Collection of Sustainable Land Management Technologies

Practices by smallholder farmers in Lao PDR

IFAD Investing in rural people

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WOCAT World Overview of Conservation Approaches and Technologies

NAFRI

Collection of Sustainable Land Management Technologies

Practices by smallholder farmers in Lao PDR

National Agriculture, Forestry and Rural Development Research Institute (NAFRI)
Vientiane, August 2019

Acknowledgement

Thanks to land users for providing information and knowledge-based experiences as well as to extension workers and field technical staff for their assistance in data collection. Thanks to the agricultural and forestry officials from the Provincial and District of Agriculture and Forestry Office at the target provinces (Attapue, Xekong and Saravan province) for facilitate and supporting the data collection process. Thank you for Nivong Sipaseuth, Viengsavanh Phimphachanhvongsod, Oulaytham Lasasimma contributed to the coordination and provided technical editorial support in Lao documentations and Thomas Redl for English editing. Special thank you for Nicole Harari and Ursula Gämperli Krauer for the overall guidance and provision of valuable comments and inputs on SLM documentations.

Definitions

Sustainable Land Management (SLM) in the context of the World Overview of Conservation Approaches and Methodologies (www.wocat.net) (WOCAT) is defined as the use of land resources – including soils, water, vegetation, and animals – to produce goods and provide services to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions.

An **SLM Technology** is a physical practice on the land that controls land degradation, enhances productivity, and/ or other ecosystem services. A Technology consists of one or several measures, such as agronomic, vegetative, structural, and management measures.

An **SLM Approach** defines the ways and means used to implement one or several SLM Technologies. It includes technical and material support, involvement and roles of different stakeholders, etc. An Approach can refer to a project/programme or to activities initiated by land users themselves.

Overview

This collection of SLM Technologies and Approaches was compiled as part of the project 'Scaling-up SLM practices by smallholder farmers' funded by the International Fund for Agriculture Development (IFAD).

SLM Technologies belonging to the following five categories are included in this collection

- Water harvesting and water management
- Prevention of soil erosion
- Improvement of soil fertility (compost, mulching)
- Livestock management
- Agroforestry and Intercropping

Documentation process

Before SLM Technologies and Approaches were documented, a Training of Trainers (ToT) was carried out at national level with staff and officials from NAFRI, MAF, Provincial of Agricultural and Forestry Office and other organizations. Then, further trainings of agriculture extension workers were implemented at provincial and district level of 3 provinces (Phouvong and Xanxay district of Attapue province, Darkchung district of Xekong province, Samouy and TaOuy district of Saravan province). The SLM Technologies and Approaches were then documented by NAFRI together with extension workers, using the standardized WOCAT tools, which were translated and made available in Lao language (https://qcat.wocat.net/Li).

Target groups

This collection of SLM Technologies available both in Lao and English language serves as a tool for technical staff, extension workers, project implementers, SLM planners, famers and policy makers. It includes the mots relevant information on different SLM practices including details on their implementation, costs, ecological and socio-economic benefits and disadvantages. The collection of information and data on SLM Technologies serves evidence-based decision-making in SLM.

SLM Technologies and Approaches documentation process

Collection of field data on SLM Technologies and Approaches using WOCAT questionnaire

Data entry into global WOCAT database

External review of data

Internal review of data by WOCAT Secretariat

Publishing of SLM Technologies and Approaches in Lao and English

SLM Technologies and Approaches available for use online and in automatic generated PDF for print

Implementing organizations

WOCAT Secretariat hosted by the Centre for Development and Environment (CDE) of the University of Bern, Switzerland, in collaboration with the National Agriculture and Forestry Research Institute (NAFRI), Lao PDR.

Project duration: February 2016 to March 2019

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Improvement of soil fertility

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Agroforestry and Intercropping

Water harvesting and water management

Local dyke (Khampheng Bounyavong)

Local indigenous dyke for water harvesting (Lao People's Democratic Republic)

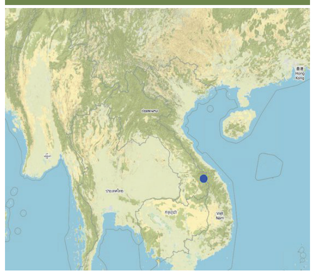
DESCRIPTION

A Local Indigenous Weir to Harness Water

Local villagers initiated the construction and use of communal weir with locally available materials such as wood and stones to create structure and stabilize the weir. Previously, the local people had constructed several irrigation weirs on a particular stream with each one being adjacent to an individual farm. However this arrangement created water use conflicts, particularly during dry season. Therefore people decided to group together in 2003 in order to build a communal weir and vowed to maintain it on an annual basis. This was a significant commitment as often it is difficult to find the necessary construction materials for the weir's upkeep.
The main features and components of its framework should be prepared in the following manner: Firstly prior to beginning the weir's construction one should gather rattan with length of 1-1.5 meters to tie the logs with each posts, as well as post with a diameter approximately 10 cm that should be cut to a length of 1.5 meters. The posts should then be sharpened at the end so that they can ideally be driven 50 cm into the ground, but this will depend on the conditions at the weir site. There should be a distance of 50 cm between each of the posts and these should be installed in two parallel rows with a space of 1 meter between the rows each rows width 1 meters and height 1 meter from the ground that cross the stream about 25 meters long.
Once this has been completed logs with diameter about 20 cm and a length of 4-5 meters should be slotted behind the rows posts and lay the another logs on the previous post until reach to the top of the post as the first layer. The second layer behind the logs should consist of small stones, soil, as well as branches and sticks. This procedure should be completed until the wall of horizontal logs has reached the height 1 meter of the top of the posts. Afterwards large stones should be placed as the top layer of the weir's crest in order to strengthening the weir from flash flood. After that continue repeating the same process for the second row, driven the posts into the ground for 50 cm in front of the first row with distance of 1 meter and lower than first low for 50 cm, slotted behind the rows posts as the first layer. The second layer behind the logs (in front of the first row) consist small stones, soil, branch and sticks. Finally install large stones on the ground in front of the second row in order to strengthening and prevent leakages at bottom of the weir until reaching the required height. For instance, install the first row, then the second row is installed same as the first row in which the height of the second row is lower than the first row about 50 cm, and install large stones on ground of the third row to prevent leakages at bottom of the weir.

The main purpose of the weir is to provide an adequate water supply for agricultural activities in communal areas. Some households have also installed a dynamo (electric generator) with a production capacity of 1 Kwh. It should be noted that it is important to maintain the weir by regularly replacing the logs and adding more stones as required. One of the benefits of the weir is the ability to carry out agricultural activities in both the rainy and dry seasons. Furthermore water can be used for household gardening and the generation of electricity with the installation of a small dynamo where a channel with fast running water has been created. However, the weir does also have some drawbacks such as the significant numbers of logs that are required to firstly build and then maintain the weir annually. Therefore some land owners or land users may not choose this scheme due to these regular maintenance requirements with the need for logs

LOCATION



Location: Tangnong village, Dakchaung district, Sekong province, Lao People's Democratic Republic

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 107.241, 15.67801

Spread of the Technology: applied at specific points/ concentrated on a small area

Date of implementation: 2003; 10-50 years ago

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

which are declining in numbers and becoming increasingly difficult to source. At the same time this requirement may also affect forest resources and places time pressure on people to conduct the maintenance.

The small dynamo installation in the dyke for community (Khampheng Bounyavong)

The canal from the main dyke to the irrigated rice field (Khampheng Bounyavong)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

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

Land use

Cropland - Annual cropping
Main crops (cash and food crops): paddy rice, vegetables

Waterways, waterbodies, wetlands - Ponds, dams
Main products/ services: paddy rice, electric generation

Water supply

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

Number of growing seasons per year: 1
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

Purpose related to land degradation

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

Degradation addressed

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

water degradation - Ha: aridification

SLM group

- water harvesting
- energy efficiency technologies
- ecosystem-based disaster risk reduction

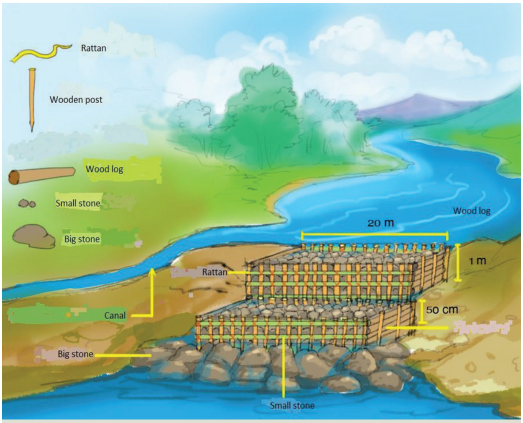
SLM measures

structural measures - S5: Dams, pans, ponds, S10: Energy saving measures

TECHNICAL DRAWING

Technical specifications

The posts have length of about 1.5 m that are fixed into the ground water bottom at a deepness of around 50 cm.
There are two dike rows, each have width of 1 m and a length of approximattly 25 m (corresponding to the width of the stream)
The space between the two dikes is 1 m, the slope angle is 3-5 %
The beneficial area of these dikes is 10 ha of irrigated rice.
The construction material used consists of wooden post (diameters 10 cm and/a length 1.5 m), wood logs with of 20 cm diameter and length of 4-5 m, rattan used to thigten the wood logs with the post. Soil and small stone are put in the back of the wood logs and between the space of the two structures to limit water penetration. Then, also big stones are placed in front of the wood posts to stabilize the structure of the dikes.
After completion of the dike construction, a canal above the upper dike has to be digged to drain the accumulated water into the rice field.



Author: Khampheng Bounyavong

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology unit (unit: **one dam** volume, length: **width 1m, height 1m, depth 50 cm in the ground, length 25 m cross the steam**)
- Currency used for cost calculation: **Kip**
- Exchange rate (to USD): 1 USD = 8000.0 Kip
- Average wage cost of hired labour per day: 50 000 kip

Most important factors affecting the costs

The labour for collecting the wood logs and the labour for the construction of the dike.

Establishment activities

1. Find dead wood logs (Timing/ frequency: None)
2. Collect and prepare the rattan to tighten the wood (Timing/ frequency: None)
3. Collect the stones and rocks (Timing/ frequency: None)
4. Dyke installation (Timing/ frequency: None)

Establishment inputs and costs (per one dam)

Specify input	Unit	Quantity	Costs per Unit (Kip)	Total costs per input (Kip)	% of costs borne by land users
Labour					
Labour	person	48.0	50000.0	2400000.0	100.0
Equipment					
Hummer	piece	4.0	150000.0	600000.0	100.0
Axes	piece	10.0	100000.0	1000000.0	100.0
Hoe	piece	15.0	40000.0	600000.0	100.0
Shovel	piece	10.0	50000.0	500000.0	100.0
Knife	piece	10.0	25000.0	250000.0	100.0
Construction material					
Wood logs	piece	10.0	50000.0	500000.0	100.0
Rattan	line	200.0	20000.0	4000000.0	100.0
Stones	m3	50.0	40000.0	2000000.0	100.0
Wood post	piece	10.0	10000.0	100000.0	100.0
Total costs for establishment of the Technology				**11'950'000.0**	

Maintenance activities

1. Find the wood logs to repair the dikes (Timing/ frequency: None)
2. Prepare the rattan to refix the logs with the posts (Timing/ frequency: None)
3. Collect the stones to imrove the stabilize the dikes (Timing/ frequency: None)
4. Repair the dike (Timing/ frequency: None)

Maintenance inputs and costs (per one dam)

Specify input	Unit	Quantity	Costs per Unit (Kip)	Total costs per input (Kip)	% of costs borne by land users
Labour					
Labor	person	48.0	50000.0	2400000.0	100.0
Construction material					
Wood logs	piece	10.0	50000.0	500000.0	100.0
Rattan	line	200.0	10000.0	2000000.0	100.0
Stones	m3	10.0	50000.0	500000.0	100.0
Wood post	piece	10.0	10000.0	100000.0	100.0
Total costs for maintenance of the Technology				5'500'000.0	

NATURAL ENVIRONMENT

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

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

Specifications on climate
Average annual rainfall in mm: 870.0
The driest month is January, with 14 mm of rainfall. In July, the precipitation reaches its peak. Heavy rain is between July-September. Total rain fall is about 3200 mm/year
Name of the meteorological station: Natural resource office
The warmest month of the year is May, with an average temperature of 22.3 °C. With16.6 °C on average, January is the coldest month of the year.

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

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

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [x] 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
- [x] 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)
- [x] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

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

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

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

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [x] subsistence (self-supply)
- [ ] 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
- [ ] manual work
- [ ] animal traction
- [x] mechanized/ motorized

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

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

Gender
- [x] women
- [x] men

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

Area used per household
- [ ] < 0.5 ha
- [x] 0.5-1 ha
- [x] 1-2 ha
- [ ] 2-5 ha

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

Land ownership
- [ ] state
- [ ] company
- [x] communal/ village
- [ ] group

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

- 5-15 ha
- 15-50 ha
- 50-100 ha
- 100-500 ha
- 500-1,000 ha
- 1,000-10,000 ha
- > 10,000 ha

- ✓ individual, not titled
- individual, titled

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 quality	decreased		✓						increased	Quantity before SLM: 8 tons/ha Quantity after SLM: 2 tons/ha Before gold mining company entered in the area the yield of rice raised to 8 tons/ha due to the aboundant irrigation water caused by the dike construction. But unfortunately actually (in 2017), due to gold excavating rice yield decreased to 2 tons/ha, only.
energy generation (e.g. hydro, bio)	decreased					✓			increased	Some households also install dynamo (electric generator) with production capacity of 1 Kwh.
irrigation water availability	decreased						✓		increased	Before, water for cultivation was insufficient especially during dry season as the stream water level was too low , after the weir construction the stream water level got high enough to fill the canal leading to the production area all-year round.

Socio-cultural impacts

conflict mitigation	worsened						✓		improved	Before dyke construction the villagers tried to bring water to their fields by small individual canals during dry season. This caused competition and conflicts on scares water scarcity. After the communal wire construction the conflicts situation have been been improved.

Ecological impacts

drought impacts	increased					✓			decreased	Even during dry season (and drought events) the farmers bring enough the water to the fields.

Off-site impacts

reliable and stable stream flows in dry season (incl. low flows)	reduced					✓			increased	The weir stopped to some extent the natural water flow. This causes slower but still regular downstream water flow during dry season.

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	
seasonal temperature decrease	not well at all				✓		very well	Season: dry season
seasonal rainfall increase	not well at all			✓			very well	Season: wet/ rainy season
None increase	not well at all				✓		very well	

Climate-related extremes (disasters)

local hailstorm	not well at all	✓ (2 of 5)	very well
extreme winter conditions	not well at all	✓ (2 of 5)	very well
flash flood	not well at all	✓ (3 of 5)	very well
epidemic diseases	not well at all	✓ (3 of 5)	very well
insect/ worm infestation	not well at all	✓ (2 of 5)	very well

Other climate-related consequences

extended growing period	not well at all	✓ (2 of 5)	very well

ADOPTION AND ADAPTATION

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

- [ ] single cases/ experimental
- [ ] 1-10%
- [x] 10-50%
- [ ] more than 50%

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

- [ ] 0-10%
- [ ] 10-50%
- [ ] 50-90%
- [x] 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- [ ] Yes
- [x] No

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

- Inputs are economically beneficial.
- Provides a reliable water supply for agricultural activities.
- Electricity can be generated with a small dynamo.

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

- Mitigates water use conflicts which could occur in the village.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- It is only possible to construct a temporary weir due to the low quality of locally available materials
- A great deal of time needs to be invested in annual maintenance work.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

REFERENCES

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Date of documentation: May 19, 2017

Last update: Nov. 6, 2018

Resource persons
Sengmany - land user
Yangmao Sekhamphone - land user
kang phanvongsa (kangphanvongsa@gmail.com) - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2306/

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Dry season rice along flat areas on both sides of the stream banks (Bounthanom Bouahom)

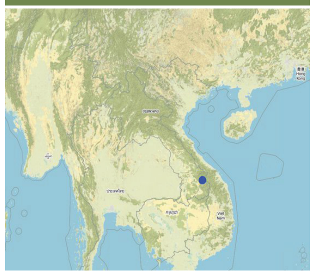
Dry season rice on flat areas of stream banks (Lao People's Democratic Republic)

DESCRIPTION

Dry season rice cultivation on flat areas of stream banks aiming towards replacement of harmful shifting cultivation practices in the upland areas and to improve livelihoods.

Technique on dry season rice cultivation on the banks of stream has been initiated by a Project of Oxfam Australia. Previously, the slash and burn agriculture was a main livelihood activity of local land users in mountainous areas and they had no experience regarding the cultivation of lowland rice. This, in fact, affected food insecurity among the local communities with limited arable land whilst population growth and increasing land pressure in the hill area. As a result, a Project supported by Oxfarm Australia that has been working in Ta Oy District since 1996 with the aim to reduce encroachment of isolated areas in natural forests. The Project e.g. has established the Natural Disaster Management Committee at village level. The project played an important role in providing options regarding permanent livelihood activities for local communities. Dry season rice cultivation along banks of streams was one of the potential alternatives for livelihood improvement particularly to ensure food security and to reduce the workload. At the beginning, the Project provided training to the local land users on how to use buffalos for ploughing as they never used this approach before. The Project also provided rice seedlings, agricultural tools (hoes and shovels) for the land preparation. During the first phase of the Project, there were only few households interested to participate as they were afraid that it would impose negative impacts on local culture and tradition. This because the land users believed that rice cultivation has only to grow in higher land areas and rice stems should not be soaked in water. Nevertheless, there were a number of households who decided to participate in the trial phase of the Project anyway. The Project encouraged them to contribute labour for the whole rice paddy development process and mainly also to support the excavation needed for the land preparation along the streams. Areas suitable to this technology should be on relatively flat land at similar level to the stream which allows simplified access to water. Usually, the land users start land preparation on December to January during the dry season. Before dry season, the land gets flooded every year and in consequence brings fertile deposits to the soils. Later, many land users expressed their interest to implement dry season rice cultivation on the river banks. As a result, village residents have expanded rice paddies wherever suitable. These terrains include stream areas very near to the village. Finally the land users got very happy to have own their paddies so near to the village. Inappropriate beliefs have been gradually eradicated prior to cultivate now lowland rice. Actually, households have more rice for household consumption although it may be insufficient for all year round. This means that many land users still need to cultivate additional areas in the uplands due to limited land in the lowlands. But the general purposes of reducing significantly the swidden agriculture in the uplands and also to decrease labour for these activities has been achieved anyway. In addition, the land users could benefit from increased animal fodder in the form of rice straw during dry season and the rice straw for soil cover in the vegetable gardens to retain soil moisture. Moreover, people from neighbouring villages also learnt from this initiative and implemented it in their villages too.

LOCATION



Location: Taouy district, Salavan province, Lao People's Democratic Republic

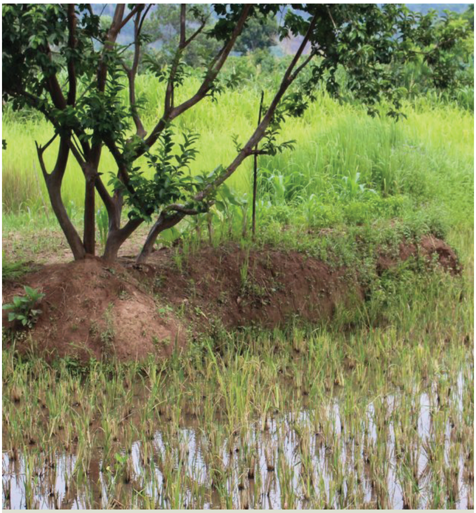
No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 107.08565, 15.60271

Spread of the Technology: evenly spread over an area (approx. < 0.1 km2 (10 ha))

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
- ☑ through projects/ external interventions



Rice planting on flat area (land preparation by manual labour (Bounthanom Bouahom)

Rice plantation in flat area after flood along stream banks (Phonesiri Phanvongsa)

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
- [x] adapt to climate change/ extremes and its impacts
- [ ] mitigate climate change and its impacts
- [ ] create beneficial economic impact
- [x] create beneficial social impact

Land use

Cropland - Annual cropping

Water supply

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

Number of growing seasons per year: 1
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

Purpose related to land degradation

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

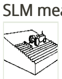
Degradation addressed

water degradation - Hw: reduction of the buffering capacity of wetland areas

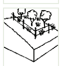
SLM group

- area closure (stop use, support restoration)
- water harvesting

SLM measures



agronomic measures - A1: Vegetation/ soil cover

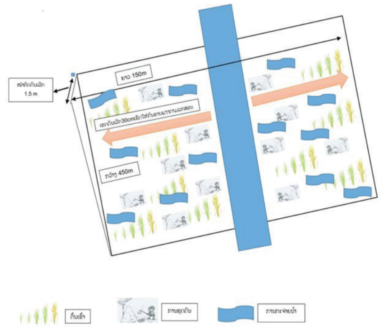


management measures - M1: Change of land use type

TECHNICAL DRAWING

Technical specifications

1. Dig to make flat land along to the banks of stream on December to January
2. Seedling preparation (January to February)
3. Ploughing
4. Transplanting of rice seedlings
5. Rice harvesting on April to May



Author: Taouy District of Agriculture and Forestry Office's team

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: **0,7**; conversion factor to one hectare: **1 ha = Hectare**)
- Currency used for cost calculation: **LAK**
- Exchange rate (to USD): 1 USD = 8000.0 LAK
- Average wage cost of hired labour per day: 50000

Most important factors affecting the costs
The preparation of the land takes lot of time and require more labour.

Establishment activities
1. Flattening of soil bank terrain (Timing/ frequency: December to January)

Establishment inputs and costs (per 0,7)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour for flattening (not paid)	person day	60.0	50000.0	3000000.0	100.0
Equipment					
Hoe	piece	2.0	30000.0	60000.0	100.0
Shovel	piece	2.0	20000.0	40000.0	100.0
Buffalo	head	1.0	7000000.0	7000000.0	100.0
Total costs for establishment of the Technology				**10'100'000.0**	

Maintenance activities
1. Labour for ploughing (Timing/ frequency: December to January)
2. Seedling preparation (Timing/ frequency: End of January)
3. Transplantation of the rice seedlings (Timing/ frequency: One month after seeding)
4. Rice harvesting (Timing/ frequency: May)

Maintenance inputs and costs (per 0,7)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour for seedling preparation	person day	2.0	50000.0	100000.0	100.0
Labour for transplanting	person day	14.0	50000.0	700000.0	100.0
Labour for harvesting	person day	14.0	50000.0	700000.0	100.0
Plant material					
Seed of rice	kg	10.0	4000.0	40000.0	100.0
Total costs for maintenance of the Technology				**1'540'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall
- < 250 mm
- 251-500 mm
- 501-750 mm
- ✓ 751-1,000 mm
- 1,001-1,500 mm
- 1,501-2,000 mm

Agro-climatic zone
- humid
- ✓ sub-humid
- semi-arid
- arid

Specifications on climate
n.a.

- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

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

Landforms
- [ ] 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.
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- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

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

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

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

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

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

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

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

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

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [x] Yes
- [ ] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [x] subsistence (self-supply)
- [ ] 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
- [x] 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
- [x] elderly

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [x] 1-2 ha
- [ ] 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

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

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

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

Water use rights
- [x] 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	Quantity before SLM: 500 kg/ha

										Quantity after SLM: 1200 kg/0.7 ha
fodder production	decreased						✓		increased	The rice straw can be used for livestock especially for cattle after rice harvest in dry season
animal production	decreased					✓			increased	The better fodder situation (rice straw) improved the animal production.
risk of production failure	increased					✓			decreased	The paddy field activity decreased risk of production failure as it get higher yield compare to upland rice cultivation.
product diversity	decreased							✓	increased	The land users can have lowland rice, diversify the vegetable by getting rice straw to mulch the vegetable plot, and they can get fish from their paddy fields.
production area (new land under cultivation/ use)	decreased			✓					increased	The upland production area decreased and is compensated only partly in the low lands (river banks)
land management	hindered				✓				simplified	
expenses on agricultural inputs	increased				✓				decreased	The Oxfarm Australia Project provide one buffalo for land users and they use the traditional seedling variety each year.
workload	increased					✓			decreased	Decreased workload as it is not labour intensive activity compare with upland rice activity.

Socio-cultural impacts

food security/ self-sufficiency	reduced					✓			improved	Increase rice production for home consumption.
cultural opportunities (eg spiritual, aesthetic, others)	reduced						✓		improved	Improve the land users believe that rice should not cultivate or soaked in water
recreational opportunities	reduced					✓			improved	The land user can take a rest along to the paddy field where peaceful and good environment.
SLM/ land degradation knowledge	reduced							✓	improved	The land users were able to generate better rice yield by simultaneous reduction of unsustainable slash and burn cultivation.
conflict mitigation	worsened					✓			improved	Improve conflict mitigation from slash and burn shifting cultivation.

Ecological impacts

plant diversity	decreased					✓			increased	Increased the number of plant diversity in the river
habitat diversity	decreased					✓			increased	Increased habitat diversity of aquaculture

Off-site impacts

impact of greenhouse gases	increased					✓			reduced	Decreasing emission of carbon and greenhouse gases by reduction of bush fires in the region due to the technology.

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	
annual rainfall increase	not well at all				✓		very well	
seasonal rainfall increase	not well at all				✓		very well	Season: wet/ rainy season

ADOPTION AND ADAPTATION

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

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

☐ single cases/ experimental	☐ 0-10%
☐ 1-10%	☑ 10-50%
☐ 10-50%	☐ 50-90%
☑ more than 50%	☐ 90-100%

Has the Technology been modified recently to adapt to changing conditions?
☐ Yes
☑ No

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
- Reduction of slash and burn cultivation areas through allocation of permanent agriculture land for local villagers.
- Increased food security for households.
- Change local belief and perceptions who never cultivated lowland rice and didn't want to cultivate rice in flooded land.

Strengths: compiler's or other key resource person's view
- The land user can use rice straws for animal fodder particularly during dry season due to limited natural grass for livestock. Besides this, rice straw provides a number of benefits including the use to cover on vegetable plots to retain soil moisture.
- Reduce time and workload in relation to the paddy field is close to the village.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome
- Insufficient suitable land availability along streams for lowland rice paddy. → Use the excavator for extend larger areas where possible.
- Rice yields from dry season remain low due to issues with land availability thereby rice shortages persist within some households.
- Pest outbreaks, including aphids, grasshoppers, birds, and rats.
- The local land users lack of technical skills for dry season rice cultivation. → Training by agriculture experts

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

REFERENCES

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Date of documentation: May 18, 2017

Last update: Nov. 28, 2018

Resource persons
ອໍາເລືອນ - land user
Theppadith - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2298/

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Water harvesting in the pond created by excavator (Chankham)

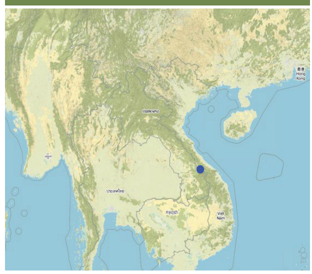
Pond development in wetland areas (Lao People's Democratic Republic)

DESCRIPTION

Conversion of wetland plots into fishpond.

At Asoy village and its neighboring villages in the Salavan Province of Lao PDR some rice fields were regularly flood prone during rainy season (August~~-~~ October) because of a newly constructed road containing culverts leading first through the rice fields and then into natural water ways. Therefore, in 2005 one of the village's land users spread the idea to convert this regularly damaged and increasingly unproductive rice land into fish ponds. The soil texture in this area is mostly clayey and therefore also generally not very suitable for agriculture, but certainly appropriate for water holding throughout the year. Thus, the main objective of these pond constructions was the raising of fishes for income generation and for getting water for household purposes during dry season; e.g. for gardening, fodder production, and for banana and bamboo cultivation along the edges of the pond dikes. The fishpond should also provide water for livestock such as cattle, buffalo, and poultry farming. The construction of the ponds in the case documented here started by shutting off the culvert at the inlets by using sawn wood and clay to close the concrete pipe (Ø80 cm) crossing the road. After, vegetation clearance was required by using a bulldozer. A backhoe then was applied to excavate an area of 1.5 ha to create a first big pond (150 m long and 100 m wide). The excavated soil was used directly for the dike construction. The dikes were around 2.5 m high and 2 m wide. For the first big pond only two dikes had to be shaped because the other two sides were road and fallow. At completion of the big pond, two smaller ponds have been constructed also by backhoe directly next to it. The first of them encompasses an area of 2,000 square meters (20 m x 100 m) and the second 3,000 square meters (30 m x 100 m). After this, four new Ø40 cm drainage pipes were installed; a first one throughout the road leading into the first pond, two of them connecting the ponds and the last pipe is needed to lead the water finally into the natural water way. The pipes have to be installed at a height of 50 cm from the edges. To stabilize the ponds Napier grass, banana, and bamboo can be cultivated on the top of the dikes. Maintenance of the pond requires regular cutting of the Napier grass, which is done by hand. Also regular weeding of the dike's edges is required, as well as the stabilization of the embankments by using timber and soil. Where repair is required, the timber can be placed vertically, and then filled out with soil. The ponds are hold and maintained individually by the land owner and the benefit of them is considerable. The annual fish production is approximately 1 ton , equivalent to 15 million Kip . The ponds also store water for utilization during dry season especially for the animals (cattle, buffalos, and poultries). The grass growing on the edges can serve as fodder for animals. Banana and bamboo shoots can be consumed and sold for income generation. Material from branches of bamboo trees is used for handicrafts such as baskets and bamboo sheets for house walls, etc. The fishpond improves the aquatic ecosystem habitats in the area. The pond provides spawning areas for a large variety of fish, shrimp, crab, and frog species. However, with changing climate and rainfall patterns it happened that the ponds dried up and the soil became hard with rapidly growing weed around the ponds. Plants such as Napier and banana that are cultivated on the edge of the dikes can die. On the other hand in particular years, there flash floods occur that can affect the dikes due to rapid water runoff; in consequence also fish and other aquatic species can be lost and crops can be damaged. Nonetheless, the land owners at Asoy village prefer this technology and want to expand and improve it, when they have

LOCATION



Location: Asoy village, Samoaui district, Salavan province, Lao People's Democratic Republic

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 106.94633, 16.30353

Spread of the Technology: applied at specific points/ concentrated on a small area

Date of implementation: 2005; 10-50 years ago

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

capability or when support from external institutions can be expected (e.g. training in fish breeding and required equipment such as hapa fish net for fish nursery, air pump, dip nets and harvesting net). Finally, the fishponds have been expanded to neighboring villages as well.


(Chankham)


Pond dyke created by excavator (Chankham)

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
- [ ] create beneficial social impact

Land use


Waterways, waterbodies, wetlands - Ponds, dams
Main products/ services: Fishs

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

Number of growing seasons per year: 1
Land use before implementation of the Technology: Before implementation of the Technology this land was a wetland that is unsuitable for agricultural activities
Livestock density: 5 buffalo, 7 goats, 30 pigs, 7 cows

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

Degradation addressed


soil erosion by water - Wg: gully erosion/ gullying


water degradation - Hw: reduction of the buffering capacity of wetland areas

SLM group
- water harvesting
- beekeeping, aquaculture, poultry, rabbit farming, silkworm farming, etc.

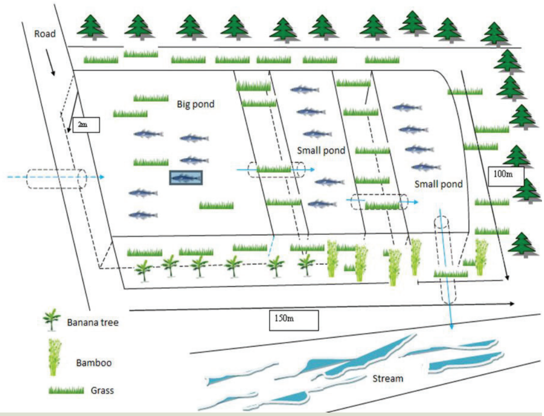
SLM measures


structural measures - S5: Dams, pans, ponds

TECHNICAL DRAWING

Technical specifications

- The dykes height is approximately 2.5m, and the water level from the bottom to the drainage pipe is 2 meters, and the canal width is 3 meters.
- The total size is 100m x150m
- Slope 3-5 %
- Water storage capacity 30,000m3
- Water storage area 1.5 ha
- Development inputs include land, concrete pipes, and sawn woods
- Fish species include: tilapia, grass fish, and crab



Author: Phonesyli phanvongsa

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology unit (unit: **1.5 ha**)
- Currency used for cost calculation: **kip**
- Exchange rate (to USD): 1 USD = 8500.0 kip
- Average wage cost of hired labour per day: 50,000

Most important factors affecting the costs

Cost for labour and backhoe service is the most important input.

