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Climate Resilient Livestock Production: Way Forward

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Background

Presently, the global demand for livestock product is growing. Also the demand of livestock product expected to double by 2050 due to the growing population and improved standard of living. Therefore, there is an urgent need to expand the livestock sector to meet the demand of growing population. Climate change is the current burning issue which is threatening the livestock sector. Livestock sector was adversely affected by the detrimental effects of persisting extreme weather conditions. The changes in the environmental factor such as temperature, rainfall, relative humidity, wind speed and solar radiation are directly and indirectly affecting the livestock productivity. Climatic extremes and the seasonal fluctuation affect the quantity and quality of fodder and water resources and also make them prone to new diseases. Among the climatic variables, heat stress seems to be the most intriguing factor which negatively affects the livestock production. Livestock production is jeopardized due to high temperature by decreasing growth, reproductive performance, milk component and milk production, meat production and animal health. Therefore, adaptation and mitigation of the detrimental effects of extreme climatic events plays important role to counter the impact of climate change on livestock production.

Resilient Animals

Resilient capacity of an animal refers to the ability of an animal to recover its normal biological functions after the exposure to the adverse stressful condition. This coping ability helps the animal to bounce back to the original state and perform better than expected. Resilience is rather a process, and not a trait of an individual. The animals restore their normal functions using their inherent genetic potential as well as the previous exposure experiences. The traits of inherent resilient and adaptive capacity are: long legs, short hair coat, higher sweating rate, large surface area, body conformation, higher capacity for maintenance of heat balance, lower metabolic rate and higher feed efficiency, higher tolerance to dehydration and adipose tissue depots and capacity to alter the hormone and biochemical profiles to adapt to a particular environment. Genetic variant related to thermo-tolerance has been identified in different livestock species, however little is known about the genetic architecture of resilience to extreme temperature changes. Given the fact that livestock production systems tend to be more resilient than crop based system, all the livestock species have the potential to strengthen their resilient capacity to climate change.

Strengthening Resilience in Livestock

The strengthening of resilience in the livestock species relies on building the adaptive capacity of livestock and it is necessary to take an ambitious approach to address the fundamental determinants of their capacity. Four dimensions of adaptive capacity of livestock which provides intervention points to improve resilience are:

i. The ability to make informed assessment of imminent threats,

ii. The ability to make to make an informed choice, from a range of options, about the best response measure,

iii. Being capable of deploying the preferred option (skills, money, infrastructure) and

iv. Being free to implement this option (policy, governance, rights).

All indigenous breeds exhibit more resilient capacity than the exotic breeds due to their higher capacity to tolerate the stressful condition. Resilience capacity of livestock species can be improved by providing comfortable, non-threatening environment and it may be possible to enhance resilience through provision of cognitive and emotional enrichment to the animal.

Assessing the Resilience Capacity of Livestock

Although there is a good amount of knowledge about the physiological aspects, the effects of heat stress at the cellular and genetic level still remain unrevealed. Functional genomics research is providing new knowledge about the impact of heat stress on livestock production and reproduction. Using functional genomics to identify genes that are up- or down regulated during a stressful event can lead to the identification of animals that are genetically superior for coping with stress. Given the complexity of the traits related to adaptation to tropical environments, the discovery of genes controlling these traits is a very difficult task. However, the tremendous progress that has been made in developing new biotechnological tools, new opportunities are available to characterize gene expression and identify key cellular pathways to heat stress. These new tools will enable to improve the accuracy and the efficiency of selection for heat tolerance. Studies evaluating genes identified as participating in the cellular acclimation response through application of microarray analyses, whole transcriptome analysis, genome-wide association studies and next generation sequencing have grouped the genes associated with thermo-tolerance into five different categories such as

i. Energy production;

ii. Genes encoding the subunits of trehalose synthetase;

iii. Classical heat shock protein genes;

iv. Genes that are involved in protein degradation and

v. Genes reducing the impact of oxidative stress

Among these genes, those that are found to have strong association with thermo-tolerance can be validated using real time PCR and this process may help to identify ideal genotypic traits to quantify heat stress response in livestock. However, the real challenge for animal breeders is to breed animals that can produce healthy, viable offspring and hold production levels constant in varied environmental condition.

Proposed new Breeding Program for Climate Resilient Animal Production

Climate change and its devastating effects on agricultural productivity threaten the global food security. Therefore, our approaches to sustain agricultural productivity to ensure food security needs a paradigm shift to meet the demands of growing human population. In particular, animal agriculture contributes immensely to the global food security. Hence, efforts are needed to improve the resilience capacity of livestock to impart them the ability to withstand the adversities associated with climate change as well as to maintain their productivity. The advanced biotechnological tools are making inroads to identify crucial biological markers pertaining to diversified traits controlling production, adaptation and low methane emission. Hence it is time to revisit our strategies in designing our future breeding programs to evolve climate resilient livestock breeds. The future research activities must be oriented towards this goal through marker assisted selection incorporating traits pertaining to production, adaptation and low methane emission in the breeding programs. These efforts apart from imparting thermo-tolerance may channelize the available energy resources towards production pathway. These efforts may help to sustain the livestock production in the changing climate scenario thereby ensuring both the livelihood security of poor and marginal farmers as well as ensuring the food security of growing human population.

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