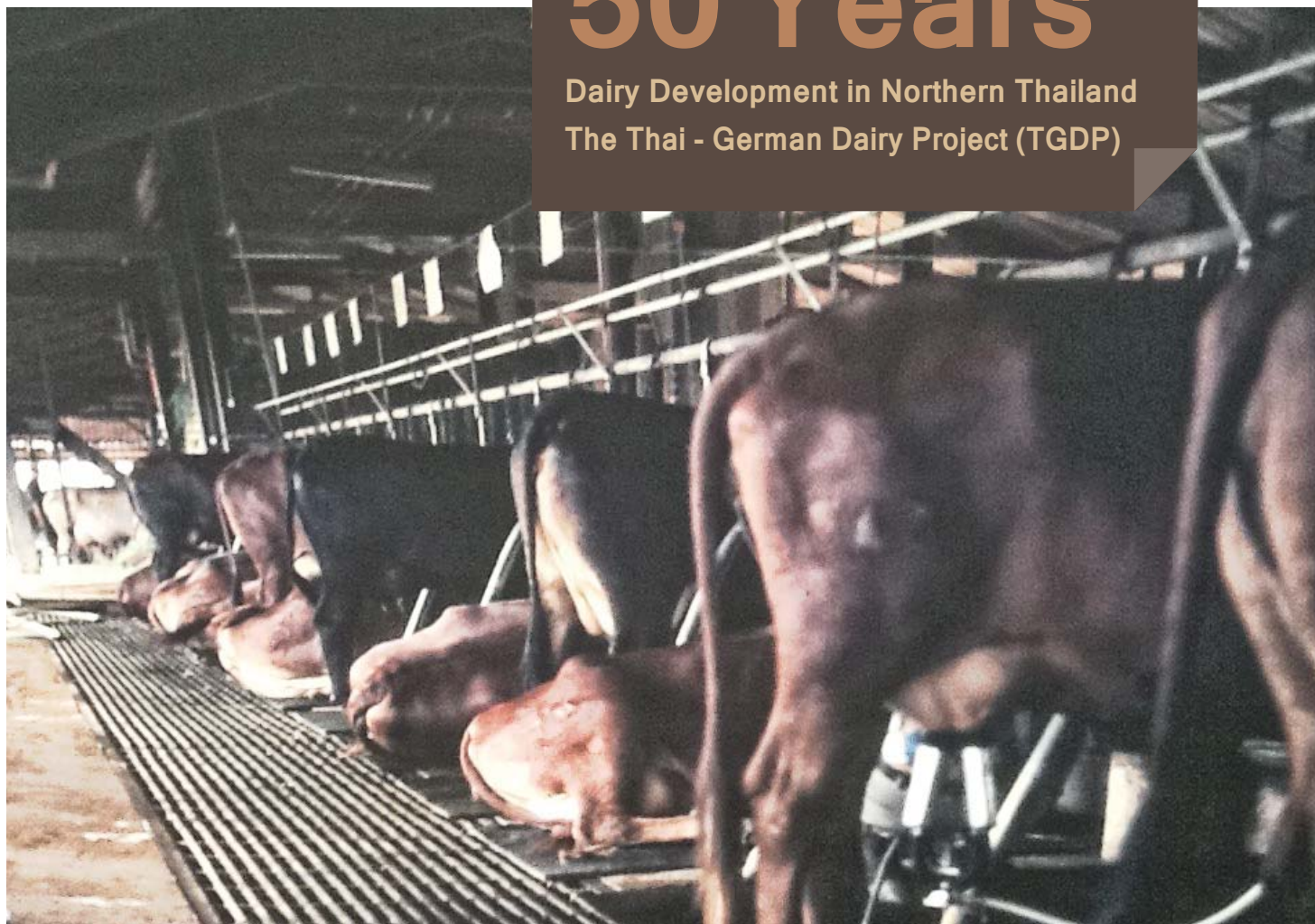


50 Years

Dairy Development in Northern Thailand
The Thai - German Dairy Project (TGDP)



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List of Acronyms

AI	Artificial Insemination
BMZ	Federal Ministry of Economic Cooperation and Development
CIDA	Canadian International Development Agency
CMU	Chiang Mai University
DANIDA	Danish International Development Agency
DLD	Department of Livestock Development
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
TGDP	Thai - German Dairy Project
USAID	US Agency for International Development

Attachments: Documents presented on attached disk

Initial Project Evaluation

Bericht zur Milchviehhaltung in Thailand, 1961 (German)

Publication by Prof. Hans-Jürgen Langholz

Artikel aus "Der Tierzüchter", 1976 Langholz (German)

Academic Activities Prof. em. Langholz following retirement

Relationship TGDP and CMU

Lübecker Nachrichten vom 11. Mai 1969

Die Lehrmeister zahlen Lehrgeld

DER SPIEGEL 26/1969

Thailand / Entwicklungshilfe/ Gefahr durch Milch

Marion Gräfin Dönhoff "Die Zeit" Nr. 3 vom 21. Januar 1972

Mit dem Helikopter zu den Bergstämmen.

The Economist, March 28, 2015

Milk and economic development, No use crying,

Bangkok Post

W. Germany gives Sheep to King, Jan 12, 1971

Sausage Exports, Nov 19, 1972

Sausages, Balonies, and delicious Meat Loaves – Made in Chiang Mai, Feb. 1973

Chiang Mai Meat Workshop a great success, Apr. 1974

Germans told to quit Dairy Farm, Aug 19, 1974

Department of Livestock Development

1977 Project Brochure

Thailand Dairy Industry

Dairy Development in Thailand

Tawatchai Indratula

Tawatchai Report on 50 Years of Dairy Development

Sornthep Tumwasorn, Dep. of Animal Science, Faculty of Agriculture, Kasetsart University

Breeding Strategy to Enhance Milk Production

Publications from the Animal Nutrition Laboratory by Dr. Jasper Holm

Feeding Tables

Fodder Analysis Base for Successful Animal Nutrition

Nutrients Produced by Cut and Carry System

Nutritive Value and Acid Content of Silage

Overcoming Fodder Shortage During Dry Periods

Providing Growing Cattle Minerals from Roughages

Yields of Tropical Fodder Plants

Assoc. Prof. Dr. Boonlom Cheva-Isarakul, formerly: Deputy Dean, Faculty of Agriculture, CMU

Impressions from a Thai Scholarship Recipient

Dr. Nico Nissen

General Characteristics of Contract Growing

Movie: The Thai German Dairy Project

Summary

During the late 1950s Thailand increasingly imported dairy products. A recognizable dairy industry did not exist. The Government therefore decided to ask Denmark and Germany to assist the country in developing a local dairy industry. Denmark met the request first and established 1962 a farm in Muak Lek, the Thai Danish Dairy Project. In cooperation with the Department of Livestock Development, the Germans decided to set up in 1965 the Thai German Dairy Project at the Huay Kaew Livestock Station in Chiang Mai.

The initial assignment focused on: genetic selection for a suitable dairy herd; assuring a sufficient forage supply; processing and marketing milk and developing smallholder dairy farms. As the project progressed the objectives were expanded to include a milk and a meat processing plant, organizing the smallholders into the Chiang Mai Dairy Group and expanding the advice to farmers into a formal extension service. Probably a most important feature was the early focus on training. Over the course of the past 50 years some 150 officers and academics have received training in the fields of Animal Production, Nutrition, Veterinary Science, Dairy Technology and Meat Processing.

The selection of a dairy breed, adapted to the climate of Northern Thailand, and suitable to perform under the smallholder's initially very rudimentary feeding and animal husbandry conditions, proved to be a long term process. Probably only during the past 20 years and due to continues efforts by the Department of Livestock Development, a well performing Thai Friesian dairy breed has been developed.