Establishment activities

1. Close up the stream (Timing/ frequency: before on set of rain)
2. Exaction works at the bog wetland or seasonal flood prone area (Timing/ frequency: None)
3. Build dykes (use backhoe) (Timing/ frequency: None)

Establishment inputs and costs (per 1.5 ha)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
labour	person-day	50.0	50000.0	2500000.0	100.0
excavator	machine	1.0	3000000.0	3000000.0	100.0
Equipment					
hoe	piece	20.0	50000.0	1000000.0	100.0
shovel	piece	20.0	30000.0	600000.0	100.0
knife	piece	5.0	20000.0	100000.0	100.0
Plant material					
fodder	bunch	3.0	20000.0	60000.0	100.0
Other					
Fry	Fry	2400.0	1000.0	2400000.0	100.0
Total costs for establishment of the Technology				**9'660'000.0**	

Maintenance activities

1. Canal maintenance (Timing/ frequency: yearly)
2. Canal reparation (Timing/ frequency: yearly)
3. Canal reparation (Timing/ frequency: yearly)

Maintenance inputs and costs (per 1.5 ha)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
labour	person	6.0	50000.0	300000.0	
Equipment					
hoe	piece	1.0	50000.0	50000.0	
shovel	piece	2.0	30000.0	60000.0	
knife	piece	1.0	20000.0	20000.0	
trolley	piece	2.0	250000.0	500000.0	
Total costs for maintenance of the Technology				**930'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall **Agro-climatic zone** **Specifications on climate**

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

- [x] humid
- [ ] sub-humid
- [ ] semi-arid
- [ ] arid

Average annual rainfall in mm: 2000.0
Rainy season from May to November, highest rainfall between July to October. dry season from December to March April (rainfall)
Name of the meteorological station: Samoui Agriculture Office

Slope
- [x] flat (0-2%)
- [x] gentle (3-5%)
- [ ] moderate (6-10%)
- [ ] rolling (11-15%)
- [ ] hilly (16-30%)
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- [ ] Yes
- [x] No

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

Gender
- [ ] women
- [x] men

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

Area used per household
- [ ] < 0.5 ha
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- [x] medium-scale
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Land ownership
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- [ ] company
- [ ] communal/ village
- [ ] group
- [ ] individual, not titled
- [x] individual, titled

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

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

Access to services and infrastructure

	poor				good
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

After ponds construction various crops can be planted on the dike of the ponds.

animal production — decreased ☐ ☐ ☐ ☐ ☐ ✓ ☐ increased

Quantity before SLM: Very rare
Quantity after SLM: 1 ton of fish
Before, only small amount of fish was captured because the fish came only from natural water bodies. The farmer also increased the poultry due to the fish ponds.

risk of production failure — increased ☐ ☐ ☐ ☐ ☐ ✓ ☐ decreased

Before, only small amount of fish was captured because the fish came only from natural water bodies. The farmer also increased the poultry due to the fish ponds.

water availability for livestock — decreased ☐ ☐ ☐ ☐ ☐ ✓ ☐ increased

Before they was only a not very suitable natural bog area that accumulated peat from dead plant material and contained only shallow water. After the pond construction the water was deep enough for fish production, drinking water for livestock and also for crop irrigation.

expenses on agricultural inputs — increased ☐ ✓ ☐ ☐ ☐ ☐ ☐ decreased

After completion of the pond the farmer has to buy costly fish breed every year from Vietnam (1000 kip/fry)

farm income — decreased ☐ ☐ ☐ ☐ ☐ ✓ ☐ increased

Before the pond construction the farmer produced only for reaching self sufficiency without any income from the agricultural production. After implementation of the technology the farmer got income from fish, crop and fruit at around 15 million kip/year.

diversity of income sources — decreased ☐ ☐ ☐ ☐ ✓ ☐ ☐ increased

Previously there is not any income from agriculture produce, after pond have been complete, they have many kind of produce for sell such as banana, vegetation, fish

workload — increased ☐ ☐ ☐ ☐ ☐ ✓ ☐ decreased

Previously the farmer relied on natural wetland without substantial maintenance work. Then after completing the ponds the farmer has to spend quite a lot of work time to maintain them properly.

Socio-cultural impacts

food security/ self-sufficiency — reduced ☐ ☐ ☐ ☐ ✓ ☐ ☐ improved

After pond construction the family was able to increase food sedcurity and self-sufficiency as they got supplmentary fish, fruits and other crops for self-consumption. Futher, they were able to sale the products and by this getting money when required.

recreational opportunities — reduced ☐ ☐ ☐ ☐ ☐ ✓ ☐ improved

The pond serves now as recreational site for fishing and swimming.

Ecological impacts

harvesting/ collection of water (runoff, dew, snow, etc) — reduced ☐ ✓ ☐ ☐ ☐ ☐ ☐ improved

Before, the water streamed though the land without beeing harvested. Since the creation of the ponds - which were surrounded by dykes - the water were collected and stored easily for different already mentioned purposes.

beneficial species (predators, earthworms, pollinators) — decreased ☐ ☐ ☐ ☐ ✓ ☐ ☐ increased

There are many kind of animals in the area including prey (rats, fish, frogs...) and predators (snakes, snake fish, bird...), all acting as a small food chain elements.

habitat diversity — decreased ☐ ✓ ☐ ☐ ☐ ☐ ☐ increased

The increase in animal types and animal species in the area indicates the increase of the habitat diversity.

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	
seasonal temperature increase	not well at all	☐☐☐✓☐	very well	Season: dry season
annual rainfall increase	not well at all	☐☐✓☐☐	very well	
seasonal rainfall decrease	not well at all	☐☐✓☐☐	very well	Season: wet/ rainy season

Climate-related extremes (disasters)

local rainstorm	not well at all	☐☐☐☐✓	very well
local hailstorm	not well at all	☐☐☐☐✓	very well
drought	not well at all	☐☐☐✓☐	very well
flash flood	not well at all	☐☐☐✓☐	very well
insect/ worm infestation	not well at all	☐☐✓☐☐	very well

Other climate-related consequences

extended 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
- ☐ 1-10%
- ☐ 10-50%
- ✓ more than 50%

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

- ☐ 0-10%
- ☐ 10-50%
- ☐ 50-90%
- ✓ 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- ☐ Yes
- ✓ No

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

- Increased aquatic resources with a variety of species including crabs, shrimps, fishes, snails
- Suitable to carry out agricultural activities all year-round including crops and animal raising
- Increased food security and cash crop production

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

- Having sufficient food for the whole year from agriculture production such as crops and animals
- Able to produce fry for individual ponds and distribute to others
- Able to store water for agricultural activities (cultivation and animal feeding) during dry season
- Able to generate income for households from integrated fishing practices

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Lack of fund to maintain the ponds → Producing fry by themselves for sale. By this, creating fund for solid maintenance work.
- Occasional floods cause repair work of the pond dykes
- Some times, occurring droughts run the ponds dry.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Lack of expertise in fish raising and breeding → provide fish breeding training activities for local people
- Lack of fund for fish raising and fish breeding (purchase of juvenile fish is needed) → provide equipment or fish breeds

REFERENCES

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Last update: Sept. 11, 2018

Resource persons
Amthae Inphet - land user
tulan keosonghueang - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2905/

Linked SLM data
n.a.

Documentation was faciliated by

Institution

- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Ponds in slope area - an overview (Chankham Sinthavong)

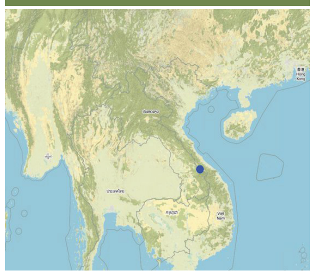
Fish pond construction on slope area on clayey subsoil for water harvesting (Lao People's Democratic Republic)

DESCRIPTION

The methods for construction of earthen pond on slope area in adjacent to the village where it forms perennial water channels with clay soil which is unsuitable for other agricultural purposes. Therefore, Oxfam encouraged the construction of communal pond to create the interest for many households to build their own ponds.

With the slope mountainous area, the top soil's soil nutrients and organisms are leached by heavy rain during wet season (July-November). This land was mainly used for Bong tree plantation (Nothaphoebe umbelliflora) and a variety of fruit trees; however, farmers have to wait for many years to be able to get small harvest from these trees. In 2004, an Oxfam Project promoted and encouraged local community to construct a communal mud-pond with a size of 50 x 40 m on steep terrains near the village. The project utilized the water resource potential by digging a pond for the villager's use as year round gravity fed water supply system. The project initially provided fish fingerlings (tilapia, silver barb: scientific name is Barbonymus gonionotus, and grass carp: scientific name is Ctenopharyngodon idella). The village residents realized immediately the significant benefits of the pond. Besides raising fishes in the pond, local people could use water for household gardening and as a source of drinking water for livestock (cow, water buffalo, pig, duck, etc). The pond is easy to manage and maintain whilst it is also more convenient to collect aquatic resources in proximity to the village. Typically, the potential site condition for pond construction is steep mountainous terrain with average slope of 10 - 15 degrees. The soil property should be clay or silt clay which can hold the water.
Later after the community pond has been constructed some villagers who had potential land left constructed their individual ponds to improve their own production. This because they have seen the benefit of communal pond which can provide approximately 200 - 300 kg of fish per years. The individual pond construction reduced finally also conflicts caused by different issues of the community pond.
The construction of the pond is not very complicated. First, the water valves from GFS (provided by the Poverty Reduction Fund) turned off the sources water from the upstream area. Bush clearing, tree felling, stump removal and vegetation stockpiling (for burning) was then required on construction areaof the pond The pond size should be designed at a size of approx. 30 x 20m. Next step, the manual excavation works (by using hoes and shovels) should ba undertaken at upper section of the canal. The ground has to be excavated with an average depth between 0.5 – 1m and with the excavated soil pond dyke has to be alligned arround the pond area (square shape). The dykes soil has to be compressed to very compact barriers to prevent water leaking and dyke erosion (even small holes in dyke can rapidly enlarge, leading to the potential future damages and dyke bursting). The pond dyke's height is 1.2m in hight and 2m wide with dyke slopes from the foot to the edge (where it also provides a walkway for feeding fishes or gardening) is approximately 45%. The design of the thick dyke is to ensure its stability from soil erosion as a result from a certain fish species that pierces the dyke slopes and rapid water flow. If the pond dyke is designed with fewer slopes, it will be susceptible to soil erosion. At least a drainage outlet is required with a P100 pipe for 4m long. The pipe should be installed with 1m height from the pond bottom at the outlet. This pipe will drain water and prevent overflow that may cause damage to the dyke. The pond area later need to be leveled by using hoes and shovels cut the undulating area. Then should

LOCATION



Location: Tangko village, Samoaui district, Salavan province, Lao People's Democratic Republic

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 106.91427, 16.31398

Spread of the Technology: applied at specific points/ concentrated on a small area

Date of implementation: 2007; 10-50 years ago

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

be kept the pond bottom dry for at least one week to allow time for pond repair as well as to increase the production of the pond bottom, after that fill the water into the pond by turn on the inlet valves that have been turn off earlier. This pond construction method may require intensive labors and extensive time to complete. Funding for construction tools and construction method are still insufficient. However, this is the effective way to maximize water from perennial stream for integrated management and its benefits are considerable especially for fish consumption in household and selling for generate household income.

Individual ponds structure measures on slopping area (Chankham Sinthavong)

Community pond and individual pond close to the village (Chankham Sinthavong)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [ ] 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
- [x] create beneficial social impact
- [x] reduce conflicts

Land use

Unproductive land - Specify: the type of soil in that area are silt and heavy clay so water can not penetrate into the soil

Water supply

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

Number of growing seasons per year: 1

Land use before implementation of the Technology: Before the application of the Technology the area was covered by several types of vegetation, and also by fruit trees of very low yield. It has taken a long period until the first harvest was possible. This compared to the short term benefits of fish raising.

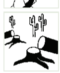
Livestock density: 2 pigs, 2 goat, 10 Poultry

Purpose related to land degradation

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

Degradation addressed

soil erosion by water - Wg: gully erosion/ gullying



biological degradation - Bc: reduction of vegetation cover

SLM group

- cross-slope measure
- water harvesting

SLM measures

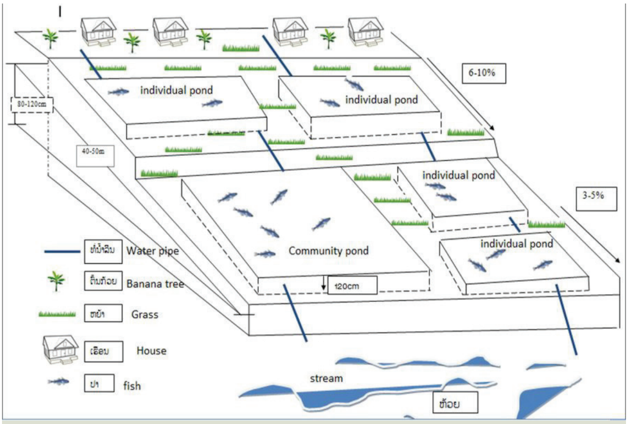
structural measures - S1: Terraces, S5: Dams, pans, ponds, S7: Water harvesting/ supply/ irrigation equipment

management measures - M1: Change of land use type

TECHNICAL DRAWING

Technical specifications

Generally pond construction in the village are the same structure because they relay on community's pond such oxfarm was excavated for them but smaller.
the area of community's pond is 50 x 30 m
the area of individual pond is 30 x 15 m
height of the pond dyke is 120 m, width 2m
depth of the water is 1m
Slope angle before 10-16% and after 3-5 % the implementation of the Technology
Construction material used include: hoe and shovel use for digging the soil to make the pond dykes or leveling the pond bottom.
Inlet tube length 80m from water sources to the ponds and outlet by using concrete pipe p100 to prevent flooding.
Capacity of pond approximate 450 m3.
Potential of pond is for water harvesting and reduce severe water runoff on the surface.
beneficial area of ponds is can produce fish and another living aquatic resources for self consumption.
Fish species used is Tilapia, common carp, grass carp, silver barb.



Author: Phonesyri Phanvongsa

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology unit (unit: **individual fish pond** volume, length: **30 X 15 meters**)
- Currency used for cost calculation: **kip**
- Exchange rate (to USD): 1 USD = 8400.0 kip
- Average wage cost of hired labour per day: 35000 kip

Most important factors affecting the costs
Most important factors is labor for digging the pond

Establishment activities
1. weeding and cleaning the area (Timing/ frequency: before onset of rain, January - Mach)
2. Burning the vegetation (Timing/ frequency: before onset of rain)
3. Making pond dyke and add outlet pipe (Timing/ frequency: before onset of rain)
4. Fill the water into the pond (Timing/ frequency: beginning of rain)

Establishment inputs and costs (per individual fish pond)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
labor for digging an individual fish pond (for individual fish pond)	person-day	180.0	35000.0	6300000.0	100.0
Equipment					
hoe	piece	4.0	50000.0	200000.0	100.0
shovel	piece	5.0	30000.0	150000.0	100.0
knife	piece	2.0	30000.0	60000.0	100.0
Construction material					
pipe	m	80.0	15000.0	1200000.0	
Total costs for establishment of the Technology				**7'910'000.0**	

Maintenance activities
1. Drainage (Timing/ frequency: After harvesting, the end of rainy season)
2. Clean the pond bottom (Timing/ frequency: After drainage)
3. Repair the pond dyke (Timing/ frequency: Before on set of rain)
4. Refill the pond (Timing/ frequency: None)

Maintenance inputs and costs (per individual fish pond)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
labor for drainage	person-day	1.0	35000.0	35000.0	100.0
clean the pond bottom	person-day	2.0	35000.0	70000.0	100.0
labor for repair pond dyke	person-day	3.0	35000.0	105000.0	100.0
refill the pond	person-day	1.0	35000.0	35000.0	100.0
Equipment					
hoe	piece	2.0	50000.0	100000.0	100.0
shovel	piece	2.0	30000.0	60000.0	100.0
Total costs for maintenance of the Technology				**405'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [x] 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
- [x] humid
- [ ] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate
Average annual rainfall in mm: 500.0
Rainy season from May to November, highest rainfall between July to October. dry season from December to March April (rainfall)
Name of the meteorological station: Samoaui Meteorological station

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

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

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [x] 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
- [x] convex situations
- [ ] concave situations
- [ ] not relevant

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

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

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

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

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

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

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

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [x] 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
- [ ] poor
- [x] average
- [ ] rich
- [ ] very rich

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

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

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

Gender
- [ ] women
- [x] men

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

Area used per household
- [x] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 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

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

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

Land use rights
- [ ] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [x] 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	Quantity before SLM: 20 kg Quantity after SLM: 5 kg Loss of land for crop cultivation because the villagers turned the crop land to pond area
animal production	decreased						✓		increased	Quantity before SLM: 200 kg Quantity after SLM: 300 kg Increase in aquatic product"bag" and decrease of hunting "bag"
production area (new land under cultivation/ use)	decreased			✓					increased	Quantity before SLM: 3 vegetable plots Quantity after SLM: 2 vegetable plots because they moved crop their crop cultivation to an other, smaller area
water availability for livestock	decreased						✓		increased	Previously the animal must to go to the river or stream to drink water after ponds has been constructed there is water available for animals in the ponds
workload	increased						✓		decreased	Decreasing in the workload for land user as he does not have to go fishing in the stream far away from the village

Socio-cultural impacts

food security/ self-sufficiency	reduced						✓		improved	Improved fish production and could contribute fish for home consumption for whole year
land use/ water rights	worsened					✓			improved	Improved land use right for fish pond as individual households have their own fish pond
community institutions	weakened						✓		strengthened	The village head did not supported the management of community pond (this caused fish depletion). Later, after the individual ponds have been constructed the village head steered the organization of maintenance work on the community pond. This allowed e.g. fishing during village festivals there. Individual ponds are maintained always by the owners themselves.
conflict mitigation	worsened							✓	improved	Improved and reduced the conflict with neighbors regarding fishing as they conduct now their own fish ponds.

Ecological impacts

harvesting/ collection of water (runoff, dew, snow, etc)	reduced							✓	improved	Improved water runoff by construction of fish pond
animal diversity	decreased					✓			increased	Increase in aquatic animals regarding both quantity and species such as crab, snail and the land user can have exotic species of fish (Tilapia, common cap).
habitat diversity	decreased						✓		increased	Decreased of vegetation on soil surface

Off-site impacts

downstream siltation	increased				✓				decreased	Reduced surface runoff by heavy rain

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	
seasonal temperature decrease	not well at all				✓		very well	Season: wet/ rainy season
seasonal temperature increase	not well at all					✓	very well	Season: dry season
annual rainfall increase	not well at all				✓		very well	
seasonal rainfall increase	not well at all				✓		very well	Season: wet/ rainy season
seasonal rainfall decrease	not well at all		✓				very well	Season: dry season
Climate-related extremes (disasters)								
local rainstorm	not well at all			✓			very well	
local hailstorm	not well at all			✓			very well	
local windstorm	not well at all			✓			very well	
cold wave	not well at all		✓				very well	
drought	not well at all		✓				very well	
flash flood	not well at all		✓				very well	
landslide	not well at all			✓			very well	
epidemic diseases	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
- [ ] 1-10%
- [x] 10-50%
- [ ] more than 50%

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

- [ ] 0-10%
- [ ] 10-50%
- [x] 50-90%
- [ ] 90-100%

Number of households and/ or area covered

5 households in Tangko village have their own private fish pond and some of them are taking the initiative to increase the number of individual fish pond where possible.

Has the Technology been modified recently to adapt to changing conditions?

- [x] Yes
- [ ] No

To which changing conditions?

- [ ] climatic change/ extremes
- [ ] changing markets
- [ ] labour availability (e.g. due to migration)
- [x] Conflict mitigation

At the beginning in 2004 only a community pond has been constructed. Later villagers started to construct also individual ponds to mitigate social tensions caused by weak coordination of maintenance work concerned with this community pond.

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- As the individual fish ponds are located close to the house it is easily for the land users to go fishing and maintain whenever they want. This serves time.
- All year round availability of water
- Increased in food and nutrition security for household members

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

- The villagers will be able to produce fish also for the next generation

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Onset of heavy rain can damage the pond dykes and leading to erosion
- Floods in rainy season → Use bigger pipe for outlet
- The technology is labour intensive regarding repair of the dykes → Use concrete dyke to make the dyke stronger

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- The land user have not real experience and knowledge on pond construction (with regard to flash floods) → Organize training course on pond construction
- The pond owner have no experience and knowledge on fish propagation. But not being able to propagate fish properly by themselves may increase their expenses in agriculture needlessly. → Organize training course to get fish breeding and propagation expertise

REFERENCES

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Date of documentation: July 9, 2017

Last update: Nov. 21, 2018

Resource persons
nep Amdang - land user
Kousoai Amdo - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2920/

Linked SLM data
n.a.

Documentation was faciliated by

Institution

- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Fish pond adjacent to paddy rice field (Jimmy Luangphithack)

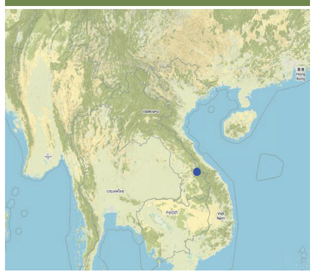
Use of water from fishpond for dry season paddy rice cultivation (Lao People's Democratic Republic)

DESCRIPTION

Technique on the use of water from fishpond for dry season rice cultivation to increase yields

Technique on the use of water from fishpond for dry season rice cultivation has been introduced in 2010 with an area of 0.5 ha of irrigated rice paddies. Dry season rice cultivation is typically hindered by insufficient water supply. Usually, farmers can only conduct rainfed rice cultivation. However, in 2012 a land user had an idea to maximize benefits from land use: He hired a backhoe to develop a pond for fish breeding. The pond has a total area of 1,700 m2 (50m x 30m) and is 1.5m deep. A canal has been dug to fill the pond with water from a nearby stream. In addition to fish breeding, he also used water from the pond for rice cultivation for both dry and wet seasons. Small irrigation canals were constructed with 40cm width to supply water to rice paddies. This technique provides additional agriculture and aquaculture benefits including fish, rice, and thus increased food security for household. In addition to this, the rice paddies are more productive throughout the plantation seasons. The fishpond also serves as erosion control facility by retaining water run-offs from forest areas. This is because the pond can hold water discharge from forests before reaching agricultural areas (rice field). Therefore, this land can sustain agricultural activities and reduce localized drought. However, supplying water to higher area remains difficult, as farmers cannot provide sufficient water without pumping. After adopting this technique, land users are very satisfied with the outputs as they can cultivate rice for all year round – both dry and rainy seasons. As a result, they can have higher crop produce (rice). They can also raise fish that provides meat for household consumption. The family is now better off. In addition, the soil is more moist and not developing clods like it used to be in the past.The fishpond is 50m long, 30m wide and 1.5m deep. The water gate is 40cm x 40cm and made of wood plank , when the rice field insufficient of water particularly in dry season, the farmer will open the gate to drain water from the pond to rice fields. They can use half of the water from the pond for one time and then the pond will be gradually filled up with water from the stream via canal (it take a few day to recharge the pond) and then they can irrigate their paddies again. The pond was developed right next the rice paddies with a canal of 40cm width between them, blocked by the gate. Diesel water pump with 5 HP is used to pump water from the fishpond to another 0.5ha rice paddy field uphill where the water in the pond is lower than the rice field that has relative slopes between 3-5% higher than fish pond on uphill. (characterized as terrain rice paddies). Fish fingerlings include tilapia, common carp, grass carp , in the growing period of fishes mostly the land user feed them by rice bran because it is easy to find. For the pump and gate when irrigating the paddy upstream or drained to the paddy field downstream they install the plastic net as a filter to avoid fish loss. The pond storage capacity is 2,000 m3 with supply water from natural sources runs through constructed channel that people have recently developed. Strengths (1) use of water from the fishpond for rice cultivation in both dry and rainy season, enabling agricultural activities without the use of water from irrigation system. (2) enable to breed and propagate fish fingerlings Weakness (1) fishpond is located lower than agricultural land and thus rice cultivation can be conducted in limited area through gravity fed; (3) diesel water pump is needed to supply water for rice cultivation.

LOCATION



Location: Doup village, Ta-oy District, Salavan Province, Lao People's Democratic Republic

No. of Technology sites analysed: single site

Geo-reference of selected sites

- 106.69135, 16.15122

Spread of the Technology: applied at specific points/ concentrated on a small area

Date of implementation: 2012; less than 10 years ago (recently)

Type of introduction

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

The outlet on the corner of the pond dyke able to open to drain water into the rice field (Jimmy Luangphithack)

The outlet door between pond and rice field (Jimmy Luangphithack)

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
- [x] 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

Cropland - Annual cropping
Main crops (cash and food crops): Paddy rice

Waterways, waterbodies, wetlands - Ponds, dams
Main products/ services: Produce fish and using water in the pond for paddy rice cultivation

Water supply

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

Number of growing seasons per year: 2
Land use before implementation of the Technology: n.a.
Livestock density: 1000 fish/season

Purpose related to land degradation

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

Degradation addressed

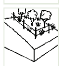
soil erosion by water - Wg: gully erosion/ gullying

SLM group

- water harvesting
- irrigation management (incl. water supply, drainage)
- beekeeping, aquaculture, poultry, rabbit farming, silkworm farming, etc.

SLM measures

structural measures - S5: Dams, pans, ponds, S7: Water harvesting/ supply/ irrigation equipment

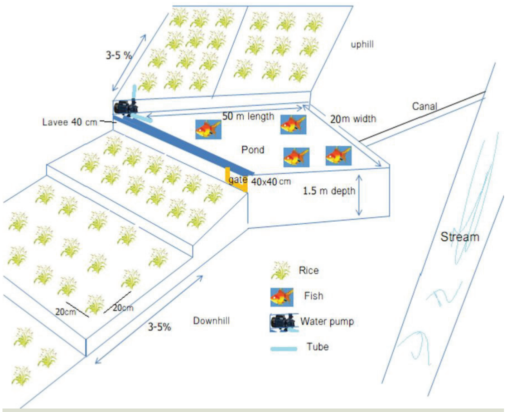


management measures - M1: Change of land use type

TECHNICAL DRAWING

Technical specifications

Fish pond have length 50 m, wide 20 m and depth 1.5 m. On the pond levees (thick 40 cm) where adjacent to the rice field is installed the outlet door 40 x 40 cm made by wood Slope angle of structure in downhill and uphill is about 3-5% Fish species used in the pond including : Tilapia, Silver cap, Grass cap Capacity of the pond is 2000 m3 Pump and tubes for uphill irrigation, tube is length 10 m.



Author: Phonesyli Phanvongsa

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology unit (unit: **Fish pond** volume, length: **length 50m, width 20m, volume 2000m3**)
- Currency used for cost calculation: **kip**
- Exchange rate (to USD): 1 USD = 8000.0 kip
- Average wage cost of hired labour per day: 50000 kip

Most important factors affecting the costs

The excavator and labor is important effect to the cost

Establishment activities

1. Digging the pond (using excavator) (Timing/ frequency: In April)
2. Build an embankment (levee) (Timing/ frequency: In April)
3. Dig a canal from stream to pond (Timing/ frequency: In April)
4. Construct a wooden gate (Timing/ frequency: In April)
5. Fill water into the pond (Timing/ frequency: May)
6. Install pump and tubes for paddy irrigation uphill (Timing/ frequency: May)

Establishment inputs and costs (per Fish pond)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
abor for Build an embankment (levee) and Construct a wooden gate	person	6.0	50000.0	300000.0	100.0
Labor for Dig a canal from stream to pond	person	5.0	50000.0	250000.0	100.0
Labor for Fill water into the pond and Install pump and tubes for paddy irrigation uphill	person	2.0	50000.0	100000.0	100.0
Equipment					
Shovel	piece	2.0	25000.0	50000.0	100.0
Excavator	Day	2.0	500000.0	1000000.0	
Hoe	piece	3.0	40000.0	120000.0	
Pump	Machine	1.0	1200000.0	1200000.0	
Tube	Meter	10.0	8000.0	80000.0	
Construction material					
Wood	piece	2.0	15000.0	30000.0	
Other					
Young fish	fish	1000.0	200.0	200000.0	
Total costs for establishment of the Technology				**3'330'000.0**	

Maintenance activities

1. Levees repair (Timing/ frequency: After harvest in June and November)
2. Repair Outlet door (Timing/ frequency: Time a year)
3. drained water to the paddy field (Timing/ frequency: Before planting rice)
4. Pumping water to uphill paddy (Timing/ frequency: Before planting rice)
5. Fish feeding (Timing/ frequency: time /day)

Maintenance inputs and costs (per Fish pond)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
Labor for repair levees and outlet door	Person	4.0	50000.0	200000.0	100.0
Labor for drained water to the paddy field	Person	1.0	50000.0	50000.0	100.0
Labor for Pumping water to uphill paddy	Person	1.0	50000.0	50000.0	100.0
Labor for Fish feeding	Person	1.0	50000.0	50000.0	100.0
Equipment					
Hoe	Piece	2.0	40000.0	80000.0	100.0
Shovel	Piece	2.0	25000.0	50000.0	100.0
Construction material					
Wood		2.0	15000.0	30000.0	100.0
Total costs for maintenance of the Technology				510'000.0	

NATURAL ENVIRONMENT

Average annual rainfall
- < 250 mm
- 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
- semi-arid
- arid

Specifications on climate
Average annual rainfall in mm: 700.0
From January - March is less rain, in April is more rain and highest is from July - September then decrease in October till December
Name of the meteorological station: Doup village meteorological Office
Warmest is in May with average temperature 27c
Coldest in January with average temperature is 20c

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

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

Altitude
- 0-100 m a.s.l.
- ✓ 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)
- moderately deep (51-80 cm)
- deep (81-120 cm)
- very deep (> 120 cm)

Soil texture (topsoil)
- coarse/ light (sandy)
- ✓ medium (loamy, silty)
- 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%)
- low (<1%)

Groundwater table
- on surface
- ✓ < 5 m
- 5-50 m
- > 50 m

Availability of surface water
- excess
- good
- ✓ medium
- poor/ none

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

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- ✓ Yes
- No

Species diversity
- high
- ✓ 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
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ 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
- ✓ men

Age
- children
- ✓ youth
- ✓ middle-aged
- elderly

Area used per household
- < 0.5 ha

Scale
- ✓ small-scale

Land ownership
- state

Land use rights
- open access (unorganized)

- ✓ 0.5-1 ha
- ☐ 1-2 ha
- ☐ 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

- ☐ medium-scale
- ☐ large-scale

- ☐ company
- ☐ communal/ village
- ☐ group
- ✓ individual, not titled
- ☐ individual, titled

- ☐ communal (organized)
- ☐ 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

Quantity before SLM: Produce rice only 1 season a year with 0.6 ton/year
Quantity after SLM: Able to produce 2 seasons paddy rice is more than 1 ton/year
Increasing in yield because of there is enough water for 2 seasons paddy rice cultivation

risk of production failure — increased ☐☐☐☐☐☐✓ decreased

The availability of water from the pond guarantees for paddy rice cultivation also in the dry season.

expenses on agricultural inputs — increased ☐☐☐☐☐✓☐ decreased

Pond can provide water for raising fish and irrigate paddy especially in dry season both quantity and quality

farm income — decreased ☐☐☐☐☐✓☐ increased

Increase in yield due to able a to cultivate 2 season of rice and addition income from selling fish

Socio-cultural impacts

food security/ self-sufficiency — reduced ☐☐☐☐☐✓☐ improved

In the past before pond construction, one season rice cultivation is enough for 6-8 months for family consumption, after this technique has been introduced, the farmers were able to expand the production area and produce rice also in the dry season, such that they produce sufficient rice to feed their families all year round

conflict mitigation — worsened ☐☐☐☐☐✓☐ improved

Water in the pond is enough for paddy rice cultivation which reduced using irrigation in the village. The pond has been filled by the canal that farmers made to drain water form the stream. the neighbor can use water from the canal as well.

