

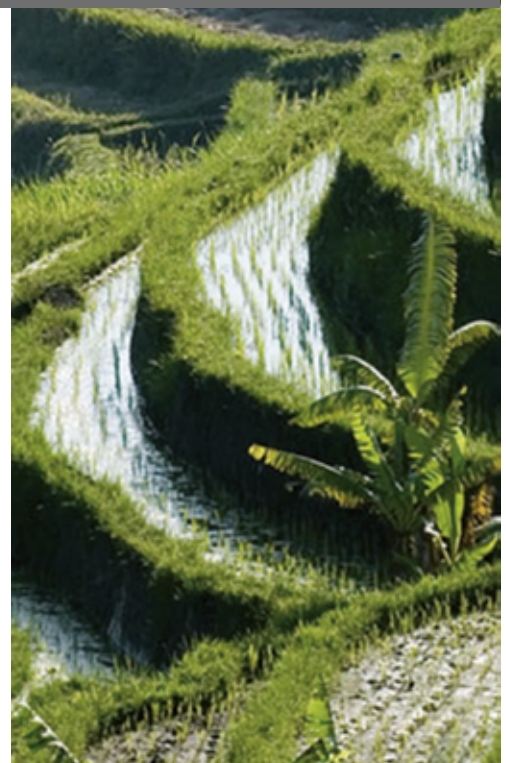
Transformation Processes in the Agri-Food Sector – the Case of Thailand

A study tour to Thailand
from February 28th to March 15th 2013

Report



**Thailand 2013
Interdisciplinary Study Tour**



Organised by:

German Institute for Tropical and Subtropical Agriculture – DITSL GmbH Witzenhausen
Group Animal Husbandry in the Tropics and Subtropics of the Universities Kassel and
Göttingen
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The University of Kassel in Witzenhausen and the University of Göttingen offer study programmes in the field of agriculture, resource management, environment, forestry, fisheries, food, nutrition and related sciences in the context of rural development, sustainable resource use and poverty alleviation with a regional focus on developing countries particularly in the tropics and subtropics.

Both universities build on a wealth of expertise on tropical land use systems and the sustainable management of natural resources. Many of the students interested herein will eventually conduct research in subtropical and tropical countries – often in the frame of their M.Sc. or Ph.D. theses. Their academic curriculum must prepare them for this task. It is obvious that even the best lecture at the university in a so-called „developed“ and temperate region cannot substitute the experience that is gained while visiting a tropical country. Therefore, field trips to tropical countries are a most desirable part of any such curriculum.

Scientists of the German Institute for Tropical and Subtropical Agriculture (DITSL) and the agricultural and forestry faculties of the universities in Witzenhausen and Göttingen maintain mutual research and academic training and networking activities and projects with Thailand universities and research institutes. Among these are Thaksin University, the National Science and Technology Development Agency (NSTD), the Pathum Thani Rice Research Center, and the Coastal Fisheries and Development Center.

The 2013 study excursion of students and lecturers from Witzenhausen and Göttingen

to Thailand was benefitted from these institutional linkages.

Particularly through its varied ecological zones and topography and diverse agricultural and forest landscapes, Thailand offers a wide variety of very interesting examples for small to large scale tropical agriculture and land use. It shows the different development pathways – all towards marked-oriented production and processing of agricultural and forestry products – which different parts of the sector have taken recently within the overall very rapid development of the national economy. These developments also offer insights into better and not so good land use practices, processing and marketing approaches at a regional, national and global scale, and illustrate the overall effects of globalisation on land use and the agricultural sector in a prominent and very dynamic South-East Asian country.

The excursion was preceded by a phase of intensive preparation. A seminar of two contact hours per week was held during winter semester 2012/13, where students presented different topics related to the forth-coming excursion.

Funds were acquired, logistics were organised and in March 2013, 23 students and 5 faculty members set out for Thailand. Acquiring funds for such a trip is difficult and we are grateful for generous financial support by the German Academic Exchange Service DAAD through the PROMOS program at Kassel and Göttingen University, the University of Kassel through the Faculty of Organic Agricultural Sciences in Witzenhausen and the International Academic Exchange Office, the University of Göttingen through the Faculty of

Agricultural Sciences, the Faculty of Economic Sciences, and the Faculty of Forest Sciences and Forest Ecology, the Foundation fiat panis Ulm, the Hochschulverband Witzenhausen e.V., the Freundeskreis Wilhelmshof e.V. Witzenhausen, and the German Institute for Tropical and Subtropical Agriculture.

From February 28 to March 15, 2013, we followed through a very interesting and physically taxing schedule. Every aspect of the programme moved exceptionally smooth, which was facilitated through the excellent support received from our partners, to whom we express our sincere gratitude.

We are very much indebted to Dr. Apron Songsang and Mrs. Thaniya Siriraks for her continued support and charming company throughout the trip! We would also like to thank our colleagues from Witzenhausen and Göttingen for their great support in preparing this trip. Finally, all participating students deserve a big “Thank You”. They worked hard to achieve the predetermined goals of this endeavour. But besides dealing with hard-core science we also had a lot of fun together. We really enjoyed this very memorable trip with all of you!

*Eva Schlecht
Andreas Bürkert
Christian Hülsebusch
Achim Dohrenbusch
Grete Thinggaard*

Introduction and Programme

From the Malaysian Peninsula in the South to the foothills of the Himalayan mountains in the North and from the Khorat Plateau in the East to the border with Myanmar in the West, Thailand hosts a variety of different ecological zones and agricultural and forest landscapes. The country's agricultural sector is still dominated by smallholder farmers, but this rapidly transforming towards being market- and export orientated. The forestry sector has become more responsive to environmental concerns and since the logging ban in 1989, Thai forest institutions have developed a policy framework linking forests, communities,

conservation and economic development. The 2013 excursion to Thailand focuses on such transformation processes.

Upon request of the organizers, the colleagues at Thaksin University in the South of Thailand, particularly Dr. Aporn Songsang, have developed a two week excursion programme including visits to a variety of producers, processors and projects, thus demonstrating the diversity from large to small scale, from intensive to extensive, and from private cooperative to public collective as per the itinerary below.

Day	Time	Activity	Location	Accomodat.
Friday 01.03.	07.00-08.00	Transfer from airport to hotel	Bangkok	
	08.00	Check in at Karnmanee Palace Hotel		Karnmanee hotel
	09.45	Departure for Thai Agro Exchange Co., Ltd.		
	10.30-13.00	Visit Thai Agro Exchange Co., Ltd. (Large wholesale market) Central Market of Thailand, for Agricultural Goods and Integrated Agro Industries of Thailand summary Dominik Berger	Phathum thani	
		Lunch		
Saturday 02.03.	14.00-16.00	Visit the Royal Grand Palace	Bangkok	
	07.00	Breakfast		Karnmanee hotel
	08.00	Departure for Charoen Pokphand Food (CPF) Co., Ltd.		

Day	Time	Activity	Location	Accomodat.
Saturday 02.03.	09.00-12.00	Visit Charoen Pokphand Food (CPF) Co., Ltd.: Chicken Processing summary Julian Plagemann	Bangkok	
		Lunch		
	13.00	Departure for Thai Orchids Co., Ltd		
	14.00-17.00	Visit Thai Orchids Co., Ltd. (laboratory and packing) summary Katharina Zipp	Bangkok	
	19.00-22.00	River Cruise Dinner on Chaophraya River		
Sunday 03.03.	06.30	Breakfast		Karnmanee hotel
	07.00	Departure for Crocodile Farm		
	09.00-12.00	Visit Crocodile Farm summary Katharina Stanzel	Sriracha / Chonburi	
		Lunch		
	13.00	Departure for Bangkok		
Monday 04.03.	14.30	Leisure time / Visit Weekend market (Jatuchak market)		
	07.00	Breakfast		
	07.45	Departure for National Science and Technology Development Agency (NSTD)		
	09.00-12.00	Visit National Science and Technology Development Agency summary Weilong Li	Pathum Thani	
		Lunch		
	13.30-16.30	Pathum Thani Rice Research Center summary Francisco Mourino	Pathum Thani	
	16.30	Departure for Dermbangnang-buach / Suphanburi	Suphanburi	
	18.00	Check in at Planta Avenue		Planta Av.

Day	Time	Activity	Location	Accomodat.
Tuesday 05.03.	07.00	Breakfast		
	08.00	Departure for Charoen Pokphan Co., Ltd.		
	08.30-12.00	Visit Charoen Pokphan Co., Ltd.: Rice grain processing, packing and quality control summary Oda Reese	Dermbang-nangbuach / Suphanburi	
		Lunch		
	14.00-17.00	Visit Wangkanai group: Sugar cane plantation and sugar production summary Frauke Ahlers	Au-thong / Suphanburi	
	17.00	Departure for Dumnernsadeuk / Ratchaburi	Dumnernsa-deuk / Ratchaburi	
	18.30	Check in at Maikew Dumnern Resort		Maikew Dumnern Resort
Wednesday 06.03.	07.00	Breakfast		
	07.30-08.30	Visit indigenous marketing system (Floating market) summary Kristin Hentschel	Dumnernsa-deuk / Ratchaburi	
	09.00-15.00	Visit Vegetable production farmer, visit fruit production (Grape production / canal irrigation) farmer summary Clessio Gomez da Silva	Dumnernsa-deuk / Ratchaburi	
	15.30-17.00	Visit Thai Orchids Co., Ltd.: Orchid farm summary Katharina Zipp	Dumnernsa-deuk / Ratchaburi	
	17.00	Departure for Hua Hin / Prachuab Khiri Khan		
	18.30	Check in at Borfai Air Force guest house		Borfai Air Force guest house
Thursday 07.03.	07.00	Breakfast		
	08.00	Departure for Siam Agro-Food Industry Co. Ltd.		

Day	Time	Activity	Location	Accomodat.
Thursday 07.03.	08.30-12.00	Visit Siam Agro-Food Industry Co., Ltd.: Pineapple production and processing summary Isabel Pleisnitzer	Pranburi / Prachuab Khiri Khan	
		Lunch		
	12.45	Departure for Kui Buri National Park		
	14.30	Visit Kui Buri National Park (Human and Wild Elephant conflict) summary Andrea Bähringer	Kui Buri / Prachuab Khiri Kahn	
	18.00	Check in at Kui Buri National Park guest house		Kui Buri National Park guest house
Friday 08.03.	07.00	Breakfast		
	07.30	Departure for Coastal Fisheries and Development Center	Pranburi / Prachuab Khiri Kahn	
	08.30-12.00	Visit Prachuab Khiri Khan Coastal Fisheries and Development Center and Small scale shrimp production farmer (Shrimp farm Cooperative) summary William Nelson	Mueng / Prachuab Khiri Kahn	
		Lunch		
	12.30	Departure for Queen Sirikit Sericulture Center		
	14.00-16.30	Visit for Queen Sirikit Sericulture Center summary Jonas Ehls	Thasae / Chumporn	
	17.00	Check in at Chumporn Cabana Resort	Pateiw / Chumporn	
	19.00-20.00	Informal discussion with Chumporn Cabana Resort representative: How to run tourism under the sufficient economy perspective		
Saturday 09.03.	07.00	Breakfast		
	07.30	Departure for Crab Bank		

Day	Time	Activity	Location	Accomodat.
Saturday 09.03.	08.00-09.30	Visit Crab Bank summary Kristin Hentschel	Pateiw / Chumporn	
	10.00-11.30	Visit small scale banana processing group and roadside marketing summary Manuel Toledo	Thasae / Chumporn	
		Lunch		
	12.00	Departure for coffee production and processing farmer group (SME)		
	13.30-17.00	Visit Khao Thalu Coffee production farmer group: Coffee production and processing summary Mareike Decker	Sawee / Chumporn	
	18.00	Check in at Chaiya Resort	Chaiya / Surat Thani	Chaiya Resort
Sunday 10.03.	07.00	Breakfast		
	07.30	Departure for Agro forestry / rubber production		
	08.00-11.00	Visit agro forestry (rubber with other crops) farmer summary Valerie Kersting	Thachang / Surat Thani	
		Lunch		
Monday 11.03.	14.00	Check in at P.N Mountain resort	Ao-Luek / Krabi	P.N Mountain resort
	07.00	Breakfast		
	07.30	Departure for Univanich Co., Ltd.		
	08.30-12.00	Visit Univanich Co. Ltd.: Oil palm plantation / Palm oil production summary Thomas Eickel	Praipraya / Krabi	
		Lunch		
	13.00	Departure for Thaksin University		
	15.00-16.30	Visit Thaksin University / University farm	Phatthalung	

Day	Time	Activity	Location	Accomodat.
Monday 11.03.	18.00	Check in at Thale Noi Non hunting area / Thale Noi wildlife Conservation Development and Extension Station	Phatthalung	Thale Noi Station
Tuesday 12.03.	06.30	Breakfast		
	07.00	Departure for Dairy Cooperative	Phatthalung	
	07.45-12.00	Visit Dairy Cooperative /small scale dairy farmer summary Dirk Landmann		
		Lunch		
	13.00-14.30	Visit Goat production integrated with tree cropping	Phatthalung	
	15.00-17.00	Visit indigenous rice production and processing farmer group summary Lea Strub		Thale Noi Station
Wednesday 13.03.	06.00-08.00	Visit water fowl national park and Buffalo production in natural wet lands summary Dominik Ganser	Phatthalung	
	08.00-09.00	Breakfast		
	09.00-17.00	Visit Home gardening Integrated production system Small scale farmer: Rice farming/duck egg production in rice field / Organic rice production and processing summary Kristina Grotelüschen	Phatthalung	
Thursday 14.03.	07.00-11.00	Visit Palm sugar production group summary Alli Kamalanathan	Songkhla	
	20.15	Departure from Hadyai Airport to BKK	Songkhla	
Friday 15.03.	23.40	Departure from BKK to Germany		

Talaad Thai wholesale market

Dominic Berger

The Thaalad Thai is a wholesale market located outside of Bangkok and administered by Thai Agro Exchange Co. Ltd.. The Talaad Thai wholesale market is the main channel for agricultural goods and commodities to Bangkok and for international imports and exports for regional and national products both domestically produced and imported. It is located less than 50 km outside of Bangkok and can be reached via the ring road of Bangkok, enabling suppliers and customers to avoid the crowded roads of Bangkok when travelling to the market. It is the biggest of six major agricultural wholesale markets around Bangkok. The area of the market covers 80 ha and is opened 24 hours every day of the year. Beside the major agricultural products and deep-frozen foods, also non-food commodities such as cars and bikes are traded here. The market consists of 20 different zones, which are mainly named after the commodities that are traded. The whole private section is owned by the Thai Agro Exchange Co. Ltd.. The company does not trade itself but provides the land, infrastructure, and facilities necessary for the functioning of the market.

Upon arrival we were welcomed in the bus by the representative of the company, Setthapas Choobut, who introduced himself as Ken. Due to the big size of the market area and the limited time of our stay, we visited only 5 of the 20 zones. The visited sections were mixed fruit, orange market, vegetables, cold-weather vegetables and fish.

Financing and methods of payment

Thai Agro Exchange Co. Ltd. creates its income by offering different services. On the one hand, some areas are rented to companies, which provide services, such as packaging of commodities for export which require special packaging. On the other hand, sellers pay rent for their permanent stand on the market via invoices and monthly bank transfer. Moreover, the company provides services for unloading of trucks and distribution of goods to the individual stands against a fee.

The sellers are producers, representatives of cooperatives or collectors, who buy the products from small farms and act as intermediaries.

Small-scale farmers sell their products on three commercial grounds directly from their trucks. They do not have to pay regular rent but a fee when entering the market. Incoming trucks have to pay a fee, which is set by the number of tires the vehicle has, e.g. 200 Baht for 4 wheelers and 250 Baht for 6 wheelers, regardless what is transported on the truck. This is only relevant for vehicles bringing goods to the market, as buyers generally do not have to pay anything for using the infrastructure. Buyers that use the market are exporters, restaurants, households, resellers, and shops.

Mixed fruit

The mixed fruit section covers 1.3 ha. Products are sold by 1,600 permanent stands. All kinds of fruits are offered, 60% origi-

nating from all regions in Thailand and around 40% being imported. Fruits are mainly imported from China and Australia, depending on the season. At the time of our visit most imported fruits, such as strawberries, came from Australia. Around 60% of the imported fruits come by boat from China, 30% over the Mekong River and the other 30% over the ocean. Some varieties, such as Papaya, are not domestic in Thailand but are commonly available and increasingly cultivated due to shifting demand patterns in Thailand. The local and imported fruits are distinguishable by packaging and offered in separated areas.

The peak time of market activities is in the afternoon and evening from around 4 pm to 9 pm, when the majority of buyers come from Bangkok to get their stocks for the next day. During nighttime, morning and midday, sellers distribute their goods and prepare them for marketing and further transport. The stores are mainly staffed by women, whereas the transportation of goods by carts is done by men.

