Challenges and Opportunities for Improvement in Dairy Production and Genetic Progress in Thailand

S. Koonawootrittriron[1] and M.A. Elzo[2]
[1]Department of Animal Science, Kasetsart University, Bangkok 10900, Thailand
[2]Department of Animal Sciences, University of Florida, Gainesville, FL 32611-0910, USA

ABSTRACT

Thailand is a tropical country with a multibreed population of 483,899 dairy cattle raised in 17,837 households under conditions of high temperature and humidity. Milk production amounted to 2,093,412 kg of milk daily in 2009 from a total of 204,805 milking cows. Studies by the authors and their research team revealed that most Thai dairy farmers had small size herds (less than 10 milking cows), and that their vast majority had primary school or no school education, kept no records, employed family members, and depended on their dairy business as the sole source of income. Milk price in Thailand is primarily determined by amount of milk, with additions and deductions due to milk components (fat percentage, solids-non-fat) and milk quality (bacterial score, somatic cell count). Monthly milk yield, milk quality and milk revenue (per farm and per cow) varied by year-season and farm size-farm location. The Dairy Farming Promotion Organization and the Department of Livestock Development conduct genetic evaluation for economically important dairy traits using animal mixed models. Estimated breeding values are published yearly. The total number of cows represented in datasets from both organizations was only 11% of the total number of dairy cows in the country. Estimated genetic trends for milk yield and other economically important traits using datasets from both organizations were small and close to zero suggesting that animal selection strategies need to be improved. Genetic trends suggested that additional training of dairy farmers in production and genetic selection techniques, improvements in data recording and utilization, creation of a national dairy database and a national genetic and genomic evaluation system, and promotion of sustainability of dairy production will strengthen the competitiveness of the Thai dairy industry.

Key Words: Genetic, Evaluation, Dairy, Milk Production, Farmers, Tropical

INTRODUCTION

Thailand and its Dairy Cattle Population

Thailand is a tropical country in Southeast Asia (5° 37' to 20° 27' North latitude and 97° 21' to 105° 37' East longitude; elev. 0 to 2565 m). Its total area is approximately 513,115 km^2, of which 99.6% is land and 0.4% is water. Arable land is 34% (6% permanent crops, 2% permanent pastures, 26% forests and woodlands and 32% for other uses). Average daily temperatures range from 17° to 36° Celsius, average relative humidity range from 66 to 81% and rainfall is approximately 1,572 mm per year. Seasons are winter (November to February: cool [17° to 32° Celsius] and dry [73% RH, precipitation 282 mm/year]), summer (March to June: hot [21° to 36° Celsius] and dry [71% RH, precipitation 245 mm/year]), and rainy seasons (July to October: hot [24° to 33° Celsius] and humid [79% RH, precipitation 1,160 mm/year]), respectively (Meteorological Department, 2009).

The number of dairy cattle in Thailand was 483,899 in 2009, of which 42% were milking cows that produced 2,093,421 kg milk per day (Department of Livestock Development, 2009b). The Thai dairy population has more than ten different breeds (e.g., Holstein (H), Brahman, Brown Swiss, Jersey, Red Dane, Red Sindhi, Sahiwal, Shorthorn, and Thai Native) represented in both purebred and crossbred forms. Most of them are crossbred animals composed of up to seven breeds. Efforts to increase milk production in Thailand combined with government policies resulted in widespread importation and use of H semen, and extensive use of high-percent H sires generated in Thailand by the Dairy Farming Promotion Organization (DPO) and the Department of Livestock Development (DLD). This mating strategy created the Thai multibreed dairy population. Currently, 90% of the population is over 75% H with small fractions of other breeds (Koonawootrittriron et al., 2002b, 2009).