Ecological impacts

water quantity — decreased ☐☐☐☐☐✓☐ increased

Paddy rice cultivation is rely on raining when dry season is coming, the farmer use water from the pond that refill by the stream via canal (water harvesting in the pond)

soil moisture — decreased ☐☐☐☐☐☐✓ increased

In dry season the soil was dry out became crusting now day they can fill the water from the pond to improve the dry soil when they need.

soil crusting/ sealing — increased ☐✓☐☐☐☐☐ reduced

Because of the water in the pond when the soil are dry out and became soil crusting farmer will let the water into the fields to improve and prepare the cultivation area

animal diversity — decreased ☐☐☐☐✓☐☐ increased

Because of making the pond there is a lot of aquatic animal such as shrimps, crabs, snail, fishes, snakes, frogs...

drought impacts — increased ☐☐☐☐☐✓☐ decreased

Drought impacts is decreased because when the drought occur they can use the water storage in the pond cope with this impacts

Off-site impacts

downstream siltation — increased ☐☐☐☐✓☐☐ decreased — Less siltation down streams to the pond which is trapping sediments

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 decrease — not well at all ☐☐☐✓☐ very well

seasonal temperature increase — not well at all ☐☐☐✓☐ very well — Season: wet/ rainy season

annual rainfall increase — not well at all ☐☐✓☐☐ very well

seasonal rainfall increase — not well at all ☐☐✓☐☐ very well — Season: wet/ rainy season

increase — not well at all ☐☐☐✓☐ very well

Climate-related extremes (disasters)

local rainstorm — not well at all ☐✓☐☐☐ very well

local hailstorm — not well at all ☐✓☐☐☐ very well

ADOPTION AND ADAPTATION

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

- ✓ single cases/ experimental
- ☐ 1-10%
- ☐ 10-50%
- ☐ more than 50%

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

- ☐ 0-10%
- ☐ 10-50%
- ☐ 50-90%
- ✓ 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- ☐ Yes
- ✓ No

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

- By using water in the pond farmer able to produce paddy rice for 2 seasons (wet and dry season)
- Potential of raising and propagate aquatic animal

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

- Able to cultivate paddy rice without irrigation system

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- The pond area is lower than cultivation area , water flow is limited. → Must use pump to fill the water to the rice field

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

REFERENCES

Compiler

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Date of documentation: July 11, 2017

Last update: Nov. 21, 2018

Resource persons

Umnoi Moad - land user

Full description in the WOCAT database

https://qcat.wocat.net/en/wocat/technologies/view/technologies_2923/

Linked SLM data

n.a.

Documentation was faciliated by

Institution

- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Prevention of soil erosion

Vegetable home garden in sloping terrain (Khampheng Bounphanya)

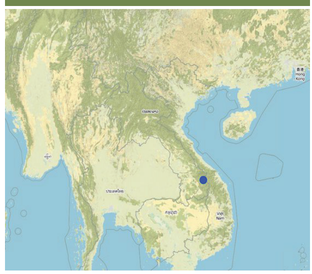
Vegetable garden to improve vegetation cover in sloping land (Lao People's Democratic Republic)

DESCRIPTION

The technique involving the creation of vegetable home gardens on sloping land was initiated through the villagers' local insight and it has been practiced over many generations. Due to the fact that the village is located on sloping land there are limitations regarding the availability of agricultural land suitable for growing vegetables in a home garden.

The local farmers mainly grow vegetables with other crops such as upland rice in upland areas and vegetable home gardens. In addition, they grow also vegetables along riverbanks during the dry season. Land users living on mountainous areas typically grow vegetables during the wet season and some manage to cultivate them during dry season if appropriate land is available along streams and river banks. Vegetables have traditionally been cultivated by farmers in Darkchung district on terraced fields for many generations. However, growing vegetables on areas of land with a higher gradient (rolling slopes: 11-15%) has a number of restrictions, namely the lack of suitable land available and the limited water supply. As a result of these restrictions on land and water farmers have developed their own initiatives to enable the cultivation of vegetables on sloping land both for household consumption and for sale. The vegetables most commonly grown are coriander, morning glory, and Chinese cabbage and mustard leaf. In 2000 farmers expanded their vegetable gardens on slopes by preparing and cultivating the land manually. Suitable land for such vegetable gardens can be selected along the lower banks of a stream (there should be a distance of approximately 5 – 10 meters from the river to the vegetable plots). Firstly, grass has to be removed prior to ploughing the soil manually. Then the soil from the top part of the land should be transferred to the bottom to result in a levelling effect so that a relatively flat garden bed is created. The preparation process to develop the whole garden takes about 3 – 4 weeks and requires a team of two to three people. In the preparation process there is a distinctive drawback when the farmers remove the humus and topsoil from the upper section of the field and leave the less fertile subsoil behind. As a result, this might affect the productivity during the early stage of vegetable growth; and on the contrary the lower sections piled with nutritious topsoil from the upper parts become more suitable for plant growth. To solve this problem, the farmers shape and level the nutrient-rich topsoil up to 3-4 small terraces top down. On average, with an area of 0.01ha such vegetable fields in Darkchung district are divided into small terraces with a width of 60 – 80 centimetres and a length of 2 – 3 metres (about 7 – 8 terraced plots per household, mostly two terrace arrangements in parallel). There is approximately a 30 cm difference between the levels of the upper to the next lower vegetable terrace. Once the land levelling has been completed, the farmers are then able to prepare the plots by firstly ploughing the soil and then letting it dry for 5 – 7 days. The next stage involves the use of wooden poles to break down bigger clods of earth. Then a small earth dike (10cm in hight) is pilled up around each terrace to protect furhter against soil erosion by water. Before starting the vegetable cultivation fencing is needed against animal entry. After this, they use a rake to adjust the plot's surface. The benefits of this terracing method is to extend the cultivation of vegetables on stream river banks for the household consumption. Futhermore, the terracing method and the better soil cover lead to protection of the stream banks from erosion and sediment transport. However, this

LOCATION



Location: Darkchung district, Xekong province, Lao People's Democratic Republic

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 107.21293, 15.63056

Spread of the Technology: evenly spread over an area (approx. < 0.1 km2 (10 ha))

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
- ☐ through projects/ external interventions

technique have some constraints as well beause it is difficult to level the surface of the soil in these areas particularly by removing soil from the upper sections to the lower sections of the terraces.

CLASSIFICATION OF THE TECHNOLOGY

Main purpose
- ✓ improve production
- ✓ 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

Cropland - Annual cropping
Main crops (cash and food crops): Chinese mustard and cabbage

Water supply
- rainfed
- mixed rainfed-irrigated
- full irrigation
- ✓ Water from stream

Number of growing seasons per year: 3
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

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

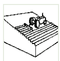
Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullying

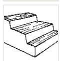
biological degradation - Bc: reduction of vegetation cover

SLM group
- improved ground/ vegetation cover
- cross-slope measure
- home gardens

SLM measures



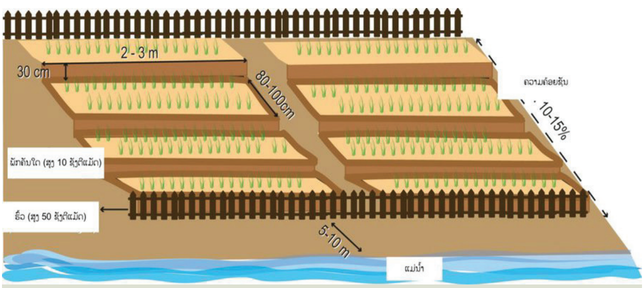
agronomic measures - A1: Vegetation/ soil cover



structural measures - S1: Terraces

TECHNICAL DRAWING

Technical specifications
The average gradient for vegetable cultivation in terrain ranges from 10 – 15% and the distance from the stream to the vegetable plots is approximately 5 metres. The width of the average plot is about 80 – 100 cm, and the length is 2 -3 metres with the difference in height between the upper and the next lower terrace is about 30 cm. Fencing around the vegetable plot is needed to prevent damages done by animals (goats, cows etc.)



Author: U.Gaemperli

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: **200 Square meters**; conversion factor to one hectare: **1 ha = 0,02 Hectare**)
- Currency used for cost calculation: **LAK**
- Exchange rate (to USD): 1 USD = 8000.0 LAK
- Average wage cost of hired labour per day: 30000

Most important factors affecting the costs
The labour for land levelling is the most important factor affecting the costs.

Establishment activities
1. Land preparation (ploughing and levelling into terraces) (Timing/ frequency: Before rainy season)
2. Fencing (Timing/ frequency: Before vegetable planting)

Establishment inputs and costs (per 200 Square meters)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour for land ploughing and levelling	person day	21.0	30000.0	630000.0	100.0
Labour for fencing	person day	4.0	30000.0	120000.0	100.0
Equipment					
Shovel	piece	2.0	100000.0	200000.0	100.0
Digger tool	piece	2.0	100000.0	200000.0	100.0
Construction material					
Nails	kg	2.0	10000.0	20000.0	100.0
Wire	roll	2.0	60000.0	120000.0	100.0
Wooden posts	piece	80.0	5000.0	400000.0	100.0
Wooden plank	piece	20.0	5000.0	100000.0	100.0
Bamboo	piece	300.0	2000.0	600000.0	100.0
Total costs for establishment of the Technology				2'390'000.0	

Maintenance activities

1. Reshaping of the the terraces (maintenance of terraces) (Timing/ frequency: After harvesting)
2. Planting of seedling (Timing/ frequency: After land preparation)
3. Weeding (Timing/ frequency: From time to time)
4. Manure (Timing/ frequency: From time to time)

Maintenance inputs and costs (per 200 Square meters)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour for re-levelling the terraces	person day	4.0	30000.0	120000.0	100.0
Labour for weeding	person day	3.0	30000.0	90000.0	100.0
Labour to apply manure	person day	1.0	30000.0	30000.0	100.0
Labour for planting	person day	3.0	30000.0	90000.0	100.0
Plant material					
Seedling	bag	4.0	5000.0	20000.0	100.0
Fertilizers and biocides					
Manure	kg	30.0	5000.0	150000.0	100.0
Total costs for maintenance of the Technology				500'000.0	

NATURAL ENVIRONMENT

Average annual rainfall
- ☐ < 250 mm
- ☐ 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
- ☐ semi-arid
- ☐ arid

Specifications on climate
Name of the meteorological station: Darkchung meteorological station

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

Landforms
- ☐ plateau/plains
- ☐ ridges
- ☑ mountain slopes
- ☐ hill slopes
- ☐ footslopes
- ☐ valley floors

Altitude
- ☐ 0-100 m a.s.l.
- ☐ 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)
- ☑ moderately deep (51-80 cm)
- ☐ deep (81-120 cm)
- ☐ very deep (> 120 cm)

Soil texture (topsoil)
- ☑ coarse/ light (sandy)
- ☑ medium (loamy, silty)
- ☐ 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%)
- ☐ low (<1%)

Groundwater table
- ☐ on surface
- ☑ < 5 m
- ☐ 5-50 m
- ☐ > 50 m

Availability of surface water
- ☐ excess
- ☑ good
- ☐ medium
- ☐ poor/ none

Water quality (untreated)
- ☐ good drinking water
- ☐ poor drinking water (treatment required)
- ☑ for agricultural use only (irrigation)
- ☐ unusable

Is salinity a problem?
- ☐ Yes
- ☑ No

Occurrence of flooding
- ☐ Yes

✓ No

Species diversity
- high
- ✓ 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
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ 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
- 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
- 15-50 ha
- 50-100 ha
- 100-500 ha
- 500-1,000 ha
- 1,000-10,000 ha
- > 10,000 ha

Scale
- ✓ small-scale
- medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- individual, not titled
- ✓ individual, titled

Land use rights
- ✓ open access (unorganized)
- communal (organized)
- 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	Increase crop production
risk of production failure	increased					✓			decreased	Lower risk of flooding compared to other areas of vegetable gardens located in the lower plains.
product diversity	decreased						✓		increased	Increase and diversification of vegetable production from their own vegetable home gardens due to enlargement of production area.
production area (new land under cultivation/ use)	decreased					✓			increased	Quantity before SLM: 0.02 ha Quantity after SLM: 0.04 ha
land management	hindered						✓		simplified	As the land users use sloping land on river banks nearer to the village by shaping the land into terraces the land management for vegetable gardens has been simplified compared to the collection of wild vegetable on sloping forest area far away from the village.
farm income	decreased						✓		increased	Before the farmers mainly produced for their home consumption. After: The vegetable production increased substantially to a level it can be also sold at the local market.
diversity of income sources	decreased						✓		increased	The new option to sell vegetables at the local market diversified the income sources.
workload	increased			✓					decreased	Workload decreased mainly for women as they do not have to spent time anymore to collect wild vegetables

in the broad upland forest.

Socio-cultural impacts

situation of socially and economically disadvantaged groups (gender, age, status, ehtnicity etc.) — worsened / improved

Women benefit from this technology and it reduces the women's workload to collect vegetable from forest.

Ecological impacts

soil loss — increased / decreased

Protect stream banks from soil erosion by rain water.

vegetation cover — decreased / increased

Increased vegetation cover by the vegetable plantation. Before it was fallow covered with scarce grass vegetation.

Off-site impacts

buffering/ filtering capacity (by soil, vegetation, wetlands) — reduced / improved

Less sediment transportation due to improved vegetation cover in the slope areas of the river banks.

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

-

ADOPTION AND ADAPTATION

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

- single cases/ experimental
- 1-10%
- ✓ 10-50%
- more than 50%

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

- 0-10%
- 10-50%
- 50-90%
- ✓ 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- Yes
- ✓ No

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

- Lower risk of flooding in relation to other vegetable fields which are located in the lower plains.
- Vegetable cultivation generates an income as well as provides food for farmers.
- Gardening is an activity which women can actively and fully become involved in as it can be implemented in the village.

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

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Vegetables require fertilizers to improve the yield. → Farmers also need to collect timber as building material to support the earth terraces so that fertilizer can be retained within the field.
- Establishing and maintaining vegetable production is time consuming as it includes a number of activities such as land levelling, fertilizing, and the construction of fencing to prevent animal entry. → It also requires other equipment and tools for fencing.
- Suitable land is limited due to mountainous terrains.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- The site selection for establishment. → This technique will establish in slopes area (less than 15% of slop) and the plots are located approximately 5 meters from the river/stream in order to avoid soil erosion.
- Land preparation and land levelling – farmers mainly remove top soil from upper to lower section to level the plots. → People will remove soil from the upper to the lower sections of the plots in order to level them. Topsoil may have to be temporarily stockpiled somewhere so that it can be used

as backfill where it is needed as the topsoil is more fertile and thus more productive.

REFERENCES

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Date of documentation: Aug. 21, 2017

Last update: Oct. 29, 2018

Resource persons
Homsamone - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_3139/

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Broom grass cultivation on slope area (Theppadith Meunpanthavong)

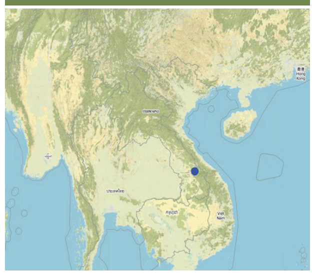
Broom grass cultivation to prevent soil erosion in sloping area (Lao People's Democratic Republic)

DESCRIPTION

The technique involves the planting of broom grass in order to prevent landslide in mountainous and stream areas which are adjacent to agricultural land. This is because broom grass has an extensive root system which can help to bind the soil. Additionally, farmers can generate an income from broom grass.

Climate change has impacted agricultural practices and the livelihoods in rural mountain areas. Due to the occurrence of more volatile climate conditions including more frequent and intense rainfall in July and August, it has affected soil erosion on steep slopes. Therefore, broom grass was introduced to help stabilize soil composition and to prevent erosion and landslide.
In 2011 farmers at Chorlaving village, Ta-oy district started the technology by taking the broom grass rhizomes from the natural forest and replanting these on their own land which had been impacted by soil erosion. Their main objective was to prevent landslides that could impact their crops. At the same time it is also easier to manage and harvest broom grass on their land, which will be sold to merchants coming to the village. Most importantly, broom grass - a native species - has an extensive root system into a depth of 1 – 2 meters that helps to bind the soil. Furthermore it is highly adaptive to local climatic and environmental conditions and is seldom affected by diseases or becomes a food source for animals (as its leaves are hairy and rough). For the collection of broom grass rhizomes simple equipment is needed. This includes blades, knifes and baskets. The rhizomes should be selected along steep slopes in mountainous areas. Then the stems are removed from the parent plants, whole young plant is removed including the root and culms of about 30 cm. The broom grass plantation of this case study area has a length of 300 meters and a width of 80 – 120 meters on a sloping terrain with a gradient between 11-15%. The seedlings can be grown from healthy rhizomes collected in local forest areas, with approximately 6,000 seedlings per hectare. They are usually planted in April and May when the soil is still warm and stimulates the growth. To start off with, the farmers need to collect broom grass rhizomes from forest areas for one or two days. Afterwards they should be maintained for few days in a well shaded area, watered and covered by plastic bags. Land preparation firstly involves bush clearance. After, the farmers create rows by digging 20 x 20 cm holes at a distance of approx. 2 meters from one hole to the next. Planting may commence at the bottom of the field with the farmer placing 4 – 5 rhizomes in each freshly dug hole as he moves upward the row following the contour of the land. Yangbong trees, but also other plants can be intercropped in every two rows of broom grass. The grass helps to retain soil moisture which promotes e.g. the Yangbong trees' growth. Once a year the broom grass area needs weeding and thinning. After harvest of the grass the cuttings and fragments can be used for mulching the soil surface around the broom grass stems and the trees. This not only retains soil moisture, but by the decaying process it enriches the soil by nutrients (natural compost).Typically, broom grass can be harvested 2 – 3 years after it has been planted. During the rainy season (June to October), the roots and the new shoots of broom grass grow quickly. The strengths of a broom grass plantation are that firstly it prevents soil erosion and secondly its different elements (e.g. flowers) which provide a higher household income. Model farmer's broom grass plantation is 1.5 ha and may generate

LOCATION



Location: Chorlaveing village, Ta-oy district, Salavan province, Lao People's Democratic Republic

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 106.53965, 16.17924

Spread of the Technology: evenly spread over an area (approx. < 0.1 km2 (10 ha))

Date of implementation: 2011; less than 10 years ago (recently)

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

an income of around 2,000,000 Kip/ton/year. Currently, broom grass can be used for handicrafts, household products such as brooms and can also be sold to neighboring countries. There are currently many households engaged in planting broom grass for commercial purposes on their own land. This reduces conflicts among the village people araising when it had to be collecte in natural areas.
Weaknesses: The root system of broom grass grows quickly which may result in the competition for nutrients and space with the other crops. Therefore appropriate management may be required by cutting and removing excessive rhizomes and culms. Furthermore, the roots can expand so extensively (difficult to remove when they grow up) that it would exceed the farmer's capacity to control them in order to get enough space for inter-crops. And planting broom grass on sloping terrain may cause difficulties to maintain and harvest the crop.

Broom grass cultivation area on slope area (Theppadith Meunpanthavong)

Broom grass feature surrounding the rice field (Theppadith Meunpanthavong)

CLASSIFICATION OF THE TECHNOLOGY

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

Land use

Cropland - Perennial (non-woody) cropping
Main crops (cash and food crops): Broom grass, Nothaphoebe umbelliflora

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

Number of growing seasons per year: 1
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

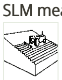
Purpose related to land degradation
- [x] prevent land degradation
- [x] reduce land degradation
- [ ] restore/ rehabilitate severely degraded land
- [ ] adapt to land degradation
- [ ] not applicable

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullying, Wr: riverbank erosion, Wo: offsite degradation effects

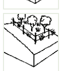
SLM group
- rotational systems (crop rotation, fallows, shifting cultivation)
- improved ground/ vegetation cover

SLM measures



agronomic measures - A1: Vegetation/ soil cover

vegetative measures - V2: Grasses and perennial herbaceous plants



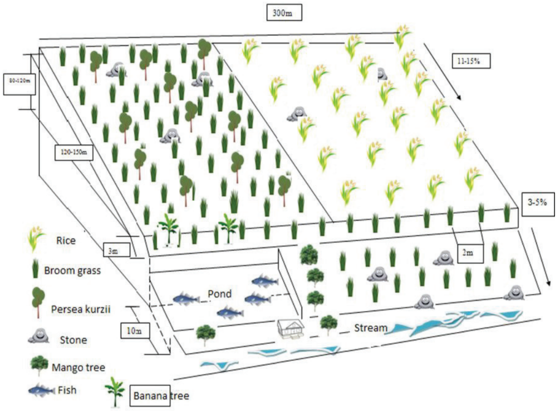
management measures - M5: Control/ change of species composition

TECHNICAL DRAWING

Technical specifications

The area have 300 m length , 80 m - 120 m width
- Space between plants is 2 x 2 m, 4-5 rhizomes per plant hole.
- Slope angle 11-15% , for foot slope is 3-5%. Protected area (protected area on foot slope along the cultivation area is 3 m)
- Equipment: knife, spade, basket for rhizom collection ond digging wholes
- Broom grass species are taken from natural forsts by cutting the rhizome include some stems.
- Density of plants is 6000 seedling/ha

The native broom grass species that can be cultivated in almost all types of soil. This species has long leaves (60-80cm) can play as a shelter from direct sunlight into the soil, and the erect culms can reach a length of 1.5 - 2 meters. One clump of broom grass would typically have between 10-20 culms. The land that was previously used for shifting cultivation has recently been planted with (Persea kuzii) Yangbong intercropped with broom grass. Now there is an expansion upland rice area next to the broom grass and the Yangbong plantation, this enables the farmer to grow rice intercropped with broom grass in the new area for first year after broom grass plantation, then rotate rice cultivation in previous area where Yangbong and broom grass will be harvest. Actually, in this model the farmer has two plots – one plot has been cultivated since 2011 consisting of predominantly broom grass and there is also Yanbong, whilst the other plot has only broom grass since 2012 and then planted Yangbong in 2015. Furthermore he planted other fruit trees and created a fishpond at the bottom of the broom grass plantation. This is because the culms which grow closely together help to block sediment run-off into the fishpond. Previously this area was used to grow rice, Yangbong and other fruit trees, after rice harvesting and Yangbong cutting, the broom grass was used before upland rice cultivation again and it is surrounded by several big stones and rocks .



Author: Phonesyli Phanvongsa

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: **3 ha**; conversion factor to one hectare: **1 ha = Length 300 meters, width 100 meters**)
- Currency used for cost calculation: **kip**
- Exchange rate (to USD): 1 USD = 8400.0 kip
- Average wage cost of hired labour per day: 50,000 kip

Most important factors affecting the costs
Labor is the most important factor affecting the costs

Establishment activities
1. Land preparation (Timing/ frequency: 30 days before onset of rain)
2. Collection of broom grass (Timing/ frequency: None)
3. Digging holes and planting (Timing/ frequency: None)

Establishment inputs and costs (per 3 ha)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
Labor for land preparation	Person-day	3.0	50000.0	150000.0	100.0
Labor for collection of broom grass seedlings	Person-day	3.0	50000.0	150000.0	100.0
Labor for digging holes and planting	Person-day	3.0	50000.0	150000.0	100.0
Equipment					
Spade	Piece	4.0	15000.0	60000.0	100.0
Knife	Piece	4.0	25000.0	100000.0	100.0
Basket	Piece	4.0	50000.0	200000.0	100.0
Total costs for establishment of the Technology				**810'000.0**	

Maintenance activities
1. weeding (Timing/ frequency: annually)
2. cut out dead stems (Timing/ frequency: annually)

Maintenance inputs and costs (per 3 ha)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
Labor for weeding and cut out dead stems	Person	4.0	50000.0	200000.0	100.0
Total costs for maintenance of the Technology				**200'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall **Agro-climatic zone** **Specifications on climate**

- [ ] < 250 mm
- [ ] 251-500 mm
- [x] 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

- [x] humid
- [ ] sub-humid
- [ ] semi-arid
- [ ] arid

Average annual rainfall in mm: 450.0
Heavy rains is occur in July - August
Name of the meteorological station: Ta-oy District Agriculture and forest Technical Service Center

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

Landforms
- [ ] plateau/plains
- [ ] ridges
- [x] mountain slopes
- [ ] hill slopes
- [x] footslopes
- [ ] 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.
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- [ ] 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
- [x] convex situations
- [ ] concave situations
- [ ] not relevant

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

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

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

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

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

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

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

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [ ] mixed (subsistence/ commercial
- [x] 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
- [ ] manual work
- [ ] animal traction
- [x] mechanized/ motorized

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

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

Gender
- [x] women
- [x] men

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

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 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

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

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

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

Water use rights
- [x] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [x] 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	Increase in crop production such as upland rice because broom grass can protect them from rainstorm damage leading to better rice yield.
farm income	decreased						✓		increased	Previously: Very low income from scarse broom grass collection in natural forests. After broom grass cultivation: the farmer gets around 2,000,000 Kip/ton.
diversity of income sources	decreased						✓		increased	Previously: the range of products to be sold on the market was small, insecure and its quantity very low (small income from banana, rice, pineapple). After broom grass cultivation: Broom grass generates further and even main income. And because it protects also the fish pond below the slope area, fish can be a further income source.
workload	increased						✓		decreased	Before, it took many days to harvest the broom grass from the natural forest, as it was far away from the village. After broom grass cultivation: It is easy to harvest the broom grass (Maintenance is not labour-intensive compared to the situation before).

Socio-cultural impacts

Ecological impacts

soil accumulation	decreased					✓			increased	Before: Without barrier and improved soil cover the soil sediments in the storm water runoff were washed directly into the stream. After: the heavy runoff is hampered by better soil cover that retain soil. Additionally, the plant detritus provides material for further soil formation.
nutrient cycling/ recharge	decreased					✓			increased	After Broom grass cultivation the detritus has been increased which improves the nutrient status of soil and provides nutrients to the soil and its organisms.
landslides/ debris flows	increased					✓			decreased	The dense and expanded cover of broom grass with its deep roots are able to reduce landslides in the watershed.

Off-site impacts

downstream siltation	increased						✓		decreased	Density of broom grass is playing a significant role as a filter to reduce downstream siltation

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

seasonal rainfall increase	not well at all					✓	very well	Season: wet/ rainy season

ADOPTION AND ADAPTATION

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

- single cases/ experimental
- 1-10%
- ✓ 10-50%
- more than 50%

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

- 0-10%
- 10-50%
- 50-90%
- ✓ 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- [ ] Yes
- [x] No

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

- Broom grass roots penetrate deeply into the the soil and are able to hold the soil together leading to prevent soil erosion.
- In this region other plants and crops can be intercropped within the Broom grass cultivation area.
- Broom grass improves the income for household.

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

- Broom grass can reduces surface runoff during heavy rains.
- Detritus of broom grass increases the biomass on topsoil and promotes organic matter and nutrients for the plants.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Broom grass roots can expand extensively and can result in competition with other crops, respectively the roots may invade soil space for inter-cropping. → Attentive and good management by cutting some parts of them
- Broom grass on a sloping terrain may make it difficult to maintain and harvest the crop.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

REFERENCES

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Date of documentation: July 12, 2017

Last update: Sept. 28, 2018

Resource persons
THEPPADITH MEUNPANTAVONG (theppadiths@gmail.com) - land user
Phonexay - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2930/

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Use wood, bamboo and rocks to prevent soil erosion along to the river bank (Sonephet Sisumung)

River banks protection (Lao People's Democratic Republic)

DESCRIPTION

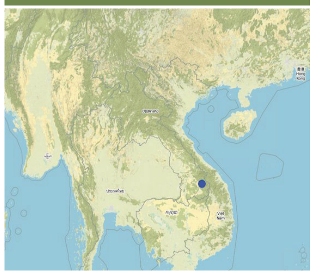
The river bank protection technique was initiated by local land users, based on local knowledge and using locally available material.

In Darkchung district there is continuous rainfall throughout the year especially from July through to November. During this period, it rains frequently and the downpours are more intense, resulting in a rise in the water level of streams and rivers. The average annual rainfall of this region is between 1,500-2,000 mm. These heavy rainstorms often lead to soil erosion in areas in the proximity of watercourses. Farmers have disclosed the loss of productive agricultural land, especially dry season rice paddies (with an average loss of 0.22 ha/annum) and erosion has been expanding over wider areas. The farmers therefore examined appropriate forms of intervention and the introduction of protection measures to preserve the river banks. They noted good practices that were being implemented by farmers in neighboring villages who were in a similar predicament. Therefore, the farmers introduced embankment protection facilities in 2016 and these have had impressive results. The fundamental construction materials that are needed to implement this riverbank protection technique for length 20 meters consist of: (i). Logs that can be sourced from native forests: 60 – 80 logs with a diameter of approximately 5 cm should be cut to a length of 150 cm. These should be sharpened at one end so that it is easy to drive them into the ground as posts. (ii). Fifty bamboo poles with a width of 6 cm should be cut to a length ranging between 3-5 meters. The maximum thickness of the poles should not exceed 1 mm and then the bamboo posts are cut lengthways and pressed the band. (iii). Approximately 300 – 400 stones in varying sizes.

The construction process should begin by identifying and selecting the erosion prone areas along to the river bank where protection is most needed. After that prepare the material and equipment that need for establishment then lining up the logs 10 cm between poles along the length of the riverbank and driving them to a depth of 50 cm so that they stand upright as posts. Then the bamboo poles are lined up horizontally against the posts and tied to them using the same methodology as fabricating a bamboo sheet. After the bamboo has been fastened to the posts, stones should be placed on the inside of the wooden wall (upper section), as well as on the river/stream side of the wall. There should be more stones on the upper section of the wall and less on the bottom section as the stones will compress the soil with their weight and prevent erosion. Placing the stones on the bottom section of the wall will help to stabilize the wooden posts so that they do not collapse during peak flows.

Every year the local farmers will repair these erosion control facilities before the peak flows occur during the rainy season by replacing some of the posts and by adding more stones in areas that have been affected by erosion. The farmers noted that this technology has been quite effective in protecting river banks and has been durable, reducing soil erosion in the area where it was set up. This traditional methodology can help alleviate soil erosion and reduce land loss along river banks. Additionally, this technique does not require a lot of financial layout as most of the construction materials can be sourced locally. However there is the need for a substantial labour force to collect timber, bamboo and stones as well as to construct and maintain the river bank protection facilities.

LOCATION



Location: Darkchung district, Xekong province, Lao People's Democratic Republic

No. of Technology sites analysed: single site

Geo-reference of selected sites

- 107.07291, 15.36685

Spread of the Technology: applied at specific points/ concentrated on a small area

Date of implementation: 2016; less than 10 years ago (recently)

Type of introduction

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

Double line of protection using wooden poles, bamboo and stones (Sonephet Sisumang)

Two steps of protection by using bamboo and stone (Phonethilack Sayyasan)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [ ] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [x] 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

Cropland - Annual cropping

Waterways, waterbodies, wetlands - Drainage lines, waterways

Water supply

- [ ] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation

Number of growing seasons per year: 1

Land use before implementation of the Technology: n.a.

Livestock density: n.a.

Purpose related to land degradation

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

Degradation addressed

soil erosion by water - Wr: riverbank erosion

SLM group

- water diversion and drainage
- surface water management (spring, river, lakes, sea)
- ecosystem-based disaster risk reduction

SLM measures

structural measures - S2: Bunds, banks, S6: Walls, barriers, palisades, fences

TECHNICAL DRAWING

Technical specifications

Length of wooden logs: 150 cm, diameter 5-10 cm, sharpened at one end
Length of bamboo posts: 3-5 m; thickness: max. 1 mm, cut lengthways and flattened to a width of 6 cm
Stone and rocks: varying sizes
Spacing between the two barriers: 10 cm


Author: Sonephet Sisumang

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology unit
- Currency used for cost calculation: **LAK**
- Exchange rate (to USD): 1 USD = 8000.0 LAK
- Average wage cost of hired labour per day: 50000

Most important factors affecting the costs
The most important factors affecting the cost are the labour for collect the material (wood and stone) from the field or forest.

