ROLE OF EXOTIC BREEDS IN DAIRY AND BEEF IMPROVEMENT IN ASIA

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SUMMARY

An evaluation of the role of exotic or introduced breeds, including both *B. taurus* and *B. indicus*, in dairy and beef breeding improvement in tropical Asia, mainly South Asia and Southeast Asia, is the major aim of this paper. For dairy production the Holstein-Friesian (HF) is one of exotic breeds which appeared to make very significant impact through crossbreeding. It is anticipated that crossbreds with high percentages of HF or even purebred HF will soon become useful and profitable for smallholder dairy farmers in Asia. Some new dairy breeds introduced by some countries in Asia were not very different in milk yield from locally produced crossbreds of similar genotypes. As for beef breeding the Brahman (BR) cattle appeared to make the most significant impact at small farm level through crossbreeding with local indigenous cattle as well as through purebreeding. During the recent years *B. taurus* genotypes such as Charolais, Hereford, and Shorthorn had been introduced to improve the growth rate and carcass qualities of the crossbreds. The future use of some new beef breeds such as Santa Gertrudis, Droughtmaster, or Charbray was very much uncertain due to their unclear genetic advantages.

Keyword : Exotic breeds, crossbreeding, heterosis, smallholder farming systems.

INTRODUCTION

Many countries in Asia are located in the tropical and sub-tropical zones. Most people in tropical asia are involved in agriculture. Livestock is generally an integral part of mixed farming systems. Beef and dairy production have been economically important sectors of livestock. Beef and milk consumption was predicted to increase in all regions of Asia from 1990 to 2020. Hence, beef and dairy development has been given high priority by every national government in order to provide sufficient beef and dairy supplies to meet domestic demand. One of the most common ways of increasing beef and dairy outputs is through animal breeding improvement by which superior breeds are imported from other countries either for use in purebred breeding or in crossbreeding with local animals. The breeds of animals imported from another country is referred to as "exotic breeds" in this paper. Only beef and dairy breeds are subjects of this analysis. This paper is not intended to be a comprehensive review of research reports but rather an analysis on the role of exotic breeds on animal genetic improvement in developing countries in Asia.

All countries in tropical Asia are economically classified as developing contries where most beef and dairy production is derived from smallholder farmers. Large-scale commercial production of beef and dairy is generally very limited due to various constraints especially those concerning economic aspects. Smallholder farms can be generally classified as (1) specialized dairy farms, or beef fattening and/or breeding operations and (2) mixed animal crop farming systems or integrated farming systems. These smallholder farms are generally faced with many problems and constraints which limit their use of high potential breeds of animals. The problems due to hot and humid climate are common to all countries in the humid tropics, while disease and parasitic problems are also serious. Good management practices and quality feeding cannot be provided due to many economic reasons especially lack of market incentives. Livestock extension services and farmer organization such as dairy cooperatives are usually not very efficient and effective. These and many other problems hinder direct and effective use of superior exotic beef and dairy breeds which exist in Europe or North America. The use of imported breeds of beef and dairy in the developing countries therefore has to go through other means of genetic improvement for instance upgrading of local strains to exotic breeds, at the same time local farmers have to be well trained in order to gain sufficient experiences in feeding and managing high producing animals profitably. Due to such variety and diversity of these production conditions and problems in different countries in tropical Asia, exotic breeds of beef and dairy cattle showed much variation in performance at different times and places.

USE OF EXOTIC BREEDS AND SOME RESULTS

The use of exotic breeds in developing countries varies in purpose, depending mainly on the stage of economic development of each country and socio-economic conditions of farmers. For dairy production, exotic breeds were usually introduced specially for (1) purebreeding (2) upgrading of local dairy cattle or crossbreeding. For exotic beef breeds, they were introduced mainly for (1) purebreeding to produce breeding stocks for sale such as Brahman cattle, (2) crossbreeding with local cattle (a) for meat production or (b) for dual purposes i.e. meat and draught power.

Reports on results of dairy breeding in the tropics are so far more numerous than that of beef breeding. This could be due to the fact that data collection in dairy farms is more practical than in beef operation since dairy cattle are more closely managed due to daily individual cares and milking of dairy cows, while records of beef animals are not commonly kept by farmers except on experimental farms. In general breeding information in dairy and beef cattle in developing countries is mostly not very complete; the majority of research reports published came from either unplanned or short-term breeding works. Hence, very often research data on beef and dairy breeding did not allow most accurate estimates of genetic effects which were free from non-genetic factors.

