Carp farming in Kaule (Nepal)
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1 Introduction

Nepal is a landlocked country without access to the ocean and is famous for its geographical and cultural diversity. Agriculture is the mainstay of the economy and is accounting one-third of the GDP. But still 38.8% (2006) of the children below the age of five years are underweight.  

The main supply of protein is through leguminous plants, eggs and, if affordable, chicken meat. With its large numbers of water streams, fish farming has a big potential of providing needed nutrients. The development of fishery was one of the priory goals of the Department of Agriculture in the last decades. Between 1982 and 1996 production the rate of produced fish increased about 10,000 t/year.  

Not only commercial fisheries are conductive to the total fish production, also more or less self-sufficient farmer add to it. “Fisheries offer a great opportunity for self employment and income generation among poor people living along (...) natural water streams” 

The Nuwakot district, located in proximity of Kathmandu, is famous for its fish, but only a few families run fish farms. Still a large amount of water is being unused a flows down the terraced hills towards the Kathmandu valley.

In context of the Project “Kaule e.V. - nachhaltig wirken” there was a concept developed on how to bring the benefits of fish farming to a wider range of the local population. Between September and December 2011 four fish ponds for selective families were constructed and the knowledge about fish farming was transferred.

2 Goals of the Project

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<tr>
<th>Type of goals</th>
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| Outcome       | • Knowledge transfer about carp farming  
• Construction of fishponds with the participating families  
• Documentation about the process of the project  
• Organizing a training on carp farming with professionals from the ministry of agriculture |
| Outputs       | 1. Sub goal: Develop a concept on how to fish farm in Kaule in the most appropriate way  
2. Sub goal: giving an introduction about fish farming to the local farmers  
3. Sub goal: determination of adequacy of the farmers land for a construction of a pond and selecting participating families  
4. Sub goal: measuring the width and length of the suitable construction terrain  
5. Sub goal: calculating the costs of a hypothetical construction  
6. Sub goal: choosing the construction site and setting marks |

3 “The status of cold water fisheries in Nepal and prospects of their utilization for poverty reduction” SWAR
7. **Sub goal:** giving instruction on how do prepare the construction terrain and monitoring it, taking new measurements
8. **Sub goal:** calculating the cost of the actual construction
9. **Sub goal:** providing the construction material
10. **Sub goal:** Handing out the construction material and monitoring the construction
11. **Sub goal:** organizing a fish farming training in Balaju and telling the farmers where to buy which kind of fish

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<th>Time frame</th>
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<tbody>
<tr>
<td><strong>Start date</strong></td>
<td><strong>Closing date</strong></td>
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<tr>
<td>03.09.2011</td>
<td>03.12.2011</td>
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### 3 Farming in Kaule

Kaule is a relatively small village with 605 households\(^4\) and is about 25 km away from Nepal’s capitol Kathmandu. It is cited at 1900 meter altitude and is characterized by humid, subtropical climate. Due to the altitude the air temperature falls low in winter and springtime, but snow is a seldom event. As a result of the south slope exposition much sunlight energy abets a fast warm up of the surface in spring time. The landscape is formed by terrace agriculture with the main crops are rice, maize, wheat and vegetables like cabbage, radish, tomatoes, onions, cucumber and chayote ("Iskus"). A few years ago the Japan International Cooperation Agency (JAICA) introduced strawberry farming to the district and a large number of farmers now grow it regularly. Also kiwi and asparagus enjoys more and more popularity. An additional income is generated by livestock breeding. Many families own some chicken, goats of water buffalos.

Several sources can be found in the village’s neighborhood. The biggest water source supplies a concrete water tank and water pipelines lead from the uphill water tank to the down hill farmhouses. The source is independent from rainfall and is irrigating the fields if needed. Owning to technical reasons the water pipelines can’t be closed to safe water, otherwise the plastic pipes would leak as a result of the rising water pressure inside. So most of the water is being unused.

### 4 Cold- or warm water fish farming?

When one travels along the road from Kathmandu in the direction of Trisuli one can recognize the large number of trout farms (*Oncorhynchos mykiss*) along the road. A popular activity for citizens from Kathmandu has become to enjoy the beautiful landscape and visit a trout restaurant on the weekend or on free festival time. Trout farming was introduced to the Nuwakot district in 1988 by the Japan International Cooperation Agency (JAICA). In following years trout farming was further developed by the Fish Farming Research Center in Trisuli\(^5\). The most common way to do coldwater trout fish

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\(^4\) "Nepal Census 2001", Nepal's Village Development Committees, retrieved 15 November 2009

farming is to build concrete cells and feed the trouts with specifically food, which is often a mixture of fish meal, oil cake and rice bran pressed to pellets and has to be imported from India (ca. 150 Rs./kg). Running a trout farm needs lots of technical knowledge and needs to be precisely and carefully maintained to be successfully run. Trout farms therefore are often the main business of a family, because the work is time consuming. Trouts need a constant flow of several liters a second of cold, clean water with high oxygen content. The water quality has to be measured regularly and the cells have to be regularly salted (salt gets mixed with the water to prevent fish diseases). The costs of the construction of concrete cells are high. It can only be done with the help of building machines; therefore road access to the building site is necessary. Due to this reasons coldwater fish farming was considered to be not a suitable fish farming type to be integrated into the self-sufficient agricultural Agroforestry systems of the local farmers.

