Household pond used for irrigation and fishing. (Christoph Kaufmann (Centre for Development and Environment CDE))

Use of household ponds for garden irrigation and fish production. (Cambodia)

ការប្រើប្រាស់ស្រះគ្រួសារសំរាប់ស្រោចស្រពច្បារដំណាំនឹងការចិញ្ចឹមត្រី (Khmer)

DESCRIPTION

Ponds are used at household level to raise fish as well as to irrigate vegetable gardens and rice seedlings

Wet-season rice is the predominantly grown crop in the area, but some land users also grow other crops (e.g. sweet potatoes, pumpkins, or peanuts). However, if droughts occur or if the rainfall patterns are erratic, the production can be harmed. Furthermore, due to the lack of water, the land users usually leave their fields bare during the dry season. This results in an increase of wind erosion and in negative impacts on the soil biota due to its exposure to the sun. In order to tackle these challenges, ponds of 4 m depth (1 m deeper than the groundwater table during the dry season) are used at household level. By building ponds, some fields can be irrigated during the dry season, thus crops can be grown the whole year round. In this case study, sweet potatoes are the main cash crop grown on the irrigated fields during the dry season. The vines can be transplanted to the fields during the beginning of the rainy season, resulting in a better productivity of the crop. Peanuts and cucumbers are other cash crops grown on the irrigated fields. Additionally, fish are introduced to the pond. These fish, which are caught during fishing for consumption in the flooded rice fields or nearby streams, increase the resilience of the land users: On one hand, they generate additional income and on the other hand, they allow the land users to eat fish the whole year round. To build the ponds, the land users of this case study benefited from the road construction. The constructer needed soil, and offered to dig a pond for free if they could use the soil. They only dug 2 of the total 4 meters depth of the pond. The land users had to hire someone to dig deeper, as the groundwater level drops below 3 meters soil level during the dry season. The additional benefits from the pond, the fish are introduced as fingerlings when they are caught with the bigger fish. They are fed with termites (around 5 kg of termite nest each day) and with rice bran (1 kg every 3 days). As the pond is only 2 years old, the maintenance activities like digging out the mud did not have to be done yet. The analysed area is flat (slope < 2%), tropic (dry and wet season), and the soils are mostly sandy or loamy. The soils contain little organic matter, the pH is sinking, the area has been deforested a long time ago and the groundwater table is rather high (1-2 m during the dry season, on the surface during wet season). and the groundwater table is rather high (3 m below soil level during the dry season, on the surface during the wet season). Due to climate change, the rainfalls are more erratic, temperatures rise and droughts are more recurrent. Rice is the predominant crop grown in the area, since it serves as staple food (mix subsistence and commercial activities). Rice is often grown in monocultures and harvested once a year. Once the rice is harvested (dry season), some farmer release cattle to the paddy fields to eat the straw and weeds. As an addition to rice, most land users grow vegetable and fruits in small home gardens (subsistence) and complement their income by producing handicrafts or through off farm income / remittances from family members working in other places. The increasing migration rate (the young generation leaves the villages to work in the cities, garment industry or abroad) results in a decrease of available labour force in the area which has detrimental effects on the agricultural activities. Furthermore, the civil war in the 1970s (Khmer Rouge) led to the loss of agricultural knowledge that different NGOs try to re-establish.

LOCATION

Location: Roloer pha-er/Bantheay Preal/Tob Srauv (Village), Kampong Chhnang, Cambodia

No. of Technology sites analysed:

Geo-reference of selected sites

- n.a.

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

Date of implementation: 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

Land user irrigating with water from the household pond. (Christoph Kaufmann (Centre for Development and Environment CDE))

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

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

biological degradation - Bq: quantity/ biomass decline

water degradation - Ha: aridification

SLM group

- irrigation management (incl. water supply, drainage)
- surface water management (spring, river, lakes, sea)
- beekeeping, aquaculture, poultry, rabbit farming, silkworm farming, etc.