A. Exotic breeds for milk production

Many comprehensive reviews of the performances of more common *B. taurus* dairy breeds introduced into the tropics and their offspring resulted from crossbreeding with the local or *B. indicus* breeds have been well documented such as that by Tibbo *et al.* (1994), Cunningham and Syrstad (1987), and Vaccaro (1975a, 1975b). In Asia most research reports on dairy cattle crossbreeding in the tropics came from India where most of the extensive crossbreeding results were based on data from military farms, as well as data from National Dairy Research Institute (NDRI) and other government bilateral projects. The data on dairy breeding from other countries such as Pakistan, Sri Lanka, Malaysia, Philippines, and Thailand were limited ; most of them came from smaller projects. In Thailand, a more extensive work on dairy breeding came from the Dairy Promotion Organization (DPO), formerly the Thai-Danish Dairy Farm.

The most significant economic impact of the exotic dairy breeds on the development of dairy farming in the countries of tropical Asia has been through crossbreeding of Holstein-Friesian (HF), and to a less extent, Jersey (JS), Brown Swiss (BS), and Red Dane (RD), with the local dairy cattle as well as with some exotic *B. indicus* breeds such as Sahiwal and Red Sindhi. The use of purebred HF and other *B. taurus* breeds for milk production in tropical Asia has not yet been proven to be widely economically viable, especially for smallholder dairy farmers. There have been some investment by large-scale dairy enterprises using purebred HF cattle in countries like Thailand, Philippines as well as others but the results so far were not economically viable although some number of purebred dairy cows were able to produce at a relatively high level of milk production. However, general experiences in dairy farming in Asia using pure European breeds indicated that the purebred *B. taurus* breeds, if properly fed and managed, can be raised to produce satisfactory level of milk yield (see Table 1), though lower than their contemporaries in Europe or North America due to different climatic, feeding, and management conditions. The data from Thailand (Himarat and Lynch 1994) showed that the cost of milk produced by purebred HF cattle was higher than milk prices paid to farmers. Therefore, smallholder dairy farmers in Thailand preferred to raise crossbred cattle of 62.5% HF or higher grades due to the fact that these crossbred animals can be raised with lower cash inputs to produce satisfactory level of milk production, usually around 8 to 12 kg of milk per day, under smallholder conditions of feeding, management, and health care.

Table 1. Milk production of purebred HF in Thailand (4% FCM at 305 d).

Breed	Lactation (kg)		
	1	2	3
Imported Holstein-Friesian (n=110)	5,668	6,875	7,514
Daughters	5,382	5,429	5,303

According to the data reviewed by Tibbo *et al.* (1994) comparing the performance of purebred JS and HF in the tropics, a comparison of different traits are shown in Table 2. The HF appeared to produce on average more milk than the JS (3,622 vs 2,404 kg). For purebred BS, Menzi *et al.* (1982) reported an average yield of 2,706 kg for 305 day lactation (n=411) using the data from the Indo-Swiss project, Punjab. Milk production of the RD in Thailand was reported to be 2,305 and 2,760 kg for first and second lactation, respectively (Madsen and

Vinther 1975). In general it appeared that the HF is the more popular dairy breeds and has been used extensively for crossbreeding with *B. indicus* breeds in the tropical countries of Asia. However, a comparative study on the performances of HF, BS, and JS purebreds at the same location in the same period of time was not available in tropical Asia. In summary it can be said that the HF has made most genetic impact on the improvement of dairy production in the developing countries in Asia.

Table 2. The performances of theJersey and Holstein-Friesian purebreds.

Trait	Jersey	Holstein-Friesian
Milk yield (kg)	2,404(95)	3,622(35)
Lactation lengh (days)	315(59)	309(24)
Butterfat (%)	4.8(30)	3.6(11)
Butterfat yield (kg)	127(13)	135(9)
Age at first calving (days)	884(42)	936(16)
Calving interval (days)	416(47)	423(23)
Services/conception	2.0(14)	1.5(4)

Source : Tibbo *et al.* (1994)

The use of exotic *B. indicus* breeds in Southeast Asia has been confined to the Sahiwal (SW) breed and less to the Red Sindhi (RS) since most data available so far indicated lower milk production in RS cows while other problems such as milk let-down was more frequent. The use of pure *B. indicus* breeds for milk production, however, has been replaced by crossbreds of *B. taurus* with *B. indicus* in most countries due to the superiority of milk production traits of the crossbreds. The problems of milk let-down and other dairy management disadvantages of the *B. indicus* breeds has made most dairy farmers to prefer *B. taurus* crossbreds or high grade animals (75 to 87.25% of *B. taurus*).

