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## Introduction

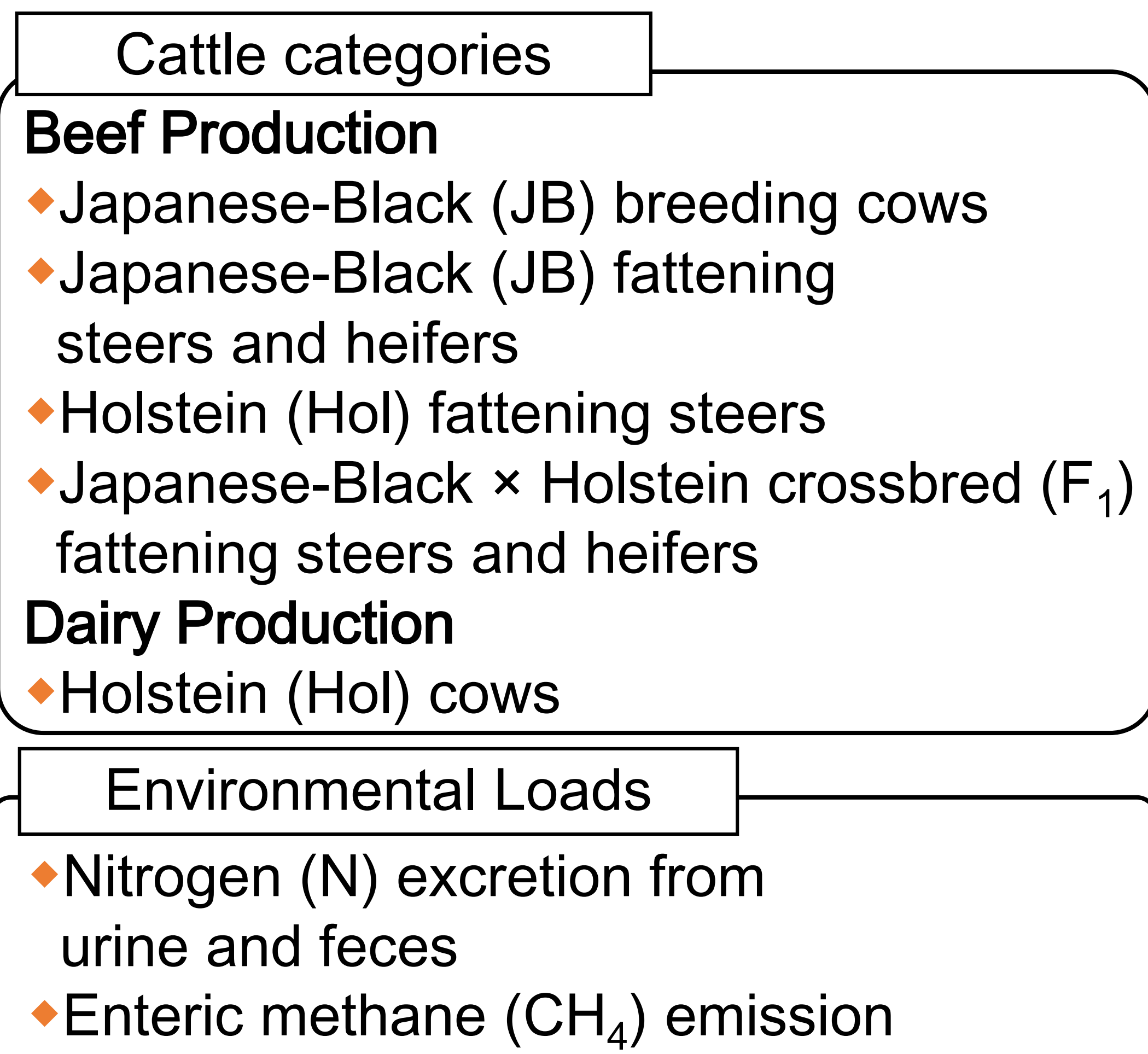
- ◆ Dairy and beef production systems cause serious environmental impacts by such as nitrogen excretion and methane emission.
- ◆ There are few studies which estimate the environmental impacts from cattle production on national scale.

