Vallerani system

Burkina Faso

A special tractor-pulled plough that automatically constructs water-harvesting catchments, ideally suited for large-scale reclamation work.

The Vallerani implement is a modified plow named Delfino3, pulled by a heavy-duty tractor. A normal plow on flat land excavates a symmetrical furrow, and earth piles up equally on both sides of the furrow. The Delfino3 plow has a single reversible plowshare that creates an angled furrow and piles up the excavated soil only on the lower (downhill) side. This soil forms a ridge that stops or slows down runoff water as it flows downhill. The plow's blade moves up and down (i.e. in and out of the soil), creating micro basins about 5 meters long, 50 cm deep and spaced about 2 m, each with a ridge. Two ripper placed before the plow work the soil to a depth of 70 cm, rise at the basin and descend between the basins. Thus to attain, in the stretch of land between the crescent, a collection bag which receives water from the crescents itself. Even with very low rainfall (150-500 mm/year) each micro-basin/storage bag can collect 1500 litres of water, including runoff. This water is protected against evaporation and remains available to plant roots and groundwater.
The Vallerani System is based on direct sowing of seeds of shrubs and trees of locally available, indigenous species. They are sown along the ridges of the basins and in the wake of the ripper. In the case study area Acacia tortilis, Ziziphus mauritania, Balanites aegyptiaca, Acacia senegal, Acacia seyal and Faidherbia albida have been sown. While for most species seeds can be collected by the local population, for species rarely present in the region, the seeds have to be purchased from tree nurseries. The use of goat excrements containing seeds has also proven successful (about 95% of all micro basin have at least one tree growing after 3 years) when directly sown. With more moisture available for a long time trees grow rapidly and the herbaceous cover improves in quality and in quantity - providing 20-30 times more livestock fodder (1000-2000kg dry herbaceous biomass ha/year), also helping to conserve the soil. The plowed and sown area is not protected by fences, grazing of animals shall be allowed so that villagers can benefit from the forage and reduce the accumulation of biomass fuel that would further the risk of fires in the dry season.
The Vallerani plow can 'treat' up to 20 ha, digging 5.720 micro basins, in a single day. The speed and effectiveness of the Delfino3 plow are its major advantages in the fight against desertification, but can also be its major limitation as to be able to make the best of it, it is necessary to find great availability of land to be reforested or cultivate. This is mainly possible related to a large public or business initiative. The spreading "like wildfire" that has characterized the case study was made possible by the presence on the territory of an NGO already active and rooted in the territory for many years and by perseverance, respect and competence of partner "of the North". Once the project has invested in the tractor and the plow (tractor ~ 70,000 EUR, plough ~ 40,000 EUR), the remaining cost of implementation – labour costs for local workers and drivers, fuel etc. amount to around EUR 125 / ha / year.
The case study area in the north east of Burkina Faso receives about 300-500 mm of annual rainfall. The soils of this agropastoral land are heavily degraded with a low tree density and an almost entirely absent herbaceous cover.

left: The Delfino3 plough at work. The picture shows the moment in which, after digging a micro bassin, the plowshare is coming out of the soil while the two rippers are going deeper in creating the underground water bag. (Photo: Deserto Verde)
right: Local people sowing indigenous tree seeds in the processing furrow and the same land 3 years after plowing. (Photo: Deserto Verde)

Location: Oudalan
Region: Gorom-Gorom
Technology area: 50 km^2
Conservation measure: vegetative, structural
Stage of intervention: rehabilitation / reclamation of denuded land
Origin: Developed through land user`s initiative, ; through experiments / research, 10-50 years ago
Land use type:
Grazing land: Extensive grazing land
Mixed: Agro-silvopastoralism
Climate: arid, subtropics
WOCAT database reference: T_BRK011en
Related approach:
Compiled by: Sabina Galli Vallerani,
Date: 2012-05-03

Classification

Land use problems:

- Land degradation-desertification with reduction of vegetation cover in terms of plant density and species diversity is the main problem: disappearance of grasses and trees, reduction of the size of the plants that are resistant and of the biological activity of the soil. Runoff, water and wind erosion increase. Drought and irregular precipitation have heavy consequences on soil fertility, availability of water for humans and livestock, and recharging groundwater. (expert's point of view)