Nutrition of a dairy cow is the essential input to secure the milk yield. The project therefore established a nutrition laboratory where suitable forage plants were selected and the nutritional value was determined through chemical analysis and practical feeding trials.

During 1968, a modern milk processing plant was completed. Soon the range of products included pasteurized milk, flavored milk, yoghurt drinks, ice cream, butter and cheese.

The number of milk producing smallholders grew fast. A milk price of 3.5 Baht (or \$0.12) encouraged many farmers to enter this new line of business. Using their typical lamyai orchards, farmers harvested grass that anyhow grew under the trees, to rear dairy cattle. For the collection and marketing of milk, the project organized the Chiang Mai Dairy Group. This later became the foundation of today's, country wide operating Thai Dairy Cooperative.

The extension service advised the smallholder, not only in animal husbandry matters and milking hygiene, but importantly also in forage production. With an improved nutritional basis, also male crossbred cattle were being raised. To properly market these animals, with high quality meat, the project established a slaughter house. Now the farmers were able to sell their fattened young bulls or steers for a premium price to the processing plant.

Thailand has today a dairy cattle population of more than 600,000 animals. Of these about 50 % are milking cows. Annual milk production exceeds 1 mill t. Close to 25,000 farmers earn all, or at least part of their living, from producing milk, selling breeding stock or fattened male animals. The Thai School Milk program, initiated in Chiang Mai during the project, uses about 40 % of fresh milk produced. As of lately, business oriented Thai entrepreneurs have also established some large dairy farms where they very successfully maintain herds of 1,000 dairy cows and more.

Preface

The introduction of the dairy industry in Thailand has been a success. Keeping dairy cows has contributed to the diversification of Thai farming. Producing and selling milk has secured farm income at times of agricultural crop failures. Maintaining, feeding, and milking cows has become an additional source of income for spare farm labor. The processing industry has created jobs for thousands of employees. Today significantly less foreign exchange is required to import a small range of special dairy products.

The Department of Livestock Development played a key role by encouraging the initial introduction of dairy breeds, artificial insemination, and forage production. Still today the Department continues its strong support for the industry.

Early on the Thai Government recognized the nutritional value of milk, particularly for children. Today about 40 % of fresh milk is used in a countrywide School Milk Program.

The two foreign aid projects, the Thai Danish Dairy Farm at Muak Lek and the Thai German Dairy Project in Chiang Mai, introduced up-to-date methods of dairy farming to smallholders.

His Majesty the King lent valuable support, by demonstrating to the public that keeping dairy cows was an acceptable new occupation. However, most importantly, the Thai farmer is entrepreneurial and had an open mind to this new occupation. His strong business sense helped to make dairy farming a success.

1.0 Historic Background

1.1 Consumption of Dairy Products

Historically, dairy products were not part of the traditional Thai cuisine. With increasing exposure to Western culture and eating habits, dairy products established a niche in the up-scale food market. Modern shops and supermarkets started offering a range of dairy products, targeting the young, educated middle class. Initially, these products were limited to ice cream, reconstituted milk, (flavored, sweetened or unsweetened), butter and cheese.

At the end of the 1950s, Thailand had basically no recognizable dairy herd. The exception was a few hundred cows that were being milked for consumption in traditional Indian households. With the growing popularity of milk based products, the Thai Government

was confronted with increasing imports of dairy products. Between 1948 and 1958, the annual value of dairy imports increased from \$4 million to \$19 million, or roughly to 50 % of total food imports. This was equivalent to an annual increase of approximately 20 %.

The imported products ranged from condensed milk and cream, whole milk powder, fresh milk and cream to butter and cheese. Converted into "liquid milk equivalent," the imported products represented a volume of more than 100,000 tons of fresh milk. Assuming an annual production per cow of 3,500 kg (which was an acceptable yield in 1960), a national herd of 30,000 dairy cows would be required to produce this volume of milk.

1.2 Supply Situation

Still, during 1960 in Thailand, the supply of fresh milk from local production was negligible. The only major supply of fresh milk came from "Indian Dairy Farmers". A study by Kasetsart University in 1946 estimated that 127 farmers kept 2,046 dairy cows. The annual production per cow was about 800 kg per year. Later, studies indicate that 200 farmers keep up to 6,000 cows that produced between 4,000 kg and 8,000 kg per day. However, the milk was consumed solely by the local Indian community.

The need to produce fresh milk locally was increasingly recognized. By 1960, three major attempts had been made to establish a local fresh milk production:

- (i) Army Dairy Farm: The Military tried a dairy farm at Sub Muang. However, this venture to produce fresh milk closed in 1958 due to insufficient production.
- (ii) Kasetsart University: The Agricultural Faculty established a small dairy herd with animals purchased from Indian dairy farmers. The herd, with a size of just 20 cows, was experimentally used by crossbreeding the local (Indian) cows with semen from Brown Swiss, Red Sindhi and Jersey. The production reached just 60 kg per day or on average 3 kg per cow.

- (iii) Sri Racha Farm: A tapioca processing enterprise in Sri Racha, 150 km southeast of Bangkok, tried to establish a herd of 90 purebred Red Danes. Due to poor animal husbandry practices, unsuitable feed resources, and the tropical climate, the Red Danes were unable to support a commercial dairy operation.

Actually, on the market in 1960, there were already three companies that produced and marketed country wide milk products. Two sold reconstituted milk and one sold soya based products.

- (i) Reconstituted Milk: "Foremost", a California based US company, and the locally financed "Pure Food" were operating factories in Bangkok to reconstitute milk. As raw material, they used imported skim milk powder and butterfat. Other ingredients included local palm oil fat, sugar, and fruit pulp. Initially, the product range included plain, sweetened, chocolate or fruit flavored milk. Later, the companies expanded into ice cream and different types yogurts. All products were UHT treated. Both companies ran very efficient operations and later became serious competitors to the emerging fresh milk producers. In 1960, Foremost sold daily between 4,000 and 5,000 kg, while 1,500 kg were sold by Pure Foods.
- (ii) Soy Milk: Green Spot, a local company in Bangkok, sold under the brand "Vitamilk", a drink made from locally produced soy beans. Again, this soy milk was marketed as plain, sweetened or a fruit flavored drink. The daily output was similar to that of Foremost, between 4,000 and 5,000 kg per day.

Due to the war in Vietnam in 1960, the US military presence in Thailand was estimated at about 50,000 military personnel. These were mostly "rest and recreation" staff on leave from Vietnam, but there was also a significant operational presence. These men and women, with typical US eating habits, demanded dairy products. Initially, this group represented a large market for Foremost, a US company.

1.3 Request by Ministry of Agriculture

Recognizing the need to establish a local dairy industry, the Ministry of Agriculture became engaged. The Ministry contacted the Governments of Denmark and Germany. The Danes agreed to assist and later established in 1962 the “Thai Danish Dairy Project” at Muak Lek.

During a visit to Germany in 1959, the Minister of Agriculture, General Sarajit Charusreni, asked the German Government for assistance to establish a local dairy industry. The German Ministry for Economic Cooperation and Development (BMZ) responded favorably. It contracted two consultants, specialized in animal production and dairy development, who had experience in developing countries. Mr. Heino Messerschmidt and Toni Meggle visited Thailand from November 1960 to January 1961. The team submitted the attached report (Report in German on disk).

1.4 Project Evaluation

Summarizing the results, the authors made the following recommendations:

1. The livestock station Huay Kaew, Chiang Mai, is the most suitable location to establish dairy production with imported cattle.
2. The station should begin preparations by focusing on nutritional deficiencies and the necessary pre-immunizations against tick born diseases.
3. After removing the present herd of cattle, the station should begin with intensive, diversified forage production.
4. Once a sufficient forage reserve had been established, a carefully selected herd of dairy cows should be imported.
5. The initial tasks of the project included: Maintain and care for the herd; produce and market the milk according to highest standards; train qualified staff; and start a long-term genetic selection program.
6. Finally it was planned to establish smallholder dairy farms for demonstration under the guidance of the station.