## Objectives

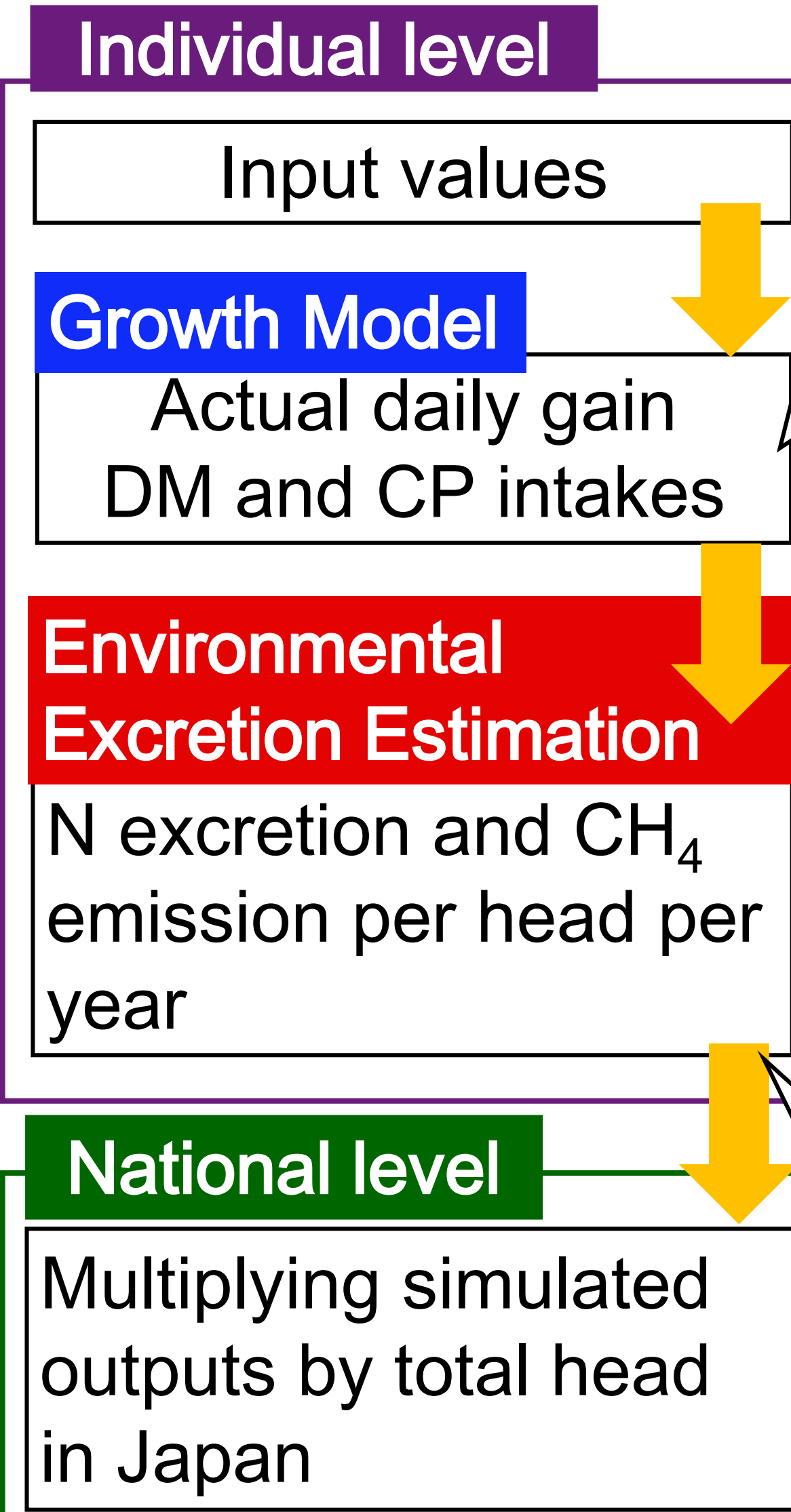
- ◆ To develop deterministic simulation models of dairy and beef cattle.
- ◆ To estimate environmental impacts from dairy and beef production on national scale in Japan.

