Masonry micro-dams (Mali)

Micro-barrage en pierres maçonnées (French)

DESCRIPTION

The role of masonry micro-dams is to raise the level of the water table so as to supply wells and create water reserves for off-season farming activities.

A masonry micro-dam is a structure built of dressed stone pointed with cement mortar. The width of the crest is 0.75 metres. The length generally ranges from 100 to 200 metres depending on the site. The height varies between two and four metres. The dam creates a water reservoir upstream covering an area of around 5 to 15 hectares. Micro-dams are equipped with buttresses and a stilling basin. Each dam has a sluice fitted with a stoplog gate for draining away sediment during the first rains of the season and to regulate water levels. The use of stoplog gates is recommended instead of sluice gates, as the latter are more technically sophisticated and require more maintenance. Farming is carried out upstream and downstream in the rainy season and off-season.

The dam increases the amount of available surface water during the rainy season and groundwater during the off-season. This results in increasing the farmland area as well as yields and production. A second growing season is made possible. Its effect on the water table depends on the depth of the scheme's foundations: the deeper the foundations, the greater the recharge of ground water. During the rainy season, the lands are used for rice growing. The wells used for irrigating market gardens are fed from the water table, meaning vegetables can be grown off-season. The water is also used for watering livestock, fish farming and, sometimes, domestic purposes.

Implementation steps: An information and awareness-raising workshop is organised on the IPRO-DB approach at the commune level, involving the villages affected by the project. A general meeting is held to secure the support of the whole village for the development request. The village chief and commune mayor sign off the request. The project team carries out a scoping study and socio-economic surveys. If the outcomes of the scoping study phase and socio-economic surveys are positive, the terms of reference are drawn up for working with consultancies. Consultancies are selected through tender processes to carry out the technical studies and create the invitation to tender document. The project team monitors the consultancies' delivery of the technical studies. The village pays its financial contribution towards the project. The management committee is set up and organisational and technical training is provided to beneficiaries. Exchange visits are organised with villages that have experience in installing these schemes. The project team, village, mayor and company sign the memorandum of understanding. Stone breaking gets underway. Landowners sign the transfer deeds for the site. The invitation to tender for the building works is published and the contractor selected. The invitation to tender for works supervision is published and the supervisory consultancy selected. The building contractor and supervisory consultancy are introduced to the village and begin the building work. Local labour is employed in building the scheme. Partial acceptance of the building works (for example, foundations, wall, buttresses, stilling basin, gabion reinforcements, etc.) is granted. The project team monitors the building works. Payment for activities is made on a unit-price basis. Interim acceptance is granted. Final acceptance is granted after one year.
A management committee takes charge of opening and closing stoplog gates, organises the maintenance of the scheme and institutes additional measures to protect the scheme (gabions, stone bunds, etc.). It collects and manages maintenance fees, ensures the committee's rules of procedure are adhered to and organises meetings of local producers. With minimum levels of maintenance, a scheme will remain functional for at least 20 years.

Around 60 masonry dams have been built or rehabilitated in the Bandiagara and Bélédougou areas.

LOCATION

Location: Bandiagara and Bélédougou area, Mali, Mali

No. of Technology sites analysed:

Geo-reference of selected sites
- n.a.

Spread of the Technology: evenly spread over an area (approx. 1-10 km2)

In a permanently protected area?:

Date of implementation: 10-50 years ago

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

Land use

- [ ] 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
- [ ] create beneficial economic impact
- [ ] create beneficial social impact

Land use mixed within the same land unit: Ja - Agro-silvopastoralism

Cropland
- Annual cropping

Number of growing seasons per year: 1

Waterways, waterbodies, wetlands - Ponds, dams

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

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

Degradation addressed

biological degradation - Bc: reduction of vegetation cover

water degradation - Ha: aridification, Hg: change in groundwater/aquifer level

SLM group
- irrigation management (incl. water supply, drainage)
- water diversion and drainage
- surface water management (spring, river, lakes, sea)

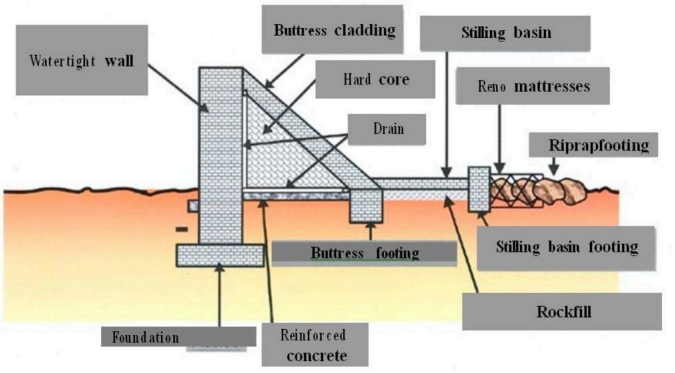
SLM measures

structural measures - S5: Dams, pans, ponds

TECHNICAL DRAWING

Technical specifications

A masonry micro-dam is a structure built of dressed stone pointed with cement mortar. The width
of the crest is 0.75 metres. The length generally ranges from 100 to 200 metres depending on
the site. The height varies between two and four metres. The dam creates a water reservoir
upstream covering an area of around 5 to 15 hectares. Micro-dams are equipped with buttresses
and a stilling basin. Each dam has a sluice fitted with a stoplog gate for draining away sediment
during the first rains of the season and to regulate water levels.