1.5 Huay Kaew Station

The station in Chiang Mai, one of eight Livestock Stations of the Department of Livestock Development (DLD), was considered the most suitable location for the development of a dairy industry in Northern Thailand. The following factors weighed in favor of Chiang Mai:



Installation of an irrigation system at Huay Kaew Station
completed in December 1966 - supplying 25 ha



- (i) In addition to the Station in Huay Kaew, with 30 ha of land, a second station in Mae Yuak, with 130 ha, was available.
- (ii) Forage crops on the 30 ha Huay Kaew station could be irrigated from a nearby waterfall. Mae Yuak, with no waterfalls nearby, could be used for the more extensive rearing of young dairy stock and experiments with raising beef cattle.
- (iii) At Huay Kaew with 30 heads, (mostly crossbred dairy cows and 5 bulls) were already being kept. Bulls were used for artificial insemination.
- (iv) The station was already experimenting with the production of forage crops: Guinea-, Mauritius-, Guatemala- and Napier-grass.
- (v) A final but important factor was the marketing of milk: Chiang Mai with a population of 80,000 inhabitants, a university, and many touristic attractions would be a good initial market for the consumption of dairy products.

1.6 Project Management

The Thai Directors of the Station, initially Mr. Sangwian Posri and later Mr. Issara Greethapon, have always maintained overall responsibility for the day to day operations of the project. The first German team leader, Dr. Hans-Jürgen Langholz (1965 to 1968), focused on the start-up of operations, import of equipment and breeding stock, animal nutrition, founding the Chiang Mai Dairy Group and the beginning of milk processing. Dr. Nico Nissen (1968 to 1974) expanded the outreach to the smallholders, established the slaughterhouse and meat processing plant and participated in the "Royal Project". Dr. Johannes H. Gwildis (1974 to 1977) focused on extension services, upland farming and beef production.

2.0 Project Components

2.1 Prof. H. - J. Langholz Reflects

Our activities and decisions are to a great deal controlled by our childhood experiences. Thus, my initial steps of implementation at the Thai - German Dairy Project (TGDP) were clearly influenced by the century old tradition of intensive livestock rearing in the North Western coastal region of Germany, where I was raised.

The implementation of new technologies in the livestock sector was just in its initial stage. The electronic control of production processes had not even yet been invented. It was difficult to imagine what fundamental structural changes in the livestock sector would be released by the ongoing technical progress in the years to come. If I would have been aware of the dominating future role of the cow cubicle housing system for dairy cattle farming, I would have made substantial efforts to adapt this system to tropical dairy farming from the first day of project implementation.



President Lübke at Huay Kaew
Station 7.3.1967

2.2 Basic Assignment

The initial task of the TGDP focused on defining a strategy for the dairy production at the livestock stations, Huay Kaew and Mae Yuak. These stations would become pilot and demonstration centers for the smallholder farm development in Northern Thailand.

While considering the implementation of different project measures, my special concern was to create sufficient incentives for the private sector to invest in dairying. Various support measures were undertaken by the project to stabilize production and marketing of private dairy production. For example, the founding initiative of Chiang Mai Dairy Group, buffering the private market volume, subsidizing milk processing, and dairy equipment supply and free on farm consulting services. Understandably, this strategy did not always get the undivided support of the DLD headquarters in Bangkok.

Our main objective was the promotion and development of dairy farming as an integrated part of rural development. In addition, we introduced complementary activities such as beef production and manure utilization. Neither the construction of a dairy processing plant nor the building of an experimental slaughter house and meat processing unit were foreseen in the original project assignment.

An essential part of the project was the Thai counterpart training program in Germany for further qualification within their professional sectors. Even though only few of the trained counterparts directly served the project for a longer period, this training effort yielded a significant impact in developing the dairy sector. This was particularly important for the training activities in Germany also for the young professors of the newly established Department of Animal Sciences at Chiang Mai University (CMU). Details are provided under 5.0 Investing in People.

2.3 Breeding and Husbandry

Milk supply in the township of Chiang Mai goes back to extensive Indian dairy farming in the districts of Chang Phuak and Chang Klan, initiated in the early 20th century by the British Borneo Company. The Zebu type cattle used at the time not only had a noticeable influence on the early dairy cattle population of Chiang Mai, but also on the breeding stock at the Huay Kaew Livestock Station which was founded in 1941. Later, crossbreeding trials with exotic dairy breeds, especially Brown Swiss in the early fifties and later with Holstein Friesian, using Artificial Insemination (AI) brought an increasing impact of *Bos Taurus* blood on the Chiang Mai dairy population. However, when the German team arrived in 1965, the production of fresh milk in Chiang Mai was still very low or just 150 kg per day.

The recommendation of the project evaluation team was to improve the breeding herd of the station which, at the time, consisted of a number of different Red Sindhi and Brown Swiss crosses. Under the project 30 German Brown Swiss cows and 10 purebred sires were imported. This outlined the future breeding strategy. The preference, in those days for the Brown Swiss, was based on the assumption

that the breed had a higher tolerance for solar radiation. Practical experience with dairy cattle crossbreds did not prove this assumption to be correct. Later, studies by Nattaphon Chongkasikit (2000) on coat color in Friesian upgrades did not reveal any impact of the degree of whiteness on milk and reproductive performance under Chiang Mai farming conditions. All in all, Friesian upgrades as compared to Brown Swiss, showed a better performance under smallholder conditions. As a result, Friesians were dominating the expanding dairy cattle population in the years to come. This happened not only in Chiang Mai but also in other Northern Thai provinces. In 2000, Nattaphon Chongkasikit observed an average upgrade status of 84 % Holstein Friesian genes in the Northern Thai dairy population of 7,375 cows.



Two young German Brown cows in a convincing physical condition at Huay Kaew Station 1967

Starting from the existing, Indian based, extensive dairy ranching systems, the introduction of new and advanced dairy farming procedures proved to be a fairly tough undertaking. A particular problem was to achieve a balanced improvement of the two most important factors: the feed resource, and marketing the produced milk. Dairy farming “newcomers” with business backgrounds turned out to be more successful than dairy farmers with traditional experience, especially those with Indian dairy farming traditions.

Dairy breeding policies in Continental Europe in those days still were following the dual purpose breeding goal. Thus, studies on quality beef production were included in the project activity in 1967, evaluating the potential of Brown Swiss crosses in comparison to Brahman crosses.



2.4 Animal Nutrition

Already the project evaluation report had indicated that special emphasis should be given to forage production. The performance of dairy cattle essentially depends on a regular and sufficient supply of nutrients. Even the highest genetic potential for milk yield remains without result, if the nutrient intake of the cow is insufficient. In addition to the energy required for the daily milk production, the fetus demands energy, particularly during the later part of the pregnancy. Due to the overriding importance of animal nutrition, the project design included an animal nutrition laboratory. The objectives and work of the lab can be divided into four parts:

- (i) Field trials to determine which forage crops would grow under soil and climatic conditions of Northern Thailand and what yields could be expected;
- (ii) Laboratory analysis of forage plants;
- (iii) Digestibility experiments using sheep; and
- (iv) Forage conservation methods.



2.4.1 Field Trials

Attached to the nutrition laboratory was a so called “grass garden” with a size of approximately 3,600 m². This grass garden was established under field conditions. It was divided into 36 plots with a size of 10 by 10 m. These plots were planted with a range of forage crops, different varieties of grasses, and tropical legumes. A detailed list of all plants that were included in the field trials and their yields are shown on the attached disk under “Publications from the Animal Nutrition Laboratory” in particular under the titles: “Yields of Tropical Fodder Plants”; and “Nutrients Produced Under Cut and Carry System”.

