

The climate effects on animal production and health are to be considered not in isolation but in association with economic, social, health and environmental perspectives.

The critical issues of climate impacting animal health and production, both long term and short term, should not only be seen in terms of alterations which the climate change brings about in the physiological functions of the animal systems but also in terms of the animals capacity to adjust to the production process/ability by adjusting its body system functioning to this climate change.

Change on livestock production systems:

Though, India is often accused in recent years, for its animal population particularly bovine (Cattle and buffalo) for global warming but that is more out of ignorance with respect of the production system in India and factual gas (CO₂, CH₄, N₂O) emission data. Extrapolating the western production model calculation to number of animal breeds in India is not only preposterous but, in fact, atrocious.

Cattle in India are just not a converting machine of feed grains to meat and milk but are essential element of man-plant-animal-ecosystem, a system stabilizer, a real converter of crop waste and a hub for agricultural sustainability and nutrition security. In this context, the performance of the animal under different climates in terms of health and disease, therefore, needs and elucidation.

Further, the fact that 59 per cent of our rural population belongs to the landless and marginal group and their livelihood is mainly due to their animal holdings, any production and health infirmity directly leads to further economic deprivation and the population further falling into poverty trap. In the rural scenario where 1 to 2 liter milk production from large ruminants is the basic unit production for our massive milk grid, even a small fall in individual animal production is constraining the market access of these small holders with increased

economic vulnerability.

Impact of climate :

Climate effect health and production due to animal's sensitivity to any change in climatic parameters. Air temperature, humidity, solar radiation load, wind velocity are the major variables that effect animal performance under different agro ecologies.

The effects of each of these variable parameters, and more of their interactions, can enhance or reduce the direct effect on animal system. Temperature Humidity Index (THI) and temperature maximum (Tmax) or temperature minimum (Tmin.) data has been analyzed along with production and disease data in different climate zones and among different breeds of cattle including buffaloes.

Under the climatic stress there can be a decrease in the efficiency of nutrient utilization, dry matter intake decrease in animals subjected to heat stress. This depression in dry matter intake can be either short term or long term depending on the length and duration of heat stress.

Decrease of 10 to 20 per cent are common in summer hot days. There is normally a decrease in milk production for cows under heat stress. This decrease can be either transitory or longer term depending on the length and severity of heat stress. This decrease in milk production can range from 10 to 25 per cent. Heat stress has also been reported to decrease reproductive performance in dairy cows.

There are number of changes in reproductive performance that have been reported the effects on reproduction can be prolonged and effect the animal for months after the heat stress exposure. These include the decrease in the length and intensity of the estrus period, decreased conception (fertility) rate, decreased growth, size and development of ovarian follicles, increased risk of early embryonic deaths, decreased

See end of the article for authors' affiliations

Correspondence to :

V.B. TAK

Department of
Agricultural Economics
and Statistics,
Marathawa Agricultural
University,
PARBHANI (M.S.)
INDIA

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Table 1 : Milk production and per capita availability

Year	Milk production (Million tones)	Per capita availability (g / day)
1950-51	17	124
1960-61	20	124
1970-71	22	112
1980-81	31.6	128
1990-91	53.9	176
2000-01	80.6	220
2003-04	88.1	231
2004-05	92.5	233
2005-06	97.1	241
2006-07	100.9	246
2007-08	104.8	252

fetal growth and calf size.

There are a number of options that exist to assist in minimizing the effect of heat stress in cattle. The two primary options are making some ration adjustments and altering the environment that the cow lives in it, which includes feed, water, management and housing facilities.

Reduced disease resistance mechanism :

In an intensive study inside a large animal climatic chamber (the only in the world) at University of Missouri in Colombia, USA, temperature (heat) stress effects were studied on cycling bovines and it was observed that temperature stress changed the circulation levels of several hormones, the most critical of them being those connected with reproduction and metabolism and they in turn effect the feed intake. Reproductive cycle, the length and intensity of the expression of heat (heat period-receptively to male in mating) conception rate (fertility) growth and size of ovarian follicles risk of early embryonic deaths, fetal growth and calf size, the efficiency of most production processes and the ability to withstand the challenge from diseases due to reduced disease resistance mechanism.

