Multi-specific plantation of semiarid woody species on slopes

Spain - Plantación pluriespecífica de especies leñosas de ambiente semiárido en laderas

Plantation of native woody species using planting holes on slopes

This technology is a restauration technology implemented on degraded south-facing slopes of a semiarid mountain range. The restoration technology consisted of a plantation of seedlings of a variety of native woody species, mostly shrubs, using deep (60cm depth) planting holes. Microcatchments were established upslope the planting hole in suitable areas. Seedlings were protected from extreme radiation and predation by biodegradable seedling shelters. The target area was highly degraded due to long-term overexploitation of resources under harsh environmental conditions. Failed previous reforestation actions on bench terraces led to further degradation in some areas. Degradation resulted in low plant cover, decreased plant biodiversity, lack of riparian vegetation on the ramblas (ravines with intermittent flow), soil erosion, development of gullies, and frequent floods. To address this problem, the Forest Administration implemented a restoration program on the south-facing slopes of the Albatera-Crevillente mountain range. The program was implemented in 2006-07.
The purpose of the plantation is the restoration of diversity and cover of vegetation on degraded south-facing slopes of a semiarid mountain range, erosion control, and flood prevention.
The target area is the south-facing side of a mountain range in a semiarid area of Southeast Spain. Exploitation of resources over centuries, mostly grazing and wood gathering, under harsh environmental conditions, led to very low plant cover, mostly consisting of dwarf shrubs sparsed in a matrix of bare soil, lack of riparian vegetation on the ramblas (ravines with intermittent flow), soil erosion, development of gullies, and frequent floods. The exploitation of the land was drastically reduced during the second half of the 20th century due to the general rural land abandonment trend that started in Spain around the 1950's driven by critical socio-economic changes such as the use of fossil fuels and the sharp increase in activity in the tourism and services business sectors, mostly in the coast land. However, despite the reduction, or even complete abandonment, of rural activity on the mountain range area, there was no sign of spontaneous recovery from degradation. Soil erosion and floods were of major concern for the resource managers in the area (Public Forest Administration), and a number of reforestation and restoration programs have been implemented in the area, with varying degree of success. In more recent decades, new pressures appeared in the mountain area, such as agricultural expansion into the range area (1970s), mining activities (late 1990's - early 2000's), and urbanization (2000s). Rural tourism and recreation are new activities in the mountain range area. For the time being, the intensity of these activities is low to moderate. However there is already some evidence of incipient degradation associated to recreation, and some regulation is being demanded by environmental NGOs.

left: Walking excavator preparing planting holes (Photo: S.Bautista)
right: Detail of a planted seedling showing one of the applied planting treatments: microcatchment and seedling shelter (Photo: S.Bautista)

Location: Spain/Alicante
Region: Albatera
Technology area: 5.7 km^2
Conservation measure: vegetative
Stage of intervention: rehabilitation / reclamation of denuded land
Origin: Developed externally / introduced through project, recent (<10 years ago)
Land use type:
Forests / woodlands: Natural
Land use:
Forests / woodlandsrests / woodlands: Natural (before), Forests / woodlandsrests / woodlands: Plantations, afforestations (after)
Climate: semi-arid, subtropics
WOCAT database reference: T_SPA013en
Related approach:
Compiled by: Susana Bautista, Universidad de Alicante
Date: 2014-07-01

Classification

Land use problems:

- Erosion, water scarcity, low productivity, loss of soil functions (water infiltration, nutrient cycling), low biodiversity, loss of landscape structure (expert's point of view)
Low productivity, aridity, erosion (land user's point of view)

Land use

Natural
Forests / woodlandsrests / woodlands: Natural (before)
Forests / woodlandsrests / woodlands: Plantations, afforestations (after)
plantation forestry

Climate

semi-arid

Degradation

Soil erosion by water: loss of topsoil / surface erosion, offsite degradation effects, Biological degradation: reduction of vegetation cover, quantity / biomass decline, quality and species composition /diversity decline

Conservation measure

Vegetative: Tree and shrub cover

Stage of intervention

- Prevention
- Mitigation / Reduction
- Rehabilitation

Origin

- Land users initiative
- Experiments / Research
- Externally introduced: recent (<10 years ago)

Level of technical knowledge

- Agricultural advisor
- Land user

Main causes of land degradation:
Direct causes - Human induced: deforestation / removal of natural vegetation (incl. forest fires), over-exploitation of vegetation for domestic use
Indirect causes: poverty / wealth

Main technical functions:

- control of dispersed runoff: retain / trap
- improvement of ground cover
- increase in nutrient availability (supply, recycling,...)

Secondary technical functions:

- control of dispersed runoff: impede / retard
- control of concentrated runoff: retain / trap
- increase of surface roughness
- improvement of surface structure (crusting, sealing)
- improvement of topsoil structure (compaction)
- stabilisation of soil (eg by tree roots against land slides)
- increase in organic matter
- increase of infiltration
- increase / maintain water stored in soil
- promotion of vegetation species and varieties (quality, eg palatable fodder)

Environment

Natural Environment

Average annual rainfall (mm)

- > 4000 mm
- 3000-4000 mm
- 2000-3000 mm
- 1500-2000 mm
- 1000-1500 mm
- 750-1000 mm
- 500-750 mm
- 250-500 mm
- < 250 mm

Altitude (m a.s.l.)

- > 4000
- 3000-4000
- 2500-3000
- 2000-2500
- 1500-2000
- 1000-1500
- 500-1000
- 100-500
- <100

Landform

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

Slope (%)

- flat
- gentle
- moderate
- rolling
- hilly
- steep
- very steep

Soil depth (cm)

- 0-20
- 20-50
- 50-80
- 80-120
- >120

Growing season(s): 240 days(November-June)
Soil texture: medium (loam)
Soil fertility: low
Topsoil organic matter: medium (1-3%)
Soil drainage/infiltration: good

Soil water storage capacity: medium
Ground water table: > 50 m
Availability of surface water: poor / none
Water quality: for agricultural use only
Biodiversity: medium

Tolerant of climatic extremes: temperature increase, seasonal rainfall increase, seasonal rainfall decrease, decreasing length of growing period
Sensitive to climatic extremes: heavy rainfall events (intensities and amount), droughts / dry spells

Human Environment

Forests / woodlands per household (ha)

	<0.5
	0.5-1
	1-2
	2-5
	5-15
	15-50
	50-100
	100-500
■	500-1,000
	1,000-10,000
	>10,000

Land user: employee (company, government), large scale land users, Leaders / privileged, men and women
Population density: 100-200 persons/km2
Annual population growth: 2% - 3%
Land ownership: state
Land use rights: open access (unorganised)

Importance of off-farm income: > 50% of all income:
Access to service and infrastructure: moderate: employment (eg off-farm), financial services; high: health, education, technical assistance, market, energy, roads & transport, drinking water and sanitation
Market orientation: No forestry production
Purpose of forest / woodland use: nature conservation / protection, recreation / tourism

Technical drawing

Test (Test)

Implementation activities, inputs and costs

Establishment activities

- Soil preparation and planting holes
- Soil and microcatchment preparation
- Fertilization plantation (holes)
- Fertilization microcatchment
- Plantation
- Plantation (microcatchments)
- Tree shelter placement
- tree shelter placement (Microcatchments)

Establishment inputs and costs per ha

Inputs	Costs (US$)	% met by land user
Labour	1343.00	100%
Equipment		
- machine use	853.00	100%
Agricultural		
- seedlings	252.00	100%
- biocides	154.00	100%
- Tree shelters	424.00	100%
TOTAL	**3026.00**	**100.00%**

Maintenance/recurrent activities

Remarks:

Assessment

Impacts of the Technology

Production and socio-economic benefits	Production and socio-economic disadvantages

Socio-cultural benefits	Socio-cultural disadvantages
+ increased recreational opportunities	
+ improved conservation / erosion knowledge	

Ecological benefits	Ecological disadvantages
++ improved harvesting / collection of water	
++ reduced evaporation	
++ reduced surface runoff	
++ improved soil cover	
++ increased biomass above ground C	
++ increased nutrient cycling recharge	
++ increased soil organic matter / below ground C	
++ reduced soil loss	
++ increased plant diversity	
++ increased / maintained habitat diversity	
+ increased soil moisture	
+ increased animal diversity	
+ increased beneficial species	