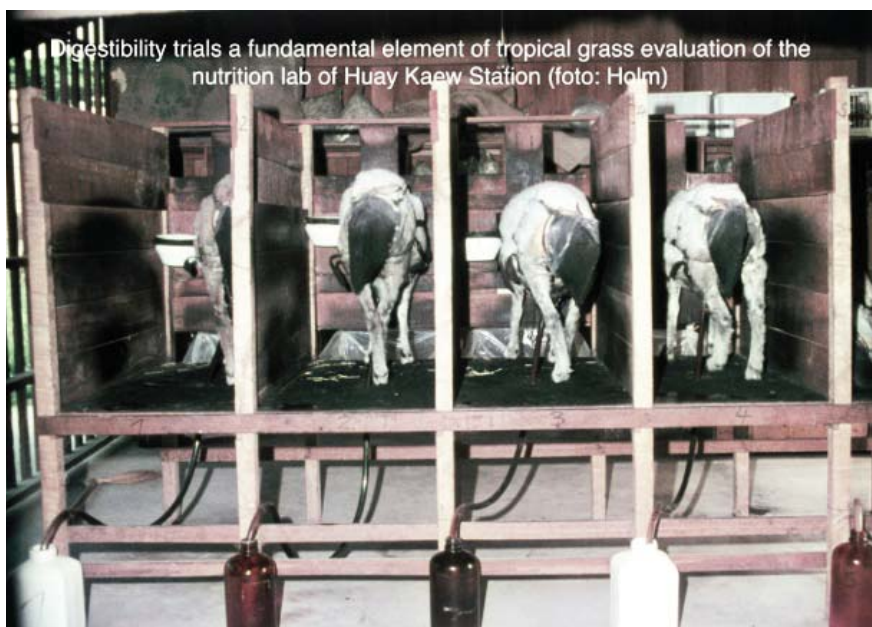


2.4.2 Laboratory Analysis

While the grass garden provided information on which plants would grow and what yields to expect during different seasons, the laboratory analysis determined details such as: Total Dry Matter; Protein; Fat; N-free Extract and Mineral Content. The mineral content was further split into Ca, P, K, and Na. Again, the results are shown in “Publications from the Animal Nutrition Laboratory” in particular under the titles: “Feeding Tables” and “Providing Growing Cattle Minerals from Roughages”.

2.4.3 Digestibility Trials

Essential for the feeding value of a plant is the digestibility of the nutrient content. Using solely the laboratory analysis gives little indication about the digestibility of the different nutrients in a certain plant. While there are certain analytical methods that will roughly indicate to what extent nutrients can be digested, the only reliable results can be obtained by conducting digestibility trials using animals. For this purpose, the nutrition laboratory carried out feeding trials using sheep. Such feeding trials are complex. The essential steps include: (i) Determine in a laboratory analysis the nutrients in the plant to be tested; (ii) Feed the animals only with the plant material to be tested; (iii) Weigh the animal's actual intake of plant material; and as a final step (iv) Weigh the feces excreted by the animal. The difference between the nutrients in the original plant material and the feces of the animal determine the digestibility.



2.4.4 Forage Conservation

Since the yields of forage plants vary during different seasons of the year, it is most economical to harvest plants when their growth has been optimal and the yield is the highest. This is the best moment to conserve the material. The two most common conservation methods are drying the plant or conserving it by making silage. The drying method, making hay, is well known all over the world and does not require special knowledge nor equipment. However, to conserve plants by making silage was new to Northern Thailand. This method has the advantage, that the nutritional value of the plant is better maintained. Drying plant material causes certain losses. These are minimized by putting the material in a silo. The nutrition laboratory introduced

silage making and conducted a series of demonstrations, not only on the Huay Kaew Station, but also with smallholders in the field. Again, the results are shown in "Publications from the Animal Nutrition Laboratory," in particular, under the title: "Nutritive Value and Acid Content of Silage" and "Overcoming the Fodder Shortage During Dry Periods".



The first „dairy plant“ at Huay Kaew Station 1965

2.5 Milk Processing

The newly imported herd of dairy cows, the increased volume of quality forage, and the improved animal husbandry practices caused the volume of milk produced on the Station to increase. Peak production could reach 300 kg per day. To keep fresh milk from spoiling and to make it marketable, it has to be either pasteurized or sterilized.

The time and temperature for pasteurization depends on the bacteria count in the milk. The bacteria count is a function of the hygiene applied during

the milking of the cow. Initially, the milk of the farm was treated in a large open vat heated with logs from below. However, with this process it was difficult to determine if the milk would be considered pasteurized (heated at a minimum to 63°C for 30 Minutes) or sterilized, which means boiled. This open vat treatment of the milk on the farm was certainly not suitable for processing milk to be marketed in a town of 80,000 inhabitants and with foreign educated consumers.

2.5.1 New Dairy Plant

During 1967, the German Government agreed to expand the project by financing the construction of a milk processing plant and providing milk processing equipment. This component was new and had originally not been foreseen. The plant was completed in 1968 and included the following facilities:

- (i) Reception area where the milk was weighed and samples taken;
- (ii) Refrigerated chambers to store raw milk and finished dairy products;
- (iii) Plate heat exchanger to pasteurize;
- (iv) Separator to adjust fat content in;
- (v) Homogenizer to ensure uniform distribution of the fat;
- (vi) Bulk storage tanks;
- (vii) Packing line;



The new dairy plant of the Thai German Dairy Project at its start on 16.11.1968

- (viii) Butter churn;
- (ix) Cheese making equipment;
- (x) Steam generator and refrigeration equipment; and
- (xi) A laboratory to test milk for acidity (sign of spoilage), fat content, bacteria count and specific gravity (diluted with water).

2.5.2 Special Issue Hygiene

Milk received from the farmers was paid according to its quality. The quality was determined by the fat content of the milk (between 3.5% and 4.5%) and its bacteria count, measured in million bacteria per ml. While the fat content is mainly genetically determined, the bacteria count is influenced by the farmer. The milk in the udder of the cow is almost aseptic. However, during the milking process (dirty udder or equipment) the milk is infected with bacteria. The bacteria multiplies vigorously as long as the milk is not chilled from the initial body temperature of the cow, 37°C down to about 4°C.



Improving the hygiene during milking is a difficult task. The first issue was to teach the farmers the basic concept of hygiene. The second problem was to ensure that the water the farmer was using to wash his hands, clean the udder and the milking equipment, was relatively clean. Usually, the water on these smallholder farms, came from an open well which was already a dangerous source of bacterial infestation.

2.5.3 Special Issue Milk Dilution

Thai farmers, economically minded as they are, soon discovered that by diluting the cows milk with water, they would increase the volume delivered to the dairy plant and thereby their payment. The dilution caused two problems in the dairy. Firstly, by mixing the milk with water, the valuable components of the milk, protein, fat, calcium and vitamins, were being diluted. Secondly, as mentioned earlier, the water on the farms was usually of low quality. As a result, the milk already loaded to a high degree with bacteria, received

additional unwanted bacteria. Again, it took the extension service great efforts to keep the farmers from mixing cows milk with water.

2.5.4 Marketing

At the time of the project, tradition in Germany said that milk should be left natural. Milk should not be blended with sugar, fruit, chocolate or other components. However, in Thailand, the market demanded sweetened or fruit flavored mixed milk drinks. It took the German team some time to accept these demands from the market. In the end, also the dairy at Huay Kaew prepared what the market wanted and sold sweetened and fruit flavored milk drinks.

To increase sales, the station built in 1969, next to the dairy plant, a pavilion where the complete range of dairy products was offered for sale. These included fresh milk, mixed fruit flavored drinks, yogurt, cream, butter, cheese and ice-cream. The pavilion became a popular meeting place for students from the nearby Chiang Mai University and visitors of the Chiang Mai Zoo, located just opposite the street.