Dietary and nutritional patterns among animals have changed widely around the world in recent decades. Actual patterns of change, at the country level, have varied considerably, as it has the mix of animal health in gains and losses.

A long time date analytic study conducted at Karnal (NDRI-Dr. R. C. Upadhyay) has revealed that a sudden change (rise of fall) in Maximum / Minimum temperature during summer and winter was observed to affect milk production in buffaloes. The decline in minimum temperature (>30°C) during winter and increase (>40°C)

during summer than normal temperature was observed to negatively impact milk production up to 30 per cent on the next or subsequent days after exposure event.

This study showed, the return to normal production, depended upon the severity and time period of thermal stress / event occurrence. In short and long term studies both milk production and reproductive function of animals are known to be affected to hot climate.

Exposure to long periods, the animals get acclimatized to constant stress situation and body physiology adjusted by adjusting its productive abilities and developing a physiological resistance to withstand the onslaught of adverse climate. These mechanism over generation become "Adapted" in the time scale leading to "Adapted breeds".

Breed advantages :

These characteristics of Indian cattle are distinctly appreciable among the cattle of the sub-continent in varying degrees across the breeds in Northern plains, Rajasthan, the Deccan plateau and the coastal ecologies. They, over centuries, have developed a resistance to several endemic diseases, which across the world are deadly and have much lowered production (milk / meat).

The process have evolved into an adaptive mechanism by which their digestive capacity has been modified to utilize coarse and poor quality materials as feed and in a efficient manner can convert this agro-waste into a high value biological material (milk and meat). The cattle of India along with sheep and goat are excellent example of "Productive Advantage" which our livestock have. 102 million tones of milk and over 408 million tones of meat is produced in this climate and resource constrained production system in India.

Higher temperature and higher humidity is most conducive for microbes and higher ambient temperature, directly helps the growth and proliferation of disease producing organism.

Within the body systems, a higher body temperature implies all metabolic reactions taking place at a higher rate (Q10 effect) and redacting the body capacity to fight the disease. The breakdown of body immune system further worsens the capacity of animal to resist diseases.

Foot mouth disease :

FMD among cattle, is an endemic weather related disease, though not a fatal disease among Indian cattle, impacts greatly the livelihoods of animal owners. Multiple attacks of FMD outbreak coincident to climate/ weather change on small holder communities and animal owners brings down the household income by 20-30 per cent

Table 2 : All India production of milk, eggs and wool from 1985-86 to 2006-07

Year	Milk (million tones)	Eggs (Billion nos.)	Wool (million kgs)
1997-98	72.1	28.7	45.6
1998-99	75.4	29.5	46.9
1999-00	78.3	30.4	47.9
2000-01	80.6	36.6	48.4
2001-02	84.4	38.7	49.5
2002-03	86.2	39.8	50.5
2003-04	88.1	40.4	48.5
2004-05	92.6	45.2	44.6
2005-06	97.1	46.2	44.9
2006-07	100.9	50.7	45.1

Source : Department of animal husbandry and dairying, New Delhi

causing macro and micro economic impact as well as a deep dent on livelihood prepositions.

Temperature and humidity with water logging are most favorable for parasitic (Ecto and endo) and diseases vectors. Helminthes (nematodes) infestation Connected with climate in south-east Asia cause 25 per cent reduction in growth rate reduction in goats. Helminthes are estimated to cause 12 per cent reduction in production globally.

It is estimated that collectively disease cause 24 per cent reduction in livestock production due to redacted

growth rate, fertility loss, morbidity and decreased work rate. Even sub clinical disease can lower productivity by 20 per cent.

Authors' affiliations

A.V. TAK, Department of Agricultural Economics and Statistics, Marathawa Agricultural University, PARBHANI (M.S.) INDIA

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