The Optimization of Environment and Genotype to Maximize Farm Income in the Tropics

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ABTRACT: The improvement of performance of livestock in the tropics has been through the crossbreeding of local native animals to superior exotic breeds. In 2011, ninety percent of dairy cattle population in Thailand averages between 75% to 93% of Holstein Friesian blood. There is 80 kg of milk yield increased from 20 years upgrading breeding program and 90% of the total variation is associated with the environment. Once genotype has been fitted to the existing environment, then there will be less variation for more improvement through upgrading due to stress and high THI level affecting survival of high milking cow. Also the marginal improvement from improving feeding and management tended to be greater than that of genetic improvement. The better genotypes need better feed and management input and more investment must be added to fully support these superior genotype animals. The optimization model is proposed for the maximization of net profit instead of maximization the yield. Once the upgraded gene pool is captured up to 90% of the existing population within the country, then the appropriate feed and management must be fully implemented. The complete development of the performance of animal must involve the education and training of stakeholders to understand the concept and mutually obtain the benefit under specified production system. Case studies in attempting to optimize genotypes and environments were presented. It is suggested that upgrading Holstein Friesian blood up to 87.5% is appropriate under 90% THI level and low input environments. For the beef cattle, it is suggested that between 65 to 75% Brahman blood cross with local native cattle should be appropriate enough to sustain well in the tropical environments.

Introduction

The improvement of livestock performance in the tropics has been limited by the THI effect. Attempts have been done in many countries in SE Asia to overcome the low performance and could only reach up to 85% of those performances in the original exotic countries. Imported animal faces genotype by environmental effects all the ways and could not be fully utilized under the tropical conditions. The optimization of genotypes and environments in the tropics to maximize profit must be deeply investigated. Dairy and beef cattle development are used as case studies in this presentation.

Fitting Genotype to Environment

The common practice in improving performance is by upgrading local native animal to superior exotic breeds. In Thailand, the selection of crossbred animals has been through phenotype rather than genotype especially during the years 1950 to 1975. Once the genetic variation of animals was estimated and fully investigated, more attention was given to genetic evaluation of individual animals for the best mating pair. The mixed model equation was used first in 1990 and yet model set up needs the precise understanding of data structure rather than knowing how to analyze the data. Large random error usually occurs when fine tune data structure was not realized in fitting the model

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and eventually creates lower genetic variation due to inflated error. It is important to reduce environmental variation especially in feeding and management and increasing genetic variation for larger genetic progress in the base gene pool once genotypes are satisfied within the tropical environments.

(a) In dairy cattle, the performance test was carried out by the Dairy Promotion Organization of Thailand (DPO) and the first EBV was released by research collaboration with Kasetsart University in 1996. The larger dataset evaluation on EBV was released by the Department of Livestock Development (DLD) in 2004 mostly on crossbred individuals. From the 60 year improvement, it was found that 90% of the population contained between 75% to 93% Holstein Friesian blood and yields an average of 4,000 kg per lactation. The upgrading to higher than 90% Holstein Friesian blood in the tropics has been limited by THI effect and normal feeding and management systems. The important job of animal breeders in the next 20 years must be paying attention on fitting conventional and molecular genetics tools to increase genetic gain while reproductive physiologist must focus on IVF and MOET with sexing. The far end development would be cloning which is projected to be feasible in the tropics in another 30 years.

(b) In beef cattle, only 1% of beef population in Thailand is three-way-cross individuals while more than 60% is two-way crossbreds. Development of synthetic breed was found to be limited in the herd size and still in an early stage to be claimed as new breed. Brahman, Charolais, Simmental, and Limousine breeds crossing with Thai local native females have been a common practice. The EBV of these synthetic breeds was first released by Kamphaengsaen breed in 2008 with minimum dataset. The fattening project required good breed specified by breed association including good feed. Usually the synthetic breeds require higher protein and energy levels than those of the two-way cross feeders. However, clear understanding of the maximization of profit from different breeds has not been captured by small farmers.

Fitting Environment to Genotype

Once the genotypes have been improved and large percentage of breed is captured in the population, then fitting the appropriate environment to genotypes must be realized and implemented. The strong emphasis must be given to improving feeding and management systems. Many research findings were presented to optimize Genotype and Environment.

(a) It was revealed that an imported Holstein Friesian could reach only 85% of performance obtained from the half-sibs under good feeding and management level of DLD station in Chiang Mai. The comparison study between imported 87.5% HF and home born 87.5% HF showed that the milk yield from the imported animal was significantly higher. In contrary, the reproductive performance exhibited inferior responses to local native crossbred cows in all environments. The imported purebred cows needed 3 lactations to adapt to the new environments. It is postulated that in the next 20 years the improvement of feeding and management must be strictly improved since there will be small marginal increase in genetic gain upon existing 90% HF population. The THI limit can be overcome

by Fog and Fan open barn and Evaporative Cooling systems in the close housing whereas feed and feeding can be improved separately. Since larger percentage of dairy farmers is small farm, then the investment on housing system is in a long term and could reach only small percentage of farmers. The short term and low investment can be done through feed and feeding systems and can be reached by larger percentage of farmers. The production of good quality and large amount roughage supply can be done by an appropriate technology utilizing waste from agro-industry and alternative energy resources. Results have been confirmed that heifers and milking cows receiving such roughage could yield higher milk yield up to 20% and exhibited significantly higher first conception rate.

(b) In beef cattle, the stratified customized contract farming model was tried with farmers in the northeast of Thailand. An appropriate beef breed for farmers in the tropics is believed to be Brahman crossbred due to its excellent adaptation and it could yield acceptable meat quality. The three-way cross individuals need plenty of good feed and better management which could not be employed by small farmers in spite of its higher meat quality and yield. Several studies showed that Brahman crossbred exhibited greater income per animal than the synthetic crossbred under restricted amount of low feed quality. Even though Brahman crossbred can be durable in the harsh environment, it is important that farmers participating in the fattening beef business must give not less than 3 kg of concentrate to these animals to ensure the profit. The fitting environment to genotype model requires more education and training program to all stakeholders and need diversified team players.

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