Thai Agro Exchange Co. Ltd. controls product standards and quality by using different methods. There is a laboratory run by Thai Agro Exchange Co. Ltd. for post-harvest control and daily random quality checks are carried out. Furthermore, the company controls the growing conditions of the products throughout its grower network and certifies the quality with their own label, assuring the fulfillment of good agricultural practices. The participation in the grower network is beneficial for farmers, because the number of intermediaries is reduced and products are directly sold by farmers on the market.

Orange market

The orange market got its name as it was solely used for the marketing of oranges. Nowadays bananas dominate the area, laid out on the floor in shrubs. Oranges are not traded anymore because most farmers changed their production from oranges to bananas or other crops to cope with deteriorated soil conditions and increased soil pollution caused by the monoculture management of orange plantations. This production system led to a decrease of quality and yields. On the orange market there is a special area for high-quality products, mainly targeting special customer groups, such as hotels and restaurants, which require a special quality for their services.

The contact between buyer and seller is direct and prices are negotiated on the spot. There was an attempt to introduce an auction system in which goods are auctioned over half a day. The attempt failed as sellers did not accept the required waiting times, because they aim at selling their goods as fast as possible in order to return to their farms or resume business. Most sellers operate fully competitive; prices are not set by the buying companies but individually bargained between seller and buyer.

Many exporters change from buying the products on the market to directly contracting farmers in order to get the products delivered to their compound. But in case of supply deficits, exporters still use the market to complete their contingents.

Although Thai Agro Exchange Co. Ltd. provides storing space for rental, most products are not stocked but sold and collected the same day of delivery to the market.



Bananas of different colours.

Vegetable market

The vegetable market is not only a wholesale market but also a retail market, where goods can be bought in small quantities directly from the producers (this is called garage sale).

Beside vegetables known in Europe, such as asparagus, there is also a wide variety of vegetables offered, which are not commonly used in the European kitchen (e.g. banana flower). Asparagus is not a domestic vegetable but increasingly cultivated due to increasing domestic and international demand. One part of the vegetable market is called the chili and spice zone, where many varieties of spices, such as ginger and pepper, are sold. In this area also exotic things, such as insects, can be found. They are caught in nature or grown on farms and consumed fried and lightly salted as a snack.

In general, many vegetables are imported from China to close the gap between a decrease in local supply and a constant demand. Local supply decreases as vegetable production requires a higher labor input than fruit or other crop production and therefore many farmers shift their production to less labor intensive products.



Market hall.

Cold weather vegetables

Cold weather vegetables can only be grown in the north of Thailand due to the colder weather conditions; therefore around 50% of the offered commodities are imported, especially from China. The local demand exceeds the local supply by far.

Fish market

On the fish market different animals are traded, many of them are sold alive, offering an uncommon sight for European visitors. Beside different types of fish, snails, frogs, and eels are sold and killed here for further sale to restaurants, households, and shops. Many of the smaller animals are not used for food preparation but are being released into nature according to traditional and spiritual beliefs to relief the person, who sets the animal free from stress, mental illness or other problems. Frogs are used for food purposes as they are common in the Thai cuisine, especially in papaya salad or fried. They are raised in special frog farms.

Charoen Pokphand Food (CPF) Co. Ltd. chicken processing plant

Julian Plagemann

After a short introduction by the production manager of the processing plant and two representatives, we saw an advertisement video about the structure and activities of the CPF conglomerate. CPF is an agro-industrial company that belongs to the multinational CP Group. It was founded in 1921 by Chinese immigrants, employs 280,000 people, invests in 15 countries and generates 33 billion \$US annually with an uprising trend. The CP Group is a private company owned by the Chearavanont family and operates in the following branches: automotive, crop integration, feed ingredient trading, international trading, information technology, pharmaceutical, pet food, plastics, property development, retail, seeds, fertilizer, plant protection, telecommunication, and financing.

The company is private, the Chairman is Dhanin Chearavanont, who is considered to be the richest Thai. CPF is the biggest company on the Thai food market, holding a share of 60% of the whole market value. Its structure is characterized by an intensive vertical integration of the value chain, starting with the agro-industry over food processing to retail-business and redistribution. More than 6,800 7-Eleven shops throughout the country were introduced by them. The company runs an "all in one hand" policy to control and standardize all production steps. Major objectives seem to be food quality and food security, guaranteed by newest technology, industrial production and high integration. They provide the contracted farmers with personal training, farm infrastructure like stables, feedstock, production facilities, and technical assistance, as well as livelihood

improvements and other support. The agricultural production includes fruits, vegetables, rubber, oil palm, and rice. A few days later we visited the Royal Umbrella Rice-Mill, which also belongs to CP. They do their own breeding and develop their own processing and production technology.

After the introductory video, we had a short guided tour through one visitor corridor. After the tour we came back to the conference room, where we could ask questions and discuss.

On the tour we saw several production stages of the slaughterhouse through glass windows. We got insights of the crumbing, cocking, cooling and packing process of chicken. The production plant is divided into three security levels and has eight parallel production lines. Two of them are producing halal meat using electroshocks for paralyzing the animals. The meat is still being exported to Europe, where a discussion is ongoing, if this practice can be considered as halal.

The high risk zone was located behind the cooker. On the production lines chicken wings and crossies are produced by roasting, steaming or frying. Some are sorted by color and size. The inside temperature of the production facilities have to be below 12°C. Depending on the product, the processed parts stay about 30 min. in a freezer (-45°C) to freeze them to -18°C. Then they get vacuum packed and stored at -20°C. Up to 2,000 t of chicken and 50 t of duck can be processed per month; the capacity is used with about 1,500 t per day. The factory relies on 20 farms, where any of them contributes with 10,000 chickens

per day. The breeding length is 45 days. About 200,000 birds are slaughtered per week. The work is organized in two shifts of 8 hours, six days a week. After each shift, there is a four hours cleaning break. Workers can change shifts and get trained by CPF. They receive three-year contracts and the official minimum wage of 300 Baht per day and 14 days of vacation. They get hired on the labor market via employer groups. 50% of the workers are female. Unfortunately, they did not want to give any information about the contract bindings between CPF and the farmers. 1,500 people are employed in the factory we visited. There are other bigger factories around, one with about 5,000 and another with 2,500 employees. The production is following international standards of GMP, HMCCP, BRC, ISO

9001/14001, Animal Welfare Pact and OHSAS 8001, in order to fulfill import requirements, for instance of the EU market. In the next months they will install new technological equipment. Within three years they want to come up with new products and during the next five years they want to develop functional food (health food).

Japan and UK are the main markets and 40% of the products are exported to the EU. 90% of the processed ducks is exported to Germany, where they hold a share of 50% of the market, having four competitors. The intensified production structure and the impact of the company's policy on development aspects had a continuing effect on our group and was further discussed during the bus ride and in a discussion one day later.



CP Chicken farm.



Production-unit for chicken wings & nuggets.

Thai Orchids Co. Ltd.

Katharina Zipp

Breeding laboratory and packing

First some general items on orchids: As Mr. Dohrenbusch told us, orchids are the second biggest family in flowers (the biggest is *asteraceae*). The number of species is discussed (15 to 30,000) because there are many varieties and subspecies. The name *orchideae* reminds to the Greek word for testis because the root tuber looks like a testis and there is no primary root system. Orchids can grow on the ground or in stony areas, but most are located on trees. This is advantageous for the flower because they get more sunlight, but water is rare.

The general manager of the Thai Orchids Cooperation, Mr. Sittichai Boonchujarad, offered us a warm welcome and showed us around. The private company is the number five of orchid producers in Thailand and this country is the biggest producer of orchids worldwide. The wife of the company owner grew up on a farm, where oranges and orchids were produced and after the marriage they specialized on orchids and started breeding. There are two farms with about 6.4 ha in total, which deliver orchids to the company and they contract some other ornamental plants like bamboo, Ziniberzumber, Habana cigar and *Euphorbia lacteal*. Production is only for export, and the different regions require different products: 45% to USA (dark colors and purple), 35% to EU (pink and white) and 20% to Asia (pink). Also a small amount goes to the Middle East (white). Mainly cut flowers are sold, for example to hotels. But also plants in pots are exported and small orchids in glass bottles with media are delivered to the airport as souvenirs. There are three orchid spe-

cies with different varieties. They tried also to produce in China, but were not satisfied with the size of the plants and number of flowers per plant.

Reproduction and breeding process

Twenty people work in the laboratory of Thai Orchid Co. reproducing about three million plants per year. The plants are sexually multiplied without use of UV light or radioactive substances. No hormones are used to avoid mutations. By using tissue culture, orchids can also be reproduced vegetative. The excise and lateral bud of a young shoot of a selected plant is cut and cultivated for two to three months in liquid media, which contains extracts of banana, coconut, and potatoe. In this time every two weeks a subculture is taken. After that protocorm proliferate from the bud. The number of protocorms multiplies during two to three months in liquid media induced by shaking. The liquid media is exchanged every two weeks. After that time protocorms are transferred to solid medium in glass bottles, where they grow in two months to small plants and after additional two months to larger plants, which are ready to go to the nursery. Out of one bud 5,000 to 10,000 plants can be gained. The most important step in this process is the selection of the plant where the bud comes from. Selection criteria are size of the flowery stem, number of flowers at the stem, health, and general appearance.

Generative reproduction in nature is very poor because only 0.0001% of seeds germinate. For breeding also liquid media is used to increase germination to nearly 100%.

Blue orchids are no product of breeding but of coloring. When white cut flowers absorb blue colored water the blossoms turn to blue.

Potted orchids, which can be bought in shops in Germany, are about six years old. Because of this long time span from selection until the product reaches the consumer, the breeder cannot react flexible to changing consumer demands. But this seems not to be a big problem, because there is a general stable demand in classic fashions and new creations only increase export. The breeder is the trend-setter and in Thai Orchid Co. every month a new variety is created. But not all of them reach the market. Customer surveys are carried out frequently and every year the orchid export association organizes a competition for orchid breeders, where consumer demands are reflected.

Orchid packaging

50 people, mainly women, with an average age of 21 years work in the packaging. They earn 300 baht for an 8-hour shift. Cut flowers are delivered in cooled trucks from the farms. The flowers are sorted by the appearance of the blossoms: symmetry, brown dots and damages. Rejected flowers are sold in a lower grade. Moreover, flowers are sorted by size (S, M, L). Then lowers are put in little vases filled with water and glucose, bunches are made and packed in plastic sheets. Several bunches are packed in cardboard boxes, which are fumigated with methylbromide gas to prevent for instance the delivering of insects in hotels of foreign countries. This gas is the only possible treatment for cut orchids because it is effective in a short time. The bunches are then repacked to smaller boxes which are delivered with a cooled truck (15 - 20°C) to the whole seller. The

time span from cutting of the flower until it is in a shop in the USA or EU is about two days. The production is ISO certified.

Orchid farm

Duangporn, who studied horticulture and now is supervisor of one of the ten zones of the orchid farm, showed us how orchid production works. Every zone has its supervisor and about 130 people work in the production. Mainly women apply for work but there is no special preference for female workers. They earn 300 Baht per day. The farm area covers about 50 ha where 80% dendrobium and 20% mokara orchids are grown. The fields are covered with nets for 60% sun protection. Orchids for cutting and potting and sansevieria are produced. Cut flowers are more profitable than potted flowers.

The breeding and packaging is located in Bangkok because of better provision of fertilizer and technical services. But in two to three years, the breeding and packing section will move to the orchid farm Duangporn because there will be a flyover constructed and the company wants to expand.

Plants for nursery are delivered by the breeding section. The about one year old seedlings are transferred out of the glass bottles to coconut mesocarp, which is used because it is cheap and has a good water holding capacity. Every morning plants are sprayed with water. After one month liquid fertilizer is applied. Nursery takes six to eight months. Then plants are transferred to bigger pots with more coconut substrate. According to the variety some plants for cutting are transferred to quarter of whole coconut husk, some are in containers (five plants per container). Flowering starts after additional 8 to 12 months and lasts for four years with a peak in the second and third



Orchid farm worker.



Orchid packing.



Plant propagation.

year. Flowers are cut when at least five blossoms of the flowery stem are open. Every plant has one big stem with five to ten flowery stems per year. If there is no flowery stem any more developed, the big stem remains for photosynthesis. After four years of cutting, plants are sold in containers or exported to China, where an extract is gained from orchids for traditional medicine. We observed some black dots on the leaves of orchids for cutting, which is a fungus. But this is not a problem until the production does not decrease. Workers cut the flowery stems when they have at least five open blossoms, bind ten together, and put them in a box situated on the main walkway. Cut flowers must be packed dry, clean and firm in boxes for transport to prevent them from being damaged.

In general, fertilizer and pesticides are sprayed once a week. Fertilizer contains NPK, micronutrients and the plant hormones auxin and cytokinin. Insect monitoring is done by using yellow trapping cards. But at the time of our visit they were dry (meaning that they were old), an indicator that the monitoring was not carried out in that moment. Fungicides, insecticides and fertilizer are ap-

pied through tubes with connectors for sprinklers. There was a discussion about ground water contamination caused by the treatments, but this seems not to be a problem because the pesticides can be applied precisely. The water, which runs through the canals of the orchid farm, goes into a fish pond. This was taken as an indicator that the content of pesticides in the water is not too high.

Some vegetative reproduction is done with shoots because it is faster than using tissue culture. Breeding plants are grown in a charcoal substrate in order to prolong their live. Breeding plants are selected at an age of 4.5 years and then are kept as long they are useful.

As currently there is no demand for organic orchids, the company has not implemented organic cultivation, although it would be possible in a closed system (glass house). The farm also produces the succulent species sansevieria which is mainly exported to the Netherlands. It is grown in pots until a height of 30 to 50 cm. Then it is cut and dipped in a hormone which induces rooting. Six stems are planted together in coconut mesocarp and braided.

From egg to belt – Crocodile production in Chon Buri

Katharina Stanzel

Worldwide there are 22 different crocodile species existing and the two major groups of them are freshwater and saltwater, i.e. brackish water crocodiles. All of them are listed on the CITES appendix I and II, i. e. they belong to the endangered species and thus trade regulations are in power. Those trade regulations require the farmer to acquire an export permit, a special certificate which also includes tagging the skins with individual numbers in order to trace the skins back to the individual crocodile. On the first Sunday of our interdisciplinary study tour we were fortunate to meet Prof. Aporn's cousin and crocodile farmer Suwit Srinna in Sriracha district in Chon Buri, which is located Southeast from Bangkok. As most of the group never had seen how crocodile production looks like and particularly because Suwit Srinna was extra-ordinarily eager to not only familiarize us with the production but also later on to show the group his close-by crocodile belt manufacture, this farm visit was, in terms of knowledge gain and the farmer's time spent for the group, more than we all expected.

General facts on crocodile production

Crocodiles have a natural life span from 70 to 100 years, meaning that crocodiles reach maturity at a rather late age, which is around 15 to 17 years depending on the body weight. Generally, it can be said that as soon as they reach 3/4 of the adult body weight maturity is triggered. Two types of crocodile production are practiced; either it is ranching where eggs are collected in the wild and after hatching the animals are raised on farm, or crocodile farming, which inclu-

des breeding on farm. Products coming from crocodiles are skin and meat which basically is a by-product, but healthy for human consumption because it is low in cholesterol. Crocodiles are fed with fresh byproducts from the slaughter house or with fishery waste. It is necessary to feed the animals with animal protein since especially alligators are not able to digest plant protein and they have a daily demand of 40 to 50% of protein. Besides the fresh feeding, commercial farms in Australia also use feed pellets. In captivity, the feed efficiency of 80%, which can be reached in the wild, is normally not achieved. Regular feeding and a faster digestion lead to a feed efficiency of 20 to 40% on farm, whereby the higher efficiencies are achieved by adding kaolin to the feed. When producing crocodile skin the housing has to be designed in a way that the skin quality will not be affected negatively by the housing and the stocking density needs to be adequate to avoid fighting. Other threats to skin quality are fungal and bacterial diseases. The skin usually is traded internationally when of flawless quality. Best quality skins belong to category A, meaning without any disruptions in the four quarters of the central parts of the skin. While the soft belly parts are processed to handbags and shoes, the back parts are used for belt production.

Suwit Srinna's crocodile farm

As one of the major attractions in the region of Chon Buri, the "Sriracha Tiger Zoo" is home to many different animal species and also responsible for conservation programs of those being endangered. Working at this zoo, Suwit

Srinna and his colleagues were so successful in breeding crocodiles that they needed more space for the crocodiles. That was when he decided to practice crocodile farming. By inviting neighboring farmers to his production sites, he was able to minimize their initial safety concerns. Starting on his own with some young animals from the zoo, at the time of our visit he was successfully running the business for five years already, now with his own 2,000 breeding animals and 60 employees.

