees)?		
Would the additional workload create a reasonable output for women, e.g. by selling timber, having enough firewood in winter?		
Would the planting of poplar trees on your plot reduce workload for women by the provision of firewood (less time for collecting wood in the forests)?		
Community impact		
Would the planting of poplar trees have a positive impact for the community in terms of timber and firewood demand?		
Could the planting of poplar trees serve as a model for other households?		
Could the planting of poplar trees reduce the effects of natural hazards (soil erosion, landslides...) in your community?		
Could poplar trees lead to less illegal tree cuttings in your community?		

Contact:

CAMP TABIAT
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+992 935 14 19 45

Jangalparvar
Jamolidin Madibron (director)
62 Druzhbi narodov str., 734025, Dushanbe,
+992 91 818 18 25

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umedsho@mail.ru

daniil.ilyasov@gmail.com

anasibov@caritas.ch

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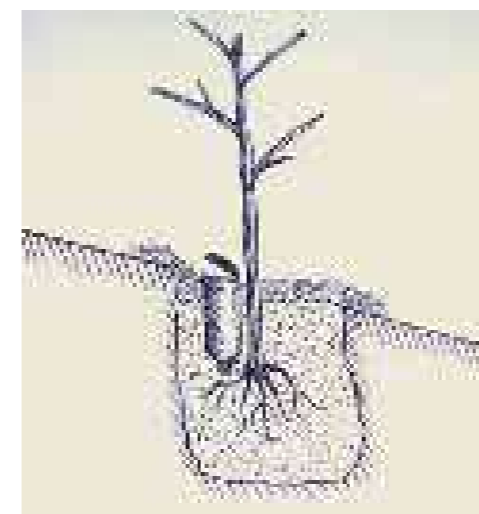
2. Soil cover and fertility

2.3

Supplementary irrigation with plastic bottles

WHAT IS SUPPLEMENTARY IRRIGATION WITH BOTTLES?

Supplementary irrigation with bottles is a water-saving irrigation technique used to ensure an optimal performance of young seedlings in arid regions. The aim is to improve the acclimation of seedlings (often fruit trees) by minimal water use. On steep slopes and especially on loess soils, furrow irrigation cannot be recommended due to the risk of landslides and mudslides. Supplementary irrigation with bottles is not only a low-cost technique but also reduces the risk of mudslides on steep slopes and erosion.



HOW DOES IT WORK?

For this technology, plastic bottles (1.5-2 liter bottles) are used: First, their bottom must be removed but kept as cover. Then, the upside down turned bottle is filled with water. Its lid (now at the bottom) is twisted open very slowly until a drip rate of around 5 drops per second is achieved and can be fixed to the bottle with some tape. At this drip rate, a 1.5 liter-bottle is drained in 90-100 minutes. With this preparation, the bottle is almost dug into the soil next to the seedlings (10 cm of the bottle should be above the ground). The bottle lid should be on the same level as the root collar. Then the newly planted seedling should be mulched with grass, straw or stones. As the water drops reach straight to the roots, no additional watering on the upper layer is needed so that there is no water loss by evaporation on the surface. During the growing period, the bottles need to be re-filled with water every 5 days. As soon as they are empty, the bottles are refilled with clean water to avoid clogging of the lids. This technique should be applied for a period of 2-3 years until the root system has developed up to 2 meters deep.

It is recommended that the plot be fenced to protect the little seedlings from livestock.

Functions and Advantages:

- **Prevention of water erosion** on steep slopes, reduction of risk of landslides, mudslides
- Increased **water storage** in the soil and **decreased demand for irrigation water** by direct watering (especially fruit trees in dry regions can thus survive)

Disadvantages / Challenges / Risks:

- **Labor-intensive:** requires frequent refilling of the bottles

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with **“Yes”**, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal land use rights for the plot of tree planting?		
Do you have enough water for regularly irrigating measurements?		
Do you have water close to the plot and enough labor to water regularly?		
Are seeds or seedlings in good quality available?		

The **“Question”** part will ask you about additional framing preconditions. If the answer is **“No”**, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Is minimum equipment for planting of trees available?		
By using other irrigation techniques, do you have problems with surface run-off?		
Are the environmental conditions in general suitable for the tree species you have chosen?		

FINANCIAL CALCULATION:

Investment expenses	Investment amount
Plastic bottles	
Water	
Others:	
TOTAL expenses:	
Investment earnings/ additional benefits	
Higher chance of survival of seedlings	
Trees in better condition, higher yields	
Degradation, landslide prevention	
TOTAL earnings:	

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with **“Yes”**.

If at the end most of the questions are answered with **“Yes”**, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefit	Yes	No
Could you estimate to save money due to reduced expenditures for replanting of trees?		
Could you see the financial benefits of implementing this technique in the short term?		
Could this technique exclusively help to plant single trees on your kitchen garden /around the village or makes the installation of an orchard interesting for you?		
Did you already include expenditures for fencing measurements?		
Ecological impact		
Could supplementary irrigation with bottles contribute to higher soil moisture?		
Could supplementary irrigation with bottles reduce the sedimentation of lower located plots, water bodies...?		
Could supplementary irrigation with bottles reduce the occurrence of landslides and gully development, compared to ditch irrigation?		
Could supplementary irrigation with bottles thus conserve fertile soil layers on your plot?		
Could supplementary irrigation make remote areas or slopes around your village/ community interesting for reforestation or orchard installation?		
Gender impact		
What role do women have in irrigation measures: Are women involved in the decision making as to what kind of technique is applied in the establishment of this technique and maintenance?		
Do women have the right to own land certificates and to decide what should cultivated or planted?		
Would the establishment and maintenance of supplementary irrigation constitute an additional workload for women?		
Does the additional workload create a reasonable output for women, e.g., higher yields = higher income?		
From these benefits, can women decide on what the additional money is spent for?		
Community impact		
Could supplementary irrigation with bottles increase the availability of water in the dry season in your community?		
Could supplementary irrigation with bottles lead to higher yields and thus, to a better food security in your community?		
Could supplementary irrigation with bottles reduce the risk exposure to natural hazards (landslides, soil erosion...) for your community?		
Could this technique be a positive model for other households/communities?		

Contact:

CAMP TABIAT
Umed Bulbulshoev (director)
9 Sohibnazarova Street, Choroug
+992 935 14 19 45

Jangalparvar
Jamolidin Madibron (director)
62 Druzhbi narodov str., 734025, Dushanbe,
+992 91 818 18 25

Cesvi
Daniil Ilyasov (Project coordinator)
+992 985 02 27 37
Dushanbe Office: Firdavsi Str., 15
Khovaling Office: Mirzo Tursunzoda Str.

Caritas Switzerland
Afzalsho Nasibov (Project coordinator)
+992 901 10 93 32
26 Titova str.ap.25, 734025, Dushanbe

Links:

<http://camp.kg/en/who-we-are/camp-tabiat/>
umedsho@mail.ru

daniil.ilyasov@gmail.com

anasibov@caritas.ch

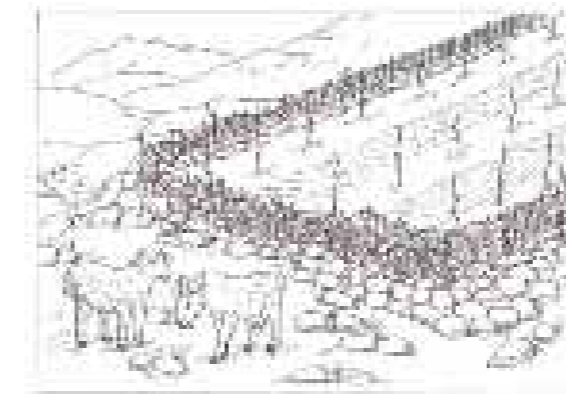
FOREST MANAGEMENT

3. Protection of forest / soil

3.1 Fencing

WHAT IS FENCING

Fencing is sometimes necessary to keep livestock inside or outside of a piece of land. This technique can be used for pasture rotation, as well as for forest protection, but also for boundary or tenure demarcation and single tree protection. It helps to meliorate pasture and forest parts or to improve the productivity by protecting against free grazing animals.



HOW DOES IT WORK?

There are two different techniques: *Life fencing*, which is described in another chapter, and *fencing*.

For fencing, you can use posts made of wood, steel or any other strong material and barbed wire, or any other kind of strong wire/material. The posts should be fixed stable in the ground (in case of livestock attacks (boars), wind/storm and blizzards). A distance between the posts of 3 m will be optimal.

The posts should reach up to a height of 1.50 m above the ground. If you install wire lines, the wire should be installed in three lines. The upper line should be installed on a height of 1.20 m. If you use other material, be sure that it is strong enough and continuously closed between the stakes.

This kind of fencing is more vulnerable for storm and blizzards than life fences, but much faster to install.

Advantages:

- **Forest, crop land and pasture are protected** from livestock and free grazing animals
- **Fences can be used to enhance ground cover on forest plots**
- **Reduction** of soil erosion, landslides...
- **Just two main components** are needed (Posts and wire, barbed wire or any other filling material)
- **Technically easy to install**, without any external support
- **Can be used for boundary or tenure demarcation as well**

Disadvantages/Challenges/Risks:

- **Costs** for barbed wire can be high, especially for big plots
- **Regular control** of the complete fence is necessary to ensure exclusion of the livestock throughout the whole year
- Compared with *live fencing*, **it will not create additional income through fruits or timber**

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“**Key questions**” If you cannot answer with “**Yes**”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for the fenced plot?		
Is the plot affected by livestock or free grazing animals?		
Do you have enough work power for the construction of fences?		
Is minimum equipment (e.g., for the establishment of fences) available?		

The “**Question**” part will ask you about additional framing preconditions. If the answer is “**No**”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Do you have sufficient information about fence construction?		
Do you need external technical support?		
Is the plot that you intend to fence in a more or less good ecological condition: Can you still gather benefits out of it?		
Is the plot affected by soil erosion?		
Do you need special equipment?		

FINANCIAL BENEFITS

It is recommended to calculate different fencing options and mixed versions with wood, stones, metal and barbed wire.

Investment expenses	Investment amount	Example
Fencing material per m. a)		
Fencing material per m. b)		
Fencing material per m. c)		
Barbed wire per m.		
Posts		
Additional costs		
Additional costs		
TOTAL expenses:		

Investment earnings/additional benefits		
Natural reforestation		
General higher crop yield (protect against animals)		
Better predictable harvest		
Plot demarcation		
Protection against wind erosion		
Additional earnings		
Additional earnings		
TOTAL earnings:		

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “**Yes**”.

If at the end most of the questions are answered with “**Yes**”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefits	Yes	No
Could you save money or labour costs due to a fenced afforestation plot, crop land or pasture?		
Will the investment in fences be higher than the expected benefits?		
Ecological impact		
Could the construction of fences improve the performance of the young trees?		
Could a fence construction around forest plots reduce further soil erosion, landslides and avalanches?		
Gender impact		
Do women have a role in the decision of afforestation? Are women involved in fence technologies?		
Would fence construction constitute only an additional workload for women?		
Does the additional workload create a reasonable output for women?		
From these benefits, can they (women) decide on what the additional money is spent on?		
Community impact		
Could fence construction have a positive impact for your community in terms of reduction of risks (soil erosion, landslides...)?		
Could fence construction lead to tensions within the community due to tenure rights on forest-, crop land- or pasture users?		

Contact:

CAMP TABIAT
Umed Bulbulshoev (director)
9 Sohibnazarova Street, Choroug
+992 935 14 19 45

Jangalparvar
Jamolidin Madibron (director)
62 Druzhbi narodov str., 734025, Dushanbe,
+992 91 818 18 25

Cesvi
Daniil Ilyasov (Project coordinator)
+992 985 02 27 37
Dushanbe Office: Firdavsi Str., 15
Khovaling Office: Mirzo Tursunzoda Str.

Caritas Switzerland
Afzalsho Nasibov (Project coordinator)
+992 901 10 93 32
26 Titova str.ap.25, 734025, Dushanbe

Links:

<http://camp.kg/en/who-we-are/camp-tabiat/umedsho@mail.ru>

daniil.ilyasov@gmail.com

anasibov@caritas.ch

FOREST MANAGEMENT

3. Protection of forest / soil

3.2 Live fencing

WHAT IS LIVE FENCING?

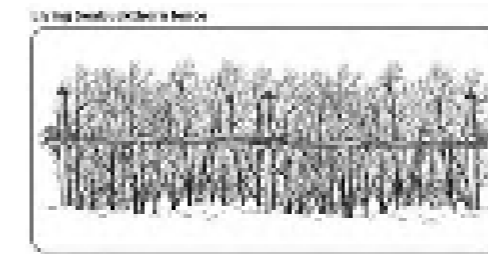
Live fencing is a technology that aims at controlling the movement of animals and people on a plot in use. It could be a plot of afforestation with newly planted trees as well as a winter or autumn pasture. To protect the plot, two options are recommended: fencing and live fencing. Fencing is a fast technique which additional income as well as the protection of trees.

Live fencing is a long-term investment with the positive side benefit of additional income.

HOW DOES IT WORK?

Live fence-posts are widely spaced, single lines of woody plants that are regularly pollarded. Between trees (fruit tree or trees with an additional benefit are suggested) thorny shrubs with an additional income like sea buckthorn or dog-rose can be planted. Until shrubs and trees are high and thick enough, metal or wooden posts for supporting barbed wire or other material can be used.

Ideally, the species used for live fence posts must have the ability to rapidly form a callus and cover the point of attachment of the wire to the post.



Planting steps for sea buckthorn fence:

A living sea buckthorn fence, for example, consists of 2 layers: the outer layer is an instant fence made of thorny sea buckthorn branches. This immediately restricts animal and human access. The inner layer is of sea buckthorn seedlings and will establish itself during several seasons.

This type of living fence can grow up to a height of 1.5-2 m.

It should be supported by fruit trees, willow or other kinds of poles: the sea buckthorn branches are fixed together with willow twigs, willow branches or wire and are attached to wooden poles.

Advantages & positive side effects:

1. Protection of young and highly exposed trees or crops
2. **Creates an additional source of income** (fruits, fodder, timber, fuelwood...)
3. **Multi-purpose trees:** provide fuel wood, timber, fodder (leaves as high quality source of forage for ruminants), biomass, nutrient-rich mulch, food if fruit trees are planted (selling on markets = income), medicine if medical plants are planted
4. Offer habitat to **insect-eating birds**
5. Serve as one method of securing **land ownership** where the law permits it = method of demarcating farms/plots
6. **Low cost technology** (establishment and maintenance), long lasting
7. **A constant fodder supply** is the basement of a dairy farming system and helps to save pasture from overuse.

Disadvantages & risks:

1. Problems of **competition** (for sunlight: can have shading effects to closely grown plants; for nutrients and water) with nearby crops and pasture grasses --> more information is required on the most appropriate species and management strategies to optimize the functions of live fences
2. **Long-term land use/tenure rights** need to be determined with certainty before a live fence is established- Live fences may harbor **insect pests**
3. **Takes time** to establish
4. **If not planted properly it is not effective**

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with **“Yes”**, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for the fencing plot?		
Is the plot in a good ecological condition and produces at least hay?		
Is the plot affected by freely grazing animals?		
Are the climatic conditions suitable for the establishment of living fences? Is there enough, sun and water?		
Are seedlings and seeds for establishing a live fence available?		

The **“Question”** part will ask you about additional framing preconditions. If the answer is **“No”**, the land user or the community needs to find a possibility to substitute for or solve these issues.

Questions	Yes	No
Do you have a demand for firewood, fruits, fodder, timber, mulch etc.?		
Is the plot exposed to soil erosion (wind or water) or to landslides?		
Is minimum equipment for the establishment/maintenance of living fences available?		
Are there for example willow poles available?		
Do you have access to enough metal or wooden posts?		
Do you have sufficient work power (for establishment and maintenance)?		
Do you need external advisory service for a efficient fruit/timber brier wood combination?		
Are there market opportunities to sell fruits (if fruit trees as fences are planted)?		

FINANCIAL CALCULATION

Investment expenses	Investment amount	Example
Price for branches and brier wood		
Price for plantlings		
Wire, string		
Water and mulching material		
TOTAL expenses:		

Financial benefits		
Fodder yield improvement (protection)		
Fruits/nuts/sea buckthorn		
Additional benefits		
Erosion protection		
Slope stabilisation		
TOTAL earnings:		

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with **“Yes”**.

If at the end most of the questions are answered with **“Yes”**, the positive impacts prevail, but the negative impacts should be still kept under careful consideration.

Financial benefit	Yes	No
Could you benefit financially in a term period from trees, bushes or shrubs planted as living fences (supply of fruits, fodder, timber, firewood, medicine)?		
Would the tree/bush/shrub products cover your household's needs?		
Could you generate additional income by selling these tree/bush products?		
Could you improve the crop yield or the successful number of afforestation trees, by fencing your plot?		
Could live fencing lead to conflicts with neighboring livestock?		
Ecological impact		
Could live fences contribute to the rehabilitation of your plot/contribute to a better performance of your plants/crops?		
Could live fences improve the soil fertility, soil structure, reduce salinization by planting, e.g., poplars or tamarisk, around your plot?		
Could live fences improve soil and water retention capacities on your plot?		
Could live fences contribute to the reduction of risk exposure to natural disasters (landslides, erosion, sedimentation of springs, avalanches...) for your community?		
Could living fences around afforestation plots contribute to a decrease of illegal cuttings in forests for fuel wood?		
Gender impact		
What role do women play in the care (husbandry) of trees/bushes/shrubs? Are women involved in the establishment of live fences/in the planting and caring for trees/shrubs/bushes?		
Could women directly benefit from tree/shrub/bush products, e.g., by processing and selling them? From these benefits, can these women decide on what the money is spent for?		
Would the establishment/maintenance of living fences constitute an additional workload for women?		
Or would it reduce their workload (spend less time for regeneration measurements of plot/ for collecting firewood...)?		
Would the additional workload create a reasonable output for women, e.g., increased income from selling products?		

Community impact		
Could your community benefit from fuel wood, timber, fodder, biomass supply by the establishment of living fences?		
Could the establishment of live fences and therefore a better development of afforestation plots have a positive impact for the community in terms of reduced risks to natural hazards, e.g., landslides, erosion, avalanches...?		
Could the establishment of live fences lead to tensions within the community in terms of competition for nutrients/sunlight/water between live fences and neighboring plots?		
Could the establishment of live fences for winter pasture and a cut and carry system for fodder production help community members to clarify tenure problems?		
Can live fences serve as a model for other communities?		

Contact:	Links:
<p>CAMP TABIAT Umed Bulbulshoev (director) 9 Sohibnazarova Street, Choroug +992 935 14 19 45</p>	<p>http://camp.kg/en/who-we-are/camp-tabiat/umedsho@mail.ru</p>
<p>Jangalparvar Jamolidin Madibron (director) 62 Druzhbi narodov str., 734025, Dushanbe, +992 91 818 18 25</p>	
<p>Cesvi Daniil Ilyasov (Project coordinator) +992 985 02 27 37 Dushanbe Office: Firdavsi Str., 15 Khovaling Office: Mirzo Tursunzoda Str.</p>	<p>daniil.ilyasov@gmail.com</p>
<p>Caritas Switzerland Afzalsho Nasibov (Project coordinator) +992 901 10 93 32 26 Titova str.ap.25, 734025, Dushanbe</p>	<p>anasibov@caritas.ch</p>

FOREST MANAGEMENT

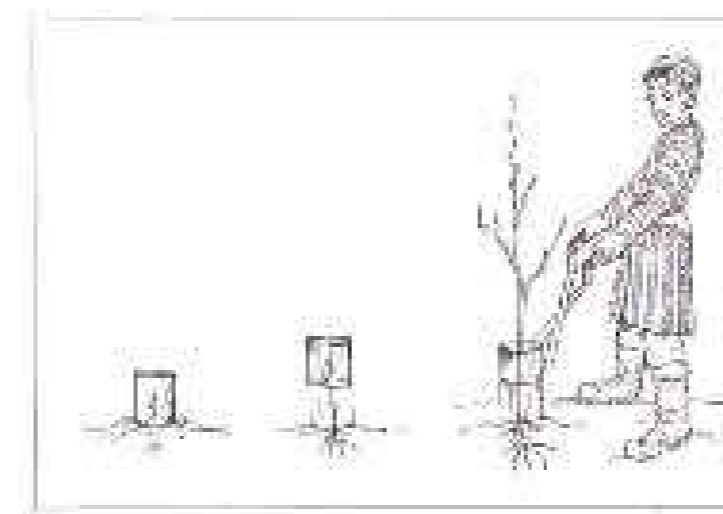
3. Protection of forest / soil

3.3 Plastic cover of plantlets

WHAT IS PLASTIC COVER OF PLANTLETS?

Plastic cover of plantlets is a technology designed to protect young plantlets of single trees or shrubs against wild animals or livestock. For planting several trees an appropriate fencing system is recommended. In case of increasing soil erosion, landslides, it is recommended that trees be planted on pasture, around villages, cropland, on slopes or kitchen garden-areas with uncontrolled browsing. The easiest way to protect the young plantlets is to use plastic bottles or plastic bags, or dried shrubs.

HOW DOES IT WORK?



Young plantlets are highly vulnerable against browsing of wild animals as well as livestock. After planting new trees or shrubs, it is necessary to protect the young plants. The easiest and cheapest way is to use empty plastic bottles. Cut off the bottle base and bottleneck and put it over the trunk of the already planted plantlets. It is possible to connect several cut plastic bottles together. The bottle can also be cut length side; then put it around the trunk and close the bottle protection with tape or string. Another option is to protect plantlets with plastic bags, covering the bark.

Willow is a highly vulnerable young tree; for the first 10 to 15 years the stem should be protected.

Take care not to break limbs or roots. The cover should start close to the ground.

It is important to look after the plantlets, because after around two to three years the plastic covers need to be removed.

Have a look at the chapters on *mulching*, *planting of poplar* or *nitrogen fixing trees* for additional information.

Advantages:

- **Little Equipment is needed** (bottles, cutter, sometimes tape or strings)
- **Cheapest** possibility to protect single plantlets against browsing
- **Maintenance is not needed**
- **Easy to install**
- **Feasible for a lot of plantlets** and small scale afforestation as well
- **Helps to protect fields and pasture** (potential shade for animals and it prevents drying of the soil)
- **Helps to install trees** against soil erosion and landslides in places that are exposed to grazing animals

Disadvantages:

- **Use of non-organic material**
- Because of the **longer term installation**, there is risk of forgetting to remove the hard covers (e.g., plastic bottles), and later they will harm the tree

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for the plot of tree planting?		
Are there plastic bottles or protecting material available?		
Is the plot accessible from your residence (to look after the plantlets)?		
Are the climatic conditions suitable for planting trees: Is enough water and sunlight available?		
Is the exposed plot for tree plantation affected by (free-) grazing animals?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to substitute for or solve these issues.

Questions	Yes	No
Is the plot in a good ecological condition to plant trees? (no heavy salinization processes, heavy erosion, or continuously waterlogged)		

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefit	Yes	No
Do tree products cover some of your household needs?		
Could the improved protection of your vulnerable young trees lead to a complete substitution of your fuelwood demand?		
Could the improved tree protection lead to a wider afforestation on your plots?		
Is there the possibility for you to sell timber?		
Did you include the reduction of soil erosion and other positive side effects into your calculation?		
Ecological impact		
Could this technique make it interesting for you to plant trees on slopes?		
Could planting trees around your fields improve the soil fertility of your plot?		
Could trees improve the soil temperature of your plot: Would the crops on your plot be more resistant to drought and frosts by the effects of the surrounding mulch and protection against wind?		
Could planting of trees (and protecting them) reduce the risk exposure to natural disasters (landslides, erosion, sedimentation of springs, flooding) for your community?		
Gender impact		
Do women have a role in care of trees: Are women involved in planting, reforestation or protection of trees?		
Could women directly benefit from tree or shrub products by selling timber or fruits?		
From these benefits, can the women decide on what the money is spent on?		
Are women allowed to decide for what the additional money (due to higher yields) is spent on?		
Community impact		
Would an efficient and wide afforestation have a positive impact for your entire community?		
Could many households benefit from successful afforestation?		
Could conflicts with neighboring households due to negative impacts of your trees on them (i.e. shadow, limited access) be easily regulated?		

PASTURE/LIVESTOCK MANAGEMENT

Contact:

CAMP TABIAT
Umed Bulbulshoev (director)
9 Sohibnazarova Street, Choroug
+992 935 14 19 45

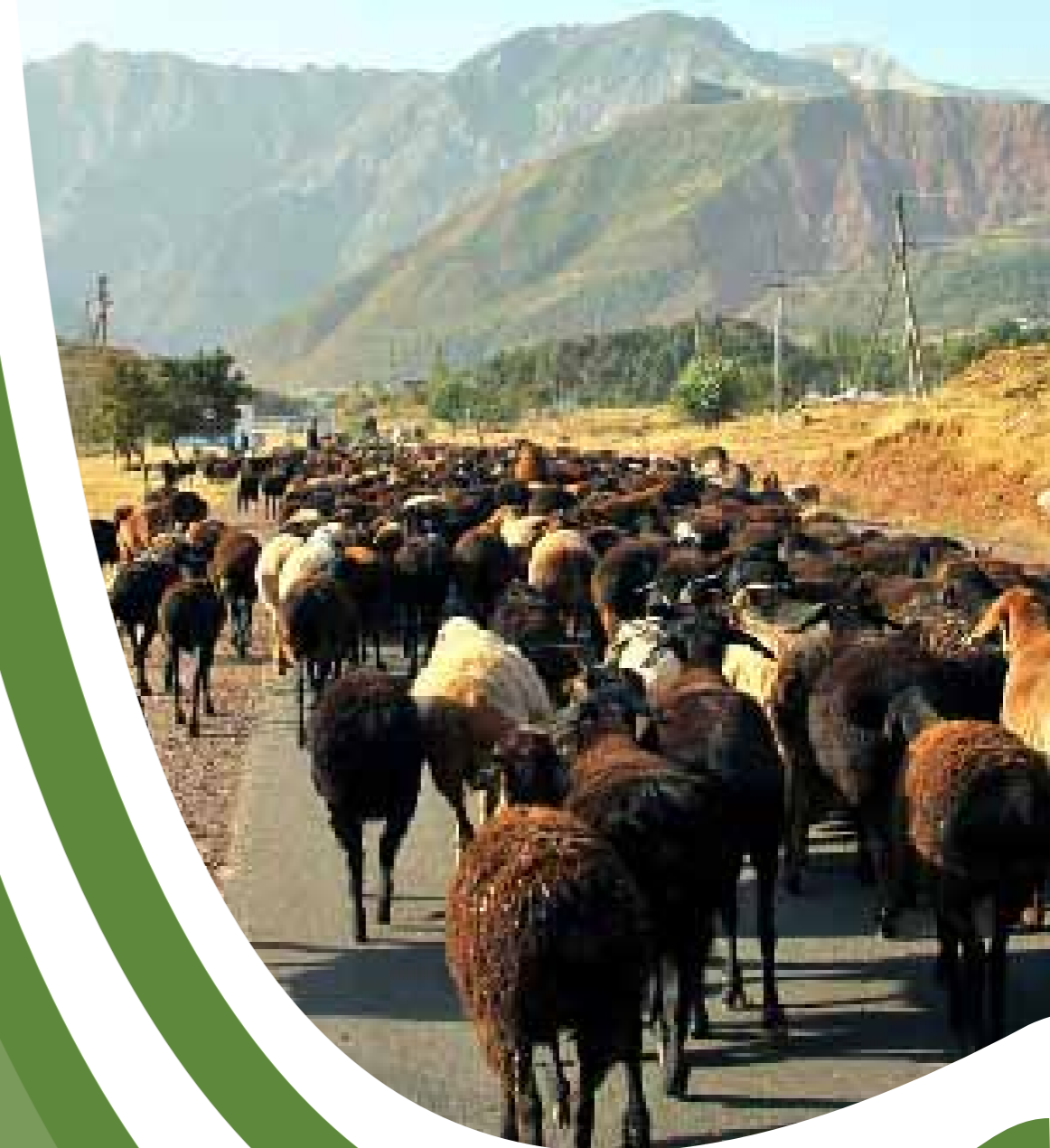
Jangalparvar
Jamolidin Madibron (director)
62 Druzhbi narodov str., 734025, Dushanbe,
+992 91 818 18 25

Cesvi
Daniil Ilyasov (Project coordinator)
+992 985 02 27 37
Dushanbe Office: Firdavsi Str., 15
Khovaling Office: Mirzo Tursunzoda Str.

Links:

[http://camp.kg/en/who-we-are/camp-tabiati/
umedsho@mail.ru](http://camp.kg/en/who-we-are/camp-tabiati/umedsho@mail.ru)

daniil.ilyasov@gmail.com



PASTURE/LIVESTOCK MANAGEMENT

1. Organizational approach



1.1 Introduction

The reference frame for pasture management usually is the community and pastures the community is using and most preferably those that have been officially allocated.

Without coordination among all stakeholders sustainable pasture management is not possible.