## Materials and Methods

### 1. Targeted Cattle Categories and Environmental Loads



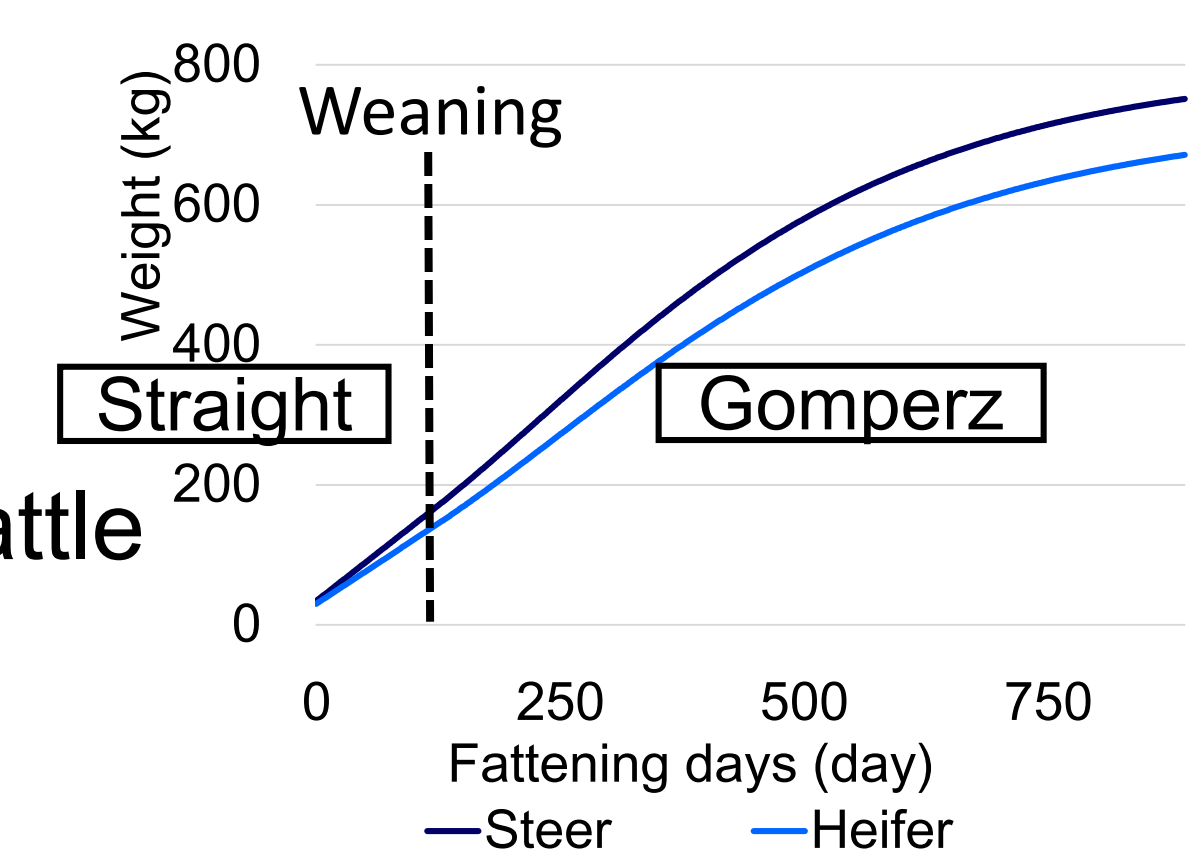
### 2. Model Overview



### Actual Daily Gain

#### Beef Cattle

- ◆ Birth to weaning: Straight lines
- ◆ Weaning to slaughter: Gompertz curves for fattening cattle
- ◆ Brody curve for Breeding cow



#### Dairy Cattle

- ◆ 0-50 days: Cubic function of days
- ◆ After 50 days: Richard curve

### Dry matter (DM) and Crude Protein (CP) intakes

- ◆ Metabolizable energy (ME) requirements of cattle were calculated using Japanese Feeding Standards.
- ◆ DM intake were calculated based on the ME requirements.
- ◆ CP intake were calculated using national statics.