Production

On his farm the crocodile rearing is divided into two major stages: breeding and fattening. The breeding stage is practiced on around 2 to 3 ha on his main farm close to the Tiger Zoo. On this particular production site the breeding crocodiles mate, eggs are collected and hatch. After hatching the young animals are kept in basins until they are transferred to his second production site at the age of five years. His larger second farm is the site where the crocodiles are fattened; first in groups for about two more years and finally for one more year in single bays.

We were shown the breeding animals first. They all were in the same age (i. e. 18 years) and kept in an enclosure which consisted of a pool where mating takes place, a concrete area, where animals rest and an area where straw is spread to

provide the female crocodiles with nesting material. Suwit Srinna explained that at the age of 6 his crocodiles can already be used for breeding, the so-called "young breeders". To keep the aggression during the mating period as low as possible and to prevent hurting, two major factors have to be considered. On the one hand, the water has to be exchanged every three months, and on the other hand, the optimal ratio of male to female animals has to be at 1:3. Asking for his breeding strategy, the farmer answered that he was not practicing any pedigree based breeding program. The stocking density he has in this area is 2 m² per animal. Every two days the breeding crocodiles are fed with 2 kg of chicken meat that is enriched with vitamins and which comes from two different slaughter houses. In the past he also tried to use pelleted feed – without success. As a possible reason he mentioned that he started feeding pellets to the animals at a too late stage and thus the animals would not accept any other feed apart from the one which they were used to. Every day a team of two people enters the breeding area and while one is taking care of the adult crocodiles the other person collects the eggs which are buried in the sandy soil beneath a straw cover. The upside of the egg has to be marked, if it is fertilized. If it was turned upside down later, the small crocodile would die. Of all eggs



Egg collection.



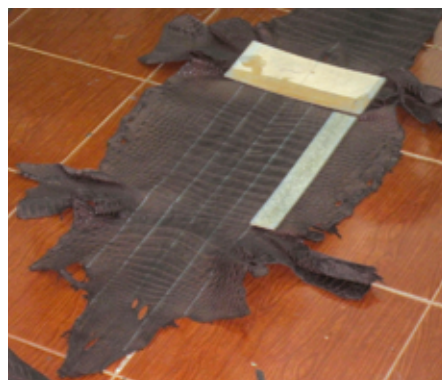
Egg cleaning and disinfection.



Egg hatchery.



Crocodile skin storage.



Skin with marked strips for belt production.



Crocodile skin belts.

collected 40% are fertilized, which is recognized by a small white stripe shimmering through the egg shell. The other 60% is sold for consumption. After the collection, the eggs are first cleaned, disinfected and numbered before bringing them to the hatchery.

The temperature in the hatchery ranges between 28 and 30°C, a temperature at which mainly female animals hatch. Suwit Srinnaan prefers female animals for fattening as they are less aggressive than male crocodiles. Asked for the mortality rates, he stated that the crucial age is one to two months and that the mortality during that phase is around 5%. Later on, problems of diseases can be minimized by optimal water management and feed quality. Those two aspects are also checked regularly by the fishery department. 20% of all eggs collected finally hatch and the small animals are brought to small tanks. After one month they are moving to a bigger one until they are finally put into a large compound with a concrete area and a pool where they stay for about three years. To show us where the older crocodiles are fattened later on, he took us to his second production site where the crocodiles first live again in groups together, being differently sized. According to the farmer, reasons for the different size are of genetic and

hierarchical origin. After two more years they are finally kept in single bays to minimize the skin damage. It is then when he sprinkles the animals with water before feeding, because he found out that the humidification contributes to a less aggressive behavior of the crocodiles.

Processing

Suwit Srinnaan does not only breed, raise and fatten his crocodiles but he also has an own slaughter house, a storage facility for the skins and a manufacture for the production of crocodile leather belts. Additionally to the processing of his own animals, he has contracts with several other crocodile farmers, who buy his small crocodiles and bring the fattened animals back to his farm for processing. At the age of 8 to 10 years all the animals which are not used for breeding, are firstly immobilized by an electric shock and mouth binding. Within 10 - 15 minutes the animals have to be transported to the slaughter house where the blood is drawn out and the skin is separated from the meat. On average, 60 crocodiles are slaughtered per day. While the meat is sold, the skin is put into a storage house where it is covered with salt.

This salt treatment lasts for at least seven days in order to prevent post-slaughter microbial damage. Before shipment, the

skins are tagged according to regulations. Skins, which are not meeting international quality standards anymore, e.g. due to disruptions, are still being used for the production of crocodile belts in Suwit Srinnaan's belt manufacture. Out of one crocodile skin six belts are made. After the six strips have been cut out of the skin, each one is glued to an equally sized strip of buffalo skin, which is providing the belt with a higher stability. After polishing and adding the belt buckle, the final product is sold.

Marketing

Product marketing is regulated by contracts. For meat he has a five years contract and for skins and leather a three years contract. According to Suwit Srinnaan the reason why he is not tanning the skins on his farm is that the technologies in Thailand are much less competitive as those used in Singapore.

The skins are sold as a high value product to international markets, mainly to Singapore and Italy, at a price of 8,000 to 9,000 Baht per skin depending on the quality. A crocodile belt is sold for 2,000 Baht either to local people or to tourists, who then will still have to apply for an export certificate in order to take the belt home legally. The byproducts meat, eggs, blood and bones are being marketed as well. For one kilogram of meat he receives 1.50 Baht and 60 Baht per crocodile egg of which the majority is sold to Chinese costumers. The blood and bones are sold as fish feed or for medical purposes.

Future

At the moment Suwit Srinnaan is starting to crossbreed salt- with freshwater crocodiles to make use of specific traits. Saltwater crocodiles show a higher feed intake and grow faster, and freshwater crocodiles are better adapted to Thai conditions. Still it is not much known to keeping saltwater crocodiles in Thailand and he wants to find out more about advantages and disadvantages especially of the hybrid breed.

National Center for Genetic Engineering and Biotechnology (BIOTEC) in the Thailand Science Park

Weilong Li

Introduction of BIOTEC

BIOTEC, founded in 1983, is a member of the National Science and Technology Development Agency (NSTDA), which is an autonomous government body under the umbrella of the Ministry of Science and Technology. 70% of the 560 staff in BIOTEC conduct research and 160 of them possess PhD degrees. Mainly relying on funding from the government, BIOTEC usually gains its research agenda from the Ministry of Science and Technology. BIOTEC consists of multiple functional units, such as research units, collaborative research units, business development units, administrative units and others. Emphasizing industrial applications of biotechnology, the business development units of BIOTEC deal with issues concerning patenting, licensing and collaborative as well as commissioned research with the private sector. Meanwhile, the research units of BIOTEC have four thematic research programs: Agriculture and Food, Health and Medicine, Energy and Environment, and Bio-resource Conservation and Utilization.

Community development project: Science in Rural Schools (SiRS)

SiRS, conducted by BIOTEC, is one of the community development projects aiming at the transfer of appropriate technologies to rural communities in Thailand. SiRS covers more than 100 schools in the rural area, especially in the northern and northeastern parts of Thailand. A team of ten researchers from BIOTEC is responsible for facilitating students to conduct small scientific projects and training the

teachers in rural schools. By encouraging students to do small scientific projects, SiRS enhances learning capacity and motivation for further education in science for rural students.

Guided laboratory tour of four research units

Food Biotechnology Research Unit (FBRU): As a part of the Agriculture and Food research program, which aims for the improvement of yield and quality of agricultural product, FBRU conducts projects on food safety and quantitative risk assessment, food chemistry and functional properties of food proteins, and starter culture technology. The microbiology laboratory of FBRU focuses on protein, bacteria and fungus relevant to food production (e.g. Thai fermented food production). With the help from public extension agencies and private companies, FBRU transfers relevant technology for improving food production to small-scale producers.

BIOTEC Culture Collection (BCC): As a part of the Bioresource Conservation and Utilization research program, which is about the management of microbial resources, BCC collects microorganisms and other biomaterials and manages the materials and related data. The collection of BCC includes more than 43,000 strains of microorganisms, of which 75% are filamentous fungi (mostly insect pathogenic fungi). The services provided by BCC consist of deposit of strains for the private sector (using either freezing or drying method), strains for education and research purpose, strain isolation

and identification, and training (personal or group training). Since the regulations about intellectual property right for microorganism have just been enforced in Thailand since 2012, BCC is not experienced in dealing issues involving intellectual property right.

Agricultural Biotechnology Research Unit (ABRU): As a part of the Energy and Environment research program, which focuses on the treatment and rehabilitation to solve environmental problems, ABRU conducts research about plant and animal biotechnology to strengthen the agriculture industry in Thailand. The Plant Physiology & Biochemistry Laboratory, one of ABRU's laboratories, runs a project addressing the problem of soil salinization in northeastern Thailand, which is a good example for the work of ABRU. The fact that northeastern Thailand used to be part of the Pacific ocean explains high levels of salt in the ground water. Meanwhile, deforestation in northeastern Thailand has led to movement of water table. Both two factors stated above contribute to the problem of soil salinization.

on. By planting local tree species with high salt tolerance and using agricultural engineering technology, researchers solved the problem of soil salinization to some extent within four years. A rice variety with relatively high salt tolerance was later developed to further solve the problem.

Medical Molecular Biology Research Unit (MMBRU): As a part of the Health and Medicine research program, which advances knowledge of neglected diseases such as malaria and tuberculosis, MMBRU operates a malaria research program to develop antimalarial drugs to overcome multi-drug resistant malaria. As a joint work of the tissue culture facility, protein unit, and biochemistry laboratory, one antimalarial drug, named P218, has been developed for ten years and is now under medical trial. Researchers expect P218 to be effective for ten to twenty years until resistance occurs. MMBRU has cooperated with other research facilities and received external funding from organizations, such as the Bill Gates foundation.



Worker in laboratory.



Group during presentation.

Pathum Thani Rice Research Center

Francisco Mouriño

On March 4 in the afternoon we visited the Pathum Thani Research Center located at Rangsit-Nakorn Nayok Road at Moo 1, Rangsit, Thanyaburi, Pathum Thani. Upon arrival Dr. Somong Chotechuen, a senior agricultural research officer, together with other staff of the station welcomed us. At first, Dr. Chotechuen presented the research center as well as a general description of rice production in Thailand. Later we visited the facilities of the research station and were introduced to the different activities carried out there.

The Pathum Thani Rice Research Center

The Pathum Thani Rice Research Center was established in 1916 as the first rice experimental station of Thailand. The station has a rather conventional organization scheme, where activities are subdivided in sections with specific goals and responsibilities. The sections are as follows: administration, plant sciences, agronomy, plant protection, post-harvest technology and seed technology. In addition, the national rice seed storage laboratory for genetic resources is administered by the Pathum Thani Research Center. The main duty of the center is carrying out interdisciplinary research that solves problems and improves rice production. The Pathum Thani station works together with two other satellite stations and their activities reach 15 provinces in the central and eastern part of Thailand. Examples of the contribution of the Pathum Thani Research Center to the quality and productivity of rice in Thailand are the development of new rice varieties and hybrids, the provision of quality seeds to farmers, the improve-

ment of technologies of production such as planting methods (e.g. broadcasting, parachuting and transplanting), and the provision of services (e.g. laboratory analysis of seeds and soils).

Rice in Thailand

Dr. Somong Chotechuen clearly stated the relevance of rice for Thailand in terms of economics, but also in culture and everyday life. More than 80% of the population consumes rice three times a day. Rice, with an approximate area of 10 million hectares, covers roughly half of the agricultural land of the country. The total production of milled rice in Thailand is approximately 20 million tons, of which about the half is consumed within the country. Most of the rice is produced in lowlands, of which approximately 17% is irrigated. Thailand, for many years, has been the most important rice exporter of the world, but this has changed: In 2012 Thailand ranked third in terms of the quantity of rice exported after India and Vietnam. This situation is attributed to Thailand's recently implemented policy to support rice farmers, which lead to higher national stocks and lower traded quantity.

Tour to the facilities and presentation of the center's main activities

During the tour in the research station three main activities were presented. First, we visited the greenhouses for a demonstration of how rice hybrids are produced. Technicians showed the process in which individual flowers are fecundated with the desired parental lines. This demonstration showed clearly how difficult and time consuming the process is and



Rice hybridization demonstration at the Pathum Thani Rice Research center.



Rice plant.

therefore how costly it can be when applied to reproduce seeds at a commercial level. Some of the students were able to apply the technique themselves.

Thereafter, we visited the germplasm bank. More than 20,000 rice cultivars, including wild species, are kept. Many of the cultivars in this collection have been identified and characterized using DNA techniques. Of the total collection 10 to 15% is rejuvenated every year. The bank is of great importance for preserving genetic resources that can be used for further improvement of rice varieties. Unfortunately, the bank is only partially backed up outside of Thailand. Within the visit we were able to get a better understanding of what is required to preserve such a valuable resource, the potential uses of the genes collections and some of the difficulties for proper preservation and international cooperation when sharing genetic resources.

At last we visited the learning center, which is used for extension. This center is visited by more than 2,000 farmers every year. In the facilities information about modern as well as traditional ways of producing rice is displayed. The learning center plays a major role in transferring the technical and scientific knowledge produced at the Pathum Thani research center to farmers.

Final remark

This visit was important for us to get a better understanding of rice cultivation in Thailand. Moreover, it allowed us to learn about how a national research institution can contribute to the productivity of a crop and to support farmers to do better cropping.

Oda Reese

Upon arrival at the site of the Suphaburi Rice Mill, we were invited to the office building where we were given a presentation about the enterprise by Mr. Sukrit Phatthanaphisedkul, the Assistant Vice President. Later we were taken through the factory by Man Noonklang, the Production Division Manager. There we learned that the Suphanburi Rice Mill belongs to the Khao C.P. Co. Ltd., which again belongs to the C.P International Business Trading Group and Crop Integration Business. This group runs three rice mills in the 300 km vicinity of Bangkok and two rice factories. At the site of Buri Ran the mill and factory are mainly used to process and pack jasmine and sticky rice. Even though the group does not own the biggest rice mill in the world, it is the biggest rice processing plant in the world. The company owns the brand "Royal Umbrella", which is renowned for its good quality worldwide.

The capacity of the mill is (July 2008):

- | | |
|----------------------------|----------|
| 1. Paddy Receiving Section | 600 t/d |
| 2. Milling | 400 t/d |
| 3. Refining | 200 t/d |
| 4. Storage | 15,000 t |

When the trucks arrive at the mill, from 30% of the trucks samples are taken from the front, middle and back of the trailer with a semiautomatic sample taker.

These samples are then taken to the laboratories for tests. First at all the moisture content is analyzed with the Single-Kernel-Moisture-Tester that takes the exact moisture content of 100 grains and then calculates the average, but also gives you information about standard deviation, temperature and the distribution of moisture contents in a histogram. Average should not be higher than 14% for good quality, for every 1% above 12% there is a price reduction of 0.2 Baht per kg. After that there is de-husking and polishing of the sample to check on impurities and colour of grains or foreign matter. The paddy standards are:

- Moisture Content $\leq 14\%$
- Damaged Kernels $\leq 0.5\%$
- Yellow Kernels $\leq 0.2\%$
- Foreign Matter $\leq 3\%$
- Other Variety $\leq 5\%$

In the next step the rice goes through the drying process. First the rice is pre-cleaned, then it goes to the wet bin (2 hrs), next to the dryer (6 hrs), temperature bin (6 hrs), again to a dryer (5 to 8 hrs according to moisture content) and last to the cooling bin (4 hrs). After that procedure the moisture content is at 13.5%. With that moisture content the paddy rice can be stored without the danger of rotting.



Presentation of the company.



Brown and polished Rice.



Rice storage hall.

After drying, the rice gets de-husked. The husk is used to heat the dryers, and surpluses are sold. After de-husking the rice is called brown rice.

Then the bran of the brown rice is removed and the rice is polished. After this the rice is sorted by colour, length and size. The whole grain is called Head Rice, grains with only small damage are called Special Big Broken Rice, and the leftover smaller pieces are Chips. The colour sorting is done by light with pressured air and also sorts out small stones.

The polished rice is ready for packing. Usually only one production line is running at the same time and the rice is taken from storage by demand. Before packing the mixing of different grades is done according to standards. The packing machines are semi-automatic and the packs consist of either 15 to 20 kg or 2 to 5 kg. The finished bags are stored in the warehouse.

Rice structure (in % of weight):

- Paddy Rice 100%
- Brown Rice 75%
- Husk 25%
- Milled Rice 66%
- Bran 9%
- Head Rice 45%

Quality Control is done by controlling the length of grains and ratio complete/broken grains.

The mill is certified by HACCP and GMP standards and also by ISO 9001:2008. For insect control inside the buildings there is fumigation according to standards.

The employees are paid minimum wage, unskilled workers earn around 10 Dollars/day, skilled workers 15 Dollars/day. Skilled workers are hard to find, this is why the next factory that is planned will have more machines and less workers.

Rice is produced throughout the year, but 60 to 70% is harvested in December and January.