Author: IPRO-DB

Technical knowledge required for field staff / advisors: high
Technical knowledge required for land users: low
Main technical functions: increase of infiltration, increase / maintain water stored in soil, increase of groundwater level / recharge of groundwater, water harvesting / increase water supply, water spreading

Dam/ pan/ pond
Height of bunds/banks/others (m): 2-4
Width of bunds/banks/others (m): 0.75
Length of bunds/banks/others (m): 100-200

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated:
- Currency used for cost calculation: **CFA Franc**
- Exchange rate (to USD): 1 USD = 517.0 CFA Franc
- Average wage cost of hired labour per day: n.a

Most important factors affecting the costs

Each dam costs between 100 and 140 million CFA francs (195'583-273'817 Dollar). Costs are reduced as a result of the availability of local materials and the fact that local masons and contractors are well versed in this type of technology.

Establishment activities

1. information and awareness-raising workshop (Timing/ frequency: None)
2. village chief and commune mayor sign off the request (Timing/ frequency: None)
3. project team carries out a scoping study and socio-economicsurveys (Timing/ frequency: None)
4. Consultancies are selectedthrough tender processes to carry out the technical studies (Timing/ frequency: None)
5. management committee is set up and organisational andtechnical training is provided to beneficiaries (Timing/ frequency: None)
6. Exchange visits are organised with villages that have experience ininstalling these schemes. (Timing/ frequency: None)
7. building contractor and supervisory consultancy are introduced to the village and begin thebuilding work. Local labour is employed in building the scheme. (Timing/ frequency: None)

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit (CFA Franc)	Total costs per input (CFA Franc)	% of costs borne by land users
Other					
total construction		1.0	273817.0	273817.0	100.0
Total costs for establishment of the Technology				**273'817.0**	
Total costs for establishment of the Technology in USD				*529.63*	

Maintenance activities

1. a management committee takes charge of opening and closing stoplog gates, organises themaintenance of the scheme and institutes additional measures to protect the scheme (gabions,stone bunds, etc.). It collects and manages maintenance fees, ensures the committee's rules ofprocedure are adhered to and organises meetings of local producers (Timing/ frequency: None)

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [x] 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
Thermal climate class: tropics

Slope
- [x] flat (0-2%)
- [ ] gentle (3-5%)
- [ ] moderate (6-10%)
- [ ] rolling (11-15%)
- [ ] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

Landforms
- [x] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [ ] footslopes
- [x] valley floors

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

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

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

Soil texture (topsoil)
- [ ] coarse/ light (sandy)
- [x] 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%)
- [x] medium (1-3%)
- [x] low (<1%)

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

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

Water quality (untreated)
- [ ] good drinking water
- [ ] poor drinking water (treatment required)
- [x] 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
- [ ] subsistence (self-supply)
- [ ] mixed (subsistence/ commercial)
- [ ] commercial/ market

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

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

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

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

Individuals or groups
- [ ] 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

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

Land ownership
- [ ] state
- [ ] company

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

- [ ] 1-2 ha
- [x] 2-5 ha
- [ ] 5-15 ha
- [ ] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

- [ ] large-scale

- [ ] communal/ village group
- [ ] individual, not titled
- [ ] individual, titled

- [ ] leased
- [ ] individual

Water use rights

- [ ] open access (unorganized)
- [ ] 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
production area (new land under cultivation/ use)	decreased ✓	increased
farm income	decreased ✓	increased

Socio-cultural impacts

food security/ self-sufficiency	reduced ✓	improved
conflict mitigation	worsened ✓	improved
Contribution to human well-being	decreased ✓	increased

Better levels of production increase producers' incomes and improve living conditions.

Ecological impacts

water quantity	decreased	increased ✓
harvesting/ collection of water (runoff, dew, snow, etc)	reduced ✓	improved
groundwater table/ aquifer	lowered ✓	recharge
soil moisture	decreased ✓	increased

Off-site impacts

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

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
local windstorm	not well at all ✓	very well
drought	not well at all ✓	very well
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

- [ ] single cases/ experimental

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

- [ ] 0-10%

- [ ] 1-10%
- [ ] 11-50%
- [ ] > 50%
- [ ] 11-50%
- [ ] 51-90%
- [ ] 91-100%

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

Strengths: compiler's or other key resource person's view

- Micro-dams increase farmland area, yields and production. Better levels of production increase producers' incomes and improve living conditions.
- Generates employment throughout the year. Seasonal outmigration is reduced.
- With minimum levels of maintenance, a scheme will remain functional for at least 20 years.
- raise the level of the water table to supply wells and create water reserves for off-season farming activities

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome

- Beneficiaries occasionally fail to monitor and maintain schemes.
- lack of quality rubble

REFERENCES

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Full description in the WOCAT database
https://qcat.wocat.net/af/wocat/technologies/view/technologies_1632/

Linked SLM data
n.a.

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- Manual of Good Practices in Small Scale Irrigation in the Sahel (GIZ)

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