The CMU with several thousand students, modern thinking and educated, was the largest single group of dairy product consumers. This fact was appreciated by the team, responsible for marketing dairy products. However, a serious problem developed, when twice a year, during the university holidays, the majority of students left town. As a result, the dairy lost, from one day to the next, close to 50% of its regular customers. To compensate for this sudden loss of market for fresh milk, the dairy started to make ice-cream and cheese, products that could be manufactured with surplus milk and had a longer shelf life.



2.5.5 Cheese Making

Traditionally western milk consumers expect dairies to also produce a range of cheeses. The German dairy experts soon learned, that the typical Thai consumer had not developed a taste yet, for this strong smelling dairy product. In the end, some cheeses were manufactured and could be marketed. The Oriental Hotel and the Swiss Inn in Bangkok became regular customers for this Tilsiter type hard cheese and the European soft cottage cheese.

2.6 Slaughter House and Meat Processing

With the increase in the number of crossbred cattle, the improved animal husbandry practices, and a good feeding regime, also high quality male crossbred cattle became available for slaughter. Only a small number of the crossbred bulls were used for breeding purposes. The majority were fattened to be slaughtered for meat. The meat from these well fed, young crossbred animals



was of far superior quality, compared to what typically was found on the local market, which was beef from old draft animals or water buffalos. Project management therefore concluded that a modern slaughterhouse and meat processing plant should be built. The purpose of the plant was threefold. (i) Slaughter crossbred animals and market high quality cuts of beef; (ii) Process the meat to high end meat products; and (iii) Demonstrate and teach the Thai meat industry the standards of quality meat processing.



2.6.1 Slaughter Crossbred Animals

When the farmers tried to sell their crossbred, young and well fed animals to the local slaughterhouse, they would only receive a standard price. The local slaughterhouse or butcher was not willing to pay for the quality he was receiving. To assist the farmers and to improve the economics of feeding cattle for meat production, the project therefore decided to build the plant. These high quality cuts of meat were initially sold only at the shop of the slaughterhouse. Later, as the volume increased, the products were also marketed to hotels, restaurants and quality conscious shops in town. As a result of this effort, the farmers received for their animals a price far superior to the price offered on the traditional market.

2.6.2 Meat Processing

Germany has, similar to Thailand and the Chinese kitchen in general, a long tradition of processing meat. It therefore was natural for the German butcher to also start making sausage. Two arguments supported this decision. Firstly, not all the parts of an animal can be marketed as valuable, high priced cuts. About 50 % of the carcass is best used in processed products. Secondly, the typical

dairy farmer, trained by the extension service in modern animal husbandry and nutrition, usually also kept highbred pigs on his farm. To breed these pigs, the farmer had used the AI services of the station or kept his own boar of races such as Large White or Duroc. Again, the meat from these improved, low fat, high meat yield hogs, were sold by the slaughterhouse for a superior price. Similar to what happened when slaughtering beef animals, also from the pigs, not all parts could be sold at a high price. The natural solution was to use the less valuable parts from both the bulls and the hogs for processed goods. With this decision also the less valuable parts could be turned into high priced products. Very soon the Huay Kaew meat shop became known not only for its quality cuts of pork and beef, but also for its wide range of different sausages, pates, smoked as well as cooked hams, bacon, frankfurters, meat loaves and very important for the local customers, traditional fermented Chiang Mai sausage, called "naem".



2.6.3 Training

The modern slaughtering facilities, the meat processing equipment, the compact smoke chambers, and the cold store facilities were a unique opportunity to train the Thai meat processing industry in the most advanced technology. An additional advantage was the fact that the head of the slaughterhouse, Mr. Ahrens, a German butcher with a Master degree in his profession, was not only acquainted with the latest technologies in meat processing, but since he had run his own butcher shop, he was also commercially experienced. The project therefore offered free of charge training courses.

Typically, these were attended by the owners of Bangkok processing plants, their managers or foremen. The attendants of these courses were allowed to stay and work at the plant as long as they desired. Some stayed for a week or two, others almost became members of the slaughterhouse team, since they came for several weeks or months and at different times of the year. An additional serviced offered by the project was to visit, on request, the plants of these meat processors and offer free advice. The recommendations ranged from improvements to plant hygiene, modifications to existing plants, and advice for the purchase of equipment.

2.6.4 Two Little Anecdotes

During the visit of a plant in Bangkok, the German butcher asked the owner why there were no fly-screens in the window openings of the plant. The response by the owner: "But then the flies can not get out!"

In another plant, the meat expert asked the owner why he had all these large cold storage rooms. Response: "As you can see, all my equipment has wheels. In the evening, we just roll the machinery into the cold store and thereby avoid washing them down every night!"

2.7 Extension Services

2.7.1 Smallholder Milk Production

The arrival of the German team with the objective to introduce and promote dairy farming around Chiang Mai, soon raised the interest of smallholders in the area, who were always on the outlook for alternative new sources of income. Typical for the farming system in the area at the time, where lamyai fruit plantations. For the start of a small dairy farm, with just two or three cows, the vegetation under these fruit trees was a sufficient source of forage to feed the cows. On these small farms, labor was usually abundant. The owners would therefore cut the grass and feed the animals in the barn. This is a very efficient system, permitting the smallholder to feed his cows and produce milk without using additional land for forage production. Later, as the herds expanded and more feed was required, forage crops had to be planted on the farmers limited land resources, replacing fruit plantations, vegetable or other crops.



Body measuring of native cows in the field Chiangmai 1966

The genetic basis for the development of a local dairy breed were Zebu cattle, *Bos Indicus*. This type of cattle was abundant in the area. They were used by local farmers as light draft animals. Adult animals were also slaughtered for meat, but with a bodyweight of just 200 to 250 kg, and a dressing weight of just over 100 kg, the yield was small. The use of the animals for draft purposes was also limited - they lacked strength. A more common and much stronger draft animal was the water buffalo.

The F1 offspring, that is the first generation of the crossbreds between the local cows (*Bos Indicus*) and the imported *Bos Taurus* sires, (Brown Swiss or Holstein Frisian), benefited from the so called "heterosis effect." This genetic phenomenon describes what happens when two genetic lines are being crossed. The effect becomes stronger, the less the two parent lines are related, that is, have a common gene pool. The effect shows in the offspring higher vitality, performance, fertility, and stress resistance.

(The following example demonstrates the heterosis effect in poultry: By crossing line A, which produces annually 100 eggs, with Line B, which produces annually 200 eggs, due to the heterosis effect, the F1 (cross

between line A and B) will produce 250 eggs per year.)

The offspring produced by crossing the local animals with sires of imported breeds showed this high vitality, performance, fertility and stress resistance. For the local dairy farmer, who just started with his milk business, this was a great benefit. It built up his confidence and made it easier for him to gain experience in this new field.

2.7.2 Range of Services

Under the term “Extension Services” a range of activities can be named, whereby knowledge and services from the station were disseminated to the farming community. These services included AI, Animal Health, Foage Production and Nutrition, Animal Husbandry, and Milking Hygiene. The initial focus was on the rural areas around Chiang Mai, where farmers had become interested in animal husbandry, in particular in the improvement of their dairy herd management. In the later years the extension services were expanded to reach also the dry “uplands” and areas near Fang, Chiang Dao, Chom Thong and Hod, where not only dairy herd management was supported, but extensive beef production as well.

2.7.3 Artificial Insemination

The AI team was the first to visit the dairy farms. The inseminations were typically carried out by a technicians, but occasionally also by a veterinarian. Initially, deep frozen semen had been imported from Germany. Later, once well adapted bulls were available on the farm, fresh semen was also collected on the station and used for AI services. On average, about 1,200 inseminations were carried out each year.