The following information was gathered by questions

- The five plants of the group process 1.5 to 1.6 million t/a, yearly production of Thailand is 30 million t/a, 50% for domestic market, 50% for export to Africa.
- The company buys the paddy rice from farmers, traders and middlemen across the whole country, by this they can work with bigger volumes.
- The capacity of the mill is 6,000 to 8,000 t/month, the actual used capacity is 4,000 to 5,000 t/month.
- There is a minimum guaranteed price for rice, for local paddy white rice 15,000 Baht/t, international price (FOB) 650 to 700 Dollars. The guaranteed price is a big problem because it is not related to the world market price, so it is hard to compete.

Sugar cane growing and sugar production „Wangkanai – Group“

Frauke Ahlers

Short facts

- Name: Wangkanai Group
- Founded: First Company of the group 1975
- Production units: six sugar production factories in Thailand
- Factory's capacity: 100,000 t of sugar cane/day in all six factories together, 18,000 t of sugar cane/day in the visited U-Thong factory (= 1,800 t of sugar/day)
- Products: raw, white, refined, brown sugar, marketed domestically and internationally
- Business volume: approx. 8 million Bath (= ca. 180 million Euro)

Sugar Cane growing: three alternative concepts

Sugar is a world market commodity that largely lacks regional or quality differentiation. To gain a profit, producers have to focus on mass production, using advantages of economies of scale and making money by mass, or they have to go for niche markets, producing sugar with certain special properties.

The Wangkanai Group, although a big producers, experiments with different concepts of special sugar products, all starting with different ways of growing sugar cane.

Low Chemical Sugar

The sugar marketed as “low chemical sugar” is produced from sugar cane that is grown according to the regulations of the GAP (Good Agricultural Practice). In these regulations, the use of chemical pesticides, fungicides and herbicides is

limited to a low level. Timing and application techniques are such that the negative side effects are reduced. Farmers are supported by extension workers of Wangkanai by applying this way of growing in their daily practice.

The “low chemical” sugar is used for example by Thai Airways in their airplane catering.

Organic sugar

In this pilot project, Wangkanai Group selected 200 farmers to convert their sugar cane fields to organic farming, using production residues from the sugar plant as fertilizers, integrating livestock keeping into the system and promoting root growth and plant health, using methods like EM (effective microorganism).

Farmers are supported by extension service and technical advice, and paid a slightly higher price for the raw sugar cane. The company's spokesperson claimed that the farmers applying the organic methods are having less problems with fungal disease due to better plant health and that the yield are at least comparable to the yields of the conventional growers.

The “100 tons per rai” – project

The aim of this project is to detect the maximum possible sugar cane yield per rai (Thai area measuring unit, 1 rai = 0,16 ha), at which the number of 100 tons is more or less symbolical. In the literature, maximum fresh sugar cane yield is indicated with about 280 t/ha (BOGDEN 1977: TROPICAL PASTURE AND FODDER PLANTS).

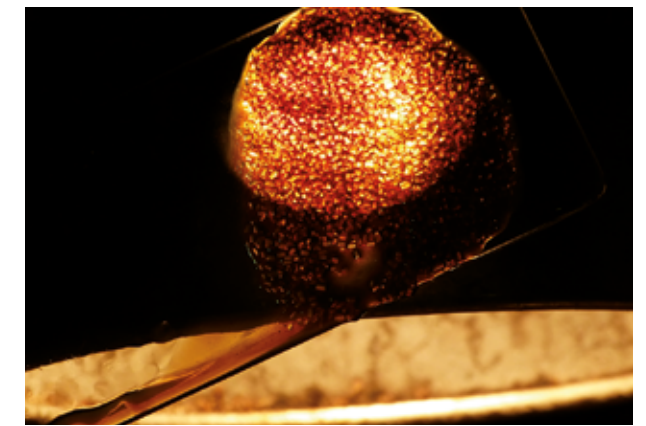
To reach maximum yields, a special way of planting is used. Normally, sugar cane

is planted from sticks of cane of approx. 15cm length. For the “100 tons per rai” project, single knots are pre-planted in nurseries and transplanted after six weeks. The seedlings are planted in rows (density is 40 plants/m²) with irrigation facilities in between.

In addition, a high amount of fertilizer and organic matter is applied directly to the planting rows. The high density and the planting of seedlings reduce the need of herbicide.

Sugar Processing

The production of sugar consists of mainly three steps: the pressing of the liquid out of the sugar cane, the evaporation of the water to concentrate the sugar, and the purification of the sugar crystals.



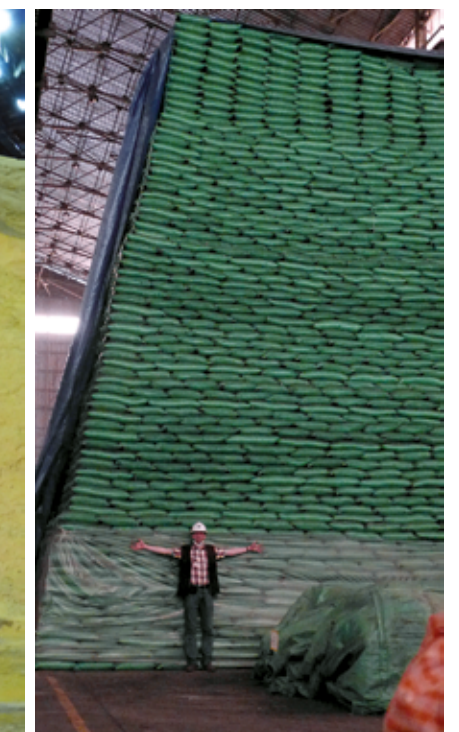
Testing of sugar crystal content in concentrated sugar liquid.



Sugar cane delivery trucks.



Mountains of unpacked sugar.



Mountains of packed sugar.

Floating Market Dumnernsadeuk, Ratchaburi

Kristin Hentschel

Almost 105 km away from Bangkok, in Damnoen Saduak District, Ratchaburi Province, there is the indigenous Damnoen Saduak floating market.

In 1866 King Rama IV gave the order to dig a 32 km long channel in Damnoen Saduak to link the Mae Kong River with the Tachine River. From the main channel, smaller channels branch off in order to drain the surrounding fields.

The soils next to the channel are highly fertile and have good properties to grow different types of fruits and vegetables. That is why a variety of crops, such as grapes, coconut palms, roses, and apple are planted in this area.



Coconut sugar advertisement.



Palm sap harvesting.

Notes: A farmer, who owns some coconut palms, showed us how he produces sugar out of the sap of the palm. He cuts the stem of the palm and collects the leaking sap in containers. The harvest of the juice happens during the whole year. The sap can be collected three years after the first flowering.

When enough sap is collected, it is filled in a big pot and cooked on a fire until the water is evaporated. Because of the heat, the sugar in the sap caramelizes and turns into a viscous mass. Once the consistency is hard enough, the mass is dropped onto a straw mat in small cakes to cool down. The final product is a hard sugar cake, which is sold in small plastic bags for kitchen use.

The floating market is an attractive place for tourists to observe the old and traditional marketing of fruits, vegetables, cooked food, spices and many more. Because it is an attractive place for tourists, one can also find clothes, souvenirs and almost everything else in all colors.

Market activities can be observed from small boats and tourists have also the possibility to see Thai houses and a part of life of Thai people.



Palm sugar cooking.



Driving the Professor up the ... palm.

Fruit and vegetable production in a drainage system

Clessio Gomez da Silva

We visited a farmer's cooperative, which is producing fruits, vegetables, and lettuces under very special conditions: They are cropping land that used to be a swamp and is still marked by an extraordinary high groundwater table. So the farmers developed a way to anyhow use the land productively for cropping purposes. Canals were dug out where the water can accumulate, the so gained soil material was heaped up between the canals. In this way they gained land is dry enough to grow a variety of crops, ranging from fruit trees, coconut, and oil palms over grapes, and vegetables like asparagus, to lettuce.

Grape production

The grapes are cultivated in alternating rows with coconut because they want to switch from grape to coconut plantation in six years time. Soil preparation is made before the plantations are flooded. The practice of flooding is done in order to clean the soil from pests and insects. One month after flooding organic fertilizer is applied and incorporated and then plantations are flooded again for 1 month.



Grape field with drainage channels.

Seedlings are grafted to increase the production and the resistance against pest and diseases and after transplanting they are watered by hand every 15 days. One month after planting, the top of the plant is cut, to trigger the growth of branches. 10 months after planting pruning is done for the first time and is then repeated 40 days after fruiting. Insecticides are sprayed after flowering. Four months later the fruits are harvested. Then the terrain is flooded for one month and the plants are pruned once more. Twenty days before harvesting, fertilizer is applied next to the plants (about 500 g / plant of NPK). Harvesting is done twice a year. The grapes are sold as fresh fruits.

Asparagus production

The cooperative produces a variety of vegetables, but only asparagus is exported. In between the asparagus rows, oil palms are planted. From planting to harvest the asparagus shoots, it takes three months. In case of high pest pressure, chemical pesticides are sprayed one month after planting.

Harvesting is done in intervals. After the first harvest, they stop for one month and then keep on harvesting for another two months and so on. Up to three years the plantation keeps the yield, afterwards it decreases. The farmers use the plantation for five to six years on average.

For exportation, there is a grading system for asparagus: with 1 cm diameter, it costs 85.00 Baht/kg, with 8 mm diameter 60.00 Baht/kg, and with 4 mm diameter, it costs 35.00 Baht/kg.



Lettuce harvesting.



Lettuce irrigation by boat.



Asparagus grading.



Self-made insect trap.

Pineapple production and processing (Dole Thailand Ltd.)

Isabel Pleisnitzer

On the 7th of March we visited the pineapple production in Phetchaburi. The first stop was the processing station, where we could gain an insight view of the whole process from sorting out the best pineapple to the last station of labeling in the warehouse, where the cans are stored before being exported.

After having visited the process line, we moved to the pineapple field to get an idea of field work.

Facts about the company

According to the manager the company is one of the top exporters in Thailand, at least in processed pineapple, which is exported to Europe (at a price of 7 to 10 Baht per kg).

The company's biggest competitor seems to be Indonesia, but apart from Indonesia there are other strong competitors in this sector.

Another aspect of market risk is the substitute fruit orange since the demand for pineapple depends also on the harvest of oranges. If there are a lot of oranges, the demand declines and vice versa. That is an additional reason why the manager has to ensure high quality and a good position in the market. Because of the mentioned high competition, he did not allow us to take photos as he explained that his way of processing is special and he wants to keep it secret.

The company has two factories and produces 200,000 tons per year, while possessing 8,000 rais (1,280 hectares) of land for renting it to farmers.

The company operates since 40 years and has a high number of workers of which

70% are from Myanmar. This shows the good economic situation in Thailand or at least for this sector as foreigners come to work there.

Furthermore, the manager stated that according to the law in Thailand the workers have a workers' council and insurance. The working hours per day are about 8 hours, 6 days a week. But if a worker would like to work more, it is possible to work up to 11 hours daily. Thus, working conditions seemed to be appropriate, which underlines also a good management.

Standards are usually set by importer countries, for instance the EU has strict rules. Therefore, respecting this standard is essential for entering the European market. Another favorable standard management is the HACCP (Hazard Analysis and Critical Control Points), a typical approach to ensure food safety in terms of avoiding allergenic, chemical and biological hazards along the process line. This type of standard addresses the process and can be used in all production stages. HACCP is a voluntary standard for pineapple and its application shows that the company matters about food safety. Another standard is the ISO 9000, which is part of the processing standard and refers to the quality management system. These requirements are based on health and safety standards regarding the product. Moreover, the company implemented the GMP (Good Manufacturing Practices), which includes hygienic concerns inside the factory for instance, wearing protecting clothes like boots, hairnet, mask and work coats. In addition, the company addresses some envi-

ronmental concerns, but mostly referring to the process line. The manager explained that they try to produce in the most efficient way to reduce waste and that they use photovoltaic solutions for the boiling process.

However, with regard to the primary production it was mentioned that only in case of fungal diseases herbicides are applied and that no insecticides are used.

Furthermore, it was stated that they try to support their farmers by providing technical services and control visits to ensure the quality of the pineapples in order to reduce the rejection rate at the gate. This is also part of the safety and quality management called GAP (Good Agricultural Practice) engaging in the first production step. Therefore, both sides benefit: the farmers reduce the risk of taking back a high quantity of fruits, if they do not meet the quality requirements, and the company makes sure that they get the demanded quantity on time.

Nevertheless, one should take into account that the rejection rate always depends on other circumstances, for instance on climate conditions. The mana-

ger told us that sometimes they have to reject 70% or even 100%.

Currently, the company works with 50% farmers, who are free lancers, which means they come and try to sell their products at the gate. The other 50% are contract farmers, who have a set of conditions to meet and a certain quantity to deliver at a specific time.

As the demanded quantities are usually very high the company works with large scale farmers, who possess about 100 rai (16 ha). This way of management is usually observed in the context of big companies because they try to reduce transaction costs with the side effect that small scale farmers are excluded from high value production chains.

Another aspect of good management is social responsibility, which implies the support of school activities in rural areas, or provision of funds for school equipment.

The Process Line

The company presents an integrated production line as the whole procedure from sorting the fruits till the labelling is made



Pineapple tasting on the field.



Growing pineapples on the field.

in this factory. Firstly, workers are at the conveyor belt to sort out the pineapples according to color and size. Therefore, the first selection is based on physical observation. Afterwards, the fruits enter into a peeling machine inside the factory, while the sorting process is made outside right after the delivery. According to the quality grade the pineapple go to different cutting machines. There are three quality grades (tested on color), which decide the way of processing. The best grade means that the pineapples are cut in round big circles, the second grade means that they are cut in smaller slices and the last grade means that the fruits are crushed or used for syrup. That is why we saw a lot of workers in the factory supporting the mechanized process or putting the slices in cans. The reason why the factory is not fully mechanized is due to the cheap labor force and therefore it is not necessary to buy other machines (besides it is generating employment).

After canning they proceed to a filling station where a certain amount of boiled syrup is added and the cans are sealed. The syrup is squeezed from the fruits, which are out-sorted at the beginning. This indicates an efficient use of by-products to reduce costs and waste. The company produces its own cans, which are made of rustproof corrugated metal with a rubber lamination at the inside for hygienic purpose.

In the next step the cans proceed for pasteurizing, sterilization and cooling. Finally, they are labelled and then stored in the warehouse. Here, we could observe that cans got different labels according to different international customers, an indicator for the huge amount of buyers all over the world.

Before the contingents leave the factory, a sample of cans is taken to check

the quality by testing on sweetness and color. Although the processing we saw seems to be very efficient, only 25% of the pineapple is good enough for the can, about 50% will be used for animal feed for example the stalk and the rest will be used for sweets, for example: dry pineapple or just syrup.

Field work

After visiting the factory, we moved to the pineapple fields. The manager explained that the growing season of pineapple is from May to June and the harvesting from November to February.

Normally the plant takes about 24 to 36 months to bear fruits and after flowering it takes approximately six months until harvest.

For maintaining soil quality it would be favorable to make use of a crop rotation system, but unfortunately this was not the case. One advantage of pineapple production is the low water demand of the plant, which allows rain-fed conditions for cultivation.

Furthermore, after planting the seedlings survive without additional water till the rainy season starts. Nevertheless, the main disadvantage of vegetative propagation using roots of old plants is that the root material may be diseased. In the field we observed an area with plants that suffered from a fungal disease. After individual plants are infected it is difficult to stop the dispersion of spores. Therefore it is important to dip the seedlings into a fungicide solution in order to avoid infections. Herbicide applications are done by hand (only wearing gloves and boots) and also growth stimulators are used, but no insecticides.

Apart from environmental constraints, crop damage can be caused by elephants

crossing the field, but it happens mostly in regions near national parks.

Conclusions

To sum up, the company seems to be well-organized, operating on high standard levels to compete internationally by meeting the required food safety standards which are necessary for high value products.

Concerning the processing in the factory, improvements could be done to increase efficiency by mechanization. Otherwise, this would mean more unemployment and less flexibility in the process line.

Additionally, they try to use the fruits in an efficient way in order to avoid waste and financial loss. Moreover, they produce their own cans in order to have a vertically integrated production chain, which indicates good management practice.

Besides, the company seems to meet crucial hygienic standards to ensure food safety and good working condition.

Referring to the field work, we observed some problems with fungal diseases, which normally could be easily eradicated by treating the propagation roots with fungicides.

Another problem was that some of the pineapple fruits did not grow properly, which could be caused by inappropriate application of the stimulator. Concerning these observations, some improvements in the agricultural management could be necessary in terms of offspring control or farmer trainings to provide incentives for good working behavior.

At the end of our visit the manager underlined that the production represents organic farming and that the company aims at meeting fair trade standards.

Overall the company is a positive example of good quality management in a high value market, except of some critical points.



Pineapple planting by excursion participants.



Pineapple planting by a professional worker.

