Inventory and Mitigation for Methane Emissions from Livestock in Indonesia

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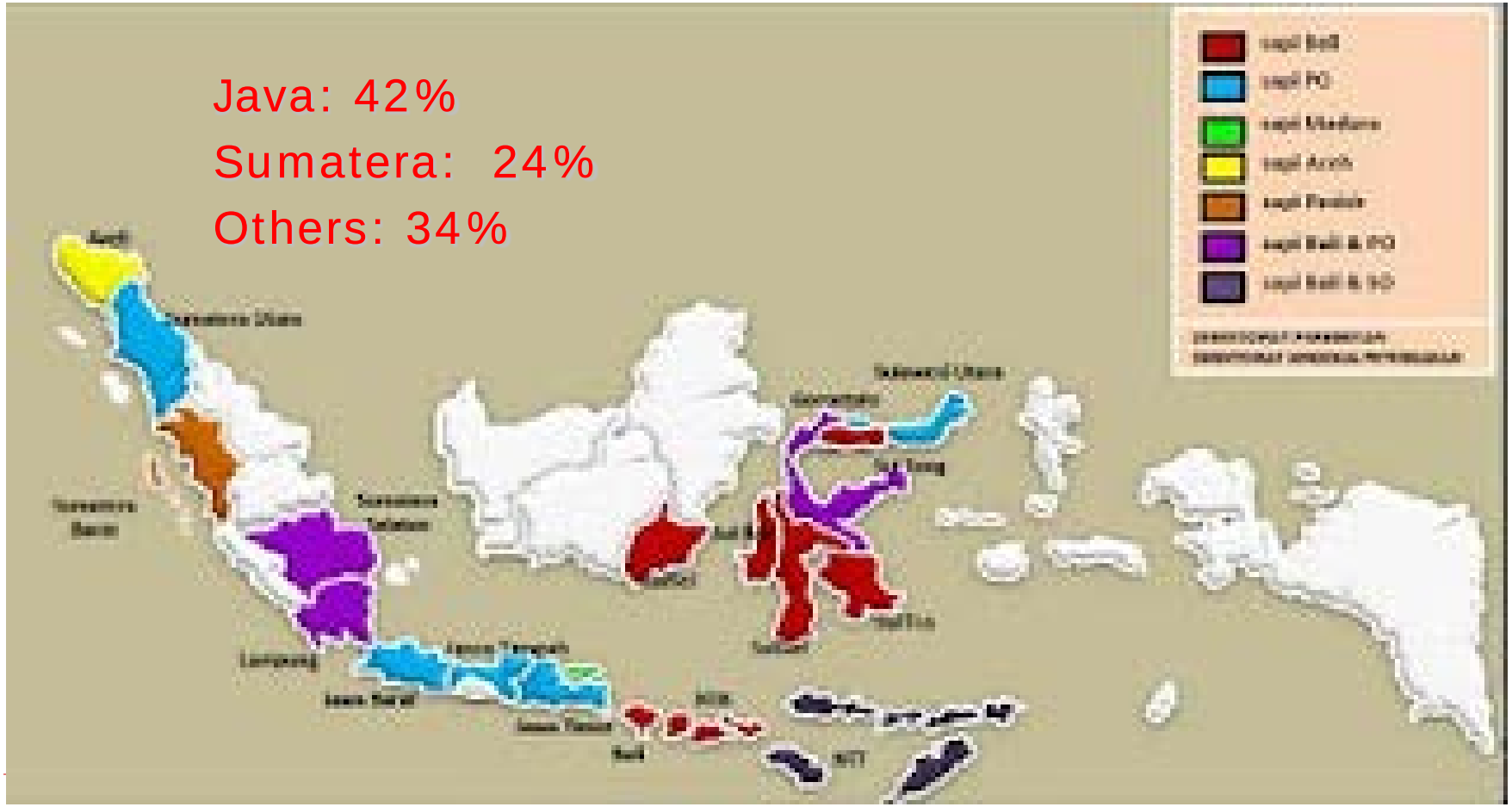
Introduction

- Methane is produced as part of the normal digestion process of ruminant animal.
- In Indonesia, livestock that contribute to methane emission are beef cattle, dairy cattle, buffalo, sheep, goat, pig, local chicken, broiler, layer and duck.
- Increase of livestock population is 1-5% per year.
- The distribution of the livestock in Indonesia is mainly in Java, Sumatera and Sulawesi.
- We have to calculate the methane emission from the livestock.