Proper heat detection was a major problem with the unexperienced “new” dairy farmers. Many calls for the urgent insemination of a cow resulted in the AI officer traveling far into the countryside only to tell the farmer that the cow was not “in heat” In later years, it became common practice that the dairy farmer used a local bull for proper “heat detection.”

In addition to inseminating dairy cows, the AI team also provided AI for pigs. On the Huay Kaew station, staff collected semen from Large White and Duroc boars. The AI services for swine increased steadily and reached by the early seventies similar numbers as the service for cattle. As to be expected, the visiting AI officer frequently also solved general animal health problems, some of which were typical for the more sensitive crossbred dairy cattle.

2.7.4 Health Services

The animal health services covered a wide range of issues. These included fertility problems, calving trouble, hoof infections, mastitis, parasites, and diarrhea in calves. Important were also The ongoing control of Brucellosis and Tuberculosis as well as the elimination of internal and external parasites. To assist the farmers with external parasites, the extension service offered farmers to spray their cattle against ticks.



Fertility problems, due to the lack of a clear signal from the cow being in heat, became a particular issue during the summer months, (July to October) when temperatures and rainfall were highest. This was a phenomenon the German livestock specialists were not used to. It was a clear indication that cows with a high percentage of European blood were stressed and suffered during these summer months

due to high temperatures and high humidity. During that time, typically also the feed intake and daily milk yield were lower. To minimize the problem, particular attention and care had to be paid to the animals during the summer months.

As a strategic policy of the DLD, all animal health services as well as AI were conducted free of charge to the farmer. Of course this did not keep those farmers that were particularly grateful for a service received, from rewarding the visiting AI officers or veterinarians with a basket of homegrown fruit, vegetables, or honey.

2.7.5 Extension Service Approaches

The general extension service used two approaches: single advice to individual farmers, or the group training method. In the group training program, between 20 and up to 45 farmers, were collectively introduced to subjects such as:

- (i) Fodder production and feeding;
- (ii) Pasture development;
- (iii) Milking and milking hygiene;
- (iv) Animal husbandry and calf rearing;
- (v) Prophylactic issues of animal health care; and
- (vi) Construction of stables.

In addition to these training sessions, farmers were invited to field tours where they were shown other particularly progressive dairy farms. Of course, farmers were always welcome to visit the station and ask the officers for specific advice. During the annual agricultural exhibition in Chiang Mai, the best animals were presented to compete for prizes.

2.7.6 Forage Production

Feeding roughage and general issues of animal nutrition required particular attention. Traditionally, farmers considered their native cattle to be self-sufficient. It was the custom that the animals would roam the countryside and graze wherever possible. However, the improved dairy breeds required a regular supply of nutritious forage, and during times of high lactation yields, additional rations of concentrated feed. This was a new concept, and the farmers had to be trained to recognize that without sufficient input in nutrients the output in milk would be unsatisfactory.





Based on the field trials and the digestibility experiments on the station, the extension staff had planted demonstration plots on farms in the area. There, the farmers could see which grass grew best and learn how to cultivate that particular variety. Planting materials for the farmers was made available at the station or could be obtained from the field plots.

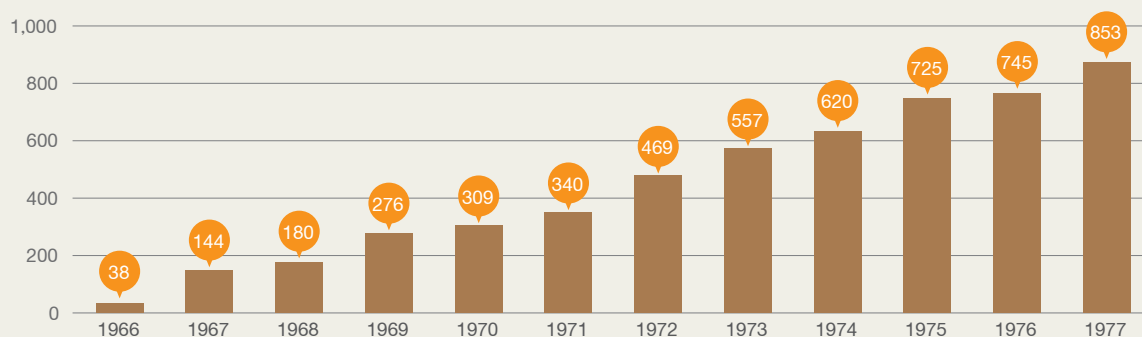
The economic oriented dairy farmers soon recognized that every kilogram of milk that was fed to the newborn calf could not be sold to the dairy plant. As a result, young calf in their early state of development, and at a time, when their digestive system was not yet ready for a major roughage intake, suffered, because the calves did not receive the necessary volume of milk. It was

only in the early seventies when milk replacer could be purchased on the market and became an acceptable alternative to feeding the calves fresh milk.

2.7.7 Cooperative

The Chiang Mai Dairy Farmer Group, was established in 1966. In 1970 this Group was registered as the Dairy Farmers Cooperative. The purpose of the Group was to collect and market the milk produced by the farmers. Between 1966 and 1977, the membership in this Group grew to 130 farmers. At the same time, the daily milk production received at the processing plant increased from 150 kg to 2,000 kg daily. In the early seventies, some of the most business oriented farmers had started to market their milk directly to end consumers. By 1977, an estimated volume of more than 500 kg per day were marketed directly.

**Milk Production Chiang Mai Area
1966 to 1977 in tons**



The building for the milk processing plant had been funded by the DLD. The equipment came from Germany. The station paid for staff, electricity, fuel, and the milk collection. In some of the larger villages around town, the Chiang Mai Dairy Group had set up collection points. Some farmers however preferred to deliver their milk directly to the plant. These farmers arrived by motorcycle or transported their milk with a small pickup truck. The milk coming from the Cooperative was processed free of charge by the station. The receipts from the sale of the milk went to the Cooperative and was distributed according to the volume of milk delivered.

2.8 Follow-up Projects

After the Thai - German Dairy Project officially terminated in 1977 there were a number of follow-up activities supporting the dairy sector at the Huay Kaew Station:

1977 to 1987	Dairy Training Center for Asia and Pacific, sponsored by FAO and DANIDA
1984 to today	National research and Training Center for Dairy Cattle, sponsored by DLD
1988 to 1991	Dairy Herd Improvement Center, sponsored by USAID
1990 to 1998	Shore-Holstein Purebred Dairy Cattle Research, sponsored by CIDA

3.0 Thailand's Dairy Sector Today

3.1 Lactose Intolerance

The description of the dairy sector would be incomplete, without mentioning, that many Thais suffer from lactose intolerance. This is the inability of adults to digest lactose. Lactose is a sugar that is found in milk (typically around 4.8 %). Usually lactase, an enzyme in the human digestive system, splits lactose into glucose and galactose, which both are well digestible.

Lactose intolerance is typically found in up to 90 % of the population in countries of Sub-Saharan Africa and South-East Asia. In Northern Europe, typically only 5 % of the population suffer from lactose intolerance. However, in Europe and the US today, an increasing number of consumers claim lactose intolerance and purchase lactose-free milk.

People that lack the enzyme lactase may suffer from abdominal bloating, cramps and diarrhea, if they drink milk. Usually these symptoms only occur when people consume more than 200 ml of milk in one serving. A recent article in the Economist from March 28th 2015 suggest that even economic development is related to the ability to digest lactose. (See articles by "Der Spiegel" and "The Economist" on attached disk).

3.2 Number of Dairy Farms

Due to good economic returns of milk production, the number of dairy farmers in the Fifth Region around Chiang Mai has expanded. Over the past 50 years the number has increased from less than a dozen to 1,800 farmers by 2013. According to the DLD in the whole country, close to 25,000 farmers keep dairy cows and earn a significant part of their income from selling milk.

