

Considerations on the future of the dairy industry in Thailand: A review**Supreena Srisaikhram^{1,*} and Boyd Rueben Jury²**¹*Faculty of Agricultural Technology, Burapha University Sakaeo Campus, Sakaeo 27160, Thailand*²*Jury Miniature Horse and Goat Farm, Bedford Road Inglewood, New Zealand*

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Abstract

Thailand possesses a large, diverse and expanding economy with a current national gross domestic product of in excess of THB 11 trillion and a growth rate of 6.5 percent (2012). As a newly industrialized economy, it is considered one of the most successful of the traditional economies in South-East Asia. The major contribution to the GDP is provided by the Thai industrial and service sectors with the agricultural sector contributing just 10 percent of GDP (2016). Thailand is a signatory to numerous free trade agreements with most of its major trading partners including being a partner to the agreement between ASEAN and China (ACFTA). Despite achieving access to these important export markets there remains commentary from some quarters that the Thai agricultural sector still underperforms both in terms of production and in meeting those markets requirements. With a notably large percentage of the Thai population involved in rural endeavors either directly or indirectly related to agricultural production (mostly rice production), there remains a significant untapped interest in improving the nation's ability to produce both for the domestic and international markets. Arguably, the rural economy is underserved by successive national governance which has either ignored the wellbeing of the agrarian industries or played a divisive game of political football with the rural economy which has resulted in Thai farming community being somewhat vilified by other sectors. This, combined with a lack of focus on agricultural technologies and with limited recognition for the many specific challenges which are faced by the rural production sector, has resulted in prevailing attitudes that have contributed to the ongoing substandard performance of rural sector activities for decades.

The reasons for this are probably deeply founded in Thai cultural dogma. Certainly today, all things including employment within Thai rural industries are considered unsophisticated, undesirable and lacking status or class. The Thai expression which is often used in a slightly disparaging manner connotes everything humble, basic and non-technological about a rural existence yet also manifests the emotional context of home, family and belonging which are the hall-marks of the simpler lives that many Thai citizens experienced as children before they matured and migrated to the larger cities for the promise of employment and prosperity. Many countries experience the rural/urban duality of a social whole yet few seem to express such a range of feelings about how that duality imposes personal conflict (and more latterly, collective national conflict) the way Thai people do. It is something of an indictment and certainly a telling social commentary that no-one in Thailand views staying back on the farm as a potential path to any measure of prosperity with seemingly only luck separating the outcomes of such a decision between a decent working life and a subsistence. For Thailand to become serious about addressing the issues which prohibit parts of the agricultural sector from achieving its true performance potential there will need to be a shift in attitude towards the value that the rural economy and rural society can bring to the nation. As with most shifts in attitude, the only way to achieve this will be through strong leadership at a governmental level or higher still.

To understand the challenges faced by Thai agriculturalists and to investigate potential new directions for the Thai rural industries and economy it is worthwhile to explore the differences in methods, environment and mindset which are prevalent in Thailand compared with nations deemed to exhibit excellence in agricultural activities, performance and production. The scope of this paper is to examine and compare the facets of the Thai agricultural environment which may prohibit the dairy industry from optimizing its industry potential.

Keywords: Dairy industry economy domestic product Thailand New Zealand

Introduction

The title of largest global food producer is competed for by China, India and the USA however in terms of high quality food production (especially in terms of dairy production), New Zealand is a world leader especially in terms of the quality of products and for the purposes of this discussion will provide an illuminating comparison which may deliver some insights for Thai dairy farming practices. To highlight the main areas of difference between the New Zealand and Thai dairying industries and economies, the following features impacting agricultural performance will be examined: Environment, Animal species, Agricultural technology, Farming practices, Administrative support, Research activities and Societal relationship.

