Chiang Mai, the capital of the former Lanna Kingdom of Northern Thailand, is a major tourist destination located some 700 km north of Bangkok. As it is about 10 hours by road from the nearest major seaport of Samut Prakan, tilapia, especially red tilapia, has become a major fish in city restaurants.

I was invited by Randy Bevis of Chiang Mai Aquatic Development Farm, and Walter Nigh of Logos Farms to visit their farms and those in the surrounding area in August, 2009. Chiang Mai Aquatic Development Farm was the only tilapia hatchery in the province and had been in operation for 12 years. They were under a social welfare foundation called the Northern Thailand Foundation for Enablement. One of the ways they helped local farmers was to create a subcontracting nursery farm system in which the farmers were provided with red fry and feed on credit and then Chiang Mai Pattana farm bought them back as large fingerlings as outlined below in the next section, and resold them to the cage farm industry mostly in the Ping River south of Chiang Mai.

Chiang Mai Aquatic Development Farm

This was the first tilapia hatchery established in Chiang Mai, by Randy Bevis based on a model developed at the Asian Institute of Technology following his graduation from the Institute in 1993. The farm occupied a total area of approximately 24 ha with two sites, one for breeding black tilapia and one for the reds. The market for black fry (2 cm) was larger than that for red fry but the reds made up the majority of the fingerling market. Graded red fingerlings were sold individually at Baht 3.5 for size 1 (38 individuals/kg), Baht 2.5 for size 2 (43 individuals/kg) and Baht 2 for size 3 (60 individuals/kg). Black fingerlings sold for less (US$1 = Baht 32 approximately).

Randy had set up a nursing network with neighbouring rice farmers to whom he sold fry and bought back fingerlings. Thirteen farmers owned a total of 60 ponds with most families having 3-5 ponds. A 600 m² pond was stocked with 25,000 fry which were nursed for 2.5 – 3.0 months. This required 35 sacks each weighing 20 kg of 32% protein pelleted feed costing Baht 500/sack. Farmers made a profit of Baht 7,000-10,000/pond. Financial assistance was provided to the farmers for a bad crop, which tended to happen every year in the cool season. Twenty percent of profits on profitable ponds were then applied to the debt from bad crops. Profitability had gone down in the last year or two due to new fish diseases and probably also due to declining water quality as the ponds were getting older.
Buy back prices were recently raised to try to help the nursery farmers do better and larger fry were being stocked as well.

**Logos Farms**

The farm had 14 1,000-1,200 m² nursery ponds and has since my visit last year constructed a small red tilapia hatchery. Tilapia fry were mainly purchased from Randy’s farm although also from Po Jalem Farm in Central Thailand and the Thai National Fishery Department in Bangkok and Khamphaeng Phet if the Chiang Mai Development Farm could not fill his orders. He bought 2 cm red tilapia fry and nursed them for 3 months before grading them into the three fingerling sizes and then sold them to pond or cage grow-out farmers. Tilapia fry are usually stocked at 35/m² in static water ponds in Thailand but Walter stocked at 50/m² as he aerated the ponds using roots blowers and superchargers through 10cm air-stones. Fertilization was initially done bi-weekly with a liquid commercial fertilizer of 12-38-0 at the rate of 1 US gallon/acre. However, pond fertilization had been discontinued for the past year because Logos Farms ponds became green naturally after pond preparation and filling with fresh water. The pond was prepared using hydrated lime, dried for about 2 weeks and was then filled with water following which the pond began to turn green within 24-48 hours. Fish were grown to a large fingerling size suitable for stocking grow-out ponds or cages of an average size of 25 g (range 15-30 g) in 2-2.5 months, 1.5 and 2 months growth in the cool and warm seasons, respectively, with 0.5 months for pond preparation.