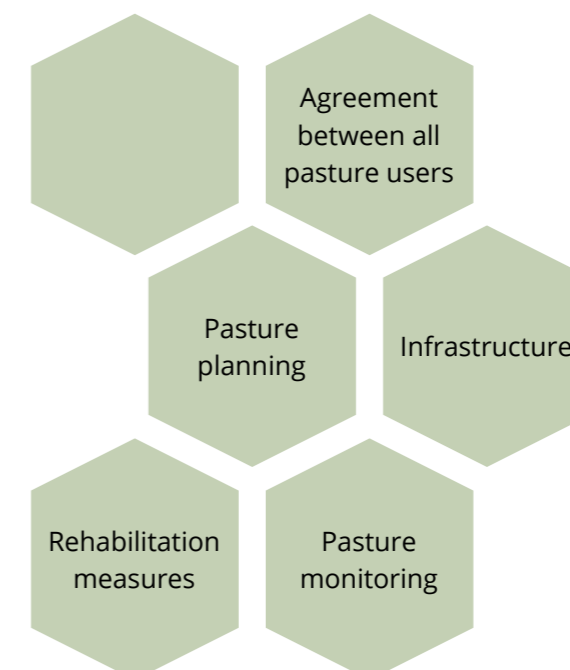
Essential activities like pasture monitoring, agreement with herders migrating or passing by the village herds, repairing destroyed infrastructure or building new infrastructure, and pasture rehabilitation measures, are difficult to be solved by a single household.

The basis for efficient pasture management is good planning and monitoring. In fact, monitoring is a difficult, constant and long term task and not feasible in a couple of days by a few shepherds. For additional information have a look at the subchapter "Monitoring".

The objective of any pasture monitoring technology is the same: "To get a view/picture of the pasture condition and the carrying capacity in order to decide on length and intensity of pasture use and application of rehabilitation techniques". Pasture overgrazing leads to weed infestation and degradation, which at the end leads to a decrease in pasture productivity and increased pressure if cattle numbers are not down-regulated.

If the pasture development shows a tendency of degradation, rehabilitation measures might be applied. Rehabilitation measures are additional measures to counteract pasture degradation, and they are only successful if they are included into a pasture management plan, discussed and agreed upon by all community pasture stakeholders. A selection of rehabilitation measures are listed in this chapter.

Another important component of a pasture management plan could be the construction or reconstruction of infrastructure. Some techniques are listed in this chapter.



PASTURE/LIVESTOCK MANAGEMENT

1. Organizational approach

1.2 Organization of pasture user

A community pasture is just as good/productive as the pasture user who manages it. It is important to ask yourself: who is using the pasture, at which time and who is crossing the pasture, how can pasture access be regulated, what is the optimum pasture rotation system, how is it possible to get new pasture shares and how can the infrastructure be improved? For a single user it is not possible to manage all these issues and it is also impossible to control agreements. Therefore, regular meetings between different pasture users, officials and specialists to discuss such challenges are required.

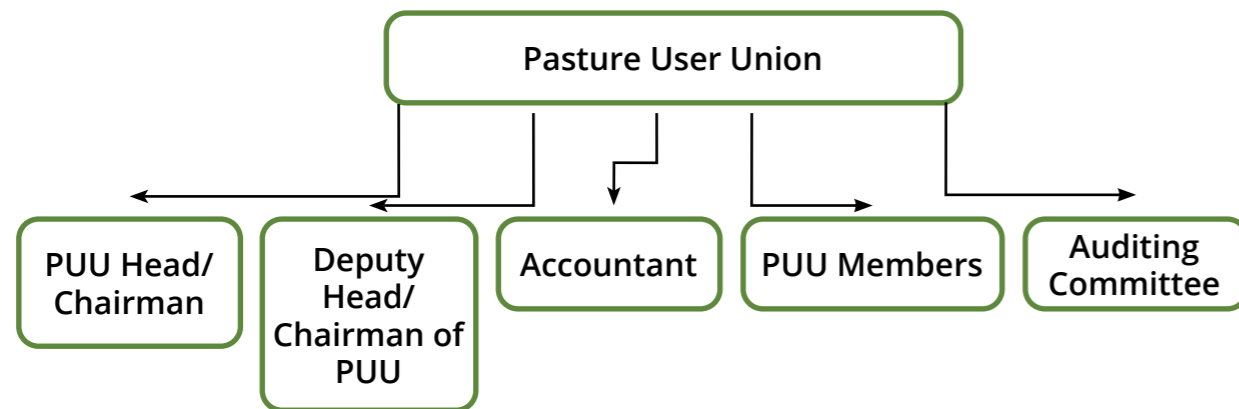
Proven institutions to deal with community-based pasture management are **Pasture Users Unions (PUU)** and **Village Livestock Associations/Committees (VLA/C)**.

Let's take a look at how they operate.

PUU: Is a union of pasture users established at the village/Jamoat level, consisting of a cluster of villages. It is a formal organization, with a statute, formal registration and has a stamp and a bank account. In its organizational set-up it consists of a chairman, a treasurer, secretary and the ordinary members. A PUU is representing several pasture user groups which use pastures adjacent to each other and the grouping takes place on a voluntary basis. The PUU is registered at the Jamoat and has a legal status.



The advantages of PUUs, as experience from the past teaches us, are better representation of interests in front of the Jamoat when it comes to important decisions about pasture or pasture access. Additionally, organizing in a pasture Union reduces potential conflicts over pasture use as its formation improves the coordination of pasture use and it eases the solving of pasture boundary issues. Also, formation of a PUU makes it possible to undertake activities (e.g., establishment of a veterinary service point or water points) that would otherwise not be feasible to undertake, by benefitting from a larger scale. PUUs also play a role in capacity development, as they enhance interactions amongst pasture users and facilitate exchange of knowledge and experiences.



Another proven organizational structure is the VLA, village livestock association. VLAs or Village Livestock Committees (VLCs) are the committees established at the village level. They usually have between 5-11 members, depending on the size of the village. It is common to have one representative from each street of the village. These representatives are elected during a special village meeting, which requires a presence of at least 70% of the whole community. Preferably one or two of the appointed members should be female, in order to ensure representation of interests of women in the decision-making process. The VLC functions as a special committee under the village CBO structure and deals with all issues related to pasture and livestock management within the community. In spring the committee usually organizes a village meeting where they discuss the grazing plan for the next season. Next to the schedule of the use of pasture plots, this includes agreeing on a roster for each family to take their turns for herding the animals or hiring of a professional herder, a schedule of working days to work on infrastructure maintenance, a schedule for the various vaccinations to be carried out, and generation of ideas for pasture improvement activities. This may include actions to improve or add new infrastructures, like opening up new cattle tracks, establishment of water points or construction of shelters in the highland pastures (for herders and/or livestock). It may also include actions that save costs on inputs like joint purchase in medicine and feeds/fodder, or activities related to marketing of livestock.

PASTURE/LIVESTOCK MANAGEMENT

1. Organizational approach



1.3 Pasture monitoring

WHY IS PASTURE MONITORING SO IMPORTANT FOR PROPER PASTURE MANAGEMENT?

The aim of pasture monitoring is to provide data for decision making and in the long run to maintain or improve the productivity of a pasture and to prevent pasture degradation. An initial assessment and consecutive monitoring of the pasture condition are indispensable for timely detection of pasture degradation and provide an opportunity for adaptation in management practices to stop the degradation process.

BUT WHAT ARE SIGNS OF PASTURE DEGRADATION THAT SHOULD BE MONITORED?

Pasture degradation becomes visible in various ways. Often the area of bare ground in a pasture plot increases and cattle trails are highly visible. Because of the decrease in ground cover, pasture land becomes more susceptible to wind and rain erosion. This becomes visible through the presence of rill erosion and gullies. Eventually this leads to a significant drop in pasture production. Another sign of pasture degradation is decline of biodiversity. This is another reason for decline in pasture productivity (both in quantity and quality). 'Bad' grasses and shrubs take over from the good grasses which are palatable and nutritious and are an important factor for livestock productivity. When pasture productivity is declining, the financial benefits from livestock production will decrease as well.

We can distinguish two types of monitoring, depending on its objective.

First of all we can annually, preferably end of May, beginning of June, do an elaborate type of monitoring and documentation of the situation of community pastures. The purpose of this monitoring is to use its results for strategic and long-term decision making, i.e., to determine the quality of the pasture in order to fix the rental fee, or to assess the carrying capacity of pastures, or to determine which plots need to be given a rest and, very importantly, to monitor the impact of certain management practices which we have taken over time. This type of monitoring and documentation should be implemented by the **Pasture User Unions** and the **Village Livestock Committees**, jointly with the pasture committee members as appointed under the March 2013 pasture law. For details on this elaborate pasture assessment method we refer to a,b (a-IWSM/GREAT manual, b-Kyrgyz manual). Such monitoring can be performed by professional herders, and external support by specialists is necessary.

The components of the pasture assessment system are (according to an example from GREAT and ISWM developed by Caritas Switzerland in Tajikistan):

- Assessment of ground cover, using a special reference sheet with pictures showing various ground cover ratios;
- Inventory of edible grasses, differentiated between edible, non-edible species and poisonous species;
- Assessment of soil quality;
- Estimation of potential annual pasture yield in tons DM/ha;
- Developing a community pasture map, showing plots in use and their boundaries;
- Documentation of the pasture situation in a fixed format, using the gathered information and photographs taken

The second type of monitoring is a “lighter” form of monitoring and provides information for day-to-day decision-making, e.g., when to start and when to end grazing of a certain pasture plot, which plot should be used this year for hay making and when to start mowing the grass and which animal species should be grazed in which plots. For this type of monitoring it is important to survey the whole pasture area on a regular basis and observe through visual inspection the grass length and vegetative stage the plant is in and ground cover. A ruler and the guide with sample pictures of ground coverage as well as a pasture plant guide are tools needed to fulfill this task. Using a stick, the sample photos, and the calculation table, one can measure grass length and density, and calculate bio-mass yield, expressed in Tons Dry Matter per hectare. A rough and visual assessment of the proportion of eatable plants can help to correct the calculated yield. This type of monitoring should be done by the professional herder, jointly with a representative of the Village committee who is experienced on this subject and has been appointed especially for this task. This is indeed important when rotational herding is practiced in a community and the herding is rotating daily from one family to another.

PASTURE/LIVESTOCK MANAGEMENT

1. Organizational approach

1.4

Pasture management planning

Developing a pasture (and livestock) management plan is an important tool for improving the pasture and livestock situation in rural communities. It involves assessment of the current situation and identification of issues that are constraining optimal use of resources. There are different ways and tools available as to how to plan pasture use, and these will be described further down.

In general, a good pasture management plan points out the activities needed in order to achieve the desired pasture and livestock management objectives. The purpose of pasture management planning is:

- To enhance management of community managed pastures in a way that increases pasture yields in quantity and quality, without causing land degradation and erosion;
- To serve as a tool to improve livestock management;
- To bring the number of animals kept by livestock keepers in balance with available fodder;
- Increase in animal off-take through better yielding pastures, adoption of improved feeding practices, and improved animal management and better animal health;
- To increase the income of the rural population from livestock keeping;
- To reduce downstream flood risk in mountain areas.

Experiences with pasture management planning have shown that the participation of livestock keepers (in this process) raises awareness and enhances understanding of the present pasture and livestock management practices as well as its linkages to environmental issues and farmers' livelihoods. It clarifies issues such as (1) what are the common ways of livestock keeping in the respective communities, who benefit from it and in which way, (2) what are the common problems encountered in pasture management & livestock keeping, (3) what do the pasture users see as key problem(s) which they would like to see addressed, and (4) what do they see as possible solutions to overcome the identified problems.

For pasture management to be effective, it requires a perspective shift: from keeping livestock “as a strategy to survive” to “keeping livestock as a means to raise income efficiently and sustainably”. For this change of mindset, a balance in the number of animals and the amount of available fodder (of good quality) is crucial.

When it comes to actual planning, it is important to carefully consider who should be involved in the process of making the plan, and, afterwards, who should be involved in its implementation. In that respect, women and poorer households of a community are often overlooked and special efforts are needed to encourage their participation. The Pasture User Unions (PUU) board members should take the lead in making the plan, supported by village livestock keepers, livestock-, pasture-, environmental- and land use experts. The first step is to develop Pasture and Livestock Management Plans (PLMP) at the village level. The village plans covered by the PUU are subsequently compiled into an overall plan together with community.

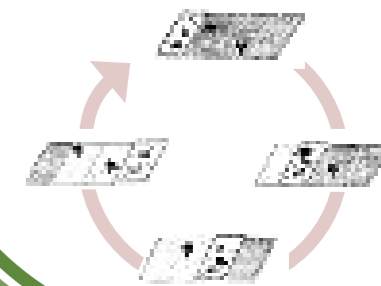
DIFFERENT PLANNING TOOLS AND TEMPLATES

The pasture management calendar developed by GIZ financed by EU and the German government provides for the minimum requirements for pasture use and management planning. The catalogue consists of 6 small drawings illustrating the most important rules on sustainable pasture use and livestock development. Template annual plans are attached, where pasture related activities can be written down as planned by the community: like the period a certain pasture is used or resting, areas used for hay and fodder making, and rehabilitation measures like reseeding and fertilization. Below the plan, there is room for a de-facto monitoring of activities. An example is also attached. Even if the calendar will not provide for the most accurate and scientifically sound planning, it can be a tool for first steps of the community towards a conscious pasture use and a self-learning process.

In 2013, The Asian Development Bank (ADB) developed another useful tool for pasture management planning: a pasture yield estimation handbook with sample photographs of different densities of surface coverage and pasture yield calculation in kg/ha based on the grass height. This quick yield assessment guide can help to assess pasture quality and capacity more frequently and provide for adaptive pasture management.

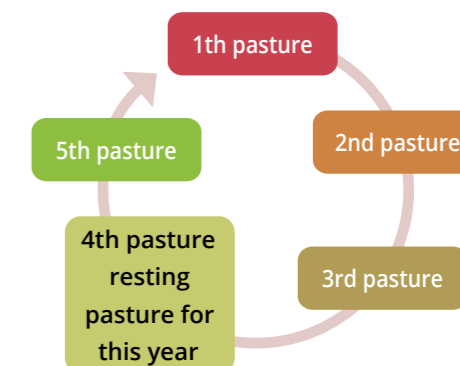
PASTURE/LIVESTOCK MANAGEMENT

2. Rehabilitation technique



2.1

Pasture rotation



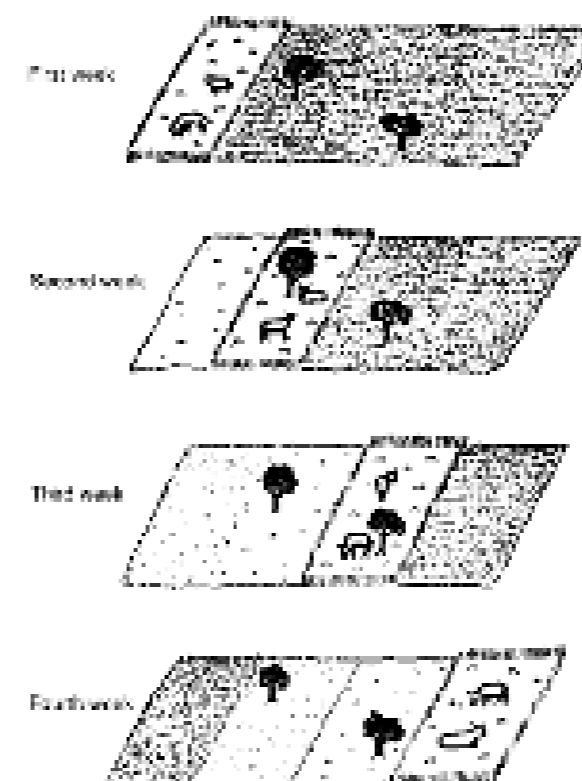
WHAT IS PASTURE ROTATION?

Grazing livestock and pasture plants adapt to each other and should remain in a healthy balance for a sustainable utilization of pasture resources.

Pasture rotation by itself is a process where livestock is moved from one pasture to another to allow the vegetative cover in previously grazed pastures to regenerate. Continuous grazing on one area often leads to overgrazing and a reduced production of forage. Under-use of pastures, on the other hand, can lead to the dominance of shrubby vegetation. The goal of pasture rotation is, therefore, to use pasture land in the most efficient way. By regulating the number of livestock and the duration of grazing, the availability of biomass is ensured and livestock production is optimal.

HOW DOES IT WORK?

For the implementation of a pasture rotational system, the following steps are necessary:



- (1) First, a single user or the community has to know who is using the pasture and how much cattle is grazing, at which time, and who is crossing the pasture on its way to summer pastures or back.
- (2) Second, yield per hectare of the pasture(s) which will be included in the rotation system should be assessed. A pasture yield calculation guide developed by GIZ will help to estimate the yields.
- (3) Then, all pasture users (for example a PUU) have to identify how much livestock can feed at which time on which pasture. A pasture calendar, developed by GIZ, can facilitate such a decision-making process.
- (4) The implementation of a pasture rotation system may be supported by establishment of (portable) drinking points and natural or artificial shelters. Measures to maintain or improve the fertility and productivity of a pasture, for example, through reseeding or removal of weeds, may be additionally applied.

Guidelines for avoiding an inappropriate pasture use:

- Don't use pasture areas under a height of 5 cm
- Negotiate and delineate areas which can be used by migrating livestock
- Don't allow grazing in early spring before pasture plants have exceeded their sprouting stage (also to prevent compaction of still wet soil). At least half of the vegetation must already flower before grazing can start
- Don't allow grazing too long, in order to preserve biomass which is necessary for the re-growth
- Keep in consideration that a pasture needs a rest every four to five years for natural reseedling

Functions and Advantages:

- **Better fed livestock** due to more **efficient use of pasture areas and increased pasture productivity**
 - **Improved pasture composition and condition due to longer regeneration phase/natural reseedling**
 - **Reduced soil erosion** due to continuous ground cover throughout the year
 - **Reduced weeds** and more eatable plants

Disadvantages / Challenges / Risks:

- Outstanding user can feel overlooked from PUU's
- Less knowledge of pasture utilization can lead to overuse on several pastures
- An agreement between pasture users about the pasture rotation system is compulsory
- **A pasture yield assessment and regular monitoring are mandatory for the design of a pasture rotation plan**

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

"Key questions". If you cannot answer with **"Yes"**, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal access to all pastures included in the pasture rotation system?		
Is the plot defined as pasture land (land category) ?		
Is the pasture or pastures which are included in the rotation system, used by other communities, shepherd or migrating herds?		
Are the pasture plots in a condition that you can still gather benefits out of them?		

The **"Question"** part will ask you about additional framing preconditions. If the answer is **"No"**, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Do you have sufficient information on your pastures and the pasture users, i. e., number of cattle units, pasture yield		
Do you have enough and sufficiently professional work power or the possibility to hire a professional herder?		
Do you have funds available for payment of the professional herder, establishment of water points, bridges, shelters or are you in need of extranal financial support?		
Do you need an external advisory service to create an appropriate management plan? (Including yield assessment and pasture monitoring)		

FINANCIAL CALCULATION:

Investment expenses	Investment amount
Continuous meetings of all pasture users	
Joint monitoring of the pasture plots and assessment of pasture yield	
Employment of a professional herder	
Infrastructure	
Others	
TOTAL expenses:	
Investment earnings/ additional benefits	
Higher pasture yield (with proper establishment of the rotation system, yield can be increase by 100%)	
Better fed animals	
Better control of pasture use and PUU members are ready to pay for pasture use	
Prevention of further degradation and erosion (if the current grazing system leads to degradation, the rotation system can help to maintain the current pasture productivity and grasslands)	
TOTAL earnings:	

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with **"Yes"**.

If at the end most of the questions are answered with **"Yes"**, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefits	Yes	No
Could you save money due to less expenditures for additional fodder?		
Could you get higher income due to less but better fed animals?		
Could you save money due to less expenditures for the purchase of additional fodder?		
Could you save money due to less expenditures for regular reseedling/ pasture regeneration measurements?		
Could you save money due to less expenditures for reconstruction measures (fences, houses...) after natural hazards (erosion, landslides, falling rocks, avalanches...)?		

PASTURE/LIVESTOCK MANAGEMENT

2. Rehabilitation technique

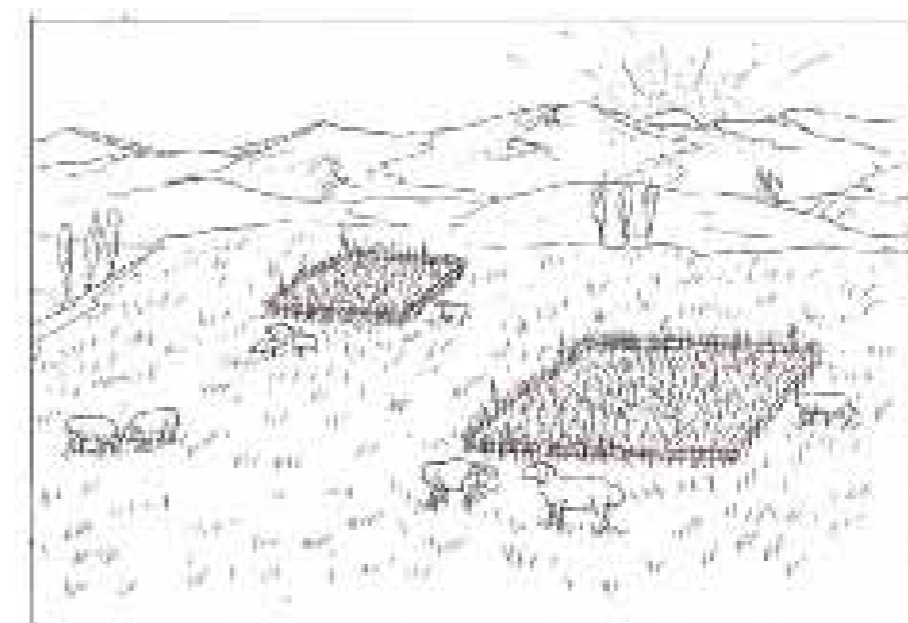
2.2 Natural pasture resowing

WHAT IS MEANT BY NATURAL PASTURE RESEEDING?

Natural pasture reseeding means to leave a piece of pasture fallow, graze or mow it for the whole growing period. It is important that all pasture plants of this plot get the chance to finish blooming. The reason, after blooming, plants need time for seed production and after finishing this cycle, which varies from species to species, the protected area and areas around will be reseeded with location-typical pasture species. Natural reseeding during grazing requires fences against livestock.

HOW DOES IT WORK?

The easiest way to reseed a pasture plot by this method is to choose a representative piece (wide composition of location-typical plant species, except weeds) of pasture and fence it against livestock and freely grazing animals. Another method could be fencing or protecting a reseeding stripe at the sidelines of the pasture. The shape of the fenced piece does not matter. If a larger pasture should reseed, a fenced strip is recommended. Otherwise, several circles or terrain adopted shapes also work well. It is important to fence the area seriously against free grazing animals, even in case the pasture is used for mowing. For this problem of short term fencing, low-voltage electrical fences are ideally suited, but not the only possibility. Only after the reseeding period can the dry hay be mowed as low-nutrition winter forage.



Ecological impact		
Could pasture rotation improve the fertility of the pasture you use?		
Could pasture rotation contribute to a regeneration of the pasture areas you use?		
Could pasture rotation reduce soil erosion, landslides, avalanches, gully development or other natural hazards?		
Could pasture rotation bring degraded pastures back in utilization?		
Gender impact		
Which role do women have in the decision on the use of pasture areas: Are women involved in pasture management?		
Do women/female headed households have the right for access to pasture areas?		
Do women have the right to lead a Pasture User Union (PUU)		
Would pasture rotation constitute an additional workload for women?		
Does the additional workload create a reasonable output for women, e.g., higher yields, e.g., dairy products, meat,...due to better fed animals (products to sell on markets)?		
From these benefits, can they decide on what the money is spent for?		
Community impact		
Is it possible to include all pasture users of the community in the rotation system (establishment of a PUU or VLA)?		
Could the implementation of a pasture rotation system have a positive impact for your community in terms of reduction of risks (soil erosion, landslides, avalanches, falling rocks...)?		
Could the implementation of a community based pasture rotation system lead to a better use of different pastures, mobilization of funds for infrastructure rehabilitation or establishment?		

Contact:	Links:
PUU network VLA network	FLERMONECA www.flermoneca.org

Advantages:

- Location-typical reseeding
- Technical simple implementation
- Removable
- Applicable during grazing
- Cost-free reseeding, except the purchase of low-voltage electrical fences
- Protection against erosion and side effects of erosion
- Natural pasture protection
- Good practice contributes to weed reduction (weed control in the fenced area)

Disadvantages / Challenges / Risks:

- Only seriously fenced areas, or fenced mowing areas, will work as natural reseeding pasture plots (challenge)
- It is necessary to protect the plot during the whole growing season
- Low-voltage electrical fences could be expensive
- Effects are localized around the fenced area
- Fenced areas with a high amount of weeds will not improve pasture, but rather will decrease pasture quality.

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with **“Yes”**, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for this plot?		
Is the plot assigned as pasture land?		
Is the plot in a good ecological condition and can provide for a diversity of plant seeds, especially high nutritious palatable plants		

The **“Question”** part will ask you about additional framing preconditions. If the answer is **“No”**, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Is the plot exposed to soil erosion?		
Is minimum equipment (for establishment of drainage ditches) available?		
Do you have access to easily removable fence material?		
Do you have more detailed information on the approach and know important palatable pasture plant species ?		
Do you need external advisory service to find out local adopted pasture grasses for reseeding measurements?		
Do you have enough work power (for the establishment of fences)?		
Do you need support with special reseeding technique?		

Investment expenses	Investment amount	Example
Fence (i.e., low-voltage electrical)		
Additional costs		
Additional costs		
TOTAL expenses:		
Investment earnings		
Natural reseeding of pasture (depending on the specifics of the pasture plot and the size of the fenced area, it can be expected that the pasture productivity can be improved by 20-50%)		
Additional benefits		
Less erosion/ soil cover		
Pasture stabilization, weed control		
Additional earnings		
TOTAL earnings:		

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with **“Yes”**.

If at the end most of the questions are answered with **“Yes”**, the positive impacts prevail, but the negative impacts should still be kept under careful in consideration.

Financial benefits	Yes	No
Are you currently reseeding your pasture with seeds that you purchase additionally and are the expenses higher/ lower and the impact of additional seeds high/low?		
Could you buy low-voltage electrical fences on your own?		
Do you see a possibility to rent an electrical fence system?		
Ecological impact		
Would natural reseeding contribute to a better soil cover and higher pasture variety on your plot? Or are your pastures in a good enough condition?		
Would natural reseeding contribute to a better soil protection and a reduction of wind and water erosion on your plot?		
Would natural reseeding contribute a higher pasture productivity on your plot? Do you expect enough high nutritious pasture plants on your plot?		
Gender impact		
Would the establishment of natural reseeding areas represent an additional workload for women?		
Does the additional workload create a reasonable output for women?		
From these benefits, can they decide on what the money is spent on?		

Community impact		
Could reseeding areas on communal used pastures contribute to a reduction of risk exposure to natural hazards (landslides, avalanches...) for your community?		
Would the establishment of reseeding areas have a positive impact in terms of increasing pasture productivity for your community's livestock?		
Could the community buy low-voltage electrical fences for community used pastures?		

Contact:	Links:
Cooperative SAROB Muhamadi Muminov (director) 127 Rudaki ave. Rudaki Plaza, room 1113;1115 Dushanbe, Tajikistan 93 5770230	sarob.net muminov01@gmail.com mmuminov@sarob.net

PASTURE/LIVESTOCK MANAGEMENT

2. Rehabilitation technique

2.3

Gully rehabilitation by barrier building shrubs

WHAT IS GULLY REHABILITATION?

Gullies develop easily on degraded areas that suffer from overgrazing, deforestation and trampling. They form after intensive rainfall events in fall and spring. Rills develop on steep areas, and eventually enlarge into gullies.

Gully rehabilitation technologies, for example constructions from flexible living branches of a sprouting variety of tree, such as willow, reduce the flow of surface water and trap sediments from muddy surface water run-off, which eventually refill the gully after several months or years. This low cost technique prevents further erosion, increases the amount of land available for pasture, and reduces the risk of mud flows or floods further down the slope.



HOW DOES IT WORK?

At each 3 to 10 m interval along the gully, barriers are constructed. For the barriers, use locally available living branches such as willow branches. The flexible branches should



create a 'wave' wall in the gully bed but should not be higher than 0.5 m. Additionally, live cuttings from local tree varieties such as mulberry can be planted in the willow wave structure. The construction activities should start in spring, so that the cuttings that are planted in the gully begin to sprout and grow within several weeks.

Functions and Advantages:

- **Control of run-off** (by improvement of ground cover) and **stabilization of soil** (by roots) --> sedimentation retention, prevention of further erosion and expansion of gullies (thus, the amount of land available for pasture activities can be increased)
- **Low cost:** materials used are locally available, free of charge to the land users
- **Simple to establish, low workload:** no training and additional skills are required
- **Flexible:** various varieties of local sprouting trees can be used

Disadvantages / Challenges / Risks:

- Living barrier needs to grow --> Choose plant material which is **adapted to drought conditions**
- **High level of maintenance** in the beginning of establishment (first initial few seasons): The gully plug is weak in the beginning as the mulberry trees become more established. It is more susceptible to the impact of heavy rainfall events and concentrated run off down the gully.
- The gully plug has to be **protected from livestock** who will eat the vegetation --> Fencing around gully.
- **Less effective** as gullies become wider and deeper.