B. Crossbreds and new breeds for milk production

Crossbred dairy in Asia. In India and Pakistan where dairy *B. indicus* breeds exist such as RS and SW extensive crossbreeding of these cattle with exotic *B. taurus* breeds such as HF, JS, BS, and RD had been conducted (Cunningham and Syrstad 1987 ; Khan 1994). The results so far indicated that the HF crossbreds appeared to produce highest milk yield under local conditions (Khan 1994). A comprehensive review of the performance of crossbreds from Zebu breeds and the *B. taurus* breeds in India was reported by Cunningham and Syrstad (1987), most results appeared to be in favor of the HF crosses as far as milk yield is concerned. Table 3 shows a comparative performance of the F1 crossbreds from HF, JS, and BS in the All India Coordinated Research Project. With respect to the first lactation milk yield the F1 crossbreds of the HF, BS and JS ranked accordingly, while lactation length and calving interval also appeared in similar order.

In Southeast Asian countries, such extensive comparative crossbreeding project as conducted in India was not carried out, most comparative crossbreeding works done in the past were small scale and limited. However, experiences from dairy development projects in various countries evidently indicated that the HF crosses were commonly accepted as they produced satisfactory milk yield under local feeding, management, and socio-economic conditions. In Thailand, the RD cattle were introduced in the 1960's and 1970"s by the Thai-Danish Farm, or presently the DPO, for purebreeding and crossbreeding. The milk yield of the F1 crossbreds between the improved native (RS x native) and the RD was 1,256 and 1,608 kg for first and second lactation, respectively ; while the F1 crossbreds between the Indian dairy, mainly RS and SW, with the RD produced 1,960 and 2,255 for first and second lactation, accordingly (Madsen and Vinther 1975). However, since early 1980's the DPO has changed its breeding policy to use the HF due to the preference of most smallholder dairy farmers. It was also noted that there was wider choice for sources of HF frozen semen, as well as broader ranges of offered semen prices.

Table 3. Performance of various F1 crossbreds.

Breed of sire	Milk yield (kg)	Lactation (d)	Calving interval (d)
Izatnagar			
HF	1,834	343	431
BS	1,448	329	434
JS	1,218	324	400
Hissar			
HF	2,434	360	447
BS	2,126	328	423
JS	1,894	323	412
Haringhata			
HF	2,063	334	446
BS	1,899	332	457
JS	1,598	317	426
Lam			
HF	2,193	333	421
BS	1,853	325	420
JS	1,546	313	401

Source : Adapted from Cunningham and Syrstad (1987), p50.

The question on optimum level of *B. taurus* genes in the crossbreds remains a discussion issue for technical meetings in Asian countries. The answer to this question varies from country to country depending on many other factors besides genetic one, such as farmers's experiences, veterinary services, milk price, and other socio-economic factors. In many countries crossbreds of 50 to 75% *B. taurus* genes appeared to be optimum, while some farmers in these countries who have had extensive experiences in dairy feeding and management were able to raise selected crossbreds of much higher level of *B. taurus* genetics, such as 87.25% HF or above.

Other important issues in crossbreedings such as heterosis and genotypic x environment interaction (GE) are much open for further study especially in SE Asian countries since available research reports so far were not clearly and sufficiently conclusive. Theoretically, the heterotic effects from crossbreeding can be expected in the crossbreds, however, from practical reality the variation due to non-genetic factors such as feeding, sometimes counfounding effects such as preferential feeding or selection, usually prevent accurate measurement of heterosis. Some reviews such as that by Cunningham and Syrstad (1987) and Rendel (1987) indicated heterotic effects in the crossbreds between *B. taurus* and *B. indicus* using available data in India and other tropical countries. The heterosis of milk yield could result from direct and indirect influences. The indirect influences on heterosis in milk yield can be contributed by heterotic effects in other traits of crossbreds such as viability, adaptability, disease resIstance, and reproductive efficiency. It was agreed in general that significant portion of heterosis in the F2 from *inter se* mating was much reduced as compared with the F1.