Off-site benefits	Off-site disadvantages
+ reduced downstream flooding	

Contribution to human well-being / livelihoods
+ Recreational use

Benefits /costs according to land user

Benefits compared with costs	short-term:	long-term:
Establishment	slightly negative	positive
Maintenance / recurrent	not specified	not specified

Acceptance / adoption:

Concluding statements

Strengths and → how to sustain/improve	Weaknesses and → how to overcome

Multi-specific plantation of semiarid woody species on terraces with stone walls in ravines and gullies

Spain - Plantación pluriespecífica de especies leñosas de ambiente semiárido en terrazas con pared de piedra sobre barrancos y c

Plantation of native semiarid woody species on small terraces with stone walls on ravines and gullies

This technology is a restoration technology implemented on ravines and gullies in a degraded semiarid mountain range. The restoration technology consisted of a plantation of seedlings of a variety of native woody species, mostly shrubs, on terraces with stone walls. Using planting holes, one or two rows of seedlings were established on each terrace; Seedlings were protected from extreme radiation and predation by biodegradable seedling shelters. The target area was highly degraded due to long-term overexploitation of resources under harsh environmental conditions. Failed previous reforestation actions on bench terraces led to further degradation in some areas. Degradation resulted in lack of riparian vegetation on the ramblas (ravines with intermittent flow), soil erosion, development of gullies, and frequent floods. To address this problem, the Forest Administration implemented a restoration program on the ravines and gullies of the south-facing side of the Albatera-Crevillente mountain range. The program was implemented in 2006-07.
The purpose of the restoration was control of concentrated erosion in gullies and ravines; mitigation of landscape degradation; flood prevention; restoration of diversity and cover of vegetation on a degraded semiarid mountain range.
The target area is the south-facing side of a mountain range in a semiarid area of Southeast Spain. Exploitation of resources over centuries, mostly grazing and wood gathering, under harsh environmental conditions, led to very low plant cover, mostly consisting of dwarf shrubs sparsed in a matrix of bare soil, lack of riparian vegetation on the ramblas (ravines with intermittent flow), soil erosion, development of gullies, and frequent floods. The exploitation of the land was drastically reduced during the second half of the XXth century due to the general rural land abandonment trend that started in Spain around the 1950's driven by critical socio-economic changes such as the use of fossil fuels and the sharp increase in activity in the tourism and services business sectors, mostly in the coast land. However, despite the reduction, or even complete abandonment, of rural activity on the mountain range area, there was no sign of spontaneous recovery from degradation. Soil erosion and floods were of major concern for the resource managers in the area (Public Forest Administration), and a number of reforestation and restoration programs have been implemented in the area, with varying degree of success. In more recent decades, new pressures appeared in the mountain area, such as agricultural expansion into the range area (1970s), mining activities (late 1990's - early 2000's), and urbanization (2000s). Rural tourism and recreation are new activities in the mountain range area. For the time being, the intensity of these activities is low to moderate. However there is already some evidence of incipient degradation associated to recreation, and some regulation is being demanded by environmental NGOs

left: Multi-specific plantation on a ravine area "barranco": Example of a restored ravine. Terrace with stone wall and planted seedlings. (Photo: S.Bautista)

Location: Spain/Alicante
Region: Albatera
Technology area: 5.7 km²
Conservation measure: vegetative, structural
Stage of intervention: rehabilitation / reclamation of denuded land
Origin: Developed externally / introduced through project, recent (<10 years ago)
Land use type:
Forests / woodlands: Natural
Land use:
Forests / woodlandsrests / woodlands: Natural (before), Forests / woodlandsrests / woodlands: Natural (after)
Climate: semi-arid, subtropics
WOCAT database reference: T_SPA016en
Related approach:
Compiled by: Susana Bautista, Universidad de Alicante
Date: 2014-07-01

Classification

Land use problems:

- Erosion, water scarcity, low productivity, loss of soil functions (water infiltration, nutrient cycling), low biodiversity, loss of landscape structure, flood risk (expert's point of view)
Low productivity, aridity, limiting conditions for tree cover, erosion (land user's point of view)

Land use

Natural
Forests / woodlandsrests / woodlands: Natural (before)
Forests / woodlandsrests / woodlands: Natural (after)
plantation forestry

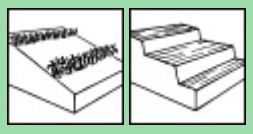
Climate

semi-arid

Degradation

Soil erosion by water: gully erosion / gullying, offsite degradation effects

Conservation measure



Vegetative: Tree and shrub cover
Structural: Bench terraces (slope of terrace bed <6%)

Stage of intervention

- Prevention
- Mitigation / Reduction
- Rehabilitation

Origin

- Land users initiative
- Experiments / Research
- Externally introduced: recent (<10 years ago)

Level of technical knowledge

- Agricultural advisor
- Land user

Main causes of land degradation:
Direct causes - Human induced: deforestation / removal of natural vegetation (incl. forest fires), over-exploitation of vegetation for domestic use
Indirect causes: poverty / wealth

Main technical functions:

- control of dispersed runoff: retain / trap
- control of dispersed runoff: impede / retard
- control of concentrated runoff: retain / trap
- control of concentrated runoff: impede / retard
- reduction of slope angle

Secondary technical functions:

- reduction of slope length
- improvement of ground cover
- increase in nutrient availability (supply, recycling,...)
- increase of infiltration
- increase / maintain water stored in soil
- promotion of vegetation species and varieties (quality, eg palatable fodder)

Environment

Natural Environment

Average annual rainfall (mm)

- > 4000 mm
- 3000-4000 mm
- 2000-3000 mm
- 1500-2000 mm
- 1000-1500 mm
- 750-1000 mm
- 500-750 mm
- 250-500 mm
- < 250 mm

Altitude (m a.s.l.)

- > 4000
- 3000-4000
- 2500-3000
- 2000-2500
- 1500-2000
- 1000-1500
- 500-1000
- 100-500
- <100

Landform

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

Slope (%)

- flat
- gentle
- moderate
- rolling
- hilly
- steep
- very steep

Soil depth (cm)

- 0-20
- 20-50
- 50-80
- 80-120
- >120

Growing season(s): 240 days(from November till June)
Soil texture: medium (loam)
Soil fertility: low
Topsoil organic matter: medium (1-3%)
Soil drainage/infiltration: good

Soil water storage capacity: medium
Ground water table: > 50 m
Availability of surface water: poor / none
Water quality: for agricultural use only
Biodiversity: medium

Tolerant of climatic extremes: temperature increase, seasonal rainfall increase, seasonal rainfall decrease, decreasing length of growing period
Sensitive to climatic extremes: heavy rainfall events (intensities and amount), droughts / dry spells

Human Environment

Forests / woodlands per household (ha)

Land user: employee (company, government), large scale land users, Leaders / privileged, men and women
Population density: 100-200 persons/km2
Annual population growth: 2% - 3%
Land ownership: state
Land use rights: open access (unorganised)

Importance of off-farm income: > 50% of all income:
Access to service and infrastructure: moderate: employment (eg off-farm), financial services; high: health, education, technical assistance, market, energy, roads & transport, drinking water and sanitation
Market orientation: No forestry production
Purpose of forest / woodland use: nature conservation / protection

Implementation activities, inputs and costs

Establishment activities

- Building small walls and terraces in ravines and gullies
- Soil and microcatchment preparation
- Soil preparation and planting holes
- Fertilization microcatchment
- Fertilization plantation (holes)
- Plantation (microcatchments)
- Plantation (in holes)
- Tree shelter placement
- tree shelter placement (Microcatchments)

Establishment inputs and costs per ha

Inputs	Costs (US$)	% met by land user
Labour	1796.00	100%
Equipment		
- machine use	853.00	100%
Agricultural		
- seedlings	252.00	100%
- compost/manure	154.00	100%
- Tree shelters	424.00	100%
TOTAL	**3479.00**	**100.00%**