Kui Buri National Park – Human and wild elephant conflict

Andrea Bähringer

The Kui Buri National Park was introduced by Mrs. Tirati Mortip, PR agent, and Mr. Thongsuk Daengchot, head of the park's management department (contact: kuiburi_np@hotmail.com).

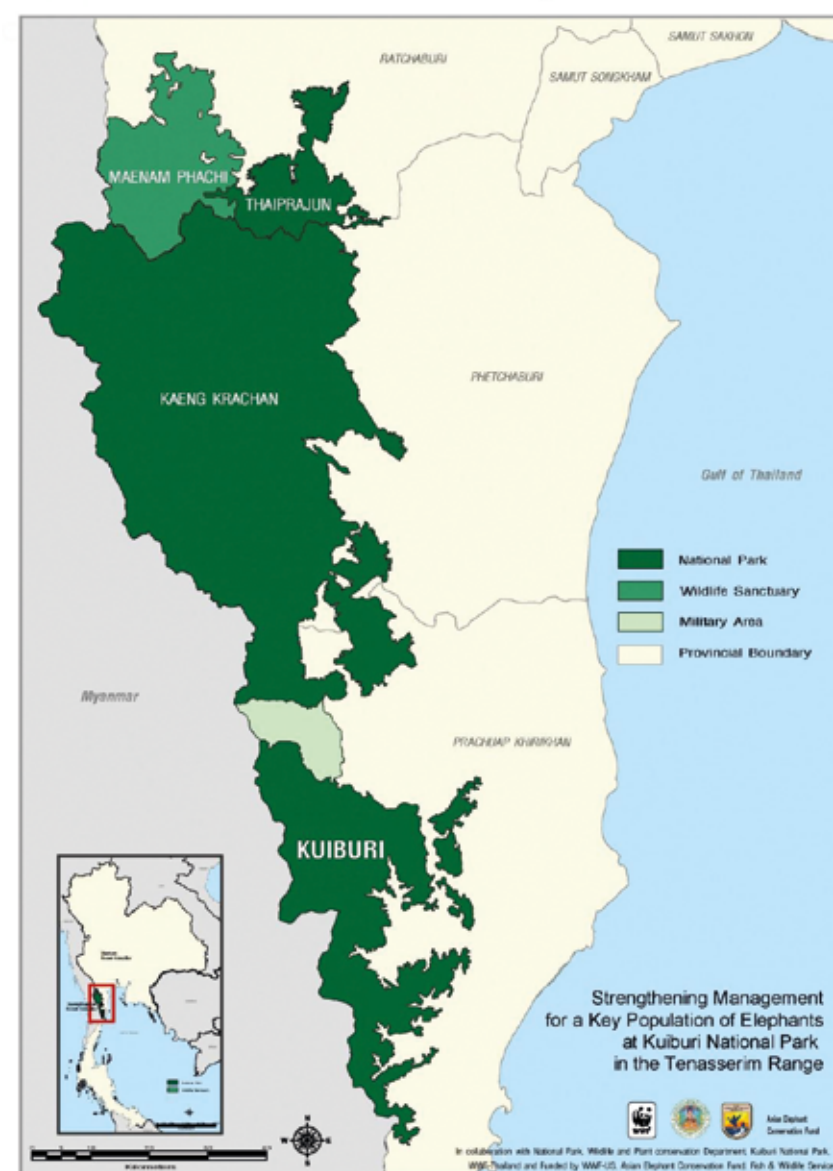
The National Park is located in Prachuab Khiri Khan Province in Thailand, approximately 250 km southwest of Bangkok. It covers an area of 969 km² (or 605.625 Rai) and shares a border with Myanmar in the West. The border area is restricted

for visitors. Rubber and oil palm plantations come up to the border on the Myanmar side, the National Park exists only on the Thai side of the border. Before afforestation and establishment of the National Park in 1998 the forest of Kui Buri was leased to farmers and companies.

The park consists of five areas; there is also a core zone that is open to tourists (where we saw the elephants). The park has small headquarters and is managed by rangers involving the local community. Community people work as guides and provide their own pick-ups for guided tours for tourists. This inclusion leads to an increasing acceptance of the National Park among the local population.

The National Park contains varied types of forest, such as mixed deciduous forest, also kinds of secondary forest and bamboo. Occurring tree species are *Casuarina* and *Mansonia gagei* (*Sterculiaceae*), a coumarin containing plant, which is used in traditional medicine in Thailand for its heart stimulating properties, amongst others (TIEW ET AL. 2002).

The occurrence of varied animal species is monitored by camera traps. The park is habitat for 230 Asian elephants (*Elephas ma-*



Map of Kui Buri National Park (WWF Thailand).



Asian elephant in the National Park.

ximus), about 100 gaurs (*Bos gaurus*) and three bantengs (*Bos javanicus*), which are supposed to be the wild ancestor of the domesticated gayal or mithun (*Bos frontalis*) (TANAKA ET AL. 2011).

Kui Buri National Park is also home of ten tigers (*Panthera tigris*), which mate on both sides of the border. There are also monkeys, tapirs, makis, foxes, porcupines and pangolins (whose blood and skin is used in the traditional Chinese medicine), as well as some non-indigenous species and several jungle fowls, such as the red jungle fowl (*Gallus gallus*), which is one of the ancestors of the domesticated chicken (ELTANANY & DISTL 2010).

Tourists can go on study tours through the national park on three trails of different length. They can watch elephants and birds or visit several waterfalls, even though most of them are available only on foot. There are 14 hotspots to observe elephants, but only four are within reach by car.

Serious problems occur in the National Park border area connected to farmland: in need of food in the dry season elephants search for pineapples and de-

stroy entire harvests. The National Park management started a project to solve and prevent conflicts between farmers and wild elephants. After discussing and creating a map about the borderline of the National Park together with the farmers, the contact details of every affected party have been collected. A road along the borderline was built to make it easy to scout at the border.

When a farmer observes at least two elephants outside the park, rangers and other farmers are called for support in order to cast out the elephants. Though it is difficult to make farmers aware of the problem, every observation of elephants aside the border must be reported to the National Park department, even at night, including time and position. Due to these observations, 8 p.m. and 1 a.m. were figured out as the main feeding times of the elephants. At this time farmers and rangers are prepared in particular.

At the moment there is no financial compensation for crop land that is destroyed by elephants, but the observation reports are hoped to effect the establishment of an appropriate fund.

Over the last two years, electric fences run by solar cells have been installed in the fields of reporting farmers only to motivate non-participating farmers to join the reporting group.

The electric fence proved to be not effective in the long run. The first time elephants came in contact with it, it worked well. An alert was sent to the farmer and he was quickly on the spot. However, after some time the elephants had developed strategies to outwit the fence, such as waiting for the short moments

between the fence's electric impulses, felling trees or kicking smaller elephants into the fence to destroy the cables.

Another attempt to protect pineapple plantations is an intercropping of pineapple with plants elephants do not feed on, for instance rubber trees.

The end of the dry season (the time of our visit) is the time of the most incidents and the ranger reported of two in a week, because of dried water ponds and lack of feed. A few years ago, many



Bathing elephant.



Inspection of elephant traces.

Excursion participants.

pregnant elephant cows had abortions caused by lack of minerals. Nowadays, there is feed supplement, such as salt and oyster shells, offered in 60 cm deep holes in the ground. But still the draught is the most serious problem.

The number of elephants is monitored twice a year. Kui Buri National Park provides enough space for the current number of elephants, but the limiting factor is the available water in the dry season.

The current number of tigers is limited due to the size of their territories (about 100 km²). There are no problems with tigers at the moment, but there was an incident five years ago, when farmers brought cattle into the park.

One section of the department is responsible for the monitoring of poaching activities. There are no incidents at the moment, but four years ago rangers stopped poachers, who preyed on ivory. Poaching is a general problem in Thailand's National Parks. The trade of ivory of domesticated elephants is permitted in Thailand, but due to insufficient controlling ivory of wild elephants from all over the world, especially Africa and Myanmar, is illegally traded in Thailand (Asian elephants are listed in Appendix I of CITES, which means that international trade is prohibited; African elephants are listed in Appendix II of CITES and trade is permitted for a few African countries (STILES 2009)).

The ranger also told us that ivory of dead wild elephants stays in museums in Thailand. Ivory is popular as talisman and is used in the traditional Chinese medicine.

The logging ban in 1989 left many working elephants in Thailand unemployed.

Instead of working in the forests they are only kept for tourists and begging today. Usually only male elephants have tusks and only few have long ones that could be interesting for traders. So there are more than 1,000 unemployed domesticated elephants, most of them live in poverty (STILES 2009). But the consciousness for elephant welfare is growing, elephant hospitals have been established and organizations for elephant protection have been founded.

The ranger negated problems with illegal logging. He explained that forest and animal protection is a royal project and in order to show loyalty to the king, people respect the forest and its animals and would rather take part in its protection than cause harm to it.

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Shrimp Farming

William Nelson

Introduction

On Thursday the 7th of March 2013 the excursion group visited a small-scale shrimp cooperative in Prachuab Khiri Kahn, one of Thailand's central provinces.

Located in the northern part of the Malay Peninsula, some 240 km south of Bangkok, the Prachuab Khiri Kahn Province neighbours provinces Phetchaburi in the North, and Chumphon in the South.

This visit aimed to expose the excursion group to the small-scale cooperative shrimp farming industry. The group firstly



Pool aeration

visited the chairman in the cooperative's office and was then led to one of the production sites.

This report aims to document the information gathered during this part of the excursion.

Background

The cooperative is six years old and today consists of precisely 261 members. The group is headed by a chairman, with 30 years of experience in the industry, and is based on members bringing together their shrimp in order to sell their catch to targeted markets. The group is mainly made-up of small-scale farmers (90%).

In terms of the farming systems used, 60% of the cooperative's members produce 'bio-shrimp', although this is not in line with European organic standards. Moreover, the remaining 40% of producers produce conventionally, i.e. adhering to no additional regulations other than those of the national government. The 60% of members that produce bio-shrimp make up around 50% of the total land area that is run by the cooperative. Although there are some efforts to produce shrimp in a globally recognised organic way, the chairman reported that this can be very difficult for some shrimp farmers, which is why the so called bio-shrimp label is offered as a compromise. Although the details were not discussed, 'bio-shrimp' assumedly adheres to less stringent regulations in comparison to 'organic' production in terms of environmental sustainability and animal welfare.

The group's aim is to maintain the practise of shrimp production and therefore the livelihoods of those that depend on

this form of farming. As a service to its members, the cooperative offers food and technical advice and has contact to many shrimp buying companies, including the major British retailer Marks and Spencer (M&S). The cooperative already supplies the M&S luxury food department with shrimps and is beginning to explore the possibilities of supplying organic shrimp.

Currently, the main type of shrimp that is farmed and traded is white shrimp. This is due to prior disease problems with black shrimp. The three key destinations for Thai shrimp are the European Union (EU), United States (US) and Japan.

Due to different taste preferences and food cultures, the EU tends to import more tiger shrimp, whereas the US and Japan receive more white shrimp.

There are reportedly 11 shrimp cooperatives operating in Thailand today. The visited coop began with only 52 members, who had previously struggled to trade as individuals due to competition from larger organisations. As a somewhat larger group of shrimp farmers, they have a great deal more power together, collectively producing around 2,800 t of fresh shrimp annually. In order to stay well organised, the coop committee meets once a month, with large gatherings including all member farmers biannually.

To be a member of the cooperative, each farm must obtain a Good Agricultural Practices (GAP) certificate - GAP represents a collection of principles to apply for on-farm and post-production processes. This aims to produce safe and healthy products, taking matters of economy, society, and the environment into account. Members must also be outright owners of their land. The chairman at the time is the first to check whether the potential

member fits the criteria. The decision is then passed on to the cooperative's committee.

In terms of financial gain, 1 kg of conventional shrimp is said to earn 4.50 EUR (170 Thai Baht) gross, bio-shrimp fetches around 5.00 EUR (190 Thai Baht) per kg. Although this information is only available with regards to bio-shrimp, 3.68 EUR (140 Thai Baht) per kg covers the production costs, meaning 1.30 EUR (50 Thai Baht) is profit. Of this profit 0.05 EUR (2 Thai Baht) is re-invested into the cooperative and used to fund the management operations.

Production

The following will briefly describe the production processes used for conventional shrimp production.

Pond Preparation:

- Water is drained from shrimp ponds.
- Wet mud mixture at the bottom of the pond is removed (this is not the case under organic production, where mud is not removed from the bottom of the pond).
- The pond is left to dry for around 15 days.
- The pond floor is then ploughed, micro-organisms are added, and the floor ploughed again.
- Nutrients can now be added to the soil, such as nitrogen, phosphorous, calcium, and magnesium. The pH may be altered, if this is out of the range required, which can differ depending on the species farmed, but usually wavers around 7 - 7.5.
- Water is then added and left to settle for three days, after which the salinity is checked.

Stocking the Pond:

- Rice bran is spread on the edge of the pond; this attracts insects to lay their eggs.
- Water and plankton quality of pond is checked.
- If the above is suitable for shrimp production, hormone and antibiotic-free Thai shrimp lava is added.
- Feeding begins after seven days. This is either done manually through throwing feed, or mechanically using an automated feeding machine. The fodder consists of fish and food-crop meal.

Production & Harvesting:

- Nets are sometimes used to cover the ponds and protect shrimp from being attacked by birds. However, as long as the shrimp farm is run well and its stock is 'happy', i.e. shrimp do not need to surface the water to gain access to oxygen, it is less likely that birds will be attracted to the ponds.
- Solar panels are used to power aeration machines, used to add oxygen to the water and therefore improve water quality. As displayed in the image at the top of this report. Machines are run for around 12 hours throughout the night.

INGREDIENTS:
Fish Meal, Marine Protein By-Product, Wheat Flour, Broken Rice, Soybean Meal, Fish Oil, Vitamin, Mineral and Preservative

โปรตีนไม่น้อยกว่า (PROTEIN MIN)	ไขมันไม่น้อยกว่า (FAT MIN)	กากไม่มากกว่า (FIBER MAX)	ความชื้นไม่มากกว่า (MOISTURE MAX)
32.0 %	5.0 %	4.0 %	11.0 %



Shrimp fodder.

Note: This level of technology is not common on shrimp farms. The solar panels featured on this farm were supplied by the cooperative's Finnish sponsor (aeration machines were put on during the day for demonstration only). Depending on the size of shrimp demanded by the producer's target market, the time period required for shrimp growth can differ, for example:

- 90 days for 60 to 70 shrimps / kg
- 110 days for 50 shrimps / kg

Evaporation causes around 3 cm of water loss every couple of weeks, which is why 3 cm of water is added to the ponds approximately every 15 days. This is usually sourced from a local river.

The harvesting of shrimp operates as follows:

- Water is drained until it is at knee height (of a fully-grown man). This ensures the shrimp do not drown, but at the same time can be seen and therefore caught
- Shrimps are then collected using nets.

For production in general, one man is said to be able to manage a shrimp farm of around 6 ha.



Shrimps harvested for demonstration.

Queen Sirikit Sericulture Center

Jonas Ehls

Universities of Kassel and Goettingen's 4th Interdisciplinary Study Tour to Thailand visited the Queen Sirikit Sericulture Center on March 8th 2013. The key objectives of the center are educational purposes, research in sericulture and egg production of silkworms to provide them to farmers. The visit included video presentations demonstrating silk production, a detailed explanation of silk processing in the showroom and a discussion round. Mrs. Payoo Budwathit welcomed the group.

Silk production

The production of silk is based on the hatching of the silkworm (*Bombyx mori*). Silk is the unspun fibre of the cocoon of the pupa-stage of the silkworm. One major part of silk production is growing white mulberry (*Morus alba*) for the feed of the silkworm, which it is specialized in. To feed the different stages of the larvae, certain qualities of mulberry leaves are harvested. The mulberry trees are coppiced to easy access the leaves. The whole hatching process of the silkworm from eclosion to spinning the silk takes approximately one month. In the first three growth stages, the young larvae of the silkworm have to be fed with only young leaves of the mulberry tree. In the latter stages, the silkworm will be fed with the older, hence larger and coarser leaves. After another 18 days, larvae are mature and spin themselves into a cocoon. This takes about five days. For the silk spinning process, these pupae are then poured into hot water. Depending on the demanded strength of the silk produced, 20 to 150 double fibres of silk are spun.

There are several varieties of the silkworm. One native Thai variety is fairly well adapted to the local climate but produces yellowish fibres with an average length of 500 m. However, there are used varieties producing white fibre with an average length of 1,200 m. One objective of breeding activities in the center is to crossbreed these genomes, to achieve a high quality and quantity fibre producing breeds adapted to the local conditions.

After spinning, the coarse fibre is bleached and colored for further processing.