The subject of GE is less clear, however, as it was alluded to earlier that high level of *B. taurus* genes in the crossbreds could be successful if feeding and management conditions were appropriate. A study by Katpatal (1979) in India indicated that the production of crossbreds with 8/16 to 10/16 HF were higher than crossbreds with lower or higher HF genetic levels and the quadratic effect of HF levels on milk yield was observed. But as mentioned earlier some farmers can get higher yield from higher grade dairy cows under suitable environmental conditions.

New Dairy Breeds. In certain countries such as Thailand, Malaysia, and Indonesia where dairy development has been accelerated by the national government during the past two decades, new dairy breeds or crossbreds (*B. taurus* x *B. indicus*) had been introduced in large numbers into each country. For Thailand, during a period of 16 years (1979-1994) atleast 34,000 dairy crossbreds had been imported mostly from Australia and New Zealand. Some of these crossbreds were selected to become new breeds such as AMZ (Australian Milking Zebu, 20-40% SW and 60-80% JS) or AFS (Australian Friesian Sahiwal, 50% HF and 50% SW) or SF (Sahiwal Friesian, 50-75 HF and 25-50% SW) from New Zealand (NZ) as well as others. These crossbreds were imported in order to meet the demand of government's accelerated dairy project. The performance of some of the SF from NZ which were raised by smallholder Thai dairy farmers in northern Thailand during 1995-1996 was reported by Lumduanhom (1997) as shown in Table 4. It can be seen that as far as milk production is concerned these imported crossbreds were not exceptionally better than local crossbred animals of similar genotypes (see Table 5).

The performance of 490 AFS imported from Australia for smallholder dairy farmers in Thailand during 1995 to 1997 was reported by the Department of Livestock Development to be 2,200 kg for 305d 4% FCM, 300 days of lactation, 440 days for calving interval, and first calving age of 2.7 years. Table 5 shows the performance of local HF crossbreds on a well-managed medium-size farm in central Thailand (Simakornpun 1994), which reflected satisfactory milk production by HF crossbreds of different HF genetic levels which appeared to be equally good or better than imported crossbreds. It should also be noted that the purebred HF outperformed the crossbreds when properly fed and managed. The cost of milk production per kg on this farm, however, was calculated to be as high or slightly higher than milk price paid to farmer.

Table 4. First lactation milk yield of Sahiwal Friesian.

Crossbreds	Number	Milk (kg)	Lactation (d)	Milk/d
New Zealand				
62.5% HF	490	1,896	245	7.7
75% HF	5	2,741	258	10.6
Australia				
75% HF	5	2,745	266	10.3

Table 5. Some traits of crossbred dairy cattle on a private farm in Thailand.

Trait	HF Level (%)			
	50	62.5-75	>75	100
Number of cows	23	40	22	8
100-d milk yield, kg				
Lactation 1	1,098	1,191	1,095	1,536
Lactation 2	1,311	1,351	1,531	1,920
Lactation 3	1,212	1,318	1,313	1,899
305 d milk (3 lact.), kg	2,403	2,958	3,527	4,522
Actual yield (3 lact.), kg	1,870	2,802	3,644	4,630
Lactation (3 lact.), d	190	260	333	324
Ave. milk/d	9.8	10.8	10.9	14.3

C. Exotic breeds and crossbreds for beef production

In tropical Asia, most beef supply (90-95%) is produced from cattle raising on small farms where animals form an important component of mixed crop-livestock farming systems. It is well known that farmers in the countries of South Asia, Southeast Asia, and the Far-East traditionally raised cattle for long-term savings (for sale) utilizing farm wastes and natural grasses, for draught power, and for meat and milk. They are multi-purpose animals. During recent decades part of Asian population has achieved higher level of education and income which created some demand for better quality beef. Some ranch-type and small-scale beef operation started to develop in many countries which stimulated the interest in exotic beef breeds. For countries such as those in Southeast Asia where their indigenous or native cattle are smaller in mature size and grow more slowly, started to import Brahman (BR) cattle and some other Zebu (ZE) breeds for crossbreeding with the native cattle. Later on the exotic breeds like Charolais (CH), Hereford (HER), and Shorthorn (SH) were introduced, mostly frozen semen, for crossbreeding. The purebred live animals of such breeds were proven to be unsuccessful for beef production in tropical Asian countries. They commonly faced with high mortality rates due to tropical diseases and parasites, low quality feeds and poor management, and especially marketing and economic problems. Other new breeds resulted from *B. taurus* and *B. indicus* cross such as Santa Gertrudis (SG), Charbray (CB), and Droughtmaster (DM) have been introduced by both private ranchers and government's beef development projects in some countries but the biological adaptability and economic viability of these breeds are very much uncertain due to various factors besides genetic suitability. Problems of cattle smuggling across national border and the presence of infectious diseases such as foot and mouth disease (FMD) alone have seriously hindered sound development of profitble beef industry in Thailand inspite of increasing beef demand for both average and high quality beef.