Warm water fish farming can be defined as a pond-based aquaculture and is the more dominant fish farming type in Nepal. Warm water carp farming was introduced in 1955, when exotic Asian carp types like Bighead carp (Hypophthalmichthys nobilis), Silver Carp (Hypophthalmichthys molitrix), Common Carp (Cyprinus carpio) and Gass Carp (Ctenopharyngodon idella) were imported from India and experimentally stocked in several ponds in Kathmandu. Today the main carp farming region in Nepal is the low altitude Terrai area. But also in the Midhills carp farming is popular. In the Kaule village there are already two carp ponds: one is under the surveillance of the local Tea farm and a smaller pond is on the property of the family of Jas Ram, who is a successful Agroforestry farmer since 15 years.

5 Carp farming

Carps are warm water fish and are grown best in stagnant, warm water. The oxygen content should now fall under 3 mg/l and the pH should be between 6.0 and 9.0. At a water temperature between 20 and 25 degrees carps the rate of food consumption and daily growth is the highest. In addition to natural food sources like zooplankton, insects and water plants the carps can be fed by:

1. fish meal
2. blood meal
3. carcass meal
4. dried insects like silkworm pulpal
5. minced flesh
6. soybean meal
7. rice bran
8. wheat flour

Maize, even when cheap, should not be fed, because it reduces the taste of carps.7

Carp are stocked in a shallow pond with a low amount of water constantly running through. The minor depth (+/- 1 meter) enhances a fast heat of the water body by the sun. Shadowy

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7 http://www.teichwirt.homepage.eu/der_teich_und_seine_fische_60334903.html
areas are needed to prevent over heating with significant reduction of the oxygen content in the water in the hot season, if water pumps are not available to stabilize the oxygen level.  

Picture 1: Production system of fish farming in Kaule  
Based on: http://www.thefishsite.com/articles/595/production-methods-for-the-common-carp

Picture one shows the production system, how it will work in Kaule. The farmers would buy Carp fingerlings in March from the governmental Central Fish Hatchery in Balaju (Kathmandu) and stock them in their pond and feed them regularly. After 10 (to 12 month) they would drainage the pond and harvest the fish. If needed in between, single fish can be cached by using fish nets. After harvesting the fish the pond would stay empty for the cold season. The sunlight can enhance sterilization of the pond and kills germs, that otherwise can influence the carp’s health. In February the farmers could

plant some weeds on the bottom of the pond, to provide some biomass, when the pond is restocked again. The biomass gives food for insects and is also eaten by carps (e.g.: Grass-Carp). Another benefit is the reduction of sapropel (organic slime) that lowers the water quality and downgrades the taste of the harvested carps.

6 Pond constructions

6.1 Planning

On the first farmers meeting several families show big interest to learn about fish farming and wanted to have fish ponds. There was checked, if the soil stability and water availability was suitable for the construction of a fishpond on their property. Important criteria were, if the chosen terrace was stabilized by trees on the edge. Otherwise the likelihood of a landslide, caused by the weight of the water body, rises. The trees can also shadow parts of the pond.  
On all potential building sites the soil quality was too sandy to make it waterproof by compressing the pond’s bed. A big amount of stones would have been necessary. But in the close area of the ponds, there were not enough stones available and the provision from a far distance would have been labor-intensive and not very effective to seal the ponds bed. Using foil was the better solution.
In Nepal there are no special pond foils (PVC or EPDM) available, like in Europe, America or Australia. So the project had to look for an alternative.
Silpaulin is a foil type, which is made out of woven heat-sealed HDPE and LDPE. It is widely known for its beneficial characteristics. It is 100% waterproof, immune to ultraviolet rays and chemicals, as well as long lasting (5 years guarantee). Produced in India and Nepal it was purchasable in Balaju (Kathmandu).

The influent flow is a black plastic pipe, which is part of the water pipe system in Kaule (see above)
The drain outlet would be also a pipe, running from the deepest spot of the pond through the ponds dam. The amount of water running through is simply controlled by plugging more or less plastic in the end of the pipe. This simple technique is being used by Jas Ram at his carp pond and works well. If he wants to drainage the pond completely he removes all plastics from the pipe’s end completely.