3.3 Milk Yields

With improved animal husbandry practices, higher yielding crossbreds and most importantly better feeding, the yields per cow and day increased significantly over time. In the early days of the TGDP, farmers were proud if they could get 3 kg of milk a day out of their cows. This was equivalent to a lactation yield of less than 1,000 kg. By 1971, the average milk yield per day had increased already by 50 %, or to 4.5 kg per cow. By 2014, according to the DLD, the average milk yield in Thailand stands at 12.3 kg per cow and day, or a lactation yield of 3,600 kg.

3.4 Processing Plants

With the overall increase in milk produced, also the number of processing plants has grown. More and more Thai businessmen considered a milk processing plant a good investment. As a result, we have today in the northern region alone 5 plants that produce UHT milk, (in total 16 plants in the country) and an additional 14 plants in the North selling pasteurized milk (68 plants countrywide).

3.5 Collection Centers

Milk collection is today organized either through cooperatives of farmers or through the private sector. Country wide 117 centers are cooperatively managed while an additional 72 collection points are privately owned. Educational facilities are responsible for 9 more collection centers. In the outlook section of this document, the advantages of private collection centers will be further discussed.





3.6 Economics of Milk Production

The development of the dairy sector in Thailand during the past 50 years has been significant. Unfortunately, reliable comparative data from the early 1970s are not available, but the total number of cows at the time was estimated at less than 15,000 dairy cows for the country as a whole. Available are numbers for the period from 1982 to 2012. During this period, the dairy cattle population increased by close to 10 % annually. According to DLD, in the Fifth Region alone, 64,000 dairy cattle are being kept. In total, Thailand has close to 600,000 dairy cattle, of which about 50 % are milking cows. The rest being calves, young stock and heifers. An interesting fact is also that dairy farmers continued to increase their herd size. While in the late sixties and early seventies a typical dairy farm kept 2 to 3 cows, by 2012 the average herd had grown to 27 cows, of which 14 were milking cows.

Thai Dairy Statistics						
Year	Dairy Cattle	Milking Cows	Farms No	Cows Per Farm	Total Milk Produced t	Kg/Cow Per Day
1971	15,000					4.5
1982	30,046	13,770			27,027	5.4
1987	75,500	36,200			79,100	6.7
1991		59,850			147,000	6.8
1996		117,130			328,000	7.8
2005	478,836	296,472	23,374	12.7	781,043	11.6
2009	483,899	293,287	17,837	16.4	882,933	12.3
2012	556,785	295,634	20,624	14.3	1,064,270	12.5

The financial returns of a dairy farmer vary from year to year, as to be expected in a market economy such as Thailand. One issue is the price of milk, but also the price of concentrated feed varies from year to year. Lastly, the size of the herd is also an economical factor. The following table with economic indicators is based on data provided by DLD and Mr. Tawatchai, the former manager of the Huay Kaew processing plant. For comparison purposes: The farm gate price in Germany during September of 2015 was 0.28 € per kg of milk, which is equivalent to 11.20 Baht. This means that the price of milk in Germany is approximately 30 % lower than in Thailand.

Economic Indicator of Milk Production (Baht per kg)				
Year	Production cost	Farm gate price	Factory price	Farmers Margin
2004	8.51	11.38	12.50	2.87
2008	13.40	15.44	16.25	2.04
2012	14.46	16.92	18.00	2.46
2014	15.17	16.91	18.00	1.74

3.7 Large Commercial Herds

While on one side we could observe, how over the past 50 years the typical small holder has expanded his herd to around 20 cows, we should, on the other side also note, that the industry has also created some large commercial farms. An excellent example of this new trend is "Chiangmai Freshmilk" in Ban Hong, near Lamphun. The farm and processing plant are owned by Dr. Bulgul Tipnate, a graduate of CMU, where he was educated by academic teachers who have their roots at the TGDP.

The target of Chiangmai Freshmilk is to keep up to 3,500 cows. Today, after more than 20 years of development, the farm milks already 1,000 cows with an average lactation yield of 5,000 kg. The farm and its facilities can be considered one of the best dairy operations worldwide. Some of the outstanding features include: (i) feeding cows a balanced ration where at least 50 % of nutrients derive from roughage; (ii) a target production of not more than 5,000 kg of milk assuring

the cow many years of healthy lactations; (iii) a feed supply that is secured mainly through contract growing operations by nearby smallholders; and (iv) liquid manure is fed into a biogas digester to produce electricity and liquid gas to power equipment, tractors and vehicles.

The milk processing plant has a daily capacity of 40 t of pasteurized, and 135 t of UHT milk. Annually, the plant processes 51,000 t which is approximately 50 % of the milk produced in the northern region. The plant sources its raw material from smallholder farms. The dairy runs its own extension service thereby assuring on one side the plant a sufficient supply of high quality raw material, on the other side assisting the smallholder to continuously improve his operations. In every respect a noteworthy operation.

4.0 His Majesty King Bhumibol Adulyadej

Throughout his reign, his Majesty the King has always devoted special attention to the wellbeing of his constituents. His particular concern focused on improving the livelihood of the poor. Among the poor, the Thai farmers probably represent the largest single group. His Majesty spent much thought and time to improve their fate. It therefore came as no surprise when his Majesty decided to install a herd of dairy cows on the grounds of the Chitlada Palace in Bangkok. The herd was placed in a paddock at the southern border of the Palace, facing Thanon Ayutthaya. The animals were thereby in full view to the public. The objective of this measure was to demonstrate to everybody - especially the Thai farmers - that keeping dairy cows was recommended, and farmers were encouraged to enter this new line of activity. In summary, His Majesty, the King's support for this new agricultural activity, was an enormous help and lent credibility to dairy farming.

4.1 Royal Visits to the Farm

A tradition of the Royal Family was to spend time between January and March at the Bhubing Palace on the mountaintop above Chiang Mai. During this stay in the North, his Majesty the King visited welfare organizations, Government institutions, and hill tribe projects. Starting in 1970, his Majesty together with the Royal family also made it a habit to pay a visit to the Huey Kaew Livestock Station.



During these annual visits, the King was briefed on matters of animal husbandry, milk or meat processing, and extension service to farmers. The station used this opportunity to offer the Royal visitors a range of typical products from the farm. This included milk and

other dairy products, fried sausage, and smoked ham. The German ladies were proud to bake cheese cake for the Royal family. A small social issue started to develop, when, at the end of the visit, her Majesty the Queen asked to take the remaining cheese cake

back to the Palace. This, of course, was considered a great honor. As a result, the German ladies developed their own special strategy to ensure, that in fact their cake, the cake they had personally baked, was taken up to the palace!



4.2 Assistance to Hill-tribes

At the time of the project, the so called, "Golden Triangle" produced three quarters of the opium traded worldwide. Opium cultivation, according to the theory of the agricultural economist, Johann Heinrich von Thunen, is an ideal crop to be produced far away from the market. It is labor intensive, the final product does not spoil or deteriorate, and it can be easily transported over long distances. By growing poppies, a whole family will produce just 1 to 2 kg of opium per year. The price of raw opium to the producer would just be \$120 to \$150 per kg, while on the world market a kilo would fetch \$20,000. Due to international pressure, the Thai Government started efforts, to eliminate poppy growing in the hills. The Government declared poppy an illegal crop. The common strategy at the time was that the Thai military would fly into the hills, and destroy poppy fields by burning the crop or spraying pesticides. On the attached disk is a newspaper article by Marion Gräfin Dönhoff, the publisher of "Die Zeit". The article describes how she joined his Majesty the King on a visit to the hilltribes.



His Majesty the King believed in a different strategy. His view was to offer the hilltribes alternative crops, so they could earn their living by selling legal products. This was also the time, the so called "Royal Project" was initiated. Through contact with the project team, His Majesty asked if the Germans could assist him in his endeavor. During several trips to the hills, accompanying his Majesty and his team, the Germans suggested to introduce the rearing of sheep and beef cattle. The German Government agreed to this measure, and soon a small herd of sheep arrived in the hills. Beef animals, mainly of the Brahman breed, were supplied by the DLD. To show his appreciation, His Majesty bestowed the head of the German team with the Rajaruchi Medal.