Establishment activities
1. Cutwoodenlogsandsharpenatoneend (Timing/ frequency: before rainy season/peak flows)
2. Cutbambooposts,cutlengthwaysandflatten (Timing/ frequency: before rainy season)
3. Collectstonesandrocks (Timing/ frequency: before rainy season)
4. Pierce the posts 50cm deep in line along the stream bank with spaces between 10 and 20cm (Timing/ frequency: before rainy season/peak flows)
5. Tie the bamboo logs with the posts in horizontal setting similar to making bamboo sheet pattern (Timing/ frequency: before rainy season/peak flows)
6. Place stones on the inside of the wooden wall (upper section), as well as on the river/stream side of the wall (Timing/ frequency: before rainy season/peak flows)

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour	person day	15.0	50000.0	750000.0	100.0
Equipment					
Knife	piece	6.0	50000.0	300000.0	100.0
Big knife	piece	2.0	100000.0	200000.0	100.0
Hammer/axe	piece	3.0	50000.0	150000.0	100.0
Total costs for establishment of the Technology				**1'400'000.0**	

Maintenance activities
1. Replace posts (Timing/ frequency: before rainy season/peak flows)
2. Adding more stones in areas that have been affected by erosion (Timing/ frequency: before rainy season/peak flows)

Maintenance inputs and costs

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour	person day	5.0	50000.0	250000.0	100.0
Equipment					
Butcher knife	piece	2.0	50000.0	100000.0	100.0
Hammer	piece	2.0	50000.0	100000.0	100.0
Total costs for maintenance of the Technology				**450'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall
- < 250 mm
- 251-500 mm

Agro-climatic zone
- humid
- ✓ sub-humid

Specifications on climate
n.a.

- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [ ] 1,001-1,500 mm
- [x] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

- [ ] semi-arid
- [ ] arid

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
- [ ] valley floors

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [x] 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
- [x] 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)
- [ ] fine/ heavy (clay)

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

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

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

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

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

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [x] Yes
- [ ] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [x] subsistence (self-supply)
- [ ] mixed (subsistence/ commercial
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- [ ] group
- [ ] individual, not titled
- [x] individual, titled

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

Water use rights
- [x] 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

risk of production failure	increased					✓			decreased	Decreased risk of production failure due to prevent river bank erosion
production area (new land under cultivation/ use)	decreased					✓			increased	No more loss of productive area due to river bank erosion

Socio-cultural impacts

Ecological impacts

water quality	decreased					✓			increased	Less erosion, better water quality
soil loss	increased						✓		decreased	Decreased soil loss after protection measures are in place
landslides/ debris flows	increased							✓	decreased	Decreased landslides along to river bank

Off-site impacts

downstream siltation	increased					✓			decreased	Less downstream siltation

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 rainfall increase	not well at all					✓	very well

Climate-related extremes (disasters)

General river flood	not well at all					✓	very well

ADOPTION AND ADAPTATION

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

- ☐ single cases/ experimental
- ☐ 1-10%
- ☐ 10-50%
- ✓ more than 50%

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

- ☐ 0-10%
- ☐ 10-50%
- ☐ 50-90%
- ✓ 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- ☐ Yes
- ✓ No

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

- This technique can help to reduce soil erosion along stream banks
- Protect dry season rice paddies along streams these are located in these areas

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

- It reduce the water velocity thereby minimizing soil erosion
- Protects the topsoil layer or land area along stream banks
- It is also increases the size of agricultural land as the new soil accumulates in areas where it was previously impacted previously, and crops can once again be cultivated.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Require labour for maintain and labour to find the material.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- The construction of the erosion control facilities requires a considerable amount of timber which may inevitably affect the natural forest in the area. → farmers are therefore advised to only select small trees or dried wood.
- A large labour force and a considerable amount of time is needed to collect timber, bamboo and stones and construct the river bank protection facilities.

REFERENCES

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Date of documentation: May 12, 2017

Last update: Aug. 2, 2019

Resource persons
Bounsope - land user
Sonephet Sisimung - None

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2220/

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Bambusa oldhamii planting along river bank to protect soil erosion (Chanvilay)

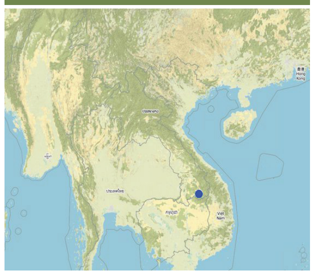
Cultivation of Bamboo to Prevent Soil Erosion (Lao People's Democratic Republic)

DESCRIPTION

Mai Sangphai (Bambusa oldhamii) planting technique for soil erosion control along river bank due to soil fixation by deep and widespread roots during rainy season when there are high water levels and increased flow velocity

During the rainy season when the rivers' water levels are high and there is an increase in the velocity of the water flow, the Bambusa oldhamii (giant timber bamboo) has been especially selected to be grown along river banks because of its deep root system which effectively binds the soil thereby controlling soil erosion along river banks.
During the annual rainy season between July – October in Vangyang village (Phouvong district, Attapue province) the region experiences intense rainfall ranging from 2,500-3,000 mm/year (source: The Phouvong District Hydrology and Meteorology Office). Soil erosion occurs along riverbanks, with the end effect of gradually widening the river bed. It can be noted that the river banks in Vangyang village have already eroded by two meters which has resulted in the loss of agricultural land that was previously used to cultivate bananas and sugarcane. In order to counteract this development some of the land users initiated the planting Bambusa oldhamii on riverbanks in 2007. This strain of bamboo was selected because people could observe that the natural bamboo forest growing on opposite side of the river to their land experienced minimal soil erosion as the deep root system was able to successfully secure the soil along these stream banks. On top, Bambuse oldhamii has delicious shoots (which are consumed by land users) and less thorns compared to other wild bamboo species.
The application of this technology involves the following:
• The site should be selected along the stream banks especially where the risk of erosion is occurring. Bamboo should be planted approximately 3 meters from the edge of the bank. Bamboo is grown to protect the bank on one side of the stream from soil erosion whilst the other side of the stream is protected by natural bamboo species.
• Land preparation involves the clearance of bush around the planting pits.
• Bamboo rhizomes (Bambusa oldhamii) should be gathered locally from the parent plants. This should amount to approximately 120 healthy one-year old rhizomes each having a considerable number of feeder roots with a length of 60 to 70cm.
Forty holes measuring 50cm x 50cm and 50 cm depth should be dug in a row leaving a gap of 5 meters between each hole along the stream bank when the bamboo's rhizome grow up it will be cover the gap for few meters from pits (it will take about 4-5 years). After the land has been prepared 2-3 bamboo rhizomes should be replanted in each of the holes. The refilling of the holes with soil and watering should take about one day. Planting can be undertaken in January (dry season) because soil texture in dry season is less sensitive to erosion. This is a suitable time for bamboo as the roots will propagate faster. In the dry season watering needs to be done twice a week until the rhizomes establish new roots and stems. Generally, the bamboo will grow 4-5 new stems during the first year after having been replanted, but at this stage it is still unable to protect the banks from erosion. Some vegetation around the pits has been cleared before replanting and leave some vegetation on the edge to minimize erosion when the bamboo trees still young. When the bamboo is about 2-3 years old, it will be able to grow up to three times the amount of additional stems compared to its output in the first year. At this time the bamboo's root system is able to expand more widely and deeply

LOCATION



Location: Vangnhang Vaillage, Phouvong District, Attapue Province, Lao People's Democratic Republic

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 106.83737, 14.70469

Spread of the Technology: applied at specific points/ concentrated on a small area

Date of implementation: 2007; less than 10 years ago (recently)

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

which helps to bind the soil and thereby it protects the stream banks from erosion during high water levels. (They left the bush and some vegetation on the edge of the stream, clearance of bush around the planting pits only) . Bamboo has multiple benefits: In fact, the older bamboo is able to provide a greater amount of protection and the bamboo shoots can either be consumed or sold by the land owners. Furthermore the bamboo culms can be used or sold for the manufacture of a variety of handicrafts. Bamboo enhances the micro-organisms habitat living in Rhizosphere (high biological activity and high nutrient availability) of the roots system and maintains the soil moisture throughout the year. The decaying bamboo leaves become a natural compost. The land owners are therefore very content and are willing to recommend the technology to their neighbors who also own land along the stream banks. The weaknesses: (1) Once the bamboo expands and grows into clumps it becomes the habitat of mosquitoes and snakes and thus weeding is required. (2) Bamboo leaves that have fallen into the water decay afterwards and deteriorate the water quality, and therefore it is recommended to cut back old branches before the leaves have the opportunity to fall into the stream.


Bambusa oldhamii planted along river bank (Chanvilay)


Bambusa oldhamii planting along river bank (Chanvilay)

CLASSIFICATION OF THE TECHNOLOGY

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

Land use

Cropland - Perennial (non-woody) cropping


Waterways, waterbodies, wetlands - Drainage lines, waterways

Water supply
- [ ] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation
- [x] Not require water

Number of growing seasons per year: 1
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

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

Degradation addressed

soil erosion by water - Wr: riverbank erosion

SLM group
- surface water management (spring, river, lakes, sea)
- ecosystem-based disaster risk reduction

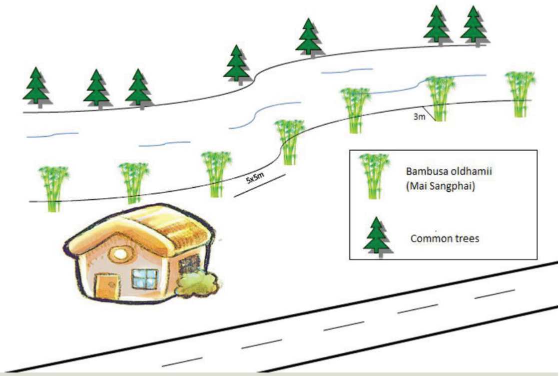
SLM measures

vegetative measures - V2: Grasses and perennial herbaceous plants

TECHNICAL DRAWING

Technical specifications

Bamboo is planted between the agricultural land (near the house) along the riverbank and on the other side of the river is natural bamboo and forest
Spacing between bamboo trees is 5 m
The planting holes a diameter of 50 cm and a depth of 50 cm. Distance from river edge is about 3 m
This technique is conducted in flat areas along river side
Species used is Bambusa oldhamii (Mai Sangphai)



Author: Chanvilay

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology unit (unit: **Along the river bank** volume, length: **200 m**)
- Currency used for cost calculation: **kip**
- Exchange rate (to USD): 1 USD = 8000.0 kip
- Average wage cost of hired labour per day: 50000 kip

Most important factors affecting the costs
Labor for maintenance is the most important effect to the cost

Establishment activities

1. Collect Bamboo rhizomes (Bambusa oldhamii) from the parent plants (120 healthy one-year old rhizomes each) (Timing/ frequency: December)
2. preparing the planting area: clear bushes (Timing/ frequency: December)
3. Dig the planting pits (Timing/ frequency: January)
4. planting Bamboo rhizomes, refill pits with earth (Timing/ frequency: January)
5. Water the plants (twice a week until the rhizomes establish new roots and stems). (Timing/ frequency: None)

Establishment inputs and costs (per Along the river bank)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
Labor	person-day	5.0	50000.0	250000.0	100.0
Equipment					
Hoe	piece	3.0	50000.0	150000.0	100.0
Knife	piece	3.0	35000.0	105000.0	100.0
shovel	piece	2.0	25000.0	50000.0	100.0
Plant material					
Rhizome variety	Rhizome	120.0	3000.0	360000.0	100.0
Total costs for establishment of the Technology				**915'000.0**	

Maintenance activities

1. Weeding around planting area (between bamboo stems) (Timing/ frequency: Once a month)
2. Replace the dead rhizome (Timing/ frequency: Once a year)

Maintenance inputs and costs (per Along the river bank)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
Labor	person-day	1.0	50000.0	50000.0	100.0
Plant material					
Rhizome variety	Rhizome	5.0	3000.0	15000.0	100.0
Total costs for maintenance of the Technology				**65'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall
- < 250 mm
- 251-500 mm
- 501-750 mm

Agro-climatic zone
- humid
- ✓ sub-humid
- semi-arid

Specifications on climate
Average annual rainfall in mm: 1500.0
Precipitation is the lowest in January. Most precipitation falls in July - October , with an average of 566 mm in that period

- [ ] 751-1,000 mm
- [ ] 1,001-1,500 mm
- [x] 1,501-2,000 mm
- [x] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

- [ ] arid

Name of the meteorological station: Phouvong District of Natural Resources and Environment Office

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

Landforms
- [ ] 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
- [x] not relevant

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

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

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

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

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

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

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

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [x] Yes
- [ ] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

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

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

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

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

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

Gender
- [ ] women
- [x] men

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

Area used per household
- [x] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 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

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

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

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

Water use rights
- [x] 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

production area (new land under cultivation/ use) — decreased / increased

Before planting bamboo the production area was gradually damaged by stream bank erosion, after bamboo has been planted the production area loss was minimized

workload — increased / decreased

In addition to the agricultural activities the farmer has to maintain their bamboo (cut stems, weed) Otherwise it will grow dense and difficult to pass in to harvest the shoots or stems

Socio-cultural impacts

recreational opportunities — reduced / improved

Bamboo could provide shade relaxing place along the stream bank for picnic or fishing

Ecological impacts

soil loss — increased / decreased

previously: soil loss by water erosion; after bamboo has been planted and grown up the soil was protected by bamboo's root system

landslides/ debris flows — increased / decreased

In the past approximate 2 meters loss of land along stream bank, after bamboo has been planted no more land has been lost in the protected area

Off-site impacts

downstream siltation — increased / decreased

Downstream siltation is decreased due to less eroded soil.

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

seasonal rainfall decrease — not well at all / very well — Season: wet/ rainy season

ADOPTION AND ADAPTATION

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

- [ ] single cases/ experimental
- [x] 1-10%
- [ ] 10-50%
- [ ] more than 50%

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

- [ ] 0-10%
- [ ] 10-50%
- [ ] 50-90%
- [x] 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- [ ] Yes
- [x] No

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

- Helps to protect the soil from erosion
- The bamboo shoots can be consumed as well as sold, and the bamboo culms can also be sold for the manufacture of handicrafts
- Enhances the micro-organisms habitat living in Rhizoshere (high biological activity and high nutrient availability) of the roots system

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

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Once the bamboo expands and grows into clumps it becomes the habitat of mosquitoes and snakes → thus weeding is required;
- the falling leaves in water decay and deteriorate water quality, → thus it is recommended to trip old branches before its leaves fall down into streams.

- Bamboo has a considerable number of roots which help to effectively bind the soil

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

REFERENCES

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Date of documentation: May 16, 2017

Last update: Nov. 28, 2018

Resource persons
Chansamay Kounthisuck Chansamay - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2251/

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Land user brings the wood logs to the rice field to make barriers (Vadsana Boualaivan)

Logs to reduce surface run-off during the rainy season (Lao People's Democratic Republic)

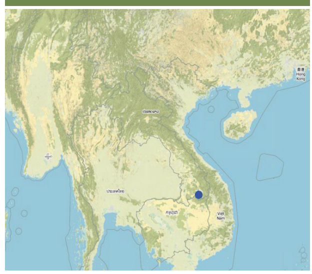
DESCRIPTION

Logs to reduce surface run-off during the rainy season.

In the upland areas with 3-5 % at foot slopes and 16-30% hill slopes of Lao PDR rotational shifting cultivation has been the primary means of the local people's livelihood for many generations. Given the topography of the area with its hill slopes it restricts the opportunities for agricultural development. After the land on foot slopes has been cleared and the remaining vegetation burned off in preparation for agricultural activities there are significant impacts on land use particularly during the rainy season which occurs between May-November. There are heavy downpours especially in the months of September and October that create significant sediment transport along the mountain valleys and it also results in flushing organic matter on the surface being flushed along the road sides and ending up in waterways. Furthermore decayed vegetation is washed over the crops. The negative impacts experienced from the loss of fertile topsoil motivated many of the land users to develop some kind of technology in 2015 that could control this run-off from the mountains.
This technology was also meant to help maintain nutrient levels on topsoil as without a technology the nutrients are being flushed down the hillside. It can be assembled using a collection of local logs approximately 4-5 meters in length and around 15-20 cm in diameter (obtained through the clearance of upland rice fields). The logs should be arranged horizontally at the position of a designated drainage site where the run-off flows from a particular agricultural area. They should be stacked on top of one another until reaching a height of about 1 meter. A buttress should also be erected using mature bamboo poles as supporting posts with a length of 1.5 meters and diameter of about 10 cm so as to prevent the logs from sliding down the hillside. The bamboo poles should be driven about 50 cm into the ground and then tightened with ropes. This technology should only be constructed after the planting of upland rice fields has been completed in mountainous areas which have slopes between 20-25%. In general, the local residents have set up this mechanism at 2-3 selected sites within an agricultural plot. The benefits of this technology include mitigating the impacts of soil run-off whilst facilitating the distribution of soil nutrients around the agricultural plot of land. The water and top soil run-off is slowed down when it reaches the log wall and is then directed to flow out on either side of the technology. Previously the average rice yield used to be 1.5 tons/ha, but then the upland rice yields increased to 2 tons/ha after the application of this technology. This is due to the reduction of soil surface losses and an increase in the soil's organic matter that accumulates through the processes of sedimentation and biomass transport. The quality of the surrounding soil improves through the decay of biomass and the breakdown of the soil by organisms such as earthworms and millipedes.
This technology can be installed on hill slopes . The technology is approximately 1 meter in height (above ground) and 4 -5 meters in length. The supporting posts need to be driven 50 cm into the ground. This technology can be used at the location of seasonal drainage points or water channels on hill slopes between 20-25% (with usually 2 or 3 sites per agricultural plot).

Strengths: Reduces sediment run-off, increases organic matter on the soil's surface (builds a thicker layer of soil), financially economical, and distributes nutrients on

LOCATION



Location: Phouvong District, North Vongvillay village, Attapue Province, Lao People's Democratic Republic

No. of Technology sites analysed: single site

Geo-reference of selected sites

- 106.83247, 14.66049

Spread of the Technology: applied at specific points/ concentrated on a small area

Date of implementation: 2015; less than 10 years ago (recently)

Type of introduction

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

agricultural plots.

Weaknesses disadvantages/ risks of the technology/ how to overcome them: Most of these technologies are not permanent and quite exposed and therefore require annual repair and maintenance. If the run-off facility is to be upgraded, it would need the use of a better quality of rope and concrete posts. However, most people still use the readily available local materials which affects the quality of the water run-off technology as well as its effectiveness. Furthermore this technology may need to be installed at several sites along the same channel on the foot slopes.

Farmer using wooden logs for the construction of a cross-slope barrier fixed by bamboo plants. (Vadsana Boualaivan)

Wooden logs residues as barrier against water flow, spread sediment and change water way to production area (Vadsana Boualaivan)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose
- ☑ improve production
- ☑ 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

Cropland - Annual cropping
Main crops (cash and food crops): Upland rice, maize, banana, sugar can, cassava

Water supply
- ☑ rainfed
- ☐ mixed rainfed-irrigated
- ☐ full irrigation

Number of growing seasons per year: 1
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

Purpose related to land degradation
- ☑ 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, Wo: offsite degradation effects

SLM group
- cross-slope measure

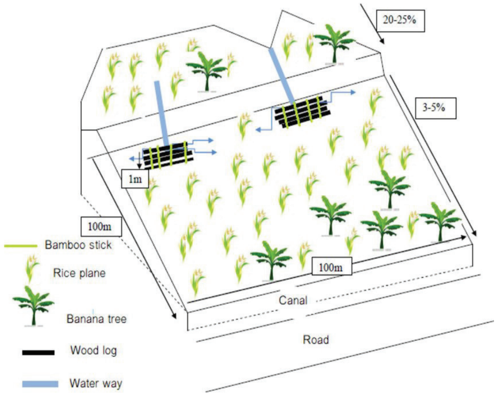
SLM measures

structural measures - S6: Walls, barriers, palisades, fences, S11: Others

TECHNICAL DRAWING

Technical specifications

The technique is applied on foot slope area
Wooden log barriers are created with hight of 1 meter from the surface.
The length of the logs is about 4-5 meters .
Depth of the bamboo post into the soil is 50 centimeters to hold the logs,
This technique is implement on the top of the rice field at the slope 20-25%, where the water form natural surface canals.



Author: Vadsana Boualaivan

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology unit (unit: **2 wooden log barriers** volume, length: **Width: 4-5 meters / High 1 meter (1 barrier)**)
- Currency used for cost calculation: **kip**
- Exchange rate (to USD): 1 USD = 8000.0 kip
- Average wage cost of hired labour per day: 50000

Most important factors affecting the costs
The equipment is the most important factor affecting the costs.

Establishment activities
1. Collect the wood logs and bamboo postsv (Timing/ frequency: After harvesting)
2. Bury the bamboo post (Timing/ frequency: None)
3. Arrange the wood (Timing/ frequency: None)

Establishment inputs and costs (per 2 wooden log barriers)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
labor (for two barriers)	person-day	2.0	50000.0	100000.0	100.0
Equipment					
hoe	piece	1.0	50000.0	50000.0	100.0
shovel	piece	1.0	25000.0	25000.0	100.0
hummer	piece	1.0	20000.0	20000.0	100.0
Plant material					
timber logs (for two barriers)	piece	10.0			100.0
bamboo (for two barriers)	stick	10.0			100.0
Total costs for establishment of the Technology				**195'000.0**	

Maintenance activities
1. Repair of the barrier (Timing/ frequency: 2 times a year)

Maintenance inputs and costs (per 2 wooden log barriers)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
labor (for two barriers)	person	2.0	50000.0	100000.0	100.0
Equipment					
knife	piece	2.0	25000.0	50000.0	100.0
shovel	piece	1.0	20000.0	20000.0	100.0
Construction material					
timber (for two barriers)	piece	10.0			100.0
bamboo (for two barriers)	stick	10.0			100.0
Total costs for maintenance of the Technology				**170'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall **Agro-climatic zone** **Specifications on climate**

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

- [ ] humid
- [x] sub-humid
- [ ] semi-arid
- [ ] arid

Average annual rainfall in mm: 2500.0
From May to September there is more rain, highest between July and September and it decreases to lowest from November to April
Name of the meteorological station: Phouvong district natural resource office
The average annual temperature is 26.2 °C

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

Landforms
- [ ] plateau/plains
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- [ ] 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
- [x] 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)
- [ ] fine/ heavy (clay)

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

Topsoil organic matter content
- [ ] high (>3%)
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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)
- [x] good drinking water
- [ ] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [x] 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
- [ ] average
- [ ] rich
- [ ] very rich

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

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

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

Gender
- [ ] women
- [x] men

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

Area used per household
- [ ] < 0.5 ha
- [x] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 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

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

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

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

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

Access to services and infrastructure

	poor				good
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	Quantity before SLM: 1.5 ton/ha Quantity after SLM: 2 tons/ha Increase in organic matter from surface accumulation
production area (new land under cultivation/ use)	decreased	increased	Before farmer lossed a lot of surface due to the water channels in the cultivation area; after wood log barriers has been constructed runoff stopped, and surface area increased by soil accumulation
farm income	decreased	increased	Previously water flow on the production area caused damages to crops and in consequence reduced crop yield
workload	increased	decreased	Installing wood log barriers to extend the cultivation area requires more labour

Socio-cultural impacts

food security/ self-sufficiency	reduced	improved	Food security has been improved because the farmer get more yield and can sale the surplus even in the local market

Ecological impacts

surface runoff	increased	decreased	The water and top soil run-off is slowed down when reaching the log barrier and the water is directed on either side. Thus, heavy surface runoff is stopped efficiently.
soil loss	increased	decreased	Before a lot of top soil by water leaching on the soil surface was lost. After the installation of the wooden log barrier water way changed and spread sediments to the area and reduced accumulation in the road canal
biomass/ above ground C	decreased	increased	Wooden log barriers can spread biomass and plant fragment and sediment to production area (increase topsoil)
landslides/ debris flows	increased	decreased	Before heavy rains caused soil erosion (rill or sheet erosion between row) in rainy season

Off-site impacts

damage on neighbours' fields	increased	reduced	Before water way flow through owners land. After the installation of the technology the water way was changed to neighborhoodt without causing damages there.
Sediment run-off into the road canal	decrease	increase	Before the sediments from the rill erosion went directly into the road canal. After wood logs installation sedement remained mostly on the field

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	
seasonal temperature increase	not well at all	very well	Season: wet/ rainy season
annual rainfall increase	not well at all	very well	
seasonal rainfall increase	not well at all	very well	Season: wet/ rainy season

Climate-related extremes (disasters)

local rainstorm not well at all very well

extreme winter conditions	not well at all				✓		very well
drought	not well at all			✓			very well
forest fire	not well at all			✓			very well
landslide	not well at all			✓			very well

Other climate-related consequences

extended 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
- [x] 1-10%
- [ ] 10-50%
- [ ] more than 50%

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

- [ ] 0-10%
- [ ] 10-50%
- [ ] 50-90%
- [x] 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- [ ] Yes
- [x] No

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

- Reduce sediment run-off
- Increased organic matters on soil surface (create thicker soil layer)
- Low cost for implementation

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

- Better distribution of nutrients on agricultural lands.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Most of these facilities are not permanent and vulnerable which require repair every year → It may require better rope quality and concrete posts.
- Some sediment accumulation are still caused by remaining run-off sites → must create many point of barrier

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- People still use available local materials which affects the quality of the water run-off facility as well as its effectiveness. → It may require installation of this kind of facility in many sites along the same channel depending on slope of the land.

REFERENCES

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Date of documentation: May 18, 2017

Last update: Dec. 5, 2018

Resource persons
Bounlert - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2279/

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Improvement of soil fertility

Compost made from burned rice bran mixed with soil (Pasalath Khounsy)

Making compost to improve soil fertility in vegetable home gardens (Lao People's Democratic Republic)

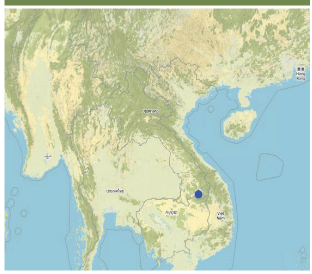
Compost

DESCRIPTION

Making compost by burned rice bran to improve the soil fertility in vegetable home gardens.

Compost is used to improve soil fertility and increase crop production. Vegetable home gardens are generally implemented across the country as part of livelihood activity for food security and other source of household's income for local people. In the past, local land users only used animal manure for improving crop yield and soil fertility. The amount of animal manure applied was dependent on the potential of each household to collect animal manure. In addition, most agricultural land is sandy with shallow depth and mixed with gravel which is not productive for agriculture. Most of vegetable home gardens are situated along streams or riverbanks near the village whereas arable land availability is an issue. In 2016, the Food Security and Nutrition Market Linkage Project supported by International Fund for Agriculture Development (IFAD) has encouraged local people and provided training on how to prepare and use compost with a view to soil improvement and increased crop yields that subsequently should increase food security. Compost is a simple process where local people can use available materials from their own farm production. Materials for compost production include 10 bags of partly burned rice bran (bran burned up to 50% / 15kg/bag), 200kg of animal manure, 50 litre of water, 15 table spoons of molasses or sugar, 5 table spoons of organic extract. All those materials has to mixed together, then should be putted it in a container which is made of cement or plastic (depth: 0,5 m /width: 1,5 m /length: 2 m). After, the compost material in the concrete tank should be flattened and then covered by a plastic sheet. The decomposing process usually takes between 1-2 weeks before the compost can be applied. Buckets or bags are used to carry the compost from the container to the home gardens where - during the land preparation - it is directly spread out on the vegetable plots by fork. Then, the compost will be mixed with the soil by hoe. Now, the soil is ready for planting. Vegetable cultivation may commence from the end of December to March (2-3 cultivation cycles per year). Most people use water from boreholes for the irrigation of the vegetables. In summary, the advantages of using compost are the improvement of soil fertility by adding more organic matters to the soil, increasing of soil nutrients and activation of the organic decomposition process. These positive effects on soil promote crop growth, and finally ends in increased crop yields. The compost production is not complicated, but it needs to be emphasized that attention should be paid to the cleaning of the storage tank and a careful maintenance of tools including shovels and watering cans to keep the costs as low as possible.

LOCATION



Location: Phouvong district, Attapue province, Lao People's Democratic Republic

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites

- 106.8282, 14.682

Spread of the Technology: evenly spread over an area (approx. < 0.1 km2 (10 ha))

Date of implementation: 2016; less than 10 years ago (recently)

Type of introduction

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

Cement tank as compost container (Pasalath Khounsy)

Vegetable garden using compost (Pasalath Khounsy)

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
- [x] 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
- [x] create beneficial social impact

Land use

Cropland - Annual cropping

Water supply

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

Number of growing seasons per year: 3

Land use before implementation of the Technology: n.a.

Livestock density: n.a.

Purpose related to land degradation

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

Degradation addressed

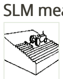
chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion

biological degradation - Bl: loss of soil life

SLM group

- integrated soil fertility management
- waste management/ waste water management
- home gardens

SLM measures

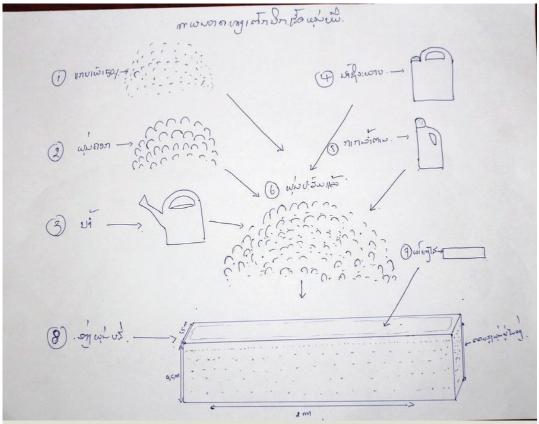


agronomic measures - A2: Organic matter/ soil fertility

TECHNICAL DRAWING

Technical specifications

Compost production process is following:
1. Husk burned 50% (incomplete carbonized) = 10 bags (approximately 150kg, or equivalent to 15kg per bag),
2. Animal manure = 10 bags (approximately 200kg or equivalent to 20kg/bag),
3. Water = 50L,
4. Molasses = 15 table spoons,
5. Organic extract = 5 table spoons.
6. Effective Micro-organism 0.5 ml
7. Mixed all material and put it in the cement tank then use plastic to cover tank.


Author: Vixay Farviseth

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: 5 x 15 m)
- Currency used for cost calculation: **LAK**
- Exchange rate (to USD): 1 USD = 8000.0 LAK
- Average wage cost of hired labour per day: 50.000

Most important factors affecting the costs
Construction of the compost container is the most important factors affecting the costs (if available, one can use the fish tank as compost container).

Establishment activities
1. Construction of compost container (Timing/ frequency: End of December)

Establishment inputs and costs (per 5 x 15 m)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour for cement tank construction (Lumsum)		1.0	500000.0	500000.0	100.0
Equipment					
Watering can	piece	1.0	25000.0	25000.0	100.0
Water bucket	piece	2.0	7500.0	15000.0	100.0
Shovel	piece	1.0	20000.0	20000.0	100.0
Bag for collecting the burned husk	bag	20.0	2000.0	40000.0	100.0
Plastic sheet to cover tank	metre	3.0	10000.0	30000.0	100.0
Construction material					
Brick	piece	100.0	4000.0	400000.0	100.0
Cement	bag	7.0	40000.0	280000.0	100.0
Sand	truck	0.5	300000.0	150000.0	100.0
Total costs for establishment of the Technology				**1'460'000.0**	

Maintenance activities
1. Collect the rice bran (Timing/ frequency: After rice harvest)
2. Collect the manure (Timing/ frequency: After rice harvest)
3. Preparing the material for the compost (Timing/ frequency: After rice harvest)
4. Spreading of compost on vegetable plots (Timing/ frequency: After rice harvest)

Maintenance inputs and costs (per 5 x 15 m)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour to prepare the material for making compost	person day	2.0	50000.0	100000.0	100.0
Labour to processing compost	person day	2.0	50000.0	100000.0	100.0
Labour to spreading of the compost on the vegetable plot	person day	2.0	50000.0	100000.0	100.0
Fertilizers and biocides					
Animal manure	bag	10.0	5000.0	50000.0	100.0
Other					
Husk burned	bag	10.0	20000.0	200000.0	100.0
Sugar	kg	1.0	10000.0	10000.0	100.0
Organic extract	litre	1.0	10000.0	10000.0	100.0
Total costs for maintenance of the Technology				**570'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall
- < 250 mm
- 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
- semi-arid
- arid

Specifications on climate
Name of the meteorological station: District of Natural Resource and Environment Office

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

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

Altitude
- ✓ 0-100 m a.s.l.
- 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)
- ✓ moderately deep (51-80 cm)
- deep (81-120 cm)
- very deep (> 120 cm)

Soil texture (topsoil)
- ✓ coarse/ light (sandy)
- medium (loamy, silty)
- 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%)
- ✓ low (<1%)

Groundwater table
- on surface
- < 5 m
- ✓ 5-50 m
- > 50 m

Availability of surface water
- excess
- good
- ✓ medium
- poor/ none

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

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- 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
- 10-50% of all income
- ✓ > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ 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
- 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
- 15-50 ha
- 50-100 ha
- 100-500 ha
- 500-1,000 ha
- 1,000-10,000 ha
- > 10,000 ha

Scale
- ✓ small-scale
- medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- ✓ individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- 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 quality	decreased						✓		increased	Quantity before SLM: 20 kg of vegetables Quantity after SLM: 28 kg of vegetables
production area (new land under cultivation/ use)	decreased					✓			increased	Because of the good production results, the farmers enlarged their vegetable gardens.
farm income	decreased					✓			increased	Before using compost, the land users cultivated vegetables mainly for home consumption, but after the application of the compost, they were able to earn money from the vegetables (500,000 Kip/year).
workload	increased			✓					decreased	The workload increased due to the additional work regarding the compost processing.