1. Environment

The two nations are quite diverse in the environments they naturally present as available for farming activities and to fully comprehend the differences, environmental considerations shall be examined under the categories of topography, climate, soils and flora. In many ways, the climate in some parts of New Zealand is considered almost naturally perfect for optimizing dairy farming production. While dairying is practiced across all regions of the country, the two most prominent areas where it is the primary industry are the central North Island provinces of Waikato and Taranaki and it is no coincidence that the single largest dairy company in the Southern Hemisphere (Fonterra) is centered in this region. New Zealand is an island nation located in the Southern Pacific Ocean between the latitudes of 35 degrees and 46 degrees south of the equator. The topography varies between plains and rolling pasture land to mountain ridges and plateaus. While prior to colonization by Europeans the land mass was largely a forested bird colony, since 1840 [1] (NZ Ministry for the Environment, 1997) the landscape has been transformed through deforestation with most of the less severe topography found very suitable for dairy or sheep farming, dry stock, horticulture and other agrarian activities and with the steeper hill-country still excellent for managed forestry operations. As an island nation, it is subject to prevailing Westerly weather features generated in the Southern Indian and Pacific Oceans and with a mountainous, central 'spine' it receives plentiful orographic rainfall in most regions through most seasons. The two provinces identified previously enjoy a climate which is broadly regarded as seasonal, mild-temperate, moderately windy and consistently wet. Mean temperatures range consistently between 8 and 25 degrees centigrade with annual rainfall of between 1000 and 2000 mm per year in 2010 [2]. Soils are volcanic in nature and considered extremely fertile with few mineral deficiencies. Suitable pastureland in New Zealand has long been cleared of the original temperate and subtropical rainforests with areas of special interest preserved as national parks. Land used for farming has been sown with cultivar pastures such as Ryegrass, Clover and Cocksfoot, all species which have been found to thrive in the soil and climatic conditions. Much of the success of the New Zealand dairy industry is attributable directly to the persistent, hardy and dense nature of the pasture growth which has been achieved in those conditions.

Many farms in New Zealand still retain some limited forested or bush areas either as a concession to stock for protection from the worst weather conditions or as a result of regulatory requirements to protect specific native tree and plant species. By contrast the environment available to Thai farming communities is significantly different. Thailand is landmass of almost twice the size of New Zealand occupying the central area of the South-East Asian peninsular at latitudes of between 6 degrees and 19 degrees north of the equator. It shares borders [3] with Cambodia, Laos, Malaysia and Myanmar and close proximity with China and Vietnam as well as an extensive coastline with the tropical waters of the Gulf of Thailand, the South China Sea and the Andaman Sea. Thai topography is diverse with mountainous areas to the North and West of the country, an upland plateau, central plains and a forested south with numerous tropical islands. Much of the terrain in the Central, East and North-East of the nation have long been identified as suitable for all manner of farming activities and have indeed been consistently utilized as such for centuries. As of 2005 over 27 percent of the land area was deemed suitable as arable land of which around 7 percent was planted in permanent crops and only 1.5 percent planted as grassland [4].

Topographically, Thailand can be considered comparable to New Zealand in many ways and certainly presents a plentiful volume of suitable land available for agricultural industries yet a large percentage is consumed for rice production. Thailand's climate can be considered as extreme for farming endeavors. The low latitudes that most of the country is located within mean that it is well founded in the tropics and the temperature range reflects this at between 13 and 40 degrees centigrade with an average temperature in the central region of around 30 degrees centigrade although there is wide variation in temperature between latitude and seasons. There are three distinct seasons for much of the country - the hot season, the cool season and the wet season (monsoon). Annual rainfall is measure as between 1500 mm and 4700 mm and thus is comparable to New Zealand's dairying regions however the annual distribution renders a challenge. The majority of precipitation occurs during the wet season (June to October) when serious flooding is not uncommon and there are frequent dry periods over much of the country during other parts of the year. A good percentage of Thailand's land area is deemed to be irrigated however this is generally considered only necessary for rice production and seldom considered as an option on a large scale to regenerate pasture for dairy production. There is unquestionably scope for the development of better irrigation schemes which can manage the wild variations of annual water supply and provide significant improvements to the quality of land utilized for dairy activities.

