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

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 constructor 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). 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.
### 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
- ✓ mixed rainfed-irrigated
- rainfed
- 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 water m²

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

<table>
<thead>
<tr>
<th>Specify input</th>
<th>Unit</th>
<th>Quantity</th>
<th>Costs per Unit</th>
<th>Total costs per input</th>
<th>% of costs borne by land users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>machine use</td>
<td></td>
<td>1.0</td>
<td>100.0</td>
<td>100.0</td>
<td>50.0</td>
</tr>
<tr>
<td><strong>Total costs for establishment of the Technology</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100.0</td>
</tr>
</tbody>
</table>

#### 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

<table>
<thead>
<tr>
<th>Specify input</th>
<th>Unit</th>
<th>Quantity</th>
<th>Costs per Unit</th>
<th>Total costs per input</th>
<th>% of costs borne by land users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td></td>
<td>1.0</td>
<td>134.5</td>
<td>134.5</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Total costs for maintenance of the Technology</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>134.5</td>
</tr>
</tbody>
</table>

**NATURAL ENVIRONMENT**

<table>
<thead>
<tr>
<th>Average annual rainfall</th>
<th>Agro-climatic zone</th>
<th>Specifications on climate</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 250 mm</td>
<td>humid</td>
<td>1486.45 mm (2013) in Kampong Chhnang</td>
</tr>
<tr>
<td>251-500 mm</td>
<td>sub-humid</td>
<td>Thermal climate class: tropics. 27-35°C</td>
</tr>
<tr>
<td>501-750 mm</td>
<td>semi-arid</td>
<td></td>
</tr>
<tr>
<td>751-1,000 mm</td>
<td>arid</td>
<td></td>
</tr>
<tr>
<td>✓ 1,001-1,500 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,501-2,000 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,001-3,000 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,001-4,000 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 4,000 mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Slope  Landforms  Altitude  Technology is applied in

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<table>
<thead>
<tr>
<th>Characteristics of Land Users Applying the Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Market orientation</strong></td>
</tr>
<tr>
<td>subsistence (self-supply)</td>
</tr>
<tr>
<td>mixed (subsistence/commercial)</td>
</tr>
<tr>
<td>commercial/commercial/market</td>
</tr>
<tr>
<td><strong>Off-farm income</strong></td>
</tr>
<tr>
<td>less than 10% of all income</td>
</tr>
<tr>
<td>10-50% of all income</td>
</tr>
<tr>
<td>&gt; 50% of all income</td>
</tr>
<tr>
<td><strong>Relative level of wealth</strong></td>
</tr>
<tr>
<td>very poor</td>
</tr>
<tr>
<td>poor</td>
</tr>
<tr>
<td>average</td>
</tr>
<tr>
<td>rich</td>
</tr>
<tr>
<td>very rich</td>
</tr>
<tr>
<td><strong>Level of mechanization</strong></td>
</tr>
<tr>
<td>manual work</td>
</tr>
<tr>
<td>animal traction</td>
</tr>
<tr>
<td>mechanized/motorized</td>
</tr>
</tbody>
</table>

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

| Poor                                          |
| Good                                         |

**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)
- 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

**IMPACTS - BENEFITS AND DISADVANTAGES**

**Socio-economic impacts**

| Crop production | increased |
| Animal production | increased |

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4/6
### 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: 
  - Decreased: ✓
  - Increased: 
- Contribution to human well-being: 
  - Decreased: 
  - Increased: ✓

### Ecological Impacts
- Water quantity: 
  - Decreased: ✓
  - Increased: 
- Soil moisture: 
  - Decreased: ✓
  - Increased: 

### Off-site Impacts
- Benefits compared with establishment costs:
  - Short-term returns: very negative ✓
  - Long-term returns: very positive
- Benefits compared with maintenance costs:
  - Short-term returns: very negative ✓
  - Long-term returns: very positive

### Climate Change
- Gradual climate change:
  - Annual temperature increase: not well at all ✓
- Climate-related extremes (disasters):
  - Local rainstorm: not well at all ✓
  - Local windstorm: not well at all ✓
  - Drought: not well at all ✓
  - General (river) flood: not well at all ✓
- Other climate-related consequences:
  - Reduced growing period: not well at all ✓

### 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
- 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
- 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
- Wocat SLM Technologies: Use of household ponds for garden irrigation and fish production.
Use of household ponds for garden irrigation and fish production.