Socio-cultural impacts

SLM/ land degradation knowledge	reduced					✓			improved	The land users got training and knowledge on how to improve the soil of the vegetable gardens by producing compost.

Ecological impacts

soil accumulation	decreased						✓		increased	expected impact, technology is still in testing phase (2017).
nutrient cycling/ recharge	decreased						✓		increased	expected impact, technology is still in testing phase (2017).
habitat diversity	decreased					✓			increased	By using compost increase in soil life and habitat diversity is expected.
pest/ disease control	decreased					✓			increased	Decrease of pest destroying the vegetable production (noted from 2016 - 2017).

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 rainfall decrease	not well at all			✓			very well

ADOPTION AND ADAPTATION

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

- [ ] single cases/ experimental
- [x] 1-10%
- [ ] 10-50%
- [ ] more than 50%

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

- [x] 0-10%
- [ ] 10-50%
- [ ] 50-90%
- [ ] 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- [ ] Yes
- [x] No

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

- Equipment and materials for compost production are available.
- Application of compost on vegetable plots improves the soil's fertility and boost the plant's growth.
- Land users had the opportunity to discuss matters directly with technical officers.

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

- Compost can modify the soil's condition making it more fertile.
- If a large quantity is produced, it can be applied over a more extensive area or be sold to generate household income.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Compost production has so far only results in small quantities as it was still at the trail phase (2017).
- It is bring benefits in the long term as it is a slow process for the compost to improve the soil/s quality (unlike the chemical fertilizer which have an immediately effective).
- If farmers intend to produce compost for rice paddies, they may need quite a large quantity which requires an intensive input of labour in order to collect sufficient raw material. → It would be preferable to build cement tanks or a concrete containers that would enable farmers to stock a large quantity for more long term use.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Local people have not yet fully realized the benefits of using compost because the farmers have never used it before. → The compost production process and its benefits shall be disseminated throughout local communities, including knowledge exchange between those communities that have been using compost and those that have not yet started.

REFERENCES

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Date of documentation: May 18, 2017

Last update: Sept. 11, 2018

Resource persons
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Khou Khounlavong - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2284/

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Rice straw mulching mixed with soil for vegetable home garden (Bounthanom Bouahom)

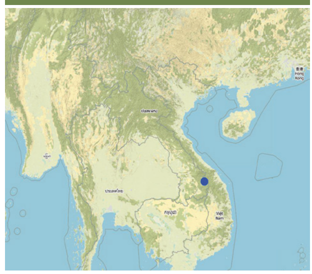
Rice straw mulching in vegetable home gardens (Lao People's Democratic Republic)

DESCRIPTION

The Technique of using decomposed rice straw in household gardening is an effective soil improvement practice carried out by the local people. The decomposed rice straw helps to improve soil moisture, provides organic matters to the soil, which a cost-effective soil amendment practice, and results finally in increased crop yields.

Rice straw mulching was initiated locally in Daktaock-noi village, Dakchueng district in 2014 as a technique to improve the soil quality in household gardens. Previously the farmers used to apply animal manure (cow and buffalo excrement) to improve the soil fertility in the village's vegetable gardens. However as a result many of them experienced an outbreak of pests such as root-knot nematode (Meloidogyne enterolobii) who damage the plant's root, and aphids which also destroyed the vegetables plant's leaves. This led to low productivity and an inferior quality of vegetables that could not be sold.
The farmers therefore explored and experimented with new methods once they had made observations of the effect of leaving rice straw on the rice paddies or surrounding areas for a period of four to five months after the rice has been harvested in October. They noted that the soil in these areas became more fertile as the emerging new rice sprouts were healthy due to rice straw decay existing in the field. It illustrated that when a layer of rice straw is left on the surface of the field that this has a positive effect on the soil. For instance it enhances the soil's moisture and there is an increase in organic matter resulting from the decomposed rice straw which improves the soil's fertility.
The land users therefore started to store the rice straw in specific locations after the rice had been harvested. They stockpiled the rice straw in parts of the rice field that were water logged or more humid. This way the rice straw could absorb water and then be collected at a later stage. If the rice straw is not stored, it will dry out and be dispersed naturally by the wind.
Typically, there are two times in the year that the farmers become active in the production of compost from the rice straw. The first time is in October after the rice has been harvested when there is not a lot of rain. The second occasion takes place from January to February, which allows a period of 4-5 months for the rice straw to decay after it has been collected. The only raw materials that are needed for the production of rice straw compost are the actual decomposed rice straw and soil. The only essential equipment consists of a blade for the cutting of the rice straw, and then bags for the collection, as well as a hoe for the preparation of the plot to grow vegetables.
The rice straw compost production process begins with the collection of two bags (20 kg) of decomposed rice straw from the rice field, which should then be well mixed with one bag (10kg) of soil. This mixture should be applied directly onto the vegetable plots before sowing the seeds. After the application of the rice straw compost it was noted that the vegetables grow successfully without being disturbed by pests or insects. The soil gradually became darker which is an indicator of good soil fertility. Thereafter vegetable production increased and the farmers were also able to grow a greater variety of vegetables including scallion and coriander, which had previously not been possible. Currently, the local people are able to cultivate three crops per year which generates an additional source of income for the households.
Additionally the application of rice straw compost can help farmers adapt to climate change, particularly in periods of heavy rainfall. This is because areas where the soil's surface has been covered with rice straw mulching are protected from surface run-off

LOCATION



Location: Darktaork noy village, Darkchung district, Xekong province, Lao People's Democratic Republic

No. of Technology sites analysed: single site

Geo-reference of selected sites

- 107.34954, 15.52254

Spread of the Technology: evenly spread over an area (approx. < 0.1 km2 (10 ha))

Date of implementation: 2014; less than 10 years ago (recently)

Type of introduction

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

during heavy rain. Once the rice straw has been distributed over the vegetable patches it was noted that the root-knot nematode had decreased in numbers when they were found in the soil.
In general, the local people are satisfied with this technique as it only requires the input of labour in order to gather the rice straw, which farmers can do on their own rice fields with no additional costs involved.
The rice straw compost production process: Firstly collect the rice straw from the field after the rice has been harvested. The rice straw should be stockpiled in particular locations around the rice field where the floor is wet or more humid for a period of 4-5 months to let them gradually decompose.
These patches should be hoed to approximately a depth of 15 cm, then decomposed rice straw should be mixed with topsoil from the prepared vegetable patches for 10 cm thick and the patches have width of 1 m , length of 3 m. There should be a distance of 15 cm in each direction between the vegetable seedlings. Once the patches are covered with an approximately 5 cm layer of decomposed rice straw. The space between each of the vegetable patches should be approximately 20 cm, and the total area of the home garden is 25 m2.

Using rice straw mulching for soil improvement in the vegetable home garden. (Bounthanom Bouahom)

Status of the soil before using rice straw mulching (Bounthanom Bouahom)

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
- [ ] create beneficial social impact

Land use

Cropland - Annual cropping
Main crops (cash and food crops): Cabbage and coriander

Water supply

- [ ] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation
- [x] Spring water

Number of growing seasons per year: 2
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

Purpose related to land degradation

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

Degradation addressed

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

physical soil deterioration - Pu: loss of bio-productive function due to other activities

biological degradation - Bc: reduction of vegetation cover, Bq: quantity/ biomass decline, Bp: increase of pests/ diseases, loss of predators

water degradation - Ha: aridification

SLM group

SLM measures

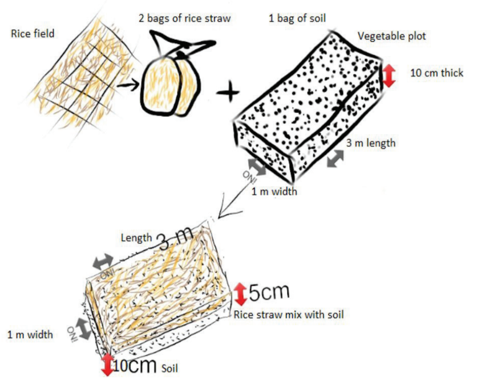
- improved ground/ vegetation cover
- integrated pest and disease management (incl. organic agriculture)
- home gardens

agronomic measures - A2: Organic matter/ soil fertility

TECHNICAL DRAWING

Technical specifications

The vegetable patches should be prepared in the garden. Each patch needs to be 3 meters in length and 1 meter in width. A hoe should be used to excavate each patch to a depth of 15 cm. The rice straw should be collected from the rice fields and mixed with the soil that has been dug out of the patches at a ratio of 2 bags of rice straw to 1 bag of soil.
This mixture should then be distributed over the patches, with each patch being filled to a depth of 10 cm. Afterwards a further 5 cm layer of decomposed straw should be added on top of the mixture of soil and rice straw. The home garden vegetable patches were established in flat area that is located next to a recently constructed road where there is only a slope angle of 1 to 2%. The plants in each patch should have an equidistance of 15 cm between each one. There should be a distance of 20 cm between each patch. The total land area containing the patches amounts to 25 m2. Cabbage and coriander are the two plant species being grown. There is a density of about 145 plants per patch.



Author: Oulaythong Phommixay

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: 25 m2)
- Currency used for cost calculation: **LAK**
- Exchange rate (to USD): 1 USD = 8000.0 LAK
- Average wage cost of hired labour per day: 50.000

Most important factors affecting the costs

Labourers are needed to collect the straw from the paddy fields because at this time most of the family members capable of working are retained for the cultivation of rice before the rainy season.

Establishment activities

1. Plot preparation (Timing/ frequency: After rice harvested (August))
2. Rice straw collecting (Timing/ frequency: October)
3. Mix soil with decayed rice straw (Timing/ frequency: January to February)

Establishment inputs and costs (per 25 m2)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour to collect the rice straw	labour day	4.0	50000.0	200000.0	100.0
Equipment					
Hoe	piece	1.0	50000.0	50000.0	100.0
Bag	bag	30.0	2000.0	60000.0	100.0
Blade	piece	1.0	35000.0	35000.0	100.0
Total costs for establishment of the Technology				**345'000.0**	

Maintenance activities

1. Plot preparation (Timing/ frequency: After rice harvest (August))
2. Rice straw collecting (Timing/ frequency: October)
3. Mix soil with decayed rice straw (Timing/ frequency: January to February)

Maintenance inputs and costs (per 25 m2)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour to collect the rice straw	labour day	2.0	50000.0	100000.0	100.0
Equipment					
Hoe	piece	1.0	50000.0	50000.0	100.0
Bag	bag	30.0	2000.0	60000.0	100.0
Blade	piece	1.0	35000.0	35000.0	100.0
Total costs for maintenance of the Technology				**245'000.0**	

NATURAL ENVIRONMENT

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

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

Specifications on climate
Average annual rainfall in mm: 870.0
Name of the meteorological station: Dakchueng district of climatology office

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

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

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [x] 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
- [x] not relevant

Soil depth
- [x] 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)
- [x] medium (loamy, silty)
- [ ] fine/ heavy (clay)

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

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

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

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

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

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [x] 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
- [ ] poor
- [x] average
- [ ] rich
- [ ] very rich

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

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

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

Gender
- [x] women
- [ ] men

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

Area used per household
- [x] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 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

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

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

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

Water use rights
- [x] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [x] 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	Quantity before SLM: 25 Kg Quantity after SLM: 30 Kg Organic matter increased within the soil and subsequently it became more fertile as well as gained in moisture
crop quality	decreased					✓			increased	Previously the soil was quite unsuitable to produce a good quantity and quality of vegetables as the soil had become clumpy due to compaction. After the use of rice straw the soil has become more fertile and it is possible to grow vegetables of a reasonably good quality.
farm income	decreased					✓			increased	Vegetable production has risen above the family's consumption needs, which has allowed them to generate a small income through the sale of vegetables in the village.
workload	increased			✓					decreased	An increased workload has resulted because after the rice has been harvested, the farmers need to collect the rice straw from the fields and store it. Furthermore once it has decayed they need to spread it over the soil of the vegetable plots.

Socio-cultural impacts

food security/ self-sufficiency	reduced						✓		improved	The land user's family has become self sufficient as it now has enough vegetables for its needs and there is even a small surplus that can be sold in the village.

Ecological impacts

soil moisture	decreased					✓			increased	TThe rice straw absorbs water from the environment, after it has been mixed with the soil. After it is spread on the surface of the vegetable plots it facilitates the retention of the soil's moisture.
soil compaction	increased						✓		reduced	When the land user breaks the clods and mixes the soil with the decomposed rice straw, the soil gradually turns darker, improves its porosity and also becomes looser.
nutrient cycling/ recharge	decreased					✓			increased	The rice straw will be digested by decomposers such as earthworms and other microorganisms, and the end products of this process provide nutrients for the vegetables.

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	
seasonal temperature decrease	not well at all				✓		very well	Season: dry season
annual rainfall increase	not well at all			✓			very well	
seasonal rainfall increase	not well at all			✓			very well	Season: wet/ rainy season

Climate-related extremes (disasters)

local hailstorm	not well at all			✓			very well
extreme winter conditions	not well at all						very well

insect/ worm infestation — 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
- 1-10%
- 10-50%
- more than 50%

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

- 0-10%
- 10-50%
- 50-90%
- ✓ 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- Yes
- ✓ No

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

- Improved soil texture and an increase in levels of organic matter
- An increase in crop yields
- An increase in beneficial microorganisms and earth worms

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

- Rice straw renders the soil more porous so that the plants' roots can more easily penetrate into the soil.
- Good water infiltration and soil moisture

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Rice straw is only available after the rice has been harvested.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

REFERENCES

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Date of documentation: April 6, 2017

Last update: June 24, 2019

Resource persons
Lindasouk Soudaphone - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2061/

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Waste from vegetable, sugar, and molasses for making Effective micro-organism (Phonesyli Phanvongsa)

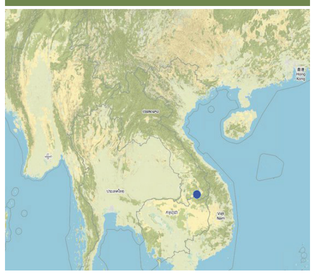
Use of Effective Micro-organism (EM) to improve soil fertility in vegetable home gardens (Lao People's Democratic Republic)

DESCRIPTION

Effective micro-organism (EM) is a liquid concentrate which can be used as a pre planting treatment, for actively growing vegetables and helps to increase beneficial soil microorganisms and suppression of harmful ones.

Farmers have practiced household gardening for a considerable period of time in order to increase food security and generate an income. However some farmers have experienced difficulties in cultivating vegetables due to various challenges such as the soil type, for example clay or compacted soil, ineffective water seepage as well as the soil's low nutrient content making it unsuitable for agricultural purposes. Consequently, the problems that the farmers often faced included vegetables of inferior quality, outbreaks of diseases, as well as surges of insects and pests which typically reduce yields by approximately 30%. In order to increase production and cultivate at a preferable period of time, farmers often applied chemical fertilizer in combination with animal compost. However the production outputs and quality of the produce were not up to expectations if compared to agricultural practices that do not involve the use of chemicals. It has been noted that vegetables grown with the use of chemical fertilizers cannot be kept for a long period of time as they tend to spoil more quickly, despite the increase in production yields. In 2015 an International Fund for Agriculture Development (IFAD) Programme introduced a technique to produce effective micro-organisms (EM) and encouraged people to use these to improve the nutrient content of the soil and thereby enhance the quality of home garden vegetables as well as other potential crops. The farmers gained an interest in EM and began to produce it according to the programme's instructions. The production of EM is actually relatively easy, and farmers can use organic waste from vegetables such as Chinese mustard (Brassica juncea), morning glory and water spinach mixed with 1kg of sugar and 0.5 kg of molasses (if available, or it can be excluded, but it should be available at an agricultural produce outlet). Firstly the organic waste should be sliced/chopped into small pieces and then sugar and molasses are added which are then all mixed in a 20 litre container. Then a one metre long stick should be used to mix all the ingredients and the container lid should then be sealed properly. Once these steps have been completed, the EM production container should avoid sunlight and be stored in the shade so as to ensure the quality of EM. After one week the container can be opened to mix the ingredients again and then it can continue to remain in the shade for another month. Thereafter, EM mixture is ready for use and one table spoon should be added to 10 litres of water, and once this has been mixed well it can be applied to the vegetables in the home garden by using water cans. Watering involves pouring the solution from the leaves to the stems or to the roots of the vegetables. After the application of the EM solution it was noted that there were more earthworms around the vegetable plots and also that there was an increase in soil moisture and nutrients. Furthermore it was also noted that the soil was previously relatively white and compacted and not black and porous allowing for good water seepage. In this way water is absorbed by the soil in the plot rather than running off over the surface. Plant pathogens and pests/insects such as red ants and leaf worms was reduced. As a result, the vegetables grew well with a good average weight, and there was an increase in both the quality and the yield. As a comparison, in the past farmers used to be able to harvest 5-6 kg per plot, but now they are capable of securing 12-15kg

LOCATION



Location: Phouvong district,, Attapeu province, Lao People's Democratic Republic

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 106.68574, 14.70076

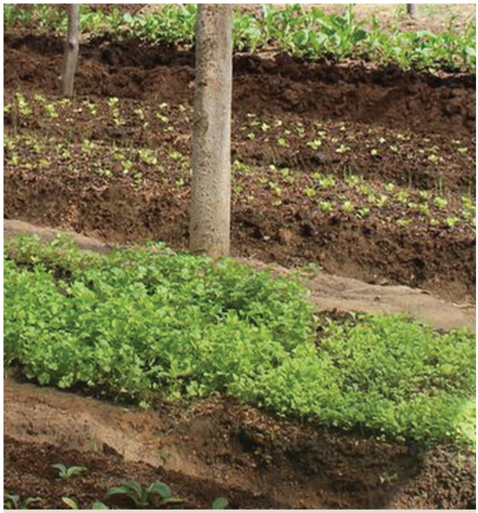
Spread of the Technology: evenly spread over an area (approx. < 0.1 km2 (10 ha))

Date of implementation: 2015; less than 10 years ago (recently)

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

per plot. However, weeds still remain a problem and these include Eleusine indica and thorny grass which compete for nutrients with the crops. It is a challenge for the farmers to control these weeds including other natural vegetables.


Waste from vegetable, sugar, and molasses (Phonesyli phanvongsa)


Vegetable garden plot where the EM solution is applied to improve soil fertility and increase crop yields (Phonesyli phanvongsa)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose
- ✓ improve production
- ✓ 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


Cropland - Annual cropping
Main crops (cash and food crops): Peppermint, Lettuce, Chinese Kale, Sweet Basil

Water supply
- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Number of growing seasons per year: 2
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

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

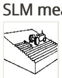
Degradation addressed


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


biological degradation - Bh: loss of habitats, Bs: quality and species composition/ diversity decline

SLM group
- integrated soil fertility management
- home gardens

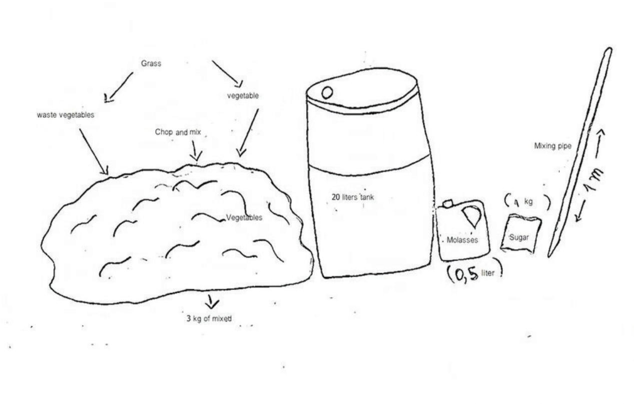
SLM measures


agronomic measures - A2: Organic matter/ soil fertility

TECHNICAL DRAWING

Technical specifications

This bio-extracting technique can be done easily and farmers can use local waste materials such as cabbage, pineapple, spinach and so on. With the following ingredients: 3 kg of vegetables, 1 kg of sugar, 0.5 liters of molasses. Then bring the vegetables to chop thoroughly and then bring the sugar and mixed molasses into a 20 liter tank prepared and mixed together, the area of the bio-extracted technique is 2 meters x 2 meters, Then put about 1 meter of wood to mix it and close the barrel to keep it in the air when practicing all the techniques and then we will bring a bio-extracted tank to a sunny shade to preserve the quality of detergent, Then one more week, we can open the tank for all the ingredients again, so we can do this for a period of time, up to a month, and then add the biological extracts 1 spoon / 10 liters of water to mix and then irrigate the vegetable.



Author: Fadavanh Souliya

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area
- Currency used for cost calculation: **Kip**
- Exchange rate (to USD): 1 USD = 8500.0 Kip
- Average wage cost of hired labour per day: 50000

Most important factors affecting the costs

Labor

Establishment activities

1. Collect the waste vegetable (Timing/ frequency: After harvesting)
2. chop to small size (Timing/ frequency: After harvesting)
3. Mix with sugar and molasses (Timing/ frequency: None)
4. Irrigate vegetable (Timing/ frequency: None)

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit (Kip)	Total costs per input (Kip)	% of costs borne by land users
Labour					
Labor	person	1.0	50000.0	50000.0	100.0
Equipment					
Knife	peice	1.0	20000.0	20000.0	
irrigation tank	peice	1.0	30000.0	30000.0	
Bucket	peice	2.0	25000.0	50000.0	
Plant material					
Molasses	kg	1.0	8000.0	8000.0	100.0
Sugar	liter	2.0	7000.0	14000.0	100.0
Total costs for establishment of the Technology				**172'000.0**	

Maintenance activities

1. Collect the waste vegetable (Timing/ frequency: After harvesting)
2. chop to small size (Timing/ frequency: After harvesting)
3. Mix with sugar and molasses (Timing/ frequency: None)
4. Irrigate vegetable (Timing/ frequency: None)

Maintenance inputs and costs

Specify input	Unit	Quantity	Costs per Unit (Kip)	Total costs per input (Kip)	% of costs borne by land users
Labour					
Labor	person	1.0	50000.0	50000.0	100.0
Equipment					
Knife	piece	1.0	20000.0	20000.0	
irrigation tank	piece	1.0	30000.0	30000.0	
tank	piece	1.0	25000.0	25000.0	
Plant material					
Molasses	kg	1.0	7000.0	7000.0	100.0
Sugar	liter	2.0	8000.0	16000.0	100.0
Total costs for maintenance of the Technology				**148'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall
- < 250 mm
- 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
- semi-arid
- arid

Specifications on climate
Average annual rainfall in mm: 2500.0
Between November and April, rainfall is about 20 - 80 mm
From May to October rain started to fall about 200-500 mm, much rainfall before the first, from June to October.
Name of the meteorological station: Climatology Department of Phouvong District

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

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

Altitude
- 0-100 m a.s.l.
- ✓ 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)
- moderately deep (51-80 cm)
- deep (81-120 cm)
- very deep (> 120 cm)

Soil texture (topsoil)
- ✓ coarse/ light (sandy)
- medium (loamy, silty)
- 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%)
- ✓ low (<1%)

Groundwater table
- on surface
- < 5 m
- ✓ 5-50 m
- > 50 m

Availability of surface water
- excess
- good
- ✓ medium
- poor/ none

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

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ 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
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- ✓ poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ 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
- ✓ 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
- 15-50 ha
- 50-100 ha
- 100-500 ha
- 500-1,000 ha
- 1,000-10,000 ha
- > 10,000 ha

Scale
- ✓ small-scale
- medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- individual, not titled
- ✓ individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Access to services and infrastructure

	poor				good
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	✓ (position 7 of 7) increased	Quantity before SLM: 5-6 kg/plot of vegetables Quantity after SLM: Increased 12-15 kg/plot of vegetables
crop quality	decreased	✓ (position 6 of 7) increased	Strong and sound plants. Due to reduced plant pathogens and pests/insects such as red ants and leaf worms.
product diversity	decreased	✓ (position 5 of 7) increased	Increase and diversity of different type of vegetables for home consumption and selling.

Socio-cultural impacts

Ecological impacts

surface runoff	increased	✓ (position 5 of 7) decreased	Water is absorbed by the soil in the plot rather than running off over the surface.
soil crusting/ sealing	increased	✓ (position 5 of 7) reduced	soil was previously relatively white and compacted and now it is black and porous allowing for good water seepage

Off-site impacts

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative	✓ (position 6 of 7)	very positive
Long-term returns	very negative	✓ (position 7 of 7)	very positive

Benefits compared with maintenance costs

Short-term returns	very negative	✓ (position 6 of 7)	very positive
Long-term returns	very negative	✓ (position 7 of 7)	very positive

CLIMATE CHANGE

Gradual climate change

annual temperature increase	not well at all	✓ (position 3 of 5)	very well	
seasonal temperature increase	not well at all	✓ (position 3 of 5)	very well	Season: dry season
annual rainfall decrease	not well at all	✓ (position 2 of 5)	very well	
seasonal rainfall decrease	not well at all	✓ (position 3 of 5)	very well	Season: wet/ rainy season

Climate-related extremes (disasters)

local rainstorm	not well at all	✓ (position 3 of 5)	very well
local windstorm	not well at all	✓ (position 2 of 5)	very well
drought	not well at all	✓ (position 4 of 5)	very well
insect/ worm infestation	not well at all	✓ (position 4 of 5)	very well

Other climate-related consequences

extended growing period	not well at all	✓ (position 2 of 5)	very well

ADOPTION AND ADAPTATION

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

- single cases/ experimental
- 1-10%
- ✓ 10-50%
- more than 50%

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

- 0-10%
- 10-50%
- 50-90%
- ✓ 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- ✓ Yes
- No

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

- Easy to find the vegetable waste and not complicate process.
- Reduces household expenses for input cost as the cost of producing of EM is cheaper than buy chemical fertilizer
- Increased household income from vegetables and improved food security

Strengths: compiler's or other key resource person's view
- Environmentally friendly and good for land user's health.
- Increased both quantity and quality of vegetable production.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome
- EM solution also encourages more grass/weeds to grow especially leusine indica and thorny grass that challenge for farmers to control weed.
- Sometimes, it is difficult to find molasses in general grocery

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

REFERENCES

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Date of documentation: Nov. 1, 2017

Last update: Dec. 5, 2018

Resource persons
Khanthavy Sysomphou - land user
Chanty Saiyaphone - SLM specialist
Vixay Phaviseth - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_3240/

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Links to relevant information which is available online
- ນໍ້າສະກັດຊີວະພາບ (ປຸຍນໍ້າ), ສພກສຍ (SEADA): http://lao44.org/content/1652

Livestock management

Bamboo plantation line to fence agricultural field (Sakmixay Sanithbounmy)

Planting bamboo for fencing and wind protection (Lao People's Democratic Republic)

DESCRIPTION

Bamboo is planted for fencing agricultural land, protecting the land from strong winds and reducing the demand of wood from the forest. Bamboo shoots are also a source of nourishment and income generation.

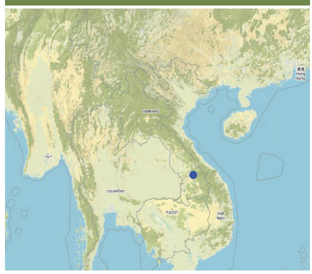
After experiencing serious impacts from the typhoon Ketsana in 2010, which included the loss of agricultural produce, the farmers needed to examine means of protecting their Yang Bong tree plantation from strong wind. One of the methods is to plant bamboo to act as fencing which at the same time protects the crops from strong winds. Initially farmers observed that natural bamboo grows in plentiful supplies along the stream banks and islands within the watercourses. Therefore, this stimulated their interest and so to start off with they conducted a trial with two tuffs. They noticed that the bamboo grows quite quickly and that the stems are a reasonably good protection against strong winds. The farmers thus decided to extend the area under cultivation and plant it around the edge of their Yang Bong tree plantation, which is approximately 1 hectare. In fact, farmers had usually harvested considerable amounts of bamboo from the surrounding natural forests for the construction of fencing around their agriculture land. This practice had actually placed ever increasing pressure on these natural forests, is quite time consuming and requires considerable labour power in order to transport it over long distances.

Normally, bamboo fences need to be constructed and maintained annually in the first year of bamboo plantation. Moreover, there is also the issue of wildlife and livestock damaging the plantation area, which results in the loss of produce (approximately 70-80% of the damaged area).

The bamboo should be planted in holes with a diameter and a depth of 20 cm with a gap of 2 m between each hole. The seedlings are selected from one to two year old stems. The individual rhizomes should be removed from parent plant and then the roots trimmed. The bamboo culms should not be too long, normally about 50-80 cm, about the length of an average human arm. Replanting should take place on the same day and at the very latest not more than two days after the rhizomes have been collected from the parent plant. May and June are the most appropriate months for planting as this is the start of the wet season. Bamboo should flourish during this period and thus it reduces the likelihood that the bamboo seedlings will wither. Maintenance of the plants may require watering, especially during the dry season, which should be done once every five to seven days until the commencement of the rainy season. Watering may not be necessary once the bamboo plants have been able to survive for two years, but they should be weeded at least twice per year.

Planting bamboo provides environmental, economic and social benefits. It helps to increase soil nutrients, porosity, and moisture and lower the temperature of the immediate surroundings. Bamboo shoots are a source of food and bamboo culms can be used for many purposes, such as the manufacture of handicrafts. Dried out bamboo can be sold for 40.000 Kip/kg and, on average, each farmer is able to sell up to 40kg per year. It is possible to harvest bamboo shoots three years after the rhizomes have been planted. Households have learnt from these positive experiences and began to plant bamboo around their rice paddies and home gardens to prevent livestock from damaging their crops and gain additional benefits.

LOCATION



Location: Samouy, Salavan province, Lao People's Democratic Republic

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 106.42772, 15.94165

Spread of the Technology: evenly spread over an area (approx. 0.1-1 km2)

Date of implementation: 2009; less than 10 years ago (recently)

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

Bamboo used for fencing to prevent from strong wind (Jimmy Luangphitak)

Bamboo trees along to the agricultural field near the village (Jimmy Luangphitak)

CLASSIFICATION OF THE TECHNOLOGY

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

Land use

Cropland - Tree and shrub cropping
Main crops (cash and food crops): Yangbong tree plantation

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

Number of growing seasons per year: 1
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

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

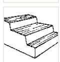
Degradation addressed

soil erosion by wind - Eo: offsite degradation effects

SLM group
- windbreak/ shelterbelt
- integrated soil fertility management

SLM measures

vegetative measures - V1: Tree and shrub cover

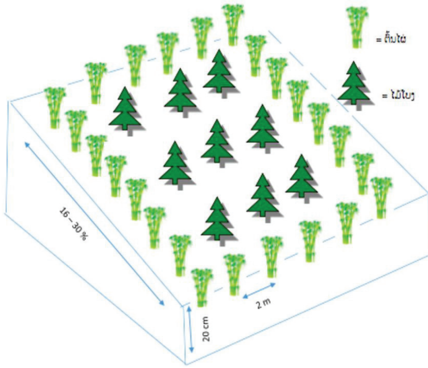


structural measures - S6: Walls, barriers, palisades, fences

TECHNICAL DRAWING

Technical specifications

The land users plant bamboo around the agricultural land, where bong trees (nothaphoebe umbelliflora) are planted . Healthy bamboo plants can be collected from strong roots, branches or remaining culms. They have to be about 40- 60 cm long (approximately 8 bags of bamboo seedlings).
After collection, the required rhizomes can be replanted immediately (or within 7 days after collection). Appropriate planting space is 2m x 2m.
The size of the planting pit is about 40 cm x 40 cm. The planting should be taken place in the early rainy season to reduce the requirement for watering and the risk of the seedling to die after planting. Once planting is completed, it may need weeding twice a year.