Despite well publicized historical episodes of cloud-seeding to adjust rainfall patterns, little can actually be done to impact weather patterns positively given the quantum of climate change which is being faced by South-East Asia and globally and probably the most challenging factor facing the Thai dairy industry today, as in the past, is the heat. Very high daily temperatures in Thailand limit the range of animal species available for farmers to use for dairy farming and reduce the productive performance of those animals. It also reduces the time available for storage and transportation of dairy products which are specifically susceptible to spoiling with exposure to high temperatures. Many measures have been investigated to improve the shelf-life of milk produced by Thai dairy farms however none are practiced properly so as to be as effective as proper refrigeration of the product from collection and transportation to the processing, distribution and storage over all stages of the product supply chain [5]. It is well understood that the costs of implementation of refrigeration systems through the whole process has been deemed as too expensive however, if the industry aspires to production, efficiency and quality improvements on a national scale then this requirement needs to be accepted and addressed. The provision of natural or artificial shade features is also a key element which could reduce the effects of heat on animals and dairy production and improve pasture quality. Farming communities require the support of education and focused research

spearheaded by government to enable them to address the harshest climatic effects. Soil quality represents an ongoing challenge to Thai farmers. In the south of the country soils are largely infertile and deficient in the major nutrients (nitrogen, phosphorus, potassium, magnesium) and micro-nutrients (zinc and copper). Soils in other parts of the country suffer from low levels of many of the major nutrients and deficiencies of some other micro-nutrients such as boron and molybdenum. As well some soils are characterized as having a sandy texture, acid reaction, low organic matter content and low cation exchange capacity. In short, Thai soils are well short of what is considered helpful for decent pasture growth.

Given that New Zealand soils are abundantly fecund, infrequently over-farmed and seem to naturally support ideal pasture conditions it is difficult to interpolate a useful comparison however the recent reforestation of the Kubuqi Desert which the Chinese have engendered in their Eastern provinces has shed new light on what is possible with focused plant selection [6], soil stabilization and a concerted research program. The salient lessons for Thailand and others is that significant change is possible even in the harshest of conditions and with enough capital and detailed research, answers to Thailand's soil issues can be identified, perhaps through soil augmentation and plant species selection and modification. With such a small portion of Thai arable land available for farming activities, pasture selection is important. Tradition legume pastures utilized on Thai farms may not be the best option to achieve a dense, leafy pasture which is optimal as a dairy cow diet. With high quality herd and pasture management isolated dairy facilities in the Kingdom have been shown to be efficient and profitable and can produce a high quality milk product however, greater emphasis and funding needs to be allocated for research on identifying the optimum grass species or cross-breeding of species to ensure that more Thai farmers have access to the most successful pasture alternatives for their conditions and remain well-informed about fertilization requirements and options.

2. Animal Species

Cattle species utilized in Thailand for dairy production are largely crossbreed species (91 percent) with the larger fraction being Holstein and minor components of Brahman, Brown Swiss, Jersey, Red Dane, Red Sindhi, Sahiwal and Thai Native [7]. It is recognized that some of these species are known to perform better in warmer climates however, some conversely are not known as the most efficient from a milk-solids producing perspective. As with dairying activities anywhere, a balance needs to be found for species which suit the environment, the pasture/feed supply and the availability and cost of the animals. In New Zealand where dairying conditions are close to ideal, two breeds dominate the landscape (literally and figuratively). Holstein-Friesian and Jersey cows are by far the breeds of choice as they are the best producers of milk-fat solids on very dense, green pastures [8], are hardy for temperate climates, relatively simple to remain disease-free and exhibit high breeding success rates. In general, the Jersey cow is a little smaller and lighter and is therefore less destructive on pasture which may be soft after a wet winter. For firmer soils the Holstein Friesian is an ideal dairy cow and the star producer of milk production in New Zealand. Many farmers run herds constituted by one breed or the other exclusively while others run herds with both breeds together and yet others include animals which are a cross-breed of the two species. Both species were European-bred and perform spectacularly well in New Zealand conditions. They are considered by some commentators as the marathon runners of the animal kingdom not because of their ability to cover distances but because of their extremely efficient conversion rate in terms of the energy efficiency as they convert pasture feed into milk fat solids. Indeed, some New Zealand cross-breeds were imported to Thailand in 1987 and 1988 [9] and reportedly performed very well in Thai conditions, albeit on a very well managed dairy operation. An ongoing problem for the Thai industry is the number of animals. Difficulties in breeding stock locally and the high cost of the importation of new

animals has seen total stock numbers remain static in some years. Given the high costs of importing animals and the relative weakness of the Thai currency, there is a clear need for a concerted breeding program supported by advice on breeding management and research on breeding techniques which suit the Thai industry. An increase in the number of productive dairy cattle is an important factor in strengthening the Thai dairy industry long term and the only cost-effective method of achieving this is through a successful breeding program increasing the numbers of the breeds identified as most productive in Thai conditions.