Land use

Extensive grazing land
Agro-silvopastoralism
extensive grazing land
rainfed

Climate

arid

Degradation

Soil erosion by water: loss of topsoil / surface erosion, gully erosion / gullying, Soil erosion by wind: loss of topsoil, Biological degradation: reduction of vegetation cover, quality and species composition /diversity decline

Conservation measure

Structural: Level ditches / pits
Vegetative: Grasses and perennial herbaceous plants
Vegetative: Tree and shrub cover

Stage of intervention

- Prevention
- Mitigation / Reduction
- Rehabilitation

Origin

- Land users initiative
- Experiments / Research: 10-50 years ago
- Externally introduced

Level of technical knowledge

- Agricultural advisor
- Land user

Main causes of land degradation:
Direct causes - Human induced: over-exploitation of vegetation for domestic use, overgrazing
Direct causes - Natural: change of seasonal rainfall, droughts

Main technical functions:
- control of raindrop splash
- improvement of ground cover
- improvement of topsoil structure (compaction)
- stabilisation of soil (eg by tree roots against land slides)
- water harvesting / increase water supply
- increase of biomass (quantity)
- promotion of vegetation species and varieties (quality, eg palatable fodder)

Secondary technical functions:
- increase in organic matter
- increase in nutrient availability (supply, recycling,...)
- increase of infiltration
- increase / maintain water stored in soil

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): 90 days
Soil texture: coarse / light (sandy)
Soil fertility: low
Topsoil organic matter: low (<1%)
Soil drainage/infiltration: poor (eg sealing /crusting)

Soil water storage capacity: low
Availability of surface water: good, poor / none
Water quality: for agricultural use only
Biodiversity: low

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

Human Environment

Grazing land 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: 3% - 4%
Land ownership: state
Land use rights: open access (unorganised)
Water use rights: open access (unorganised)

Importance of off-farm income: less than 10% of all income: The only activity people of the region are engaged in is goat and cattle breading. Crop production is practiced only for subsistence use.
Access to service and infrastructure: low: health, technical assistance, employment (eg off-farm), market, energy, roads & transport, drinking water and sanitation, financial services; moderate: education
Market orientation:

Technical drawing

Above: A. The land chosen together with the local population is plowed with the special Delfino3 plow. B. Local people sow seeds (collected from local trees or bought if species are rare) or goat dung containing seeds (collected in the night enclosures after feeding the goats shaking trees with ripe seeds). C. The micro basins collect the rain that falls into the crescents and 50% of the runoff water. The water easily penetrates into the soil, fills the storage bags, remains available to plant roots and drains into the groundwater without risk of evaporation. Each micro basin/storage bag can collect up to 1.500 l of water. Below h1-Depth of the ploughshares work: =40/50 cm Width of the micro basin: 40/50 cm L1-Length of the micro basin, programmable: =3,5/5 m h2 Depth of the rippers work: =50/80 cm P-Total length of work: 4/8 m Tractors horsepower 210/250 (150-198 Kw) Working speed: 4/7 Km/h Weight : 2000 Kg (Deserto Verde)

Implementation activities, inputs and costs

Establishment activities

- Project planning, consulting and training by VS and national experts
- Plowing with the Delfino special plow pulled by a 210hp tractor
- Seed harvesting can be done by local people either collecting them directly from plants or by shaking the plants at the appropriate time, to feed the goats and sheep with the fallen seeds and collect their dung in the night enclosure
- Missing seeds can be purchased in local markets or, if trees are too rare or if the species is no longer present, seeds must be purchased at a nursery
- Direct sowing

Establishment inputs and costs per ha

Inputs	Costs (US$)	% met by land user
Labour	72.00	50%
Equipment		
- machine use	23.40	0%
TOTAL	**95.40**	**37.74%**

Maintenance/recurrent activities

- No maintenance activities are required

Remarks:
Upfront costs for the aquisition of the required materials are around 40,000 EUR for the plough and 70,000 EUR for the tractor. All data presented in the table refer to an ideal project which lasts 5 years with 3000 hectares plowed each year. All works are carried for economic retribution. Item number 1 refers to the planning, training and consulting engineers that has a strong impact on the cost per ha ($47). This voice would remain the same if 3 MTU (Mechanized Technical Unit) were used in the same area reducing its impact to $ 15,6 per ha.