Feeding is primarily based on concentrate (5 to 15 kg/d, or 1 kg of concentrate per 2 kg of milk), and fresh grass (direct grazing or cut and carry; 30 to 40 kg/d). Grasses are Guinea (*Penicum maximum*), Ruzi (*Brachiaria ruziziensis*), Napier (*Pennisetum parpureum*), and Para (*Brachiaria mutica*). During dry seasons (winter and summer) grasses are usually insufficient because of lack of irrigation. Rice straw, urea-treated rice straw, crop residues, and agricultural byproducts are used as supplement. A free-choice mineral is available throughout the year. Farms keep cows in open barns, except for a couple of commercial farms with closed barns and evaporative cooling systems. Less than 10% of farms use fans to reduce heat stress. Nearly all farms milked cows twice a day (morning and afternoon) using machine milking. After each milking, either the farmer or a private carrier takes the raw milk to a milk collection center. Farmers breed their cows all year round by artificial insemination (Koonawootrittriron et al., 2009).

Thai Farmers and Their Dairy Production System

The number of dairy farmers in Thailand was 17,837 households (Table 1). Most of them (69%; 12,240 dairy cattle) were in the central region, and their dairy herds (139,175 cows) produced the highest volume of raw milk (1,370,990 kg/d; 65% in the country; Department of Livestock Development, 2009b).

Table 1 Distribution of dairy cattle, milk production and farmers classified by regions

Region	*Males*	*Females*					*Milk Production*	*Total no. of dairy cattle*	*Farmers (households)*
		0 to 1 year old	1 year old to pregnant	Milking cows	Dry cows	All females			
North	683	8,014	13,573	19,409	4,609	45,605	201,656	46,288	1,697
Northeast	2,942	19,747	23,038	44,718	10,826	98,329	508,350	101,271	3,723
Central	17,719	61,224	77,962	139,175	36,818	315,179	1,370,990	332,898	12,240
South	317	552	698	1,503	372	3,125	12,426	3,442	177
All regions	21,661	89,537	115,271	204,805	52,625	462,238	2,093,421	483,899	17,837

Source: Department of Livestock Development (2009b)

Information on dairy farming in Thailand is limited. However, using a dataset from Central Thailand (34,082 records from 800 farms; questionnaires from 627 farms; January 2004 to December 2008), Yeamkong et al. (2010a) found that most farms (55%) were small holders (had less than 10 milking cows per day) and the vast majority of farmers had primary school or no school education (65%), kept no records (78%), and employed family members for dairy work (85%). The average farm size was 4 acres (SD = 6 acres) and the majority of dairy farmers (52.4%) relied on their dairy business as the sole source of income. The remaining farmers received additional income from other livestock trade (2.9%), horticulture or

agronomy (41.2%), and other sources (3.5%). Each farm employed an average of 2 people (SD = 0.8). The average number of dairy cattle per farm was 29 (SD = 20) for all types of dairy cattle, and 11 (SD = 8) for milking cows. Monthly averages were 3,551 (SD = 2,681) kg for milk per farm, 338 (SD = 124) kg for milk per cow, 44,789 (SD = 34,994) baht of revenue per farm, and 4,398 (SD = 1,850) baht of revenue per cow.

Because 93% of Thai dairy farms had less than 20 milking cows, farmers sold their milk to dairy cooperatives (96 centers; 71% of Thailand's milk production) or to private organizations (60 centers; 29% of Thailand's milk production) they were members of. Dairy cooperatives belong to farmers, are supported by the government, and are managed by a committee of elected farmers. In contrast, private dairy organizations belong to a business person who also manages the business and makes decisions. Milk revenue was related to amount of milk produced and to milk quality factors (fat percentage, bacterial contamination and somatic cell count). (Seangjun and Koonawootrittriron, 2007; Rhone et al., 2008b; Yeamkong et al., 2010a). Studies on factors affecting milk quantity and quality in Thailand were conducted both for farmers from a dairy cooperative (Seangjun and Koonawootrittriron 2007; Rhone et al., 2008a, b) and also for farmers from a private dairy organization (Yeamkong et al., 2010a).

