# 14. HAFTA: **Yardımcı bilgiler**

- **Yardımcı bilgiler**
- **Genel terminoloji**

- **14.4 Enteric Fermentation—Greenhouse Gases**
- 14.4.1 General
- The description of this source is drawn from a report by Gibbs and Leng.1 The methodology
- and factors presented in this section are drawn directly from the methodology description in the *State*
- *Workbook: Methodologies for Estimating Greenhouse Gas Emissions, prepared by the U. S. EPA Office*
- of Policy, Planning and Evaluation (OPPE),2 *International Anthropogenic Methane Emissions: Estimates*
- *for 1990,3 and Crutzen, et al. (1986).4 A more detailed discussion of biology and variables affecting*
- methane (CH4) generation from ruminant digestion can be found in those volumes.

Enteric fermentation is fermentation that takes place in the digestive systems of animals. In particular, ruminant animals (cattle, buffalo, sheep, goats, and camels) have a large "fore-stomach," or rumen, within which microbial fermentation breaks down food into soluble products that can be utilized by the animal.1,2 Approximately 200 species and strains of microorganisms are present in the anaerobic rumen environment, although only a small portion, about 10 to 20 species, are believed to play an important role in ruminant digestion.5 The microbial fermentation that occurs in the rumen enables ruminant animals to digest coarse plant material that monogastric animals cannot digest.a

Methane is produced in the rumen by bacteria as a by-product of the fermentation process.

This $CH_4$ is exhaled or belched by the animal and accounts for the majority of emissions from

ruminants. Methane also is produced in the large intestines of ruminants and is expelledThere are a variety of factors that affect $CH_4$ production in ruminant animals, such as: the

physical and chemical characteristics of the feed, the feeding level and schedule, the use of feed

additives to promote production efficiency, and the activity and health of the animal. It has also been

suggested that there may be genetic factors that affect $CH_4$ production. Of these factors, the feed

characteristics and feed rate have the most influence.2

To describe $CH_4$ production by ruminant animals, it is convenient to refer to the portion of feed
energy (food caloric value) intake that is converted to $CH_4$. Higher levels of conversion translate into
higher emissions, given constant feed energy intake. Similarly, higher levels of intake translate into
higher emissions, given constant conversion. There are, however, interactions between level of intake
and conversion to $CH_4$, so these values are not independent.[1,2]

Methane production as a fraction of the animal's gross energy intake generally will decrease as
daily intake increases for the same diet, but the actual quantity of $CH_4$ produced may increase due to
the greater amount of fermentable material. Because of the complex relationship between the quantity
of feed and the $CH_4$ yield percentage, emission factors and straightforward emission equations can be
used for general approximations only. In cases where the animal type, feed quality, and feed quantity
are narrowly characterized and matched to reliable $CH_4$ yield percent values, $CH_4$ emission factors are
much more accurate. In addition, feed intake changes over time with animal performance. Periodic
updates to the emission factors are required to reflect changes in animal management characteristics.

As a result of the various interrelationships among feed characteristics, feed intake, and
conversion rates to $CH_4$, most well-fed ruminant animals in temperate agriculture systems will convert
about 5.5-6.5 percent of their feed energy intake to $CH_4$. Given this range for the rate of $CH_4$ formation, $CH_4$ emissions can be estimated based on the feed energy consumed by the animals.
Because feed energy intake is related to production level (e.g., weight gain or milk production), the
feed energy intake can be estimated for these regions based on production statistics.1,

Monogastric animals have a single-chambered stomach, unlike the multi-chambered stomachs of ruminants. Examples of monogastric animals include swine, dogs, monkeys, and humans.

The rates of conversion of feed energy to $CH_4$ for non-ruminant animals are much lower than
those for ruminants. For swine on good quality grain diets, about 0.6 percent of feed consumed is
converted to $CH_4$. For horses, mules, and asses the estimate is about 2.5 percent. While these estimates
are also uncertain and likely vary among regions, the global emissions from these species are much
smaller than the emissions from ruminant animals. Consequently, the uncertainty in these values does
not contribute significantly to the uncertainty in the estimates of total $CH_4$ emissions from livestock.2,4

**Emissions**
Given their population and size, cattle account for the majority of $CH_4$ emissions in the United
States for this source category. Cattle characteristics and emissions vary significantly by region.
Therefore, it was important to develop a good model for cattle which takes into account the diversity of
cattle types and cattle feeding systems in the United States. The variability in emission factors among
regions for other animals is much smaller than the variability in emission factors for cattle.2





# TEŞEKKÜR LER

**Gürsel DELLAL**
Ankara Üniversitesi, Ziraat Fakültesi, Zootekni Bölümü