Maintenance/recurrent activities

Remarks:

Assessment

Impacts of the Technology

Production and socio-economic benefits	Production and socio-economic disadvantages

Socio-cultural benefits	Socio-cultural disadvantages
+ increased recreational opportunities	
+ improved conservation / erosion knowledge	

Ecological benefits	Ecological disadvantages
+ + reduced surface runoff	
+ + improved soil cover	
+ + increased biomass above ground C	
+ + increased nutrient cycling recharge	
+ + increased soil organic matter / below ground C	
+ + reduced soil loss	
+ + increased plant diversity	
+ + increased beneficial species	
+ + increased / maintained habitat diversity	
+ improved harvesting / collection of water	
+ increased soil moisture	
+ reduced evaporation	
+ increased animal diversity	

Off-site benefits	Off-site disadvantages
+ reduced downstream flooding	

Contribution to human well-being / livelihoods

+ Recreational use

Benefits /costs according to land user

Benefits compared with costs	short-term:	long-term:
Establishment	slightly negative	positive
Maintenance / recurrent	not specified	not specified

Acceptance / adoption:

Concluding statements

Strengths and → how to sustain/improve	Weaknesses and → how to overcome

Unvegetated strips to reduce fire expansion

Italy - Firebreaks

Firebreaks are stripes cleared of vegetation that divide a continuous forest in smaller patches to reduce spreading of wildfires and allow intervention.

The technology consists of creating gaps of vegetation of about 5 to 7 meters, every 50 to 75 meters distance contourline large forested areas. These clear strips are connected to main roads having varying length in relation to the size of the area.
Fire breaks act as a barrier to stop or slow the progress of fires and allow firefighters to better position themselves to operate.
Clearing activities which must be carried out annually by specialized workers using minor devices (hand and hedge cutter).
This technology is applied mostly in publicly owned woods (or very large private woods). The network of these fire strips is rather dense as the number of flammable species increases. So it creates patches of 2500 to 5000 meters according to the type of species. The context of production is characterised by a medium level of mechanisation (only the most demanding operations are carried out using mechanical means), the production system is essentially mixed, a small part is destined for personal consumption whilst the bulk of production is destined for local markets. The property is predominantly privately owned but also includes some public land, especially in the case of pasture land. Most farms in the area are livestock farms whilst the agricultural component is destined exclusively for private consumption.

Location: Basilicata
Region: Castelsaraceno
Technology area: 0.1 - 1 km2
Conservation measure: management
Stage of intervention: prevention of land degradation
Origin: Developed through experiments / research, traditional (>50 years ago)
Land use type:
Forests / woodlands: Natural
Climate: subhumid
WOCAT database reference: T_ITA007en
Related approach: MUNICPAL FOREST MANAGEMNT PLAN (DECADE 2010-2019) (A_ITA001en)
Compiled by: Velia De Paola,
Date: 2014-05-27
Contact person: Giovanni Quaranta, University of Basilicata Via dell'Ateneo Lucano 10, 85100 POTENZA (IT)
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Classification

Land use problems:

- In some wooded areas, especially nearest the roads, there is an excessive amount of undergrowth (with some shrubs reaching a height in excess of two metres) which leaves the area vulnerable to the start and spread of forest fires. (expert's point of view)
The increase in shrubs has increased fire risk. (land user's point of view)

Land use

Natural
clear felling of (semi-)natural forests

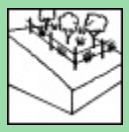
Climate

subhumid

Degradation

Biological degradation:
detrimental effects of fires

Conservation measure



Management: Waste Management: includes recycling, re-use or reduce

Stage of intervention

- Prevention
- Mitigation / Reduction
- Rehabilitation

Origin

- Land users initiative
- Experiments / Research: traditional (>50 years ago)
- Externally introduced

Level of technical knowledge

- Agricultural advisor
- Land user

Main causes of land degradation:

Main technical functions:
- control of fires

Secondary technical functions:

Environment

Natural Environment

Average annual rainfall (mm)

- > 4000 mm
- 3000-4000 mm
- 2000-3000 mm
- 1500-2000 mm
- 1000-1500 mm
- 750-1000 mm
- 500-750 mm
- 250-500 mm
- < 250 mm

Altitude (m a.s.l.)

- > 4000
- 3000-4000
- 2500-3000
- 2000-2500
- 1500-2000
- 1000-1500
- 500-1000
- 100-500
- <100

Landform

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

Slope (%)

- flat
- gentle
- moderate
- rolling
- hilly
- steep
- very steep

Soil depth (cm)

- 0-20
- 20-50
- 50-80
- 80-120
- >120

Growing season(s): 120 days(March to august)
Soil texture: fine / heavy (clay)
Soil fertility: medium
Topsoil organic matter: medium (1-3%)
Soil drainage/infiltration: good

Soil water storage capacity: medium
Ground water table: 5 - 50 m
Availability of surface water: medium
Water quality: good drinking water
Biodiversity: medium

Tolerant of climatic extremes: temperature increase, seasonal rainfall increase, heavy rainfall events (intensities and amount), wind storms / dust storms, floods, droughts / dry spells, decreasing length of growing period

Human Environment

Forests / woodlands per household (ha)

- <0.5
- 0.5-1
- 1-2
- 2-5
- 5-15
- 15-50
- 50-100
- 100-500
- 500-1,000
- 1,000-10,000
- >10,000

Land user: Individual / household, Small scale land users, common / average land users, mainly men
Population density: 10-50 persons/km2
Annual population growth: negative
Land ownership: individual, titled
Land use rights: individual
Relative level of wealth: average, which represents 90% of the land users;

Importance of off-farm income: 10-50% of all income: Most of the off farm income derives from public sector, i.e. Municipality, Mountain Community, Region and other public bodies. Very few farmer members run local shops or handcraft.
Access to service and infrastructure: low: employment (eg off-farm); moderate: health, education, technical assistance, market, energy, roads & transport, drinking water and sanitation, financial services
Market orientation: commercial / market
Purpose of forest / woodland use: fuelwood

Implementation activities, inputs and costs

Establishment activities

Maintenance/recurrent activities

- Cutting vegetation with the help of device (hedge cutters, usually owned by the specialized workers who are doing the job, and their cost is included in the salary) The hectare is intended to mean the area of cleared vegetation which is usually 5-7metres wide.

Maintenance/recurrent inputs and costs per ha per year

Inputs	Costs (US$)	% met by land user
Labour	1351.35	100%
TOTAL	**1351.35**	**100.00%**

Remarks:
Manual labour (including fuel for hedge cutter).

Assessment

Impacts of the Technology

Production and socio-economic benefits

++ reduced risk of production failure

Production and socio-economic disadvantages

+ reduced wood production

Socio-cultural benefits

Socio-cultural disadvantages

Ecological benefits

+++ reduced hazard towards adverse events
+++ reduced fire risk

Ecological disadvantages

Off-site benefits

++ reduced damage on neighbours fields
++ reduced damage on public / private infrastructure

Off-site disadvantages

Contribution to human well-being / livelihoods

Benefits /costs according to land user

Benefits compared with costs	short-term:	long-term:
Establishment	slightly positive	slightly negative
Maintenance / recurrent	positive	positive

Acceptance / adoption:

100% of land user families have implemented the technology with external material support.
0% of land user families have implemented the technology voluntary.
There is moderate trend towards (growing) spontaneous adoption of the technology.

Concluding statements

Strengths and → how to sustain/improve

1) The creation of firebreaks is a very useful method to reduce the spread of fires. → Public funding is needed to ensure this method can continue.

the technique is an important tool in preventing the spread of fires, however, when winds are strong they can make little difference → some as before

Weaknesses and → how to overcome

Apart from the annual cost of clearing vegetation, it reduces the number of trees per hectare of wooded areas →

Cleared strip network for fire prevention (firebreaks)

Spain - Área cortafuegos

The basic principle of a firebreak network is to split continuous forest areas (where a lot of fuel is built up) into smaller patches separated by vegetation-free strips in order to prevent large forest fires.