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with **“Yes”**, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Is the pasture already affected by degradation, erosion and gully development?		
Is the plot already used as pasture ?		
Is minimum equipment (e.g., for establishment of barriers) available?		
Do you have legal user rights for the pasture?		

The **“Question”** part will ask you about additional framing preconditions. If the answer is **“No”**, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Is the plot in a more or less good ecological condition: Can you still gather benefits out of it, can you produce enough fodder?		
Do you have sufficient information in gully rehabilitation technologies?		
Do you have enough work power (for the construction of barriers, maintenance)?		
Do you need an external advisory service for an appropriate barrier installation?		
Do you need special technical support for cement or other equipment?		

FINANCIAL BENEFITS

You have to consider calculating the expenses not only for one gully barrier but also for several.

Investment expenses	Investment amount
Shrubs (dry and/or fresh)	
Willow branches as stakes (thin/ thicker)	
Material to seal / for sealing	
Transport	
Work power	
Additional costs	
TOTAL expenses:	
Investment earnings/ benefits	
Soil stabilization	
Prevention against further landslide risks	
Recovery of crop or pasture land	
Additional earnings	
TOTAL earnings:	

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with **“Yes”**.

If at the end most of the questions are answered with **“Yes”**, the positive impacts prevail, but the negative impacts should still be kept under careful in consideration.

Economic benefits	Yes	No
Could you save money due to less expenditure for reconstruction measurements (fences, houses...) after natural hazards (erosion, landslides, falling rocks, avalanches...)?		
Ecological impact		
Could gully rehabilitation improve the stability and fertility of the pasture you use?		
Could gully rehabilitation on the pasture used reduce further soil erosion, gully development, landslides, avalanches...?		
Gender impact		
What role do women have in the decision in the use of pasture areas/ crop fields: Are women involved in gully rehabilitation technologies?		
Would gully rehabilitation constitute an additional workload for women?		
Does the additional workload create a reasonable output for women, e.g., improved pasture, more land available,... therefore higher yields, e.g., dairy products, meat...(products to sell on markets)?		
From these benefits, can these women decide for what the money is spent on?		

Community impact		
Could gully rehabilitation have a positive impact for your community in terms of reduction of risks (soil erosion, landslides, avalanches, falling rocks...)?		
Could successful gully rehabilitation serve as a positive model for other communities?		
Could gully rehabilitation lead to tensions within the community due to the prohibition of grazing on regenerating pasture areas?		

Contact:	Links:
Cooperative SAROB Muhamadi Muminov (director) 127 Rudaki ave. Rudaki Plaza, room 1113;1115 Dushanbe, Tajikistan 93 5770230	sarob.net muminov01@gmail.com mmuminov@sarob.net

PASTURE/LIVESTOCK MANAGEMENT

2. Rehabilitation technique

2.4

Planting of single trees or bushes on pasture

WHAT IS SILVOPASTORAL MANAGEMENT?

Silvopastoral management is a combination of planting trees or bushes on pasture. On the one hand, trees will give shade for resting animals to cool their body temperature; otherwise animals try to cool down by eating more fresh fodder. This means that offering shade on pasture helps to work against overgrazing and animals will grow faster as stress is reduced. On the other hand, trees are integrated into the pasture in order to raise the fertility of the soil and therefore the productivity of the pasture will rise. This diversification of the land use has several other positive effects: additional timber and firewood; moreover, leaves can serve as fodder, as protection against solum erosion, wind breaks, higher biodiversity on the pasture. This technique is limited by steep slopes, but also helps to stabilize slopes.

HOW DOES IT WORK?



Trees are planted widely distributed (maximum 400 trees per hectare, dependent on tree species) into grazed, permanent pastures. Places of interest are slopes and erosion affected areas, which can be fenced to protect them against grazing. It is recommended to plant at least 10 trees around or close to drinking points. This technique has several advantages. First, the shade of trees will be used as a resting place for livestock during hot times. Second, you have to keep the distance between resting place and drinking place as short as possible. Another advantage

of planting trees close to drinking points is the need of watering until they can stay only rain-fed. The young trees must be fenced safely; otherwise the livestock will destroy the young trees.

You have to plant and even to mulch them like single trees (*see single tree mulching and supplementary irrigation by bottles*). During the first years you have to maintain the trees (watering, renew mulching material, renew protection material against browsing) seriously, to be successful.

Trees in consideration:

Tree type	Price in TJS	First harvest year	Average yield kg per tree	Water demand liter per year
Apple	8-15	5	100-120kg	4.000- 8.000
Pistachio	3-4 (package)	15	10kg	----
Willow	2-3 per stick	----	---	----
Mulberry	2-3, rear	7- 8	---	----
Junipers	---	---	----	----
Sea buckthorn	15	6	---	----
Dog rose	3	3	---	----

Advantages:

- long-term income due to simultaneous production of trees and grazing animals
- production of fuel wood, timber, fruits and fodder at the same time
- livestock use the trees for shelter from wind -> in hot times, the animals are less stressed and put on weight faster when grazing in a cooler, shaded environment
- animals eat the leaves of trees or shrubs
- increase of soil fertility by falling of leaves (organic material)
- reduction of wind speeds and a reduction of maximum temperatures

Disadvantages / Challenges:

- sheep spending time close to trees causes a greater soil compaction around them; compaction when trees are planted at very low densities
- it is recommended that trees are planted close to watering points or erosion affected pasture areas
- during the first years, must protect the trees against browsing and evapotranspiration

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for this pasture?		
Is enough workpower available for the establishment and care of trees?		
Are the climatic conditions suitable for planting trees/shrubs, is there enough sunlight, water...?		
Are seedlings and seeds for trees and shrubs available?		
Is the plot suitable in case of a sloping site?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to substitute or solve these issues.

Questions	Yes	No
Is the plot already used as pasture land?		
Is the plot in a more or less good ecological condition: Can you still gather benefits out of it, can you produce enough fodder?		
Do you have a demand for: firewood, fruits, nuts, timber, fodder etc.?		

Is the plot exposed to soil erosion (wind or water) or to nutrient losses?		
Do you have a watering point on your pasture (additional tree watering)?		
Is there sufficient minimum equipment (for planting trees) available, or do you need special technical support?		
Do you have information on forestry and pasture management?		
Are there market opportunities to sell the tree products?		
Do you have infrastructural access to markets to sell tree products?		
Do you need additional advisory service to choose possible trees and planting places?		

FINANCIAL CALCULATIONS:

It is recommended to calculate different possibilities (different tree varieties)

Investment expenses	Investment amount
Price for trees	
Strong individual tree protection	
Water, mulching material	
TOTAL expenses:	
Financial benefits	
Fuelwood	
Fruits/ Nuts/ Sea buckthorn	
Additional benefits	
Shade for animals (resting place)	
Pasture fertilisation	
Erosion protection	
Slope stabilisation	
TOTAL earnings:	

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefit	Yes	No
Can you manage the first investments (e.g., price for trees)?		
Is it possible for you to construct strong fences around the young trees?		
Is it possible for you to carry the harvest of the trees down to the village?		
Can you save money through natural soil fertilization from tree leaves?		
Could you generate more income from fat, healthy livestock?		
Ecological impact		
Could watering trees on your pasture lead to reduction of water supply for your animals?		
Could silvopastoral management improve the soil fertility and structure of your plot?		
Is your pasture in good enough condition to tolerate several highly degraded areas around trees?		

Could silvopastoral management improve soil and water retention capacities, and therefore reduce the risk of soil erosion?		
Could silvopastoral management contribute to the reduction of risk exposure to natural disasters (landslides, erosion, sedimentation of springs, avalanches, falling rocks, flooding)?		
Could silvopastoral management contribute to a reduction of illegal cuttings in your community?		
Gender impact		
What role do women play in the care of trees: Are women involved in planting, reforestation, protection of trees?		
What role do women play in supplying fodder to animals and management of grazing activities? Are women involved in planting fodder crops?		
Could women directly benefit from tree products, e.g., by processing and selling them?		
Do women have decision-making power on how any money received from sale of tree products is used?		
Would silvopastoral management constitute an additional workload for women (establishment and care for trees)?		
Would the benefits justify the additional workload for women, e.g., increased income from selling products?		
Community impact		
Would the implementation of silvopastoral management have positive impact for your community in terms of energy, food and timber supply?		
Would the implementation of silvopastoral management have a positive impact for your community in terms of reduction of risks (soil erosion, wind speed, landslides...)?		
Could silvopastoral management serve as a model for other households/communities?		

Contact:

CAMP TABIAT
 Umed Bulbulshoev (director)
 9 Sohibnazarova Street, Choroug
 +992 935 14 19 45

Jangalparvar
 Jamolidin Madibron (director)
 62 Druzhbi narodov str., 734025, Dushanbe,
 +992 91 818 18 25

Cesvi
 Daniil Ilyasov (Project coordinator)
 +992 985 02 27 37
 Dushanbe Office: Firdavsi Str., 15
 Khovaling Office: Mirzo Tursunzoda Str.

Caritas Switzerland
 Afzalsho Nasibov (Project coordinator)
 +992 901 10 93 32
 26 Titova str.ap.25, 734025, Dushanbe

Links:

<http://camp.kg/en/who-we-are/camp-tabiati/umedsho@mail.ru>

daniil.ilyasov@gmail.com

anasibov@caritas.ch

PASTURE/LIVESTOCK MANAGEMENT

2. Rehabilitation technique

2.5 Control of weeds by hand

WHAT ARE WEEDS AND WHAT IS WEED CONTROL BY HAND?

What are weeds? Weeds are plants which are less digestible or undesirable for livestock grazing, and include:

- Toxic plants that cause sickness or even mortality among livestock, particularly young animals
- Unpalatable plants with little or no fodder value that compete with good forage species and oppress their growth
- Bushy plants with thorns that can cause loss of wool or harbour harmful insects or parasites

Weed control by hand is an efficient technique to improve the quality and productivity of a pasture. Each weed belongs to a botanical family of plants with a good and worse fodder quality, even toxic qualities, for livestock. Each weed belongs to a botanical family of plants which are grouped according to different characteristics regarding development/growth and morphology. A herbicide, even a selective herbicide, kills both the bad and the good ones of a botanical family. If you pull the specific dangerous weed by hand, of course you keep the ones with a better fodder quality. During the resting time of your livestock or the daily "pasture monitoring", for example, you can control your pasture against weeds. This technique reaches a critical point if you have bigger areas with rank weeds or pests.

With a specific knowledge of weeds, you will realize some of them are traded as medical herbs and can create an additional income for you.



HOW DOES IT WORK?

While herding your livestock on a pasture, each day you should try to check the quality and productivity of each plot. While screening your pasture you can also check it against weeds. If you see single plants or small areas, pull the weeds out by hand, but be sure that you can do it without gloves, otherwise use a spade or cut it carefully. The best period for cutting or pulling is before or during the blooming period.

The best way to kill the weed is to dig it out, including the roots. If you only cut the stem, it will give the plant the chance to regenerate and become stronger as the roof part remains in the ground.

For easy digging you can use a stick with a metal tip (Sheppard's crook). This technique is a critical stage, if you have areas with rambling weeds, or weeds on deep slopes. On slopes it is better to keep them for soil stabilization and erosion protection, but avoid a spreading of weed on good pasture areas. An additional advisory is recommended against rambling/ rank weeds.

Advantages:

- **High selective weed control**
- Pasture improving in case of: **Better fodder quality**
Higher productivity
Future reseeding prevention
- **Better livestock health**, reduction of poisoning
- **Daily pasture control**
- **Additional income by** selling medical herbs

Disadvantages / Challenges:

- **Labor- intensive**
- **Requires detailed knowledge** of pasture weeds
- **Not useful** against rank weeds
- **Slopes should be stabilized, even weeds growing there**

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

"Key questions" If you cannot answer with **"Yes"**, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for this pasture plot?		
Do you have knowledge about different weeds and medical herbs?		
Is the plot exposed to heavy soil erosion (wind or water) or to nutrient losses?		

The **"Question"** part will ask you about additional framing preconditions. If the answer is **"No"**, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Is there minimum equipment (stick with metal tip) available?		
Is the plot already used as pasture land?		
Do you need external specialist advice or training in weed control?		
Is the plot in a more or less good ecological condition: does it provides enough quality fodder?		
Do you have the possibility to store medical herbs?		
Do you know how to process herbs?		
Are there market opportunities to sell medical herbs?		

FINANCIAL CALCULATION:

Investment expenses	Investment amount
Price for a stick with metal tip, crook	
Storage of herbs	
Others	
TOTAL expenses:	
Investment earnings/ additional benefits	
Higher pasture yield	
Better pasture control (overgrazing)	
Medical herbs	
Degradation prevention	
TOTAL earnings:	

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with **"Yes"**.

If at the end most of the questions are answered with **"Yes"**, the positive impacts prevail, but the negative impacts should still be kept under careful in consideration.

Financial benefit	Yes	No
Could you benefit from pasture improvement?		
Could you get additional income by selling medical herbs?		
Could you save money through future reseeding with improved fodder crops?		
Could you get more income from improved livestock maintenance practice and animal husbandry?		
Ecological impact		
Could manual weed management improve soil protection through encouraging complete plant cover?		
Could hand pulling weed control improve soil and water retention capacities, and therefore reduce the risk of soil erosion?		
Could manual weed control contribute to a reduction of overgrazing through more regular pasture control?		
Gender impact		
What role do women play in pasture management?		
What role do women play in supplying fodder for the animals and management of grazing activities?		
Are women involved in manual weed control on pastures?		
Would manual weed control constitute an additional workload for women?		
Do women have sufficient knowledge of different weeds to be confident in identifying weeds and controlling them and collecting medicinal plants?		
What benefits would women obtain from weed control in order to justify the additional workload for women?		
Are the benefits from weed control for women greater than the benefits they might obtain from using their labour in other ways?		

Community impact		
Would successful manual weed control have a positive impact for your community in terms of more productive pastures?		
Would successful manual weed control have a positive impact for your community in terms of reduction of risks (soil erosion, landslides,...)?		
Could manual weed pulling serve as a model for other communities?		

Contact:	Links:
PUU	www.flermoneca.org
Cesvi Daniil Ilyasov (Project coordinator) +992 985 02 27 37 Dushanbe Office: Firdavsi Str., 15 Khovaling Office: Mirzo Tursunzoda Str.	daniil.ilyasov@gmail.com

PASTURE/LIVESTOCK MANAGEMENT

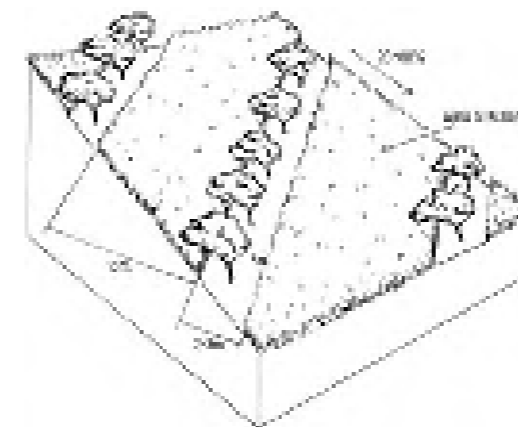
3. Fodder supply

3.1

Orchard-based fodder production

WHAT DOES ORCHARD-BASED FODDER PRODUCTION MEAN?

An orchard-based fodder production system is a land use system in which legumes, such as beans or alfalfa, or other fodder crops are planted between fruit, timber, and nitrogen fixing trees (NFT) or fodder trees. The aims of this system are versatile: on the one hand, production of fresh fodder, hay or crops; on the other hand, tree products like fruits, fuel wood or timber. An orchard is a production system with a high soil stabilization conservation function through an enhancement of water storage capacities and a higher ground cover.



HOW DOES IT WORK?

Orchards need to be established in a way that gives enough room for inter-cropping purposes. In cases of apple tree plantations, 10 m between the rows and 4 m within the rows is recommended. Along each row of trees a 2-3 m strip of grass should be left to grow. The optimal arrangement of the trees is along the contour and against the prevailing wind direction (here, compromises are needed). The crops between the trees can be rotated, for example, with legumes or alfalfa, followed by wheat. To increase the production supplementary irrigation can be applied (cutoff drains and drainage ditches).

Overview:

Tree type 1x	Price TJS	First harvest Years	Average yield In tones/ha	Water demand Liter per ha
Apple	8-15	5	7-15	4,000-8,000
Cherry	3-7	3-4	3-4.5	4,000-8,000
Apricot (dried)	10	7-8	2-3.5	4,000-8,000
Pistachio	3-4 per package	15	3	----
Junipers	---	--	----	----
Sea buckthorn	----	--	----	----
Almond	3-12	3-4	2-3	6.000

Advantages:

- **Income generation** through fodder (alfalfa, legumes)
- **Income generation** through food crops (fruits, cereals, beans)
- **Additional income** generation through fuel wood and timber
- **Improvement of ground cover** by additional crops
- **Protection from floods**, control of run-off, **reduction of soil erosion**
- Increase of **nutrient availability**, improvement of **soil fertility** (especially when planting legumes), higher biomass production (by litter fall), enhancement of **nutrient** capture (by deep-rooting trees/crops)
- **Reduction of wind speed**, reduction of **micro-climate** extremes (shadowing and higher soil cover reduce temperature and therefore evaporation; higher soil moisture) --> enhancement of **water storage** capacities

Disadvantages / Challenges/ Risks:

- **Skill-intensive in the field of tree management** (Pruning, crop protection, fertilizing and picking season on narrow spaces)
- **More complicated water and irrigation management**
- **Skill-intensive in the field of crop rotation**, seed time/ harvest time
- **Competition** between trees and crops (remark: apple trees possess a lateral rooting system, there is no competition for nutrients with wheat; also no shading due to loss of leaves during crop establishment period)
- **More and orchard adopted equipment is needed**
- **Higher work load in comparison to single crop production**

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for this plot?		
Is the plot located on a flat area (less than 12% degree)?		
Are the climatic conditions suitable for planting trees: Is there enough and continuously water, sunlight...?		
Is the plot easily accessible from your residence (for pruning, harvest, watering.. trees & crops)?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Do you have enough work power (establishment, watering, harvesting, pruning, ...)?		
Are seedlings and seeds for trees and crops available?		
Is the plot allowed for use as orchard/agricultural land?		
Is the plot exposed to soil erosion (wind or water) or floods?		
Do you have a demand in: fodder, fruits, firewood? Or can you easily sell your product on the market?		

Is the plot in a more or less good ecological condition: Can you gather benefits out of it?		
Is minimum equipment (for establishment of terraces, orchard, drainage ditches...) available/ rentable?		
Do you have information about the planting of orchard-based agroforestry systems, or do you need external advisory service?		

FINANCIAL CALCULATION

Investment expenses (Almond Orchard)	Investment Example	Own calculation
Trees 333/ ha	333 USD	
Fertilizer for 5 years (K,N,P)	810 TJS/ha	
Pest control 2 years	200 TJS/ha	
Labor: irrigation, pruning (1-5 year)	3,770 TJS/ha	
Additional costs:		
Additional costs:		
TOTAL production costs year 1 to 10:	21,338.50 TJS	
Investment earnings		
Fruits	6USD per kg	
Additional fodder	Depends on the crop	
Additional benefits		
Erosion control on pasture	Depends on soil cover and slope	
Timber	Depends on the trees	
Additional earnings		
TOTAL profit during 10 years (one ha):	80,616.50 TJS	

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefit	Yes	No
Is it possible for you to sell additional fruits?		
Planting fodder on your orchard would help you to fill a lack of winter fodder storage?		
Fodder overproduction would make a cut and carry system (dairy farming) interesting for you?		
Could you save money because of less expenditure for firewood?		
Do you have the possibility to fertilize such a high productive system properly?		
Ecological impact		
Could an orchard-based fodder production system improve the productivity of your plot?		

Could an orchard-based fodder production system improve soil and water retention capacities of your plot?		
Could an orchard-based fodder production system reduce landslides, erosion, avalanches, flooding on your plot?		
Could an orchard-based fodder production system contribute to a reduction of illegal cuttings in the forest?		
Gender impact		
What role do women play in fodder harvesting and hay making? What role do women play in fruit tree plantations: Are women involved in planting, watering, harvesting and pruning?		
Can women directly benefit from fodder production, for example, for small-scale dairy farming?		
Can women directly benefit from fruit tree products (e.g., by processing and selling fruits) or from the crops in between?		
From these benefits, can the women decide on what the money is spent for?		
Would the establishment of an orchard-based fodder production system on your plot constitute an additional workload for women (establishment and care for trees)?		
Would the additional workload create a reasonable output for women, e.g., by an increased income from processing and selling fruits?		
Community impact		
Would the establishment of an orchard-based fodder production system have a positive impact for your community in terms of fodder supply, food security, fuel wood?		
Could an orchard-based fodder production system reduce the risk of exposure to natural disasters (landslides, erosion, avalanches, flooding) in your community?		
Could orchard-based fodder production systems serve as a model for other households or neighboring communities?		
Could the establishment of an orchard-based fodder production system lead to tensions within your community due to shadowing of neighboring plots, unclear land titles?		

Contact:

Cooperative SAROB
 Muhamadi Muminov (director)
 127 Rudaki ave.
 Rudaki Plaza, room 1113;1115
 Dushanbe, Tajikistan
 93 5770230

Links:

sarob.net
 muminov01@gmail.com
 mmuminov@sarob.net

PASTURE/LIVESTOCK MANAGEMENT

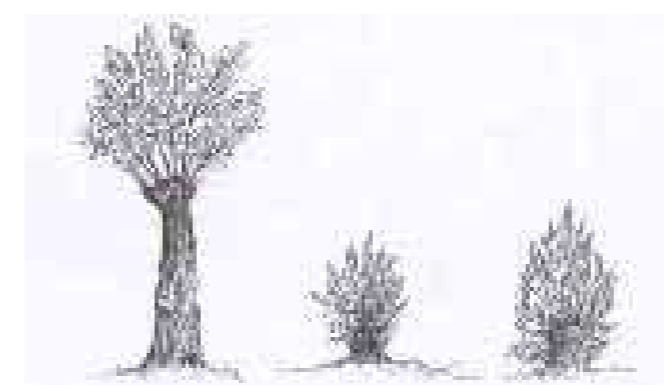
3. Fodder supply

3.2

Tree branches as fodder

WHAT IS MEANT BY BRANCHES AS FODDER?

Branches from willow or mulberry can be used as an additional fodder for livestock. It depends on the type of livestock, the main fodder, the season, and how much animals accept branches. Leaves are used as fodder, not the branches. After foddering the leaves, the branches can be used as fire wood.



HOW DOES IT WORK?

Branches which are full of leaves can be cut during the whole year. In case of a shortage of fodder in spring, fresh branches of willow can be cut as additional fodder supply. The nutritional value is not equal to hay or straw, but it is still usable. It is recommended to plant fodder trees in your backyard for different reasons. At first you will get additional fodder for emergencies. Second, branches and trees can be used for fuel wood or timber. Third, it is very easy to plant such trees by yourself. Put willow branches (with leaves) in your soil and water them carefully. Cut them close to the soil surface to promote sprouting of new shoots. Branches from mulberry can also be used as fodder during tough times.

Advantages & positive side effects:

1. Fast growing plants with a lot of utilizations
2. Fodder with a good quality for livestock
3. Use as fuel wood after foddering
4. Early and long growing period
5. Willow and mulberry plants as well as branches can also used for fencing plots or shade yards
6. Deep cut willow trees will grow like bushes with more branches

Disadvantages & risks:

1. Branches for fodder are just additional and can never be a substitute for fodder like hay or litter
2. Too many nitrogen fixing shrubs can over-nitrify the soil, pollute ground water, surface waters
3. Heavily harvested trees will die fast

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with **“Yes”**, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights/permission to use branches as fodder?		
Do you have enough work power for the establishment and care of the trees?		
Are the climatic conditions suitable for planting trees; is there enough sunlight, water,...?		
Is the plot accessible from your residence (for care, harvest, watering,.. the trees)?		
Are there seedlings or plantlings for trees available?		

The **“Question”** part will ask you about additional framing preconditions. If the answer is **“No”**, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Is the plot affected negatively from wind/ water erosion and nutrient depletion?		
Is the plot negatively effected by landslides or gullies?		
Is the plot/ backyard in a more or less good ecological condition: Can you still get benefits out of it, are yields high enough?		
Is equipment for planting and harvesting available?		
Do you need external technical support (e.g., in planting them)?		
Do you know local trees which are appropriate for foddering?		
Would planting of trees for fodder production constitute an additional workload especially for women?		
Do you need external financial support?		

FINANCIAL CALCULATION:

This questionnaire has to be answered carefully. Not every option has to be answered with **“Yes”**.

If at the end most of the questions are answered with **“Yes”**, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Investment expenses	Investment amount Willow	Investment amount mulberry	Investment Example, willow
Trees			2-3 TJS per stick
Equipment for cutting			
Additional costs:			
TOTAL expenses:			
Investment earnings			
Additional fodder in autumn (storage saving)			
Additional fodder in spring (pasture control)			
Additional benefits			
Erosion control on early pasture			
Branches as fuelwood			
Timber			
Erosion control on kitchen garden			
Utilisation as fence and land mark			
Additional earnings			
TOTAL earnings:			

CRITERIA FOR DECISION MAKING

Financial benefit	Yes	No
Could livestock benefit from higher fodder supply in autumn and spring?		
Could your spring pasture benefit from later grazing (erosion protection) with a higher productivity?		
Would you benefit from livestock in a better condition in spring?		
Would you benefit by less moisture losses on your backyard?		
Could you generate more income by higher yields due to higher fertility on your kitchen garden?		
Does the current fuel supply cover your household needs?		
Could you save money because of less expenditures for fertilizers on your kitchen garden?		
Could you get additional income from selling firewood (infrastructure access)?		

Ecological impact		
Could trees improve the soil fertility on your backyard?		
Could trees reduce soil erosion processes on your plot and the spring pasture as well?		
In case of more shadow on your kitchen garden, how will this affect the productivity of other crops on your plot?		
Gender impact		
Is cutting branches for fodder a technique already used by women? If not, is it a suitable technique for women?		
Would cutting branches (for livestock feeding) create an additional workload for women?		
Do women benefit from better fed livestock?		
Do women have decision making power on how any money received from the sale of livestock products is used?		
Community impact		
Would cutting branches as fodder in spring protect early used pastures of your community?		
Could your community benefit from planting trees in the village for fodder and fuel wood production in terms of protection against natural disasters (reduction of wind/ water erosion, avalanches, landslides, degraded pasture...)?		
Would harvesting of branches for additional fodder supply affect households of the community negatively?		
If yes, is it possible for the community to solve this problem?		
Can your community share this technique with other community members or neighbouring communities?		

Contact:	Links:
Jangalparvar Jamolidin Madibron (director) 62 Druzhbi narodov str., 734025, Dushanbe, +992 91 818 18 25	
Cesvi Daniil Ilyasov (Project coordinator) +992 985 02 27 37 Dushanbe Office: Firdavsi Str., 15 Khovaling Office: Mirzo Tursunzoda Str.	daniil.ilyasov@gmail.com
Caritas Switzerland Afzalsho Nasibov (Project coordinator) +992 901 10 93 32 26 Titova str.ap.25, 734025, Dushanbe	anasibov@caritas.ch

PASTURE/LIVESTOCK MANAGEMENT

3. Fodder supply



3.3 Small-scale dairy farming or zero grazing

WHAT IS MEANT BY SMALL-SCALE DAIRY FARMING?

Dairy farming can be a farm business based on dairy production through a cut and carry system. Households create a milk production system based on, e.g., two cows managed throughout the year in a shed close to the house. The main objective is to generate income and to ensure the economic stability of the household by selling dairy products and breeding calves. Furthermore, overgrazing can be decreased by improving livestock management through a cut and carry fodder system.



HOW DOES IT WORK?

The most important aspect you have to consider when managing a cut and carry system is that the dairy cow has a **basal metabolic requirement**, just to stay alive and an **active metabolic requirement** to produce milk or muscle (mass). The active metabolic requirement is much higher if the cow grazes around the village and moves every day. That is why it is called cut and carry system: you bring the fodder to the

cow, not the cow to the fodder. It is also important to consider that a cow needs 40-60l of water daily. In addition, for the calf, a bucket feeding with warm milk or yoghurt is necessary to have a controlled supply. Start twice a day with 3- 4l each feeding, going down to one liter within a 3 month period. Beginning from the first week, provide hay, water and straw. A cow will produce per year 8t of manure and 5t of liquid manure, that's 25kg/15l per day. To safeguard the quality of manure you have to install a special place to store it and protect it from the sun. Experience from Muminabad shows it is possible to sell manure to generate additional income.