5.0 Investing in People

If the saying is correct, that if you want to feed a person for a day, you give him a fish. However, if you want to feed him for life, you teach him how to fish! Following this philosophy, already early on the project took a number of measures to convey knowledge on a wide range of subjects. During the project and in later years, some 150 Thais have received training in five different programs: (i) Counterpart training in Germany; (ii) Initial practical Master Degree Program in Thailand; (iii) Practical training of Thai students in Germany; (iv) Academic exchange between CMU and the University of Göttingen; and (v) Master Degree Program in CMU. On the none academic side, a number of meat processors were trained in modern food processing technology. Prof. Dr. Boonlom Cheva-Isarakul, former Deputy Dean, Faculty of Agriculture, CMU, has made a written statement, summarizing the view of many scholarship recipients (see disk). Following his retirement Prof. Langholz has continued his broad support for animal production

at the CMU through a wide range of activities. (see disk) It is impressive to note the far reaching network of academic teachers and Thai business managers that can be traced back to experience gained at the TGDP.

5.1 Project Counterparts

Over the course of the project, some 20 Thai officers were sent to Germany for special training. Depending on the technical background of the officer, the subjects ranged from maintenance of agricultural equipment to animal nutrition, dairy technology, and meat processing. Usually, the officer would stay for one year in Germany. The only condition for receiving such a scholarship, was that the officer had to agree upon return to continue his service at the DLD.

5.2 Local Master Degree Program

The German Government agreed to support students of CMU with a three-year scholarship program. During this timespan, the student received practical training on the farm. They worked in the Nutrition Laboratory, Animal Husbandry and in Milk Processing. Following the practical work on the farms, these students attended a Master Degree Program at Kasetsart University in Bangkok. A total of 16 Students received this support (list attached on disk)

5.3 Farm Training Thai Students in Germany

In Europe, it has been proven valuable, that a student of agriculture receives also some practical training on a farm. Ideally, the training should be taken prior to entering the university. But it is



of similar benefit if the student at least uses the time of the annual university vacation to work on a farm. Prof. Langholz has made his farm available for such practical training. In total, 18 students worked on the farm and gained experience in practical farm management. (list attached on disk)

5.4 Ph.D. Program

Starting in the early 1980s, an academic exchange program between CMU and the University of Göttingen was started by Prof. Langholz. The objective was to permit graduates of CMU to receive a Ph.D. degree from Göttingen. Up to the present time 13 Thai academics have graduated with a Ph.D. in Germany. Typical research programs ranged from different subjects of livestock production to degrees in aquaculture. (list attached on disk)

5.5 Master Degree Program

Since 2002, Prof. Langholz has conducted a Master Degree Program at CMU. During his annual visits between January and March, a total number of some 70 students have participated in this program.



6.0 Outlook

6.1 Production System

Producing milk is a very popular agricultural activity worldwide. The ten top producers range from the United States with 87 mill tons of milk per year, India with 50 mill, New Zealand with 17 mill, to Turkey with 12 mill. (Thailand just 1 mill tons). However, there are large differences between countries in their particular production method.

In Europe, we observe annual milk yields per cow of approximately 7,000 kg, while in the United States, 10,000 kg are common. Unfortunately, these high performance cows usually only produce milk during two or three lactations. This means they have a lifespan of only five years (two to three years as a calf and heifer). After this short period, the cow has to be culled and goes to the butcher. The reasons for being culled are: fertility problems, cows do not become pregnant any more, they develop mastitis, udder problems, or they become lame. Economically, this means the cost of raising a heifer has to be depreciated over two to three lactations only. In Germany, this adds €0.07 to production cost of every kg of milk during the life of the cow. In Germany the depreciation is equal to 25 % of milk production cost.

In New Zealand, with the 8th largest milk production in the World, cows only produce 3,600 to 4,000 kg per year. There, cows mainly graze on natural pasture, where they can find enough roughage to produce the required 10 to 12 kg per day. The result is, in New Zealand cows typically reach an age of 10 years or more before they have to be retired. Therefore in New Zealand only €0.03 have to be added as depreciation to the production cost.

Observations over years indicate that countries like New Zealand have been able to produce milk for the lowest ex farm price, typically around \$0.16 per kg. Therefore, it is interesting to see what general lessons can be drawn from the dairy industry in a country like New Zealand.

6.1.1 Nutrition

Cows are ruminants, which means their digestive system has developed to consume large volumes of roughage. Roughages have a significantly lower concentration of nutrients compared to concentrated feed. A typical cow is able to consume enough roughage to have sufficient nutrients for the production of about 10 to 12 kg of milk per day. However, dairy farmers in many countries of the world want their cows to produce significantly more milk. The only way to provide these high producing cows with sufficient nutrients is to feed up to 10 kg of concentrated feed. The digestive system, as mentioned earlier, is not made for these large volumes of high energy concentrate. As a result, the ruminant system suffers. The cow develops problems with their digestive system, mineral or vitamin deficiencies occur, and fertility problem become common.

6.1.2 Mastitis

A dairy cow with a peak production of 30 to 40 kg of milk per day will have up to 10 kg of milk flow through each single teat a day. This is an enormous stress for the organism ("teat sphincter muscle"). Soon, the teat no longer can close properly. Bacteria can enter the udder, and Mastitis becomes a common problem.

6.1.3 Lameness

According to international statistics, in the US, 39 % of all dairy cows suffer from lameness. In Germany the rate is 25 %, and in New Zealand it is below 10 %. A cow that has trouble walking or standing up is less interested in feeding; it just wants to relax and rest. The reason for these differences is that cows in New Zealand regularly exercise by walking on the pasture during grazing. In Europe and the

United States, cows are mainly kept in stables. The floor is wet, the hoofs of the cow become soft, which results in hoof infections and lameness.

6.1.4 Recommendation

Thai dairy farmers should feed their cows with as much roughage as possible. When growing the roughage, they should give preference to roughage with a high nutrient content. The feeding of relatively expensive concentrate should be limited to the time of peak performance of the cow. Dairy cows should be kept in a dry paddock, where they can exercise and keep their hoofs dry.

6.2 Extension Services

6.2.1 Historic Description

In the past, it was considered that the Government had the obligation to teach the farmers in the latest technology. For animal husbandry matters, it was the DLD that would send out extension officers to train farmers in dairy farming matters. Lately however, it has become clear, that the Government extension officer has often very little motivation or incentive to leave his office and drive into the villages to train farmers in the latest technology.

6.2.2 A New Strategy

The new approach of transferring knowledge to a farming community is called "Contract Growing". Contract Growing applies to a wide range of agricultural products and ranges from vegetable production, to fruit growing and milk production. The underlying philosophy is that the processor and/or marketing company, (example Chiangmai Fresh Milk) has the greatest interest in an efficient producer, high quality milk, and a regular supply. Under the contract growing system, it is therefore the dairy plant that employs the extension officer. By working for the dairy plant, the extension officer has, on one side, to ensure a sufficient supply of high quality milk for the processing plant. On the other side, the officer has to advise the farmer in the best practice to produce milk, otherwise the farmer will stop dairying. The officer has to satisfy both. A detailed description of the system, its opportunities, and threats are presented on the attached disk.

Is this the future of the Thai dairy industry?

In summary, the growing popularity of contract farming models can be interpreted as proof that the opportunities or benefits outweigh the threats or negative aspects of the contractual arrangements. At its best, contract farming constitutes a “Win – Win” situation for both the farmer and the processor.



Chiangmai Freshmilk with stable for 1,000 cows!

