Agroforestry with Acacia senegal - cultivated part (Julie Zähringer)

Agroforestry with Acacia senegal (Senegal)

DESCRIPTION

An agroforestry system, dominated by Acacia senegal, developed through protection of all naturally regenerating trees with improvement of soil properties through presence of trees, application of manure and a fallow rotation.

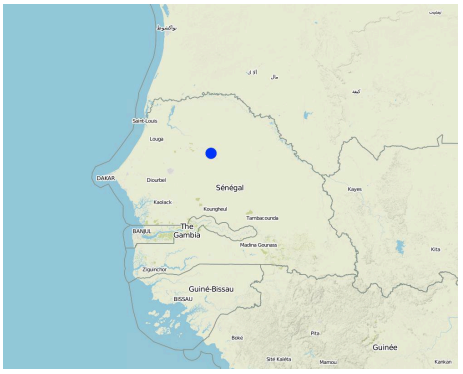
Acacia senegal is the dominating woody species in this agroforestry system. To improve soil properties and crop production, organic manure is applied and a fallow system practiced. One part of the field is being cultivated with either millet (Pennisetum typhoides), cowpea (Vigna unguiculata), groundnut (Arachis hypogaea) or maïz (Zea mais] whereas the other part is left fallow for two years before rotation.

Purpose of the Technology: Initially, the main objective of the land user applying the technology was to improve soil properties and crop production in his fields by maintaining any tree and protecting natural regeneration when preparing his land for cultivation. With the start of exploiting Acacia senegal for the exudates, gum arabic, the potential of revenue increase through gum exploitation became evident and the objective shifted from soil protection to gum exploitation.

Establishment / maintenance activities and inputs: Because of knowledge his father passed on to him, the land user applying this agroforestry practice believes that any tree in his fields is useful and should be protected.Through the technique of assisted natural regeneration, trees naturally growing in the field are protected to reach mature age instead of being cut to clear area for cultivation. The only inputs related to this technology are those for seeds for crop cultivation. During the 3-4 months of gum Arabic exploitation, the land user is obliged to survey his fields day and night, as intruders try to tap the Acacia senegal trees illegally. However, this task is fulfilled by the landuser himself and does not involve expenses for payed manpower.

Natural / human environment: This SLM technology site is located in the sylvopastoral region of the Ferlo in the north of Sénégal. The agro-climatic zone is classified as semi-arid with mean annual precipitation of 300-400 mm. The main land use type in the area is extensive pastoralism followed by rainfed agriculture. Pastoralism is primarily practiced by transhumant Fula (Peulh) herders and further by Mauritanian Moor herders with herds of dromedaries. Vegetation cover in the area has been largely degraded due to cutting for domestic uses and cattle feeding, bushfires and overgrazing. The soil is exposed to wind erosion which carries away nutrients in the topsoil and therefore declines soil fertility. During intense rains in the rainy season, surface runoff is accelerated and leads to the formation of gullies and ravines.

LOCATION



Location: Barkédji, Louga, Senegal

No. of Technology sites analysed:

Geo-reference of selected sites
- -14.9131, 15.271

Spread of the Technology:

In a permanently protected area?:

Date of implementation: 10-50 years ago

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose
- [x] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [ ] reduce risk of disasters
- [ ] adapt to climate change/ extremes and its impacts
- [ ] mitigate climate change and its impacts
- [x] create beneficial economic impact

Land use
Land use mixed within the same land unit: Ja - Agroforestry

Cropland
- Annual cropping: cereals - millet, legumes and pulses - peas, oilseed crops - groundnuts

Number of growing seasons per year: 1

Forest/ woodlands Tree types: Acacia senegal

- [ ] create beneficial social impact

Water supply
- [x] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation

Purpose related to land degradation
- [x] prevent land degradation
- [ ] reduce land degradation
- [ ] restore/ rehabilitate severely degraded land
- [ ] adapt to land degradation
- [ ] not applicable

Degradation addressed


soil erosion by water - Wt: loss of topsoil/ surface erosion


soil erosion by wind - Et: loss of topsoil


chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)


biological degradation - Bc: reduction of vegetation cover, Bq: quantity/ biomass decline, Bs: quality and species composition/ diversity decline

SLM group
- agroforestry
- rotational systems (crop rotation, fallows, shifting cultivation)

SLM measures


agronomic measures - A1: Vegetation/ soil cover


vegetative measures - V1: Tree and shrub cover

TECHNICAL DRAWING

Technical specifications

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated:
- Currency used for cost calculation: **n.a.**
- Exchange rate (to USD): 1 USD = n.a
- Average wage cost of hired labour per day: n.a

Most important factors affecting the costs
seeds for crop planting

Establishment activities
1. Get all the seeds (Timing/ frequency: None)

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit (n.a.)	Total costs per input (n.a.)	% of costs borne by land users
Plant material					
Seeds for millet	ha	1.0	1.68	1.68	
Seeds for groundnut	ha	1.0	5.25	5.25	
Seeds for cowpeas	ha	1.0	7.85	7.85	
Total costs for establishment of the Technology				**14.78**	
Total costs for establishment of the Technology in USD				*14.78*	