Advantages & positive side effects:

1. **Milk cow**, with a higher milk production
2. **Less risk exposure** (while not having large numbers of unproductive animals)
3. **Higher values of cattle**: well fed --> higher quality --> higher market prices
4. **Dung and liquid manure collection with higher nutrient amount --> better fertilizer** for crops
5. **Specific fertilization of crops through house storage**

Disadvantages & risks:

1. **Initial costs** (land, seeds for fodder crops, fertilizer, stall, troughs)
2. **Dependency** on decisions about long term land rights to minimum rent price from community
3. **Milk storage and transportation** to markets can be difficult in marginalized areas
4. **High animal/milk hygiene** is necessary
5. **Reliable facilities require cooling**

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have enough labor force for cut and carry/ processing/ selling and cleaning the stall?		
Is the plot fertile and in a ecological condition: could you get enough fodder out of it?		
Are the climatic conditions suitable for the cultivation of fodder crops (alfalfa, esparcet, maize...)?		
Is enough water available within reasonable carrying distance?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Is there any plot you could rent in your community, one which would be suitable for fodder cultivation?		
Are good quality seeds or seedlings for fodder crops available?		
Is minimum equipment/ construction material for field cultivation, building up stalls, processing milk ... available?		
Would dairy farming with stall feeding constitute an additional workload for women?		
Do you need technical support for shed installing, dung/manure storage?		
Do you need external advisory service for fodder cultivation and storage?		
Can you sell dairy products on the market? Is there a market or a collection point to sell it?		
Do you have access to other markets or milk collecting stations?		

FINANCIAL CALCULATION:

Investment expenses	Investment amount	Examples
Price milk cow		
Construction of shed, total		
Construction of manure and liquid manure storage		

Feeding buckets for cow and calf	Self:	Additional:
Fodder: 1 cow = 5 goats/ sheep 1.2 cow = 1 horse Fodder for one cow, for 4-5 month in winter period		
1.5 – 2.0 t hay		
2.0 – 3.0 t haylage		
400 – 500 kg concentrate fodder		
Fodder alternative 1:		
Apples, potatoes, forage beet, e.g. (winter time)		
Fodder alternative 2:		
Dried corn plants, millet, alfalfa		
Fodder alternative 3:		
Water , >10 °C, 40-60l per day		
Milking equipment (clean bucket, only for milking)		
Cooling of milk (community cooperation)		
Transport, to collecting point		
Additional costs		
Additional costs		
TOTAL expenses:		
Investment earnings/ benefits		
Milk price per litre at collecting point		1-2.5 somoni
Milk price x ca.6l x 300 days		1800 – 4500 somoni
Calf (per year)		300\$ (8 month old)
Meat (after 1/6 year)		800- 1000\$
Manure (rise in crop output)		8t
Liquid manure (rise in crop output)		5t
Additional earnings:		
TOTAL earnings:		

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefits	Yes	No
Could you benefit from the sale of milk or milk products?		
Could you generate more income due to better quality of fodder and milk?		
Could you get additional income by processing milk and selling it at a later stage?		
Could you benefit from breeding calves?		
Do you have a lack of fertilizers and would manure/urine help to solve the problem?		

PASTURE/LIVESTOCK MANAGEMENT

4. Infrastructure

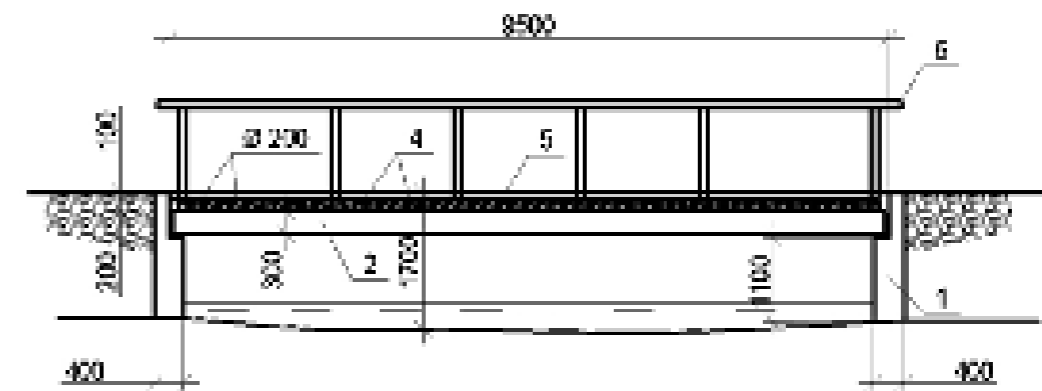


4.1 Bridges

WHAT DOES CONSTRUCTION OF BRIDGES MEAN?

A bridge helps to access remote areas. It is constructed to traverse rivers, wider gullies or canyons. The specific construction of a bridge depends on the needs of the users. For example, the bridge may be used only by shepherds and their herds or it may also be used by cars and trucks. The frequency of passage will also define the construction. The third question is stability against natural hazards, especially floods in spring and glazier melt season. It has to be assured that the bridge is constructed in a nearly fixed riverbed; otherwise you have to stabilize the waterbed around the bridge, too.

A bridge can help to bring remote pastures back into utilization or back into a pasture rotation system, but can also lead to a competition between wildlife and livestock.



Source: Pamir bridge, drawing of bridge No. 80, exemplary dimensions

HOW DOES IT WORK?

For bridge construction you use different types of materials. Foundations and surfaces out of steel and cement are highly recommended (but not necessary); the bridge lane for animals or cars can be made of timber.

Steps of pre-construction:

At first, you need to have access to the place of construction and to keep in mind that the best time of construction is when the water is at its lowest level. Second, discuss the purpose of the bridge with all future users as this mainly defines the crucial parameters/ characteristics of the

Ecological impact		
Could stall feeding lead to a rehabilitation of already degraded pastures?		
By focusing on a few cattle, could this intensive system contribute to a reduction of overgrazing of pastures you use in your community?		
Could alfalfa as legume fodder crop contribute to improving soil fertility on your plot and fertilize following crops?		
Could alfalfa as a drought resilient fodder crop contribute to a reduction of risks?		
Could alfalfa as a fodder crop with its deep rooting system contribute to a reduction of soil erosion?		
Could alfalfa as a nitrogen fixing fodder crop contribute positively to climate change mitigation?		
Gender impact		
What role do women play in livestock raising: Are women involved in feeding, breeding, milking the cows and processing and selling milk?		
Could women directly benefit from a cut and carry system? Would they spend less time for collecting dung as heating and cooking material? Would they spend more or less time than this for cleaning the stall?		
Would the benefits of the cut and carry system, i.e., higher productivity of and dairy products, justify the higher workload for women?		
Would women be able to sell dairy products? Is there a local market and would women be able to trade there?		
Do women have decision-making power on how any money received from the sale of dairy products is used?		
Community impact		
Could your community benefit from the rehabilitation of degraded pasture areas due to shed feeding?		
Could your community benefit from reduced risks due to decreased soil erosion/ landslides/avalanches,...(cultivation of alfalfa with a deep rooting system)?		
Could your community benefit from a joint marketing of dairy products?		

Contact:

Cooperative SAROB
 Muhamadi Muminov (director)
 127 Rudaki ave.
 Rudaki Plaza, room 1113;1115
 Dushanbe, Tajikistan
 93 5770230

Links:

sarob.net
 muminov01@gmail.com
 mmuminov@sarob.net

construction (loading capacity, wide, stability ...). Figure out the high water level in early summer to construct the bridge high, long and strong enough. The individual work steps depend on the specific natural circumstances and the access to equipment. In case of complicated and precise calculations, a professional advisor is highly recommended.

Prestages and Advantages:

1. **Pre-construction stages:**
Purpose, access, natural circumstances (hazards, highest water level)
2. **Advantages:**
 - Access to remote pasture**
 - Release the burden** on the currently used pasture
 - Decrease of soil erosion** on the currently used pasture
 - Decrease of overgrazing**

Disadvantages/Challenges/Risks:

- **Expensive**
- **External advisory is highly recommended**
- **Competition** between wildlife and livestock can rise
- **Does not necessarily decrease overgrazing** on old pasture
- **Good remote pasture** can also be overgrazed very fast after access
- **Maintenance of the bridge**
- **Competition about pasture access** with neighboring communities

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights (cooperation/contract with the leskhoz) to construct a bridge?		
Do you have enough work power for the construction?		
Is the place of construction highly vulnerable for hazards?		
Is the envisaged place embedded in a stable riverbed?		
Is the envisaged construction strong enough to persist strong hazards, floods or slides?		
Do you need external advice to find the best place of construction or to calculate the load capacity?		
Do you need special equipment for the construction or transport?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Does overgrazing make it essential to access new pasture?		
Does the low fodder supply make it essential to access new pasture?		
Is equipment (for construction, tracks, basement, riverbed stabilization...) available?		
Do you have information on/about the construction of bridges?		
Do you need external knowledge and technical support?		
Do you need external financial support?		

FINANCIAL CALCULATION

Investment expenses	Own calculation	Example Calculation (US\$)
External advisory		
Construction:		
Machinery		----
Wood		----
Materials		538.00
Wages		986.00
Development and survey works		94.00
Additional costs		291.00
Additional costs		360.00
TOTAL expenses:		-----
Investment earnings		-----
Additional pasture		2,269.00 Exchange rate of KGZ Som/ US\$: 42,6/1
Additional benefits		
Better fed cows		
Reduction of livestock on current pastures		
Enhancement of current pastures		
Additional earnings		
TOTAL earnings:		

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefit	Yes	No
Does the additional pasture help to cover your fodder demand?		
Would an additional income result from selling livestock in a better condition?		
Would saving money result from reduced expenditures for fodder, due to better fed livestock?		
Would access to a former remote pasture help to increase the productivity on your spring pasture?		
Ecological impact		
Could the access to remote pastures save currently used pastures against overgrazing?		
Could the enlarged pasture system attract a storage fodder production?		
Could the access to a remote pasture reduce landslides, erosion, sedimentation of springs, avalanches, flooding?		
Could the access to a new pasture bring your livestock in conflict with wildlife?		
Gender impact		
Could women benefit from the construction of a bridge to remote pastures?		
Would the construction of a bridge and the establishment of fodder production on your plot constitute an additional workload for women?		
Would the additional workload create a reasonable output for women, e.g., by an increased income from processing and dairy products?		
Community impact		
Would the construction of a bridge to remote pasture have a positive impact for your community in terms of prevention against overgrazed pastures close to village?		
Could the access to remote pasture reduce the risk of exposure to natural disasters (landslides, erosion, sedimentation of springs, avalanches, falling rocks, flooding) in your community?		
Could successful construction of a bridge and the stabilization of overgrazed pasture serve as a model for other neighboring communities?		
Could the construction of a bridge lead to competition about pasture access between communities?		

Contact:

Erkinbek, Koichumanov
Bernard, Repond

Links:

<http://camp.kg/>
www.pamirbridges.ch/welcome-ang.htm

PASTURE/LIVESTOCK MANAGEMENT

4. Infrastructure

4.2 Drinking troughs

WHAT ARE DRINKING TROUGHS?

To provide water for livestock on pasture, different drinking trough systems can be considered. Mobile drinking troughs and fixed drinking troughs can be filled and refilled via a river stream system or a fixed installed water supply system, like a water well or water bunker.

Mobile drinking troughs can be very light (plastic troughs), between 9-10kg, or 40-45kg depending on the size. Fixed drinking troughs can also be made out of plastic, but materials like cement or zinc are recommended.

Besides the daily fodder ratio, animals need a lot of water per day. As long as enough fresh green fodder is available, the livestock covers its daily need of water mainly through green fodder. From midsummer till autumn, additional water points should be installed. The same should be considered for degraded pasture, because the livestock will try to cover the need of water through a higher consumption of green fodder. Otherwise the pasture will continue to degrade.

HOW DOES IT WORK?

A water drinking system, adapted to every specific situation can be installed. If there is a small stream, a device to slow down the stream speed can be installed to make access easier for animals.

Another option is to install drinking troughs permanently on degraded pastures, or on pastures that face fresh water shortage in the end of the season. Both systems need to be chosen carefully, because the ground around troughs will be highly degraded from siltation. It



is suggested that plant trees be planted close by for shade opportunities. The location of the trough should also be chosen depending on the animal, for example, sheep don't like to walk too much for a water point. Long distances also cause energy losses. For installing permanent troughs without external access to refill, check the option *rainwater harvesting*.

MATERIALS AND REQUIRED CONDITIONS FOR DIFFERENT TROUGH SYSTEMS

- Fixed troughs can be made out of metal (e.g., zinc) with a big orifice and grounded edges to prevent injuries.
- Mobile troughs can be bought as plastic troughs and used seasonally.
- An inflow from a stream or water supply into the barrels and an adequate drain has to be installed. Otherwise the runoff will destroy the ground around the trough which soils the sheep wool.
- Offer a dry and shady place for rest.

Advantages:

1. **Low costs**, only unused barrels needed
2. **Quick to install**
3. **Pasture protection against overgrazing**
4. **Better feed conversion ratio**
5. **Time saving**, long daily efforts for watering the animals are no longer needed
6. **Makes pasture rotation more effective**
7. **Distant pastures become attractive again**: discharge of degraded pasture

Disadvantages/risks/difficulties:

1. Technical **advice needed** for installation in the beginning (afterwards easy to install and maintain)
2. More **pressure to watershed**
3. More **bare soils**

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Is it allowed to install a water point (mobile or fixed) on the pasture you are using?		
Are the listed materials available?		
Do you have enough work power for installing and caring for drinking points?		
Is a small river/spring on your pasture accessible?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to substitute or solve these issues.

Questions	Yes	No
Is it possible for you to substitute plastic drinking troughs?		
Do you need additional advisory service for the installation or the water demand calculation?		
Is the plot/pasture in a good condition for a herding and installing a water point?		
Is the plot located on a steep slope?		
Is a highly degraded area around the drinking trough acceptable?		

FINANCIAL CALCULATION

I.: example: 0.9x3,5x0,6m (40-45kg) 250USD (2014), AZAL

II.: example: 0,8x1,2x0,5m (9-10kg) 100USD (2014), AZAL

Investment expenses	Investment amount	Example
Material of construction		
Transport of materials		
Work for construction		
Additional costs		
Additional costs		
TOTAL expenses:		
Investment earnings		
Well fed animals		
Better proportion of meat		
Additional benefits		
Optimized pasture grazing		
Pasture enhancement		
Erosion prevention		
Additional earnings		
TOTAL earnings:		

CRITERIA FOR FINAL DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefit	Yes	No
Does your current water access on the pasture cover your needs?		
Would you save time with a close central drinking trough?		
Would you have higher expenses for water, through using additional drinking points?		
Ecological impact		
Would a water point reduce the general degradation of the pasture by an improved use of green fodder?		
Could a water point help to rehabilitate degraded pasture?		
Could drinking troughs contribute to the reduction of rill, sheet and gully development on the pasture (Less trail erosion)?		
Could the installation of a water point on a remote pasture reinforce its use or bring it back into use?		
Could a new drinking point bring remote pastures back into use and lead to conflicts with wildlife?		
Could a water point also be used for irrigating pasture during the hay making period?		

Gender impact			
What role do women have in herd management and livestock watering? Can women directly benefit from the installation of water points?			
From these benefits, can these women decide on what the money is spent for?			
Would the installation of a drinking trough constitute an additional workload for women (refilling, maintaining)?			
Community impact			
Would the installation of water points on pasture have a positive impact in terms of a better green fodder supply on community used pastures?			
Could a community associated water point lead to conflicts with other pasture users (e.g., migrant herds)?			
Could your community benefit from a better water supply for livestock in terms of a reduced exposure to natural risks, e.g., landslides, avalanches?			

Contact:	Links:
NGO "AZAL" Sergej Nazarov Office Dushanbe, 24 square meters, 40 Somoni str. Office Garm, Rasht district, 7 O. Tuychi st. tel.: (992 3131) 2 24 34	http://www.azal.tj/
WOCAT	https://qt.wocat.net/qt_report.php T_TAJ100en www.wocat.com

PASTURE/LIVESTOCK MANAGEMENT

4. Infrastructure

4.3

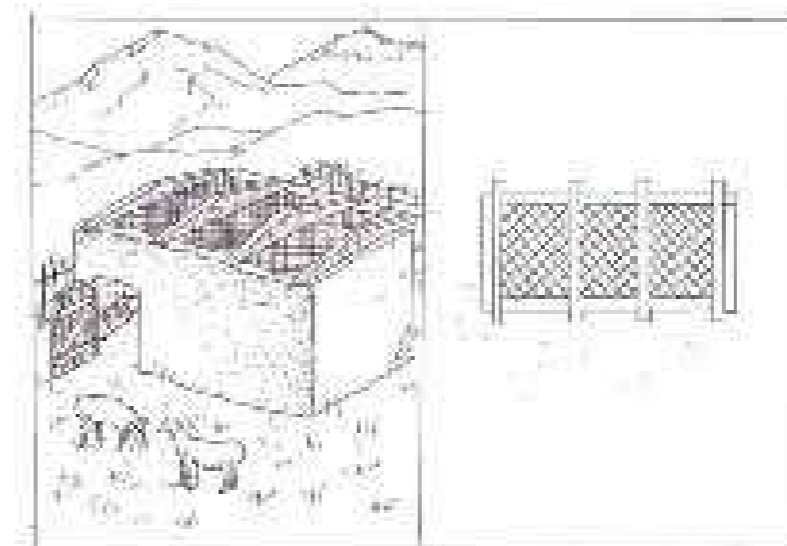
Shelters against predators

WHAT DO SHELTERS AGAINST PREDATORS MEAN?

Predators like snow leopards, wolves, or other carnivores can pose a serious threat to livestock farmers. Therefore, an effective shelter/corral system is recommended. A corral made solely of wire mesh is not sufficient against bigger predators. An enclosure with stone walls (as shown in the picture) protects successfully against predators. It is most crucial to cover the complete roof opening with wire mesh. The whole construction is simple and can be built from local materials. Such enclosures are built by single pasture users/families but also by communities to protect their livestock. The size of the corrals depends on the size of the herd and the needs of the families/user groups.

HOW DOES IT WORK?

A well-constructed corral effectively prevents predators from breaking in. This means the stone walls should at least be of 2,40 m height, and the entire roof opening should be covered by 8x8 cm mesh wire (that provides protection while allowing snow to fall through) and supported every 50 cm with wooden poles. The corrals are approximately 15 m long, 8 m wide. The structure usually has no windows; if so they also must be covered with mesh wire. There will be a single wooden closely fitting door that can be securely locked at night. Corrals are built from local materials – stone, timber and wire, and are able to house over 500 sheep and goats. The most important points: Completely covered roof, no gaps in the wall, securely locked door at night.



Advantages:

- Protection against carnivores and snow leopards
- Optimized body temperature of sheep during the night
- No complicated construction
- Sometimes only improvement of existing shelters
- Use of local materials

Disadvantages / Challenges/ Risks:

- Expensive
- Bad construction with gaps, no complete roof cover > counterproductive
- No securely looked shelter door also counterproductive

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Are you affected by predator attacks?		
Do you have legal user rights for the pasture or a contract with the rights owner (lezkhos) to build a shelter/corral?		
Do you have enough work power for the construction?		
Is the place of construction highly vulnerable for hazards?		
Do you need external support for transport of timber or mesh- wire?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Do you have access to all needed materials?		
Do you already use a shelter, that needs to be improved?		
Do you have information on the construction of shelters?		
Do you need external knowledge and technical support?		
Do you need external financial support?		
Are you interested in saving snow leopards?		

FINANCIAL EXAMPLE CALCULATION:

Approximate costs (2013):
 250\$ for reconstruction and installing wire mesh on the roof
 200\$ for a medium-size corral
 400-500\$ for a large one (up to 700 small animals)
 Prices includes transport, material prices can fluctuate a lot between regions

Investment expenses	Own calculation
External advisory	
Construction	
Machinery	
Wood	
Mesh-wire	
Additional costs	
Additional costs	
TOTAL expenses:	
Investment earnings	
Less livestock losing	
Additional earnings	
TOTAL earnings:	

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefit	Yes	No
Would the construction of a shelter help to protect your livestock?		
Is the construction of a shelter in the long run cheaper and more effective than hunting predators?		
Would a safe corral make your livestock less vulnerable to predators?		
Could a shelter lead to a better and constant dung supply?		
Ecological impact		
Could the construction of a corral lead to higher livestock numbers?		
Could a higher amount of animals lead to erosion and landslides?		
Could the construction of a shelter make remote pastures attractive and create conflicts between pasture users and wildlife?		
Gender impact		
Could women benefit from the construction of a corral/shelter? Through the fact of livestock protection?		
Would the construction of a shelter simplify milking for women? For example, through division of herds within the shelter?		

Community impact		
Could the construction of a shelter have a positive impact for your community? For example, through communally herded livestock?		
Could the successful construction of a shelter serve as a model for other community members or neighboring communities?		
Could the construction of a communal shelter lead to competitions on pasture access between communities? Or make such competitions manifest?		

Contact:	Links:
Tatjana, Rosen/Michel trosen@panthera.org +992 907 720140	www.panthera.org

PASTURE/LIVESTOCK MANAGEMENT

4. Infrastructure

4.4

Live fencing on village pastures

WHAT IS LIVE FENCING ON VILLAGE PASTURE?

Live fencing is a technology that designed to control the movement of animals and people on a plot in use. It could be a plot close to the village - a so called winter or autumn pasture. During the summer, livestock will be sent to the summer pasture and the fenced plot can be used for winter-fodder production.

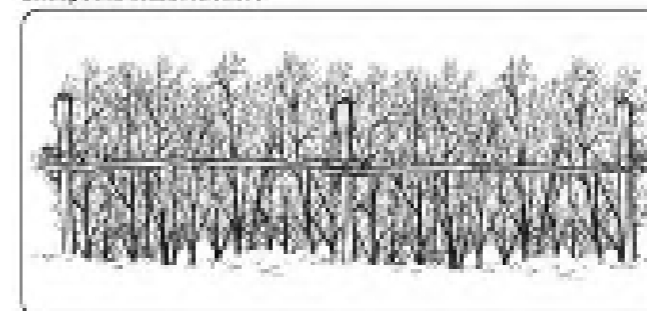
Through establishment of a line of trees, shrubs or bushes (sea buckthorn, willow, fruit trees, poplars) alongside the boundaries of a plot as dense, often thorny hedges, access to the plot can be regulated. This technology is particularly recommended around plots where plants are still in their juvenile phase and are especially exposed to the threat of free grazing animals. Inside the fenced plot, high productive fodder, like esparcet or alfalfa, in a rotation with fodder crops is highly recommended. Furthermore, this technique can be used to demarcate land.

HOW DOES IT WORK?

Live fence-posts are widely spaced, single lines of woody plants that are regularly pollarded. Between trees (fruit trees or trees with an additional benefit are suggested), shrubs like sea buckthorn can be planted. Until shrubs and trees are high and thick enough, metal or wooden posts for supporting barbed wire or other material can be used.

Ideally, the species used for live fence posts have the ability to rapidly form a callus and cover the point of attachment of the wire to the post.

Living Sea Buckthorn Fence



Planting steps for sea buckthorn fence:

A living sea buckthorn fence, for example, consists of 2 layers: the outer layer is an instant fence made of thorny sea buckthorn branches. This immediately restricts animal and human access. The inner layer is of sea buckthorn seedlings and will establish itself during several following growing seasons. This type of living fence can grow up to a height of 1.5-2 m. It should be supported by fruit trees,

willow or other kinds of poles: the sea buckthorn branches are fixed together with willow twigs, willow branches or wire and are attached to wooden poles.

Advantages & positive side effects:

1. **Creates an additional income** (fruits, fodder, timber, fuelwood, ..)
2. **Multi-purpose trees:** provide fuel wood, timber, fodder (leaves as high quality source of forage for ruminants), biomass, nutrient-rich mulch, food if fruit trees are planted (selling on markets = income), medicine if medical plants are planted
3. Offers habitat to **insect-eating birds**
4. Serve as one method of securing **land ownership** where the law permits it = method of demarcating farms/plots
5. **Low cost technology** (establishment and maintenance), long lasting
6. **A constant fodder supply** is the basement of a dairy farming system and helps to save pasture from overusing
7. **Protects farmland** from human access, freely grazing or wild animals
8. Serve as **windbreaks**
9. Serve as **nutrient traps** (preventing loss of nutrients that are normally lost through leaching or surface runoff)
10. **Erosion control**, soil stabilization

Disadvantages & risks:

1. Problems of **competition** (for sunlight: can have shading effects to closely grown plants; for nutrients and water) with nearby crops and pasture grasses --> more information is required on the most appropriate species and management strategies to optimize the functions of live fences
2. **Land tenure laws** need to be well understood before looking at how trees/ live fences can be incorporated into local farming systems. The development of live fences must take account of existing patterns of land distribution and control
3. May harbour **insect pests**
4. **Takes time** to establish
5. If not planted properly, it is not effective

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for this plot?		
Is the plot already used as pasture/fodder or crop land?		
Is the plot affected by freely grazing animals?		
Are the climatic conditions suitable for the establishment of livefences? Is there enough sun and water?		
Are there seedlings and seeds available for establishing a live fence?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Do you have a demand in firewood, fruits, fodder, timber, mulch etc.?		
Is the plot exposed to soil erosion (wind or water) or to landslides?		
Is minimum equipment for the establishment/maintenance of live fences available?		
Are there for example willow poles available?		

Do you have access to enough metal or wooden posts?		
Do you have information on the establishment of this technique?		
Do you need external technical support?		
Do you have sufficient work power (establishment and maintenance)?		
Do you need external financial support?		
Are there market opportunities to sell fruits (if fruit trees as fences are planted)?		
Do women have equal rights for access to resources and investment decisions?		

FINANCIAL CALCULATION

Investment expenses	Investment amount	Example
Price for branches and brier wood		
Price for plantlings		
Wire, string		
Water and mulching material		
Work power for:		
Planting		
Maintaining (watering, renew fences, ...)		
TOTAL expenses:		
Financial benefits		
Fodder yield improvement (protection)		
Fruits/nuts/sea buckthorn		
Fuelwood		
Additional benefits		
Erosion protection		
Slope stabilisation		
TOTAL earnings:		

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful in consideration.

Financial benefit	Yes	No
Could you benefit from trees, bushes or shrubs planted as living fences (supply of fruits, fodder, timber, firewood, medicine,..)?		
Would the tree/ bush/shrub products cover your households´ needs?		
Could you get additional income by selling these tree/bush products?		
Could you improve crop yield/pasture growth by fencing your plot?		
Could live fencing lead to conflicts with neighboring livestock?		
Ecological impact		
Could live fences contribute to the rehabilitation of your plot/contribute to a better performance of your plants/crops?		
Could live fences improve the soil fertility, soil structure, reduce salinization by planting, e.g., poplars or tamarisk around your plot?		
Could live fences improve soil and water retention capacities on your plot?		

Could live fences contribute to the reduction of risk exposure to natural disasters (landslides, erosion, sedimentation of springs, avalanches,...) for your community?		
Could live fences contribute to a reduction of illegal cuttings in forests for fuel wood?		
Gender impact		
What role do women play in the care (husbandry) of trees/bushes/shrubs? Are women involved in the establishment of live fences/in the planting and caring for trees/shrubs/bushes?		
Could women directly benefit from tree/shrub/bush products, e.g., by processing and selling them? From these benefits, can the women decide on what the money is spent for?		
Would the establishment/maintenance of living fences constitute an additional workload for women?		
Would the additional workload create a reasonable output for women, e.g., increased income from selling products?		
Community impact		
Could your community benefit from fuel wood, timber, fodder, biomass supply by the establishment of live fences?		
Could the establishment of live fences have a positive impact for the community in terms of reduced risks to natural hazards e.g. landslides, erosion, avalanches,...?		
Could the establishment of live fences lead to tensions within the community in terms of competition for nutrients/sunlight/water between live fences and neighboring plots?		
Could the establishment of live fences for winter pasture and a cut and carry system for fodder production, help community members to clarify tenure problems?		
Can live fences serve as a model for other communities?		

Contact:

CAMP TABIAT
Umed Bulbulshoev (director)
9 Sohibnazarova Street, Choroug
+992 935 14 19 45

Links:

<http://camp.kg/en/who-we-are/camp-tabiati/umedsho@mail.ru>

Jangalparvar
Jamolidin Madibron (director)
62 Druzhibi narodov str., 734025, Dushanbe,
+992 91 818 18 25

Cesvi
Daniil Ilyasov (Project coordinator)
+992 985 02 27 37
Dushanbe Office: Firdavsi Str., 15
Khovaling Office: Mirzo Tursunzoda Str.

daniil.ilyasov@gmail.com

Caritas Switzerland
Afzalsho Nasibov (Project coordinator)
+992 901 10 93 32
26 Titova str.ap.25, 734025, Dushanbe

anasibov@caritas.ch

PASTURE/LIVESTOCK MANAGEMENT

4. Infrastructure

4.5

Hay cabling

WHAT IS HAY CABLING?

Hay Cabling is construction of an iron wire from the hill top to the valley in order to transport hay down. Farmers can harvest hay for the stock and feeding in winter season. Enough feed stock could postpone the re-entry of livestock into the pasture area in early spring. Furthermore, it avoids rill, sheet and gully development (before a simple wooden construction was used to bring the hay in the valleys which destroyed the sward of the pastures and led to gully development) and deforestation and gives degraded pasture land more time for rehabilitation.



