GENERAL INTRODUCTION

With the present increased rate of increase of the world population, and technological advances remaining comparatively sluggish, it is possible that in a few more years global hunger will loom in most of its habitation.

Agriculture and livestock products are of central significance, therefore, in saving humanity which can be feasibly achieved in accelerating production by implementing scientific technologies, and managerial techniques.

In this context, foremost of the present needs will be universally developing the dairy industry which will eventually enhance the health of the people. The world today, momentarily faces an intensifying food crisis and
unless feasible remedies are explored the life of the incoming generations will be at a very depressing level of economic stability. To a greater extent the welfare of the human population demands the improvement of the cattle wealth, thereby contributing largely in satisfying the food demands. On the other hand, the betterment of the cattle depends upon the environments, climatic, nutritional and managerial in which they live. The economics of physiological efficiency depends upon the nutritional, climatological and managerial considerations. Every livestockman expects immediate return from his enterprise. The aim is to turn out maximum continuous profits. In attaining this level, animals should be provided congenial environments. The ill effects of unfavourable climatic conditions, nutritional and other factors, limit the inherent genetic potentials of the animals. It is, therefore, very essential that the livestockman should have a sound knowledge of the measures for efficient livestock production by adopting approved practices.

Scientific findings revealed that unsuitable microclimate largely affects the productive efficiency and growth of the cattle populations. An ideal environment is necessary for efficient animal production (Bonsma, 1949 and Ragsdale et al., 1950). A comfortable cow converts feeds in milk more efficiently than one exposed to high environmental temperature (Campbell and Lasley, 1969). However, Hathaway and Kelley (1957) did not observe significant difference in the milk production and
reproductive efficiencies of animals on pastures (exposed to summer climate) compared to those under yarded management.

Physiological mechanisms are brought into play during climatic stress (Dukes, 1943). The heat balance in the body of the animal during heat stress is controlled by evaporative cooling mechanism for skin and lungs, and by increased or decreased blood circulation (Brody, 1945). In poorly sweating animals like cattle, buffaloes and birds the heat dissipation during heat stress is effected through increased respiratory rate (Kibler and Brody, 1950; Kehar, 1953; Raghavan and Mullick, 1960 and Campbell and Lasley, 1969).

Milk production has been shown to be affected by heat stress. Rako and Marinic (1957); Richardson, (1961) and Hahn (1969) reported a drop in milk yield and feed consumption during heat stress among dairy cattle. El-R Ashoule and El-Bahay (1965) and Johnston, Stone and Frye (1967) had also observed variations in milk composition of animals exposed to climatic stress.

Variations in the reaction to heat stress were profoundly noticed between different species (Findlay, 1954), between breeds (Worstell and Brody, 1953) and between animals within a breed (Payne and Hancock, 1957 and Ray, 1971) of animals.

Tropical cattle react less to heat stress than those of temperate origin. It was even reported that highly
productive cows of the West deteriorate their productive performance when transferred to the tropics (Payne, 1967-a).

Management system must be so designed in order that the cattle gain as little heat from external sources (Johnston, 1968). However, partial acclimatization to climatic elements of cows for milk production was observed by Johnston et al. (1967).

Cold temperatures were noticed to have little, if any, effect on the health of animals (calves) adjusted to cold environment (Albright and Alliston, 1971).

Crossbred cattle in India, in some instances, failed to reproduce because of climatic stress. The more the foreign inheritance, the more severe the reaction exhibited under heat stress. Not only growth rate and milk production but also puberty, oestrous cycle, gestation and prenatal growth of calves were shown to be affected by seasonal variations. Dale, Ragsdale and Cheng (1959) reported that calves raised at 80°F reached puberty later than those calves raised at 50°F. The age of puberty was shown to be 320 days in heifers kept in an open shed. Razdan (1965) observed earlier onset of oestrus and calving in Tharparkar cows under comfort conditions compared to the contemporary cows exposed to climatic stress. Cole (1966) likewise observed low fertility in rams and ewes as a result of exposure to high temperatures. It was even found that the surface area undergoes systematic changes during seasonal variations (Brody, 1945 and Saini, Rao and Sadhu, 1967-a).
It is evident that changes in climate, particularly high ambient temperature and humidity affect all the productive functions in cattle. It has been stressed above that the milk yield varied significantly with changes in climatic conditions. In order to minimize the bad effects of these meteo-climatological hazards including solar radiation, that animal needs protection and managerial approaches should be modified and adjusted accordingly to the prevailing environment. However, Payne (1967-c) stressed the need for the management analyst should have in mind the economically justifiable measures that will decrease the total heat load of the animal or help to spread the heat load of the animal more evenly over the 24 hours. For keeping the animal in a physiologically harmonious atmosphere, it is necessary to undertake intensive studies which will enable one to bring out thorough understanding of the intrinsic and extrinsic mechanisms which are manifested during heat stress. These serve in filling the lacunae in our knowledge regarding environmental adaptation, and hence reject dogmatic belief.

General observations elsewhere show that the productivity of domestic animals varies in different climatic conditions and that observations revealed less yields in hotter regions of the globe. This holds particularly true to milk and also to beef and even draught animals. Payne (1967-b) put forward the idea that high productivity creates additional body heat that the animal disposes of with
difficulty.

While cattle productivity lags behind in the tropics somehow it could not be wholly attributed to scientific technicalities which can not solely be a panacea in profitable cattle production. It seems inescapable that inclement weather or adverse climate depresses the efficiency of the animals. Hence, enlightened livestockmen should particularly focus attention on efficient and proper management religiously. One should be familiar with the prevailing meteo-climatic elements which are the bases of adjusting the housing engineering and feeding of the animals.

It has been brought out into light of scientific knowledge that climatic variables, viz., ambient temperature, humidity, solar intensity, radiation, etc. affect the productive capacities, reproductive abilities, physiological behaviours and other body mechanisms of the animals. Unless, the animal is in its perfect thermal balance, normal physiological norms cannot be attained and production enhanced.

It is therefore, logical for a livestockman or management analyst to possess sound knowledge of the effects of adverse climate on the animals as a whole to caution oneself in any eventuality.

Under Karnal (India) conditions, the climate exhibits extreme variations of severe heat and cold. During the height of summer months, the distressing effect of weather
(of high ambient temperature, high humidity, hot winds, etc.) is aggravated by the stress imposed by solar radiations. Similarly, during severe cold and rainy months animals suffer discomfort.

Paucity of data regarding the physiological behaviours, production and reproductive abilities of straightbred cattle vis-a-vis crossbreds to acclimatize themselves to prevailing conditions invited scientific curiosity in investigating the effects of feeding practices, shelter conditions and other managemental involvements.

The inclusion of the studies on surface area and other body measurements including body weight, body length, height and heart girth were considered with the objective of investigating the degree of relationships with one another particularly to production performances of the breeds under study. And, since surface area can vary with the body weight independently and/or with all the body measurements collectively, suitable formulae can be calculated for practical application under field conditions.