Author: Jimmy Luanglath

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: 1 Hactare)
- Currency used for cost calculation: **LAK**
- Exchange rate (to USD): 1 USD = 8000.0 LAK
- Average wage cost of hired labour per day: 30000

Most important factors affecting the costs

Bamboo seedlings are an important factor affecting the costs. Family members go to collect the bamboo seedlings from the forest.

Establishment activities

1. Landpreparation (Timing/ frequency: DryseasononJanuarytoFebuary))
2. Slash and burn (Timing/ frequency: March)
3. Collect the bamboo seedlings (Timing/ frequency: 1 week after finish land preparation)
4. Planting bamboo (Timing/ frequency: rainy season)
5. Weeding along bamboo fencing (Timing/ frequency: 3times per year)

Establishment inputs and costs (per 1 Hactare)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Equipment					
Knife for weeding	piece	4.0	30000.0	120000.0	100.0
Big knife to cut the bamboo tree	piece	1.0	100000.0	100000.0	100.0
Total costs for establishment of the Technology				**220'000.0**	

Maintenance activities

1. Weeding along bamboo fencing (Timing/ frequency: During the first year of plantation(3timesperyear)

Maintenance inputs and costs (per 1 Hactare)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour for weeding	person day	6.0	30000.0	180000.0	100.0
Total costs for maintenance of the Technology				**180'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall

- < 250 mm
- 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
- semi-arid
- arid

Specifications on climate

Name of the meteorological station: Samouy meteorological station

Slope

- flat (0-2%)

Landforms

- plateau/plains

Altitude

- 0-100 m a.s.l.

Technology is applied in

- convex situations

- gentle (3-5%)
- moderate (6-10%)
- rolling (11-15%)
- ✓ hilly (16-30%)
- steep (31-60%)
- very steep (>60%)

- ridges
- mountain slopes
- ✓ hill slopes
- footslopes
- valley floors

- 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.

- concave situations
- ✓ not relevant

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)
- coarse/ light (sandy)
- ✓ medium (loamy, silty)
- 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%)
- low (<1%)

Groundwater table
- on surface
- < 5 m
- ✓ 5-50 m
- > 50 m

Availability of surface water
- excess
- good
- medium
- ✓ poor/ none

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

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ 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
- ✓ 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ 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
- ✓ 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
- 15-50 ha
- 50-100 ha
- 100-500 ha
- 500-1,000 ha
- 1,000-10,000 ha
- > 10,000 ha

Scale
- ✓ small-scale
- medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- individual, not titled
- ✓ individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- ✓ open access (unorganized)
- communal (organized)
- leased
- individual

Access to services and infrastructure

	poor				good
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

farm income	decreased					✓			increased	The land user can earn income from bamboo shoots (1,600,000 LAK/year)
diversity of income sources	decreased					✓			increased	Increased income from bamboo shoots and Yang Bong trees.
workload	increased							✓	decreased	

Land user's workload to go to collect and cut the wood from the forest to make fencing is reduced.

Socio-cultural impacts

Ecological impacts

soil moisture	decreased	✓ (slightly positive)	increased	Increase soil nutrients, porosity, and moisture.
impacts of cyclones, rain storms	increased	✓ (slightly negative)	decreased	Bamboo trees getting bigger and taller can prevent the strong winds.
wind velocity	increased	✓ (moderately positive)	decreased	Decreased wind velocity protecting Yang Bong trees plantation area.

Off-site impacts

wood logging from forest	None	✓ (moderately positive)	None	Reduced the wood logging from forest to make fences.

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative	✓ (slightly positive)	very positive
Long-term returns	very negative	✓ (very positive)	very positive

Benefits compared with maintenance costs

Short-term returns	very negative	✓ (moderately positive)	very positive
Long-term returns	very negative	✓ (moderately positive)	very positive

CLIMATE CHANGE

-

ADOPTION AND ADAPTATION

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

- ☐ single cases/ experimental
- ☑ 1-10%
- ☐ 10-50%
- ☐ more than 50%

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

- ☐ 0-10%
- ☑ 10-50%
- ☐ 50-90%
- ☐ 90-100%

Number of households and/ or area covered

2 households

Has the Technology been modified recently to adapt to changing conditions?

- ☑ Yes
- ☐ No

To which changing conditions?

- ☐ climatic change/ extremes
- ☐ changing markets
- ☐ labour availability (e.g. due to migration)
- ☑ Different way of bamboo planting

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- One of the methods is to plant bamboo to act as fencing which at the same time protects the Yang Bong trees from strong winds.
- Prevents livestock and wildlife from damaging Yang Bong trees as bamboo produces many culms that impede animals from entering agricultural areas.
- Bamboo can be used for handicraft activities (bamboo wall, bamboo sheets). Bamboo shoots are a source of food and can be sold to generate household income.

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

- The bamboo can also withstand against wind to some extent. The bamboo roots penetrate deep into the soil and are thus preventing soil erosion. The bamboo also acts to some extent as a wind barrier.
- The land user can save time and labour for harvesting bamboo shoots for household consumption.
- Reduce the wood logging from forest to make fences.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Crops that are shaded by bamboo will not flourish as successfully or will produce low yields. Therefore, bamboo branches need to be trimmed regularly. → Therefore, it requires regular trimming of branches.
- Some people in the village steal bamboo shoots without getting permission.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

REFERENCES

Compiler
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Date of documentation: July 5, 2017

Last update: Oct. 30, 2018

Resource persons
Aphouy - land user
ທ່ານ ອາຢຸຍ - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2904/

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Napier Grass cultivation area (Latsamone Vongphosy)

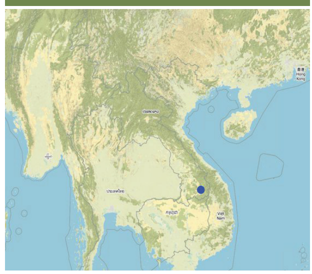
Conversion of rocky area to grazing area for livestock management (Lao People's Democratic Republic)

DESCRIPTION

Forage and Livestock Management

One of the main causes of land degradation in the Tadseng village (Sansay district, Lao PDR) is the flow of storm water that results in sediment run-off which leaves only rocks behind. It is estimated that approximately 20% of clay soils on the top soil have been washed away in recent years. In 2009 The Sustainable National Resources Management Product and Enhancement Project supported by Asia Development Bank (ADB) encouraged villagers to set up cow and forage farms. Ten cow breeding groups were established in the village. The cow farming group had used the communal land with a total 15 ha. After four years of implementation, some group members ignored their responsibilities and the group experienced a number of difficulties in both the management of the livestock and grass, which finally led to the collapse of the system. However, by 2014, one of the former members regained his interest in cow farming. He was able to rent the former 15 ha of land and he re-established the cow farm to a herd of 130 heads. At the beginning he only chose the healthiest stems of grass that remained from the old farm and replanted these. Three grass species were planted in rows on one area, namely Nepir, Guinea and Paspalum. It took thirty days to plow and prepare the land using a tractor and a labour force of more than fifty workers. For about five days, ten of these laborers had to remove the forage roots from the old fields. Generally, mid-May is the most suitable time to plant the grass as there is only a small amount of rain. Work begins by clearing the land and plowing the soil and then leaving it to dry for 15 days in order to get rid of some of the weeds and pests. During this period, some of the organic matter decays and develops into green compost which helps to improve the soil's structure. This subsequently successfully regenerates the growth of the grass as its roots are able to easily expand throughout the soil. Whilst waiting for the soil to dry fences will be constructed around the plot. Then 40 tons of manure should be transported to the field using a two-wheel tractor. After, the manure has to be distributed and plowed into the soil. At the beginning of June grass can be planted by digging holes in rows, as to place the grass suckers into the ground at a depth of 5 cm. Irrigation is unnecessary as rain is expected in June. Optionally the farmer can use a gravity fed irrigation, if necessary. The forage can be harvested around 90 – 100 days after plantation. There are two options regarding the feeding of livestock: First option involves hired labourers to harvest the grass. The second option is to allow the livestock to graze freely in the field, 6 months after grass plantation. However, this can only be undertaken on a bi-weekly basis so as to allow the grass to regenerate. It is important to extract the weeds and apply organic fertilizer or green manure after the grass has been cut. Maintenance may also involve the repairing of fences. Advantages of this planting grass are the reduction of soil erosion and preventing nutrients from being washed out during heavy rains, as well as reducing soil compaction. Meanwhile the organic matter in the soil increases due to the decay of dead leaves of grass and roots. Further advantage is to grow up stronger and healthier cows. This also means that the farmers get higher household revenue from the sale of his livestock which on average amounts up to 80,000,000Kip/annum. Family members also have more time for other household activities because cows are released in the early morning and called back in late afternoon. However, one of the disadvantages could be a reduction in the local

LOCATION



Location: Tadseng village Sansay district, Attapue province, Lao People's Democratic Republic

No. of Technology sites analysed: single site

Geo-reference of selected sites

- 106.97136, 14.98797

Spread of the Technology: evenly spread over an area (approx. 0.1-1 km2)

Date of implementation: 2011; less than 10 years ago (recently)

Type of introduction

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

biodiversity such as edible insects and crickets. Furthermore the availability and variety of non-timber forest products declines such as Hed Amanita hemibapha, broom grass and rattan. Wildlife numbers have also reduced as people used to find and squirrels in this region. Another challenge may be that households have limited labour power to maintain fences and the forage fields, as it is relatively expensive to hire workers at 50,000 Kip/day. Difficulties in carrying out weeding include Nga Nam Keo. It should be noted that farmer make significant savings by not having to buy grass seeds as he can collect grass rhizomes from the old farm area.

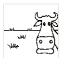
Grass cultivation area that shows the soil mixed with larger stones (Latsamone Vongphosy)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- ☐ improve production
- ✓ 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



Grazing land - Extensive grazing land: Ranching Intensive grazing/ fodder production: Improved pastures
Main animal species and products: Napir (Pennisetum purpureum), Guinea and Paspalum grass commonly known is a popular fodder crop for small scale dairy farming.

Water supply

- ☐ rainfed
- ✓ mixed rainfed-irrigated
- ☐ full irrigation

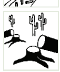
Number of growing seasons per year: 1
Land use before implementation of the Technology: n.a.
Livestock density: 130 cows/15 ha

Purpose related to land degradation

- ☐ prevent land degradation
- ☐ reduce land degradation
- ✓ restore/ rehabilitate severely degraded land
- ✓ adapt to land degradation
- ☐ not applicable

Degradation addressed

physical soil deterioration - Pc: compaction



biological degradation - Bc: reduction of vegetation cover, Bf: detrimental effects of fires

water degradation - Ha: aridification

SLM group

- pastoralism and grazing land management
- improved ground/ vegetation cover

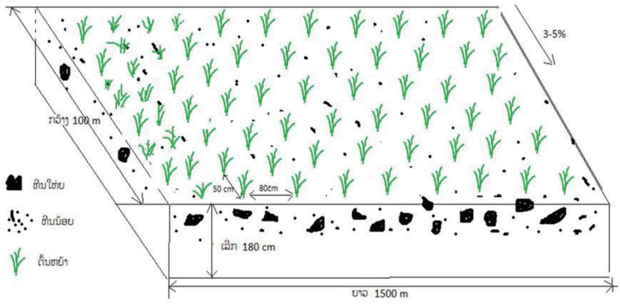
SLM measures

management measures - M2: Change of management/ intensity level

TECHNICAL DRAWING

Technical specifications

Density of plants is 37,000 plants/ha
Planting area wide is 100 m, the length is 1500 m
The grass stems should be planted at a distance of 50 cm from each other and there should be a distance of 80 cm between the rows.
The land is in foot slop with slop about 3 - 5%
Plant varieties in use are e.g. Napir, Guinea, Paspalum
Growing period is 90 - 100 day before it can be cut.
Around the plot a barbed wire has been installed fore livestock control and to prevent other animals from outside. The fence was 1.5 m high with 5 lines of barbed wire from the top of the posts to the surface.
Further technical specifications: Land preparation involved the use of a tractor with 4,000 horse power engines. This grass cultivation technology is practiced around the foot slopes with an average gradient of 3-5%. Weeding and the application of fertilizer are required twice a year in May and December. The grass can be harvested around 90 – 100 days after it has been planted.



Author: Sinnalong Vongkhamdy

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: **ha**; conversion factor to one hectare: **1 ha = 15**)
- Currency used for cost calculation: **kip**
- Exchange rate (to USD): 1 USD = 8000.0 kip
- Average wage cost of hired labour per day: 50000

Most important factors affecting the costs
The high cost for fencing and the construction material are the most important factors

Establishment activities
1. land estimation (Timing/ frequency: January-Febuary)
2. land preparation (Timing/ frequency: None)
3. Planting (Timing/ frequency: None)
4. Fertilizing (Timing/ frequency: None)
5. Fencing (Timing/ frequency: None)

Establishment inputs and costs (per ha)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
planting labour	person-day	20.0	50000.0	1000000.0	100.0
fencing labour	person-day	30.0	50000.0	1500000.0	100.0
fertilizing labour	person	60.0	50000.0	3000000.0	100.0
Equipment					
Hummer	piece	6.0	35000.0	210000.0	
Draper Fence Wire Tensioning Tool	piece	3.0	170000.0	510000.0	
Manure transfer by tractor	trip	60.0	35000.0	2100000.0	
Glass packing machine	Machine	3.0	1500000.0	4500000.0	
Plant material					
Paspalum seeds	Kg	55.0	50000.0	2750000.0	
Guniea seeds (Megathyrsus maximus)	Kg	40.0	50000.0	2000000.0	
Napier seeds (Pennisetum purpureum)	Kg	35.0	50000.0	1750000.0	
Fertilizers and biocides					
Manure	ton	40.0	200000.0	8000000.0	100.0
Construction material					
Nail	box	1.0	80000.0	80000.0	
Wire	roll	48.0	250000.0	12000000.0	
Post hole	hole	1600.0	10000.0	16000000.0	
Fence post	piece	1600.0	3000.0	4800000.0	
Total costs for establishment of the Technology				**60'200'000.0**	

Maintenance activities
1. Fertilizing (Timing/ frequency: annually, each cultivating season)
2. Cutting the grass (Timing/ frequency: during growing period)
3. Weeding (Timing/ frequency: after harvest)
4. Fence repair (Timing/ frequency: after harvest)

Maintenance inputs and costs (per ha)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
Labor	person-day	50.0	30000.0	1500000.0	100.0
Equipment					
Hoe	piece	25.0	30000.0	750000.0	
Total costs for maintenance of the Technology				2'250'000.0	

NATURAL ENVIRONMENT

Average annual rainfall
- ☐ < 250 mm
- ☐ 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
- ☐ semi-arid
- ☐ arid

Specifications on climate
Average annual rainfall in mm: 2500.0
The driest month is January. There is 7 mm of precipitation in January. With an average of 501 mm, most of precipitation falls in June/August. Annual rainfall is 2300 mm
Name of the meteorological station: Sanxai natural resource and environmental district office
With an average of 28.4 °C May is the warmest month. January has the lowest average temperature of the year. It is 22.6 °C

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

Landforms
- ☑ plateau/plains
- ☐ ridges
- ☐ mountain slopes
- ☐ hill slopes
- ☐ footslopes
- ☐ valley floors

Altitude
- ☐ 0-100 m a.s.l.
- ☑ 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)
- ☐ moderately deep (51-80 cm)
- ☐ deep (81-120 cm)
- ☑ very deep (> 120 cm)

Soil texture (topsoil)
- ☐ coarse/ light (sandy)
- ☑ medium (loamy, silty)
- ☐ 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%)
- ☐ low (<1%)

Groundwater table
- ☐ on surface
- ☐ < 5 m
- ☑ 5-50 m
- ☐ > 50 m

Availability of surface water
- ☐ excess
- ☐ good
- ☑ medium
- ☐ poor/ none

Water quality (untreated)
- ☐ good drinking water
- ☐ poor drinking water (treatment required)
- ☑ for agricultural use only (irrigation)
- ☐ unusable

Is salinity a problem?
- ☐ Yes
- ☑ No

Occurrence of flooding
- ☐ Yes
- ☑ No

Species diversity
- ☐ high
- ☑ 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
- ☐ 10-50% of all income
- ☐ > 50% of all income

Relative level of wealth
- ☐ very poor
- ☐ poor
- ☑ average
- ☑ rich
- ☐ very rich

Level of mechanization
- ☐ 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
- ☑ 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
- ☑ 15-50 ha
- ☐ 50-100 ha

Scale
- ☐ small-scale
- ☐ medium-scale
- ☑ large-scale

Land ownership
- ☐ state
- ☐ company
- ☑ communal/ village
- ☐ group
- ☐ individual, not titled
- ☐ individual, titled

Land use rights
- ☐ open access (unorganized)
- ☐ communal (organized)
- ☐ leased
- ☑ individual

Water use rights
- ☐ open access (unorganized)
- ☐ communal (organized)

- 100-500 ha
- 500-1,000 ha
- 1,000-10,000 ha
- > 10,000 ha

- 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	Previously the soil was mixed with rocks and big stones, so that it was difficult for planting. By applying the grass cultivation method and gradually remove of those stones and rocks crop production is increased.
fodder production	decreased						✓		increased	Before the land user let his animals take up only natural grass from the sourroundings. After, by cultivating different grass varieties in a large area the fodder production increased substantially
fodder quality	decreased						✓		increased	Natural grass is low in nutrients and proteins necessary for animal growth compared to the high potential grass varieties planted by the farmer. This grass varieties have many nutrients and proteins required for animal husbandry.
animal production	decreased						✓		increased	Previously the lack of fodder for animal husbandry resulted in low animal production. From the moment the farmer was able to get enough fodder from his grasslands the animal production increased significantly.
risk of production failure	increased					✓			decreased	Because limited fodder especially in dry season the animal production failure quit a problem. From the moment he was able to produce high valued animal fodder on a large area the risk of production failure decreased to some extent.
product diversity	decreased					✓			increased	Before the farmer got only natural grass from the surroundings, but now he produce Napir grass, Guinea grass, Paspalum grass by himself.
production area (new land under cultivation/ use)	decreased						✓		increased	Before animal husbandry is dependet from natural forests and from rice fields. After the farmer was able to expand the productive area by 15 square metres of grassland.
land management	hindered				✓				simplified	Before the animal had grazed freely in the village sourroundings and so the farmer had to guard them. After grass cultivation the animals graze on fenced grass lands on a bi-weekly basis. And futher the cattle can be fed by own freh or dried fodder grass.
expenses on agricultural inputs	increased			✓					decreased	There enlarged area called for more monetary inputs to establish the cattle farm and to cultivate the additionoal 15 ha (new expenses: cattle housing, fencing, grass varieties and farm maintenance).
farm income	decreased						✓		increased	Quantity before SLM: None Quantity after SLM: 80,000,000 kip/annual The increase in revenues base on the fact, that now the farmer can sell many healty and strong cows every year at a good price. Actually, he produces cows even for the export to Vietnam.
diversity of income sources	decreased						✓		increased	Before cows has been sold in few numbers. After the application of the technology the farmer raises besides of a larger amount of cows also goats, pigs, poultry for the market. In addition he can sell different grass seed varieties.
workload	increased								decreased	

Previously the animal raising based on free grazing in the village sourroundings. The establishment and maintenance of the new grassland area and the increased cow herd and other livestock resulted in increased workload.

Socio-cultural impacts

Ecological impacts

		1	2	3	4	5	6	7		
soil cover	reduced						✓		improved	The soil cover increased significantly because of the cultivation ot the strong and expansive grass varieties.
soil loss	increased						✓		decreased	The soil can be fixed by the expanding and deep roots of the different grass varieties. Furhtermore, grass residues promote better soil cover that reduces soil loss by water erosion too.
soil accumulation	decreased						✓		increased	During the rainy season the plant detritus and manure promote soil accumulation.
soil compaction	increased						✓		reduced	The expanding and deep root system of the grass cultivation improves the soil structure significantly.

Off-site impacts

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

		1	2	3	4	5	6	7	
Short-term returns	very negative		✓						very positive
Long-term returns	very negative						✓		very positive

Benefits compared with maintenance costs

		1	2	3	4	5	6	7	
Short-term returns	very negative					✓			very positive
Long-term returns	very negative						✓		very positive

CLIMATE CHANGE

Gradual climate change

		1	2	3	4	5		
annual temperature increase	not well at all						very well	Answer: not known
seasonal temperature increase	not well at all				✓		very well	Season: dry season
annual rainfall decrease	not well at all			✓			very well	
seasonal rainfall decrease	not well at all			✓			very well	Season: wet/ rainy season
increase	not well at all						very well	Answer: not known

Climate-related extremes (disasters)

		1	2	3	4	5	
local rainstorm	not well at all			✓			very well
local windstorm	not well at all			✓			very well
extreme winter conditions	not well at all			✓			very well
drought	not well at all		✓				very well
insect/ worm infestation	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%
- [ ] 10-50%
- [ ] more than 50%

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

- [ ] 0-10%
- [ ] 10-50%
- [ ] 50-90%
- [x] 90-100%

Number of households and/ or area covered

15

Has the Technology been modified recently to adapt to changing conditions?

- [x] Yes
- [ ] No

To which changing conditions?

- [ ] climatic change/ extremes
- [ ] changing markets
- [ ] labour availability (e.g. due to migration)
- [x] ownership and organization

At the beginning in 2009, the technology covered 15 ha of village land and had been established by project support and maintained by breeding groups. Later in 2014 - after project failure due to organizational and maintenance difficulties - one land user of the village rent this land from the local autorities and applied the Technology by himself.

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Initially the project (ADB) provided an equipment, grass seeds and land preparation
- Improved the livestock quality
- Increased household income from livestock

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

- Improved soil quality due to animal manure and plant detritus

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Insufficient water in dry season which effects limited grass production → water harvesting area is required
- Difficult to control the animals in such large area → restrict the grazing areas
- Difficult to collect manure for fertilizing the soil

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

REFERENCES

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Date of documentation: July 2, 2017

Last update: Nov. 1, 2018

Resource persons
Khamthy Keosymonkong - land user
Amphone Chaluensunk - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2891/

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Napier grass cultivation area (Khamhou Nala)

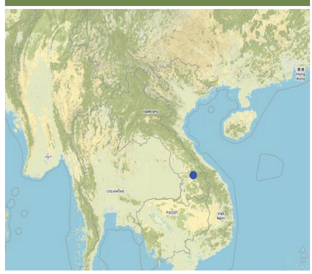
Developing forage for sustainable livestock management (Lao People's Democratic Republic)

DESCRIPTION

The purpose of forage management is to increase vegetation cover in unproductive land for sustainable livestock management as well as to improve soil fertility.

In the past the local people's primary use of land in upland areas consisted of shifting cultivation and raising of livestock and therefore these were their main livelihoods. Shifting cultivation requires the farmers to rotate their plots after a minimum period of 4 – 6 years. Because agricultural land is limited and as part of their efforts to reduce shifting cultivation practices, land users modified their activities to permanent agricultural land use. In upland areas local land users normally let their cattle roam free in the vicinity of the village, but they encounter a lot of problems with such livestock raising practices. Every year an average of 7-8 heads of cattle are reported lost. Some of the animals contract diseases, which result in weight loss and death. Owners also have difficulties in locating cattle that are allowed to roam free, whilst others have to look after their livestock in areas that are far from the village. Additionally, another issue facing many households is insufficient labour force to look after the cattle.
In 2016, land users tried to find solutions for these challenges encountered when raising livestock and started cultivating forage. The Agricultural Technical Research Centre's technical staff had advised the land owners to grow Napier grass and Ruzi grass as forage to feed their cattle and manage livestock stay in the stall. The land users cut the grass to feed the livestock in stall. In fact, these grass species are rich in nutritional elements for animals such as CP, ADF, CF, and NDF, which are all essential for cattle. Moreover, these grass species can improve the soil's fertility. A land user initially began to prepare 0.2 ha of land for grass cultivation, as it was just at the trial stage with a limited supply of grass seeds. A number of grass species were planted on different plots as the land user grow grass plot by plot to stock for livestock, after the seeds had been provided by the Nongdeng Agricultural Research Centre in Salavan province, Lao PDR. The farmers started by ploughing the soil and then it was raked even. Next they formed individual plots measuring 120 cm by 15 m with a distance of 20 cm between each of the plots. Along each row of Napier grass there should be a space of 50 – 70 cm between the individual plants. The reason why there is a difference in the distance between individual plants of the two grass species is because Napier grass has longer stems than Ruzi grass once it grows to its full size. PVC18 pipes with a length of 120m and fitted with 10 sprinklers should be installed. The grass should be watered once every 2 – 3 weeks, and can be harvested 2 – 3 times a month. Farmers use knives to harvest the grass and after every harvest has been completed approximately 1 – 3 kg of green compost is applied to enhance regrowth. Napier and Ruzi grass also bring other benefits to the local ecosystem, they add more organic matter to the soil as there is an increase in the number of earthworms. The roots of the grass help to bind the soil and to improve its moisture at all times, but there may also be some pests within the root system. Planting Napier and Ruzi grass also encourages the land users manage the land in a more sustainable way as it can grow for 8 – 9 years after it has been planted. The land users therefore do not need to replant it for many years. However, it does require the application of animal manure after each harvest so that it enhances the grass's regrowth. These grass species are relatively easy to cultivate and suitable for the local climate. Land users were therefore pleased with the results and expanded the area

LOCATION



Location: TaOuy, Salavan, Lao People's Democratic Republic

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 106.42784, 15.94179

Spread of the Technology: evenly spread over an area (approx. < 0.1 km2 (10 ha))

Date of implementation: 2016; less than 10 years ago (recently)

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

under grass cultivation resulting in more sustainable use of land.

Napier grass to be cut for feeding livestock (Khamhou Nala)

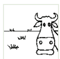
The forage row management (Khamhou Nala)

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

Land use



Grazing land - Intensive grazing/ fodder production: Cut-and-carry/ zero grazing
Main animal species and products: Napier and Ruzi grass to feed cattle and goat

Water supply

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

Number of growing seasons per year: 2
Land use before implementation of the Technology: n.a.
Livestock density: 11 cattle and 23 goats

Purpose related to land degradation

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

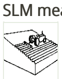
Degradation addressed

biological degradation - Bc: reduction of vegetation cover

SLM group

- integrated crop-livestock management

SLM measures



agronomic measures - A2: Organic matter/ soil fertility

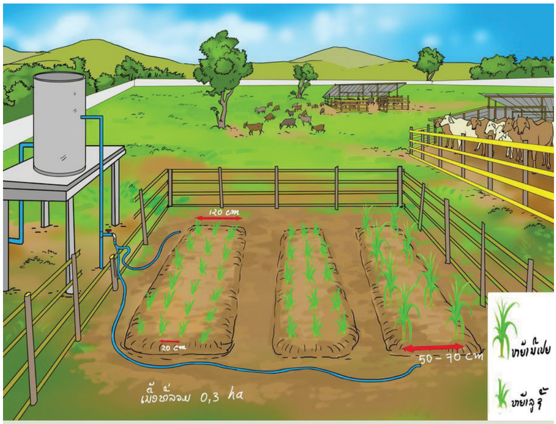
vegetative measures - V2: Grasses and perennial herbaceous plants

management measures - M2: Change of management/ intensity level

TECHNICAL DRAWING

Technical specifications

The grass is grown in a flat area (2-3% slope)
Then form up parcel with 120 cm by 15 m long.
When planting Ruzi grass, the space should be 20cm.
When planting Napier grass, it should be between 50 – 70cm asNapier grass is growing faster and taller than Ruzi grass. Set up the PVC pipe for watering management



Author: Phanthamith Vilayvan

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **0,3**; conversion factor to one hectare: **1 ha = hactare**)
- Currency used for cost calculation: **LAK**
- Exchange rate (to USD): 1 USD = 8000.0 LAK
- Average wage cost of hired labour per day: 30000

Most important factors affecting the costs

The most important factors affecting the costs for this technology is labour and high cost of equipment for management especially for set up the irrigation scheme.

Establishment activities

1. Land preparation (Timing/ frequency: April to May)
2. Set up irrigation scheme (Timing/ frequency: Before planting)
3. Planting Napier and Ruzi grass (Timing/ frequency: June)

Establishment inputs and costs (per 0,3)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour for land preparation	person day	10.0	30000.0	300000.0	100.0
Labour for planting	person day	35.0	30000.0	1050000.0	100.0
Equipment					
PVC pipe size 18	piece	30.0	20000.0	600000.0	100.0
Springer	piece	10.0	25000.0	250000.0	100.0
Net for fencing	roll	9.0	250000.0	2250000.0	100.0
Plant material					
Napier grass stem	stem	50.0	1000.0	50000.0	100.0
Ruzi seedlings	kg	10.0	5000.0	50000.0	100.0
Total costs for establishment of the Technology				**4'550'000.0**	

Maintenance activities

1. Apply manual into Napier and Ruzi grass field (Timing/ frequency: 2 times/months after planting)

Maintenance inputs and costs (per 0,3)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour to use fertilizer	person day	6.0	30000.0	180000.0	100.0
Labour for watering	person day	1.0	30000.0	30000.0	100.0
Fertilizers and biocides					
Manure	bag	10.0	10000.0	100000.0	100.0
Total costs for maintenance of the Technology				**310'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall

- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm

Agro-climatic zone

- [ ] humid
- [ ] sub-humid
- [x] semi-arid
- [ ] arid

Specifications on climate

n.a.

- [ ] 1,001-1,500 mm
- [x] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

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

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

Altitude
- [x] 0-100 m a.s.l.
- [ ] 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
- [x] not relevant

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

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

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

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

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

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

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [x] Yes
- [ ] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [x] 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
- [ ] poor
- [x] average
- [ ] rich
- [ ] very rich

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

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

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

Gender
- [ ] women
- [x] men

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

Area used per household
- [ ] < 0.5 ha
- [x] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 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

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

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

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

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

fodder production	decreased				✓			increased	Before land user let animals take up only natural grass and after cultivating grass the fodder production increased substantially.
fodder quality	decreased				✓			increased	Natural grass is low in nutrients and proteins necessary for animals growth compared to the high potential grass varieties planted by land users.
animal production	decreased				✓			increased	Improved fodder for animal husbandry results increase high animal production
farm income	decreased				✓			increased	Healthy animals that have good income
workload	increased			✓				decreased	Reduce the workload to collect livestock in freely grazing land

Socio-cultural impacts

Ecological impacts

soil cover	reduced				✓			improved	Soil cover increased significantly because of grass cultivation
nutrient cycling/ recharge	decreased				✓			increased	Good pasture management practices foster effective use and recycling of nutrients.

Off-site impacts

damage on neighbours' fields	increased					✓		reduced	Reduce the number of livestock access to the neighbor's field

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

seasonal temperature decrease	not well at all				✓		very well	Season: winter

ADOPTION AND ADAPTATION

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

- ☐ single cases/ experimental
- ☑ 1-10%
- ☐ 10-50%
- ☐ more than 50%

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

- ☐ 0-10%
- ☑ 10-50%
- ☐ 50-90%
- ☐ 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- ☑ Yes
- ☐ No

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

- Save labour for other animal raising activities
- Able to provide adequate and nutritional fodder for cattle as well as having healthy animals

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

- A reduction in conflict that occurs when animals graze on other people's agricultural land
- A reduction in the risk of a break out of animal diseases

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- A lack of labour power to maintain the grass plantation and to undertake other animal raising activities
- The expense of purchasing grass seeds → The need to train local farmers how to produce grass seeds by themselves

Weaknesses/ disadvantages/ risks: compiler’s or other key resource person’s view → how to overcome

- A lack of labour power to plant, cultivate and harvest grass as well as clean the farmhouse. → These activities normally require the labour of 1 – 3 people and so the farmer has to hire or ask someone to help so that the animal raising and grass planting activities are carried out more effectively.
- A lack of knowledge and experience in cattle management. This is because the farmers or the land owners were sometimes neglegent when their animals had contracted diseases and later died because of this. → They should actually have their animals vaccinated regularly and seek advice from the volunteer village vet in order to cope with any problems in a timely manner.

REFERENCES

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Reviewer

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Last update: Aug. 2, 2019

Resource persons
Sean Keobounsan - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2962/

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Agroforestry and Intercropping

Rice-fish system (Xaiyarsid Khamphila)

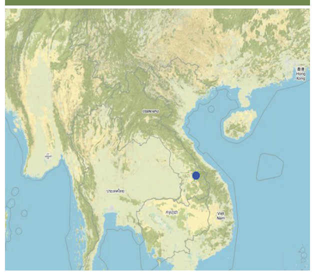
An integrated rice - fish system (Lao People's Democratic Republic)

DESCRIPTION

Raising fish in rice paddy to optimize the use of land.