HOW DOES IT WORK?

The hay cabling can be installed everywhere on slope lands with an inclination of $> 30^\circ$. The length of the cable should not exceed 1000-1200 m.

The metal cable is to be installed before the hay harvesting season begins. After harvesting it can be struck and stored during the winter season and re-installed in summer again.

MATERIALS USED FOR SET UP

- Iron wire (cable) D-3-3.5 mm
- Iron or wooden poles for fixing construction of sending and receiving points, approx. D-70-80 mm 4 pieces (approx. 2 m length)
- For the ground of receiving point, cement or local materials such as stones can be used

Advantages:

1. **Low cost**, costs shared by community and the construction can be used jointly
2. **Quick to install**, easy to maintain by communities themselves
3. **Reduction of further gully development**
4. Time for **rehabilitation** of degraded pasture areas
5. **Time-saving** for transportation of hay into the valley/ villages (for comparison: with out hay cabling households could transport 20-30 bundles of hay per day, with hay cabling they can transport 1000-1500 bundles of hay per day)
6. **High Quality** of forage, **less loss** of hay

Disadvantages/ risks/ difficulties:

1. Technical **advice needed** for installation in the beginning (after that easy to install and maintain)
2. More **pressure to watershed**
3. More **bare soils**

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you prepare hay for winter from slopes?		
Is the list of materials for hay cabling available?		
Do you have legal rights to use the plot for hay mowing and installing a hay cabling device?		
Do you need a permission for the installation of a hay cabling system?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Is the plot in a more or less good condition for hay production: Can you get sufficient hay (for winter stock) out of it?		
Do you have any information about the installation of hay cabling?		
Do you need external technical support?		
Do you need external financial support for the material/ construction?		
Do you have enough work power?		
Do women have equal rights for access to hay and to the use the hay cabling technique?		
Are women involved in investment decisions?		

FINANCIAL CALCULATION:

Experience from the Rasht valley shows: around 320- 350 USD (2013/14) are needed to construct a hay cabling system (AZAL), which includes construction materials and labor.

Investment expenses	Investment amount	Example
Iron or wooden poles		
Iron wire (3- 3.5mm)		

Mounting material for the receiving point		
Hooks for the straw bales		
Others:		
TOTAL expenses:		
Investment earnings		
Less transport loses		
Fodder yields from former not/bad accesable fields, pastures		
Additional Benefits		
Natural reseeding sources		
Protection of natural pasture composition		
Enhancement of pasture composition		
Others		
TOTAL earnings:		

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful in consideration.

Financial benefit	Yes	No
Does your current hay stock cover your needs during the winter time?		
Could you save time and money for pasture rehabilitation measurements (re-seeding) on your plot?		
Could you save money through the substitution of hay purchases?		
Could you earn additional money from selling hay?		
Could you get money by renting the hay cabling technique?		
Ecological impact		
Would hay cabling reduce the degradation of the pasture you use by a postponed re-entry of livestock in the early spring?		
Could hay cabling contribute to the rehabilitation of the pasture you use?		
Could hay cabling contribute to a reduction of rill, sheet and gully development on the pasture you use?		
Could hay cabling contribute to a reduction of risk exposure to natural hazards (landslides, avalanches...) for your community?		
Gender impact		
What role do women have in hay making: Can women directly benefit from selling hay (more hay can be transported per day by hay cabling --> selling surplus)?		

CROPLAND MANAGEMENT

From these benefits, can women decide on what the money is spent for?		
Would the installation of a hay cabling system constitute an additional workload for women?		
Does the additional workload create a reasonable output for women?		
Community impact		
Would the installation of the hay cabling technique on the pasture the community uses have a positive impact in terms of fodder supply for the livestock of community members?		
Would a hay cabling system contribute to a feeling of/joint action management in your community, for close by village pastures?		
Could your community benefit from hay cabling in terms of a reduced exposure to natural risks, e.g., degradation, landslides, avalanches...?		

Contact:

NGO "AZAL"
Sergej Nazarov
Office Dushanbe, 24 square meters,
40 Somoni str.

Office Garm,
Rasht district, 7 O. Tuychi st.
tel.: (992 3131) 2 24 34

WOCAT

Links:

<http://www.azal.tj/>

https://qt.wocat.net/qt_report.php
www.wocat.com



CROPLAND MANAGEMENT

1. Organizational approach



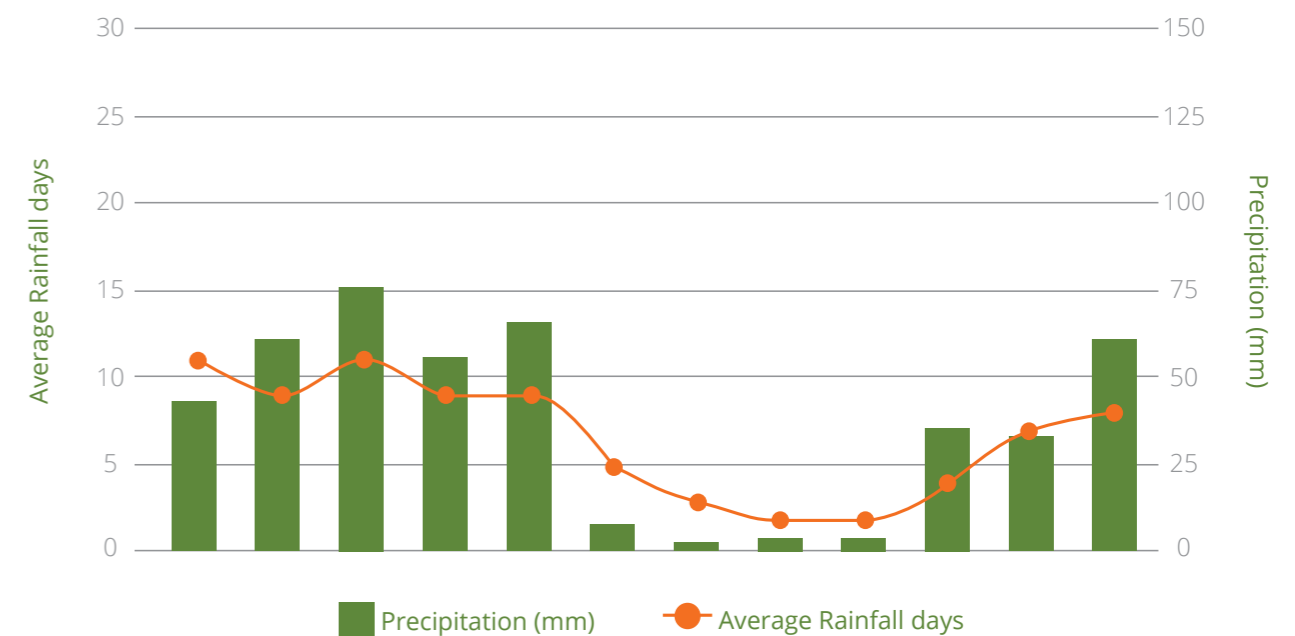
1.1 Water management approach

I. WATER SUPPLY AND AVAILABILITY

Water, next to soil, is the main and most restricted resource for land use management systems. Water is a limited resource which should be used carefully and sensibly. In general, water supply systems get water from a variety of locations after appropriate treatment, including groundwater (aquifers), surface water and rivers, and the sea through desalination. It is important for the land user to know where the water does comes from, and when, and what does it mean for the future development (climate change) of an appropriate land use management system.

The irrigation period determines the crop which can be planted and at which season. Knowledge about the impact of climate change on water supply and demand will help the land user in decision-making. A future change in water supply should be kept in consideration not only for crop management but also for the range of trees for an orchard and orchard planting.

Average Rainfall (mm Graph for Dushanbe)



What are the possibilities in Tajikistan - - where does the water come from?

A) If the water comes from a glacier, which is fed by snow and glacier ice, the land user is in the comfortable situation of a continuous water supply from spring until the end of summer.

B) If the water comes from top of the mountains fed by snow and rain, since most of the water is melting water, availability depends on the amount of snow and rainwater in the nearby mountains.

C) If the water comes only from rainwater, and if you are depending only on rainwater, the beginning and ending of rain season is most important for seedling, drilling and planting of crops.

Of course, intermediate forms of water supply are possible.

But what does this mean when it comes to climate change and glacier melting?

For situation A). If you depend on glacier fed irrigation water, the situation of water supply from the glaciers like "Fedshenko glacier" will change your situation in two different stages. At first, the water supply will rise; this also means an increasing risk of mood floods during the next years. After the glaciers are melted down the situation will change tremendously. The water supply will depend on the snow and rain which fell in winter in the mountains.

For situation B). If the land user is actually depending on snow and rainwater from the mountains, the situation, affected by climate change, will keep the land user depending on the seasonal snow and rainfall in the mountains.

For situation C). If the crop production is based on rainwater, climate change will have the impact of more irregular rainfall and no fixed rain season in spring.

Therefore, it is important to consider the beginning of the rainy season and plant winter crops to be unaffected by a dry spring, and use the winter moisture as effectively as possible. All these scenarios for the resulting three different "irrigation types" are important for current decision-making processes on crop production, but they also are very important for future long term decisions, for example, the establishment of an orchard.

II. CHALLENGE OF THE COMMONS

If the land user knows where the irrigation water comes from, the water has to pass through a wide irrigation system. In fact, each irrigation system is used by different users and is regulated by different authorities. Difficulties on both sides determine the problem of a fair distribution of water.

Each water user will have and use as much water as possible to irrigate the crops and increase, if possible, crop production. If we transfer this behavior to the whole community, the personal benefit in relation to the overall benefit: the overall benefit loss is higher than the positive personal benefit.

This problem can be solved through an appropriate participatory water management system based on common planning which includes all users and their crop plans.

Different crops have a different water demand and some of this demand can be shifted during the year.

III. CROP TABLE WITH WATER DEMAND, FLEXIBILITY AND PLANTING PERIODS

Crop seeding and planting time	Water supply flexibility	Spring	Summer	Autumn
Maize 4,000-8,000 l/ha	Flexible in the end			
Tomato 9,000-20,000 l/ha	No flexibility			
Onion 8,000-14,000 l/ha	No flexibility			
Sunflower 3,000-5,000 l/ha	Flexible in the end			
Potato 2,000-5,000 l/ha	No flexibility			
Cotton 5,000 l/ha	Flexible in the end			

A very important point for successful plant production is a tailored water supply. The water demand varies during the planting period. This is also relevant for establishing an orchard or planting fruit trees.

During the first years the water demand is higher, but single tree irrigation can be managed by mulching and supplementary irrigation by bottles.

Fruits	Plantation structure	General yield per ha	Water demand per l/ha
Apricot (dried)	8x8	0,75 t/ha	4,000- 8,000
Almond	300 trees/ha	3 t/ha	6,000
Apple	8x8	10 t/ha	4,000-8,000

CROPLAND MANAGEMENT

1. Organizational approach



1.2 Crop rotation

Growing the same crop in the same place for many years in a row disproportionately depletes the nutrients in the soil. Therefore, crop rotation is the very common and widespread practice of growing a series of dissimilar/different types of crops in the same area in sequenced seasons. A traditional element of crop rotation is the replenishment of nitrogen through the use of green manure in sequence with cereals and other crops. It is one component of polyculture. Crop rotation is a very important mechanism to keep the soil productive, the yield high, and the pest infestation, plant diseases and weeds low. Different crops have different nutrient needs and impacts on the soil structure and productivity. Therefore, it is important to have in consideration what was cultivated the year before and what could be planted in the following year. Sunflower or example is a crop with a high nutrient need, contrary to legumes which are N suppliers.

In addition to the nutrient impact of crops, pest pressure can be regulated by crop rotation. Crops which belong to the same botanical family have the similar problems with pests, plant diseases and weeds. Therefore, it is important to have at least an understanding of botanical similarities and differences of the cultivated crops, and to change between cereals/maize/potato and vegetables regularly. The choice and sequence of rotation of crops depends on the nature of the soil, the climate, and precipitation, which together determine the type of plants that may be cultivated. Other important aspects of farming such as crop marketing and economic variables must also be considered when deciding crop rotations. The table below shows which crop can be planted after another crop. The table gives a short overview and compares nutrient supply/need, potential pest infestation, and an appropriate combination.

previous fruit Current fruit	Potato	Maize	Sunflower	Cereals	Mungo beans	Chick peas	Carrots	Tomato	Onion	Cabbage	Clover	Alfalfa
Potato	☹️	😊	😊	😊	☹️	☹️	☹️	☹️	☹️	😊	☹️	☹️
Maize	☹️	☹️	☹️	😊	😊	😊	☹️	😊	😊	😊	😊	😊
Sunflower	☹️	☹️	☹️	😊	😊	😊	☹️	☹️	☹️	😊	😊	😊
Cereals	😊	☹️	😊	☹️	😊	😊	😊	😊	😊	😊	😊	😊
Mungo beans	😊	☹️	😊	😊	☹️	☹️	😊	😊	😊	😊	☹️	☹️
Chick peas	😊	☹️	😊	😊	☹️	☹️	😊	😊	😊	😊	☹️	☹️
Carrots	☹️	😊	☹️	😊	😊	😊	☹️	😊	😊	😊	☹️	☹️
Tomato	☹️	☹️	☹️	😊	😊	😊	😊	☹️	😊	😊	😊	😊
Onion	☹️	😊	☹️	😊	😊	😊	😊	☹️	☹️	😊	😊	😊
Cabbage	😊	😊	😊	😊	😊	😊	😊	😊	😊	☹️	😊	😊
Clover	😊	😊	😊	😊	☹️	☹️	😊	😊	😊	😊	☹️	☹️
Alfalfa	😊	😊	😊	😊	☹️	☹️	😊	😊	😊	😊	☹️	☹️

CROPLAND MANAGEMENT

1. Organizational approach

1.3 Orchard planting and maintaining

Orchard-based agroforestry is a land use system where crops like legumes and cereals are planted in between trees (fruit, nut, timber). An orchard can be installed in low lands as well as on slopes and in mountainous terrain. The water supply and the type of crop and tree play important roles.

The aims of this system are, on the one hand, to raise the productivity of a marginal location (by the production of additional crops, for home consumption or local markets) and, on the other hand, to conserve the soil and to increase the nutrients and carbon content by an increase of the soil cover. Therefore, this system can also be considered as a climate change mitigation measurement.

The water supply and slope degree are the most important components for installation of an orchard. The water supply determines the tree type and the crop rotation. The slope degree determines the row distance and the irrigation technique.

Orchards need to be established (for example on terraces) leaving enough room for intercropping purposes. In planting apple trees, 10 m between the rows and 4 m within the rows is recommended. Along each row of trees a 2-3 m strip of grass should be left to grow, for soil protection not for grazing.

The optimal arrangement of the trees is along the contour lines and against the prevailing wind direction (here, compromises are needed). Next to the water supply and natural environment, the chosen tree type determines the number of trees (and the male/female relation by pistachio and almond) on the orchard plot.

The crops between the trees can be rotated, for example, with two years of wheat followed by one year of legumes. The crop rotation is also determined by the water supply, the slope and tree type. To increase production, a supplementary irrigation system can be applied (cutoff drains and drainage ditches).



With this table at hand, an efficient and soil-protecting crop rotation can be put together. It is recommended that at least one period in the rotation be filled with legumes like alfalfa (alfalfa can be cultivated for three years in a row) to improve the soil fertility.

Different kinds of crop rotation systems exist, and an appropriate rotation system is determined by the available crops which are possible to cultivate on the fields. The choice and sequence of rotation crops depends furthermore on the nature of the soil, the climate, water, machinery, the plot sizes, working power and access of available crops which are possible to cultivate on the fields.

Using some forms of crop rotation, farmers can keep their fields under continuous production, instead of letting them lie fallow, as well as reducing the need for artificial fertilizers, both of which can be expensive. A general effect of crop rotation is that there is a geographic mixing of crops, which can slow the spread of pests and diseases during the growing season. The different crops can also reduce the effects of adverse weather for the individual farmer and, by requiring planting and harvest at different times, allow more land to be farmed with the same amount of machinery and labor.

ONE ROTATION EXAMPLE FOR VEGETABLES:

The first bed starts with a mixture of root crops (carrots, beetroot, parsnips) and vegetables belonging to the allium family (onions, garlic and leeks). The second bed begins with sweet corn and curcubits (pumpkins, squash, cucumber, zucchini, watermelon). Thereafter, manure needs to be dig into the plot before seeding the "acid lovers". The third bed in spring starts with the vegetables known as "acid lovers" (tomatoes, bell pepper, eggplants, chillies). Finally, the fourth bed can be used to grow legumes (peas, beans) to improve the soil fertility, as well as brassicas like broccoli, cauliflower and cabbages. By spring the following year, the sweet corn (second bed) replace the root crops (first bed). The "acid flowers" (third bed) replace the first bed (sweet corn). The legumes (fourth bed) replace the third bed ("acid lovers"). The circle is closed by the root crops (first bed) replacing the legumes and brassicas (fourth bed).

MIXED CULTIVATION/INTERCROPPING

Besides crop rotation as a means to improve soil fertility, and to manage pest infestation and weed control, crops can be cultivated together. Mixed cultivation/intercropping on small plots or kitchen gardens can have the same pos./neg. effects as crop rotation. The following table shows possible intercropping options:

Mix cultivation	Beans	Pea	Cucumber	Cabbage	Carrot	Radish	Beetroot	Salads	Spinach	Tomato	Onion
Beans	☺		☺	☺		☺	☺	☺		☺	☹
Pea	☹	☺	☺	☺	☺					☹	
Cucumber	☺		☺	☺		☹				☹	☺
Cabbage	☺	☺	☺	☺	☺	☺		☺	☺	☺	
Carrot		☺			☺	☺	☹	☺		☺	☹
Radish	☺	☺	☹	☺	☺	☺		☺	☺	☺	
Beetroot			☺				☺	☹	☹		☺
Salads	☺	☺	☺	☺		☺	☹	☺		☺	☺
Spinach	☺			☺		☺	☹		☺	☺	
Tomato	☺	☹	☹	☺	☺	☺		☺	☺	☺	
Onion	☹	☹	☺	☹	☺	☹	☺	☺			☺

WHAT ARE ADVANTAGES AND RISKS OF AN ORCHARD SYSTEM?

The advantages of an Orchard agroforestry system are, on the one hand, improved productivity per unit area due to dual use for fruit as well crop production and thus additional income generation and food availability, and on the other hand, through a higher agro-biodiversity and less single crop dependency. Well managed almond orchards can be reinvested after 2 years of fruit harvesting.

It also has different advantages for the natural environment and thereby indirect advantages for the land user. Firstly, a reduction of wind speed can be noted and therefore an improvement of the micro-climate on the plot. This means that through a higher shadowing rate and a higher soil cover, the soil temperature will drop, the evaporation rate will drop and the soil moisture will be raised. A more continuous moisture level helps to protect the soil against runoffs, erosion, and reduces the external water demand for the field crops.

The different crops and trees can influence each other positively and negatively during the different stages of installation. In the beginning, crops with a higher shadowing rate will influence the tree growth negatively. After the completed tree development, crops with a high sun light demand in summer are negatively affected by the tree shadowing.

The high complexity of the system is the general risk for proper management of an orchard. Irrigation, shadowing, fertilizing, cropping, pest management and harvesting must be considered from both sides: crop management and tree management.

Therefore, an external advisory service is highly recommended.

CROPLAND MANAGEMENT

2. Improvement of soil fertility and moisture

2.1

Field cleaning

WHAT IS FIELD CLEANING?

Field cleaning means, in general, to clean your field from stones of any size. As a result of ploughing and deep ploughing the field, new stones are always brought up to the surface of the field. But also erosion of nearby slopes can bring stones to your field. These stones not only destroy your agricultural machinery, but they also minimize your yield and field productivity. However, stones can be used in a beneficial way. Stones can be used to fence your plot (see fencing) for marking your plot with stone heaps.

Stone heaps also improve the biodiversity on your plot as they represent a possible habitat and protect the soil against erosion.

HOW DOES IT WORK?

Besides technical cleaning of the field, the most common and effective method is to clean the plot by hand. You can clear the field from stones after harvesting or before preparing the new seedbed. It is important to clean your fields regularly, if necessary. If you collect stones during the growth period, keep attention not to destroy the plants.

Besides stone cleaning, a general field cleaning (including plastic, as well as other waste) is highly recommended.

Advantages:

- **Protects agriculture machinery**
- **Higher yields**
- Stones can be used to **fence the plot** against livestock or wild animals
- In case of building fences, it additionally protects your plot **against water and wind erosion**
- Stones can be used **to mark your plot** (as fence or heap)
- Heaps can improve the biodiversity on your plot

Disadvantages and challenges:

- **Regular work load**

CHECKLIST FOR THE SCOPE OF APPLICATION

“Key questions” If you cannot answer with **“Yes”**, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for this plot/field?		
Is the plot in a good ecological condition: Can you still get benefits out of it?		
Are there spaces for fences or heaps close to your plot?		
Do you have enough work power for regular field cleaning?		

The **“Question”** part will ask you about additional framing preconditions. If the answer is **“No”**, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Would this kind of work constitute mainly hard work for women?		
Are means for carrying materials available?		

FINANCIAL CALCULATION

Investment expenses	Investment amount	Example
Work for cleaning		
Additional costs		
TOTAL expenses:		
Investment earnings/benefits		
Protection of agricultural engineering		
Yield increase		
Additional earnings		
TOTAL earnings:		

CRITERIA FOR DECISION-MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with **“Yes”**.

If at the end most of the questions are answered with **“Yes”**, the positive impacts prevail, but the negative impacts should still be kept under careful consideration

Economic benefits	Yes	No
Could you benefit from the reduction of the effects of water and wind erosion and therefore higher yields?		
Could you get more income by selling harvest surpluses?		
Could you save money by less expense for repairing of agricultural machinery?		
Ecological impact		
Could fencing with stones reduce soil erosion on your plot?		
Could fencing with stones (e.g., walls) improve the biodiversity on your plot?		
Could fencing with stones reduce the risk exposure to natural disasters (landslides, erosion, and sedimentation of springs, flooding) for your community?		
Gender impact		
What role do women play in caring for crops: Are women involved in fertilizing, weeding, watering, cleaning fields?		
Could field cleaning from stones have a negative impact on the work load of women?		
If cleaning the field from stones for example has not been done before, would the additional workload create a reasonable output for women?		
Are women allowed to decide on what additional money (due to higher yields) is spent on?		
Community impact		
Would field cleaning have a positive impact in terms of fencing or marking plots in your community?		
How many people or crop users could benefit from field cleaning or heap installing?		
Would plot marking with heaps affect other households of the community negatively?		
Would this eventually lead to tensions or conflicts within your community?		
Would plot marking with heaps from field cleaning be a positive example for neighboring communities?		

Contact:

Cooperative SAROB
Muhamadi Muminov (director)
127 Rudaki ave.
Rudaki Plaza, room 1113;1115
Dushanbe, Tajikistan
93 5770230

Links:

sarob.net
muminov01@gmail.com
mmuminov@sarob.net

CROPLAND MANAGEMENT

2. Improvement of soil fertility and moisture

2.2 Drip irrigation

WHAT IS DRIP IRRIGATION?

The majority of high value cash crops in Tajikistan are produced on irrigated crop land.

Therefore, an efficient irrigation technique and system is needed. A drip irrigation system can be used for kitchen gardens, combined with a rooftop rainwater harvesting system or for field crop and orchard irrigation. For both systems, drip irrigation has the advantage of 1.5 to 2 times more efficient water use compared to open channel irrigation.

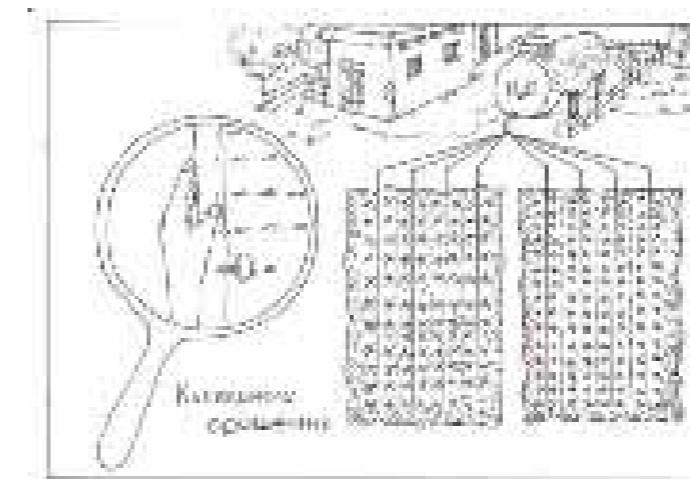
On the one hand, it could be used for increasing the [size of the] field, on the other hand to save expenses for water taxes. Next to water saving, drip irrigation has the advantage of improving fertilizer utilization by 90 percent, as nutrients can be added to the irrigation water.

In general, drip irrigation helps to stop water erosion, suppresses weeds and minimizes labor for digging and cleaning irrigation channels.

HOW DOES IT WORK?

At the moment, drip irrigation in Tajikistan has the potential to be used in kitchen gardens and orchards, because water storage and the delivery system (water pump) are the biggest challenges. For water storage, a cistern made of stones can be installed combined with a water pump, or any kind of barrel installed at a height which creates enough pressure on the tube system. A 50m² to 100m² kitchen garden needs a system pressure of 0.1 to 0.2 bar.

Besides the water reservoir, polyethylene tubes and drippers are necessary. For cost saving purposes, screws can be used as simple drippers. A drip irrigation system can save 90% on fertilizer input. The larger the tube system the higher the effort for cleaning.



Advantages:

1. **Water saving** technology (water price, taxes ...)
2. **Up to 90% fertilizer saving capacity**
3. **Possibility to increase production** or improve the water supply
4. **Protection of soil erosion** through more efficient water use?
5. **Minimization of labor for digging and maintenance of ditches and weed control**
6. **Makes former water intensive production systems attractive**
7. **Even water distribution across the field**
8. **Improvement of building structure** through a rooftop rainwater harvest system
9. **Better weeds management**

Disadvantages / Challenges/ Risks:

1. **High investment amount** for larger plots
2. If a system is installed widely, **maintenance could be complicated and expensive?**

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“**Key questions**” If you cannot answer with “**Yes**”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for the plot?		
Do you have the space and possibility to install a water reservoir or water barrel?		
Is the plot continuously accessible from your residence (for maintenance and care of pumps, tubes and drippers)?		
Is minimum technical equipment: tubes, reservoir and drippers/screws available?		
Do you have enough work power for the project (reservoir and gutters)?		

The “**Question**” part will ask you about additional framing preconditions. If the answer is “**No**”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Is the plot in a more or less good ecological condition: Can you still get benefits out of it, are yields high enough?		
Is the plot affected negatively from erosion?		
Would installing a drip irrigation system reduce the workload especially for women (for watering crops or trees)?		
Do you need special technical support (installing tube lines, water reservoir, drippers)?		
Do you need external advisory service for financial calculations and writing a management plan?		

FINANCIAL CALCULATION:

Investment expenses	Investment amount	Example
Water reservoir		
Tubes		
Water pump		
Others		
TOTAL expenses:		
Investment earnings/benefits		
Water savings		
Fertilizer savings		
Saving time		
Soil protection		
TOTAL earnings:		

CRITERIA FOR DECISION-MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “**Yes**”.

If at the end most of the questions are answered with “**Yes**”, the positive impacts prevail, but the negative impacts should still be kept under careful in consideration.

Economic benefit	Yes	No
Could you directly benefit from water savings?		
Could you benefit in the long term from less nutrient and fertilizer losses on your plot?		
Could you directly benefit from investments in a drip irrigation system?		
Could you enlarge your crop fields through more efficient water utilization?		
Could you directly save money because of less expenditure for fertilizers?		
Could the additional yield and the reduced workload justify the high investment costs?		
Ecological impact		
Could drip irrigation and continuous water supply for your orchard be interesting to you?		
Could drip irrigation improve your farming structure?		
Could drip irrigation reduce the risk of exposure to natural disasters (landslides, erosion, sedimentation of springs, flooding) on your crop fields?		
Gender impact		
What role do women play in watering kitchen gardens and orchards? Are they mainly watering plants?		
Could women directly benefit from less workload for maintenance of ditches?		
Do women have decision-making power on how money received from higher yields is used?		

Community impact

Could the establishment of an individual drip irrigation system have a positive impact in terms of reduced water demand and higher agricultural output for the whole community?

Could your community benefit (economically and ecologically), from a larger and communally organized drip irrigation system installed and maintained by different land users?