Genetic Evaluation and Selection

A large-scale dairy genetic evaluation program in Thailand was created through collaboration between the DPO and Kasetsart University in 1996 (Dairy Farming Promotion Organization, 2009). Animal genetic predictions for economically important traits in the multibreed dairy population controlled by DPO have been published yearly since 1996. To improve the genetic evaluation system, collaboration with the University of Florida, USA, was added in 2002. Currently, estimated breeding values (EBV) for purebred and crossbred animals are computed for milk yield, fat yield, fat percentage, lactation length, age at first calving, and lactation pattern (i.e., initial yield, peak yield, days to peak yield, and persistency) using multiple trait animal models applied to the Thai multibreed population (Koonawootrittriron et al., 2002b). These evaluations are published and distributed to farmers in the yearly DPO Sire and Dam Summary (Dairy Farming Promotion Organization, 2009). The DLD began to publish a genetic evaluation in 2007 using dairy information from farmers associated to 7 Artificial Insemination Services Centers located around the country. It currently evaluates animals for milk yield, fat yield, fat percentage, protein yield, protein percentage, age at first calving, and 17 type traits using animal models. These evaluations are published yearly in the DLD Dairy Sire Summary (Department of Livestock Development, 2009a).

Sire selection in Thailand has been primarily based on semen availability, and secondarily due to their genetic ability for economically important traits (Koonawootrittriron et al. 2002a, b). Farmers tried upgrading their cow herd to fractions close to H. However, because of health and reproductive problems, farmers keep their own cattle at 80 to 90% H. Most Thai dairy farmers (59%) lacked sufficient knowledge and understanding of genetic selection and mating strategies. Sarakul et al. (2009) reported that when the farmers selected sires, most of them (96%) sought the advice of artificial inseminators, semen sellers, consultants, or other people. On the other hand, farmers who decided by themselves (4%) used their own knowledge and experience (49%) rather than discussing with other farmers or considering EBV of potential sires. Unfortunately, most farmers (90%) did not know how to use EBV. Among famers who knew the benefit of EBV for selection, less than 5% of them frequently used it.

Genetic and Phenotypic Trends

Genetic and phenotypic trends have been constructed in Thailand since dairy genetic evaluations were first implemented by Kasetsart University in collaboration with the DPO in 1996. Their purpose was the documentation of changes in the population for economically important traits over time, the assessment of the impact of selection and mating strategies used by farmers, and the identification of areas in need of improvement. Estimated genetic trends in the Thai dairy population were small (less than 4 kg per year) for 305-d milk yield, and near zero for milk composition traits (Koonawootrittriron et al., 2004, 2009; Department of Livestock Development, 2009a; Sarakul et al., 2010).

Genetic yearly means for 305-d milk yield in cows, sires and dams (Figure 1a) suggest that sires and dams were primarily chosen based on considerations other than their EBV for this trait. This is supported by the closeness of weighted (number of daughters) and unweighted sire yearly mean EBV which suggests that sire usage was similar among available sires within years (Figure 1b; Koonawootrittriron et al., 2009).

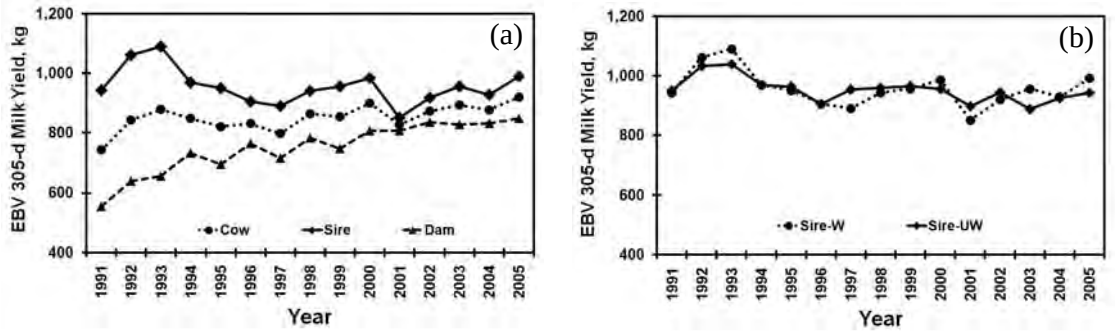

Figure 1 Genetic yearly means of cow, sire (weighted), and dam (weighted) EBV for 305-d milk yield (a), and weighted (W) and unweighted (UW) yearly means of sire EBV for 305-d milk yield (b)
Source: Koonawootrittriron et al. (2009).

