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# Methane yields from grazing livestock : an overview

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**Summary** Grasslands are chiefly utilised by ruminant and ruminant-like (camelids) livestock species . A unique property of these species is their ability to convert cellulose , hemicellulose and non-protein nitrogen to useful animal products ; which is achieved by the microbial fermentation in their forestomach . Fermentation , however , is associated with production of methane ($CH_4$) , which not only represents a waste of feed energy , but $CH_4$ is also a powerful greenhouse gas . Ruminants are the single most important source of $CH_4$ emission and globally enteric $CH_4$ emissions from managed grasslands have been estimated to account for 44 Tg/yr (Clark et al . 2005) . There is a convention in international inventory comparisons of expressing enteric $CH_4$ emission from ruminants as $CH_4$ yield (% of gross energy intake , GEI) . Here we overview the main factors responsible for $CH_4$ yield from grazed livestock .

The general underlying mechanisms by which enteric $CH_4$ yield is determined include the rate and extent of fermentation , the fermentation pattern (type of volatile fatty acids produced) , and the hexose partitioning between fermentation and microbial growth ; which encompass diet , animal and microbial interactions . In grazing systems , the most important factors influencing $CH_4$ yield include feed intake , animal species , botanical composition and plant maturity , and management interventions . Tropical plant species are not only less digestible than temperate species , but they contain larger amounts of more methanogenic plant constituents (cell walls) than the temperate species . In addition , the livestock species found in tropical environments have evolved physiological , structural and behavioural adaptations to counter environmental stresses and the highly fluctuating feed resources . Prolonged retention in the forestomach of fibrous feeds to extract the maximal amount of energy would appear to be the strategy adopted by species adapted to the feed-scarce tropical environment (Pinares-Patiño et al . 2003) . Thus , it would be expected that $CH_4$ yield from livestock in tropical environments be higher than in temperate environments .

Calculation of $CH_4$ yield requires estimations of both feed intake and $CH_4$ emission . Despite the large research efforts , the estimation of feed intake of grazing animals is still inaccurate ; whereas the $SF_6$ tracer technology allows reliable estimations of $CH_4$ emissions , although with high variability . The considerable number of grazing trials involving $CH_4$ emission measurements conducted during the last decade indicate mean $CH_4$ yields from cattle and sheep grazing temperate grasslands in the range of 3.7-7 .5% of GEI (e .g . Pinares-Patiño 2000 ; Machmüller & Clark 2006) , although some studies in the northern hemisphere have reported $CH_4$ yields for cattle up to 8 .8% of GEI (e .g . McCaughey et al . 1999) ; whereas $CH_4$ yields for cattle in tropical environments fall in the range 7 .8-11. 9% of GEI (Primavesi et al . 2004) . In temperate environments , mean $CH_4$ yields for dairy cows are 5 .5% of GEI , whereas non-lactating animals tend to have higher $CH_4$ yields (e .g . Pinares-Patiño et al . 2007) . In contrast to non-lactating or slow-growing animals , lactating cows have increased feeding drive and therefore higher intakes likely result in shorter retention times of feed and therefore lower fibre digestibility and lower $CH_4$ yield . It seems that the IPCC (2006) default $CH_4$ conversion factors are appropriate for livestock in temperate regions , but it likely underestimates $CH_4$ yields for livestock in tropical regions . Attempts to predict $CH_4$ emissions from grazing animals have been so far unsuccessful .

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