In the forest law 3/1993 the declaration of special areas to “Zonas de Actuación Urgente (ZAU)” (zone of urgent actions) through the regional government of Valencia is defined. Objectives are the protection against natural hazards and the promotion of forest restoration within this area. Ayora was declared to a ZAU in 1997 due to its high risk of fires. In the “Plan de Selvicultura Preventiva de Incendios en los Sistemas Forestales de la Comunidad Valenciana” which became operative in 1996 and whose main objective is the reduction of the fire risk, the ZAU is practically addressed for the first time in the establishment of firebreaks (áreas cortafuegos). Based on this plan, the firebreaks were established within a pilot project “Proyecto Piloto de Selvicultura Preventiva” between 1998 and 2002, carried out by the company VAERSA (public company of the Generalitat Valenciana).
A firebreak is a strategically located strip on which the vegetation cover has been partially or totally removed down to mineral soil with the aim of controlling the spread of large forest fires. The main purposes are 1) to interrupt the continuity of hazardous fuels across a landscape to decrease the area affected by fires, 2) to provide areas where fire fighters are protected and can work more efficiently, 3) to slow down a fire, to reduce the fire intensity and caused damages, and 4) to provide strips where fuel management is facilitated. The total surface protected by the firebreaks is 33’851 ha while the management measures are executed on 1944,81 ha. This technology is also applied in other countries, e.g. Portugal, South Carolina or South Africa. The establishment and maintenance are labour-intensive and expensive. Firebreaks can range between a protected area of 2000-6000 ha (first order), 500-1500 ha (second order), and 100-300 ha (third order), together forming a system isolating separate areas by wide strips. This parcelling aims in limiting the burnt area to a maximum of 6000 ha. Each firebreak consists of a bare vegetation-free strip (banda decapado). The width of the bare area ranges between 6m (first order), 3m (second order) and 1.5m (third order). Existing vegetation-free areas (e.g. roads) are used to establish firebreaks to have less visual impact. If there is no road, trees and shrubs have to be cleared and chipped entirely using chainsaws and special tractors. On each side of the bare area there is a totally cleared strip (banda de desbroce total). The width depends on the climatic zone, the order and the hazard of fuel, therefore ranging between 28m (first order), 11m (second order) and 6m (third order). Almost all the existing vegetation is cleared, only some isolated mature trees are not cut if they do not contribute to the propagation of a fire. On both sides of these strips there are auxiliary strips (banda auxiliar) where selective clearing is applied until reaching a desired density. Sick trees are cleared with priority. Species of high ecologic value and low flammability level are not cleared, such as Juniperus phoenicea, Juniperus oxycedrus and Quercus ilex ssp. rotundifolia. The width of these elements can vary according to the prevalent conditions. A part of the wood generated by the clearings is used as fuelwood, the other part is chipped and distributed on the soil as mulch. Firebreaks are often located on mountain ridges and created with 45° to the dominant wind direction (west) to facilitate fire extinction. The maintenance of firebreaks is extremely important. Without clearing, fire-prone species will encroach which decreases the effectiveness of the firebreak. The maintenance is realized depending on the vegetation, usually in firebreaks of first order the maintenance is done every 2 years (“decapado” and “desbroce total”) or every 4 years (“banda auxiliar”) while firebreaks of second and third order are cleared every 4 years. In the here described project the maintenance was carried out in three phases (2001-2004, 2004-2008 and 2008-2012).
The region of Ayora is mountainous with a dry subhumid climate (~380 mm annual rainfall). The risk of fire incidence is at its highest from June to September when there are adverse conditions like drought, high temperatures and strong winds (mainly the winds coming from central Spain, called “poniente”). The population density is very low and there are only few job opportunities (e.g. marginal agriculture, grazing, hunting, beekeeping, artisanry, wind mill parc). Most of the inhabitants work in the nuclear power plant. Forest management could be a source for jobs.

left: Firebreaks are classified in first, second and third order, together forming a system isolating separate areas by wide strips. This parcelling aims in controlling the spread of large forest fires. (Photo: Nina Lauterburg)
right: Firebreaks are often located along existing roads to guarantee the access for fire-fighting vehicles and to keep the environmental impact limited. (Photo: Nina Lauterburg)

Location: Spain, Valencia
Region: Region of Ayora (including the municipalities Requena, Cofrentes, Jalance, Jarafuel, Zarra, Ayora)
Technology area: 338.5 km^2
Conservation measure: vegetative
Stage of intervention: prevention of land degradation
Origin: Developed externally / introduced through project, 10-50 years ago
Land use type:
Forests / woodlands: Natural
Forests / woodlands: Plantations, afforestations
Climate: subhumid, temperate
WOCAT database reference: T_SPA009en
Related approach: Plan of preventive silviculture (PSP): implementation of firebreak network within a forest intervention area (ZAU) (A_SPA002en)
Compiled by: Nina Lauterburg, CDE
Date: 2013-05-06
Contact person: Jaime Baeza, Fundación Centro de Estudios Ambientales del Mediterráneo (CEAM), Parque Tecnológico Paterna. C/ Charles Darwin 14, 46980 Valencia, Spain. E-Mail: jaime.baeza@ua.es

Classification

Land use problems:

- In Ayora, the prevalent dense shrublands (dominated by seeder species), which resulted from past agricultural land use (changes of the vegetation composition, e.g. removal of key species), land abandonment/rural depopulation and fire occurrence, contain a high fire risk because of both the high fuel loads and their continuity. Also dense forests (either afforestations or natural regeneration) show a high risk for fires. Through the modifications of the vegetation composition in the past (removal of more fire resistant resprouter species (mature forest), whereas fire-prone seeder species are now spreading), the resilience of the ecosystem to fires has decreased. Today a higher fire recurrence can be observed which could still be worsen by future climate change impacts, undermining more and more the ecosystem's capacity to buffer such shocks. Before the implementation of firebreaks, it was almost impossible to stop a fire and it was much more dangerous for fire fighters. There was also no access for fire-fighting vehicles. (expert's point of view)

Land use

Natural
Plantations, afforestations selective felling of (semi-) natural forests, plantation forestry

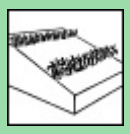
Climate

subhumid

Degradation

Biological degradation: detrimental effects of fires

Conservation measure



Vegetative: Clearing of vegetation (eg fire breaks/reduced fuel)

Stage of intervention

- Prevention
- Mitigation / Reduction
- Rehabilitation

Origin

- Land users initiative: traditional (>50 years ago)
- Experiments / Research
- Externally introduced: 10-50 years ago

Level of technical knowledge

- Agricultural advisor
- Land user
- Engineer

Main causes of land degradation:
Direct causes - Human induced: deforestation / removal of natural vegetation (incl. forest fires)
Indirect causes: population pressure, poverty / wealth, labour availability

Main technical functions:
- control of fires

Secondary technical functions:
- reduction of dry material (fuel for wildfires)

Environment

Natural Environment

Average annual rainfall (mm)

- > 4000 mm
- 3000-4000 mm
- 2000-3000 mm
- 1500-2000 mm
- 1000-1500 mm
- 750-1000 mm
- 500-750 mm
- 250-500 mm
- < 250 mm

Altitude (m a.s.l.)

- > 4000
- 3000-4000
- 2500-3000
- 2000-2500
- 1500-2000
- 1000-1500
- 500-1000
- 100-500
- <100

Landform

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

Slope (%)

- flat
- gentle
- moderate
- rolling
- hilly
- steep
- very steep

Soil depth (cm)

- 0-20
- 20-50
- 50-80
- 80-120
- >120

Soil texture: fine / heavy (clay)
Soil fertility: medium
Topsoil organic matter: low (<1%)
Soil drainage/infiltration: medium

Soil water storage capacity: high
Ground water table: 5 - 50 m
Availability of surface water: poor / none
Water quality: good drinking water
Biodiversity: medium

Tolerant of climatic extremes: temperature increase, seasonal rainfall decrease, heavy rainfall events (intensities and amount), floods
Sensitive to climatic extremes: seasonal rainfall increase, wind storms / dust storms, droughts / dry spells
If sensitive, what modifications were made / are possible: The technology was not modified. The firebreaks are quite resistant against climate change or weather extremes. Only if there will be more rainfall the vegetation might grow faster and the maintenance costs could increase. Furthermore, if there are heavy windstorms the effectiveness of firebreaks is undermined because strong winds result in faster spreading fires.