A commercial 32% protein pelleted feed was used beginning from about 4 weeks of age, or when the fish were large enough to eat the small pellet. For the first 3-4 weeks the fry were fed a 1:1 mix of rice bran and 62% fish meal which provided about a 35 - 40% protein diet. The fish were fed at a reducing average body weight (ABW) rate of from 20% with the rice bran and fish meal diet down to about 5% ABW when the fish had reached about 20 g body weight. With all 14 ponds in full production, about 100,000-120,000 fingerlings/
month were produced although during the cool season this will drop by about 20%. Under optimal conditions it took only about 2 months to nurse a 0.35 g fry to a 30-35 g fingerling.

The farm was in the process of building a Christian Training Center where 1-2 month courses on small-scale fish culture would be available for current and future Christian Pastors, leaders and workers. Trainees would also be able to access loans and on-going support to establish their own fish farms on completion of their programme. This training programme should be available from mid-2011.

Walter who was a printer by profession was encouraged by Milton Coke, an American who works in development mostly in Bangladesh and has two tilapia hatcheries there, to develop the fish farm to provide a profitable base to support their activities. Randy advised Walter to set up a fish nursery as it is more profitable than grow-out. Walter told me that initially he thought that aquaculture would be easy as well as profitable but now he realized that it

Large black tilapia fingerlings being packaged for sale at Chiang Mai Pattana Farm.

Making hapas at Chiang Mai Pattana Farm.
is labour and management intensive, and with increasing incidence of disease in tilapia, also technically intensive. It is 'not just digging a hole, water, fish and feed' he lamented.

**Mae Khet Luang**

The village in San Sai district was the only major area in Chiang Mai with fish ponds. Although irrigated it flooded and so was ideal for conversion of agricultural land to fish ponds. There were about 80 farming households organized into three cooperatives which helped the farmers to work together to market their fish through middlemen and get standard prices. The lady farmer I interviewed outlined an interesting background history indicating several issues concerning the role and future potential of small-scale aquaculture. The family initially farmed rice but diversified first into cut flowers and then into aquaculture with their first three ponds dug 26 years ago. They took out a loan from the government Bank of Agriculture and Agricultural Cooperatives (BAAC) to become a contract chicken farmer to integrate the birds with the fish ponds. The major initial expense was construction of two bird sheds over fish ponds to house 5,000 birds/cycle. Following the outbreak of bird flu a few years ago the government banned integration of chicken/fish integration although it has since been allowed providing that the bird sheds are enclosed in netting to prevent entry of other birds. However, the lady farmer had not restarted chicken rearing as she said that she had a bad back. Her husband had a full-time off-farm job as a technician at a local factory. Neither of their two children was interested in farming, the son working in a bank after studying information technology and their daughter was still at university studying computer management. This interview illustrated the widespread phenomenon of small-scale farming households diversifying their sources of income, both on- and off-farm, and their children usually not wishing to follow in their parents’ farming footsteps.

To partially replace the chicken manure, 10 cattle were purchased and grazed on the pond dikes. The woman said that they had lost money on the cattle operation as well. They nursed their own fry using green manure and buffalo manure although transferring fish was said to be hard work. The husband, being a skilled machinist, had constructed a small-scale on-feed manufacturing plant and used a formula provided by the Department of Fisheries (DoF) to produce a feed with 18% protein containing cassava, rice bran, maize, soybean meal, fish meal, bone meal, leucaena meal and calcium phosphate. The feed cost Baht 250/20kg compared to Baht 300 for purchased feed. They still obtained the same farm production of 6-7 tonnes/crop as when previously integrated with chickens but the grow-out period from 2 cm fry to table-size fish increased from 8 to 10 months. Unfortunately, like most of the fish farmers in the area, the lady farmer was in debt to the tune of Baht 1 million, although most farmers had a more modest debt of about Baht 100,000.
Irrigation canal farms

The local government in Poh Thong Chalerm village in Doi Saket district provided 50 families each with one cage, taught them how to raise fish and provided them with fingerlings and one bag of pelleted feed. As the location was in an urban area, they were not farming households. Each household-level 2 x 4 x 0.8 m cage was stocked with 500 tilapia fingerlings. Fish attained inconsistent sizes of 0.3 – 0.5 kg as they were not fed regularly, due in part to families later having to buy their own feed. Unfortunately most of the cages were washed away by a flood with only about 12-15 remaining during my visit. Some of the fish were sold, Baht 80/kg for black tilapia and Baht 120/ kg for red tilapia, but mostly they were consumed by the households. The household I interviewed said that they were waiting to see if the local government would redo the project. At the time of my visit the level of the water in the irrigation canal was low, with the Department of Irrigation (DoI) releasing water twice/month. Cage farming in irrigation canals designed for agriculture may be constrained by insufficient or irregular supply of water.

