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Heat Stress in Dairy Cattle in Kenya

Tropical Animal Production
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1 GENERAL INTRODUCTION

There are three cattle based dairy production systems in the better-watered regions[1] of Kenya namely: the semi-intensive dairy-meat-draught-manure system which uses predominantly pure East-African Zebu mainly in the western uplands and coastal regions; the small scale intensive and semi-intensive dairy-manure system which uses mainly first generation crossbreds with exotic or high performing grade cattle mainly in Central Province, Central Rift Region and at the Coast; and the high input system based on pure temperate dairy breeds or grade cows mainly in the Central Rift Region (Omore *et al*., 1999).

The East African Zebu producing 1-2 litres milk per day on a poor diet (Stotz, 1975) helps to meet the subsistence needs of the people. This indigenous herd is, however, not the foundation of the modern Kenyan dairy industry, which supplies almost all the marketed milk, particularly to the rapidly expanding urban population. The commercial dairy herd is based on temperate breeds and or grade cows and European-Zebu crossbreds.

Dairy farming using such cattle genotypes has been going on for nearly a century in the highlands located above 1500 m where its cool montane climate is considered suitable for such livestock. This area has therefore been the hub of the modern Kenyan dairy industry and boasts some of the most successful dairy enterprises in the tropics (Chamberlain, 1993). Israellson and Lindberg (1996) reported Kenya to have over three million dairy cattle. The same authors report that the improvement of the genetic potential of the Zebu for increased milk production is a continuing exercise, so that the number of crossbreds and grade dairy cattle in Kenya is set to increase, thanks also to a relatively functional artificial insemination programme. Because of its inherent high milk yields, the Holstein Friesian has been the dairy breed of choice the world over where it has been the dominant breed of the 20th century (Grothe, 1993). For the same reasons this has been the breed of choice for most farmers in Kenya and most farmers who upgrade their Zebu do so to the Holstein-Friesian (Matthewman, 1993). The Friesian is also popular because marketed milk in Kenya is paid based on volume without any premium for milk butterfat per cent and solids-not-fat content (Kahi *et al*., 2000).

Improved incomes as a result of a larger number of Kenyans working outside the agricultural sector, competitive prices for milk when compared with other farming enterprises and better dietary knowledge is leading to a spread of intensification of dairy farming into the other

[1] These are regions where the mean rainfall can exceed 750 mm in 30 out of 100 years (Ominde, 1984).

better-watered regions of Kenya in the western uplands and coastal lowlands especially among progressive farmers. In the key economic regions of these zones, Zebu are increasingly being replaced by Zebu-exotic crosses either through artificial insemination or direct purchases from the highland areas (Waters and Odero, 1986; Vorlaufer, 1990). A number of farms in these zones are also keeping pure temperate breeds including Holstein-Friesian, Ayrshire, Guernsey, Simmental and Jersey.

The altitude in these 'new' dairying regions varies from about 1200 m to sea level where the climate is hot and sub-humid to humid with afternoon temperatures going up to 30°C (East African Meteorological Department, 1963). Therefore as these cattle move out of the cool highland and into these hot sub-humid to humid regions it is expected that heat stress will become an increasingly important constraint to the biological and economic efficiency of such cows. Furthermore environmental heat and humidity will become an increasingly greater constraint as the genetic potential for production is increased and other constraints are removed (Johnson 1987). McDowell (1994) states that the lower altitudes in the WCZ[2] (< 1000 m elevation) represent physical environments, which can have deleterious effects on all domestic animals and especially improved dairy breeds through both direct and indirect ways.

Even in the relatively cool highlands the performance of such cows has not often been comparable to their counterparts in the temperate lowlands under similar management regimes. For instance Kiwuwa (1974) reports an average calving intervals of 421 days in large farms in Kenya, which is against 375 days for the British Friesian (Bourchier *et al*., 1987). The Kenyan Friesian is reported to have on average an oestrus duration of 11.4 hours (De Vries *et al*., 1972) compared with 15.0 hours for the British Friesian (Esslemont *et al*., 1980). De Jong (1996) reports that the Kenyan Friesian in well managed farms may give up to 5100 kg milk per lactation (17 kg per day) while Phipps (1992) reports the British Friesian to give 6050 kg per lactation (20 kg per day). The figure on milk yields might be misleading, if this is calculated per length of calving interval using the figures provided here, this translates to 12 kg per day of calving interval for Kenya and 16 kg per day of calving interval for the UK.

The indirect effects of climate namely nutrition and disease and pest challenge along with unreliable access to inputs, particularly credit, breeding and veterinary services, especially in areas with poor marketing infrastructure are often cited as the primary constraints on increasing productivity in intensive and semi-intensive smallholder dairy production systems of Kenya. Another constraint is poor management (Mburu, 1989; Omore *et al.,* 1999). The

[2] WCZ = Warm Climate Zone, is the region of the earth lying between latitudes 30° N and 30° S and in which are found most of the world's developing countries (McDowell, 1994).

depression of production due to the direct effect of the physical climate is often not mentioned. Using the afternoon Temperature-Humidity-Index values it was, however, found that dairy cattle both in the lowland and highland locations might be exposed to high temperature and humidity conditions, which might be detrimental to their performance (Ikiror, 1997).

On the basis of the above arguments, dairy farmers in the better-watered regions and in general other stakeholders in the modern dairy industry in Kenya might be blaming low production (biological and economic inefficiency) on nutrition especially in the dry season and/or diseases and pests particularly during the wet season while underestimating the heat stress component. It has been observed that within the *Bos taurus* groups, Holstein-Friesians are the most heat sensitive (Rodriquez *et al*., 1985), which is probably due to their high milk yields. High yielding cows have higher heat increment of feeding due to their higher feed intake necessary to support their high milk yields, such cows tend to be the most sensitive to heat and least sensitive to cold (Webster, 1993). Declines in milk yields for Holsteins in a tropical climate when compared to temperate climate are very great, approximately half the genetic potential (Roman-Ponce *et al*., 1978).

For these reasons it was important to test whether heat stress was placing limits to production in both the lowland and highland regions.