In spite of existing biological and socio-economic limitations the Brahman cattle have found their way to become one of the most popular introduced breeds in many tropical Asian countries, both as purebreds and crossbreds, due to their adaptability to local conditions as well as superior beef abilities over the indiginous cattle, such as that reported by Chantalakhana (1984) for Thailand and Sivarajasingam (1984) for Malaysia. The performance of BR crossbreds was expectedly found to fall between the BR and the indigenous parents when being fed and managed under typical rural farm conditions. The BR purebreds generally required better feeding and cares but with good experiences and price incentives small farmers can gain good income from Brahman raising.

The *B. taurus* breeds, either bulls or frozen semen, were usually imported for crossbreeding with BR purebred or crossbreds in order to improve growing abilities and carcass qualities of the three-way crosses or BR x *B. taurus* crossbreds. One of the more common introduced *B. taurus* breeds has been the CH, since the blending of body color of BR and CH appeared to be more uniform in the crossbreds or the Charbray (CB). The three-way crosses, for example the KPS (Kamphaengsaen) cattle in Thailand which resulted from crossbreeding of the CH with the F1 crossbreds between BR and the Thai indigenous cattle, were also widely accepted by local small farmers and beef fatteners since these crossbreds possessed some desirable characteristics of the indigenous ancester, such as adaptability, heat tourance, or some disease resistance. Table 6 shows feeding performance of five beef genotypes in Thailand which were fattenned for 243 days (Bunyavejchewin 1996).

The effect of heterosis on beef traits has been well recognized in many European and North American studies (Rendel 1987), but a well-planned beef breeding work was not available in tropical Asia, especially a study in which the crossbreds can be compared with both parental breeds under the same feeding conditions. The superiority of the F1's over their indigenous parents is of course common but the evidence of heterosis is usually unclear, especially when feeding and management conditions do not allow full genotypic expression of beef production traits.

Table 6. Comparative fattening performance of five beef breeds.

Trait	DM	KPS[1]	BG[1]	BR	IB[1]
Number of animals	6	6	6	6	6
Weight gain, kg/d	0.79	0.91	0.91	0.69	0.75
DM intake, kg/d	8.6	9.9	9.7	8.6	9.1
Feed/gain ratio	10.5	10.7	10.6	12.1	12.1

[1] KPS = Kamphaengsaen, BG = Brangus, IB = Indo Brazilian

As mentioned earlier the data on beef breeding in tropical Asia were much more limited as compared to those for dairy due to lack of consistent record keeping and good recording facilities and systems in both farmers's farms and government stations. Beef breeding experiment is a long-term research and requires substantial investment, which is generally not attractive to research funding agencies.

CONCLUDING REMARKS

The exotic breeds of both *B. taurus* and *B. indicus* have made significant impacts on dairy and beef improvement in Asia. However, a lack of well-planned crossbreeding systems were also evident in many countries, which as a consequence nullify any benefits due to the effect of heterosis. The choice of exotic breeds and the most profitable crossbred genotypes have to be considered not only by genetic aspects but also other related factors especially farmers' experiences in livestock, socio-economic and market conditions, and profitable and practical levels of feeding, management, and health cares. In many countries selection or culling of crossbred dairy cows has not been practiced due to many reasons, such as lack of record keeping, which makes national average production level very low.

From the standpoints of animal germplasm conservation, it is very important to note that the use of exotic breeds for crossbreeding such as in pigs has caused the extinction of the indigenous pigs in certain countries, while an introduction of commercial strains of chickens has made the indigenous chickens become very rare and endangered for extinction. Crossbreeding of Brahman breed to the indigenous cattle also appeared to threaten the existence of some excellent local genetic resources. Hence, animal breeders need to be aware of this problem and put real efforts toward protection and conservation of such indigenous breeds which are valuable biological resources for present and future generations of mankind.

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