A rice-fish system is effectively the integration of a rice field and a fish pond. This idea was initiated by local people who have been living with natural resources including forests, mountains and streams for generations. Their idea was to optimize these resources – namely the land and water to fish raising in the rice field at the same time. In the past, people were dependent on shifting cultivation. However, they recently switched to lowland rice cultivation because shifting cultivation for upland rice cultivation is insufficient for household consumption and against government policy for natural environment conservation; whatever the farmer still keep the upland rice cultivation in burned area but no allow to expand the new area. Raising fish in a rice paddy is an important technique to encourage permanent land use. It should be initiated in an appropriate environment especially one where there is water supply throughout the year. The rice paddy should be located along a stream, a river or an irrigation canal so that the water can be adequately channeled both in and out of the field. Ta-Oy is a district where there is limited productive agricultural land with most of the rice paddies being situated along mountain valleys and at the base of the hills. In this area agricultural activities rely entirely on natural rainfall. The creation of rice fields requires a considerable amount of labour from local households or otherwise a tractor needs to be hired to clear the area along the mountain valleys. Basically, rice paddy development in such areas requires the construction of small dykes in cross sections of the stream channel. Ground levelling may be required to ensure that the water reaches all of the plots. Typically, these paddy fields are arranged in a terraced formation. Raising fish in rice fields may require different methods from those of traditional rice paddies as there need to be appropriate measures taken in order to prevent natural disasters, particularly soil erosion. Rice fields that are suitable for fish raising need to have higher levees built around them and be equipped with an appropriate drainage system. The farmer also needs to construct deep retention water in the pond next to the rice field so as to regulate the water from the canal flow directly to rice field, which helps to reduce levees erosion. The integrated rice-fish system sets out to maximize land use as it enables both rice production and the raising of fish thereby providing increased food security for households as well as improving their income. In order to apply the technology, farmers need drainage pipes which are installed on levees to leveling the water in rice fields that are a part of the irrigation system. Other production inputs include the rice variety, fish fingerlings, knifes, hoes, spades, shovels and sickles. Both of these activities are mutually beneficial because the food waste and suspended nutrients in the water resulting from the fish waste provide a natural fertilizer for the rice and this also enhances the soil's fertility, whilst at the same time the rice stalks provide a habitat for the fish. When pests or insects threaten the rice crop, fish fulfill the role of consuming them. The practice of raising fish in rice paddies also helps to reduce water pollution due to the process of eutrophication through fertilization, even though process of decaying is loss of oxygen production but it can be regenerated by phytoplankton's photosynthesis and water sources recharge . In fact, the technology reduces expenses and labour required for the cultivation of rice and at the same time preserves the environment, as the soil is moist throughout the year. This technology is very pragmatic for farmers as it allows them to provide sufficient rice and fish for their families' needs. Benefits also

LOCATION



Location: Duekdong village Ta-oy District,, Salavan Province, Lao People's Democratic Republic

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 106.63326, 15.89668

Spread of the Technology: applied at specific points/ concentrated on a small area

Date of implementation: 2013; less than 10 years ago (recently)

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

include increased productivity in comparison to shifting cultivation which provided insufficient outputs and farmers often experienced rice shortages. Farmers can now cultivate rice for two seasons. Another benefit are the nutrients and the decay from fish faeces which become a natural fertilizer for the rice and add microorganisms to the soil. An integrated rice-fish system can be implemented in an area of 500 sqm (25m x 20m), with a water depth of 0.5 – 1 m and a gradient between 3 - 5% which is similar to that of terraced rice paddies. The space between rows of rice stems should be 20 – 25cm with an open area for the fish without any rice plants approximately 5 square meters from the levee to the field where there is a water pipe to generate oxygen for fishes. The fish population should be at a density of five fish per square meter, and suitable species include Pa pak (Barbonymus gonionotus), tilapia and Pa kheng (Anabas testudineus).Strengths: (1) An increase in rice production in a smaller area because the farmer is able to cultivate rice for two seasons as well as in fish production (both a dry season and a rain fed rice crop). (2) An integrated fish culture maximizes the agricultural land. (3) Nutrients and fish faeces are essential for rice as well as add microorganisms to the soil. (4) Raising fish in a rice field provides a good return and optimizes land use. Weaknesses (1) A lack of funds to implement this technology – farmers need some source of funding. (2) It has been implemented traditionally without any technical knowledge –there is the need for farmers to receive technical advice regarding the maintenance of a rice-fish system as well as land management. (3) The need for appropriate equipment to implement the production process. (4) If the fish population density is too high, it might affect the health of the rice. (5) It is not possible to propagate an adequate number of fish fingerlings for the next year in the existing rice-fish system, an individual nursery pond for propagation is required.


The bamboo tube for filling water from field to field (Xaiyarsid)


Free space for fish feeding (Xaiyarsid)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose
- [x] improve production
- [ ] 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
- [ ] create beneficial social impact

Land use


Cropland - Annual cropping
Main crops (cash and food crops): Paddy rice


Waterways, waterbodies, wetlands - Drainage lines, waterways
Main products/ services: Paddy rice

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

Number of growing seasons per year: 2
Land use before implementation of the Technology: n.a.
Livestock density: 5 fishes/m2

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

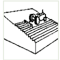
Degradation addressed


biological degradation - Bc: reduction of vegetation cover

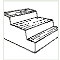
SLM group

SLM measures

- Rice-fish system



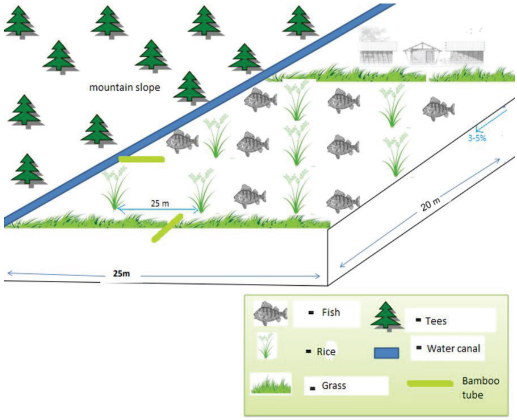
agronomic measures - A4: Subsurface treatment



structural measures - S2: Bunds, banks, S3: Graded ditches, channels, waterways, S6: Walls, barriers, palisades, fences

TECHNICAL DRAWING

Technical specifications
The rice field is 25 m long, 20 m wide and 0.5 m deep, in the field there is small space for fish feeding
Slope angle is 3-5%
Density of fish is 5 fishes/m2
Species used is silver carp, Tilapia, Climbing perch
Rice variety space between plants is 25 cm
Bamboo tube is 1-2 m long with a diameter of 20 cm to fill the water
5 square meters free space for feeding and harvesting fish



Author: Xaiyarsid

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: **ha**; conversion factor to one hectare: **1 ha = 0,5 ha**)
- Currency used for cost calculation: **kip**
- Exchange rate (to USD): 1 USD = 8000.0 kip
- Average wage cost of hired labour per day: 35000

Most important factors affecting the costs
Tractor hiring (including tractor driver) and fish breed (young fish) are the most important factors affecting the costs.

Establishment activities
1. Make levees (Timing/ frequency: May)
2. Surface leveling (Timing/ frequency: May)
3. Fill the water (Timing/ frequency: July)
4. Rice planting (Timing/ frequency: July)
5. Release the fish (Timing/ frequency: July)

Establishment inputs and costs (per ha)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
Labour	person-day	5.0	35000.0	175000.0	100.0
Equipment					
Hoe	piece	1.0	40000.0	40000.0	100.0
Shovel	piece	1.0	25000.0	25000.0	100.0
Tractor	Day	1.0	1000000.0	1000000.0	100.0
Knife	piece	1.0	35000.0	35000.0	100.0
Plant material					
Rice variety	Kg	30.0	5000.0	150000.0	100.0
Fish breed	Fish	2500.0	200.0	500000.0	100.0
Fertilizers and biocides					
Bio fertilizer	Bag	10.0	10000.0	100000.0	100.0
Manure	Bag	10.0	5000.0	50000.0	100.0
Construction material					
Bamboo tube	Piece	5.0	10000.0	50000.0	100.0
Total costs for establishment of the Technology				**2'125'000.0**	

Maintenance activities
1. Fertilizer (Timing/ frequency: One time per season after rice planting)
2. Fish feeding (Timing/ frequency: Once a day)
3. Weeding (Timing/ frequency: Once a month)
4. Levees repair (Timing/ frequency: Once a season)

Maintenance inputs and costs (per ha)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
Labor for weeding on the levees	Day	5.0	35000.0	175000.0	100.0
Labor for both fish and rice harvesting	Day	10.0	35000.0	350000.0	100.0
Equipment					
Hoe	Piece	1.0	40000.0	40000.0	100.0
Shovel	Piece	1.0	15000.0	15000.0	100.0
Knife	Piece	2.0	35000.0	70000.0	100.0
Fertilizers and biocides					
Bio fertilizer	Bag	5.0	10000.0	50000.0	100.0
Manure	Bag	5.0	5000.0	25000.0	100.0
Total costs for maintenance of the Technology				725'000.0	

NATURAL ENVIRONMENT

Average annual rainfall
- < 250 mm
- 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
- semi-arid
- arid

Specifications on climate
Average annual rainfall in mm: 700.0
In January - March it is the lowest , in April is the beginning of the rainy season and highest rainfall is in July - September, then a gradual decrease till November.
Name of the meteorological station: Doub village agriculture and forestry technique service center
Cold weather for prolonged period combine with rain

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

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

Altitude
- 0-100 m a.s.l.
- 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)
- ✓ moderately deep (51-80 cm)
- ✓ deep (81-120 cm)
- very deep (> 120 cm)

Soil texture (topsoil)
- coarse/ light (sandy)
- ✓ medium (loamy, silty)
- ✓ 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%)
- low (<1%)

Groundwater table
- on surface
- ✓ < 5 m
- 5-50 m
- > 50 m

Availability of surface water
- ✓ excess
- good
- medium
- poor/ none

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

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ 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
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ 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
- ✓ men

Age
- children
- ✓ youth
- ✓ middle-aged
- elderly

Area used per household

Scale

Land ownership

Land use rights

- < 0.5 ha
- ✓ 0.5-1 ha
- 1-2 ha
- 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

- small-scale
- ✓ medium-scale
- large-scale

- state
- company
- communal/ village
- group
- ✓ individual, not titled
- individual, titled

- open access (unorganized)
- communal (organized)
- 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
crop quality	decreased					✓			increased
animal production	decreased							✓	increased
demand for irrigation water	increased	✓							decreased
farm income	decreased						✓		increased
workload	increased		✓						decreased

Crop production: Produced upland rice only which is insufficient for household consumption. After introducing the rice-fish system farmers are able to harvest more yield of rice.

crop quality: Rice production is without any fertilizer. When they raise fish in the rice field the fish feces are functioning as a natural fertilizer for paddy rice.

animal production: When raising fishes in the rice fields, the number of fishes can reach 2000-2500 fishes/field

demand for irrigation water: Shifting cultivation on slope area (upland rice) does not require irrigation water but the expansion of lowland paddy rice cultivation requires more water, so irrigation has to be used.

farm income: Income increases because of fish, about 2-3 million Kip / year

workload: The upland rice is the traditional activity for local people, the addition is lowland rice cultivation combined with fish that increases work for land users.

Socio-cultural impacts

food security/ self-sufficiency	reduced						✓		improved

food security/ self-sufficiency: Upland rice cultivation only is not enough for whole year consumption. Having upland rice and lowland rice is sufficient for family consumption for the whole year and in addition there is fish.

Ecological impacts

soil moisture	decreased							✓	increased
soil compaction	increased		✓						reduced
nutrient cycling/ recharge	decreased					✓			increased
animal diversity	decreased					✓			increased
drought impacts	increased					✓			decreased

soil moisture: In the dry season the land user brings the water from the stream to the cultivation area via the canal and the soil is more moist (stream is not dry in dry season)

soil compaction: Heavy machine (tractor) used for soil tillage lowland rice cultivation is causing soil compaction.

nutrient cycling/ recharge: Bio fertilizer and manure can create green water (plankton) as a food for fishes and the byproduct of fishes will be a nutrient for the rice plant.

animal diversity: There is many species of fish that have been released each year and other animals such as crabs, frogs, snails, shrimps which come from the nature.

drought impacts: During dry spells water is provided through the water canal to the lowland rice cultivation to provide consistent water flow.

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	
seasonal temperature increase	not well at all			✓			very well	Season: dry season
annual rainfall increase	not well at all			✓			very well	
seasonal rainfall decrease	not well at all				✓		very well	Season: dry season

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
land fire	not well at all			✓			very well
landslide	not well at all			✓			very well
insect/ worm infestation	not well at all			✓			very well

Other climate-related consequences

extended 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
- ☐ 1-10%
- ☑ 10-50%
- ☐ more than 50%

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

- ☐ 0-10%
- ☐ 10-50%
- ☐ 50-90%
- ☑ 90-100%

Number of households and/ or area covered

5 household initiate implement this technology

Has the Technology been modified recently to adapt to changing conditions?

- ☑ Yes
- ☐ No

The technology was adapted to a long period of rain

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 in yields even in small area, able to produce 2 seasons a year
- Integrated rice and fish can produce 2 products in one area
- Fish byproduct can increase soil organic matter in the rice field

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

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Farmers need to buy the fry in the next season, as they have a lack of knowledge in fish breeding → Fish breeding training course is needed

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Fish raising in rice fields is limited because its water is shallow compared to a pond in general (fish pond)

REFERENCES

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Resource persons
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Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2928/

Linked SLM data
n.a.

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- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Coffee cultivation with the trees in a fallow area (Bounthanom Bouahom)

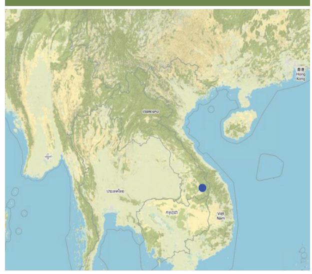
Coffee cultivation between big trees in sloping fallows (Lao People's Democratic Republic)

DESCRIPTION

Coffee plants cultivated between big trees in sloping fallows for income generation as well as maintaining biodiversity and increased forest cover.

Since 1980 a number of villagers worked on coffee plantations in Paksong District, Bolaven Plateau of Champasack Province. Thus, they learnt how to cultivate coffee and brought their knowledge to their villages due to suitable natural conditions there. Temperature suitable for coffee there ranges from 15 – 25°C and pH levels of soils between 5.5 and 6.5, average rainfall between 1000-1500 mm/year, and altitude of approximately 800 m.a.s.l. Subsequently, small coffee plantations were observed all over the region, but failed soon because the villagers planted coffee intercropped with upland rice within their traditional extensive slash and burn practice. One of the reasons of very low coffee yields was the lacking shadow and the inconsistent humidity during dry season.
In 2009, a project supported by IFAD promoted coffee cultivated between big trees as a trial to villagers in Paksong District. But the selection of “Mai Thorng” (Erythrina stricta Roxburgh) - a type of savannah tree that provides enough shade to coffee plants - unfortunately was not successful as well, as it was not adapted to the local climate. Therefore, in 2012, Mr. Bouathong in Chalurnxay village, Xanay district of Attapue province tried to use locally grown trees which provide adequate shade to the coffee plants. They started to clear carefully fallow fields from vegetation whilst preserving bigger trees (age of fallow 5- 10 years and older). This included most of the trees older than 5 years. The clearance has to be conducted in January by removing smaller trees and shrubs. However, it is important that the remaining trees do not create to excessive shadow, as coffee plant needs approximately 50-60 percent of sunlight to grow well. The space between the seedlings is 3 x 3 or 4 x 3 meters. The size of the planting holes is 50x50x50cm. Before planting of coffee seedlings organic manure has to be filled in the hole to improve soil fertility (5kg/hole). To establish such kind of coffee plantation following inputs are needed: coffee seedlings, sunlight protection sheets, watering pot, fork, plastic bags for the seedlings, and organic fertilizer. The most important input is the labour for selective clearance, land preparation, and fencing (around 5 to 10 workers for 1 ha). From the very beginning a wooden fence out of timber from previously cleared small trees has to be installed for getting protection against livestock damages. Also weeding (3-4 times a year) and thinning of tree branches is required. The decayed plant material can be used as soil cover to increase natural soil nutrients and to control storm water from run-off.
Outcomes from this method indicated that coffee plants grow successfully with healthy stems and suckers, and dark green leaves. And coffee plant survival rate of 80 percent was far higher compared to the rate of only 50% in former plantations without trees. Three years after planting coffee plants produces coffee beans.
Coffee now is playing an important role for the local land users regarding revenue generation. The coffee prices in mountainous areas of Xanxay District vary depending on species and range from 5,000 to 8000Kip/kg for fresh coffee beans; 12,000 to 16000Kip/kg for threshed coffee beans (average annual income 5,000,000Kip / household). Estimated production of fresh beans is between 4,000-5,000Kg/ha. Yields significantly increase compared to old plantations that provided only 500-800Kg/ha.

LOCATION



Location: Xanxay district, Attapue province, Lao People's Democratic Republic

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 107.09672, 15.10799

Spread of the Technology: evenly spread over an area (approx. < 0.1 km2 (10 ha))

Date of implementation: 2012; less than 10 years ago (recently)

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

Purpose and advantage of this technology include the use of fallow and degraded forest areas to the benefit of local land users such us improved land use rights and reduction of land conflicts because of stabilization of shifting cultivation. People are required to find animal manure to fertilize the coffee plant, but they can also use coffee bean husk as green compost around the coffee plant, as this promotes soil nutrients, soil organisms (e.g. earthworms), and it keeps soil moisture and increases soil porosity. Benefits of this agroforestry that reduction of slash and burn practice. The coffee cultivation in a agroforsestry system as permanent land use practices reduces pressure on forest land, increases the forest canopy, preserve bigger trees as habitat for local animals, and promotes higher plant diversity. Furthermore, people can collect local mushrooms and other edible plants/vegetables such as Phak Varn, Phak Koum, rattan shoots, ferns, and others.

Coffee cultivation with big trees to prevent coffee plants from too much of sunlight (age of trees more than 10 years) (Bounthanom Bouahom)

Land preparation technique of clearance from bushes and shrubs. (Bounthanom Bouahom)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [x] improve production
- [ ] reduce, prevent, restore land degradation
- [x] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [x] 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
- [ ] create beneficial social impact

Land use

Cropland - Tree and shrub cropping

Forest/ woodlands - (Semi-)natural forests/ woodlands: Selective felling

Water supply

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

Number of growing seasons per year: 1
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

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

biological degradation - Bc: reduction of vegetation cover, Bh: loss of habitats, Bs: quality and species composition/ diversity decline

SLM group

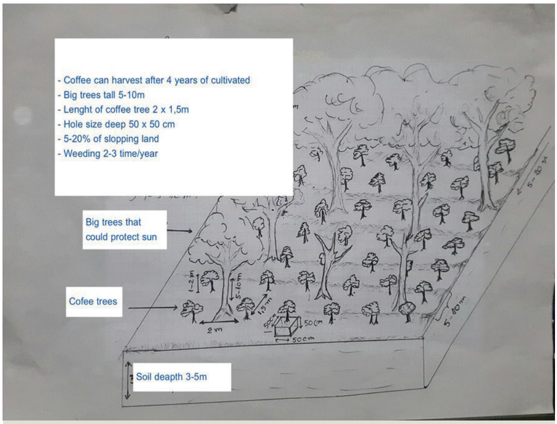
- agroforestry

SLM measures

management measures - M1: Change of land use type

TECHNICAL DRAWING

Technical specifications



Author: Vongsackda Khounyasay

1. First, the local land users need to select sites in fallow forest areas where big trees still remain through observation on the land use history. The old fallow forest may range from 5-10 years and above. Clear first the shrubs and bushes and retain approximately 50% of the vegetation. 2. The vegetation clearance can begin with removing small trees (wherever easy to start with) and preserve
some of the big trees (5 years old and over). 3. After clearing all small trees, observe the bigger trees with approximate 5-10m height whether it requires thinning and further clearance around the retention trees to allow some sunlight reaching coffee plants understory. 4. It is not necessary to burn spoiled vegetation after clearance. Instead, suitable logs shall be used for fence construction whilst other grasses and weeds can be used to cover grounds for soil improvement. 5. After completion of vegetation clearance and land preparation, farmers can plant coffees seedlings appropriate to site conditions. 6. Weeding is required for coffee plantation and about 3 – 4 times a year until coffee seedlings are mature (weeding may not require after third years of planting). Farmers also need to conduct regular thinning of big trees to ensure sunlight reaches the coffee plants. 7. After completion of each weeding and thinning activities, farmers are recommended to collect decaying vegetation to cover the ground of coffee plantation as a mean to increase natural soil nutrients and control storm water run-off.

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **1,5**; conversion factor to one hectare: **1 ha = Hactare**)
- Currency used for cost calculation: **LAK**
- Exchange rate (to USD): 1 USD = 8000.0 LAK
- Average wage cost of hired labour per day: 20000

Most important factors affecting the costs

The most important factor affecting cost is labour for selective clearance.

Establishment activities

1. Seedling preparation (Timing/ frequency: Begining of November)
2. Nursery preparation for seedlings, fencing, net and other inputs for seedlings (Timing/ frequency: November to December)
3. Seedling maintenance (Timing/ frequency: None)
4. Land preparation for planting (Timing/ frequency: None)
5. Dig hole (Timing/ frequency: None)
6. Planting (Timing/ frequency: None)

Establishment inputs and costs (per 1,5)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour for selective clearing of fallow and land preparation	person day	18.0	20000.0	360000.0	100.0
Labour for seedlings preparation	person day	1.0	20000.0	20000.0	100.0
Labour for putting soil and seedlings into plastic bag	person day	32.0	20000.0	640000.0	100.0
Labour for fencing	person day	16.0	20000.0	320000.0	100.0
Equipment					
Big knief	piece	4.0	15000.0	60000.0	100.0
Shovel	piece	4.0	50000.0	200000.0	100.0
Plant material					
Seedlings	seed	30.0	1000.0	30000.0	100.0
Fertilizers and biocides					
Manure	kg	50.0	5000.0	250000.0	100.0
Construction material					
Sunlight protection sheet	Metre	10.0	10000.0	100000.0	100.0
Plastic bag for seed	bag	100.0	500.0	50000.0	100.0
Other					
Labour for planting the seedlings	person day	12.0	20000.0	240000.0	100.0
Total costs for establishment of the Technology				**2'270'000.0**	

Maintenance activities

1. Weeding (Timing/ frequency: 2-3 time/year)
2. Maintenance the fence (Timing/ frequency: None)

Maintenance inputs and costs (per 1,5)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour for weeding	person day	3.0	20000.0	60000.0	100.0
Labour for maintenance of the fence	person day	4.0	20000.0	80000.0	100.0
Labour for bring the manure	person day	2.0	20000.0	40000.0	100.0
Total costs for maintenance of the Technology				**180'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [x] 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
- [x] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate
n.a.

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

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

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [x] 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
- [x] not relevant

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

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

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

Topsoil organic matter content
- [ ] high (>3%)
- [x] medium (1-3%)
- [ ] 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
- [x] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [ ] mixed (subsistence/ commercial
- [x] 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
- [ ] poor
- [x] average
- [ ] rich
- [ ] very rich

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

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

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

Gender
- [ ] women
- [x] men

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

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [x] 5-15 ha
- [ ] 15-50 ha
- [ ] 50-100 ha

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

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

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

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

- 100-500 ha
- 500-1,000 ha
- 1,000-10,000 ha
- > 10,000 ha

- 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	Quantity before SLM: Coffee production 500-800 kg/ha Quantity after SLM: Coffee production 4000-5000 kg/ha
crop quality	decreased						✓		increased	Increased both productivity and quality
forest/ woodland quality	decreased					✓			increased	Under former slash and burn technique the whole vegetation was cleared, now big trees are saved and forest cover has been improved.
non-wood forest production	decreased					✓			increased	Apart from coffee beans, now mushrooms, Phak Varn, Phak Koum, rattan shoots, ferns are available in the agroforestry area.
farm income	decreased						✓		increased	Increased income from coffee (5 million LAK/year).
workload	increased					✓			decreased	Decreased labour due to reduction of shifting cultivation.

Socio-cultural impacts

land use/ water rights	worsened					✓			improved	Under this technique the land user own the plantation area legally.
conflict mitigation	worsened					✓			improved	Reduction of land conflict because of stabilize shifting cultivation legalization of land use rights.

Ecological impacts

soil moisture	decreased						✓		increased	The land user uses the dry grase/leaves for mulching to improve soil moisture.
vegetation cover	decreased						✓		increased	Increase in tree canopy as well as increase in forest cover.
plant diversity	decreased					✓			increased	Increase of local mushroom and wide vegetables for food consumption.
emission of carbon and greenhouse gases	increased						✓		decreased	Due to the reduction in slash and burn cultivation, forest cover increased and in consequence, more greenhouse gases were assimilated and furthermore, the reduction in fires has decreased the emission of greenhouse gases.

Off-site impacts

impact of greenhouse gases	increased					✓			reduced	Due to the reduction in slash and burn cultivation, forest cover increased and in consequence, more greenhouse gases were assimilated and furthermore, the reduction in fires has decreased the emission of greenhouse gases.

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	✓ (4th of 7)	very positive
Long-term returns	very negative	✓ (6th of 7)	very positive

CLIMATE CHANGE

Gradual climate change

seasonal rainfall decrease — not well at all ✓ (5th of 5) very well — Season: wet/ rainy season

ADOPTION AND ADAPTATION

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

- [ ] single cases/ experimental
- [ ] 1-10%
- [ ] 10-50%
- [x] more than 50%

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

- [ ] 0-10%
- [ ] 10-50%
- [ ] 50-90%
- [x] 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- [ ] Yes
- [x] No

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

- Unnecessary to slash and burn clearance as bigger trees have to be retained.
- The coffee plantation can protect the environment and forest.
- Farmers can sell their coffee that generate good household income.

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

- Ecosystem sustainability and increased biodiversity.
- Increase in forest cover and stabilization of shifting cultivation.
- Reduced encroachment in agricultural lands of other local land users.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- The local land users still lack knowledge and skills to estimate necessary amount of retaining vegetation or big trees which is different to complete clearance and burning. → The need to engage skilled labour to provide advice during land preparation.
- Some coffee plantations are not maintained effectively enough. This promote bush and shrub growth and in consequence impede harvest of coffee beans. → Therefore, the weeding requires intensive labours prior to coffee collection.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- There are no rules or standard operating procedures regarding the selective clearance and retention of vegetation and trees. → It needs advices from local expert who have skill to estimate on the number of trees to be maintained.
- Most of the local land users select now land to grow coffee in slope areas where the land is limited. → It is most suitable if local land users can establish coffee plantation near streams due to fertile soil with suitable climate.

REFERENCES

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Date of documentation: May 29, 2017

Last update: Sept. 24, 2018

Resource persons
Bouathong - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2688/

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Bong tree plantation area (Jimmy Luangphithuck)

Plantation of Yangbong (Persea kurzii) Trees on Slopes (Lao People's Democratic Republic)

ການປູກກະແລວແຮງ

DESCRIPTION

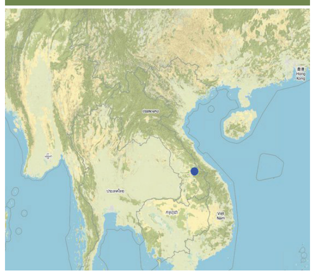
Bong tree (Persea kurzii) plantation in slope area to increase forest canopy and to utilize the plantation areas for animal grazing such as cows and poultry.

Bong tree (Persea kurzii), is a native tree species found in different regions in Lao PDR. In the past, farmers collected Bong barks from natural forest, as it contains gum and aromatic oils for the internationally very requested production of joss sticks. But the availability of wild Bong trees has been declining significantly. In order to keep this important source of income for farmers, Bong tree cultivation can be seen as valuable alternative to maintain the local livelihood whilst ensuring the preservation of the natural forests. The idea of commercial Bong tree plantation came from a Vietnamese trader (in 2000) who introduced Bong tree through a trial plantation. In 2006 land users who were experienced in the highly costly and labor-intensive coffee and pepper cultivation shifted to Bong tree cultivation. And in 2010, land users who gained lessons on seedling production and Bong tree cultivation from Vietnam established first trial cultivations on their farms. Later an IFAD Project in collaboration with the Samouey District Agriculture and Forestry Office promoted Bong tree plantation by providing organic fertilizer and advisory support to model households of the Samouey District . Due to the easy handling and the potential benefits a number of farmers have been interested to participate. Bong trees are perennial and fast growing plants (first harvest of bark or log 6-7 years after planting) preferring humid climate and can be easily planted also on sloping terrain. Currently, Bong tree covers approximately 38 ha of land with an average increase of 1-2 ha/year. This land belongs to Mr. Sailava at Samoey district. The detailed method of Bong tree plantation is following:

1)Land preparation: first, it requires land clearance by removing weeds and bushes, along with hole digging in advance of rainy season (July to September);
2)Spacing: the appropriate spacing between the tree plants should measure about 2.5 x 2.5 meters. Staking is required throughout the plantation area before the holes can be dug. The planting holes are 25 cm x 25cm. The excavated topsoil should be stockpiled around the holes for refilling them later;
3)Planting and applying fertilizers: Bong seedlings need organic fertilizer (0.5kg/tree) that is mixed with soil and then filled in the holes. Finally the seedlings are gently placed in the holes by filling up with further topsoil. If the seedlings are tall, staking is required.
4)Maintenance: 2-3 months after planting – only in case it is needed – additional fertilizer will be added and/or weeding is carried out. The plant residues from weeding are used to cover the ground around the seedlings to keep soil moisture, and once decomposed, to provide natural organic matters to the soil. In conditions of dry climate and hard soil, watering is required to prevent soil cracking which is a cause of breaking tree’s roots and subsequently trees will die.

The advantages of planting Bong trees include direct income generation for households as well as increased forest canopy. It minimize the carbon emissions of slash-and-burn land use. The falling Bong tree leaves provide organic matters to soils, help retaining soil moisture and subsequently increase soil fertility. Under-story vegetation includes lianas and grasses that provide fodder for livestock. Three years after plantation, the land users

LOCATION



Location: Lavatai village, Samou y district, Salavan province, Lao People's Democratic Republic

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites

- 106.5228, 16.1753

Spread of the Technology: evenly spread over an area (approx. 0.1-1 km2)

Date of implementation: 2010; less than 10 years ago (recently)

Type of introduction

- ☐ through land users' innovation
- ☐ as part of a traditional system (> 50 years)
- ☐ during experiments/ research
- ☑ through projects/ external interventions

can utilize the area for animal grazing such as cows and poultry. In fact, poultry can find earthworms around Bong trees which provide rich nutrition for animals. However, some disadvantages of planting Bong trees have to be mentioned as well: Some plantations may become shrubs where weeding is not conducted regularly. Poor maintenance provokes invasion of snakes, bees, and mosquitos.