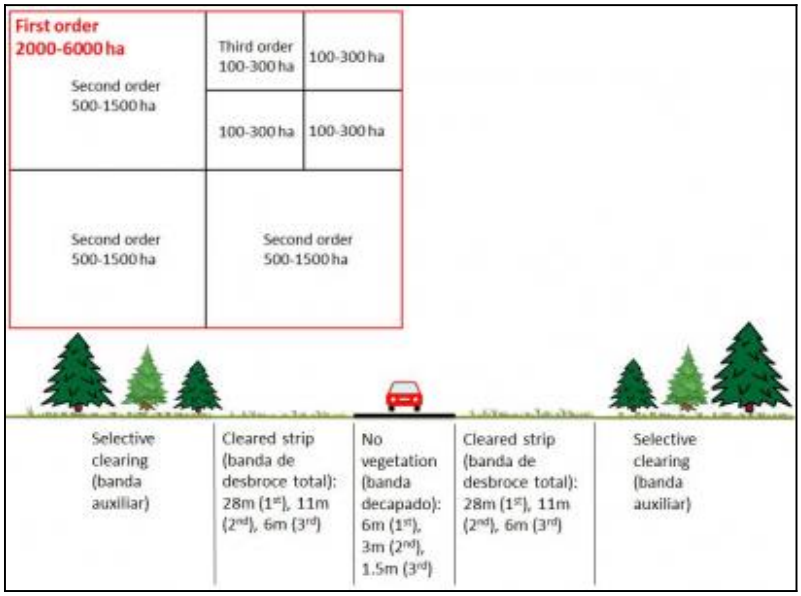
Human Environment

Forests / woodlands per household (ha)

	<0.5
	0.5-1
	1-2
	2-5
	5-15
	15-50
	50-100
	100-500
	500-1,000
	1,000-10,000
	>10,000

Land user: employee (company, government), common / average land users, mainly men
Population density: < 10 persons/km2
Annual population growth: negative
Land ownership: state, individual, titled
Land use rights: individual, open access but organised (e.g. wood, hunting)
(There is some public land, controlled by the state. But there is also some private land. The access to the public land is open but organized. Permission is needed from the government to cut trees, to build a house or to hunt. There are some private hunting areas for which the hunting association has to pay a fee.)

Importance of off-farm income: : The forest brigade is only working when there is money and a project. If there is no money they have no work and need to have a look for another job.
Access to service and infrastructure:
Market orientation: mixed (subsistence and commercial)
Purpose of forest / woodland use: timber, other forest products / uses (honey, medical, etc.), recreation / tourism



Technical drawing

Firebreaks can range between a protected area of 2000-6000 ha (first order), 500-1500 ha (second order), and 100-300 ha (third order), together forming a system isolating separate areas by wide strips. This parcelling aims in limiting the burnt area to a maximum of 6000 ha. Each firebreak consists of a bare strip (banda decapado) ranging between 6m (first order), 3m (second order) and 1.5m (third order). On both sides of the bare area there is a totally cleared strip (banda de desbroce total) whose width ranges between 28m (first order), 11m (second order) and 6m (third order). On both sides of these strips there are auxiliary strips (banda auxiliar) where selective clearing is applied. The width of these elements can vary according to the prevalent conditions. (Nina Lauterburg)

Implementation activities, inputs and costs

Establishment activities

- Project planning and design of firebreak system
- Adaption of the agricultural tractors with forest management machinery (wheels, protection of the machine against stones, clearing machinery with chains)
- Cutting and chipping (in-situ) of trees and shrubs (execution of firebreak network)
- Transport of wood (fuel wood)

Establishment inputs and costs per ha

Inputs	Costs (US$)	% met by land user
Labour	1095.00	0%
Equipment		
- machine use	675.00	0%
TOTAL	**1770.00**	**0.00%**

Maintenance/recurrent activities

- Clearing of firebreaks of first order (every 2 years)
- Clearing of firebreaks of second and third order (every 4 years)

Maintenance/recurrent inputs and costs per ha per year

Inputs	Costs (US$)	% met by land user
Equipment		
- machine use	557.00	0%
TOTAL	**557.00**	**0.00%**

Remarks:
The costs of the establishment of firebreaks can be affected by numerous factors, such as slope (if the slope is steep, the work is much more difficult and takes more time, because machines cannot be used on steep slopes), vegetation density (it takes more time to clear a dense area), stone content of the soil (if there are many stones the work is much more difficult for the machines and more dangerous for the workers), availability of a road (where a firebreak can be established, costs can be saved). Important to note is that maintenance costs could increase with an increase in rainfall because the vegetation will grow faster (otherwise firebreaks are quite resistant against climate change or weather extremes). Furthermore, modifying a normal tractor for forest management can be extremely expensive.
The total costs of the firebreaks (establishment and maintenance) were calculated for the application of the technology on one hectare, based on the indications given in the official project documents of the regional government (Generalitat Valenciana) and information from different stakeholders (e.g. forest agent, university staff, employee of VAERSA). The whole project costs were around 3 Mio Euro for the establishment and around 1.5 Mio Euro for the maintenance phase. The maintenance costs refer to the third maintenance phase taking place from 2008 to 2012. The costs of the execution of the project were 1312 Euro/ha (1770 Dollar) and the costs of the maintenance were 82.03 Euro/ha (110 Dollar, after 2 years) and 331.37 Euro/ha (446 Dollar, after 4 years). The currency rate (Euro-Dollar) was calculated on November 16th, 2013.

Assessment

Impacts of the Technology

Production and socio-economic benefits

++ increased wood production
+ increased fodder production
+ increased fodder quality
+ increased animal production

Production and socio-economic disadvantages

++ high establishment and maintenance costs
+ loss of land
+ job uncertainty

Socio-cultural benefits

++ improved conservation / erosion knowledge
++ improved situation of disadvantaged groups
++ Increase of the security for fire fighters
+ conflict mitigation
+ improved food security / self sufficiency

Socio-cultural disadvantages

+ loss of recreational opportunities
+ socio cultural conflicts
+ increased health problems

Ecological benefits

++ reduced hazard towards adverse events
++ reduced fire risk
+ reduced emission of carbon and greenhouse gases

Ecological disadvantages

+ increased surface water runoff
+ decreased soil cover
+ decreased soil organic matter
+ increased soil erosion locally
+ increased habitat fragmentation

Off-site benefits

++ reduced risk of wildfires
+ reduced downstream flooding
+ reduced downstream siltation
+ reduced damage on neighbours fields
+ reduced damage on public / private infrastructure

Off-site disadvantages

Contribution to human well-being / livelihoods

+ Through the establishment and the maintenance of firebreaks it is easier to control fires and protect people. Furthermore it created jobs for the unemployed. But it seems that in general forest management is not something people want to do, they work in this sector only if there are no other job opportunities. Forest management means a hard job and this kind of work is not well-respected in society

Benefits /costs according to land user

Benefits compared with costs	short-term:	long-term:
Establishment	very positive	very positive
Maintenance / recurrent	very positive	very positive

Both the short-term and the long-term benefits are very positive assuming that maintenance is done. Together with the creation of jobs, directly after establishing the firebreaks there is firewood and timber available and a reduced risk of wildfires. But it should also be considered that the establishment costs are high. If maintenance is not done the long-term returns will be very negative because an increase in the risk of fire will occur again (without management, there will also be no firewood, no timber and no jobs). The maintenance costs increase the longer you wait because the vegetation will grow again densely.

Acceptance / adoption:

There is little trend towards (growing) spontaneous adoption of the technology. The existing firebreak network system was established within the pilot project. Other firebreaks were created afterwards by the regional government of Valencia or already existed before. Maybe the network is enlarged in some areas from time to time. This technology is also applied in other countries/regions, amongst others in Portugal, South Carolina and South Africa.