Reservoir cage farms

Mae Ngat reservoir is a large reservoir in Sri Lanna National Park in which only a small number of farmers were allowed to operate by the DoI. There was also a high cost of Baht 100,000 investment to buy rights to farm in the reservoir. The farmer I interviewed used to be an engineer but won the lottery and bought the cage farm from his sister. Fry of 2 cm length purchased from Randy’s farm were stocked 4 months before my visit and would be harvested after another 2 months. Only 10% of the stocked fish were lost to disease. Because of recent widespread disease in tilapia fingerlings in Chiang Mai, reported to have been introduced from fingerlings imported from Central Thailand, the farmer expected to obtain a good price of Baht 80/kg. The fish would also be of high quality because of the excellent water quality in the reservoir.

Ping River farms

Cage culture of tilapia began on the Ping River about 10 years ago. Technology and loans were provided to farmers initially by BAAC who took potential farmers to see cage culture elsewhere, but subsequently Bangkok Bank and various projects helped farmers to develop cages. Most farmers were organized in groups, each related to an important person who was normally a village leader with connections. Most of the groups had arrangements with certain feed companies to provide feed on credit although there were also some individual farmers with larger scale operations who bought their own feed.

Aquaculture was a secondary occupation for most cage farmers with lam yai (longon fruit) orchards being the most common primary activity. Cages extended along the river for about 25 km with 6-7 households involved in each village from San Pa Tong to Chom Thong. At the peak there were

Nursing red tilapia fingerlings at Logos Farms.
about 4,000 cages but the number had declined recently due mainly to disease. According to the farmer I interviewed in Ma Kampom, Doi Loo area, there used to be 70 families with cages in his cooperative but there were only about 30 remaining with about 300 cages in total at the time of the interview.

Cage dimensions were 3x3, 3x6 and 4x4 m with a depth of 2 m. Fingerlings were obtained from Randy and Walter in Chiang Mai, Tong Chai (another nursery in Chiang Mai); and also from hatcheries in Central Thailand which were believed to be the source of the disease. Some farmers had ponds to nurse seed; and a few farmers also nursed in cages but the survival was poor. A total of 1,500 fingerlings were stocked in a 4x4m cage and harvested at 0.9-1.0 kg size. Mainly red tilapia were farmed. Fish disease started in April/May 2009 and in a single day all farmers lost about 70 % of their stocked fish. They restocked but up to 50 % of the stocked fish died over a 1 month period after stocking which was the reason why so many cages were not stocked with fish during my visit.
Lady farmer and her daughter who is studying computer management.

Cages in an irrigation canal.

Cages in a reservoir.
The farm-gate price for red tilapia had been static at about Baht 45/kg for many years but earlier in the year had risen to Baht 70/kg for the Ping River cages due to a shortage in the market although the price had declined at the time of my visit to Baht 60/kg. Black tilapia had a farm gate price of Baht 51/kg, again for a fish of 0.7-1.0 kg. Local people could differentiate between usually better quality cage-raised black tilapia and pond-raised black tilapia with a much higher chance of off-flavour as the former were much more plump in shape.

Barbecued tilapia

CP had established a franchise selling barbecued fish in the city of Chiang Mai. A sum of Baht 8,000 was required for an operator to start the business and be provided with a cart to barbecue the fish. Operators bought their own charcoal, vegetables and sauces. They bought red tilapia of about 1 kg size at Baht 60/fish and sold the barbecued fish at Baht 90, making a daily profit of about Baht 600/day from selling 20 fish.