The land user shows how to prepare the hole before planting the Bong tree seedling. (Pasalath Khounsy)

Bong tree plantation area (5 years old) (jimmy Luangphithuck)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose
- ☐ improve production
- ✓ 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

Forest/ woodlands - (Semi-)natural forests/ woodlands: Shifting cultivation
Tree plantation, afforestation: Monoculture local variety
Products and services: Grazing/ browsing
other (specify): construction material (house, fence and furniture)

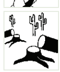
Water supply
- ✓ rainfed
- ☐ mixed rainfed-irrigated
- ☐ full irrigation

Number of growing seasons per year: 1
Land use before implementation of the Technology: n.a.
Livestock density: 15 cows

Purpose related to land degradation
- ✓ prevent land degradation
- ✓ reduce land degradation
- ☐ restore/ rehabilitate severely degraded land
- ☐ adapt to land degradation
- ☐ not applicable

Degradation addressed

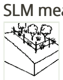
soil erosion by water - Wg: gully erosion/ gullying



biological degradation - Bc: reduction of vegetation cover, Bq: quantity/ biomass decline, Bf: detrimental effects of fires

SLM group
- agroforestry
- pastoralism and grazing land management
- integrated soil fertility management

SLM measures

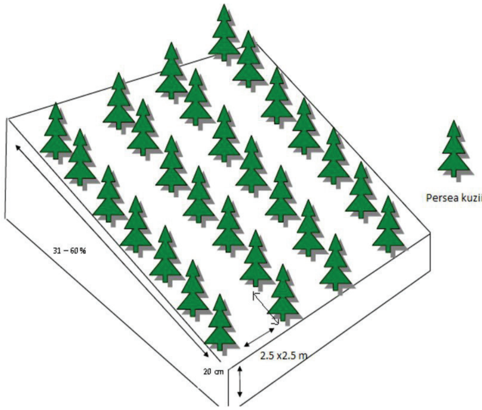


management measures - M1: Change of land use type

TECHNICAL DRAWING

Technical specifications

The holes for Bong tree seedlings are 20 cm in depth, 25 cm in width and 25 cm in length
The spaceace between plants is 2.5 x 2.5 m
Slope angle in that area is between 16 - 30 %
Density of plants is about 1600 plants/ha



Author: Jimmy Luangphithuck

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **1 ha**)
- Currency used for cost calculation: **kip**
- Exchange rate (to USD): 1 USD = 8000.0 kip
- Average wage cost of hired labour per day: 30,000

Most important factors affecting the costs
Labour is an important factor especially for larger plantation areas that require more labour for maintenance

Establishment activities

1. Bong tree nursery (Timing/ frequency: November-Febuary)
2. Land preparation (Timing/ frequency: January-February)
3. Dig the hole (Timing/ frequency: July-August)
4. Use bio fertilizer (Timing/ frequency: August-September)
5. Planting (Timing/ frequency: August-September)
6. Weeding in first 3 years (Timing/ frequency: August-September and January-February)
7. Weeding after year 4-6 (Timing/ frequency: August-September)

Establishment inputs and costs (per 1 ha)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
labor for hole digging	hole	1600.0	500.0	800000.0	100.0
labor for planting	hole	1600.0	1000.0	1600000.0	100.0
labor for cleaning	person-day	60.0	30000.0	1800000.0	100.0
Equipment					
knife	piece	20.0	20000.0	400000.0	100.0
hoe	piece	20.0	35000.0	700000.0	100.0
shovel	piece	20.0	35000.0	700000.0	100.0
Plant material					
Bong tree seedlings	tree	1600.0	1000.0	1600000.0	100.0
Total costs for establishment of the Technology				**7'600'000.0**	

Maintenance activities

1. maintenance (weeding) (Timing/ frequency: January and August each year)
2. timber harvesting (Timing/ frequency: None)
3. bark collection (Timing/ frequency: None)

Maintenance inputs and costs (per 1 ha)

Specify input	Unit	Quantity	Costs per Unit (kip)	Total costs per input (kip)	% of costs borne by land users
Labour					
labor for weeding	person	60.0	30000.0	1800000.0	100.0
labor for timber harvesting	person				100.0
labor for bark collection	person				100.0
Fertilizers and biocides					
Bio fertilizers	bag	1000.0	15000.0	15000000.0	100.0
Total costs for maintenance of the Technology				**16'800'000.0**	

NATURAL ENVIRONMENT

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

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

Specifications on climate
There is significant rainfall in most months of the year. The short dry season has little effect on the overall climate.
Name of the meteorological station: https://en.climate-data.org/location/1063801/

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

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

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [x] 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
- [x] not relevant

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

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

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

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

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

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

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

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [x] 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
- [ ] poor
- [x] average
- [ ] rich
- [ ] very rich

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

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

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

Gender
- [x] women
- [x] men

Age
- [ ] children
- [ ] youth
- [x] middle-aged
- [x] 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
- [ ] medium-scale
- [x] large-scale

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

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

Water use rights
- [x] 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

animal production	decreased					✓			increased	Before the husbandry area was very limited in the forest. After active expansion of the Bong tree area by the mean of plantation, livestock got an ideal area for grazing and thus, the land user was able to enlarge his herd.
workload	increased			✓					decreased	Workload of the land user increased significantly due to the large area of bong tree plantation (38 ha).

Socio-cultural impacts

conflict mitigation	worsened		✓						improved	Because some people cut his trees and steal the wood.

Ecological impacts

nutrient cycling/ recharge	decreased							✓	increased	The grass growing naturally in the Bong tree area can be eaten by the livestock. The excrements of the animals mixed with the leaves of the Bong trees, serve as ideal manure for plants (Bong tree and grass).
fire risk	increased					✓			decreased	The land user transformed the land from shifting cultivation by traditional method of slash and burn to a stable plantation area. The method of shifting cultivation is the main cause for fires in the local forests.

Off-site impacts

impact of greenhouse gases	increased					✓			reduced	Reducing of shifting cultivation and subsequently less fires/improved forest cover and subsequently higher area for carbon sequestration

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 rainfall increase	not well at all			✓			very well

Climate-related extremes (disasters)

landslide	not well at all			✓			very well

ADOPTION AND ADAPTATION

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

- [ ] single cases/ experimental
- [ ] 1-10%
- [x] 10-50%
- [ ] more than 50%

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

- [ ] 0-10%
- [x] 10-50%
- [ ] 50-90%
- [ ] 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- [ ] Yes
- [x] No

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

- Acts as a counterbalance to slash and burn agriculture
- Once the trees have been planted it facilitates the raising of livestock such as cattle and poultry and therefore reduces the workload involved in such farming activities
- The plantation of bong trees further diversifies the sources of household income.

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

- The Bong tree has an expansive root system that is effective in binding the soil on slopes, and this reduces and prevents soil erosion.
- It reduces the loss of top soil during prolonged precipitation.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Due to the large area that is under the cultivation of Bong trees it makes it difficult to control and maintain the plantation.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

REFERENCES

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Date of documentation: May 19, 2017

Last update: Nov. 28, 2018

Resource persons
Konterp Sailava - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2307/

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Banana cultivation in sloping land (Anousith Namsena)

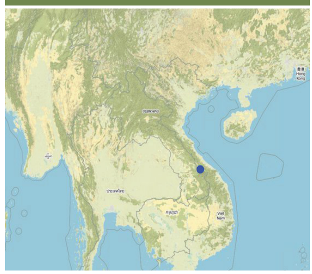
Banana intercropping in sloping land (Lao People's Democratic Republic)

DESCRIPTION

In mountain regions of Laos Banana cultivated with intercrops during the first year of plantation led to mutually better plant growth by higher availability of soil nutrients and subsequently produces better yield. It also prevents soil erosion, air pollution (reduction of slash and burn cultivation) and it mitigates climate related drought.

The banana provides significant benefits for the households in the uplands of Lao PDR. It serves for own consumption and for selling to generate regular household income. Its leaves are wanted on the market as well and can therefore generate good income too. Besides its low maintenance cost and easy to grow, banana can retain soil moisture and complement with ecology and biodiversity, on condition that its cultivation sustainable. Currently, the banana consumption in the region is increasing and results in banana expansion in the upland areas of Lao PDR. By tradition during the first year of banana plantation the local land users of Samouy district, Saravan province, Lao PDR cultivated banana intercropped with other upland crops (potentially with upland rice and maize) . However, the farmers implemented this cultivation technique without exact planning, measurement, in unorganized rows, or inadequate size of the hole. Also the poor maintenance after planting led to low banana productivity. In 2010, a Project supported by IFAD encouraged local people to grow banana with provision of technical advice through training and implementation. Banana plantation method recommended by the Project is following:1. Site selection: the land area with slope between 10-20 percent and rich loamy soils.2. Spacing and digging of holes: farmers arrange banana plants in lines and rows with spacing of 3m x 3m. 3. Dimension of hole: 25cm x 25cm with a depth of 30cm.3.Soil amendments: If the fertility of soil is low, manure (3 – 5kg/hole) has to be added on the bottom of the holes.4. Intercrops during first year of planation: Between the banana's rows upland crops can be seeded in regular rows. This helps to prevent soil erosion during the first year.5. Maintenance: Regular thinning and cutting of the banana branches are required after planting to get good yield. Thinning may also involve removal of excess banana suckers if there are more than 3-4 shoots per hole.6. Farmers are required to maintain banana plantation areas including regular weeding as well as soil amendment (animal manure) to promote successful banana production. Covering the soil constantly with banana leaves is one of the most important activities to maintain the soil's fertility (prevent soil leaching), structure and moisture, to improve the soil life, to lessen the burden of weeding and to prevent soil erosion. Chemical pesticides and fungicides are not foreseen to be used in this practice.7. After harvest of the intercrops: After the first year, when the maize or upland rice has been harvested, banana suckers will be planted in the rows on the remaining space between the one year old banana trees.In summary, this method of banana planting in sloping areas is simple and with average of 3-4 million Kip per household per year it generates good and regular income for the households. Banana provides fruits all year round that can be sold throughout the year whilst demand is also increasing. Currently, the average of the banana plantation area is approximately 10 ha per household. In addition, banana is tolerant to drought. Banana leaves spread over the soil (mulching) keep the soil moist provide best nutrients for soil organisms. And supplement amendment in form of animal manure improves the nutrient recharge. The soil cover improved to some extent from the beginning by the improved intercrop method according to the criteria learned by the project. However, the workload increased due to improved maintenance of banana

LOCATION



Location: Samouy district of Salavan province, Lao People's Democratic Republic

No. of Technology sites analysed: 10-100 sites

Geo-reference of selected sites

- 106.93332, 16.29723

Spread of the Technology: evenly spread over an area (approx. 0.1-1 km2)

Date of implementation: 2010; less than 10 years ago (recently)

Type of introduction

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

Banana cultivation intercropping with maize (Anousith Namsena)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

✓ improve production
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

Cropland - Perennial (non-woody) cropping
Main crops (cash and food crops): Banana as perennial (noon-woody crop / upland rice and maize at first year of banana cultivation.

Water supply

✓ rainfed
mixed rainfed-irrigated
full irrigation

Number of growing seasons per year: 1
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

Purpose related to land degradation

✓ prevent land degradation
reduce land degradation
restore/ rehabilitate severely degraded land
adapt to land degradation
not applicable

Degradation addressed

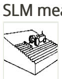
chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion

biological degradation - Bc: reduction of vegetation cover

SLM group

- rotational systems (crop rotation, fallows, shifting cultivation)
- improved ground/ vegetation cover

SLM measures

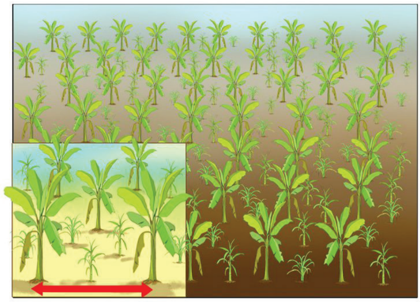


agronomic measures - A1: Vegetation/ soil cover

TECHNICAL DRAWING

Technical specifications

1. Site selection: land area with slope range between 10-20 percent and rich loamy soils; 2. Spacing and digging of holes: farmers arrange planting in lines and rows with spacing of 3m x 3m.; dimension of hole: 25cm x 25cm with a depth of 30cm. 3. Soil fertility: If the fertility of soil is low, manure (3 – 5kg/hole) has to be added on the bottom of the hole.4. Intercrops during first year of plantation: Between the banana rows upland intercrops can be seeded. This helps also to prevent soil erosion in the first year.5. Maintenance: Regular thinning and cutting of banana branches are required after planting to get good yield. Thinning may also involve removal of excess banana suckers, if there are more than 3-4 shoots per hole. The young banana suckers that are removed can be planted in new areas.6. Farmers are required to maintain banana plantation areas including regular manual weeding as well as soil amendment (cow manure) to promote successful banana production. Covering the soil constantly with banana leaves is one of the most important activities to maintain the soil's fertility (prevent soil leaching), structure and moisture, to improve the soil life, to lessen the burden of weeding and to prevent soil erosion. Chemical pesticides and fungicides are not foreseen to be used in this practice.7. Year after intercropping: After harvest of the crops such as maize or upland rice, banana sucker will be planted in rows on the remaining space between the 1 year old banana trees.



Author: Anousith Namsena

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: **1ha**)
- Currency used for cost calculation: **LAK**
- Exchange rate (to USD): 1 USD = 8000.0 LAK
- Average wage cost of hired labour per day: 30000

Most important factors affecting the costs
The most important factors affecting the costs is labour for establishment and maintenance.

Establishment activities
1. Slash and clearance vegetations (Timing/ frequency: January to Febuary)
2. Burning for land preparation (Timing/ frequency: March)
3. Digging the holes for the seedlings and planting (Timing/ frequency: April (before rain))
4. Collecting the banana suckers from forest (Timing/ frequency: May)

Establishment inputs and costs (per 1ha)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour for land preparation	person day	70.0	30000.0	2100000.0	100.0
Labour for planting	person day	10.0	30000.0	300000.0	100.0
Labour for collecting banana suckers	person day	10.0	30000.0	300000.0	100.0
Equipment					
Knief	piece	4.0	30000.0	120000.0	100.0
Shovel	piece	4.0	20000.0	80000.0	100.0
Plant material					
Banana sucker	sucker	60.0	5000.0	300000.0	100.0
Fertilizers and biocides					
Manure	kg	240.0	1000.0	240000.0	100.0
Total costs for establishment of the Technology				**3'440'000.0**	

Maintenance activities
1. Weeding (Timing/ frequency: 2 times after planting)
2. Cutting of banana "branches" (Timing/ frequency: At different times when necessary)
3. Banana harvest (Timing/ frequency: After one year of planting)

Maintenance inputs and costs (per 1ha)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour for weeding	person day	20.0	30000.0	600000.0	100.0
Labour for cutting of banana "branches"	person day	12.0	30000.0	360000.0	100.0
Labour for harvest	person day	15.0	30000.0	450000.0	100.0
Total costs for maintenance of the Technology				**1'410'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall
- < 250 mm
- 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
- semi-arid
- arid

Specifications on climate
Name of the meteorological station: Meteorological Office in Samouy district of Salavan province

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

Landforms
- plateau/plains
- ridges
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- ✓ hill slopes
- footslopes
- valley floors

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- 0-100 m a.s.l.
- 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)
- moderately deep (51-80 cm)
- deep (81-120 cm)
- very deep (> 120 cm)

Soil texture (topsoil)
- coarse/ light (sandy)
- ✓ medium (loamy, silty)
- 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%)
- low (<1%)

Groundwater table
- on surface
- < 5 m
- ✓ 5-50 m
- > 50 m

Availability of surface water
- excess
- ✓ good
- medium
- poor/ none

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

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ medium
- low

Habitat diversity
- high
- ✓ medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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- ✓ mixed (subsistence/ commercial
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- > 50% of all income

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- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ 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
- ✓ 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
- 15-50 ha
- 50-100 ha
- 100-500 ha
- 500-1,000 ha
- 1,000-10,000 ha
- > 10,000 ha

Scale
- small-scale
- medium-scale
- ✓ large-scale

Land ownership
- state
- company
- communal/ village
- group
- individual, not titled
- ✓ individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- 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	Compared to the traditional cultivation practice the new technology introduced by the IFAD project bear far better banana yield.
crop quality	decreased						✓		increased	The land users got bigger bananas and the productivity increased comapred to the former cultivation practice.
farm income	decreased						✓		increased	Due to better yield all year round the income from banana selling increased.
workload	increased		✓						decreased	Workload increased do to improved maintenance of the banana cultivation area (weeding, manuring, branch cutting etc).

Socio-cultural impacts

food security/ self-sufficiency	reduced					✓			improved	Food security improved due to better banana production that provide enough income to meet other important household needs.
community institutions	weakened					✓			strengthened	Established and strengthened banana producer groups to negotiate with the traders.

Ecological impacts

soil moisture	decreased						✓		increased	The banana leaves on soil as mulch improved the soil moisture.
soil cover	reduced					✓			improved	The soil cover is improved to some extent as both, banana and intercrop (maize and upland rice), are planted according to the criteria learned by the project. Futhermore, banana leaves scattered as mulching material cover the soil now.
soil loss	increased					✓			decreased	Due to better soil cover.
nutrient cycling/ recharge	decreased					✓			increased	Amendment in form of manure and the mulching by banana leaves improved the nutrient recharche.
beneficial species (predators, earthworms, pollinators)	decreased						✓		increased	The banana plantation and its leaves on soil is good for increase in predators, earthworms, pollinators.
habitat diversity	decreased					✓			increased	Increased micro organism (millipede, earth worn, centipede).
emission of carbon and greenhouse gases	increased						✓		decreased	Decreased emission of carbon and greenhouse gases from slash and burn shifting cultivation.

Off-site impacts

impact of greenhouse gases	increased						✓		reduced	The improved banana cultivation reduced the slash and burn practice and thus as well the emission of carbon and greenhouse gases.

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

annual rainfall increase — not well at all ☐ ☐ ✓ ☐ ☐ very well

Climate-related extremes (disasters)

drought — not well at all ☐ ☐ ☐ ☐ ✓ very well

ADOPTION AND ADAPTATION

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

- ☐ single cases/ experimental
- ☐ 1-10%
- ☐ 10-50%
- ✓ more than 50%

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

- ☐ 0-10%
- ☐ 10-50%
- ✓ 50-90%
- ☐ 90-100%

Number of households and/ or area covered

80 households out of 110 holds within the village hold such kind of banana plantations.

Has the Technology been modified recently to adapt to changing conditions?

- ☐ Yes
- ✓ No

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

- The planting technique promoted by the project was not complicated to be implemented.
- Banana plantation became the main source of household income.
- Stabilized slash and burn shifting cultivation.

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

- The land users can harvest bananas during the whole year, that ensure regular income.
- The low investment costs for banana plantations.
- The banana plantation can contribute to the climate change resilience and to reduce CO2 emission.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Weeding is a problem as it is labour intensive activity and family labour force is limited. → The land users have to pay more attention on weeding on time by hiring more labour for weeding activity.
- Lack of experience and knowledge for which part of banana trees is the best to cut the banana branches to get the banana productive. → The land users require more specific training and field visiting to exchange with other land users who are experienced in good practices.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- The land users have not enough experience by which means they can design the rows and lines exactly with regard to the sloping area before planting. → The land users can use plastic rope to measure the length from one hole to another hole.

REFERENCES

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Date of documentation: July 5, 2017

Last update: Oct. 29, 2018

Resource persons

Amyem Saylaveng - land user

Full description in the WOCAT database

https://qcat.wocat.net/en/wocat/technologies/view/technologies_2907/

Linked SLM data

n.a.

Documentation was faciliated by

Institution

- National Agriculture and Forestry Research Institute (NAFRI) - Lao People's Democratic Republic

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Wild cardamom in the land user's field (Sinnalong Khamvongchan)

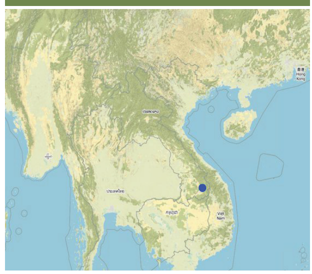
Wild cardamom plantation for sustainable forest management (Lao People's Democratic Republic)

DESCRIPTION

Cardamom planting is a non timber forest product. Wild cardamom planting take place in traditional agroforestry systems based on shifting agriculture. The objectives of this technologies are to reach sustainable forest use and to generate household income.

Wild cardamom (Amomum subulatum) is a non-timber forest product (NTFP) that grows naturally in South Asia at elevations between 600 and 1.200 meters under the canopy of humid tropical forests (average temperature between 15-25 °C, PH level between 5,5-6,5). In Laos, completely wild cardamom is still found in mountainous secondary forest at an elevation upwards of 700 meters, mainly near watercourses. In the past, it was commonly found by local people but never harvested or used. However, the international demand for cardamom began in 2000, and increased dramatically since then. This encouraged an increasing number of local villagers to collect cardamom from natural forest areas for sale to generate income for their households. This, however, caused depletion of cardamom in forest areas and also created conflicts among the people. Hence, the village people started to collect cardamom seedlings from the forest to cultivate them in their own upland fields, where farmers used to have upland rice cultivation before. Normally after rice harvest, they planted wild cardamom seedlings and led them grow up thogether with other wild plants and trees. It was treated as a kind of fallow. As a result of the domestication they were able to save time compared to the collection of wild cardamom in the forest. In 2002 it is estimated that two third of the harvest came from plantations. Cardamom cultivation on former fallow fields does not require significant investments – only hoes, knifes, and bags for collecting natural cardamom seedlings. One hectare of land requires around 15 days of seedling collection in the forest. The selected seedlings should reach an appropriate maturity (dark green leaves with 1 to 2 yellow leaves, height of stem about 1 to 2 meters) that promotes stem production, ensures high survival rate during transportation, and tolerates new environmental conditions at the planting site. Then, cardamom seedlings need to be replanted at latest two days after collection in the prepared plot. Typically, people plant cardamom during June – July with the beginning of wet season. Before in May, bush clearance is needed, but higher trees should be preserved at approximately 40 percent to provide a canopy for the required shadow to the cardamom. Vegetation removal necessitates observation and background knowledge of the individual land user. Cardamom planting should be established in lines and rows as follow: the space between the rows is 1 meter and 1.2 meters between the lines. The planting holes for the cardamom seedlings are 20 x 20 cm and 10 to 15 centimetres in depth. The space between the plants is 2 x 2 m, which facilitates the accessibility during weeding, maintenance, and harvest. It is recommended that farmers should plant three seedlings per hole. On average, there will be 2,500 holes/ha that requires a total of 7,500 seedlings per hectare. After that, fertile soil should be applied to refill the holes by moderate feet pressure at the end. Most farmers don't use manure or fertilizers in their cardamom cultivations. Maintenance requires mainly the thinning of some tree branches to provide adequate sunlight as required by the cardamom plants. This can be implemented once a year after harvest. Cardamom plants provide fruits within four years after planting. During the establishment period till the first harvest the farmer's workload increases as they have to collect still wild cardamom in the forests as well. Harvesting can be carried

LOCATION



Location: Xayxay district, Attapue province, Lao People's Democratic Republic

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 107.09553, 15.10652

Spread of the Technology: evenly spread over an area (approx. < 0.1 km2 (10 ha))

Date of implementation: 2010; less than 10 years ago (recently)

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

out annually during August – September with an average production of 320 kg per hectare for dried cardamom and approximately 578 kg of fresh cardamom. The market demand for this kind of cardamom is high, because it is internationally requested as medicinal product. Therefore, the local people are satisfied with the selling price offered by middle men who buy the production at 70,000 Kip/kg. Benefits from cardamom plantation include more income for local people, increase in forest cover, stabilization of slash and burn shifting cultivation and less impacts on agricultural lands. In addition, cardamom plantations help balancing the ecosystem and provide natural habitats for various animal and plant species.

Wild cardamom tree and seed (Catherine Aubertin)

Wild cardamom tree in humid forest (Bounthanom Bouahom)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose
- [ ] improve production
- [ ] reduce, prevent, restore land degradation
- [x] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [x] 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
- [ ] create beneficial social impact

Land use

Cropland - Tree and shrub cropping

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

Number of growing seasons per year: 1
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

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

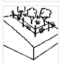
Degradation addressed

biological degradation - Bh: loss of habitats, Bq: quantity/ biomass decline

SLM group
- agroforestry
- ecosystem-based disaster risk reduction

SLM measures

vegetative measures - V1: Tree and shrub cover

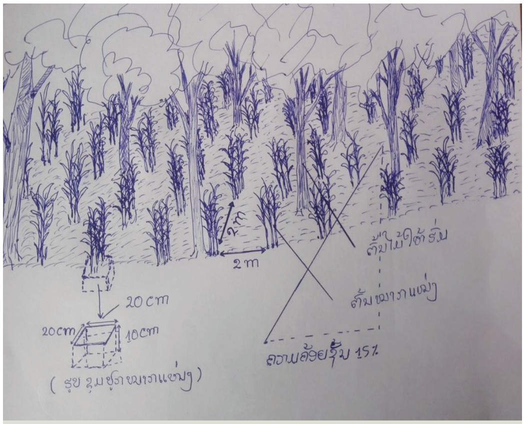


management measures - M1: Change of land use type

TECHNICAL DRAWING

Technical specifications

- The land users prepare land during 5 days in May (selected cutting of trees and shrub)
- During June to July, when wet season starts, the cardamom seedlings are collected in the forest. To cover 1 hectare 2 persons have to collect during 15 days (during the time cardamom is flowering). The land users select mature cardamom seedlings of (1 to 2 meters in height).
- Planting holes are 20 x 20 cm, depth 10-15 cm, planting distance is 2 x 2 meters and per hole 3 seedlings are planted (2500 trees/ha).
- Cardamom here is cultivated at a slope rate of 15%. No fertilizers were in use in the example of this case study.



Author: Sinnalong Vongkhamchan

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: **1**; conversion factor to one hectare: **1 ha = hactare**)
- Currency used for cost calculation: **LAK**
- Exchange rate (to USD): 1 USD = 8000.0 LAK
- Average wage cost of hired labour per day: 50.000

Most important factors affecting the costs
Labour and cost for manure are the most important factors.

Establishment activities
1. Clearing soil from bushes and weeds (Timing/ frequency: April to May (before rain))
2. Thining of tree branches (Timing/ frequency: Before planting)
3. Collecting of cardamom seedlings (Timing/ frequency: June to July)
4. Planting (Timing/ frequency: July)

Establishment inputs and costs (per 1)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour for land preparation	person day	10.0	50000.0	500000.0	100.0
Labour for collection of seedlings	person day	30.0	50000.0	1500000.0	100.0
Labour for planting	person day	10.0	50000.0	500000.0	100.0
Equipment					
Knief	piece	3.0	60000.0	180000.0	100.0
Shovel	piece	3.0	80000.0	240000.0	100.0
Blasket for cardamom tree	piece	3.0	150000.0	450000.0	100.0
Bag	piece	30.0	2500.0	75000.0	100.0
Fertilizers and biocides					
Manure	kg	2500.0	300.0	750000.0	100.0
Total costs for establishment of the Technology				**4'195'000.0**	

Maintenance activities
1. Weeding (Timing/ frequency: March to April)
2. Use manure (Timing/ frequency: September after harvesting)
3. Harvesting (Timing/ frequency: August to September)

Maintenance inputs and costs (per 1)

Specify input	Unit	Quantity	Costs per Unit (LAK)	Total costs per input (LAK)	% of costs borne by land users
Labour					
Labour for weeding	person day	10.0	50000.0	500000.0	100.0
Labour to use manure	person day	10.0	50000.0	500000.0	100.0
Labour for harvesting	person day	10.0	50000.0	500000.0	100.0
Fertilizers and biocides					
Manure	kg	300.0	2500.0	750000.0	100.0
Total costs for maintenance of the Technology				**2'250'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall
- < 250 mm
- 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
- semi-arid
- arid

Specifications on climate
Name of the meteorological station: District of Agriculture and Forestry Office in Xanxay district

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

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

Altitude
- 0-100 m a.s.l.
- 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)
- ✓ moderately deep (51-80 cm)
- deep (81-120 cm)
- very deep (> 120 cm)

Soil texture (topsoil)
- coarse/ light (sandy)
- ✓ medium (loamy, silty)
- 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%)
- ✓ low (<1%)

Groundwater table
- on surface
- < 5 m
- 5-50 m
- ✓ > 50 m

Availability of surface water
- excess
- good
- ✓ medium
- poor/ none

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

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ 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
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- average
- ✓ rich
- very rich

Level of mechanization
- ✓ 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
- ✓ 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
- 15-50 ha
- 50-100 ha
- 100-500 ha
- 500-1,000 ha
- 1,000-10,000 ha
- > 10,000 ha

Scale
- small-scale
- ✓ medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- ✓ individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- communal (organized)
- leased
- individual
- ✓ Rain

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

farm income — decreased ✓ increased

Before the farmer did not cultivate cardamom on the fallow area.Thus, the farm income increased by selling the cardamom.

diversity of income sources — decreased ✓ increased

Increase income from Cardamom because before farmers did not collected cardamom for commercial Cardamom plantations under the forest canopy generate an additional income source.

workload — increased ✓ decreased

Famers have now their own cardamom fields near the villages. And hence, this not anymore needs searching the natural forest after wild cardamom which is time consuming.

Socio-cultural impacts

conflict mitigation — worsened ✓ improved

Conflictual situations decreased because farmers have now their own cardamom fields.

Ecological impacts

soil moisture — decreased ✓ increased

plant diversity — decreased ✓ increased

Increase in local mushrooms and moss.

invasive alien species — increased ✓ reduced

Increase in number of snakes and mosquitos.

habitat diversity — decreased ✓ increased

Increased in earthworms, milli pest and bug.

Off-site impacts

impact of greenhouse gases — increased ✓ reduced

Better protection of the natural forests, as cultivated cardamom produces satisfactory yields for around 15 years. Thus, long fallow period normally needed for rice cultivation on the same plot can be compensated. Less frequent forest burning, less aerosols and stalilization of forest area.

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 rainfall decrease — not well at all ✓ very well

seasonal rainfall decrease — not well at all ✓ very well — Season: winter

ADOPTION AND ADAPTATION

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

- [ ] single cases/ experimental
- [ ] 1-10%
- [x] 10-50%
- [ ] more than 50%

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

- [ ] 0-10%
- [ ] 10-50%
- [ ] 50-90%
- [x] 90-100%

Has the Technology been modified recently to adapt to changing conditions?

- [ ] Yes
- [x] No

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

- Reduced conflicts regarding cardamom harvest that formerly was collected in the open forest.
- Increase in forest cover.
- Improved soil in the slash and burn shifting cultivation area.

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

- Preservation of the forest resources and improvement of the local ecosystem through this sustainable cardamom cultivation.
- The former traditional and extensive cardamom collection in the forests has been reduced, but the new cardamom plantation technique stabilized at the same time the shifting cultivation area.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- The higher amount of cardamom plants in the humid forest promoted snakes and mosquitos.
- The land users had difficulties to find suitable cardamom seedlings, because the natural forests are very messy and humid.
- The strict eradication of the slash-and-burn practice by the new land allocation policy, limited and threat the traditional cardamom collection.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

REFERENCES

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Date of documentation: May 15, 2017

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Resource persons
Bouathong Souvanchieng - land user
ບົວທອງ ບຸດດາທິບ - None

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2237/

Linked SLM data
n.a.

Documentation was faciliated by
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Project
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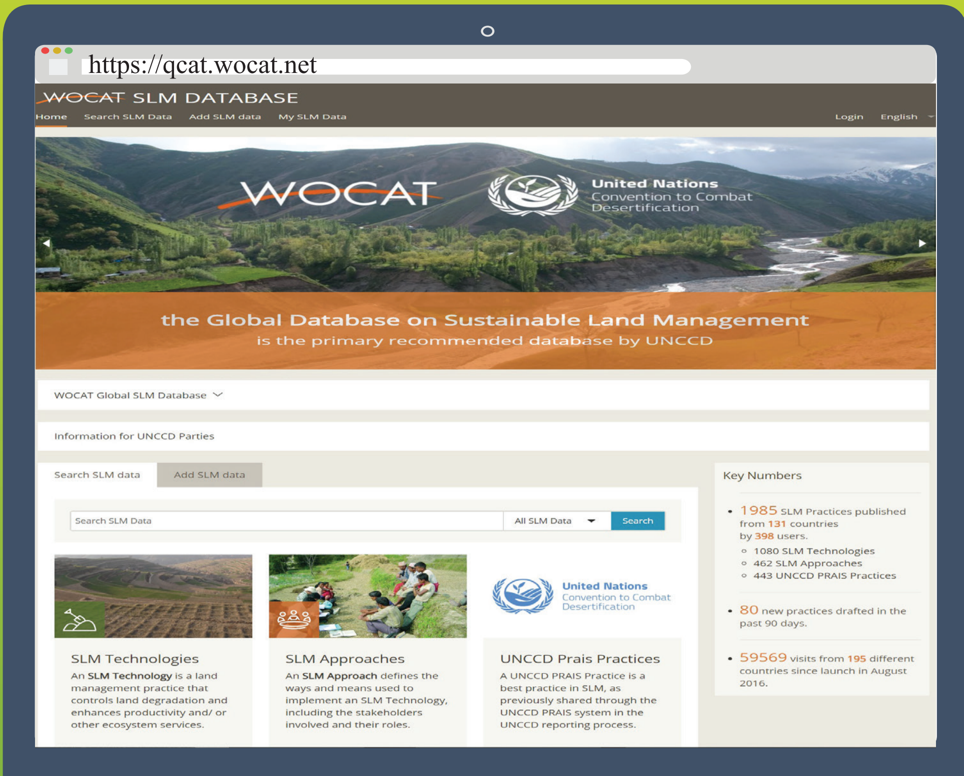

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