Concluding statements

Strengths and → how to sustain/improve	Weaknesses and → how to overcome
There is a reduction of fuel load within the firebreaks and therefore they contribute to fire prevention. → The maintenance of firebreaks is crucial	Firebreaks are a strong disturbance of the natural environment. People often criticise the negative aesthetic/visual impact which results in a decline of the recreational value. → This problem is difficult to overcome, but the technology helps to prevent an even bigger disturbance of the forest caused by a fire. Even though criticising the firebreaks due to its visual impact people know about the importance of this measure and are also concerned with the devastating effects of a forest fire. There is always the question of what is better: to establish firebreaks and disturb nature, or to experience a large fire.
A firebreak does not stop a fire but facilitates the access for fire fighters (and vehicles) and guarantees a higher security for people, thus increasing the possibility to control/slow down a fire. By arranging the territory in different parcels (firebreaks of first, second and third order) the spread of large forest fires is less probable → The maintenance of firebreaks is crucial. Furthermore, there must be a good coordination and organisation within the fire fighter staff in case of an emergency.	The establishment and the maintenance activities are expensive and labour-intensive. Without management the firebreaks are not effective anymore. It would be necessary to extract biomass from the forest to decrease the continuity of the trees and shrubs. In case of a lack of management the risk of fires increases. → Management is crucial. It should be noted that prevention measures are often less expensive than rehabilitation activities after a fire. More investment in forest management and fire prevention is required. Managing the forest would not only decrease the risk of fire but also generate benefits (e.g. wood, biomass). Furthermore, jobs would be generated which is especially important during the current economy crisis in Spain. There are some good practices found in other regions to cover the maintenance costs: In Jarafuel (next to Ayora) a part of the rent paid by the wind mill company to the state is reinvested in forest management. Or in Andalucia, the government launched a project to invest subventions in maintenance of firebreaks through grazing and this was very successful. This could be a good alternative to expensive management measures. It was also mentioned by many stakeholders that traditional activities (such as grazing, agriculture, wood gathering) should be reactivated and that the villagers should get economic compensation to maintain the forest in a good state.
There are both social and economic benefits for local people. The establishment and the maintenance of firebreaks provide jobs for rural people which allows them to increase their livelihood conditions. A part of the extracted wood is used for biomass, fertilizers, pellets, or firewood. Furthermore there would be improved conditions for grazing. → More investment in forest management is required to sustain these benefits. Furthermore, many local stakeholders mentioned the importance of reactivating traditional activities (such as grazing, agriculture, wood gathering) and that the villagers should get economic compensation to maintain the forest in a good state.	Firebreaks are not that efficient because after clearing, the first plants which grow are Ulex parviflorus and Cistus albidus which are fire-prone species. Furthermore, if you cut them each 4 or 5 years there will only be grassland which is not natural in Mediterranean region. A fire could be caused more easily due to the high amount of thin and dead material. → CEAM suggests to plant more fire-resistant species (late successional stages) within some spots in the firebreaks to increase the resilience of the ecosystem. Green living plants have a higher humidity content which slows down a fire (oxygen is consumed). The issue is not to cover the whole firebreaks with plants but to establish some green spots. By planting late-successional species densely you don't allow seeders to grow. This measure could also decrease management costs. People keep in their minds the idea of having to clear all the vegetation in order to not have fires or to stop them, but it is not really the most sustainable one. The idea of green firebreaks is already common in some other countries but you need to ensure water availability for irrigation.
Vegetation removal produces fresh vegetation growth, therefore more diverse and nutritious fodder is available for animals (game and livestock) in the cleared areas. Game/wildlife and livestock are better because there is an increase in fodder quantity and quality. → The maintenance of firebreaks is crucial.	In some areas, the implementation of firebreaks can occupy productive land which means a loss of land → The main objective of this technology is to provide protection from forest fires instead of creating productive land.
Due to the high stone content of the soil, and due to mulching through in-situ brush-chipping of the cleared material, the firebreaks are not that prone to erosion as in other regions/countries (e.g. Portugal). →	The work is dangerous and there is a high risk to harm oneself when clearing and chipping the vegetation. It is also a physical stress due to the exhausting work →
Improvement and maintenance of the forest paths and streets to establish firebreaks and to guarantee access for fire fighter vehicles but also for recreational activities (rural tourism). → Establishment and maintenance of the firebreaks can improve the forest track network.	When there is a strong and dry wind from the inland (poniente) the smaller firebreaks are useless because the fire just passes over. It should also be noted that without human intervention the firebreaks do not stop a fire → Establish big firebreaks and ensure maintenance.
Fewer fires result in a decrease of the destroyed area, less money will have to be invested in restoration or fire extinction. Furthermore, farmers, hunters and honey producers will experience fewer losses. → The maintenance of firebreaks is crucial.	
In Jarafuel where most of the land is public retired people receive the firewood gained by forest clearings for free. They can use the wood for cooking and heating and save a lot of money. → People from the region (outside of Jarafuel) like this idea that villagers benefit from what is removed from the forest. More mechanisms like this should be developed so that people recognize that they also benefit from forest management, which in turn would ensure a sustainable forest management.	
There are also off-site benefits. Fewer fires will result in a reduction of downstream flooding, downstream siltation and damage on neighbours' fields. When fire removes less vegetation the soil is less vulnerable to erosion → The maintenance of firebreaks is crucial.	

Primary strip network system for fuel management

Portugal - Primary strip network system for fuel management

Linear strips are strategically located in areas where total or partial removal of the forest biomass is possible. This technology contributes towards preventing the occurrence and spread of large forest fires and reducing their consequences for the environment, people, infrastructures, etc.

There are three types of strip for fuel management in forest areas: primary, secondary and tertiary, defined by the Law 17/2009. The most important differences between them are in terms of size (primary being the widest and the tertiary the narrowest) and scale (primary referring to the district level, secondary to the municipal level and tertiary to the parish level). The primary strip network system for fuel management (RPFGC) is integrated in the National System to Prevent and Protect Forest against Fires and it is defined by the National Forest Authority (AFN).
The RPFGC aims to re-arrange landscape elements, through the establishment of discontinuities in the vegetation cover, in forest areas and in the rural landscape (for example using water bodies, agricultural land, pasture, rocky outcrops, shrubland and valuable forest stands). Land tenure is private in most of the areas covered by the RPFGC. The main objectives of this technology are: to decrease the area affected by large fires; to enable direct access by fire fighters; to reduce fire effects and protect roads, infrastructures and social equipment, urban areas and forest areas of special value; and to isolate potential fire ignition sources.
These primary strips are ≥ 125 metres wide and preferably between 500 and 10,000 ha in area. The tree cover should be less than 50% of the area and the base of the tree canopy should not be lower than 3 metres. The RPFGC concept should include the adoption of a maintenance programme. The implementation and maintenance operations can be performed through different agro-forest technologies, such as clearance of bushes and trees, pruning, prescribed fire, harrowing and cultivation of the ground beneath the trees. Timber products can be sold and the removed litter can be used in a biomass power plant or applied to the fields to improve soil fertility, using mulching technology.
This SWC Technology needs considerable financial resources in terms of labour and equipment at the implementation phase. Costs, however, undergo considerable reduction thereafter. The implementation of this infrastructure to prevent and protect the land from forest fire is entirely funded by the government and implemented by the forest municipal services.

left: Reduction of the density of trees and or vegetation removal using machinery (Photo: João Soares)
right: Primary strip network system for fuel management. (Photo: João Soares)

Location: Portugal
Region: Santarém / Mação
Technology area: 400 km^2
Conservation measure: structural
Stage of intervention: prevention of land degradation
Origin: Developed externally / introduced through project, recent (<10 years ago)
Land use type:
Forests / woodlands: Natural
Mixed: Agroforestry
Climate: subhumid, temperate
WOCAT database reference: T_POR001en
Related approach: Forest Intervention Area (QA | POR01)
Compiled by: Celeste Coelho, University of Aveiro
Date: 2011-10-16
Contact person: Celeste Coelho, Centre for Environmental and Marine Studies University of Aveiro 3810 - 193 Aveiro Portugal Tel.: +351 234 370 349 Fax: +351 234 370 309 E-mail: coelho@ua.pt

