An education management model based on cognitive learning for small dairy farmers in the tropics[1]

Viriya Munprasert, Phahol Sakkatat, Varaporn Punyavadee, Siriporn Kiratikarnkul, Dumrong Leenanuruksa

Faculty of Animal Science and Technology Maejo University, Chiang Mai, Thailand

ABSTRACT: An activity-based cost accounting model was developed for Thai dairies as the first step in educating farmers. The second step was to introduce the dairy cow lifetime milk production model to illustrate potential profitability based on genetic potential of the cows and to facilitate a higher levels of cognitive learning. In teaching these steps the four noble truths of Buddhism were used to create an awareness of the problems, their causes and the solutions. The result was to focus education on feeding management in the transition period prior to calving and the critical two month period after calving.

Key words: cost accounting, cognitive learning, dairy farmers, management model

INTRODUCTION

The average milk yield in Thailand has increased from 5-7 kg to about 12 kg per cow per day in the 30 years since 2006 (Vorawan, 1977; Vachiraprakorn, 2006). It is generally accepted that this increase in milk yield was the result of improved genetics that came from upgrading programs that used frozen semen from high merit bulls. However, as the genetic potential of dairy cattle has increased, the feeding and management methods have not changed much. For example, the old rule of thumb suggestion for feeding concentrates is still in common practice. Farmers still feed cows the ratio of 1 kg of commercial pelleted feed to 2 kg of milk produced, regardless of the types and quality of the roughages. In addition, the significant role of body condition score used as a key indicator for feeding management has been ignored by the majority of farmers. For example, in a progressive dairy cooperative in Central Thailand, most of the dairy cows lost an unacceptable amount of body weight in the first 3 months of lactation resulting in poor reproductive performance (Leenanuruksa et al., 2008). This observation suggests that most of the dairy cows in Thailand produce less milk than their genetic potential.

Niumsup and Leenanuruksa (1997) proposed that the feeding and management problems at the farm level arose from farmers' lack of knowledge and the low capacity to learn. The farmers, with their limited education, have been trained in the routine labor necessary on a dairy farm. But since feeding management in early lactation is a complicated subject, to be capable of proper management, farmers need a higher level of knowledge and understanding to know why they must change their routine. The difficulty for the majority of farmers to gain a higher level of knowledge can be explained by the cognitive learning process (Senge et al., 1994; de Grues, 1997).

Cognitive Learning and Development of Intensive Skill of the Farmers

Cognitive learning was used to study learning development at the village level by Roy and Randhawa (2001). They found that cognitive learning was according to the order of difficulty, from simple to complex, and also followed a hierarchy where knowledge formed as a base for comprehension and application was then subsequently built upon in a hierarchical manner.

Prior experience, values, beliefs and knowledge influence a farmer's current mental model of farming. There might be a component of a farmer's current mental model that poses a barrier to a

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change that would lead to improved viability or profitability. When a farmer can benefit from further knowledge, and thus development of some aspect of his or her mental model, then direct instruction, visits to other farms or similar approaches can prime the farmer to consider new possibilities (Ecker and Bell, 2006). Knowledge must be at a higher level for the sustainability of agriculture. A complex of cognitive skills in intensive agriculture, or "Knowledge Intensive Management", will lead to the increasing in yield profit and sustainability of the activity (Woods et al., 2003).

The different levels of cognitive learning, from the lower to higher, are described as Remembering, Understanding, Applying, Analyzing, Evaluating and Creating (quoting Woods, et al. (2003) from Anderson and Sosniak (1994) and Bloom et al. (1956)). Knowledge Intensive Management requires the complex cognitive learning of the latter four levels. This is in contrast to the basic knowledge of farmers in Greater Mekong Sub-region (Myanmar, Yunnan, Laos, Cambodia, Vietnam and Thailand) which is consists mainly of the first two levels of cognitive learning, namely, Remembering and Understanding.

MATERIALS AND METHODS

An education model was developed based on two steps to be learned by farmers. The first step was to establish activity-based cost accounting (ABC) on farms. The second step was to introduce the lifetime milk production model based on the three main factors affecting lifetime milk production per cow; age at first calving, number of calves born and milk yield per lactation (Leenanuruksa et al., 2008).

Step One: Establishing Activity Based Cost (ABC) Accounting. Since most dairy farmers in Thailand have never used a farm accounting system, the actual cost of milk production has never been measured. Therefore, there is a lack of the most important information for management and future investment decisions. Generally, farmers record credits and debits in one book which are not representative of the actual cost of the farm operation. The basis of ABC accounting was to separate dairy farm activities into two accounts, one for replacement heifers and the other for the milking and dry cow operations as shown in Figure 1.