Silkworm-egg production

Farmers producing silk need a constant supply of silkworm-eggs, which are produced in Queen Sirikit Sericulture Center. For the egg production, adult motts of the silkworm have to be risen. Seven days after eclosing from the cocoon, the less winged male motts are coupled with female adults of the silkworm. One mott produces 300 to 500 eggs. On 20 x 30 cm glued cardboards 60 to 70 pregnant motts are placed to produce a total of 23,000 eggs (~ 1 g). These cardboards containing the silkworm-eggs are sent out to the farmers for hatching and rearing. Approximately 200 farmers are receiving a total of 3,000 units of silkworm-eggs per annum from the center.

Economics of small-scale silk production

Silk production with prices around 1,200 to 1,500 Baht / kg provides a quick and good revenue for farmers. Furthermore, the mulberry tree can be used for various purposes: It grows delicious fruits and leaves can also be used to prepare a tea.

The silkworms from the unspun cocoons can be sold as food. One rai of mulberry trees is needed to produce 300 to 400 kg of leaves, which is sufficient for the feed of one unit of silkworm-eggs provided by Queen Sirikit Sericulture Center. One cardboard containing 1 g of eggs is sold for 30 Baht. It has a production potential of 4 kg of raw silk. Thailand's silk production is aiming a special quality mar-

ket. The production of silk in Thailand is mainly located in the North, though climatic conditions are more favorable in the South. Anyway, the climatic conditions of the South provide opportunities for other cash-crops, too. In northern Thailand's silk production there is a break from January to May due to low leave production of the mulberry tree during the dry season.



Mulberry tree.



Silk moth.



Silk worms.



Cocoons.



Traditional silk production.

Crab Bank in Pathiu, Chumphon

Kristin Hentschel

Mr. Jang Fuengfung, the chairman of one of the crab banks in the Gulf of Thailand, remembered when there was a crisis with the reduced swimming crabs 12 years ago. Thus, he thought of different ways of how to advance the crab bank including the increasing population, reduce the time consuming labour, which is getting more and more expensive and not a favourable job (the number of crab farmers decreased from 18 to 10).

He developed the idea of a floating net in the sea as a hatchery. The female, egg-bearing crabs are then marked with a number and the date to guarantee that they would not be caught again within 10 days after the laying of the eggs. This idea was so good that the chairman went to Japan to share his ideas of leading a crab bank, and in Thailand it spread through the whole country, too.

The number and the date on the crabs assure that there is no destructive exploitation of the egg laying crabs. The crabs

with eggs are kept in the hatchery. After the eggs are laid, the "old" crabs are sold and the "younger" crabs go back into the sea. One crab is able to lay from 200,000 up to one million eggs, depending on the size of the crab. After a week the new crabs hatch. Then the farmers feed them. The baby crabs can float through the net back into the free sea, while the adult crabs are caught in the net and are sold. The hatching period depends on the water quality (in regard to the salinity). In close cooperation with the Thai Fishery Department, they agreed on the restriction that 3 km around the hatchery net no crab fishing is allowed to assure that there will be enough crabs in future. This area is a protected area. Further, strict regulations exist regarding the size of the nets, which are bigger now.

The peak of the crab catching season is between November and December until February. Every three days the nets are inspected, whereas the cages are che-

cked each day.

To attract the crabs to the nets and cages, fodder (fish parts) is placed inside. The crabs enter the nets and don't manage to exit them anymore. Just smaller, younger crabs can swim both ways through the net.

The cooperative has a contract with two private companies, where they are selling the crabs. The money used for the development of the cooperative is lent from private companies for investment.

To conclude, we can remember that this cooperative is conscious of the need of sustainability to not overfish the sea and be aware of enough young crabs and eggs. Another point is the improvement of the techniques, so they are using bigger cages with a certain number of crabs inside. Furthermore, they have to deal with problems concerning the labour: the crab farmers are getting older and most of the young generation have no interest in continuing the work of their parents.



Mr. Jang Fuengfung during presentation



Crab fisher on his boat.



Excursion participants coming from the boat trip to the crab banks.

Small-scale banana processing women cooperative

Manuel Toledo Hernández

On the 9th of March 2013 at around 12:00 we visited a small women cooperative of banana processing located in the Tha Sae District of Chumphon, Thailand. The visit began with a brief introduction of our excursion group held by Prof. Buerkert and a short presentation of the cooperative's initiation. Around 12 staff members of the cooperative were present.

The oldest member of the group was in charge of explaining to us the idea of the cooperative. A group of women gained awareness that in order to boost the sales of bananas it was important to improve the quality in the banana processing. She mentioned that the increment of customers seeking for quality products is rapidly increasing in Thailand as well as the interest of the government in establishing social programs aiming to guarantee a self-sufficiency economy in Thai rural areas. She also explained that as a cooperative it is easier to obtain financial support than when working individually.

The cooperative functions as follows:

1. Generally, the banana production takes place at the household level.
2. Following the "Good Agricultural Practices" (GAP)* principles, the cooperative selects the households, which are allowed to take part in the banana processing.
3. The selected households bring their production into the cooperative facilities in order to start the banana processing. It can be summarized in four steps: 1) peeling off the banana, 2) drying the peeled banana in the green house or in conventional ovens, 3) addition of chocolate cover or other ingredients (in some cases) and 4) packaging in labelled boxes, called banana-box. It is important to mention that in some cases fresh bananas are also directly marketed.
4. The processing ends with the packaging of the dried bananas (or fresh



Cooperative members presenting the banana-boxes, the final processed product.

bananas) which is labelled either with the name of the cooperative or an individual householder label. Most households use a combination of the own label and the cooperative one.

5. The packaged product "banana-box" can be marketed either directly by the cooperative or by the producer members. The banana-boxes are marketed across the whole country and in some cases also exported abroad to countries such as Canada.

After the presentation, the audience was encouraged to ask open questions to the cooperative members. The members explained that currently there are 45 active members participating in the organization, and they expected this number to increase over the time. All members are female under 50 years old. The majority of the members are housewives, and their husbands usually work in other activities not related to the banana production. Moreover, the women told us that their decision to join the organization was in order to increase their income opportunities for their households. In most of the cases the families are the owners of the land where they grow the bananas. In cases where the members don't possess any land they might be allowed to use the land belonging to the cooperative.

The average size of banana plantations is not precisely known by the cooperative members, but they assure to produce approximately 20 t of bananas per month and the banana bunch weight in average is 15 kg. The members also mentioned that the use of chemical fertilizers and pesticides is not allowed in the production. Therefore, they use only the banana peels as fertilizer. According to them there are no current problems with pests or diseases. The bananas are usually in-

tercropped with trees such as mango, rubber, durian and long kong.



Banana plantation.



The green house facility with bananas drying on metal plates.

The organization members mentioned that every year they call for new members' applications. The decision making in the cooperative is taken democratically. Basically, the members can finance the banana production and processing thanks to the economical support given by several instances such as the government and the NGOs. The government encourages the members to produce high quality products in order to be invited to present their products on an important national fair exhibition. Moreover, they can receive financial support, if they reach a good yield of around 30 t. The

members mentioned that this year they began receiving financial support from the Research Ministry as an acknowledgment of the cooperative to be a learning center of banana processing. Individual members may apply to receive labelling or funding opportunities. When they are granted help, they are encouraged to exchange information with others to animate them to apply as well.

The last stop during our visit was the processing area, where the members showed and explained the drying process. The two main facilities are a greenhouse and four conventional ovens. The green house has the capacity to dry 600 kg of peeled bananas within three days. This method uses solar light radiation to produce a greenhouse-effect inside the complex. Temperatures inside may reach

up to 60 to 70°C. After two to three days the peeled banana drying process is accomplished. In order to avoid confusions and misunderstanding, only bananas of one owner are dried each time. If climatic conditions do not allow using the greenhouse or high amounts of bananas have to be processed at the same time, the conventional gas ovens are used.

One of the main constraints the members mentioned was that the small-scale banana processing does not allow them to reach the requirements to export their products. The cooperative experienced this as being problematic, when exporting their products to Canada, in which case the contract was canceled.

* Note: To consult the GAP principles, follow the link <http://www.fao.org/prods/gap/>



Greetings for the German guests.



Children demonstrating banana processing.

Khao-Thalu Chumporn Coffee

Mareike Decker

The Khao-Thalu Chumporn Coffee Agriculturist Group is located in Thailand's Southern region, in Chumporn province. Established 21 years ago, Khao Thalu Coffee has specialized in the production of instant coffee, or 3-in-1 coffee products. The group, also registered as an OTOP community development project, is now consisting of roughly 500 farmers and produces a niche market coffee product for the local market.

Group organization

During the time of the group's establishment, the coffee price was at a historically low level, which was the reason why approximately 15 farmers initiated the formation. Because of price fluctuations, the number of farmers in the group kept changing. It has now come to a more constant number of 500 farmers. About 80% of the members are small-scale farmers, owning about 10 Rai (1 Rai = 1,600 m²) for coffee production. Members for the group are selected by a committee, mainly consisting of the chairman and the vice-chairman. Incentives and reasons for the farmers to join the group were said to be as follows (among others):

- having a better negotiating power, especially in times of low prices,
- the possibility to process their own coffee beans at the factory and
- being able to offer an increased variety of products to the customers.

Coffee plants and harvest

The Robusta coffee plant is the major coffee type in Chumporn province and amounts up to 60% of the total coffee plantation. It is said to be more fungi re-

sistant than the Arabica type. But even here, especially the flowers face fungal problems, which is why some of the fruits are underdeveloped.

The climate for the coffee growth is tropical-monsoon with heavy rainfalls from November to January, which is also the season for the plant to receive its flower. During December and February the beans will be harvested. The amount of harvest depends on the age of the tree, but on average a 5-year-old-tree will have about 50 kg of beans. One time per harvest, chemical fertilizer is applied to the coffee plant, among others (e.g. coffee husk, rice bran, residuals from fish sauce production rock phosphate, urea).

Generally, the red beans are collected by hand, but for other production steps, the farmers have the possibility to rent machinery from the group for a certain amount of money.

Residuals from the coffee production are again used as fertilizers and for composting and are mostly sold to its member farmers. Usually, coffee plants are planted next to other fruit trees (e.g. Durian, Mangosteen, Banana plants) to avoid monocultures and to have a larger product variety in times of price fluctuations.

Coffee processing and production

After harvesting the coffee beans, the beans will go to the husking machine, where they are de-husked. The machine will also do the sorting and grading, as well as emit foreign material. The second step is the roasting. For the Khao-Thalu 3-in-1 coffee products, the green beans are roasted several times at high temperatures (ca. 180°C), especially if the be-

ans are small and underdeveloped. Moreover, the silver skin of the beans is not polished off before further processing, as the strong roast makes up for this lower quality criterion. Other coffee products do not need to be roasted very strongly, as the bean's quality is more sufficient.

After roasting, the beans will be grinded in the grinding machine. Once roasted and ground, the coffee is dissolved in water. The machines at Khao-Thalu Coffee will boil the water and reduce the air pressure (vacuum evaporation), by which the coffee solution is concentrated. This process is called "spray drying". After that the caffeine is added to the now soluble coffee. The spray drying can process up to 20 kg/h.

Overall, Khao-Thalu coffee has several plants. One is mainly producing the 3-in-1 coffee products and covers all processing steps, from grinding to packaging. Roasting and husking is done at another plant.

In order to have the final 3-in-1 product, non-dairy creamer and sugar is added to the spray dried coffee. After having done some market research, the group found out that Thai people favor the flavor of non-dairy creamer, which is gained from palm oil. Moreover, it is more suitable to follow the dietary habits of a larger group of the population, such as vegans. Overall, Khao-Thalu coffee produces about 10,000 containers of coffee products per year (7,000 kg of "3-in-1" per month).

To maintain its market share and to be competitive on the market, the group offers a highly value-added, community development product, which mostly serves the local Thai market. It now offers four different types of coffee products. The group has also been certified by several agencies (e.g. Halaal certificate, Thai FDA and OTOP certificate) and has won a prize for the best farmer group awarded by the crown prince Vajiralongkorn.

About two years ago, the group received some government funding at no interest rate, from which they bought machinery and trucks. The market for this type of instant coffee is expected to further grow within the next years.



Coffee plant with flowers (partly infected by fungal diseases).



Three different qualities of coffee.



Final 3-in-1 coffee product.



The company's products as a gift for the visitors.



Discussion during plantation visit.

Rubber-Based Agroforestry System

Valerie Kersting

On Sunday, the 10th of March 2013, we visited a rubber based agroforestry system near to Thachang. The Farmer Tuan Sovijang and his family built up an agricultural learning center 45 years ago on their own farm and they teach regional people, who are interested into small-scale agriculture and exchanging ideas with the local community and do some activities and projects together. Besides the education center, they cooperate with research stations, which take soil samples for soil and diversity studies.

The farm is divided into three parts: their garden, animal husbandry and rubber agroforestry.

In their garden they have a lot of different plants and herbs, which are used for demonstration, animal feed or have healing properties, for example *Thunbergia laurifolia*, which has detoxifying and anti-allergic effects.

For demonstration they also keep animals like ducks, chicken, and pigs. On one side they rear the European pig type, which they feed with concentrate feed in form of pellets and keep them on coconut bedding. The local Asian breed they keep on concrete floor so that they have nothing to play around with, but because they cannot sweat and the outside temperature is much higher than the optimal temperature of 20°C, they use the cooler concrete floor to loose heat through lying on it. They feed the Asian type traditionally with banana stamps and kitchen residues, but do not let them go out grazing in the forest so that the Asian breed look very skinny and not as well fed as the European breed, which is fed with pellets. In the old traditional

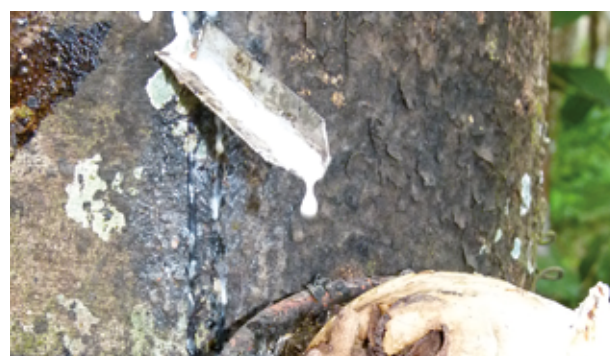
way of letting the pigs graze in the forests they also pick up insects and worms as protein feed besides plants, because they cannot synthesize essential amino acids. To enhance their physical status the pigs should be fed with a good protein source like concentrate feed, soybeans or legumes. It also would reduce the actually very high mortality rate of 90% of the Asian pig breed.



Local Asian pig breed.



Rubber tree with cut bark and latex collection device.



Collecting the liquid latex in cups.

When Tuan Sovijang built up his education center, he also bought 16 Rai of rubber wood from a traditional farmer and started to create a rubber agroforestry system due to planting other plants like herbs, yams, pineapple, and bamboo between the rows of rubber trees for a natural regrowth of biodiversity in the secondary forest. Rubber agroforestry systems are an agricultural practice for small-scale rubber farmers to enhance the ecological integrity and crop diversity, meaning the production of trees and a variety of crops or animals, which grow together at the same time and on the same area. According to the philosophy of natural rubber production, the farmer shares his products from the forest with the community and has no economical goals. If anyone needs wood for furniture, herbs, fruits, or other plants, one can go into his forest and take it.

The rubber trees grow in combination with other trees and plants and are left to grow uncontrolled without weed control or enhancement of soil fertility. There is no implementation of controlled intercropping with food crops, timber trees or cover crops and trees. In terms of weeding, plants are sometimes cut to get access to the trees. The farmers do not apply any fertilizing management and they quit the use of chemical fertilizers. Irregularly, when they have enough ferment, fuel, and plant extracts they spread them in between the trees. The tapping of the trees starts, when they are seven years old. Tapping is first only done on one side on the top of the tree from the left to the right side and after another seven years they change the side of the tree and start to cut another row down. Because they cut them very carefully, they can use those trees until they are 40 years old. The liquid latex is col-

lected in cups and accumulated, so they do not have to cut every tree every day. They do not add value to their product by cleaning, drying, or smoking it. The raw product is sold to the local market or to the factory. The rubber price is fluctuant, but currently at a level of 40 Baht (1.069 EUR) per kg raw material. This price is still lower than the labor costs and there is no price difference between the raw rubber from traditional or natural production.

After using the trees, they are sold to local wood traders, which come to the farm, give a price and cut the trees by themselves. From the rubber wood they mainly produce furniture. One worker is required for tapping. The farmer himself goes cutting sometimes during the day. To have the best yield, they start tapping the trees at 2:00 am until 5:00 am, equipped with a headlamp. During these morning hours, when it is dark and cold outside, the latex is more liquid and will flow out of the bark more easily. No hormones are used to make the latex flow easier, which is done in conventional tapping. Actually, they tap on a lower intensity: 700 from 1,400 trees. A tree is tapped every third day and generates an average yield of 2 kg rubber/tree/year. From March to May, when the leaves fall down, the farmers stop tapping the trees and start again when the rainy season begins.

