Dairy cattle genetics by environment interaction mismatch contributes to poor mitigation and adaptation of grazing systems to climate change (CC) actions in the Peruvian high Andes

Velez Marroquin, VM[*]; Manhire, J[†]; Garcia Ticllacuri, R[†]; Bernal Madrid, JL[§]; Pinares-Patino, CS[*†]

[*]Universidad Nacional Mayor de San Marcos, Contract N° 027-2019-Fondecyt-BM-INC.INV, Lima, Peru; [†]New Zealand Peru Dairy Support Project (NZPDSP), The Agribusiness Group, Lincoln, New Zealand; [§]Ministerio de Desarrollo Agrario y Riego (MIDAGRI), Lima, Peru

Introduction

Peruvian Andes support more than 85% of the livestock population, providing the livelihoods to 1.4 M smallholder families.

Over the last 3 decades, dairying boom has occurred. Brown Swiss of high genetic merit predominates, whereas farming of creole cattle and sheep, and camelids have become marginal.

The prevailing dairy genetics is unfit to perform at the severe biotic and abiotic conditions of the Andes and climate change (CC), hence associated with large environmental footprint.

The dairying system

Dairying is based on feedlot principles. Concentrates and forage crops feeding are favoured, whereas management of pastures and grazing are neglected.

Animals are of high genetic merit, hence large body size; bred to suit high input industrial dairying.

Herd feed demand is constant across the year due to year round calving, which contrasts with seasonal pasture growth. Summer excess pasture is not conserved, but oats are grown for hay, harvested at full maturity.

Seasonal home-grown feed supply and unaffordability of imported feeds result in poor body condition of animals. Consequently, key performance indicators are undesirable.

Cows are housed overnight (~18 h). Sheds are rarely cleaned, implying a huge environmental impact and loss of soil fertility. Cow sheds also compromise animal health and milk quality.

The government subsidises pasture sowing, by which native grasslands are converted into pastures, with subsequent release of soil organic carbon. New pastures are poorly sown and managed, resulting in soil and biodiversity erosion.

Drinking water is provided 2 or 3 times a day.

Constraints at the Andes

Climate in the Andes is turning warmer and drier, affecting pasture physiology, botanical composition, productivity, and forage quality. Warming increases the risk of pests and diseases, and heat and water stress in animals.

High altitude hypoxia increases basal metabolism (BM) of non-adapted animals by 30–50% (Qiao et al., 2013).

Feed digestibility decreases at high altitudes, whereas CH_4 production increases (Zhang et al., 2016; Wu et al., 2020).

The Andes exhibits the highest UV radiation, affecting forage production and feeding value, and health (Comont et al., 2013).

Night cold stress is a high risk due to poor body condition, animal genetics, poor feed supply and milking.

Heat stress at high altitudes is an increasing risk in winter, aggravated by lack of clouds, shade and drinking water. Heat stress may increase BM of cattle by up to 50%, compared to that on shade (Han et al. 2003).

Pasture growth is decreasing due to the shortening rainfall period, the increasing evapotranspiration, and the lost in soil fertility (Torres-Batlló et al. 2020).

The mismatch between the dairy genetics and the high altitude abiotic and biotic constraints and CC limit the actions of mitigation and adaptation to CC

Mitigation and adaptation to CC

Andean dairying involves many smallholder families. So, improvement is needed. The New Zealand Peru Dairy Support Project (NZPDSP, 2020) had demonstrated that rapid and significant improvements in productivity and profitability are feasible by applying improved animal husbandry practices (e.g., managing body condition, provision of water, etc) that are simple,of little or nil cost, but of significant and rapid impact; reducing environmental footprint.

One single major decision that may enhance productivity and decrease vulnerability to CC is establishing seasonal calving to match forage demand and offer.

The current animal genetics (specialised, of large body size) contrasts with the Andean abiotic and biotic constraints. Consequently, resulting in a system that has poor overall feed efficiency, high cost and high environmental footprint.

The objective of production should not be milk yield per cow *per se*, but production with the lowest cost and environmental impact. The best bet genetics should use creole cattle crossbred with medium sized dairy bred for grazing situations.

Conclusions

Andean dairying provides the livelihood to many impoverished villagers. It is of low productivity and profitability, but of high environmental footprint and vulnerability to CC. Animal genetics is a key limiting factor for system improvement.

References

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