3. Agricultural Technology

Hand-in-hand with a strong and successful dairy industry, the support of world-class agricultural research and technology institutions are vital. It is not possible for nations which practice traditional farming techniques to keep pace with other producers who understand the value of, and proactively fund, research efforts for the benefit of the agricultural industries and, more broadly, the nation through resulting increases in production and export growth. In New Zealand, agricultural research has been a focus for academic institutions for decades with one university in particular (Waikato University) largely dedicated to the sector. The programs offered at this institution cover all facets of agricultural industry practice including; Agribusiness, Animal Behaviour, Anthropology, Biochemistry, Biological Sciences, Biotechnology, Chemical and Biological Engineering, Earth Sciences, Ecology and Biodiversity, Economics, Environmental Engineering & Planning, Environmental Sciences, Ethics, Geography, Geology, Hydrology, Management and Sustainability, Marketing, Molecular and Cellular Biology, Science Technology and Environmental Education, Soil Science, Supply Chain Management, as well as a host of other conventional tertiary courses.

The courses are considered to be some of the best matriculation available globally and most have specific focus on New Zealand applications. Some areas of the research at this institution are government funded and there is considerable emphasis placed on research and innovation for the dairy industry. Furthermore, a recent announcement from the new government which has taken power during October 2017 is that from 2018[10] all first-time tertiary students will study free of charge for their first year and the long-term target will be three years free tertiary education. Such focus on education and research has meant that New Zealand has remained a world-leader in dairy production and continues to set new standards of quality for existing products and enjoys a reputation as a vanguard of innovation for new products. Historically, agricultural production has contributed the largest portion of New Zealand's GDP and hence it was natural that there would be significant academic and governmental focus placed on agricultural research and development. Over the last ten years, tourism now competes with dairy production for the top spot as New Zealand's largest export earner but dairying remains a very important contributor to the New Zealand economy with around 3.5 percent of the GDP (\$7.8 billion - 2016) [11].

The lesson from this for Thailand or any nation aspiring to improve its standing in global dairy exports or quality of products is that in order to realize those aspirations, significant emphasis must be placed on support activities such as education, research and development and administrative support to ensure that primary industries like dairy farming have a solid base on which to improve, develop and grow. Because dairy activities are heavily influenced by localized physical environments and national and regional market conditions, sensitivity to those local factors must be recognized. It is alleged that Thai dairy exports are the largest of the ASEAN nations however it is also recognized that there is significant room for improvement and as the taste for dairy products among Thai citizens increases, so too does the demand generated by the local market.

4. Farming Practices

Historical farming practices have changed little for many Thai farmers for hundreds of years save the introduction of mechanization over the last half century. The introduction of tractor technology and other farm machinery has ushered in improvements in terms of somewhat reducing heavy labor activities associated with farming practices however; this is where the advancements have halted on all but a few Thai farms. Part of the reason for this is the small nature of the average Thai landholdings which means that expensive technologies are not affordable to the average farmer and the lack of communication and education surrounding the advantages of such technologies (or even information on what is available) is not well disseminated among farming communities.

In New Zealand, the dairy farming industry is considered affluent both economically as well as in terms of the availability of, and access to, new technologies which can render significant improvement to farming activities. Some examples of this are the use of drones to travel to distant corners of farms to observe pasture/herd conditions without the farmer needing to visit the location himself rendering an increase in safety as well as time savings, farm management technologies involving high-tech automation [12], and extensive use of artificial breeding technologies and programs. Other very recent trends in New Zealand farming practices have seen a renewed focus on environmental impact of dairy activities involving increased monitoring of the quality of affected waterways. This has seen a heightened awareness for individual farmers who are now more invested in improving the quality of fresh water courses which in turn improves the sustainability of their operations and salves the public angst over the quality of the nation's fresh water reserves. New Zealand farmers have also moved to make improvements to overall herd health through the introduction of shelter sheds; open sheds with large roof area which provide shelter for their stock while feeding out hard feed during the coldest winter weather. This is a technology which could be transferred to the Thai industry for the inverse reason - to provide shelter to Thai herds from the heat in the hottest parts of the year. There are numerous new technologies coming onto the industry scene which will introduce impacts on farming productivity and some of them will be significant. Some commentators opine about enormous changes set to occur within the industry resulting from the incorporation of robotics and artificial intelligence which will play much larger roles in agricultural operation and management and may further reduce employment rates within the industry. Whatever changes do take place, it will be to the benefit of economies which already covet existing technologies within the farming sector and it will be for the rest to make up ground if they wish to optimize the potential of the latest technologies which become available.