Classification

Land use problems:

- Forest fires increase due to rural depopulation and to land management abandonment. (expert's point of view)

Land use

Natural
Agroforestry
rainfed
silvo-pastoralism
rainfed
selective felling of (semi-) natural forests, clear felling of (semi-)natural forests

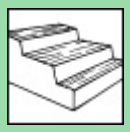
Climate

subhumid

Degradation

Biological degradation: detrimental effects of fires

Conservation measure



Structural: Others ()

Stage of intervention

- Prevention
- Mitigation / Reduction
- Rehabilitation

Origin

- Land users initiative
- Experiments / Research
- Externally introduced: recent (<10 years ago)

Level of technical knowledge

- Agricultural advisor
- Land user

Main causes of land degradation:
Direct causes - Human induced: deforestation / removal of natural vegetation (incl. forest fires)
Indirect causes: Property size

Main technical functions:
- control of fires

Secondary technical functions:
- reduction of dry material (fuel for wildfires)

Environment

Natural Environment

Average annual rainfall (mm)

- > 4000 mm
- 3000-4000 mm
- 2000-3000 mm
- 1500-2000 mm
- 1000-1500 mm
- 750-1000 mm
- 500-750 mm
- 250-500 mm
- < 250 mm

Altitude (m a.s.l.)

- > 4000
- 3000-4000
- 2500-3000
- 2000-2500
- 1500-2000
- 1000-1500
- 500-1000
- 100-500
- <100

Landform

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

Slope (%)

- flat
- gentle
- moderate
- rolling
- hilly
- steep
- very steep

Soil depth (cm)

- 0-20
- 20-50
- 50-80
- 80-120
- >120

Growing season(s): 1 days(1 per year)
Soil texture: medium (loam)
Soil fertility: low
Topsoil organic matter: low (<1%)
Soil drainage/infiltration: poor (eg sealing /crusting)

Soil water storage capacity: low
Ground water table: 5 - 50 m
Availability of surface water: medium
Water quality: good drinking water
Biodiversity: medium

Tolerant of climatic extremes: temperature increase, seasonal rainfall increase, seasonal rainfall decrease, decreasing length of growing period
Sensitive to climatic extremes: heavy rainfall events (intensities and amount), wind storms / dust storms, floods, droughts / dry spells

Human Environment

Forests / woodlands per household (ha)

- <0.5
- 0.5-1
- 1-2
- 2-5
- 5-15
- 15-50
- 50-100
- 100-500
- 500-1,000
- 1,000-10,000
- >10,000

Land user: groups / community, Small scale land users, common / average land users, men and women
Population density: 10-50 persons/km2
Annual population growth: negative
Land ownership: individual, not titled
Land use rights: individual
Water use rights: open access (unorganised)
(Individual, not titled: Usually, legal documents for the property are missing.)
Relative level of wealth: average, which represents 50% of the land users; 50% of the total area is owned by average land users
poor, which represents 50% of the land users; 50% of the total area is owned by poor land users

Importance of off-farm income: > 50% of all income:
Access to service and infrastructure: low: employment (eg off-farm); moderate: education, technical assistance, telecommunications; high: health, market, energy, roads & transport, drinking water and sanitation, financial services
Market orientation: mixed (subsistence and commercial)

Technical drawing

This technical drawing indicates the technical specifications, dimensions and spacing for the Primary Strip Network System for Fuel Management. The figure shows a road as the axis of the RPFGC, but it can also be a river or a ridge, amongst other breaks in the forest cover. (João Soares)

Implementation activities, inputs and costs

Establishment activities

- Primary System design
- Shrubs cleaning + Thinning (reduction of fuel load) + Pruning
- Removing the cut waste material
- Litter Shredding
- Transport to the Biomass Plant

Establishment inputs and costs per ha

Inputs	Costs (US$)	% met by land user
Labour	1076.00	0%
Equipment		
- machine use	568.00	0%
- Transport	100.00	0%
TOTAL	**1744.00**	**0.00%**

Maintenance/recurrent activities

Remarks:
The costs include the activities to ensure the vertical and horizontal discontinuity of the fuel load and also the activities needed to manage the waste produced from the shrubs cleaning and thinning.
The costs calculation was made for the implementation of the first section of the RPFGC. The implementation phase lasted for 2 or 3 months during the dry season. This section included 28 ha and 4 teams of forest sappers were involved.

Assessment

Impacts of the Technology

Production and socio-economic benefits

+++ reduced risk towards adverse events (droughts, floods and storms)
++ increased fodder production
++ increased fodder quality
++ increased animal production
+ increased energy production: biomass

Production and socio-economic disadvantages

++ costs of implementation
+ reduced wood production
+ increased maintenance costs

Socio-cultural benefits

++ community institution strengthening
+ national institution strengthening
+ conflict mitigation
+ improved conservation / erosion knowledge

Socio-cultural disadvantages

+ socio cultural conflicts

Ecological benefits

+++ reduced hazard towards adverse events
+++ reduced fire risk
+ improved soil cover

Ecological disadvantages

++ decreased soil cover
+ increased surface water runoff
+ decreased soil organic matter
+ increased soil erosion locally
+ increased habitat fragmentation

Off-site benefits

+++ reduced damage on public / private infrastructure
++ reduced damage on neighbours fields

Off-site disadvantages

Contribution to human well-being / livelihoods

+ reduced risk of wildfire

Benefits /costs according to land user

Benefits compared with costs	**short-term:**	**long-term:**
Establishment	neutral / balanced	positive
Maintenance / recurrent	neutral / balanced	positive

The maintenance will only start 2 or 3 years after the technology implementation, so no returns are expected at short-term.

Acceptance / adoption:

There is strong trend towards (growing) spontaneous adoption of the technology. After the implementation period there was a high local acceptance of the technology. It is also expected that grazing activities contribute to the technology maintenance

Concluding statements

Strengths and → how to sustain/improve	Weaknesses and → how to overcome
Fuel load reduction → This will be achieved using prescribed fire and specialised machinery. The efficacy of prescribed fire depends on the collaboration of technicians and forest sapper teams. To guarantee the effectiveness of RPFGC implementation, long-term maintenance has to be ensured.	Soil erosion increase → Forestry good practices should be used in the RPFGC implementation, especially concerning the use of machinery and avoiding disturbance of soil at depth. Soil cover after the removal of the existing vegetation should be promoted (by seeding, mulching or creating a low intensity pasture).
Reinforcement of the forest path system → Clearing the strips of the RPFGC can enhance the forest track network.	Soil cover reduction → Soil cover after the removal of the existing vegetation should be promoted (by seeding, mulching or creating a low intensity pasture).
Forest fire prevention and fighting → The know-how of the local stakeholders and communities will contribute to the design of the RPFGC . This information should be integrated into the Municipal Plans to Prevent and Protect Forest Against Fires (PMDFCI). Any further information should be provided to the Civil Protection Agencies and to the Forest Technical Office and also to the local fire-brigade team.	Runoff increase → Soil cover after the removal of the existing vegetation should be promoted (by seeding, mulching or creating a low intensity pasture). Excessive vegetation removal should be avoid, especially near water courses where the removal should be nil or minimum.
Increase in landscape resilience → This will only be effective if the RPFGC is continuous and without gaps. The acceptance of the RPFGC by the landowners is fundamental to widespread the use of this technology. Information and awareness about the need to change vegetation cover is also very important, in order to avoid extensive areas of monoculture.	Budget for implementation and maintenance → European and national funds. Collaboration of the local government providing equipment and labour force. Information and awareness to the landowners about the importance of this technology. Campaigns of national awareness and definition of this technology as 'public use' to overcome some potential social conflicts concerning the land rights.

Municipal forest management plan -MFMP (decade 2010-2019)

Italy - PAF

Management plan for silvopastoral areas with a ten year intervention plan

Aim/objectives: The management plan is a legally binding document which outlines an analysis of the current situation of the forest and pastures and gives indications on the best future interventions to ensure their sustainable future management. The MFMP provides prescription to: cutting periods and tree ages, forest cultivation care, opening of firebreaks and their maintenance, allowance of grazing animals in the forest area, etc.