### N excretion (kg/day)

$$N = (CP_{intake} - CP_{retained} - CP_{pregnant} - CP_{milk}) / 6.25$$

### CH<sub>4</sub> emission at the age of t (kg/day) (t = day)

$$CH_4 = (3.4 \times (\frac{t}{7}) - 1.2) / 1000 \quad (t < 175)$$

$$CH_4 = 0.016 \times (-17.766 + 42.793DMI - 0.849DMI^2) / 22.4 \quad (t \geq 175)$$

### 3. Input Values

Table 1. Assumed values of biological input variables of the model

Cattle Categories	Birth weight (kg)	Weaning weight (kg)	Age at weaning (days)	Mature weight (kg)	Slaughtered weights (kg)	Age at slaughter (days)	Total milk yield (kg/parity)	Calving interval (days)	Gestation length (days)	Lactation period (days)	Protein content in milk (%)	Age at first mating (days)	Culling parity	Total heads in Japan (heads)
JB	Fattening steer	34	165	120	800	751	-	-	-	-	-	-	-	650,500
	Fattening heifer	30	140	120	725	670	-	-	-	-	-	-	-	538,800
	Breeding cow	30	140	120	515	-	738	404	285	120	3.8	483	6	642,200
F <sub>1</sub>	Fattening steer	38	75	45	910	834	-	-	-	-	-	-	-	258,400
	Fattening heifer	34	62.5	45	860	750	-	-	-	-	-	-	-	240,700
Hol	Fattening steer	46	125	90	1100	761	-	-	-	-	-	-	-	384,540
	Cow	43	-	-	707	-	8167	436	280	370	3.22	459	4	1,012,000

## Results

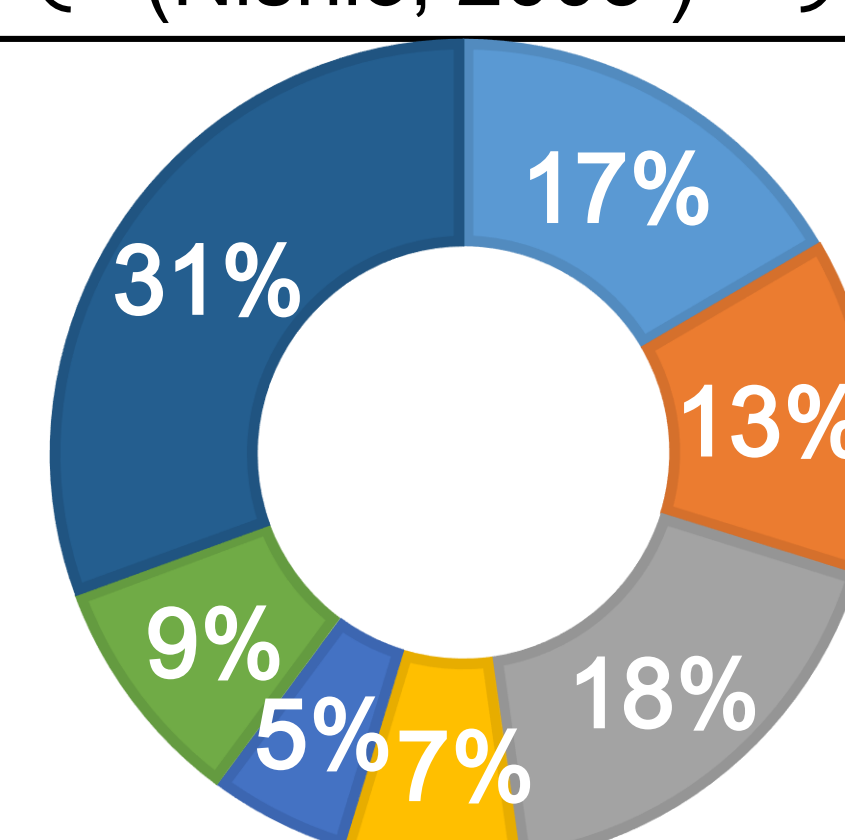
### Individual level

Table 2. Simulated outputs of feed intake, N excretion and CH<sub>4</sub> emission