Contact:

Cooperative SAROB
Muhamadi Muminov (director)
127 Rudaki ave.
Rudaki Plaza, room 1113;1115
Dushanbe, Tajikistan
93 5770230

Umed Sharipov
928 222 553
Sughd region

Links:

sarob.net
muminov01@gmail.com
mmuminov@sarob.net

CROPLAND MANAGEMENT

2. Improvement of soil fertility and moisture

2.3

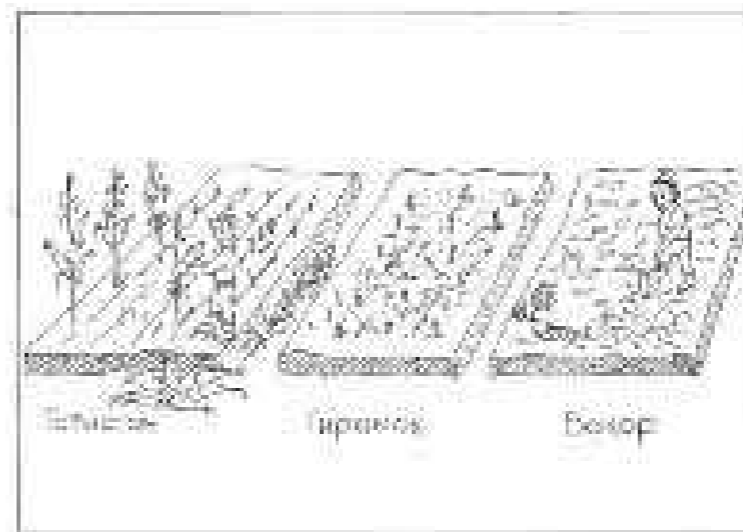
Crop mulching

WHAT IS CROP MULCHING?

Crop mulching is an agricultural mechanism to conserve moisture, improve the fertility and health of the soil, reduce weed growth and enhance the visual appeal of the area. Mulch is mostly organic in nature.

You can use leaves as well as straw mulch or field hay. Crop mulching can be used for vegetable production as well as for cereal production. It can also be combined with compost. Another type of mulching is using a catch crop or direct seeding. All the different types improve the soil fertility and protect the soil from water and wind erosion.

HOW DOES IT WORK?



Directly after the main crop, you seed another, so called, catch crop. The benefit at first will be the protection from wind and water erosion. Secondly, after the winter you will dig the crop into the soil to fertilize it and improve the soil structure. The easiest way to improve your soil is with mulching, keeping livestock far from your plot, and leaving the straw on the field. During the late autumn and winter it will protect the soil from erosion and in the spring time you plow the straw under the soil and fertilize it, for the next crop.

Another possibility, more interesting for smaller plot sizes, is to dig your compost under the soil as a mulching material and improve the structure this way. Another simple technique is direct seeding or no-tilling. This means you leave the straw on the field during the winter and in the following year you will seed directly in the standing straw. This technique also saves soil moisture and improves the fertility of soil microorganisms.

Advantages:

- Higher yields thus nutrient management
- Improvement of soil and soil structure
- Improvement of soil moisture
- Permanent soil cover protects the plots against soil erosion
- Improvement of the soil structure > higher yields
- Improvement of the water holding capacity > higher yields
- Saving of energy and money because of less plowing
- Compost can also be used

Disadvantages / Risks / Challenges:

- Withdrawal of fodder (straw mulching on field, direct seeding)
- Improved knowledge about pest and weed management [why a risk?]
- Expenses for catch crops
- Loss of harvest residues as livestock fodder in autumn

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for this plot?		
Is the plot already used as agricultural land?		
Is the plot in a good ecological condition, is the soil still fertile enough to cultivate crops?		
Do you have access to organic mulching materials?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Do you have access to catch crops?		
Is it possible for you to use compost for mulching measures?		
Do you have enough work power and knowledge to manage a more complex crop system?		
Could it be possible to use harvest residues as mulching material?		

FINANCIAL CALCULATION

Investment expenses	Investment amount	Example
Catch crop		
Loss of straw as fodder		
Pest control		
Additional costs		
TOTAL expenses:		
Investment earnings		
Protection against erosion		
Protection of soil moisture		
Soil improvement		
Additional earnings		
TOTAL earnings:		

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Economic benefit	Yes	No
Could you benefit by the improvement of your soil in term of higher income by selling the crops in the markets?		
Could you benefit by higher fertility of plots in terms of food security and by the substitution for the purchase of food?		
Could you thus save money?		
Could you save money due to less expenditures for pesticides, erosion protection measurements,...?		
Ecological impact		
Is crop mulching suitable for the climatic conditions in your community: is there enough water and sunlight?		
Could crop mulching increase the fertility of your plots?		
Could crop mulching increase the water capacity on your plot (soil coverage by other crops)?		
Could crop mulching reduce the risk of exposure to natural disasters (landslides, erosion, sedimentation of springs, avalanches, flooding)?		
Could crop mulching improve the biodiversity on your plot?		
Gender impact		
What role do women play in the crop mulching: are they responsible for the compost system, collecting leaves, ...?		
Would crop mulching constitute an additional workload for women?		

Would the additional workload create a reasonable output for women, e.g., by an increased income from selling tree products?		
Would women be able to decide on what the additional money is spent for?		
Could women directly benefit from additional crops on your plots in terms of better food supply?		
Community impact		
Would crop mulching have a positive impact for your community in terms of better food supply, soil improvement?		
Could crop rotation reduce the effects of erosion processes, landslides,...in your community?		
Could crop rotation serve as a model for other communities?		

Contact:	Links:
Cooperative SAROB Muhamadi Muminov (director) 127 Rudaki ave. Rudaki Plaza, room 1113;1115 Dushanbe, Tajikistan 93 5770230	sarob.net muminov01@gmail.com mmuminov@sarob.net

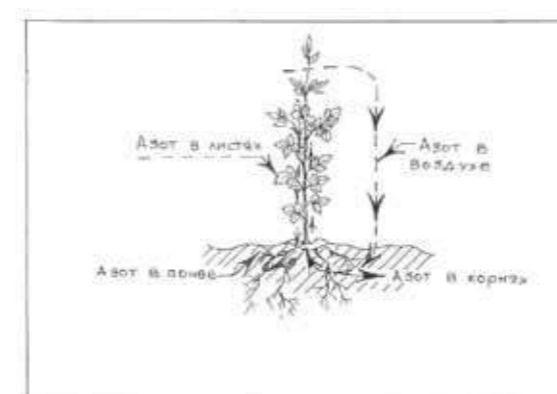
CROPLAND MANAGEMENT

2. Improvement of soil fertility and moisture

2.4 Nitrogen fixing crop plants

WHAT ARE NITROGEN FIXING CROP PLANTS?

Nitrogen fixation is a pattern of nutrient cycling: nitrogen is a stable gas, normally unavailable to plants. Nitrogen fixation is a process by which certain plants "fix" or gather atmospheric nitrogen and make it biologically available. The plant itself needs most of the gathered atmospheric nitrogen. But some of the nitrogen will be available for the subsequent crop. The amount of nitrogen available for the subsequent crop depends on the nitrogen fixing crop, the soil and soil cultivation for the subsequent plant.



HOW DOES IT WORK?

Plants that contribute to nitrogen fixation include the legume family such as alfalfa, clover, white clover, peanut, lupines and soybeans. They contain symbiotic bacteria within nodules in their root systems, producing nitrogen compounds that help the plant to grow and compete with other plants. When the plant dies, the fixed nitrogen is available to other plants and this helps to fertilize the subsequent crop. In fact the seed of legumes like clover and alfalfa are very small, and a fine

seedbed for an improved seed soil contact is necessary. The small seeds need a direct moisture contact. Therefore, rolling the field after seeding is recommended.

Mineral nitrogen fertilizer can be substituted partly from prior nitrogen fixing crops.

Advantages & positive side effects:

1. Supports **nutrient cycling** and soil **fertility**
2. Some nitrogen fixing crop plants are **deep-rooted** → **access to nutrients** in subsoil
3. Extensive root system **stabilizes soil** → constantly growing → more **organic matter** in soil, channels for aeration (mainly alfalfa)
4. **Nutritious and protein rich animal fodder**
5. Protect soil from **erosion and landslides**

Disadvantages & risks:

1. Nitrogen fixing crops need a different management as compared to cereal crops
2. The productivity depends on the water demand. It is also possible to cultivate legumes like alfalfa on water-scarce fields
3. Due to ability to thrive under poor conditions, they can **easily become weedy, e.g., sainfoin**
4. Legumes like pea need an appropriate nutrient supply-Phosphor (For one expected yield t, 10kg per ha)

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for this plot?		
Is the plot accessible from your residence (for care, harvest, watering,.. the trees)?		
Is minimum technical equipment for planting and cutting available?		
Do you have enough work power for the establishment and care of the crop plants?		
Are the climatic conditions suitable for planting crop plants, is there enough sunlight, water,...?		
Are there seeds or seedlings for nitrogen fixing crop plants available?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these issues

Questions	Yes	No
Is the plot in a more or less good ecological condition: Can you still get benefits out of it, are yields high enough?		
Which locally adapted nitrogen fixing plants do you know?		
Is the plot highly affected negatively from wind erosion and depletion (nutrient losses)?		
Would planting nitrogen fixing crops constitute an additional workload, especially for women?		
Do you need special technical support (e.g., seeding machinery)?		
Do you need external advisory service to integrate legumes in an efficient crop rotation system or to understand combining possibilities better?		

RAIN FED CULTIVATION:

Crop	Seed price/kg	Yield/ha	N-fixing for next year	N-price equivalent next year 34/64% N
Alfalfa	25-30 TJS	5-7 t	70-100 kg N/ha	266-380 TJS
Lupine	>50TJS	0.8-1.0 t	15-20 kg N/ha	57-290 TJS
Clover	30 TJS	5-7 t	70- 100 kg N/ha	266-380 TJS
Peanut	10- 12 TJS	No data	50- 150 kg N/ha	No data

IRRIGATED CULTIVATION:

Crop	Seed price/kg	Yield/ha	N-fixing for next year	N-price equivalent next year 34/64% N
Alfalfa	25-30 TJS	20-25t	70-100 kg N/ha	1075-1345 TJS
Lupine	>50TJS	1.5-2 t	40-70 kg N/ha	110-147 TJS
Clover	30 TJS	18-20t	70- 100 kg N/ha	1075-1345 TJS
Peanut	10- 12 TJS	1.5-3 t	50- 150 kg N/ha	190-570 TJS

FINANCIAL CALCULATION:

Investment expenses	Investment amount
Price for (N-fixing) crop	
Others	
TOTAL expenses:	
Investment earnings/ benefits	
Natural fertilization (see table)	
Soil improvement	
Hazard protection	
Degradation prevention	
TOTAL earnings:	

CRITERIA FOR DECISION-MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful in consideration.

Economic benefit	Yes	No
Could you benefit in the short term (directly) from integrating legumes into your crop rotation?		
Is it possible for you and does it make sense to get and give additional fertilizer to generate higher yields?		
Do you have access to markets to sell peas and fodder legumes?		
Ecological impact		
Could nitrogen fixing crops integrated into your crop rotation improve the soil fertility on all of your plots?		
Could nitrogen fixing crops reduce soil erosion processes on your plot?		
Could nitrogen fixing crops reduce the risk of exposure to natural disasters (landslides, erosion, sedimentation of springs, flooding) in your community?		
Could nitrogen fixing crops improve the biodiversity on your crop fields?		
Does it make sense to cultivate clover before mungo beans or peas?		

Gender impact		
Which role do women play in caring for (nitrogen fixing) crop plants: Are women involved in planting, weeding, watering (nitrogen fixing) crops?		
Could women directly benefit from nitrogen fixing crops through improved/higher dairy-farming outputs?		
Do women have decision-making power on how any money received from the sale of dairy-farming products is used?		
Community impact		
Would the establishment of nitrogen fixing crops have a positive impact in terms of higher agricultural output for your community?		
Could your community benefit, from planting nitrogen fixing crops on village pasture, in terms of protection from natural disasters (reduction of wind/ water erosion, landslides...)?		
Would the establishment of nitrogen fixing crops affect other households of the community negatively?		

Contact:	Links:
Cooperative SAROB Muhamadi Muminov (director) 127 Rudaki ave. Rudaki Plaza, room 1113;1115 Dushanbe, Tajikistan 93 5770230	sarob.net muminov01@gmail.com mmuminov@sarob.net

CROPLAND MANAGEMENT

3. Reduction of erosion and crop protection

3.1

Orchard planting on slopes

WHAT IS MEANT BY ORCHARD PLANTING ON STEEP SLOPES?

The aim of planting fruit trees (peach, pear, apricot...) on slopes is to conserve the soil from erosion and landslides by reducing surface water runoff. Furthermore, fruits are available for the family, and income can be generated by selling fruits. As described in the subchapter on "Orchard based agro forestry", the space between the tree lines can be used for crop or fodder production. The system itself is very complex to manage, and on slopes, for irrigation and specific fertilizing measures, it becomes even more challenging.

HOW DOES IT WORK?

Fruit trees are planted along irrigation contours running at shallow angles parallel to the slope. The trees are irrigated through a contour trench as shown in the photo above. Piped irrigation and drip irrigation techniques can be applied also if rain water is not sufficient and the risk of soil erosion is too high. For almonds, at least 300 trees per hectare, for pistachio 300-400 trees depending on the variety and the correct proportion of female and male plants per hectare, are recommended.

To further stabilize the slope, other crops such as alfalfa or wheat can be cultivated between the trees and tree lines. For this kind of orchard management the positive and negative impacts of both production types and their interactions have to be considered.

A (wire) fence has to be erected to protect the fruit trees and crops from uncontrolled grazing.

Functions and Advantages:

- Soil and slope stabilization
- Double income from field crops and tree products (fruits, timber, fuel wood)
- Conservation of soil **fertility** (biomass production)
- Improvement of soil chemical, physical and biological **characteristics** (stabilization by roots, shade from tree canopy improves soil biological activities)
- Reduction of **soil erosion** (windbreaks, higher water infiltration, soil stabilization by roots)

- Enhancement of **nutrient** capture (by deep-rooting trees)
- Enhancement of **water storage** capacities (reduced evaporation)
- Contribution to **biodiversity** (reduces financial risks in case of extraordinary environmental conditions and increases income opportunities)
- Contribution to **climate change** resilience and mitigation (carbon storage)
- Reduction of **micro-climate** extremes (shadowing and higher soil cover reduce temperature and therefore evaporation; higher soil moisture)
- Conservation of **energy** (reduction of heating costs in homes due to windbreaks)

Disadvantages/Challenges:

- **High complex system** with many different challenges in proper crop cultivation as well as tree cultivation
- **Additional trainings** and advisory are recommended
- **Competition** between trees, crops (water, nutrients, sun)
- Continuous water supply for the young trees
- Cannot afford adoption or **start up costs** (It can take 2-10 years before the fruits can be harvested, depending upon the variety)
- Lack of **equipment**, lack of high quality **seed/seedling** sources

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for the plot?		
Is the plot already used as agricultural land?		
Is the plot located on a steep slope?		
Is the plot highly exposed to soil erosion?		
Is the plot continuously accessible from your residence (for care, pruning, watering, harvest...)?		
Are the climatic conditions suitable for the cultivation of fruit trees: is there enough water (water access), sunlight...?		
Is the plot in a good ecological condition: is there sufficient depth of top soil to sustain a fruit orchard?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to substitute or solve these issues.

Questions	Yes	No
Do you have a demand for: fruits, nuts, timber, firewood, etc.?		
Is minimum equipment (for the fence ...) available?		
Are enough other inputs such as fertilizer/ pesticides available?		
Are tree seedlings and seeds available?		
Do you have enough work power (for the planting, establishment of the fence, watering, harvesting, pruning, ...), especially in the first years after the establishment?		

Are there market opportunities to sell the surplus ?		
Do you have information on planting/caring for different crops and fruit trees together?		
Do you need special technical support for ditch installation or drip irrigation measures?		
Do you need external advisory services for developing a management plan, or to get more information about the challenges of orchard planting on slopes?		

FINANCIAL CALCULATION PER HECTARE:

Investment expenses (Almond Orchard)	Investment Example	Own calculation
Trees 333/ha	333 USD	
Fertilizer for 5 years (K,N,P)	810 TJS/ha	
Pest control 2 years	200 TJS/ha	
Labor: irrigation, pruning (1-5 year)	3,770 TJS/ha	
Additional costs		
Additional costs		
TOTAL production costs year 1 to 10:	21,338.50 TJS	
Investment earnings		
Fruits	6 USD per kg	
Additional fodder	Depends on the crop	
Additional benefits		
Erosion control on pasture	Depends on soil cover and slope	
Timber	Depends on the trees	
Additional earnings		
TOTAL profit during 10 years (one ha):	8,0616.50 TJS	

CRITERIA FOR FINAL DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful in consideration.

Economic impact	Yes	No
Does the reinvestment period depend on the planted trees?		
Is it possible to grow fruit trees instead of timber trees on the plot?		
If it is financially not possible to build an orchard on your own, do you have the possibility to have a JFM contract with a nearby leskhoz?		
Could you get additional income by selling the fruits and/or timber, firewood or fodder?		
Could you save money because of less expenditure?		
Could you save money because of less expenditure for reconstruction in cases of natural disasters like landslides or avalanches?		

Ecological impact		
Could the planting of an orchard prevent future landslides?		
Could orchard planting improve the soil fertility (nutrient cycle recharge by litter fall, more organic material) and soil structure (roots) of your plot?		
Could orchard planting on steep slopes improve soil and water retention capacities of your plot?		
Could orchard planting contribute to a reduction of illegal cuttings for firewood in nearby forests?		
Gender impact		
What role do women play in the care of trees: Are women involved in planting, pruning, watering, harvesting?		
Can women directly benefit from the fruit tree products, e.g., by processing and selling them?		
From these benefits, can the women decide on what the money is spent on?		
Would the establishment of an orchard on your plot constitute an additional workload for women (planting and care for trees)?		
Do women have decision-making power on how any money received from fruits or orchard products is used?		
Community impact		
Would the establishment of an orchard have a positive impact for the community in terms of firewood and food supply?		
Could the establishment of an orchard on steep slopes reduce the effects of natural hazards (destruction after heavy rains/ landslides...) in your community?		

Contact:

Cooperative SAROB
 Muhamadi Muminov (director)
 127 Rudaki ave.
 Rudaki Plaza, room 1113;1115
 Dushanbe, Tajikistan
 93 5770230

Links:

sarob.net
 muminov01@gmail.com
 mmuminov@sarob.net

CROPLAND MANAGEMENT

3. Reduction of erosion and crop protection

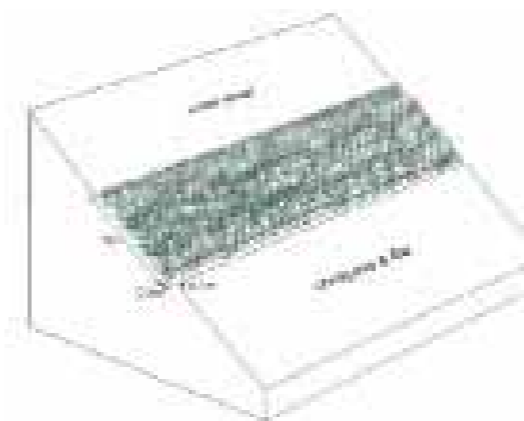
3.2

Buffer stripes on slopes

WHAT ARE BUFFER STRIPES?

A (fenced) buffer stripe of grass or legume (around 10 m wide) is planted on downward sloping cropland or village pasture (with a slope until $>12^\circ$) and left uncultivated in order to stabilize and reduce soil erosion (water and wind erosion). The grass stripe can furthermore be used for haymaking once in each cropping season. If this technique is used on village pasture, it is recommended to use the fenced buffer stripe for protection against uncontrolled grazing animals as well as natural reseeding. This measure includes haymaking after the seed-formation phase.

HOW DOES IT WORK?



The buffer stripe of grass or legume – planted on the upper part of the slope – should be around 10 m wide. This buffer stripe can be followed by an adjacent drainage ditch to enhance the technology's capability of reducing run-off onto the crop field further down the slope. The drainage ditch needs to be cleared out of soil regularly. The grass/legume can be cut for haymaking once each growing season. This technique can be also a part of a crop rotation or pasture reseeding system. It should be combined with other soil conservation technologies (Orchard plantation).

Disadvantages/ Challenges/ Risks:

- **Could be labor-intensive:** digging of drainage ditch, clearing of drainage ditch from washed in soil, cutting of grass (haymaking)
- **Inefficient if it is not or little protected** against freely grazing animals
- This option cannot fully prevent soil erosion. **It should be combined** with other soil conservation technologies (Orchard plantation)
- **It could be a source of weeds** for the framing crop fields. Therefore haymaking before the seed-formation phase

Functions and Advantages:

- **Reduction of soil erosion, and gully development** (reducing run-on onto the field further down the slope)
- Conservation of soil **fertility** (crop rotation, pasture rotation)
- **Haymaking** or cut and carry harvest from the grass stripes
- **Pasture improvement** (natural reseeding)

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key question	Yes	No
Do you have legal user rights for this plot?		
Do you have enough work power (for establishment of stripes and regular cleaning of ditches)?		
Is the expected area for a buffer stripe plantation under 12 degree slope?		
Do you have the possibility to protect the buffer stripe against freely grazing animals?		
Are there grass or legume seeds available?		
Is the plot in a good ecological condition: Can you still gather benefits out of it?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to substitute or solve these issues.

Question	Yes	No
Is the plot already used as pasture or agricultural land?		
Is minimum equipment (for establishment of drainage ditches) available?		
Is special equipment like mobile fences available?		
Do you need additional advisory service for an appropriate seed selection?		

FINANCIAL CALCULATION:

Investment expenses	Investment amount
Seeds (legumes)	
Ditch installing (if necessary)	
Fencing (mobile fences)	
Additional costs:	

Additional costs:	
TOTAL expenses:	
Investment earnings	
Hay/Fodder	
Pasture reseeding	
Additional benefits	
Erosion control on pasture/ slope crop fields	
Additional earnings	
TOTAL earnings:	

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still kept carefully in consideration.

Economic benefits	Yes	No
Could you combine this technology with other soil protecting measurements		
Could you integrate buffer stripes into your crop rotation or pasture reseeding measurements?		
Could the additional hay make small scale dairy farming for you interesting?		
Ecological impact		
Could buffer grass stripes contribute to a reduction of soil erosion, landslides, gully development, avalanches...on your plot?		
Could buffer stripes have a negative impact on your crop yields (weeds, insects)?		
Could buffer stripes, integrated into a rotation system, help to improve the soil moisture and soil fertility?		
Gender impact		
Could the establishment of grass stripes and drainage ditches constitute an additional workload for women (ditch cleaning, grass cutting, hay making)?		
Does the additional workload create a reasonable output for women e.g. Can women directly benefit from selling hay?		
Do women have decision making power on how any money received from hay making or animal feeding is used?		
Community impact		
Could buffer grass stripes on close village pastures contribute to a reduction of risk exposure to natural hazards (landslides, avalanches...) for the whole community?		
Could the establishment of barrier grass stripes on your plot have a positive impact in terms of fodder supply and village pasture rehabilitation for community’s livestock?		

Contact:

Cooperative SAROB
 Muhamadi Muminov (director)
 127 Rudaki ave.
 Rudaki Plaza, room 1113;1115
 Dushanbe, Tajikistan
 93 5770230

Links:

sarob.net
 muminov01@gmail.com
 mmuminov@sarob.net

CROPLAND MANAGEMENT

3. Reduction of erosion and crop protection

3.3 Live fencing on crop lands

WHAT IS LIVE FENCING?

Live fencing is a technology designed to control the movement of animals and people on a plot in use or for controlled use of a pasture. It could be a pasture close to the village or an individual crop field, kitchen garden or orchard. It can consist of a line of trees (timber or fruit), shrubs or bushes like sea buckthorn, barbarize, or dug rose. This technology is particularly recommended around plots where plants are still in their juvenile phase and are especially exposed to the threat of free grazing animals. Inside the fenced plot, highly productive fodder like sainfoin or alfalfa, in a rotation with fodder crops, even winter growing crops like winter wheat or raps, are highly recommended. Furthermore, this technique can be used to demarcate land and for the growth of firewood or wood used for shelter and house construction.

HOW DOES IT WORK?

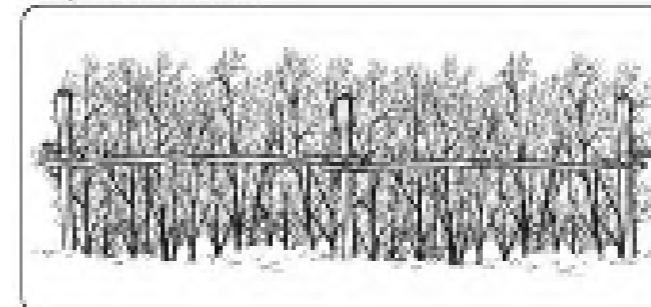
Live fence-posts are widely spaced, single lines of woody plants that are regularly pollarded. Between trees (fruit trees or other trees with an additional benefit are suggested), shrubs with an additional benefit like sea buckthorn can be planted. Until shrubs and trees are high and thick enough, metal or wooden posts for supporting barbed wire or other material can be used.

Ideally, the species used for live fence posts have the ability to rapidly form a callus and cover the point of attachment of the wire to the post.

Planting steps for sea buckthorn fence:

A living sea buckthorn fence, for example, consists of 2 layers: the outer layer is an instant fence made of thorny sea buckthorn branches. This immediately restricts animal and human access. The inner layer is of sea buckthorn seedlings and will establish itself during the several following growing seasons. This type of living fence can grow up to a height of 1.5-2 m. It should be supported by fruit trees, willow or other kinds of poles; the sea buckthorn branches are fixed together with willow twigs, willow branches or wire and are attached to wooden poles.

Living Sea buckthorn Fence



Advantages & positive side effects:

1. **Creates additional income** (fruits, fodder, timber, fuelwood)
2. **Multi-purpose trees:** provide fuel wood, timber, fodder, food if fruit trees are planted
3. Offer habitat to **insect-eating birds**
4. Serve as one method of securing land ownership where the law permits
5. **Low cost technology** (establishment and maintenance)
6. The combination of trees and shrubs **helps to keep the soil moist**
7. **Nitrogen fixing trees and shrubs help to fertilize the soil (soil structure, root penetration)**
8. **Protect farmland** from human access, and freely grazing or wild animals
9. Serve as **windbreaks, erosion control**, soil stabilization
10. Serve as **nutrient traps** (preventing loss of nutrients that are normally lost through leaching or surface runoff)

Disadvantages & risks:

1. Problems of **competition** (sunlight, water, nutrients)
2. **Land tenure laws** need to be well understood before looking at how trees/live fences can be incorporated into local farming systems. The development of live fences must take into account existing patterns of land distribution
3. May harbor **insects and pests**
4. **Takes time** to establish
5. **If not planted properly**, it is not effective
6. Young trees and shrubs need also to be protected against freely grazing animals via plastic bottles or other protecting techniques.

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for the plot to be fenced?		
Is the plot already used as crop land, or a kitchen garden?		
Is the plot affected by freely grazing animals?		
Are the climatic conditions suitable for the establishment of living fences? Is there enough, sun and water?		
Are there seedlings/seeds or tree cuttings for establishing a live fence available?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Do you have a demand for firewood, fruits, fodder, timber, mulch, etc.?		
Are the plot or the boundaries exposed to soil erosion (wind or water) or to landslides?		
Is minimum equipment for the establishment/maintenance of living fences available (fencing material in the first years)?		
Do you have access to enough metal or wooden posts?		

Do you have sufficient work power (establishment and maintenance)?		
Are there market opportunities to sell fruits (if fruit trees as fences are planted)?		
Do you need external advisory service to find regionally or locally adapted trees or shrubs in the right composition?		

FINANCIAL CALCULATION

Investment expenses	Investment amount
Price for branches and brier wood	
Price for plantlings	
Wire, string	
Water and mulching material	
Work power for Planting	
Maintaining (watering, renew fences, ...)	
TOTAL expenses:	
Financial benefits	
Fodder yield improvement (protection)	
Fruits/nuts/sea buckthorn	
Fuelwood	
Additional benefits	
Erosion protection	
Slope stabilization	
TOTAL earnings:	

CRITERIA FOR DECISION-MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefit	Yes	No
Could you benefit from trees, bushes, or shrubs planted as living fences immediately?		
Would the tree and shrub products cover your complete household’s needs for fruits and soft fruits?		
Could you get additional income by selling these tree/bush products?		
Could you improve crop yield/pasture growth by fencing your plot?		
Could live fencing lead to conflicts with neighboring livestock users?		
Ecological impact		
Could live fences improve the soil fertility, soil structure, reduce salinization by planting, e.g., poplars or tamarisk, around your plot?		
Could live fences improve soil and water retention capacities on your plot?		
Could the higher retention capacity through live fencing help you to adapt to higher temperatures and climate change?		

Could live fences contribute to the reduction of risk exposure to natural disasters (landslides, erosion, sedimentation of springs, avalanches....) for your individual crop field or kitchen garden?		
Could living fences contribute to a reduction of illegal cuttings in nearby forests for fuel wood?		
Gender impact		
Are women involved in the establishment of live fences/in the planting and caring for trees shrubs?		
Could women directly benefit from tree shrub products, e.g., by processing and selling them? From these benefits, can the women decide on what the money is spent for?		
Would the establishment/maintenance of living fences constitute an additional workload for women?		
Community impact		
Could your community benefit from self-sufficiency in fuel wood of an individual user?		
Could the establishment of individual live fences have a positive impact for the community in terms of reduced risks to natural hazards, e.g., landslides, erosion, avalanches...?		
Could the establishment of live fences lead to tensions within the community in terms of competition for land rights between neighboring land users?		
Could the establishment of live fences for winter pasture and a cut and carry system for fodder production, help community members to clarify tenure problems?		
Can individual live fencing serve as a model for other neighboring communities?		