Methods: This legislative instrument, provides provisions and directions wich have to be followed and wich are legally binding in the local territory the plan covers. Any violations of the plan will result in sanctions.

Stages of implementation: The MFMP is a commitment of the municipality imposed by the Region. The Region provides funds to both to build and implement it when it has been approved. A specific forestry committee is appointed by the Region who provides the technical support to approve the MFMP presented by the municipalities.

Role of stakeholders: Stakeholders participate in drawing up the plan (at a municipal level) which is then approved at a regional level.

Location: Basilicata, Castelsaraceno
Approach area: 1 - 10 km^2
Type of Approach: recent local initiative / innovative
Focus: mainly on conservation with other activities
WOCAT database reference: A_ITA001en
Related technology(ies): Selective cutting (T_ITA008en), Unvegetated firebreaks (T_ITA007en)
Compiled by: Velia De Paola,
Date: 2014-05-28
Contact person: Giovanni Quaranta, University of Basilicata, viale dell'Ateneo Lucano 10, 85100 POtenza.
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Problem, objectives and constraints

Problems

The management plan aims at a correct, rational and sustainable management of woods and silvo-pastoral areas.

Aims/Objectives

The land-use plan has the general objective of managing public forests and rangelands.

Constraints addressed

	Constraint	Treatment
technical	The technologies aim at preventing fires. However, in public woodland, which makes up the majority of the territory, no-one has a “vested interest” in carried out fire prevention actions and, as such, interventions must be made compulsory under law.	The management plan, being legally binding, forces the implementation of the two technologies associated with this approach.

Participation and decision making

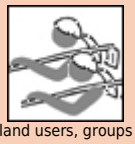
Stakeholders / target groups


planners


land users, individual


SLM specialists / agricultural advisors


politicians / decision makers


land users, groups

Approach costs met by:

local government (district, county, municipality, village etc) (70% region, 30% municipality)	100%
Total	**100%**

Annual budget for SLM component: US$ 2,000-10,000

Decisions on choice of the Technology(ies) mainly by SLM specialists with consultation of land users

Decisions on method of implementing the Technology(ies): mainly by land users supported by SLM specialists

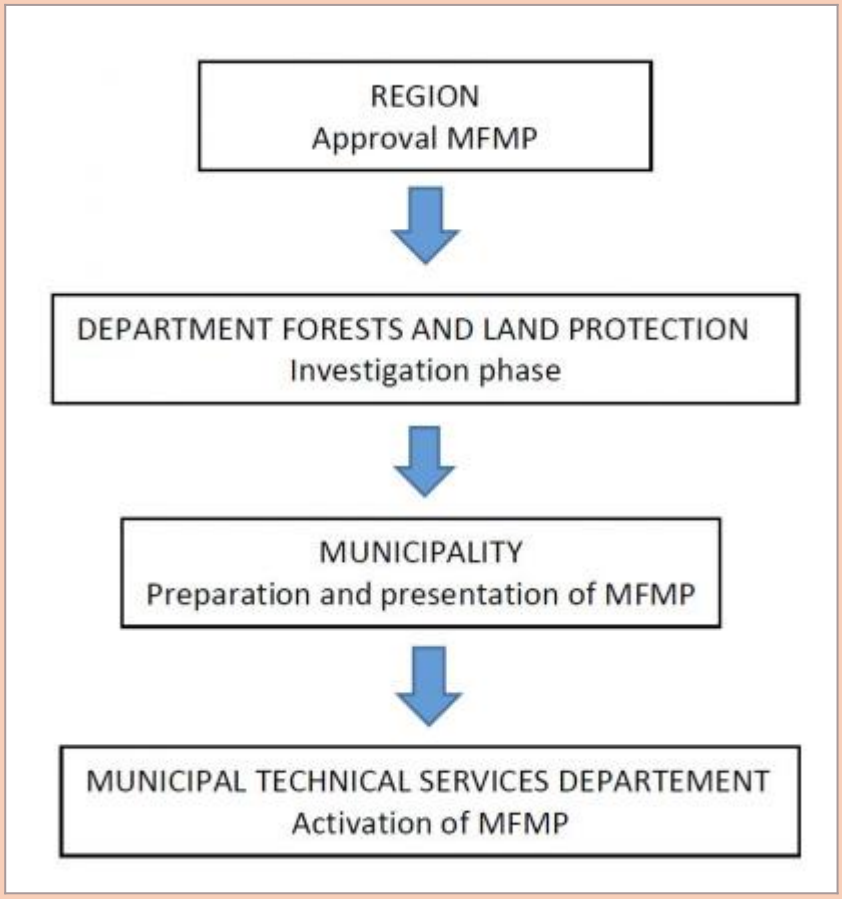
Approach designed by: national specialists

Implementing bodies: local government (district, county, municipality, village etc) (Region), other (Municipality)

Land user involvement		
Phase	**Involvement**	**Activities**
Initiation/motivation	Passive	Municipality, region, relative associations
Planning	Interactive	During the planning phase local land users help the specialists in identifying the problems facing the territory and in the choice of best technologies to improve land mangement
Implementation	Interactive	
Monitoring/evaluation	None	State forest service
Research	None	

Differences between participation of men and women: No
there is minimal participation of women because of the nature of the implementation work.

Involvement of disadvantaged groups: No



Organogram: Organization chart of MFMP (Velia De Paola)

Technical support

Training / awareness raising:
No

Advisory service:
Name: Publication in the Regional Official Gazette.
Key elements:
1. Local stakeholders presentation
2. Distribution of MFMP copies to whum is concerned

When approved, the MFMP is published on Regional Official Gazette. Implementation responsible is the Municipal thought its technical department and forestry services who is also responsible for updating and upgrading it periodically. The extension system is quite adequate to ensure continuation of activities. the forest service constantly monitors the implementation of the management plan and in cases of violations applies sanctions

Research:
No research.

External material support / subsidies

Contribution per area (state/private sector): No.

Labour: Paid in cash.

Inputs:

Credit: Credit was not available

Support to local institutions: Yes, little support with dissemination of paf

Monitoring and evaluation

Monitored aspects	Methods and indicators
area treated	Regular observations by other: State forest service

Changes as result of monitoring and evaluation:
There were no changes in the approach.

There were no changes in the technology.

Impacts of the Approach

Improved sustainable land management: Yes, moderate; Since the region adopted the Forest Management Plan for each municipality the management of woods and silvo-pastoral areas has been much more sustainable compared to the past.

Adoption by other land users / projects: Yes, few; Larger owners adopted some measures of the path although they were not obliged.

Improved livelihoods / human well-being: Yes, little; With the Forest Management Plan the income from the sale of woods is much more stable and constant over the years.

Improved situation of disadvantaged groups: No

Poverty alleviation: No

Training, advisory service and research:

- Advisory service effectiveness

  Land users*: good

  During the presentation of the management plan to the land users, the proposed technologies were fully explained and land users were given instructions on their implementation.

- Research contributing to the approach`s effectiveness: Moderately
  Research activities are not foreseen under the Forest Management Plan but play a role in giving general support

Land/water use rights:
None of the above in the implementation of the approach. The Forest Management Plan applies exclusively to public lands and so does not affect private property in any way.

Long-term impact of subsidies:

Concluding statements

Main motivation of land users to implement SLM:

Rules and regulations (fines) / enforcement

Well-being and livelihoods improvement

Sustainability of activities:

No the land users can`t sustain the approach activities without support.

Strengths and → how to sustain/improve	Weaknesses and → how to overcome
The Forest Management Plan plays a vital role in local land management. It is revised and renewed every ten years which allows for a periodic re-assessment of changes to economic and environmental conditions. → Public funding must be guaranteed for actions as interventions aim at protecting public resources.	The only disadvantage is the high initial costs to draft the plan. After the first 10 years the costs for updating the plan are greatly reduced so that costs are ultimately spread out over the long term. → The only thing which garantees the adoption of the plan is public funding.
The Forest Management Plan was first viewed with suspicion as another example of red tape but then during its implementation land users saw the benefits it brought and even private land owners began implementing the same technologies on their own land. → They rely on public funding for implementation.	