SLM measures

structural measures - S4: Level ditches, pits

TECHNICAL DRAWING

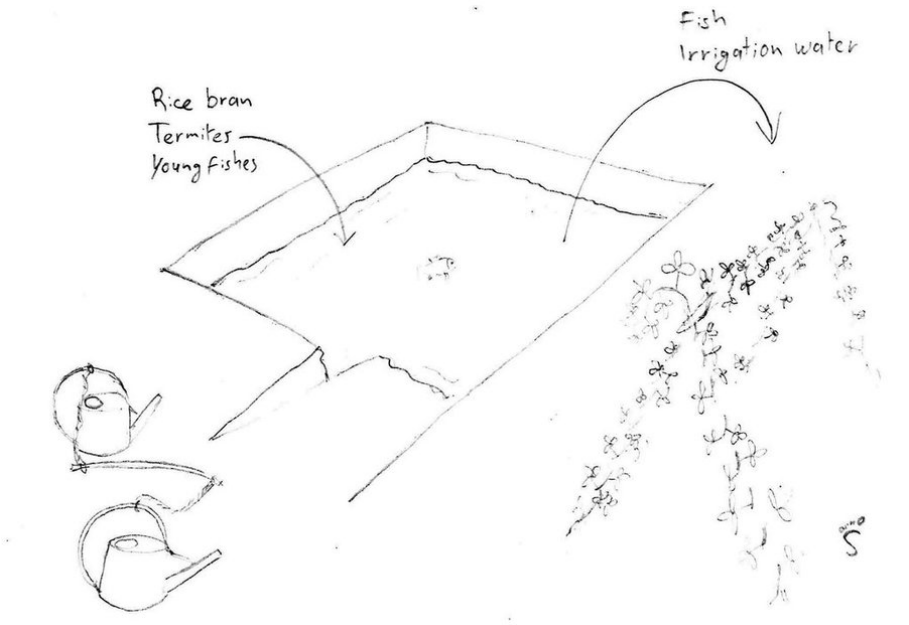
Technical specifications
Pond used for irrigation as well as for fish production. In this case two watering cans are used, with a stick between them to transfer the weight to the shoulders.

Kampong Chhnang
Date: 2014

Technical knowledge required for field staff / advisors: low (No field staff was involved.)
Technical knowledge required for land users: low
Main technical functions: water harvesting / increase water supply

Dam/ pan/ pond
Depth of ditches/pits/dams (m): 4

Width of ditches/pits/dams (m): 12
Length of ditches/pits/dams (m): 18
Specification of dams/ pans/ ponds:
Capacity 800m3
Catchment area: ground waterm2



Author: Stefan Graf, Switzerland

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated:
- Currency used for cost calculation: **n.a.**
- Exchange rate (to USD): 1 USD = n.a.
- Average wage cost of hired labour per day: 5.00.

Most important factors affecting the costs
The most expensive factor is the availability of an excavator to dig the pond.

Establishment activities
1. Dig the first 2 m (Structural; Dry season)
2. Dig the last 2 m (Structural)

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit	Total costs per input	% of costs borne by land users
Equipment					
machine use		1.0	100.0	100.0	50.0
Total costs for establishment of the Technology				**100.0**	

Maintenance activities
1. Catch and select fingerlings in the rice fields and canals. (Structural; Every year during wet season)
2. Select fingerlings from catch in local streams to add in pond. (Structural)
3. Dig out the pond. Not yet done, as the pond is still new. (Structural)
4. Feed the fish with termites and rice bran. (Structural)
5. Fertilize the pond (Structural)

Maintenance inputs and costs

Specify input	Unit	Quantity	Costs per Unit	Total costs per input	% of costs borne by land users
Labour					
labour		1.0	134.5	134.5	100.0
Total costs for maintenance of the Technology				**134.5**	

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
1486.45 mm (2013) in Kampong Chhnang
Thermal climate class: tropics. 27-35°C

Slope | **Landforms** | **Altitude** | **Technology is applied in**

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

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

- [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.