Phenotypic trends for 305-d milk yield varied among Thai dairy populations. Estimated Phenotypic trends for 305-d milk yield were from 12 kg/year (Sarakul et al., 2010) to 60 kg/year (Department of Livestock Development, 2009a).

Challenges and Opportunities for Improvement

Training of producers in dairy production and genetic improvement: Most farmers in Thailand (90%) did not know how to use animal EBV. Less than 5% of farmers understood the value of EBV for selection, but used them infrequently. Most Thai dairy farmers (59%) lacked knowledge and understanding of genetic selection (Sarakul et al., 2009). Experience and type of labor were found to be important for milk yield and revenue per farm and per cow ($P < 0.05$), and education of farmers was important only of milk yield per farm and revenue per farm ($P < 0.05$; Yeamkong et al., 2010). The small genetic trends in Thai dairy populations (Koonawootrittriron et al., 2004, 2009; Department of Livestock Development, 2009a; Sarakul et al., 2010), suggest that farmers may have limitations in their ability to understand new technology and to acquire new knowledge for improving dairy production and profitability. To overcome these limitations, Thai dairy farmers would need a program that includes systematic training and continuous support to improve milk production and revenues in a sustainable manner. Furthermore, a national program of this kind seems advisable.

Data recording and its utilization: Although dairy farms that kept individual animal records achieved higher performance than farms that did not (Rhone et al., 2008a), most farmers did not keep records (Rhone et al., 2008a; Sarakul et al., 2009; Yeamkong et al., 2010a). According to surveys in these studies, most of farmers did not know how to utilize recorded data in their dairy business, and they considered data recording to be costly and a waste of time. This situation needs to change. Proper data recording and utilization needs to continue to be promoted and explained to Thai dairy farmers. This will not only benefit individual dairy farmers through improved practices and higher revenues, but it will also benefit the complete dairy industry through improved regional and national dairy databases for potential use in production, genetic, economic, and social programs.

National Dairy Genetic and Genomic Evaluation Systems: The number of cows providing information to the DPO and DLD was only 27,802 in 2009 (Dairy Farming Promotion Organization, 2009; Department of Livestock Development, 2009a). This represented only 11% of the total number of dairy cows (milking and dry cows) in Thailand. In addition, genetic trends for economically important traits in Thai dairy cattle populations were small and close to zero. Thus, a "*National Dairy Genetic Evaluation*" needs to be implemented to improve the accuracy of genetic predictions and to increase the availability of Thai and imported sires evaluated under Thai environmental conditions. A substantially larger number of dairy herds and cows should provide individual animal information for genetic evaluation purposes. In addition, research and development efforts towards the implementation of a "*Genomic Evaluation system*" are needed. Genomic research will provide needed information on the importance of genes associated with dairy traits under Thai environmental conditions.

Sustainability of dairy production: Economically, the most important dairy traits in Thailand are milk yield and fat percentage. Milk price in Thailand is primarily determined by amount of milk produced, with additions and deductions due to milk components (fat percentage, solids-non-fat) and milk quality (bacterial score, somatic cell count; Rhone et al., 2008a; Seangjun and Koonawootrittriron, 2007). Most Thai dairy herds are small (less than 10 milking cows). To stimulate increases in herd size and number of dairy farms willing to participate in genetic improvement programs, the milk price paid to farmers in Thailand needs to increase. On the other hand, cows between 75% H and less than 100% H had higher milk production than purebred H (Koonawootrittriron et al., 2009). This suggests that selection programs in Thailand need to include adaptability (heat and humidity tolerance, tolerance to insects), reproduction, and production traits. Thus, a sustainable dairy production program in Thailand needs to consider economic, social, production, and genetic improvement aspects.

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