Assessment

Impacts of the Technology

Production and socio-economic benefits	Production and socio-economic disadvantages
+++ increased wood production	
++ increased fodder production	
++ increased fodder quality	

Socio-cultural benefits	Socio-cultural disadvantages
+++ community institution strengthening	
+++ national institution strengthening	
+++ conflict mitigation	
+++ improved conservation / erosion knowledge	
+++ improved situation of disadvantaged groups	
+++ improved food security / self sufficiency	
+++ improved health	
+++ Training of skilled labour in disadvantaged regions	
++ improved cultural opportunities	
++ increased recreational opportunities	

Ecological benefits	Ecological disadvantages
+++ improved harvesting / collection of water	++ increased fire risk
+++ increased soil moisture	+ Increased threat from wild animals
+++ reduced surface runoff	
+++ increased biomass above ground C	
+++ reduced soil loss	
+++ reduced soil compaction	
++ recharge of groundwater table / aquifer	
++ increased nutrient cycling recharge	
++ increased soil organic matter / below ground C	

Off-site benefits	Off-site disadvantages
+ reduced downstream flooding	
+ reduced damage on public / private infrastructure	

Contribution to human well-being / livelihoods

+++ Thanks to the enormous increase of trees, pasture and crop production, the quality of life and health of men and animals have improved considerably.

Benefits /costs according to land user

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

Acceptance / adoption:

100% of land user families have implemented the technology with external material support. The system includes the use of a heavy duty tractor and a special plow whose costs are high though difficult to sustain by the local population. All correlated activities are done (or can be done) without external material support
0% of land user families have implemented the technology voluntary.
There is strong trend towards (growing) spontaneous adoption of the technology. The system includes the use of a heavy duty tractor and a special plow whose cost is high though difficult to sustain by the local population. All other activities part of the system are practicable from the population under an initial guidance of someone with specific training. Where the technology is known there is active participation of local people and a strong demand for new interventions

Concluding statements

Strengths and → how to sustain/improve	Weaknesses and → how to overcome
This practice allows for the rapid and efficient treatment of large degraded areas within a short time → good maintenance of machinery	The investment costs for the machinery are extremely high and cannot be covered by single land users or even communities → projects must be financed externally
The tree and shrub species planted are mainly indigenous and locally adapted species → reintroduction of indigenous plants that have disappeard in last decades to improve biodiversity and resilience	The speed and effectiveness of the Delfino3 plow are its major advantages in the fight against desertification, but can also be its major limitation as to be able to make the best of it, it is necessary to find great availability of land to be reforested or cultivate → This is mainly possible related to a large public or business initiative. The spreading "like wildfire" that has characterized the case study was made possible by the presence on the territory of an NGO already active and rooted in the territory for many years and by perseverance, respect and competence of the partner "of the North"
Through its tillage process the Vallerani system offers the highest degree of efficiency in the first years from processing. Its effects last for a long time so it does not need to be repeated on the same site → sensitize the local population to a sustainable use of the products of the processed soil	Since great extentions will be processed, a big organisation is needed for all activities (awareness raising, collecting seeds, personnel training, logistics, etc), → this must be well organized and should operate already before starting plowing
The VS does not use any water (except rain) in countries where water is rare and precious. It further avoids the risk of soil salinisation. → converge the funds allocated to the nurseries to spread the Vallerani system, the nurseries workers can do the activities necessary to the explication of the Vallerani system: collecting seeds, sowing, village animators, tractor drivers, etc	
The delfino3 can plow strongly degraded land, this makes that local people often ask to work their worse land → Raise awareness so that it can work the land that will produce the best possible results for the local conditions	

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