Cattle categories	Feed intake (TDNkg/year)	N excretion (kg/year)	CH <sub>4</sub> emission (kg/year)	
Fattening steer	2153.4	55.4	66.8	
JB	Fattening heifer	2095.0	53.5	72.9
	Breeding cow	2343.3	61.0	89.6
F <sub>1</sub>	Fattening steer	2322.4	58.0	67.7
	Fattening heifer	2106.0	49.5	67.2
Hol	Fattening steer	2126.1	52.2	60.7
	Cow	3517.8	65.9	97.5

### National level

(a) N excretion  
217.7 thousand tons  
(301 thousand tons (Nishio, 2003))



(b) CH<sub>4</sub> emission  
297.2 thousand tons  
(291.5 thousand tons (GIO, 2014))

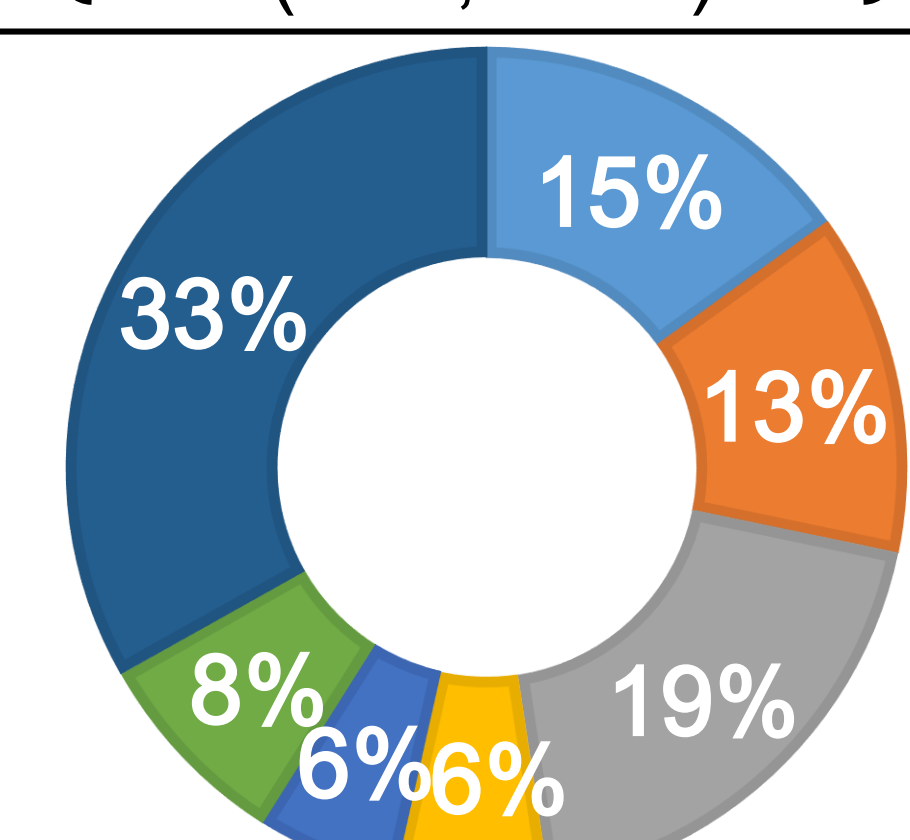


Figure 2. Total environmental loads excreted from beef and dairy production on national scale

◆ Japanese-Black breeding cow and Holstein cow categories excreted more N and CH<sub>4</sub> than fattening cattle.

◆ Total amount of CH<sub>4</sub> emission on national scale estimated in this study was almost equal to the estimation by national report.