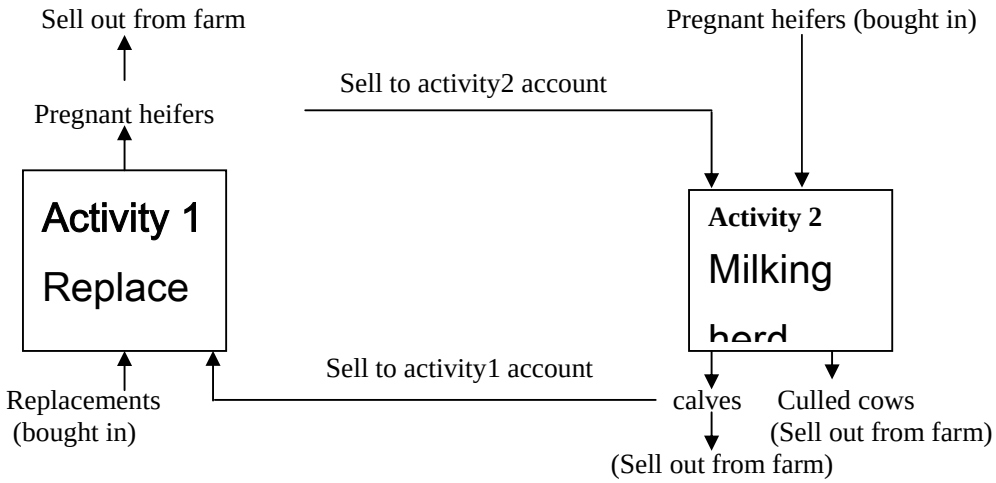

Figure 1. The relationship of the accounting systems for replacement heifers (Activity 1) and mature cow herd (Activity 2).

In this accounting system the costs of sharing the same facilities were split between the two activities. The time period for depreciation of the cost of replacements placed in the cow herd began at calving (2 years) and ended at culling (8 years) or 6 years of productive life. Farmers will appreciate the up to date information derived from this accounting system. The cost of rearing each pregnant heifer or the cost of milk production was determined on each individual farm.

Step Two: Introducing The Lifetime Milk Production Model. The return on investment in a dairy cow is calculated from lifetime milk production per cow. This can be calculated from three factors that affect lifetime milk production: age at first calving, numbers of calves born or numbers of lactations and milk yield per each lactation (Radostits and Blood, 1985; Holmes, 1988; Leenanuruksa et al., 2008). In the simulation model for full genetic potential, using a 6 year productive life, a calving interval of one year (one lactation per year) and a milk yield per lactation of 4500 kg, the calculated potential lifetime milk production is 27,000 kg of milk.

Age at First Calving is the starting point for determining the productive lifetime of each cow and age at culling is the end of her productive life. The standard age of first calving is 2 years of age. For heifers calving first at 3 years of age the productive lifetime is reduced by one year. Thus, farmers have already lost about 1/6 of the potential lifetime milk.

Numbers of Lactations or numbers of calves born is the second factor for the lifetime milk production. The longevity of a cow is primarily determined by her fertility which becomes a problem about 8 years of age. To maximize the numbers of calves born in cow's productive life (from 2 to 8 years old), the cow must conceived within three months after each calving. Months from calving to breeding is determined by a sound fertility status and feeding management during the first two months of lactation.

Milk Yield Per Each Lactation is the last factor affecting lifetime milk production. Proper dry cow preparation and intensive feeding management during the first three months of lactation are taught to farmers emphasizing the use of the cow's body condition score as an important tool in nutrition management. The genetic potential for milk production can only be realized by proper feeding according to the nutrient requirements of each cow. Otherwise a penalty will be paid for weak cows in poor body condition that stay open longer resulting in a longer calving interval (NRC, 2001). This ultimately affects the second factor, the numbers of calves born within her lifetime.

RESULTS AND DISCUSSIONS

The Four Noble Truths

The four noble truths are the principles for problem solving in Buddhism. They were used to investigate the problem of dairy production at the farm level in Thailand along with the innovative cognitive learning model. This included a challenge to the ignorance of the farmers' mind set on the actual cost of production by assimilating the activity based cost accounting to be learned and applied. Following the expansion of the farmers' mental model, by introducing the dairy cow lifetime production model, the potential income was calculated for genetic potential of the cows under the proper management or the no-problem state. This was used as a bench mark for comparison to the actual income from the actual performance of the cows belonging to the farmers of the Wang Nam Yen Dairy Cooperative, which had both poor productive and reproductive performances. This comparison gave farmers new insight and recognition of the problem state they were in. The third step of the four noble truths was to analyze the cause of the problem based on the loss of body condition of all the dairy cows within the first two months after calving. Investigation suggested improper feeding practices and that all the dairy cows suffered from underfeeding of nutrients. The fourth step of the four noble truths was to resolve the problem by confirming the causes and effects learned. It was suggested that an understanding of feeding management in the transition period prior to calving, and the critical two month period after calving, were the core to the learning process of the farmers and that they could be simplified into four learned management concepts.

The Paths to Maximizing the Cow's Genetic Potential

As described, the proper feeding management of dairy cows within the first three months of lactation can be considered a "Complex intensive cognitive skill" which needs the later four levels of cognitive learning, namely Applying, Analyzing, Evaluating and Creating (Woods, et al., 2003). We offered four paths of management to be learned by the farmers as following (Leenanuruksa et al., 2008):

1. To understand the deteriorative effects of heat stress on feed intake and the production of milk and to educate in proper feeding management.
2. To emphasize the understanding of nutrient requirements and the importance of obtaining high quality dairy pellets and roughages to feed dairy cows in the first three months of lactation.
3. To educate farmers on the phenomenon of low feed intake during early lactation which tends to increase the ratio of dairy pellets to roughage and thus to advise farmers in proper feeding to avoid ruminal acidosis.
4. To educate farmers on how to understand and use cow body condition scoring as a key management tool for monitoring, and change if necessary, the feed and nutrient intake and the milk production on a daily basis.

CONCLUSIONS

Our aim in establishing this lifetime milk production model was to educate Thai farmers on the three factors affecting lifetime milk production of each dairy cow. Each factor reflects soundness in fertility after each calving and feeding management during the first two months of lactation. The two step model suggested was used as a tool for assisting Thai dairy farmers to improve their management and feeding practices and, in so doing, improve profitability (Leenanuruksa *et al*,.2008).

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