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The impact of Climate Change on Reproductive performance of Livestock

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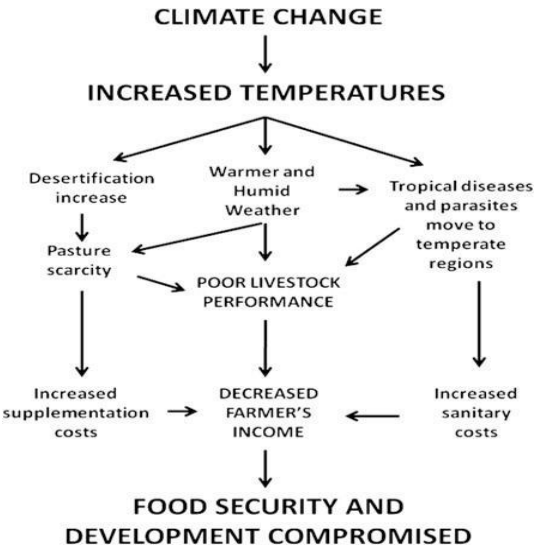
India has vast resources of livestock which plays a vital role for socio-economic status, and food security of the people. The major resources of income for the farmers or livestock owner are animal husbandry and agriculture directly affects the economic conditions of farmers. Climate change is one of the foremost hitches for the stability of livestock production systems in tropical countries like India. Heat stress or high environmental temperature has unfavorable effects on the reproductive, productive and biological function on the body of dairy animals (Sere et al., 2008).

Many climatic factors, i.e., include temperature, humidity, radiation and wind velocity which affect animal's environment directly or indirectly (Gwazdauskas, 1985). A major factor that contributes to reduce in fertility in lactating dairy cows is high ambient temperature (Dash et al. 2016). Heat stress causes 20 to 30% reduction in conception rate and pregnancy rate (Khan et al., 2013). The concentration of atmospheric CO_2 ranges from 400 to 480 ppm according to the IPCC (Intergovernmental Panel on Climate Change) projections in the year 2030. Global climate change is mainly produced by greenhouse gas (GHG) emissions that consequence in warming of the atmosphere. The contribution of livestock sector is 14.5% in global GHG emissions (Gerber et al., 2013) and thus may increase air and water pollution, land degradation and decreases in biodiversity (Bellarby et al., 2013). IPCC Fifth Assessment Report found that increase in global average surface temperature by 2100, which is between 0.3 LC and 4.8 LC. Surroundings of the animals are directly affected by numerous climatic factors, i.e., relative humidity, temperature, radiation and wind (Gwazdauskas, 1985). Thermostatic control unit consists of heat loss center (anterior hypothalamus) and heat production center (post hypothalamus) which maintain core body temperature (Bianca, 1968). The

production of poor quality of feed and fodders, forages, grains are important effect of climate change in livestock. Designing scheme to lowering the negative effects of fertility; such as increased environmental temperature, enhanced cooling, sudden change in the rations, and reproductive protocol changes, will enhance the success rate of dairy farm. Most profitable and effective technique to enhance reproduction in the livestock during the summer months is decrease the environmental temperature by providing cooling atmosphere.

Causes of Heat stress are

- ❖ Inability of animals to dissipate sufficient heat to maintain homeostasis.
- ❖ High Radiant energy.
- ❖ Increase in air temperature.
- ❖ Depletion in conception rate.
- ❖ Death rate of embryo (Gwazdauskas, 1985).
- ❖ Luteal function impairs (Wolfenson et al., 1993).
- ❖ Disturbs gonadotrophin & oestradiol secretions (Wilson et al., 1998).
- ❖ Development of ovarian cysts.



Schematic view of the expected outcome of climate change as a result of global warming on farm animal productivity: Adapted from the article (Singh et al., 2014).

1. Effects of climate change in reproductive performance of livestock

The reproductive performance is the key factor markedly affecting profitability in many livestock production systems. Reproduction performance of both livestock sexes may be affected by heat stress. It affects oocyte growth and quality in cows and pigs (Barati et al., 2008), embryo development impairment, and pregnancy rate (Hansen, 2007). Cow fertility may be affected by heat stress (King et al., 2006). It also affects lower sperm concentration and quality in bulls, pigs, and poultry (Kunavongkrita et al. 2005).

Heat stress has detrimental effect on the reproduction of cattle and buffaloes (Tailor and Nagda, 2005). The heat stress causes the release of ACTH from the anterior pituitary which triggers release of cortisol and other glucocorticoids from the adrenal cortex. Luteinizing hormones is inhibited by the secretion of glucocorticoids. Thermal stress causes hyperprolactinaemia which inhibits the secretion of both FSH and LH at hypophyseal level (Singh et al., 2013). Heat Stress results in low fertility in the livestock because the embryo loses its capacity to alter prostaglandins synthesis in a manner that favours the maintenance of the corpus luteum. Heat stress has more pronounced effects on reproduction than is seen with other stressors (Moberg, 2000). The dry period is very important in the livestock for mammary gland involution and later development, induction of lactation and rapid fetal growth. High ambient temperature or thermal stress can affect endocrine system during dry period that may cause shorten the gestation length, fetal abortions, lower calf birth weight, and reduce follicle and oocyte maturation. Prepartum heat stress may reduce placental estrogen levels and thyroid hormones, while elevating nonesterified fatty acid concentrations in blood; all of these factors alter growth of the udder and placenta, unborn calf growth, and future milk production. Postpartum heat stress affects the ability of the dairy cow to increase production. Dairy cows in late gestation during heat stress had calves with lower birth weights and produced less milk in comparison with cooled cows (Collier et al., 2007). The increasing ambient temperature from 12.5°C to 35°C was followed by decline of conception rate in cattle from 40 to 31% (Ulberg and Burfening, 1967). Oocytes quality is deteriorated due to continuous exposure of animals to the heat stress (Roth et al., 2001) and elevated level of GH and nonesterified fatty acid (Butler, 2001). Infertility is the significant effect of heat stress in the dairy cows (Lopez Gatius, 2003). All the climatic variables showed positive and nonsignificant effects on the intercalving period and dry period (Zewdu et al., 2014). In male livestock, the scrotal circumference, size and weight are decreased in high ambient temperature due to degeneration in the germinal epithelium (Chou et al., 1974). High environmental temperature negatively affect the thermoregulatory mechanism of the testes, sexual desire, ejaculate volume, live sperm percentage, sperm concentration, viability and motility (Gamcik et al., 1979).

Conclusion

Climate change such as high ambient temperature, relative humidity etc. could affect the animal's productivity, reproductive and health performance. Of late, few practices to minimize heat stress in dairy cows, such as air cooled shades, sprinklers and proper ventilation will be suitable for adapting to future climates changes. Enhanced cooling and proper ventilation in their houses are still the most profitable and effective method to improve both milk production and reproduction during summer stress. In case of buffalo, allowing for wallowing and water sprinkling are successful step for reduction in heat stress mainly during summer season. In our opinion, it is important that such mitigation

strategies would focus on the study and use of local genetic resources exhibiting a highly adaptation to the most significant issue for that specific region, either climate or disease. Such markers would be of great importance and use in the definition of selection strategies and objectives to enhance livestock productivity and reproductive performance, with special reference to developing countries. Selection practices will helpful for genetic improvement of the livestock for important heat tolerance traits. Implementation of newly and scientific strategies to minimize negative effects of heat are proper cooling system, ration adjustments in the diet and changes in reproductive protocol, stress depletion etc. will improve the economic conditions of dairy farms.

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