Maintenance activities
1. Sowing of crops (Timing/ frequency: beginning of growing season once a year)
2. Application of manure (Timing/ frequency: several times during growing season)

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [x] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [ ] 1,001-1,500 mm
- [ ] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

Agro-climatic zone
- [ ] humid
- [ ] sub-humid
- [x] semi-arid
- [ ] arid

Specifications on climate
Average annual rainfall in mm: 300.0
During one rainy season (july-september), dry period from october-mai
Thermal climate class: tropics, in the sylvopastoral zone of the Ferlo

Slope
- [x] flat (0-2%)
- [ ] gentle (3-5%)
- [ ] moderate (6-10%)

Landforms
- [x] plateau/plains
- [ ] ridges
- [ ] mountain slopes

Altitude
- [x] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.

Technology is applied in
- [ ] convex situations
- [ ] concave situations
- [ ] not relevant

- [ ] rolling (11-15%)
- [ ] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

- [ ] hill slopes
- [ ] footslopes
- [ ] valley floors

- [ ] 1,001-1,500 m a.s.l.
- [ ] 1,501-2,000 m a.s.l.
- [ ] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

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

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

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

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

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

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

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

Water quality refers to:

Is salinity a problem?
- [ ] Ja
- [ ] Nee

Occurrence of flooding
- [ ] Ja
- [ ] Nee

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

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

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

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

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

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

Gender
- [ ] women
- [x] men

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

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [ ] 5-15 ha
- [x] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

Scale
- [ ] small-scale
- [x] medium-scale
- [ ] large-scale

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

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

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

Access to services and infrastructure

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

IMPACTS

Socio-economic impacts

Crop production	decreased	✓ increased
risk of production failure	increased	✓ decreased
product diversity	decreased	✓ increased

As the land user can count on income from gum exploitation he is less vulnerable to crop failure

production area (new land under cultivation/ use)	decreased	increased	Applies especially for fallow part, cultivation might be entirely given up
farm income	decreased	increased	Income from gum arabic exploitation
diversity of income sources	decreased	increased	

Socio-cultural impacts

food security/ self-sufficiency	reduced	improved
conflict mitigation	worsened	improved

Ecological impacts

soil cover	reduced	improved	Applies for the part left fallow, in the cultivated part negligible
soil loss	increased	decreased	Applies for the part left fallow, in the cultivated part negligible
nutrient cycling/ recharge	decreased	increased	Biological N-fixation (A.senegal), but amount questionable
soil organic matter/ below ground C	decreased	increased	Through plant litterfall, application of manure
biomass/ above ground C	decreased	increased	Mainly applies for the part left fallow, in the cultivated part only little
plant diversity	decreased	increased	Applies for the cultivated part only
pest/ disease control	decreased	increased	Birds building nests in trees on fields
wind velocity	increased	decreased	Applies for the part left fallow, in the cultivated part negligible

Off-site impacts

wind transported sediments	increased	reduced

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative	very positive
Long-term returns	very negative	very positive

Benefits compared with maintenance costs

Short-term returns	very negative	very positive
Long-term returns	very negative	very positive

the landuser is expecting a rise in income through increased gum production

CLIMATE CHANGE

Gradual climate change

annual temperature increase	not well at all	very well

Climate-related extremes (disasters)

local rainstorm	not well at all	very well	Answer: not known
local windstorm	not well at all	very well	Answer: not known
drought	not well at all	very well	Answer: not known
general (river) flood	not well at all	very well	

Other climate-related consequences

reduced growing period	not well at all	very well

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology

- [x] single cases/ experimental
- [ ] 1-10%
- [ ] 11-50%
- [ ] > 50%

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

- [ ] 0-10%
- [ ] 11-50%
- [ ] 51-90%
- [x] 91-100%

Number of households and/ or area covered
1

Has the Technology been modified recently to adapt to changing conditions?
- Ja
- Nee

To which changing conditions?
- climatic change/ extremes
- changing markets
- labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view
- increase of crop production

  How can they be sustained / enhanced? maintain or increase number of trees in fields
- increase of income

  How can they be sustained / enhanced? assist natural regeneration of Acacia senegal
- provision of shade for cattle and increased availability of manure as consequence

  How can they be sustained / enhanced? maintain or increase number of trees in fields

Strengths: compiler's or other key resource person's view
- increase of soil fertility
  increase of soil organic matter

  How can they be sustained / enhanced? increase the number of trees with positive impact on soil fertility
  improve manure application and increase number of trees in cultivated part
- reduction of wind erosion

  How can they be sustained / enhanced? increase tree abundance
- maintenance of woody species diversity
- improvement of soil cover

  How can they be sustained / enhanced? increase tree abundance
- little to no costs of establishment

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome
- surveillance of Acacia senegal trees during exploitation season required establish a fence
- crop damaging birds find a habitat to build nests in trees put scarecrows

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome
- tendency towards a monoculture of Acacia senegal (in the part of the field left fallow) encourage natural regeneration of other local species as well

REFERENCES

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Full description in the WOCAT database
https://qcat.wocat.net/af/wocat/technologies/view/technologies_1119/

Linked SLM data
n.a.

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