CASE STUDY #5: NONPOINT SOURCE – LIVESTOCK MANAGEMENT

Part 1: Goal

The objective of this case study is to learn how to characterize, estimate, and report emissions for a nonpoint source category. The specific goals to be achieved by this case study are:

- To estimate methane emissions from the livestock enteric fermentation nonpoint source category within a localized boundary;
- To use local cattle population and characterizations to prepare the inventory estimates;
- To document the inventory process so that the results can be duplicated.

Part 2: Problem Description

In this agricultural region of the country methane emissions from livestock enteric fermentation are a key source contributor to greenhouse gas emissions. Methane is produced as part of normal digestive processes in animals. During digestion, microbes resident in an animal's digestive system ferment food consumed by the animal. This microbial fermentation process, referred to as enteric fermentation, produces CH_4 as a by-product, which can be exhaled or eructated by the animal. The amount of CH_4 produced and excreted by an individual animal depends primarily upon the animal's digestive system, and the amount and type of feed it consumes.

Cattle are the main ruminant animal of concern for this source category. In the inventory region, large populations of cattle are grazed in open pasture, often on relatively poor quality grasses and ground cover. However, certain portions of the livestock population have access to higher quality feeds as more feedlots are used for animal fattening, along with some high producing dairy farms, which can affect the methane produced from the animals. The objective is to prepare an estimate of methane that better reflects the region's population of cattle.

Note to the student: All of the activity data and their references provided in this case study are fictitious and made up for the sole purpose of demonstrating the emissions inventory methodology. However, the emission factors and their references are based on the actual references as provided.

Livestock Population

In order to estimate CH_4 enteric fermentation emissions from cattle in the study region, the population is divided into age, sub-type (e.g., calves, heifer replacements, cows, etc.), and production (i.e., lactating, fattening, etc.) groupings to more fully capture differences in CH_4 emissions from these animal types.

For the local inventory area being evaluated, the breakdown of cattle population is as follows:

Cattle Type	**Population**
High-producing dairy cows (4000+ kg/head/yr milk)	4000
Feedlot-fed beef cattle	4500
Mature grazing males (bulls)	2000
Mature grazing females (beef cows)	10000
Young cattle (replacements, growing heifers and steers)	7500
Calves (on milk)	4000

Population values are in terms of average annual standing herd size. The population data was developed from local farm surveys and cross-verified against national level agricultural statistics to verify reasonableness.

The dairy cows and feedlot cattle are stall-fed in commercialized operations striving for maximum production of milk and meat products. The high-producing dairy cows and feedlot-fed cattle are fed relatively high-quality feed, with high digestibility (70 to 80%). The producing dairy cows are rather large (450-500kg). The rest of the cattle population is

primarily in a pasture grazing management system, with relatively low quality grasses (digestibility of 55% of less).

Emission factors are available from the Intergovernmental Panel on Climate Change (IPCC) Revised 1996 Guidelines for National Greenhouse Gas Inventories. Factors are provided for different regions of the world based on animal and feed characteristics. The following factors best represent the conditions of the localized animal population as described above:

Cattle Type	**Emission Factor (kg CH_4/head/yr)**
Dairy Cows	70
Feedlot Cattle	40
Grazing Mature Males (Bulls)	50
Grazing Mature Females (Beef Cows)	50
Young Cattle	40
Calves (on milk)	0

Emission Factor Source: Compiled from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Tables A-1 and A-2, Data for Estimating Enteric Fermentation Emission Factors for Dairy and Non-dairy Cattle.

Part 3: Planning

The contents of the Inventory Preparation Plan/Quality Assurance Plan are outlined as follows:

- Background and uses of the inventory;
- Inventory area status (i.e., attainment or nonattainment);
- Inventory scope (i.e., geographic area and population, pollutants of concern, base year, temporal resolution);
- Data quality objectives;
- Inventory resources;
- Emissions estimation methodologies; and

- QA/QC Procedures
  - Internal QA/QC procedures; and
  - External QA/QC procedures (to be conducted in Step 6 by exchanging solutions with another group, and completing the QA/QC Checklist).

Student teams will conduct the following 4 activities as part of this exercise.

1. Prepare an Inventory Preparation Plan
2. Perform emission estimation calculations
3. Prepare documentation outline
4. Student teams will exchange emission estimation calculations and documentation outlines with other teams and perform QA on other team's products