- [ ] convex situations
- [ ] concave situations
- [ ] 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)
- [x] coarse/ light (sandy)
- [x] 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%)
- [x] medium (1-3%)
- [x] low (<1%)

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

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

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

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

Occurrence of flooding
- [ ] Yes
- [ ] No

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

Habitat diversity
- [ ] high
- [ ] 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
- [x] rich
- [ ] very rich

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

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

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

Gender
- [x] women
- [x] men

Age
- [ ] children
- [ ] youth
- [ ] 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
- [x] communal/ village
- [ ] group
- [x] individual, not titled
- [ ] individual, titled

Land use rights
- [ ] open access (unorganized)
- [x] 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 - BENEFITS AND DISADVANTAGES

Socio-economic impacts

Crop production	decreased				✓		increased
animal production	decreased					✓	increased

Fish

risk of production failure	increased				✓		decreased		
product diversity	decreased					✓	increased		
production area (new land under cultivation/ use)	decreased					✓	increased		
farm income	decreased					✓	increased		
diversity of income sources	decreased					✓	increased		

Socio-cultural impacts

food security/ self-sufficiency	reduced				✓		improved		
contribution to human well-being	decreased				✓		increased		

Ponds allow the land user to grow crops the whole year round. Furthermore, there are fish in the pond which provide a reliable source of food.

Ecological impacts

water quantity	decreased					✓	increased		
soil moisture	decreased				✓		increased		

Off-site impacts

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

Climate change/ extreme to which the Technology is exposed	How the Technology copes with these changes/extremes								
Gradual climate change									
annual temperature increase	not well at all					✓	very well		
Climate-related extremes (disasters)									
local rainstorm	not well at all					✓	very well		
local windstorm	not well at all					✓	very well		
drought	not well at all					✓	very well		
general (river) flood	not well at all			✓			very well		
Other climate-related consequences									
reduced growing period	not well at all					✓	very well		

ADOPTION AND ADAPTATION

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

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

Of all those who have adopted the Technology, how many have did 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

- Water available in the dry season for cash crops. The rice fields can be used in the dry season instead of being left bare. (land user's view)
- The rice seedlings can be irrigated during the early wet season in case of drought or erratic rainfall. (land user's view)
- Diversification of diet and income: fish is available the whole year round. (land user's view)
- As parts of the rice fields are irrigated and planted during the dry season, there is less wind erosion and the soil is improving. (compiler's or other key resource person's view)
- The fish feed (rice bran and termites) consists of local resources. (compiler's or other key resource person's view)

Weaknesses/ disadvantages/ risks → *how to overcome*

- If flooded the fish can go away. → *Nets need to be put around the pond in the wet season. This farmer already does this.* (land user's view)
- Fingerlings are difficult to find. → *Find a fish breeder, or breed fish by themselves. Creating niches in the ponds for the offspring, where the bigger fish do not eat it, could do the breeding.* (land user's view)
- Fingerlings of different sizes and species are put into the pond. The bigger eat the smaller. → *Fence off areas for bigger fish, and move the big fish there so they cannot catch the smaller. Or build structures where the smaller fish can hide.* (compiler's or other key resource person's view)

REFERENCES

Compiler

Christoph Kaufmann - christoph.kaufmann91@gmail.com

Questionnaire created
Oct. 16, 2014

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Dec. 29, 2016

Resource persons

Christoph Kaufmann (christoph.kaufmann91@gmail.com) - SLM specialist
Lean Hak Khun (kleanghak@yahoo.com) - SLM specialist

Full description in the WOCAT database

https://qcat.wocat.net/en/wocat/technologies/view/technologies_1627/

Linked SLM data

n.a.

Documentation was faciliated by
Institution
- n.a.

Project
- n.a.

Key references

Konhel Pith, Local Agricultural Research and Extension Centre LAREC in Kampong Chhnang; khonhel@gmail.com:

Links to relevant information which is available online