6.2 Realization

The width and length of the suitable building site was measured and land marks were set to point out the ponds shape. The work on the digging of the pond was carefully explained und maintained. Within several weeks all families were finished with digging the ponds beds and banking the earth for forming a dam. There was giving the indication to remove all sharp objects like stones and roots to prevent an injury of the Silpaulin. The ponds turned out to be bigger than planned (the families worked very enthusiastic) and new measurement of the width, depth and length had do be taken. Afterwards the amount of foil was calculated using the formulas:

1. length+2*depth + edging
2. width+2*depth + edging

After knowing what amount of Silpaulin would be needed, an order was given to a wholesaler in Balaju, who could get the wanted quantity and quality within one day for a reasonable price. The packages were delivered to Kaule with a local Truck.
7 Results

7.1. Damai Tamang

This is how the ponds bed of Damai Tamang looked like in September. All Stones, that have been found in the soil were moved out and randomly placed around the ponds edge. The pond bed was rough at several areas of the ponds wall and was stuffed with sharp stones that would injury the foil. Also bigger stones were still pocked in the wall, as you can see on the picture in the left side.

The ponds dam to the left side is round and it was difficult to walk on it.
By the time of December the ponds bed was cleared and the big stones, which were in the wall were removed. Still many parts of the wall is ragged and not suitable for the foil. It was given the advise to mix water with small grained soil and create mud an stuck it to the sharp areas of the wall to soften it. The left side dam was flattened and now is accessible easily. (Compare dam to picture above)

The spare stones were used by Damai Tamang to construct a wall on the slope downside of the ponds dam to prevent a collapse.
7.1.2 Nirmaya

Above one can see how Nirmayas ponds bed looked like in September. The hole was digged, but the ponds walls were not prepared for the foil.

Many parts of the wall were uneven and had sharp edges, which would injury the foil.
In December the volunteers of Kaule e.V. helped to prepare the subgrade. Mud was attached to the sharp areas of the walls, to flatten and soften them. Stones were collected and moved away.
A channel was constructed by the volunteers to prevent, that monsoon runoff from the terrace above would flow into the pond and lower the water quality. On the other hand no external soil would get washed into the pond.
After some final adjustments the Silpaulin got installed and fixed with stones at the edges. It was recommended to seal the edges of the foil with earth, so the wind could not lift it.
By the time of September Thirtas pond had many small stones and the bottom of the ponds bed was uneven.
In December the volunteers prepared together with Thirta the ponds bed, so the foil would not be injured by stones etc. The bottom got flattened and compacted.
As with the pond of Nirmaya after some final adjustments the Silpaulin got installed. It was made sure, that the foil was not pulled tight, so it would not rip, when the pond would get filled with water. Again, stones were used to fix the edges and it was recommended to seal the edges with soil.
7.1.4 Kumari

Rising groundwater filled the pond of Kumari in September. The ground has no major stones and is of a sandy and muddy consistence.
In December the pond was completely filled with groundwater. Even though it was dry season, the water level didn’t fall significant. So it was decided, that no foil would be needed at this pond. Kumari’s son installed an outlet pipe and it was given the advice to install an inlet pipe as well to create an constant exchange of the water body. This would rectify the water quality and would improve the growth rate of the carps.
8 Ideas for the future

8.1 Optimal water temperature

During the planning period I measured the water temperature of the water, which is going to be used to run the ponds. On this particular sunny day the water temperature of water, which had flown through the black water pipes was about 20 degrees. Directly at the water sources or in natural water streams the temperature was 2 degrees lower. So flowing through the black pipe heated the water up.

Carp's grow best and consume the most food on a water temperature between 20 and 28 degrees. To prevent landslides most of the ponds are surrounded by trees, which support the stability of the soil with their roots. Therefore sunlight doesn't touch the ponds surface all day and parts of the ponds are shaded. If future shows, that the water temperature in the pond is most of the time to low, the water could be heated up artificially before reaching the pond. To improve the growth rate of the carps, a removable intermediary section could be added to the existing pipe, before it reaches the pond. The black pipe, exposed to sunlight, would cause the water to heat up and support the optimal temperature of the water body. Picture 2 shows a simple technical solution for a solar collector, made by pupils and a teacher in a German school in Rottenburg. For installing at the farmers pond a technically
simpler and less fragile solution would be appropriate and can be considered for the future. An idea would be to simply hammer pins into a black colored board and adjust black water pipes in a meandering way onto it, just like one can see one the picture shown above.

8.2 Optimal oxygen content

In future it would be good, if an oxymeter (oxygen content measurement equipment) would be brought to Kaule to monitor the oxygen level in the water throughout the year. If the oxygen is considered to low, ideas should be developed how to enrich the water.

9 Quellen