Contact:

Cooperative SAROB
 Muhamadi Muminov (director)
 127 Rudaki ave.
 Rudaki Plaza, room 1113;1115
 Dushanbe, Tajikistan
 93 5770230

CAMP TABIAT
 Umed Bulbulshoev (director)
 9 Sohibnazarova Street, Choroug
 +992 935 14 19 45

Jangalparvar
 Jamolidin Madibron (director)
 62 Druzhbi narodov str., 734025, Dushanbe,
 +992 91 818 18 25

Cesvi
 Daniil Ilyasov (Project coordinator)
 +992 985 02 27 37
 Dushanbe Office: Firdavsi Str., 15
 Khovaling Office: Mirzo Tursunzoda Str.

Links:

sarob.net
 muminov01@gmail.com
 mmuminov@sarob.net

<http://camp.kg/en/who-we-are/camp-tabiati/umedsho@mail.ru>

daniil.ilyasov@gmail.com

CROPLAND MANAGEMENT

4. Improvement of kitchen gardens



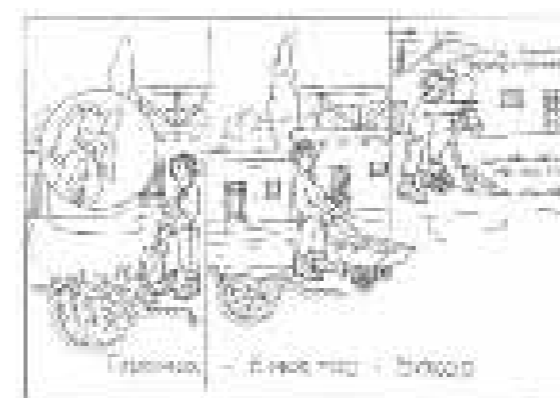
4.1

Compost preparation technologies

WHAT IS A COMPOST PREPARATION SYSTEM?

Compost by itself is the organic waste of a household, garden or yard. The idea behind composting is to transfer the waste into a soil improving material. You can leaf your organic waste/material directly on the soil, but with a compost system you can improve parts of your kitchen garden more efficiently. Compost not only improves the soil structure but also porosity and density, and creates a better plant root environment as well. It also increases the permeability of heavy soils and reduces erosion and runoffs. It supplies a variety of macro and micronutrients and in general a significant amount of organic matter. It supplies beneficial microorganisms to soil and growing media and improves and stabilizes the soil pH level. Different technique and types are used. If you have an average household, one single box would be enough. If you more people or you have a big garden, a two or three box system could be interesting.

HOW DOES IT WORK?



Before you start to build a compost system you have to ask yourself: How much waste do I throw away and is there space in my yard to increase the size of my system in the future? Can I easily remove finished compost? All the questions define the size of the compost system and the chosen material. Experience from the NGO "Jovid" shows that 1x2m and 1m deep compost will produce 6m³ of compost per year. During the summer it needs nearly 3 months; in winter depending on temperature and rain up to 4 months. Some people choose a two pit system. After 1-2 months they put the decayed mass from one into the other one and start to fill the first one again.

You have to protect the compost material against moisture loses. Its necessary to keep the compost a bit wet, otherwise the microorganisms will die and the compost will lose its function. You can also mix wood ash from time to time under the compost material.

WHAT CAN BE USED FOR COMPOST?

Fill the bin/hole: Add nitrogen compounds, which are greens. These include cut grass, weeds, raw vegetable peelings, green prunings, manure, eggshells, waste paper, hedge clippings and brown prunings, and old leaves.

Advantages:

- Improves the soil structure, porosity and density, creating a better plant root environment
- Increases permeability of heavy soils, reducing erosion (wind and water)
- Improves water holding capacity of sandy soil, reducing water loss and leaching
- Supplies a variety of macro and micronutrients
- Supplies a significant amount of organic matter
- Improves cation exchange capacity of soils, improving their ability to hold nutrients for plant use
- Supplies beneficial microorganisms to soils and growing media
- Improves and stabilizes soil pH level
- Increase of agricultural output

Disadvantages / Challenges:

- Hot and dry summer days will stop the processes of the compost
- Wood is needed for fencing
- Knowledge of separating organic from non-organic garbage

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have some place to install a compost system?		
Do you have a plot which is already used as agricultural land?		
Is minimum equipment for establishment of compost fences available?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Is water (from rivers or channels) available during hot dry summer days for additional compost watering?		
Is the area for the compost in a acceptable place (not the entire day in sun)?		
Is the kitchen garden highly exposed to soil erosion (wind or water)?		
Do you have information in using and managing a compost system?		
Do you have enough work power to manage a compost system?		
Do you have infrastructural access to markets to buy fences?		

FINANCIAL CALCULATIONS:

The experience from “Jovid” shows: Digging and fencing the pits cost between 400-450 somoni. 6m³ of compost fertilizes and improves 0.02ha and saves 100 somoni in market fertilizers.

Investment expenses	Investment amount
Pit fences	
Others	
TOTAL expenses:	
Investment earnings/ benefits	
High quality fertilizer	
Soil improvement	
Yield increase	
Soil protection against erosion	
Others	
TOTAL earnings:	

CRITERIA FOR DECISION-MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefit	Yes	No
Could you finance a knock-on financing by yourself?		
Can you benefit from higher yields on your garden plots?		
Do the garden yields cover your household’s needs?		
Could you get additional income by selling vegetables?		
Could you save money because of less expenditure for fertilizers on your crop land? Or does the amount of compost only cover the needs of your kitchen garden? [2 questions]		
Ecological impact		
Is there water (e.g., for hot summer days) for watering the compost?		
Could compost improve the soil fertility and structure of your plot?		
Could compost improve soil and water retention capacities of your plot?		
Could compost protect your plots from water and wind erosion?		
Gender impact		
What role do women play in vegetable production: Are women involved in planting, maintain and harvesting?		
Can women directly benefit from higher yields, e.g., by selling vegetables?		
From these benefits, can the women decide on what the money is spent for?		
Could the building and using of a compost system constitute an additional workload for women?		
Could the additional workload create a reasonable output for women, e.g., by selling vegetables on the local market?		

Community impact		
Could the use of compost have a positive impact for the community in terms of yield improving and food security?		
Could using compost serve as a model for other households in your community?		
Could compost partly reduce the effects of natural hazards (soil erosion, landslides...) in your community?		

Contact:	Links:
Ramazon Nurmamadow Jovid, NGO 735730. Kurchatov Str 19, Chkalovsk city, Sugd Region, Republic of Tajikistan Tel: (+992 3451) 5 93 67 Fax: (+992 3451) 5 85 16	JOVID http://www.jovid.tj http://www.icimod.org/?q=10344 icpo.jovid@gmail.com
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CROPLAND MANAGEMENT

4. Improvement of kitchen gardens



4.2 Ash and nutrition management

WHAT IS ASH AND NUTRITION MANAGEMENT?

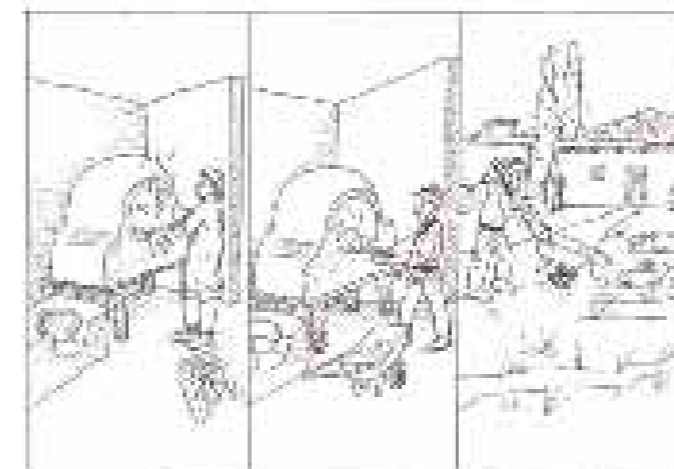
Ash (only wood ash) as a leftover is a very good fertilizer for plants and trees. Ash has a high pH level (between 10- 12) that neutralizes high acid levels when mixed into soil. In fact, many commercially available fertilizers have wood ash mixed in. Ash has a high amount on calcium, potassium and phosphorus. In fact, ash can be used for nutrition management on your yard and fields to return necessary minerals into the soil. Since ash has a high pH level, it should be used with caution on acid loving plants like potatoes and alfalfa, because it increases the possibility of potato scab. But in general wood ash should never be used on soils with a pH level higher than 7. From time to time, ash can also used for the compost system.

HOW DOES IT WORK?

Before you start using ash, you have to clarify where the ash comes from. Only wood ash is made for use as a fertilizer. Wood ash must not be contaminated with ash from burned plastic or from coal; otherwise it destroys the microorganism biodiversity of your soil and therefore reduce the productivity.

Amount of ash: 1kg of ash can used for 1sqm, once a year.

Note: Fertilizing your soil too much and too often works like poisoning it.



It is best not to bring ash on your fields on a windy day in spring, because water will help bring the needed nutrition deeper in the soil and available for the new crops. Note that heavy rainfalls will destroy the nutritional value. Another good date is at least one month before planting trees.

Functions and Advantages:

1. **Production:**
 - Don't use ash on alkaline soils (less than pH level 7)
 - Store ash on a wind and rainwater protected place, a metal bucket for example
 - Application in spring or at least one month before planting
 - Once a year 1kg per 1sqm
2. **Advantages:**
 - Improves soil fertility
 - Improves and stabilizes soil pH level on your plot
 - Supplies a verity of macro and micronutrients
 - Improves caution exchange capacity of soils, improving their ability to hold nutrients for plant use
 - Increase of agricultural output
 - Cheap fertilizer
 - Ash fertilizers also help repel insects from trees and plants, acting as a natural pesticide

Disadvantages/Challenges:

- Floods in spring can carry off and destroy the function of wood ash
- Ash contaminated from burned plastic or coal works like poison for the soil fertility
- Too much ash also destroys soil fertility
- Ash can decrease the yield of fruit trees through acidification

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for this plot?		
Can you produce ash free of plastic and coal contamination?		
Do you have a plot which is already used as agricultural land?		
Do you have a place to collect ash (metal pot) that is safe for children?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Is minimum equipment for application and storing of ash available?		
Is the plot exposed to soil erosion (wind or water)?		
Do you have information in using and managing ash ?		
Is the plot in a more or less good ecological condition: Can you gather benefits out of it?		
Do you have enough work power to apply ash?		
Do you need external advisory service for using compost not only on a kitchen garden but also on crop fields?		

FINANCIAL CALCULATION

Investment expenses	Investment amount	Example
Metal bucket		
Others		
TOTAL expenses:		
Investment earnings/ benefits		
Higher yields		
Soil improvement		
Others		
TOTAL earnings:		

CRITERIA FOR DECISION-MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefit	Yes	No
Can you benefit from higher yields in your kitchen garden?		
Do the garden yields cover partly your household's needs?		
Could you get additional income by selling vegetables?		
Could you save money because of less expenditure for vegetables?		
Do you already produce ash, by cooking or heating?		
Ecological impact		
Do you see a possibility to improve soil fertility on your plots?		
Do you have water in spring or autumn for ash application?		
Could clean wood ash improve the soil fertility and structure of your plot?		
Could plastic free ash stabilize the pH level of your plot and the availability of micronutrients?		
Gender impact		
What role do women play in the vegetable production: Are women involved in planting, maintaining and harvesting vegetables?		
Can women directly benefit from higher yields?		
From these benefits, can the women decide on what the money is spent for?		
Would the construction and utilization of compost constitute an additional workload for women?		
Would the additional workload (carry ash and apply it on the field) create a reasonable output for women, e.g., by selling vegetables and fruits in the local market?		
Community impact		
Would the use of wood ash have a positive impact for the community in terms of yield improving and food security?		
Could using wood ash serve as a model for other households?		
Could wood ash partly reduce the effects of natural hazards, by fertilizing trees (soil erosion, landslides...) in your community?		

Contact:

Ramazon Nurmamadow
Jovid, NGO
735730. Kurchatov Str 19, Chkalovsk city,
Sugd Region, Republic of Tajikistan
Tel: (+992 3451) 5 93 67
Fax: (+992 3451) 5 85 16

Links:

JVID
<http://www.jovid.tj>
<http://www.icimod.org/?q=10344>
icpo.jovid@gmail.com

CROPLAND MANAGEMENT

4. Improvement of kitchen gardens

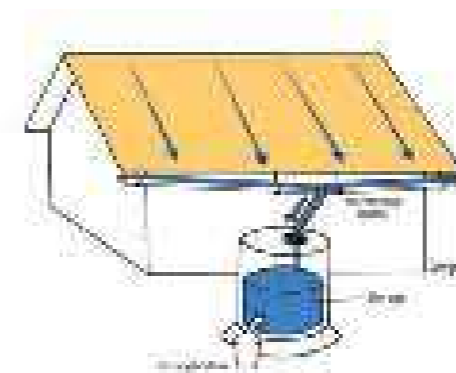
4.3

Rooftop rainwater harvesting

WHAT IS ROOFTOP WATER HARVESTING?

Rooftop rainwater harvesting is the collection of rainwater from the rooftop in a tank, cistern or in another reservoir. During the rainy season, a lot of water is lost as surface runoff. Rooftop water harvesting makes it possible to use water that otherwise would be lost.

The goal of this technique is to make rainwater available for the irrigation of crops, vegetables and fruits, sanitation, and potentially drinking water or watering of livestock. It is saved in a retention tank to be utilized in seasons with water scarcity, especially during the hot dry summer months.



HOW DOES IT WORK?

Water can be harvested from the household roof to an earth built retention pond with plastic sheet lining. The retention pond is covered with a removable metal plate for access. For the water reservoir, a hole must be prepared and lined with a polyethylene sheet to prevent leakage. The reservoir can also be made of cement for longer use for both types, the top of the hole is covered with a removable plate for access.

The roof of the house is fitted with a plastic/metallic guttering that captures the rainwater and funnels the water via a pipe into the earth tank. For the installation of the tank a location needs to be selected so that expenses are minimized and it is easy to access. The establishment of ponds near big trees is not recommended, because the polyethylene layer might be punctured by the roots.

As the sketch shows, if you have access to barrels (**except oil barrels or barrels for chemicals and unknown origin**), clean them carefully and you can use them also for rain water harvesting.

Steps of construction:

The actual steps of constructing the tank involve: (1) digging the pond, (2) plastering the inside walls with a fine soil and water mixture to smooth them, (3) lining the pond's walls with a double polyethylene layer (or cement), (4) connecting the inside polyethylene sheets with the pond cover through a piece of cord, so that it can be taken out of the pond any time to be cleaned of sediments, (5) covering the pond with any available material such as a soil, water and straw mixture, reinforced by several poles, leaving an opening of 0.25 x 0.25m to extract water, (6) finally connecting the roof to the pond with a pipe. To avoid dirty water flowing from the roof into the pond, the pipe should only be connected to the pond some time after the rainfall has started. Gutters need cleaning once a year.

Functions and Advantages:

- **Availability of water** during dry season
- **Buffering rainfall variability**, helping to cope with **extreme events**
- Offering **flexibility and adaptability** to suit circumstances
- **Reducing production risks** (vulnerability), increasing resilience
- **Access to clean water**
- Reducing **women's workload**

Disadvantages / Challenges / Risks:

- Pond water can be a **breeding ground for mosquitoes** (waterborne diseases)
- **Initial costs**
- **Use of unsuitable barrels which might lead to poisoning**
- **Labor intensive:** installation, maintenance
- **Keep water loss as small as possible to be economic**

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

"Key questions" If you cannot answer with **"Yes"**, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Is your rooftop technically suitable for the collection of rainwater?		
Do you have space for a retention tank that is easy to access?		
Do you have space for installing one or more barrels?		
Is minimum equipment (for establishment and maintenance) available?		
Is there enough precipitation to collect in the rain season?		

The **"Question"** part will ask you about additional framing preconditions. If the answer is **"No"**, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Do you have a demand for water during the dry season (water for household purposes, sanitation, livestock watering, irrigation)?		
Do you have problems with surface run-off in the rainy season?		
Do you have enough work power (for establishment and maintenance)?		
Do you need special technical support for the installation of the water reservoir?		

FINANCIAL CALCULATION:

Experience (GBAO): 100m² roof surface, 240mm rainfall per year, 20% collecting losses,

- 20m³ cistern. Costs in total 400Euro (2010): for guttering and cement (cistern), without work loan.
- A small drop irrigation system costs 30 Euro (2010).

Investment expenses	Investment amount
Guttering	
Cistern	
Maybe drop irrigation system	
Additional costs	
TOTAL expenses:	
Investment earnings/ benefits	
Additional water for irrigation	
Additional water for livestock	
Building protection against moisture	
Land gain	
Additional earnings	
TOTAL earnings:	

CRITERIA FOR DECISION-MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with **"Yes"**.

If at the end most of the questions are answered with **"Yes"**, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefits	Yes	No
Could you save money due to less expenditure for water (irrigation, household, livestock, sanitation)?		
Could you get higher yields due to less harvest losses in the dry season?		
Could you increase your crop land?		
Could a rainwater harvesting system make growing of cash crops more interesting?		
Could a rainwater harvesting system make dairy farming for your household interesting?		
Could a rainwater harvesting system protect your house from wet foundation/ moisture penetration and therefore from reconstruction expenses?		
Ecological impact		
Could rooftop rainwater harvesting contribute to increase the agro-biodiversity on your plot/kitchen garden?		
Could the availability of irrigation water lead to an increase of fruit production in your kitchen garden, or to growing trees with a higher water demand?		
Could a higher water demand make drop irrigation for you interesting?		
Could rooftop rainwater harvesting lead to a better indoor climate, because of less moisture penetration?		
Gender impact		
What role do women have in the establishment of water conservation techniques: Are women involved in the establishment and maintenance?		
Do women have the right for access to this water?		
Would the establishment and maintenance of a water reservoir constitute an additional workload for women?		

Would the existence of a water reservoir close to the farm reduce the workload for women (don't need to fetch water from a location far away)?		
Does the additional workload create a reasonable output for women, e.g., higher yield in kitchen gardens (products to sell on markets)?		
From these benefits, can the women decide on what the money is spent for?		
Community impact		
Could extensive rooftop rainwater harvesting increase the availability of water in the dry season in your community?		
Could the availability of water in the dry season have a positive impact on food security for your community?		
Could an extensive rooftop rainwater harvesting system reduce the risk exposure to natural hazards (landslides, soil erosion...) for your community?		
Could this technique be a positive model for other households in your community?		
Could an extensive rooftop rainwater harvesting system improve the irrigation system on some crop fields?		
Could an extensive rooftop rainwater system bring some crop fields back into use?		

Contact:	Links:
Cooperative SAROB Muhamadi Muminov (director) 127 Rudaki ave. Rudaki Plaza, room 1113;1115 Dushanbe, Tajikistan 93 5770230	sarob.net muminov01@gmail.com mmuminov@sarob.net http://akvopedia.org/wiki/Rooftop_rainwater_harvesting

CROPLAND MANAGEMENT

4. Improvement of kitchen gardens



4.4 Single tree mulching

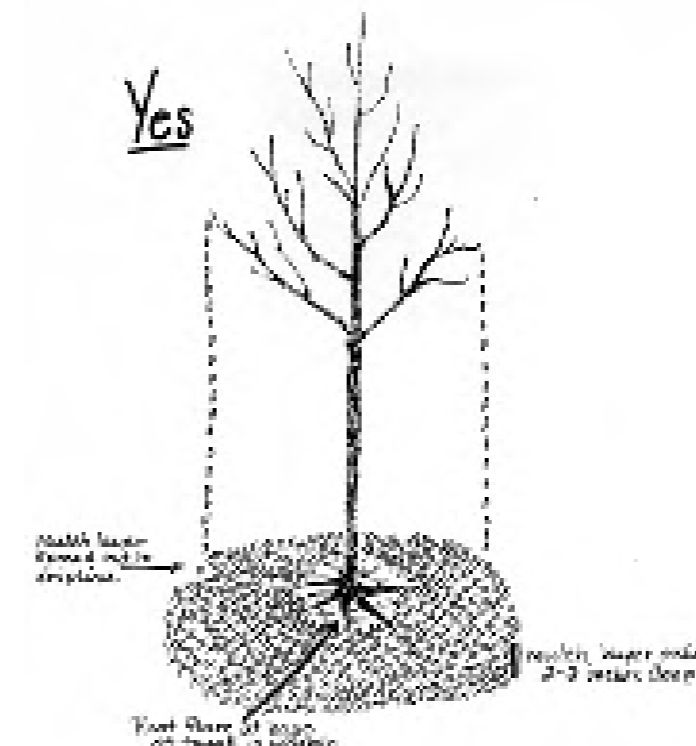
WHAT IS MULCHING?

A **mulch** is a layer of material applied to the surface of an area of soil.

Its purpose is any or all of the following:

- to conserve moisture
- to improve the fertility and health of the soil
- to reduce weed growth
- to regulate soil temperature
- to prevent soil erosion on slopes
- to raise plant productivity

There are two basic kinds of mulch: organic and inorganic. Organic mulches include formerly living material such as chopped leaves, straw, grass clippings, compost, wood, and even paper. Inorganic mulches include gravel and stones. Mulch may be permanent or temporary. It may be applied to cover bare soil or around plants in use. Mulching can, when applied correctly, improve soil productivity and plant productivity.



HOW DOES IT WORK?

Mulch is applied to the soil surface or around trees to prevent soil erosion on slopes, and in production areas for flower and vegetable crops. There are two rules for using organic mulches to combat weeds:

First, be sure to lay the mulch down on already weeded soil, and second, lay down a thick enough layer to discourage new weeds from coming up through it. It can take 10-15cm of mulch to completely discourage weeds, although 5-8cm are usually enough in shady spots where weeds aren't as troublesome as they are in full sun.

Compost: Compost will enrich your soil, but keep in consideration that when

any kind of mulch is dry, it is not a hospitable place for plant roots. So you may want to reserve your compost material to spread as a thin layer around plants and mix it with soil layer. Compost as a high nutrient mulching material will stay moist and biologically active, which will provide a maximum benefit for your plants. Mulches of manure or compost should be mingled with the first soil layer.

Straw and hay: Straw or weed-free hay can also be used as mulching material. It has many benefits: retaining soil moisture, keeping down weeds, and adding organic matter to the soil when it breaks down. But be sure the hay you use is weed and seed free. And don't pull hay or straw up to the stems of vegetables or the trunks of fruit trees or you will be inviting slug and rodent damage.

Advantages:

1. Improves **fertility and health of soil**
2. Suppresses **weed** growth
3. Prevents erosion and water runoff
4. Raises **drought resistance** --> less time for watering
5. Inorganic mulches **warm the soil** and radiate heat during the night --> early seeding in beginning of season, excellent for heat-loving vegetables
6. Retains **soil moisture**, regulates **soil temperature**
7. Higher agricultural plant productivity

Disadvantages:

1. Higher plague level of **small animals**
2. Mulching with **hay** ends up with a lot of **weeds**
3. Adding **too much compost** will result in **soil nutrients being out of balance**
4. Using harvest residues can cause a **lack of livestock fodder supply**

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with **“Yes”**, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for the area of tree planting?		
Are mulching materials available?		
Is the plot in a good ecological condition: Can you still get benefits out of it?		
Is the plot accessible from your residence (to bring mulch to the plot)?		

The **“Question”** part will ask you about additional framing preconditions. If the answer is **“No”**, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Are the climatic conditions suitable for producing compost: Are enough water and sunlight available?		
Is minimum equipment available (e.g., pushcart)?		
Would using harvest residues cause a lack of winter fodder?		

CRITERIA FOR DECISION-MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with **“Yes”**.

If at the end most of the questions are answered with **“Yes”**, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Economic impact	Yes	No
Could you benefit by the reduction of the effects of frosts, droughts or weeds and, therefore, by higher yields?		
Could you get more income by selling harvest surpluses?		
Could you save money from less for fertilizers/ pesticides/ irrigation water?		
Ecological impact		
Could mulching improve the soil fertility on your plot?		
Could mulching improve the soil temperature on your plot: Would the crops on your plot be more resistant to drought and frosts by the effects of the surrounding mulch?		
Could mulching improve the soil moisture on your plot?		
Could mulching reduce soil erosion on your plot?		
Could mulching reduce the risk exposure to natural disasters (landslides, erosion, sedimentation of springs, flooding) for your community?		
Gender impact		
What role do women play in caring for crops: Are women involved in fertilizing, weeding, watering, composting?		
Could women directly benefit from single tree mulching, due to higher yields?		
If composting (using compost as mulching material) was not done before, would the additional workload create a reasonable output for women?		
Do women have decision-making power on how any money received from the sale of tree products is used?		
Community impact		
Would mulching have a positive impact in terms of food supply for your community?		
How many people could benefit from a joint compost system, for example?		
Would mulching affect other households of the community negatively in terms of limited availability/access of materials (hay, straw...), for example, for feeding purposes?		
Would this eventually lead to tensions or conflicts within your community?		
Would these households have other options or alternatives to get these materials? From where could they get it? [not a yes or no question]		
Does this mean that they would have to spend more time and money?		

Contact:

Cooperative SAROB
 Muhamadi Muminov (director)
 127 Rudaki ave.
 Rudaki Plaza, room 1113;1115
 Dushanbe, Tajikistan
 93 5770230

CAMP TABIAT
 Umed Bulbulshoev (director)
 9 Sohibnazarova Street, Choroug
 +992 935 14 19 45

Links:

sarob.net
 muminov01@gmail.com
 mmuminov@sarob.net

<http://camp.kg/en/who-we-are/camp-tabiati/>
 umedsho@mail.ru

CROPLAND MANAGEMENT

4. Improvement of kitchen gardens

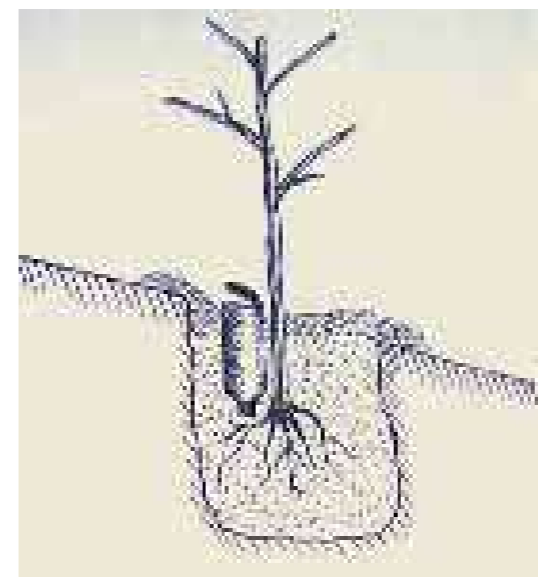
4.5

Supplementary irrigation by bottles

WHAT IS SUPPLEMENTARY IRRIGATION BY BOTTLES?

Supplementary irrigation by bottles is a water-saving irrigation technique used to ensure optimal performance of young trees and bushes seedlings in arid and semi-arid regions. The aim is to improve the acclimation of seedlings (often fruit trees) by minimal water use. As furrow irrigation on steep slopes causes landslides and mudslides, especially on loess soils, it is not recommended. In contrast, supplementary irrigation by bottles is not only a low-cost technique, but it also reduces erosion and the risk of mudslides on steep slopes.

HOW DOES IT WORK?



For this technology, plastic bottles (1.5-2 liter bottles) are used: First, their bottom must be removed but kept as a cover. Then, the upside down turned bottle is filled with water. Its lid (now at the bottom) is twisted open very slowly until a drip rate of around 5 drops per second is achieved and can be fixed at the bottle with some tape. At this drip rate, a 1.5 liter-bottle is drained in 90-100 minutes. With this preparation, the bottle is almost dug into the soil next to the seedlings (10 cm of the bottle should be above the ground). The bottle's lid should be on the same level as the root collar. Then the newly planted seedling should be mulched with grass, straw or stones. As the water drops reach straight to the roots, no additional watering on the upper layer is

needed so that there is no water loss by evaporation on the surface. During the growing period, the bottles need to be re-filled with water every 5 days, for at least 2 years, depending on the rainwater situation. As soon as they are empty, the bottles are re-filled with clean water to avoid clogging of the lids. This technique should be applied for a period of 2-3 years until the root system has developed up to 2 meters deep.

It is recommended to fence the plot to protect the little seedlings from livestock.

Functions and Advantages:

- **Prevention of water erosion** on steep slopes, reduction of risk of landslides, mudslides
- Increased **water storage** in the soil, **decreased demand for irrigation water** by direct watering (especially fruit trees in dry regions can thus survive)
- Increased survival rate and plant growth, stronger plants and no delayed first harvest

Disadvantages / Challenges / Risks:

- **Labor-intensive:** requires frequent re-filling of the bottles, fencing of the plot

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” If you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal land use rights for the plot of tree planting?		
Do you have enough water for regular irrigation?		
Do you have water close to the plot of plantlets and enough labor to water regularly?		
Are seeds or seedlings in good quality available?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Is your plot already affected by soil erosion, landslides, mudslides,...(or the like)?		
Is your plot on a mountain slope?		
Is minimum equipment (for planting, fencing) available?		
Are tree and fruit tree plantlets in good quality available?		
Do you have infrastructural access to markets to buy tree plantlets?		
By using other irrigation techniques, do you have problems with surface run-off?		
If supplementary irrigation by bottles was not done before, would the additional workload create more work for the women?		