The rubber industry of Thailand is dominated by small-scale farmers, which have a lower productivity compared to big plantations. Like the farm we visited, most of the small-scale rubber plantations are lacking management techniques and technologies to improve production

In the case of the natural produced latex and rubber wood as well as in the pig

husbandry the farmer do not generate extra money for his alternative way of production. Through an individual initiative of creating a local brand (e.g. for their special pig meat) they could increase the household income and reserve the Asian pig breed. However, they don't want to do active promotion and until now there is no special market for rubber produced in a natural way or meat from local breeds and traditional animal husbandry.



Explanation and demonstration of a useful plant on the farm.

Univanich Palm Oil Public Company Limited

Thomas Eickel

Univanich has been a pioneer of the oil palm industry in Thailand since 1969. Today Univanich is one of Thailand's leading palm oil producers and the country's largest exporter of crude palm oils and high quality oil palm seeds. The three oil palm crushing mills of Univanich Siam Factory, Lamthap Factory and Topi Factory are located in Krabi Province, in southern Thailand. Worldwide oil palm plantations are generally located within the 10th degree latitude.

Univanich has 6,200 ha own oil palm plantations and purchase approximately 80% of their palm fruit from approximately 4,000 small-scale farmers with mostly less than 8 ha. The farmers altogether cultivate about 40,000 ha. Creation of surplus value is up to the farmers. Univanich is operating principally on the processing work. The three mills produce more than 150,000 tonnes of palm oil annually.

The company's main operating branches are oil palm plantation, crushing mills, oil palm research, and seed production. The main products are Crude Palm Oil ("CPO"), Palm Kernel Oil ("PKO"), Palm Kernel Cake ("PKC"), hybrid oil palm seeds, and seedlings. The wastewater of the factories is used for methane production, adding value to the company.

On the excursion, we visited Topi Factory with the crushing mill, biodigester, powerhouse, and Univanich nursery and a typical oil palm plantation. Univanich plans to expand production in the future.

Nursery

Hybrid seeds express favorable traits like fast plant growing, higher yield and drought tolerance. The germina-

tion of the oil palm seed occurs during three months in wet plastic bags. 75% of the plants are selected for cultivation. The kernels are planted in a special soil, which contains 4/6 parts of top soil, 1/6 of shell, and 1/6 of palm oil mill effluent ("PMOE"), so the plants are adapted to the natural soil conditions and thus promote root development and overall plant resistance. After 12 months, the plants reach a weight of 13 to 15 kg being ready for plantation. Univanich sells the seedlings to collaboration farmers, so the company can guarantee that farmers cultivate oil palm plants with an appropriate quality, selling the harvest later to Univanich factories. Univanich exports germinated Deli x Yangambi hybrids to growers in over 15 countries in Asia, Africa and South America.

Tissue culture

Oil palm tissue culture is the next innovation in oil palm breeding and expected to become more popular in the future. For economical sustainability, Univanich is developing a new generation of high yielding oil palm clones.

Oil palm plantation and research

Oil palm starts bearing bunches 2.5 to 3 years after planting. After 25 years, the plants have to be replanted for two main reasons: First, the harvest is highest from 10 to 15 year old plants, decreasing with age, and second, the harvest at older palms, higher than 15 m, is too difficult to manage. Most of the harvest is done manually, cutting the fresh fruit bunches ("FFB") with a sickle. Some machinery, farm equipment, and trucks for FFB transportation are required.

Harvesting happens two to three times a month. The plantation has normally 140 trees per hectare and 17 to 28 t FFB, or 4 to 6 t oil per year and hectare, or about 200 kg FFB per tree and year. Thai farmers earn 1,500 to 2,000 Bath (40 to 54 EUR) / t FFB. The price per ha of agricultural land in Krabi province rose up to 15,000 EUR because of high value change of oil palm plantation.

The water requirement for the plantation is mostly met by rainwater, but from December to April there is a soil water deficit from 50 to 350 mm in Krabi. In dry seasons about 450 l of drip irrigation per day and palm are required. Univanich has installed storage lakes for this purpose. Irrigation and fertilizer application increase the yield by approximately 10 t FFB per ha, but not all farmers do irrigate.

On some plantations empty fruit bunches ("EFB") are used as fertilizer, reducing the need for chemical fertilizers, covering the soil, conserving moisture and reducing chemical weeding. The Legume *Pueraria* is convenient as cover crop.

Univanich started the first replanting of oil palms in 1992 and has developed different replanting techniques. Underplanting spreads the economic cost of replanting, optimizes the use of biomass nutrients from the old stand of palm and prevents a total break of farmer's income. It is done by cutting every second palm.

The Univanich Research Department is employing 100 people and has more than 650 ha for field trials. Research areas include oil palm breeding and seed production, irrigation research, planting density trials, replanting trials, oil palm tissue culture, DNA marker research (with Kasetart University), methane biogas capturing and others.

Factories

The largest proportion of oil is found in the mesocarp extracted as CPO. It is dark red due to different carotenes contained. CPO has to be sterilized and cold-pressed. It is used as both cooking oil and biodiesel. The kernel oil PKO is principally used for margarine or soap and other cosmetics or industrial products. The oil extraction rate in CPO and PKO production is between 18 and 20% of FFB. 2011 Univanich factories processed 908,000 t of fruit, producing 179,000 t of palm oil, 154,000 t of CPO and 22,000 t of PKO. This equals approximately 9% of Thailand's CPO.

FFB processing capacity of Univanich factories is about 135 t/h. Topi factory has a capacity of 60 t/h. The utilization rate of Univanich factories in 2011 was about 66% throughout the year, 24 hours daily. Worker's salary is, depending on skills, between 300 and 500 Baht (i.e. 8 to 13.50 EUR) daily.

Fiber residues are used as a fuel to generate electricity in the palm oil processing mill itself by being fermented in a biogas plant nearby. The electricity generated in the factory is between 1.350 and 1.500 kWh or about 100% of total electricity consumption, the rest is fed into the grid or purchased from the grid, respectively. PMOE is generated at various points during processing in the oil mill. These include sewage sludge, sterilization condensates, fruit washing water, tank and decanter drain.

Methane capturing and renewable energy from factory waste water

From 2007 to 2009 Univanich completed the construction of three biogas digesters, one attached to each factory. The anaerobic digester of Topi factory

contains 60,000 cubic metres of waste water, originating from PMOE. Bacteria within the digester ferment the organic fraction of the factory wastewater, and emit gas, which is captured under a balloon cover. The balloon cover is the cheapest technique to cover a big digester. The emitted gas contains methane, carbon dioxide and trace gases such as hydrogen sulphide. Hydrogen sulphide can cause corrosion damage on the long run, therefore the emitted gas is cleaned in a bioscrubber, which reduces the hydrogen

sulphide content from 2,500 to 100 ppm. The clean biogas (high methane concentration) is able to fuel three gas engines in the powerhouse to generate up to 2.7 megawatts. After transforming, the electricity can be fed into the provincial electricity grid and be sold to the provincial electricity authority. The digester is cleaned out every year and the residues are used as fertilizer for the plantations. By capturing and utilizing the methane the company manages to reduce greenhouse gas emissions.



Seed propagation unit.



Cernel oil.



Young plants in the field.



Laboratory plant propagation testing.

Dirk Landmann

The Phatthalung Dairy Cooperative Ltd. in Phatthalung was founded in 1982, had the first dairy plant in 1984 and started with the production of UHT-milk in 2012. Nowadays, the cooperative has 294 members (224 active and 70 passive), and the members own 2,341 cattle (1,086 dairy cows) in total.

On the 12th of March 2013 we visited the Phattalung Dairy Cooperative, a university dairy farm and a small-scale dairy farmer.

In the Phattalung region, 13,000 cows are producing 13 l per day and cow on average. The income of the cooperative comes from dairy business, bank-business, selling animal feed and ice cream. The cooperative also offers several services for farmers like artificial insemination, veterinary service and much more. The members own 30 animals and 8 Rais (1.3 ha) on average. The breed of the cows is a mixture of Holstein Friesian (75%) and the local Thai-Zebu cattle. These breeds are crossbred, because of the Holstein Friesian weaknesses like heat stress and skin, which is less sun-tolerant. The main trait of Holstein Friesian cows is the amount of milk produced in one day. The milk processed comes from two different areas. One area is around Phatthalung and the other one around Pranburi. In total the cooperative gets 45 tons of milk per day (15 tons from Phatthalung and 30 tons from Pranburi). In the region of Phatthalung there are 100 farmers, each producing 150 kg of milk on average per day.

The milk is tested in two ways after arriving. One test analyses the pH-value of the milk and the other test is the acid

test for mastitis with 68% of alcohol. The mastitis test is made directly for each pot arriving at the cooperative and the other test is made from samples later on.

The milk must be cooled down to 4°C in 24 hours. The minimum fat content is 3.3%. The price depends on the amount of milk, the fat content, the number of somatic cell counts and the absence of antibiotics. After calving it is not allowed to use the milk of the first six days. If a farmer is not obeying these rules, he gets less money for one month, which is a very hard sentence for the farmers. If the milk plant discovers a health problem in one of the herds and the farmer cannot solve the problem himself, the cooperative sends a veterinarian to the farm to check each cow.

The milk is prepared by two processes before sale. The first one is homogenization and the second one is pasteurization (heating it up to 80°C for 16 min.). The cooperative produces plain milk (82 to 93% of the total milk) and milk with the flavor of chocolate, pineapple, orange, banana or coffee (7 to 18% of the total milk).

Almost 40 tons of milk per day are produced for schools. The school milk is passing the UHT-process where it is heated for 3 to 4 sec. up to a temperature of 139°C. The school milk project is run by the government, which is offering the milk to schools for a lower price. Normally the supporting money is given to the local administration and later to the farmers. If the farmers sell the milk to the school project, they get a guaranteed price of 7 Baht (0.18 EUR) for 200 ml.

The cooperative was also thinking about

organic milk production, but at the moment the costs are too high and the acceptance of the consumers is too low. If the the farmers sell the milk to the supermarkets they usually get a price of 10 Baht (0.26 EUR) per 200 ml and the production costs are 5 Baht (0.13 EUR). The milk board, where the ministry of agriculture has the majority sets the milk price. The decision of selling the milk to the school project is made because of the price guarantee, even though they could earn more money by selling to supermarkets.

The conditions to be a member of the cooperative are to own a farm and to produce milk. The cooperative is organized by a president and a board. The board is elected by the members every two years. The cooperative's main idea is: "One farmer, one vote". If a farmer wants to be a member, he has to pay 50 Baht (1.31 EUR) plus 5 Baht (0.13 EUR) per stock for entering the cooperative. The farmer has to buy at least 50 stocks at the

beginning. The difference between a farmers group and a farmers cooperative is that the cooperatives are supported by the government and that they even have their own governmental department. The cooperative is regulated by a law and it has to be formed by more than seven people. Another way to get support from the government is to get a loan of 1 million Baht (26,289 EUR) per year. For this loan farmers have to form a group and plan a project in which more than 50 people have to participate.

We also visited two farms. One was run by the university and had the main goals of research and teaching students. The other farm was run by a private small-scale farmer (see table below).

For artificial insemination (AI) the semen used is produced in Thailand and the target is to have a milk yield of the Holstein Friesian like in Denmark and Germany.

On the university farm, the calf is wea-

Comparison of the University farm and the private small scale farm.

Variable	University farm	Private farm
Cattle / in dairy cows (n)	70 / 34	40 / 27
Total milk yield (kg/d)	360	380
Milk yield per cow (kg/d)	11	14
Breed	Holstein Friesian (87.5%) x Zebu	Holstein Friesian x Zebu
Feeds	Grass, Rice straw, Concentrate	Grass
First calving age (months)	24	27
Calving interval (days)	385	
AI Non return rate	3.5	
Calf mortality (%)	2	
Lactations per cow (n)	7 - 8	8
Workers (n)	5	4

ned at an age of 3.5 months. With an age of 15 months the heifers get inseminated and are having their calf at an age of 24 months. On this farm, the Dairy-Promotion organization chooses the bull for each cow and the farm follows their recommendation. The heat of the cow is detected by the observation of the workers. The biggest problem of the university farm is the prevalence of mastitis. On the day of our visit, three cows got mastitis treatments.

In total, there are five workers on the farm. The highest cost in the production is the concentrate. The university farm is cutting the grass for fodder every 40 days and the concentrate costs 8.5 Baht/ kg (0.22 EUR). The employed workers earned 135 Baht (3.55 EUR) per day before the reform of the workers' rights. Now, they are earning 300 Baht (7.89 EUR) per day.

The small-scale private farm had four workers in total, who are the farmer couple and his parents. The private farmer has 15 Rai (2.4 ha). He wants to expand, and increase his dairy herd from 40 animals to 100. The farmer is harvesting 750 kg grass per day and cultivating 40 Rai (6.4 ha). He is cutting the same plot every 14 days. He can harvest five days from one Rai. For fertilization he is using

25 to 50 kg UREA (46% N) per year. In total the cows get 40 kg dry matter per cow and day. The grass the farmer is feeding is paragrass, a tropical grass that does not need to be replanted. The farm also has water sprinklers above the feeding troughs, which run when it is too hot for the cows, mostly two hours in the morning and two in the afternoon.

70% of the calves are born in October even though it is not seasonally planned. After calving, the farmer is separating the cows right away and the calves get 6 l first of colostrum and then of milk a day. The calves are weaned at an age of three months. After five days the calves get dehorned with Sodiumhydroxid and Calciumhydroxide. The private farmer can sell the male calves for 700 to 1,000 Baht (18.40 to 26.29 EUR) at an age of one week. The veterinarian is coming every week to generally exam the cows and cut claws, if necessary.

Both the university and the private farm are selling the milk to the cooperative and getting a standard price of 18.5 Baht (0.49 EUR) with a minimum fat content of 3.3%. The milk price is stable, moving between 16 and 20 Baht (0.42 to 0.53 EUR).

On both farms almost every cow had problems with the claw edges. The claw

crowns were swollen, which is a sign that the protein content in their feed is too high. Normally a cow needs a ratio of 13 MJ ME (metabolizable energy) per g CP (crude protein), but the private farmer, for example, was feeding 15 MJ ME/ g CP.

Compared to Germany the milk yield is relatively low. Reasons for the relatively

low milk yield can be the overall health condition of the cows, the feeding situation, which could be optimized and the breed. It seems that they almost have 100% Holstein Friesian, which are not heat tolerant at all, they tolerate a temperature of 20 to 25°C.



Cows on private farm.



Water sprinkler.



Calf.



Arriving of milk cans at the cooperative.



Dairy cows at university farm.



Packing facility in the dairy cooperative.

Ban Khaow Klang Community Enterprise

Lea Strub

On Tuesday, 11th March 2013 we visited the Ban Khaow Klang Community Enterprise in the Sangyod Rice Village. We were welcomed by the chairman and by Assist. Prof. Dr. Amonrat Thanonkaew from Thaksin University, who has been doing her research in this community for many years.

In the community, the Sangyod Rice is grown, processed and marketed. After a short introduction of the enterprise, its form of organization and a presentation giving details on the different products produced, we had the chance to visit the rice mill and a shop selling the products at the community center.

In the following, I will summarize the information given dividing it into details on the enterprise, the distinctive features of the Sangyod Rice and the special way of processing and marketing of the enterprise.

Community Enterprise

The community enterprise consists of two different types of members: there are permanent members, which invest in the enterprise and can benefit from revenues. The other members are only cooperating and selling their products to the group. Currently there are 88 permanent members and 250 farmers that cooperate with the enterprise.

The central goal of the community is to have an independent value chain from the primary production of the good to the completely processed good in the end. The community's most important goals are traditional and quality values. The enterprises' philosophy does not rely on profit maximization but more on the

satisfaction of the consumers and producers. The prices are to be fair for both and the quality of the products is very important and regularly checked.

The enterprise is very much embedded into the village. Drinking water is produced and they possess a gas plant. The community has one common harvester, especially for the older farmers. A lot of charity work is done and the money earned is often used for the village. The community within the group is very strong and of major importance. The chairman of the farmer group is also the major of the village. A problem of the community is that many children are not staying in the village but rather moving to the cities.

Assist. Prof. Dr. Amonrat Thanonkaew has been doing her research in this village and has been supporting the community for many years. Especially in the case of filing proposals for government support, she has played an important role and has influenced the development of the different products significantly.

Sangyod Rice

The Sangyod rice is native to Southern Thailand and was originally grown around Songkhla Lake and in the Phattahalong Province. In 1987 the variety was improved under the so called pure line selection by the Phattahalong Rice Research Center and was then given back to the farmers.

The vegetation period is 130 days long. No chemicals are used in the process, meaning no herbicides and no pesticides. Only mineral fertilizer is applied such as NPK with a concentration of 16/20/0.



Rice field with traditional rice variety.

The big problem in the growth process is that this is a low area and the fields are almost constantly flooded. The harvest can only take place at the end of the dry season. This is why there can only be one vegetation period a year. Furthermore, the fertility of the soil is very low. The yield per rai is approximately 500 kg, i.e. around three tons per hectare. The rice was said to be very strong and well adapted to the area so that there are not many problems with pests even though it is the main crop in the area.