5. Administrative Support

Leadership surrounding farming practice is needed to come at an administrative level if major changes are to be seen at base-level Thai farming operations. Far more can be done to set up new organizations whose role will be in education, advice and technical or economic support for individual Thai farmers. Historically Thai farmers have been left largely to their own devices with little official support mechanisms to assist them with the technical or financial challenges of operating a farm in Thailand (other than commercial banks whose focus is firmly fixed on their own profitability rather than the health of the farming industry or even the wellbeing of the national economy). Such support mechanisms are not difficult to introduce and can impose significant improvements disproportionate with the initial capital outlay required especially in the first few years of operation.

Given that Thai farmers have had little intervention from external sources, farming knowledge and practice has previously been a congenital legacy. Information about 'how to farm' was handed down from father to son and followed

familial lines of wisdom. Agricultural economies which demonstrate strong growth and perform well at an international level are open to disruptive technologies which sometime radically alter farming practice and market dynamics over short time periods. This is where a strong commitment by government to research and development can play a leadership role in promoting new technologies and ensuring that the next generation of Thai farmers are themselves leaders in novel farming techniques and embrace of disruptive technologies which will provide advantage for Thai agricultural aspirations of the future. This practical adjustment and the mindset which it engenders is vital toward moving Thailand away from the type of farming which is manifest in developing nations to a genuine producer which can competently compete in the global export market.

6. Research Activities

The importance of research and development to the future of the Thai farming industry has been highlighted numerous times thus far but it is worthwhile examining specific areas of focus which will be of most immediate benefit to the industry. Research into the quality of animal breeds for the specific Thai environment should be undertaken with a view to optimizing outputs through increased milk-solids production. Associated with this will be research into the best natural and artificial breeding programs required to maintain and increase herd sizes. Research into the optimum diet for dairy cattle in the Thai environment is required to enable farmers to identify appropriate pastures, hard feeds and feed supplements which will help to deliver optimum animal health and maximize productive performance. Further research into animal health and welfare with a focus on the specific conditions animals conventionally suffer on Thai farms will further provide alternatives for Thai farmers in terms of herd health benefits. Soil quality research and investigations into the possibility of soil augmentation and fertilization alternatives which are affordable for the Thai industry could reap significant rewards for agricultural productivity and for the viability of certain regions for dairy farming activities [13]. Investigation into the performance of known pasture types in the Thai environment and development of alternative grass varieties either through cross-breeding or through artificial modification of turf genetics should be undertaken to improve awareness of the most appropriate pastures for farmers to utilize in Thai conditions.

Hydraulic analysis of Thailand's northern and central natural water network is already well underway with the aftermath of the 2011 floods [14] and with calls for the government to initiate major infrastructure projects to control such events in future however, more detailed analysis surrounding appropriate irrigation measures for farming activities especially in some of the drier regions in the central and Eastern provinces is required. Thailand is certainly blessed with sufficient quantities of precipitation for any agricultural venture. The challenge lies in the distribution of fresh water where and when it is most needed. This is technically less difficult than many issues which the industry faces and only needs to be considered as a priority to be addressed. A greater emphasis needs to be placed on agribusiness education and marketing if Thailand wishes to compete successfully at a global or regional level for its agricultural export products. Government and educational institutions need to make this option and attractive course of study for young Thai students to bolster the numbers and quality of people educated in this sector. Unfortunately, research and development has not been a priority for recent Thai administrations with agricultural research budgets reduced from 0.9 percent of agricultural GDP in 1994 to just 0.2 percent in 2017) [15]. This trend must be reversed if improvements in the agricultural industries are to be reflected in expansion of Thai agri-exports and profitability.