FINANCIAL CALCULATION:

Investment expenses	Investment amount
Plastic bottles	
Water	
Others: transport of water to the plot	
TOTAL expenses:	

Investment earnings/ benefits	
Higher chance of survival of plantlets	
Trees in better condition, higher yields	
Degradation, landslide prevention	
TOTAL earnings:	

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Financial benefit	Yes	No
Could you save money due to reduced expenditures for irrigation water?		
Could you get higher yields due to reduced harvest losses in the dry season?		
Could you thus earn more money?		
Could you save money due to reduced expenditures for reconstruction purposes (houses, fences, store houses...) after natural hazards (landslides, erosion, mudslides,..)?		
Ecological impact		
Could supplementary irrigation by bottles contribute to higher soil moisture?		
Could supplementary irrigation by bottles reduce the sedimentation of lower located plots, water bodies...?		
Could supplementary irrigation by bottles reduce the occurrence of landslides and gully development?		
Could supplementary irrigation by bottles thus conserve fertile soil layers on your plot?		
Gender impact		
What role do women have in irrigation measures: Are women involved in the decision-making as to what kind of technique is applied, in the establishment of this technique and maintenance?		
Do women have the right to own land certificates and to decide what should be cultivated?		
Would the establishment and maintenance of supplementary irrigation constitute an additional workload for women?		
Does the additional workload create a reasonable output for women, e.g., higher yields = higher income?		
From these benefits, can the women decide on what the money is spent for?		
Community impact		
Could supplementary irrigation by bottles increase the availability of water in the dry season in your community?		
Could supplementary irrigation by bottles lead to higher yields and, thus, to better food security in your community?		
Could supplementary irrigation by bottles reduce the risk exposure to natural hazards (landslides, soil erosion...) for your community?		
Could this technique be a positive model for other households/communities?		

SALINE AND WATERLOGGED LAND

Contact:

Cooperative SAROB
Muhamadi Muminov (director)
127 Rudaki ave.
Rudaki Plaza, room 1113;1115
Dushanbe, Tajikistan
93 5770230

Links:

sarob.net
muminov01@gmail.com
mmuminov@sarob.net

CAMP TABIAT
Umed Bulbulshoev (director)
9 Sohibnazarova Street, Choroug
+992 935 14 19 45

<http://camp.kg/en/who-we-are/camp-tabiati/umedsho@mail.ru>

Cesvi
Daniil Ilyasov (Project coordinator)
+992 985 02 27 37
Dushanbe Office: Firdavsi Str., 15
Khovaling Office: Mirzo Tursunzoda Str.

daniil.ilyasov@gmail.com



SALINE AND WATERLOGGED LAND

1. Saline soils

1.1 Saline soil management

Dryland regions, like Tajikistan, which mostly depend on irrigation for crop production, are even more vulnerable to soil salinity.

Soil salinity is the salt content in the soil; the process of increasing the salt content is known as **salinization**. Salts occur naturally within soils and water. Salination can be caused by natural processes such as mineral weathering or by the gradual withdrawal of an ocean. It can also come about through artificial processes such as irrigation.

The consequences of salinity are:

- detrimental effects on plant growth and yield
- damage to infrastructure (roads, bricks, corrosion of pipes and cables)
- reduction of water quality for users, sedimentation problems
- soil erosion ultimately, when crops are too strongly affected by the amounts of salt.
- Salinity is an important land degradation problem.

In irrigated agriculture, salt comes to the field with the irrigation water and when not leached out accumulates in the soil profile through evaporative water loss, a process that removes the soil water but concentrates salts in the top soil. Common consequences of these practices include a dispersion of soil aggregates, reduction of soil organic matter and increased salinity levels in soils. Soil salinity affects crop growth, yield and quality, and hence the sustainability of irrigated agriculture.

Mitigation or cropping measure can be achieved through appropriate soil and water management. Suggested management practices include irrigation at night to reduce evaporation loss, pre-sowing seed treatments to enhance germination even under saline conditions, improved cultivation methods such as sowing on raised beds, increased seed rates, increased application of nitrogen and potassium fertilizers, and mulching the soil surface with crop residues. Conservation agriculture practices, i.e., reduced or even no tillage, residue retention and appropriate crop rotation, can influence the location and accumulation of salts by reducing evaporation and upward salt transport in the soil. The selection of salt-tolerant crops like cotton, rape and sugar-beets and vegetables like asparagus and spinach, is of great importance.

Because of high evaporation rates in dryland areas, appropriate drainage is indispensable.

If the mechanisms to combat soil salination were not successful, practices to desalinate soils are difficult, expansive and labour-intensive.

For high saline top soils, leaching the salt out of the soil cover could be an option. This technique is complicated in case of calculating the correct water amount with regard to the soil salinity level.

Another option is to remove the top salinated soil. This option is labour-intensive and doesn't solve the problem of a wrong irrigation, drainage and crop management.

In summary, it can be said that the combating of soil salination in dryland areas starts with appropriate water and crop management. Based on experience of appropriate water and crop management, which includes mulching, raised bed cropping, and a wider crop rotation, new technologies like drip irrigation can be help to reduce the water supply and therefore the entering of salt into the soil.

SALINE AND WATERLOGGED LAND

1. Saline soils



1.2 Suitable crops and varieties for saline soils (salt-tolerant plants)

WHAT COULD BE SUITABLE CROP PLANTS FOR SALINE SOILS?

The tolerance of plants to soil salinity is not a fixed characteristic of each species or a variety but may vary with the environmental conditions. The tolerance to salinity may even vary with the stage of crop growth of the same species. The following table will give a general overview about salt tolerance at two different stages.

Crop	Germination stage	Establishment stage
Barley	Very good	Good
Triticale	Good	Good
Corn	Good	Poor
Wheat	Fairly good	Fair
Alfalfa	Poor	Good
Beans	Very poor	Good

For an appropriate soil salinity crop management, it is important to know at about which stage the cultivated crop faces the salt problem. Only then can an appropriate management plan be written.



HOW DOES IT WORK?

Without laboratory analyses it is difficult to find out the exact saline level of the soil, even for a larger plot. Therefore, conservation agriculture practices with more tolerant crop plants are suggested. In general salinisation problems can be overcome by appropriate irrigation, increased seed rates, residue retention and improved cultivation methods such as sowing on raised beds, reduced soil tillage and appropriate application of nitrogen and potassium fertilizers.

Advantages & positive side effects:

1. Soil stabilization and soil aggregate protection
2. Yield stabilization
3. Protects soil from erosion and total loss through desertification
4. Conservation agriculture helps to save water as well and to use irrigation water more efficiently
5. Former saline crop fields can be brought back into crop production

Disadvantages & risks:

1. Knowledge about the saline level on different plot areas is not obvious
2. Perennial cropping plan is recommended
3. Appropriate fertilization could be difficult to manage
4. A higher seeding rate means higher investments
5. With the wrong management the use of former marginalized fields can accelerate development of desertification

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” if you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for this plot?		
Is the plot accessible from your residence (for care, harvest, watering)?		
Is minimum technical equipment for soil tillage (raised bed) and appropriate fertilizing and sowing available?		
Is it possible to connect or reconnect the crop field into an irrigation system?		
Are the climatic and soil conditions suitable for planting crop plants?		
Are there seeds or seedlings for cropping on saline soils available?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these additional issues.

Questions	Yes	No
Is most of the plot in a more or less good ecological condition: Can you still get benefits out of it?		
Do you know locally adapted saline tolerant crop plants?		
Do you have the possibility to mulch the soil surface with crop residues?		

FINANCIAL CALCULATION:

Investment expenses	Investment amount
Price for higher seed rates	
Price for increased nitrogen and potassium fertilizer	
Mulching material (fodder loss)	
Furrow construction	
Others	
TOTAL expenses:	
Investment earnings	
Crop yield	
Lower investment costs for irrigation water (water saving cropping practices)	
Soil improvement and yield stabilization	
Prevention of desertification	
Eventually new crop fields in production, through conservation agriculture	
TOTAL earnings:	

CRITERIA FOR DECISION MAKING

Economic benefit	Yes	No
Could you benefit immediately by using conservation agriculture and restoring saline affected crop fields?		
Could you lose feed amount through crop mulching and stopping evaporation on your saline soils?		
Could you bring lost crop fields back into farming, through conservation agriculture and saline soil adapted crops?		
Ecological impact		
Could saline soil adapted crop plants improve the soil fertility on your plot?		
Could saline soil adapted crop plants reduce soil erosion and desertification processes on your plot?		
Could cropping on marginalized crop fields reduce the risk of exposure to natural disasters (landslides, erosion, sedimentation of springs, flooding)?		
Could using saline soil adapted crop plants and conservation agriculture improve the biodiversity on your crop fields and soil?		
Gender impact		
What role do women play in caring of crop plants: Are women involved in planting, weeding, watering (nitrogen fixing) crops?		
Do women have decision-making power to decide which conservation agriculture technique should be used, or which saline adopted crop cultivated?		
Would the additional workload for mulching, furrow establishment, additional fertilizing, irrigation at night create a reasonable output for women?		

Community impact		
Would the establishment of conservation agriculture through water saving techniques have a positive impact in terms of higher agricultural output for your community?		
Could the use or reuse of saline crop fields lead to tensions on water distribution in your community?		

Contact:	Links:
Cooperative SAROB Muhamadi Muminov (director) 127 Rudaki ave. Rudaki Plaza, room 1113;1115 Dushanbe, Tajikistan 93 5770230	sarob.net muminov01@gmail.com mmuminov@sarob.net

SALINE AND WATERLOGGED LAND

1. Saline soils

1.3

Cover crops in wintertime for salinity management

WHAT COULD BE SUITABLE COVER CROP PLANTS FOR SALINE SOILS?

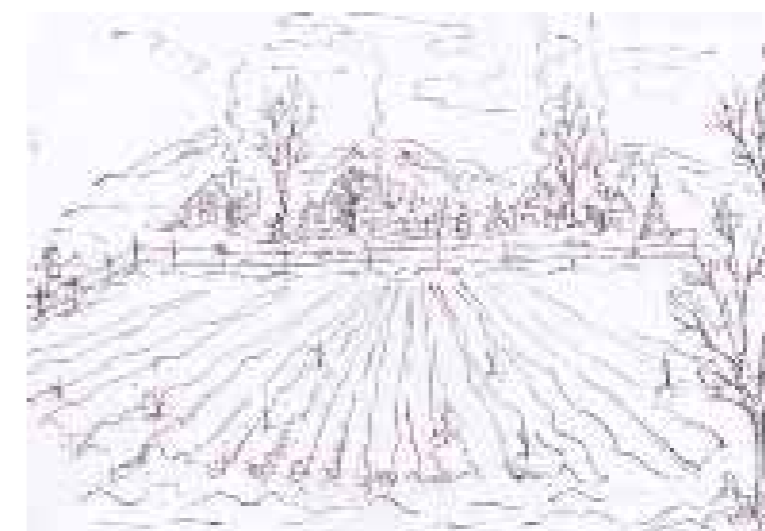
The main objective of cropping on saline soils is to manage the water regime.

Saline tolerant crop plants play an important role. During wintertime cover crops are of great importance. The idea behind cultivating winter crops is to keep soil moisture and work against evaporation as soon as possible. That why mulching and zero tillage should also be considered. Crops with a high tolerance at the germination stage, such as rapeseed, winter triticale and winter barley are recommended for winter cropping. Perennial crops also cover the soil surface against higher evaporation rates in spring.

HOW DOES WINTER CROPPING WORK?

For good yields, especially on saline soils, it is important to have a pre-winter stock in a very good condition. Depending on the expected rainfall, sowing time for winter crops is between September and October. The young plants should have three to four plant shoots before winter and freezing time starts. The placement depth of winter growing crops is a bit deeper than for summer growing crops: for winter barley and winter triticale 3cm.

If winter barley is sowed too early, it is highly vulnerable to plant pests and diseases. To protect the young plants, especially in saline soil affected areas, against freely grazing animals, field fences are recommended.



Functions and Advantages:

1. Soil stabilization, soil aggregate protection, and erosion protection
2. Yield stabilization, even for succeeding summer/intermediate crops
3. Reduction of evaporation losses
4. Humification and increased soil biodiversity
5. Former saline crop fields can be brought back into crop production

Disadvantages / Challenges / Risks:

1. It is difficult to know the exact saline level especially at different plant stages
2. An appropriate fertilization could be difficult to manage
3. It could be difficult to find the correct sowing date in autumn
4. With the wrong management the use of former marginalized fields can accelerate desertification
5. The establishment of fences is necessary to protect the young plants, especially in spring, against freely grazing animals
6. Additional advisory service is recommended for analyzing the saline level
7. Additional investment cost during one year

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” if you cannot answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for this plot?		
Is the plot accessible from your residence (for care, harvest, watering)?		
Is minimum technical equipment for soil tillage, appropriate fertilizing and sowing available?		
Are the climatic and soil conditions suitable for planting crop plants? (Is the plot highly affected by salinisation)		
Are there seeds or seedlings for winter cropping on saline soils available?		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these issues.

Questions	Yes	No
Is the plot in a more or less good ecological condition: Can you still get benefits out of it?		
Do you know locally adapted saline tolerant winter crop plants?		
Do you have the possibility to mulch the soil surface with crop residues?		
Do you have the possibility to cultivate perennial crops?		
Is it possible to establish furrows or raised beds?		
Is it possible to protect the crop field against uncontrolled grazing animals, to protect the investment?		

FINANCIAL CALCULATION:

Investment expenses	Investment amount
Costs for winter crop seeds	
Probably additional fertilization: Nitrogen Potassium	
Crop mulching material (fodder loss)	
Others:	
TOTAL expenses:	
Investment earnings	
Crop yield	
Lower investment costs for irrigation water (water saving cropping practices)	
Soil improvement and yield stabilization	
Eventually new crop fields in production, through conservation agriculture	
TOTAL earnings:	

CRITERIA FOR DECISION MAKING

Economic benefit	Yes	No
Could you benefit immediately by using winter growing crops on saline affected crop fields?		
Could you reach the same yields without fencing your crop field?		
Could you bring lost crop fields back into farming, through conservation agriculture and winter growing crop cultivation?		
Could winter cropping and intermediate cropping be an alternative to perennial cropping?		
Ecological impact		
Could winter growing crop plants improve the soil fertility on your plot?		
Could winter growing crops reduce soil erosion during wintertime and spring?		
Could cropping on marginalized crop fields reduce the risk exposure to natural disasters (landslides, erosion, sedimentation of springs, flooding)?		
Could using winter growing crops and conservation agriculture improve the biodiversity on your crop fields and soil?		
Gender impact		
What role do women play in caring for crop plants: Are women involved in planting, weeding, watering crops?		
Do women have decision-making power to decide which winter growing crop should be cultivated?		
Would the additional workload in autumn, soil tillage and sowing create a reasonable output for women?		

Community impact		
Would using winter growing crops have a positive impact in terms of higher agricultural output and water saving for your community?		
Could the use or reuse of saline crop fields, through winter growing crops, lead to tensions on water and land distribution in your community?		

Contact:	Links:
Cooperative SAROB Muhamadi Muminov (director) 127 Rudaki ave. Rudaki Plaza, room 1113;1115 Dushanbe, Tajikistan 93 5770230	sarob.net muminov01@gmail.com mmuminov@sarob.net

SALINE AND WATERLOGGED LAND

2. Waterlogged soils



2.1

Bio drainage and waterlogged land management

Waterlogging and salinity are widespread problems in irrigated areas. Often, subsurface drainage is needed in irrigation command areas to avoid waterlogging and soil salinization. Though the benefits of subsurface drainage are well documented, it is still an expansive technology. An alternative option is bio-drainage, which is projected as the least expensive and more environmentally friendly method of land reclamation. Bio-drainage relies on vegetation, rather than mechanical means, to remove excess water through consumptive water use for planting the vegetation, and when established, the system could produce economic returns through fodder, fuel wood and timber.

Bio-drainage systems may be established under both rainfed and irrigated conditions. When established in rainfed land, the plant roots loosen the soil and enhance groundwater, or backwater recharge capacity. The roots also draw a part of subsurface flow to reduce water load in the downstream.

In irrigated and low lands, which are prone to become waterlogged, the discharge planting method is useful. For this, highly transpiring tree varieties are selected, which also mitigate waterlogging due to canal seepage in irrigated areas. Water quality in supply canals is good and can be effectively intercepted and used by the trees planted along canals (woodland belt creation).

The land under bio-drainage cannot be utilized for growing other crops, as in the case of conventional drainage, like surface drainage, horizontal subsurface drainage and vertical subsurface drainage.

Considerable crops are:

Cotton, wheat, barley and some pulses (rapes) and beans (except soya beans).

In Tajikistan only a few poplar varieties are able to grow under strong waterlogged and saline conditions. Next to poplar, willow and tamarisk also accept seasonal waterlogged conditions.

Principals of planning and design

The aim of bio-drainage is to remove excess groundwater, or backwater, through the process of transpiration by vegetation. This is achieved by enhancing the transpiration capacity of the landscape by introducing high-water use vegetation types in large enough areas to balance recharge/discharge processes to maintain groundwater balances below the rootzone of the agriculture crop. The following issues should be considered in the development of bio-drainage systems:

Water balance: Bio-drainage plantations should be able to extract groundwater/ backwater volumes equal to the net recharge. The water balance is to be maintained such that the water is kept below the rootzone.

SALINE AND WATERLOGGED LAND

2. Waterlogged soils

Plantation area: The bio-drainage plantation area should be kept as small as possible. Particularly in semi-arid regions, dryland areas surrounded by irrigated land could be earmarked for tree plantations without loss of productive resources.

Salt tolerance: Bio-drainage crops need to be salt tolerant. Groundwater qualities can vary greatly spatially. Normally they have a higher salinity than irrigation supplies. The water use capacity of trees and other crops decreases with increase in water salinity.

Drawdown of water table: Crops, including trees, act as biopumps; they depress the water table directly underneath plantation areas and consequently lower the water table in the surrounding area. The drawdown effect under trees/crops depends on the tree/crop's water use, the rate of recharge in the surrounding area, the hydraulic conductivity of substrata and the depth to deeper barrier layers. Bio-drainage plantings should be established in blocks or strips and spaced to keep water table levels in the irrigated farmland in between the plantings below the rootzone.

Salt balance: To achieve salt balance without conventional drainage, the irrigated crops, along with interspersed bio-drainage plantings, would have to accumulate the salts introduced by irrigation, and would subsequently have to be harvested and removed from the region. This is only (potentially) achievable in situations where very low-salinity water is available to the plants.

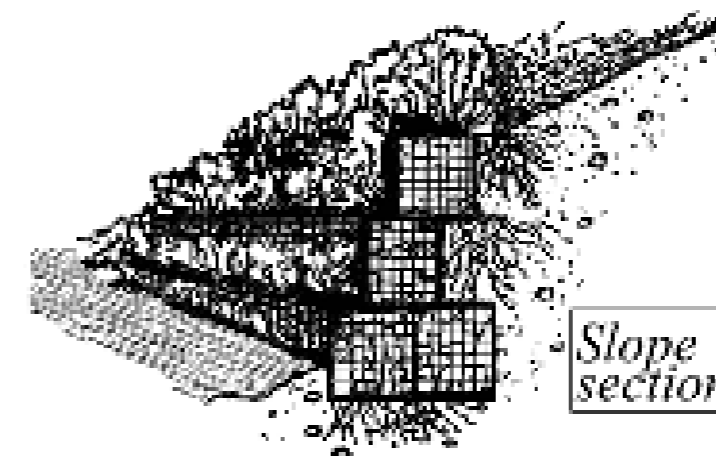
Economic aspects: The growing of bio-drainage trees and crops requires a different operational management approach than the growing of agricultural crops. Up-front costs associated with planting and maintenance precedes the income from harvesting by many years.

2.2

River bank stabilization with gabions

WHAT IS RIVERBANK STABILIZATION AND GABIONS?

The main objective of riverbank stabilization is to protect the adjacent land regardless of its use as cropland, forest or free land, against heavy run-offs and riverbank expansion. Therefore, gabions can be installed. Gabion erosion walls are a low cost riverbank protection method that do not require expensive concrete foundations or deep footing piles, unlike other erosion methods. Gabions are easy to build and very flexible in handling them. Furthermore, gabions consist of local and natural material; hence the material is free. Gabions are also used for slope and landslide stabilization and for water drainage systems. Sometimes the gabions cubes are filled with live cuttings, such as poplar or willow sticks, for further stabilization.



HOW GABIONS ARE BUILT?

First, stones of an average size of 20-40 cm diameter as well as tree branches must be collected. They are then laid in places that are most affected by the water flow and most prone to washouts: either, laid like vertical stone walls bounded with tree branches or wire (as gabions), or laid on the tree branches (as masonry).

From time to time, destroyed sections of stones need to be replaced.

- Installing rock filled gabions along a river bank offers immediate and long lasting protection against soil erosion
- Often, gabions are used to divert the flow of a river that may be threatening a bridge or pier supporting structures
- Gabions can protect riverbeds from being washed away
- Strengthening the stability of the river beds

Advantages & positive side effects:

- **Stabilization** of soil and river banks --> less risk to lose arable land
- **Cheap** local material
- **Easy** to establish
- **Applicable** to any river bank
- Very flexible structure to follow the river bed, or drainage
- Lost cropping/ forest areas can be bring back into use

Disadvantages / Challenges/ Risks:

- Modern technologies are required
- **Gabion** construction must be high and strong enough, especially for expected floods and mudd- floods in the flood season
- **The best time** for installing are autumn and winter (water low level). Labour- intensive seasons

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” you need to answer with “Yes”, otherwise the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Is the plot affected by seasonal floods and increasing riverbeds?		
Does the community have legal user rights?		
Is the technical equipment and material available?		
Is it technically possible to stabilize the riverbed?		

The “Question” part will ask you about additional framing preconditions. It is possible to answer these questions with “No”. If the land user or the community see a possibility to substitute or solve these additional questions, the option is still practicable.

Questions	Yes	No
Are enough stones with the specific diameter locally available?		
Do you have the commitment of the community to maintain the riverbank stabilization?		
Do you have a concrete plan about the area behind a riverbank? (In case of a riverbed reduction)		

FINANCIAL CALCULATION:

Investment expenses	Investment amount
Mesh wire	
Wire	
Gabion cube stabilizers	
Other:	
TOTAL expenses:	
Investment earnings	
Riverbed stabilization	
Riverbank stabilization	
Eventually gain of cropland	
Other:	
TOTAL earnings:	

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Economic benefit	Yes	No
Could you save money due to less of your use crop and pasture land, due to seasonal floods and wave erosion?		
Ecological impact		
Could gabion construction improve the stability and fertility of the pasture/ cropland you use?		
Could gabion construction on the pasture/ crop plot you use reduce further soil erosion, landslides, avalanches?		
Gender impact		
Which role do women have in the decision in the use of pasture areas/ crop fields: Are women involved in gabion constructing technologies?		
Would gabion construction constitute an additional workload for women?		
Does the additional workload create a reasonable output for women e.g. improved pasture, more cropland available, therefore higher yields e.g. dairy products, meat, (products to sell on markets)?		
From these benefits, can they decide on what the money is spent for?		
Community impact		
Could gabion construction have a positive impact for your community in terms of reduction of risks (soil erosion, landslides)?		
Could gabion construction serve as a positive model for other communities?		
Could gabion construction lead to tensions within the community because of part stabilization and therefore speed up of floods, downstream?		

Contact:

Kust, German

CESVI, WeltHungerHilfe,
MMK

Links:

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"Tripod for river works"
<http://www.cesvi.com>

SALINE AND WATERLOGGED LAND

2. Waterlogged soils

2.3

Woodland belt creation

WHAT IS MEANT BY WOODLAND BELT CREATION?

Because of the bad condition of most irrigation canals and irrigation furrows, water is lost on a massive scale. Beside open water canals, furrows and field irrigation points, waterlogging is a serious problem. Waterlogging causes salinization and leads to cropland losses. To prevent this problem of salinization, tree belts alongside canals and furrows are recommended. Trees are transpiring the lost water around canals and prevent waterlogging. This technique can be used for small private canals and wide concrete canals. Using trees in belt structure has many additional advantages, such as windbreaks, soil cooling, improved microclimate, increased habitat for birds and insects, as well as erosion protection. With the right management, irrigation water can be saved through tree shade and less evaporation.

HOW DOES THE ESTABLISHMENT OF WOODLAND BELTS WORK?

Young tree cuttings, as described in *poplar plantation*, can be used; fresh tree sticks are put crosswise in the soil. The distance between the canal and tree belt shouldn't be less than 1.5m; otherwise the root system will destroy the canal walls. A second line should be considered, depending on the waterlogged level for a density plant stock. Besides poplar, willow, mulberry and tamerix can also be used for woodland belt creation. The planting roles are nearly the same, only pruning is different. The tree products can be used for the next 10-15 years as fodder, fuel wood, or timber. Mulberry trees provide fruits for yam, silk worms.



Advantages & positive side effects:

1. Erosion protection
2. Cropland protection against waterlogging and salinisation
3. Reduction of evaporation losses in canals and furrows
4. Woodland belts work as windbreakers
5. Improved microclimate and increased biodiversity
6. After successfully combating waterlogging and/or salinization, the area previously woodland can be used as cropland
7. Soil improvement around the trees because of litter fall and fertilization

Disadvantages & risks:

1. Woodland belts which are installed too close to canals can destroy the canal walls
2. Mainly non-fruit trees are waterlogged and saline resistant: Tree varieties of secondary interest
3. Except solitaire poplar pruning would be necessary
4. Young trees need to be protected against uncontrolled grazing animals

CHECKLIST OF PRECONDITIONS AND APPLICABILITY

“Key questions” you need to answer with “Yes”, the suggested option is not suitable for the land user and the community at all.

Key questions	Yes	No
Do you have legal user rights for this plot and canal?		
Is the plot and irrigation system constantly accessible from your residence and is enough space available for a woodland belt?		
Is minimum technical equipment for planting and maintenance available?		
Are the climatic and soil conditions suitable for planting trees? (Is the plot highly affected by salinisation and constantly waterlogged)		

The “Question” part will ask you about additional framing preconditions. If the answer is “No”, the land user or the community needs to find a possibility to solve these additional issues.

Questions	Yes	No
Are there seeds or seedlings of different trees available?		
Do you know locally adapted saline tolerant tree varieties?		
Do you have the possibility to mulch the space around the young trees?		
Do you have the possibility to share the installation with a neighbour?		
Is it possible to establish additional furrows for drainage?		
Is it possible to protect the young trees against uncontrolled grazing animals, to protect the investment?		

FINANCIAL CALCULATION:

Investment expenses	Investment amount
Costs for seedling	
Cost for tree fencing	
Crop mulching material	
Others	
TOTAL expenses:	
Investment earnings	
Cropland protection	
Erosion protection	
Soil improvement	
Future reclamation of lost cropland	
TOTAL earnings:	

CRITERIA FOR DECISION MAKING

This questionnaire has to be answered carefully. Not every option has to be answered with “Yes”.

If at the end most of the questions are answered with “Yes”, the positive impacts prevail, but the negative impacts should still be kept under careful consideration.

Economic benefit	Yes	No
Could you benefit immediately by installing a woodland belt?		
Is it important to fence the young trees against freely grazing animals?		
Could you reclaim crop fields back into farming through woodland belts?		
Could you get some fuel wood and fodder for your animals out of woodland belts, after 5 years?		
Ecological impact		
Could woodland belts improve the soil fertility on your plot, during the next 5 years?		
Could you benefit from windbreaks through woodland belts?		
Could woodland belts prevent your cropland from salinisation?		
Could the installation of woodland belts on marginal/waterlogged areas make these areas more productive?		
Could you benefit from a higher biodiversity around your crop fields and reduced evaporation?		
Gender impact		
What role do women play in caring for crop plants: Are women involved in planting, weeding, watering crops?		
Does the installation of woodland belts create additional work for women (e.g., collecting fuel wood, pruning and fencing the young trees)?		
Do women have decision-making power in choosing tree varieties?		
Would the additional workload create a reasonable output for women (e. g. by selling fodder)?		

Community impact		
Would installing woodland belts have a positive impact in terms of reclamation of waterlogged and saline areas of the community?		
Could woodland belts lead to tensions because of fuel wood harvesting, pruning, shade, or destroyed canals in your community?		

Contact:	Links:
Cooperative SAROB Muhamadi Muminov (director) 127 Rudaki ave. Rudaki Plaza, room 1113;1115 Dushanbe, Tajikistan 93 5770230	sarob.net muminov01@gmail.com mmuminov@sarob.net

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Author(s)

Matthias Maiwald, Willem van Werpen (Pasture rotation, Dairy farming, Pasture monitoring),
 Tatjana Rozen-Michel (Shelters against predators)

Responsible

Dr. Stepan Uncovsky
 stepan.uncovsky@giz.de

Design and Layout

Aleksandr Gorbatovskiy

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