The brown rice has a red color and the coarse rice is pink and white. The rice is said to have a higher nutritional value with a higher iron, vitamin B and niacin content. It contains compounds that have an anti-inflammatory and anti-cancer effect.

Specialty Market – GI and GAP

Since 2006 the rice has been protected under the law of geographical indication (GI) under the name "Sangyod Muang Phattalung Rice". This means that the rice is traced and the original can only be grown in the specified area. Officially the

name of the Sangyod Muang Phattalung rice can only be used, if the rice is grown in the region and a certain quality production is being applied.

There have been cases of people using the name illegally. The enterprise has not undertaken any steps to pursue these cases. Their response to this is that they have their fixed customers and are making sufficient profit. The higher profit is not important, if the people are happy in the village. Therefore they don't see the need to follow up on this.

The rice is being sold all over Thailand. Contracts exist with different supermarkets. The rice is especially being sold in health food stores and to people, who have a special connection to the region. It used to be especially grown for certain festivals. They are debating about exporting the rice and the government has been supporting this project, but until now the quantity being produced is too little. Currently approximately 10,000 tons are grown per year in the Phattahalong province. Furthermore, the GI is only registered in Thailand. To overcome this

difficulty they are also certified by the Good Agricultural Practices (GAP), which are more recognized internationally. In order to become known better, in preparation for export they have been participating in exhibitions in other countries.

The price of the rice is significantly higher than that of standard rice. For the “Sangyod Muang Phattalung Rice” 17,000 Baht per ton are paid compared to a rough average of 10,000 Baht per ton for rice varieties such as normal white rice.

Special Products and Processing

The processing of the rice takes place at the community rice mill. The process was similar to the one seen at Charoen Pok-phan Co. Ltd. Rice Mill. Starting out with the drying, then de-husking, sorting and cleaning, continuing to the polishing and then packing. Around 150 tons of rice are processed within one year. Around 45 to 50% of the rice is lost in the process from paddy to polished rice. The husk is used for heating of the silo and to make oil,

which is done by another group.

Several machines used were given to the community enterprise by a private company in the context of corporate social responsibility.

The enterprise furthermore receives support from the government, for instance, a ten million Baht investment into machines. For the last three years the production has become larger through these interventions, and for one year the production site has been certified by Good Manufacturing Practices (GMP). The machines are still very new and not well known by the members. But they also receive technical support from the government that is training one worker and teaching him the necessary skills.

All farmers in the surrounding can use the rice mill since it is supported by the government. They only charge the running costs. The farmers bring their rice there individually and the marketing is then done by the group. No middle-man



Excursion participants inspecting the rice mill.

exists. The farmers bring their rice and it is tested for the quality and the moisture (average moisture is at 22 to 24%). The rice is dried and then the quality is controlled and farmers are paid accordingly.

The broken rice that is created in the process is sold cheaper or used for further production of goods such as flour or sweets. The community produces special products from rice, such as flour, sweets, rice grain oil, shampoo and body lotion.

Conclusions

This point of the program was about understanding the value creation around an indigenous rice species sold to a very specific market and adapted to certain growing conditions. There are two challenges they have to face: the state of almost constantly flooded field and the low fertility of the soil. The yields are very low, but the community enterprise seen has used the particularities of the region as an opportunity to produce their special products. There are not many alternatives than rice production in the area. It was noted that the important aspects in this community enterprise was the strong cohesion within the village and the commitment of the professor of Thaksin University.

Further Literature

Thanonkaewa, A., Wongyaib, S., McClements, D. J., Decker, E. A. (2012): Effect of stabilization of rice bran by domestic heating on mechanical extraction yield, quality, and antioxidant properties of cold-pressed rice bran oil (*Oryza sativa* L.). *LWT - Food Science and Technology*. Volume 48 (2), pp 231–236.



Traditional rice harvesting by hand demonstrated by an older community member.

Thale Noi Waterfowl National Park and buffalo husbandry in natural wetlands

Dominic Ganser

The Thale Noi Waterfowl National Park is located in the South of Thailand, spread over three provinces. The National Park covers an area of around 285,000 ha and consists of peat swamp forest, grassland and some rice fields. The department of National Park, Wildlife and Flora and the Ministry of National Resources and Environment declared it as a non-hunting area in 1975. It is the first Ramsar Site in Thailand. Ramsar Sites are founded for conservation and conservative use of wetlands. The secondary forest accrued after primary forest was destroyed by fire and storms. Storms occur periodically and destroy a huge number of trees. The conditions for plants and animals are very harsh. The reasons for that are high water level and periodical flooding. All of the native species are therefore well adapted to the area. The Thale Noi National Park hosts a big variety (180 species) of waterfowls including migratory as well as indigenous species. Migratory species are mainly from Australia. Besides the sound of these many different birds, the many different coloured water plants (e. g. water lilies, reed, bulrush and lotus) and the swamp buffaloes are the highlights of the park.



Canal in the wetlands in morning light.

The National Park has one headquarter for administration issues and visitors. Furthermore, there are several small centers spread over the park. Up to eight staff members are responsible for each area. They have to control water condition, keep birds under review and prevent illegal usage of the park. Many farmers still use parts of the land for farming, but human impact should be minimized in the park. The collected data about water condition and bird observation is saved electronically and shared for scientific purpose. There are several projects by the government and universities especially about the development of the ecosystem. There is an increase of one centimeter of peat-land every year. To stop the growing of peat, they take it away yearly.

As it is a non-hunting area, it is not allowed to hunt or to collect plants. Fishery is a special case. Due to the fact that many fishers in the area are heavily dependent on the fishing grounds, fishing is allowed for registered fishermen. They strictly have to follow the regulations of the fishermen department. The swamp buffaloes occurring in this area were



Water buffalo calf.



Stable for water buffalos.



Water lillies in the swamps.

brought a long time ago by people and have a long tradition. Therefore the buffalo production in the wetlands is still allowed as well. There are eleven farmer groups taking care of the buffaloes. The buffalo production there is strongly associated with the separate seasons:

During the dry season from February / March until October, the animals graze freely on the fields. The farmers just control the number of animals every month. In this period most farmers also have another job. Sheds, which are built 1.5 m above the ground, are visited by buffaloes just once a week. Buffaloes eat several kinds of vegetation. They can also dive to pick the grass under water. Therefore the feeding is no problem.

During the rainy season, when the water rises, the buffaloes leave the flooded area and go back into the sheds. The water can rise up to 2 m. Now every morning the farmers have to lead the animals to the grazing areas and bring them back in the afternoon. These areas can be up to 2 km away from the sheds. If there is too much water, the farmer has to cut extra grass and feed it to the buffaloes at the shed. At this period the buffalo production becomes a full time job and is dangerous for the animals. As a farmer you have to look for the buffaloes frequently. It is not uncommon, that several ani-

mals die at once because of heavy rain falls (200 in the last rainy season). Due to the long tradition and experience, the farmers treat every illness of the animals themselves. Often they have no veterinarian in the area. The farmers use own-cut herbs as medicine. Moreover, there is no use of ear tags, because every farmer knows each of his buffaloes. That points out the close relationship between animals and humans. Because the hand ploughing machine took over the task of buffaloes in agriculture, the use of buffaloes as draught animals is not necessary anymore. The farmers today just use the meat of the animal.

There are two different kinds of markets for buffalo meat. On the one hand, there is a special market, where Thai people buy meat for ceremonies. For these celebrations, they traditionally need buffalo-meat, which is from the described area. On the other hand, the farmers sell the meat at normal markets.

Buffalo production is not a very profitable business. But it is becoming more and more popular. One reason for that is the long tradition of swamp buffaloes in Thailand and another reason the alarming decline of buffaloes in the past years.



University members and excursion participants in boats.



Water buffalo calves.



Skipper.

Rice farming with integrated duck-egg production

Christina Grotelüschen

On Wednesday, the 13th of March 2013 we visited a farmer group with integrated rice and duck-egg production near Phatthalung, South Thailand. This farmer group was founded in 1999 and now consists of 80 smallholder farmers from the surrounding area producing organic rice, which is processed traditionally.

reduced to 200 kg/Rai, implying 1 t/ha. In comparison, conventionally produced rice on average supplies 6 t/ha. Together this farmer group cultivates 40 Rai irrigated rice, which represents about 6.4 ha, resulting roughly in 7 t of rice grain per cropping season. The organic rice is then sold for 50 Baht/kg.



Ducks on flooded rice field.



Ducks on the way to the farm.

Formerly this area was characterized by low income, high economic vulnerability and high unemployment rate. The farmer group therefore is a form of risk management and besides is offering employment to people in the area, especially for old, unemployed women. The farmer group offers employments within the whole rice production line, including harvest, husking and milling, all done with traditional equipment and without machinery. Especially old women without a chance on the labour market are employed. Further, the group offers schooling in traditional rice farming. However, as the rice is produced quite extensively, with only a little adding of compost from molasses, rice husk and cow manure, and there are great problems with rats, the rice grain harvest is

The aims of this farmer group therefore seem to be rather creating social benefits than economic profits.

One member is keeping 2,000 ducks for egg production additionally to his 10 Rai farmland. This member is cultivating his farmland independently, but the farmer group bears liability for the credit to invest in the purchase of the ducks. These ducks are kept on the flooded, harvested rice fields during the day from 8:00 am till 16:00 pm and fed on remaining rice grain, snails and eggs from various insects. All ducks are kept in one group and are moved to another rice field every second day. As his own farmland is not sufficient to provide enough feed for the ducks, he is allowed to use the neighboring harvested rice fields as well, without

being asked for any payments. Overnight they are kept on a drained rice field in a corral 9 x 9 m in size. This means that one duck can only claim 45 cm². On the one hand, corralling is done to keep the animals together and protect them against predators, in this area predominantly dogs, but also to more easily collect the eggs laid in the morning. Ducks lay the eggs directly on the floor, so there is no nest building and therefore no bedding material necessary. During the cropping season of rice the ducks are kept in wetland areas which are about 50 km away from the rice fields.

The ducks are bought by the age of one year for 85 Baht/duck and kept till the age of four to be then slaughtered and sold for 30 Baht/duck (1.00 Euro is about 37.9 Baht). The price reduction is due to decreasing productivity of the ducks within these three years. The ducks get one vaccination at the age of 18 months. There are normally no other expenses as there is no supplementary feed given. Exceptions are made in times of very high water levels. Shelter is just provided during the rainy season to reduce the disease pressure. On average the ducks lay 1,200 eggs per day, which sum up to about 432,000 eggs per year and 1,296,000 eggs during the entire three years usage of each duck group. These eggs are sold on the local market and price 3 Baht/egg. To be able to afford the purchase of the 2,000 ducks, this farmer got help from the farmer group to borrow money from a private loaner who charges 5% of interest. These informations lead to the following assumptions:

Duck purchase:

- 2,000 ducks x 85 Baht purchase costs x 5% of interest = 178,500 Baht expenses

Duck-egg sale:

- 432,000 eggs per year x 3 Baht sale x 3 years of usage = 3,888,000 Baht revenue

Duck sale:

- 2,000 x 30 Baht at slaughtering = 60,000 Baht revenue

Therefore the farmer earns 3,948,000 Baht from egg-production and slaughtering during the entire usage of one duck group. However, from that earnings there still has to be subtracted the expenses for purchase and interest rate and also the expenses for the next duck group. Therefore the overall revenue aggregates to 3,591,000 Baht for the entire usage, which is a daily earning of 3,325 Baht, about 87 EUR a day. But these calculations do not include expenses for vaccinations and supplementing feed if needed and also assume a 0% mortality rate, which is not realistic. Furthermore, the time during moulting, where the egg production is significantly reduced, is not considered. Anyways, the integration of ducks still seems to be economically advantageous. To reduce investment costs, the ducks could be bred by the farmer himself. However, up to now this is not done due to missing raising facilities. There are also some ecological advantages from this integration. As the ducks feed on snails and eggs from various insects, the pest pressure is reduced for the following rice season. The droppings of the ducks provide nutrients for the following planting season; they are a form of organic fertilization. Anyways, the farmer stated that he is still using some inorganic fertilizer in addition, in contrast to the farmers group.

Palm Sugar Production in Songkhla

Alli Kamalanathan

Sugar palms as well as coconut palms and rubber trees are often grown by farmers as a form of insurance additionally to vegetable and animal production. In the case of the palm sugar production in Songkhla, the owner had 45 Palmyra trees mainly for the production of palm sugar.

The Palmyra Palm (*Borassus flabellifer*) is a sugar palm, which is used for various purposes. A great benefit of this palm is that the entire palm tree can be utilised. The range of usages of the Palmyra Tree is wide. For instance, the leaves can be used for building fences or roofs of houses, the strong wood for building houses or manufacturing furniture, the fruits as an additional source of income and the palm sap to produce palm juice, sugar, vinegar and alcohol.

The Palmyra fruit, also called Nungu, yields high revenue. The Palmyra fruit contains three pieces of translucent, white and lychee-like pulp, which is covered in a yellowish skin. These jelly pieces contain seeds, which can be used for seeding.

The palm sap can be tapped from both male and female Palmyra tree. However, it is preferred to have female rather than male trees as female trees they have fruits. For 10 to 12 female trees only one male tree is needed to pollinate them.

Production of Palm sugar

Palm sap for sugar production cannot only be obtained from Palmyra trees but also for instance, from coconut palms, date palms and other palms. The differences can be tasted in the various types of sugar.

The Palmyra tree can first be used for sugar production, from the age of 20 years. Then it can be used for more than three generations or more than 100 years. After the use the wood is used for building. However, it is difficult to determine the age of a tree, as Palmyra trees do not have annual rings.

The palm juice is obtained by collecting the sap from the cut inflorescence. The container will be affixed to the inflorescence to tap the juice. It will be changed once a day, which means that from



Sugar palm fruit.



Climbing the sugar palm for sap collecting.



Mixing of sugar liquid.

6 am to 3 pm the first container will be affixed and from 3 pm onwards the second. Hence, the visited farmer has to do about 90 climbs daily for collecting the sap.

The sap can directly be sold as palm juice for drinking. For sugar processing, the sap has to be boiled in a large pot on a wood-burning stove for seven hours, so that the water in the palm juice can evaporate. The result is concentrated palm sap. Besides that, boiling the juice reduces the occurrence and growth of bacteria. The resulting palm sugar concentrate is too intense to be ingested as juice and can only be further processed to sugar. The syrup can be sold in liquid or in solid form, both is used as sweetener.

For solid sugar production, the concentrated sap will be further cooked on wood fire for another 30 minutes. Under constant stirring with a spiral stirrer the sap becomes a thick brown paste. This is a caramelization process. The brown caramel paste will then be formed into small cakes and put on a leaves or bamboo mats to cool down. It takes only 10 minutes for the cakes to become solid.

The palm sugar is more profitable than the commercial sugar. While the normal sugar's prices lies at 20 Baht (0.50 EUR), the palm sugar costs about 70 Baht (almost 2,00 EUR per kg).

Production of Palm wine

For the production of palm wine, a different container for sap collection is used. A wooden container will be affixed at the cut inflorescence and left for four days for sap collection and sap fermentation. The wood contains tannins and therefore enhances the alcohol production. Its anti-bacterial character prevents bacteria growth. However, the wood

does not have anti-fungal properties, which could stop yeast growth. The yeast in the wooden container is necessary for the alcohol production. The fermented sap will be washed with wood chips and subsequently be collected in a big jug. After adding vinegar, the sap has to sit another eight days to complete the production of palm alcohol. The result of the sap fermentation is a low percentage palm wine.

This was the traditional way of producing palm sugar and other palm products. Here, intellectual property, as often experienced in Thailand, is not of importance and hence, protecting this knowledge, e.g. through patents, is also not important.

However, an issue of traditional production is the risk of low quality products. A wide range of problems can occur such as the impurity of the end products. The long cooking and boiling process to keep bacteria growth and impurity to a minimum is one method to counteract this problem, but it cannot solve it completely.

Another problem is the use of a zinc coated pots for the caramelization process. Zinc, a heavy metal, would not be allowed in the production process neither in German nor in the European market; instead only iron or stainless steel. The problem is that very small amounts of the heavy metal can get into the sugar. Then again, these very small amounts might not be harmful as sugar is not consumed en masse. But it also contributes to the lower quality of the sugar. However, palm sugar is a very common ingredient in the Thai cuisine.

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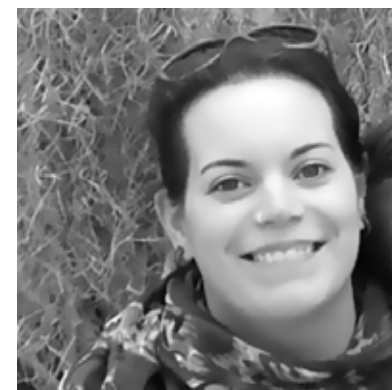
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