7. Societal Relationship

With 40 percent of the Thai population employed in agriculture related fields (and historically much higher) farming should enjoy a more elevated profile as an industry [16], course of study or as a selected profession. The fact that it does not is reflected in both the way ordinary Thai people consider it and the way successive governments have ignored it and underfunded it. Many other sectors in Thailand have undergone enormous transformation over the last 50 years [17] and have become highly industrialized in the process such as manufacturing, transportation and the service sector often as a result of the influx of foreign companies which set up in Thailand in order to take advantage of lower labor costs and favorable business conditions. The Thai agricultural sector has not been so fortunate and has dropped further behind comparable sectors in recent years. In order to recapture some of the status the industry has lost, a concerted effort is required to identify the benefits of a career in the field and to somehow make farming in Thailand 'sexy' again or at least an attractive proposition for Thai students looking for a career outside of the glittery confines of Thailand's urban centers. In 2016 Thailand's military government introduced a model^[15] to dramatically increase the revenue stream of the Thai farming community by 2037. While the direction is absolutely commendable the plan is short on detail about how this will be achieved. It is recognized that the average Thai farm is small, with most farmers owning less than 50 rai (approximately 8 hectares) [18] and it may be that individual farming operations need to expand/combine to remain economically viable. This is not a local phenomenon. While dairy farms in New Zealand are much larger, farmers there also feel a growing pressure to increase the size of their farms and herds to keep pace with expanding costs of their farming operations.

Discussion

While efforts at a governmental level are definitely required to practically enable some of the organizational improvements recommended herein, Thai people generally do not seek the type of social and spiritual leadership required for attitudinal change from their elected administrations which over the last 85 years have been usurped with monotonous regularity [19] (frequently via an unfortunate penchant for coup d'état) and such social redirection may be required from other sources. Obviously, many of the measures discussed here will be more effective with the introduction of as many as possible of the other measures alongside them. Increases in productive efficiency will be more noticeable with the cumulative effects of multiple improvements which is why it is important that future endeavors to identify and instigate actions designed to improve agricultural production are promoted in a concerted fashion. Without insights into the specifics of the governments 'Thailand 4.0' initiative it is difficult to determine if the new directions set out for Thai dairy farmers will include some or any of the suggestions mentioned above however, one thing is certain: it is very difficult to make significant changes to an industry in isolation. All of the ideas for advancement of the industry discussed above have been, or are being, trialed in other dairying nations like New Zealand and there is specific opportunity for the developing industry in Thailand to take advantage of the research and development which other nations have been refining for decades.

One of the concepts that the new government model should consider including as part of its arsenal (if it has not done so already) is the introduction of an official scheme of international knowledge transfer. With respect to the dairy industry specifically, it would not be too onerous to initiate a plan whereby dairy experts from neighboring Pacific nations (New Zealand, Australia) could be invited to stay in Thailand for predetermined periods to perform a role defined as 'consultative, educational, guiding'. Individuals selected for the scheme would be best sourced from research academics, stock agencies and most importantly, actual farmers and farm managers and the greater number of Thai farmers, administrators and others involved in the industry who can be exposed to the transfer of information that these individuals

can impart, the greater the impact of the scheme. Significant leaps in farming technology and methodology can be achieved in a relatively short duration using people who are expert in every area of improvement identified herein and the scheme can work in reverse also with selected Thai individuals visiting high-performing operations in partnering nations.

Conclusions

To address the current issues faced by the Thai dairy industry and to forge a future as a producer of high quality domestic product and as a successful dairy export nation, a pathway for significant industry improvements needs to include focus and funding in specific areas. Those area include research and development covering facets such as climatic factors (heat, rainfall and irrigation), soil quality/augmentation, pasture selection/fertilization, cattle diet/feed supplementation, animal breed selection, breeding programs and agricultural technology. Simultaneous improvements in administrative support including support and funding for increased education, farming advice, technical support, economic support and improved education in agri-business and marketing as well as support and advice on optimizing farming operations are required at a national level. More complex challenges are faced in attracting young people back to rural careers to become Thailand's future farmers and in making agrarian occupations desirable, profitable and competitive with careers in other sectors. A partial solution for both finding solutions to Thailand's technical farming issues and in assisting to make Thai faming an attractive option again will be a knowledge transfer scheme entailing international exchange of foreign agricultural experts and young Thai people involved in the industry to develop a deeper understanding of international dairy practices and farming cultures and mindsets.

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