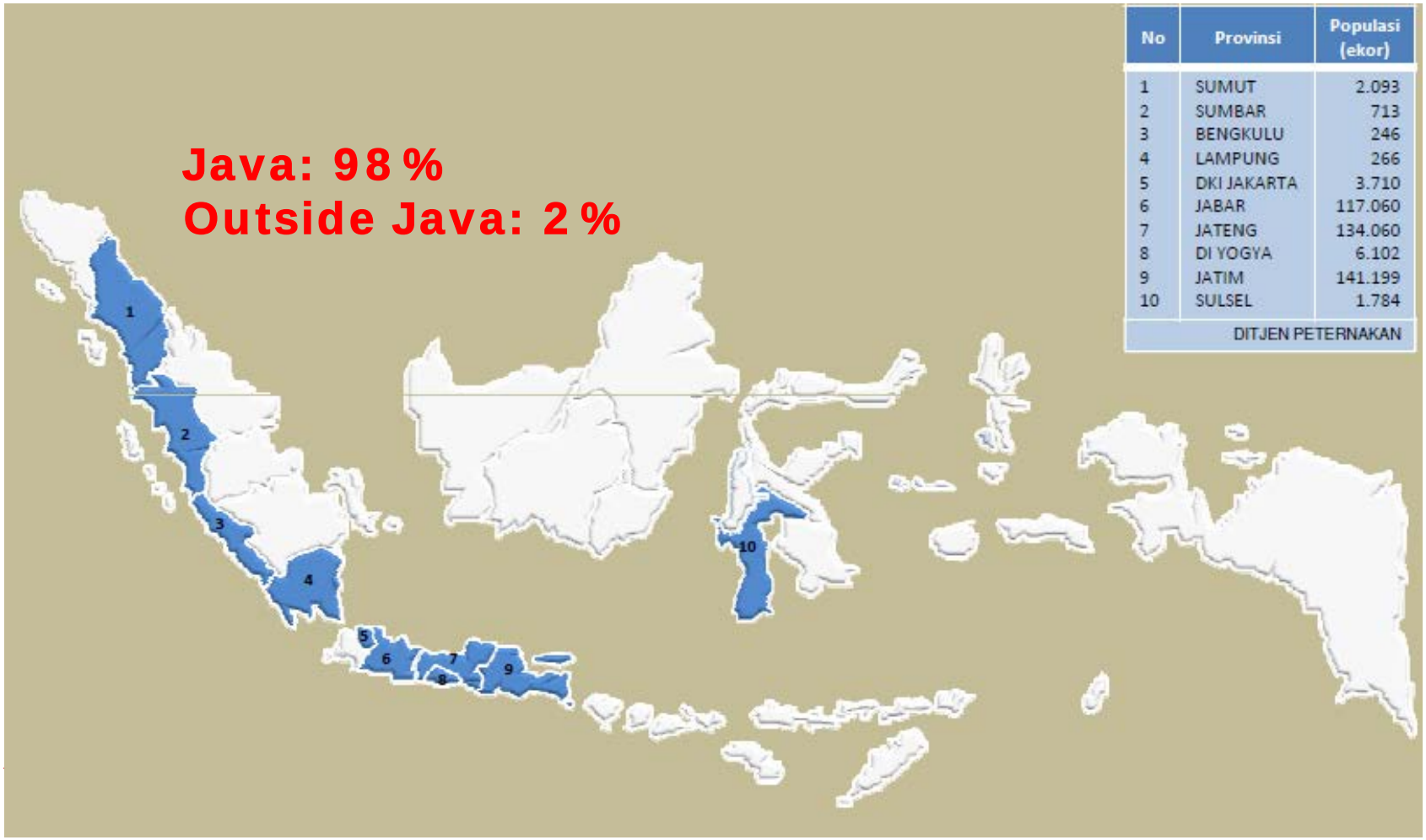
Livestock Population in Indonesia (2000-2006)

No.	Species Type	2000	2001	2002	2003	2004	2005	2006
1	Beef Cattle (AU)	8,121,691	8,069,525	8,183,187	7,546,157	7,547,990	7,561,691	7,799,932
2	Dairy Cattle (AU)	265,744	260,249	268,873	280,388	273,098	271,065	276,803
3	Buffalo (AU)	1,766,248	1,710,212	1,754,202	1,796,835	1,751,355	1,550,100	1,575,649
4	Sheep (head)	7,414,965	7,367,776	7,603,892	7,774,294	8,037,667	8,290,477	8,947,878
5	Goat (head)	12,613,108	12,198,587	12,292,318	12,465,046	12,592,730	13,203,098	13,567,972
6	Pig (head)	5,247,200	4,871,896	5,237,758	5,429,766	5,548,999	6,043,706	5,378,041
7	Horse (head)	412,919	404,162	396,697	388,599	376,378	365,478	373,981
8	Local Chicken (000 head)	261,132	268,786	276,023	278,068	278,966	281,431	292,122
9	Broiler (000 head)	534,811	624,690	849,644	855,669	785,547	820,501	808,510
10	Layer (000 head)	69,703	70,127	78,024	79,168	93,497	84,688	100,236
11	Duck (000 head)	29,674	32,591	46,624	34,547	33,255	33,102	33,195

Distribution of Beef Cattle in Indonesia

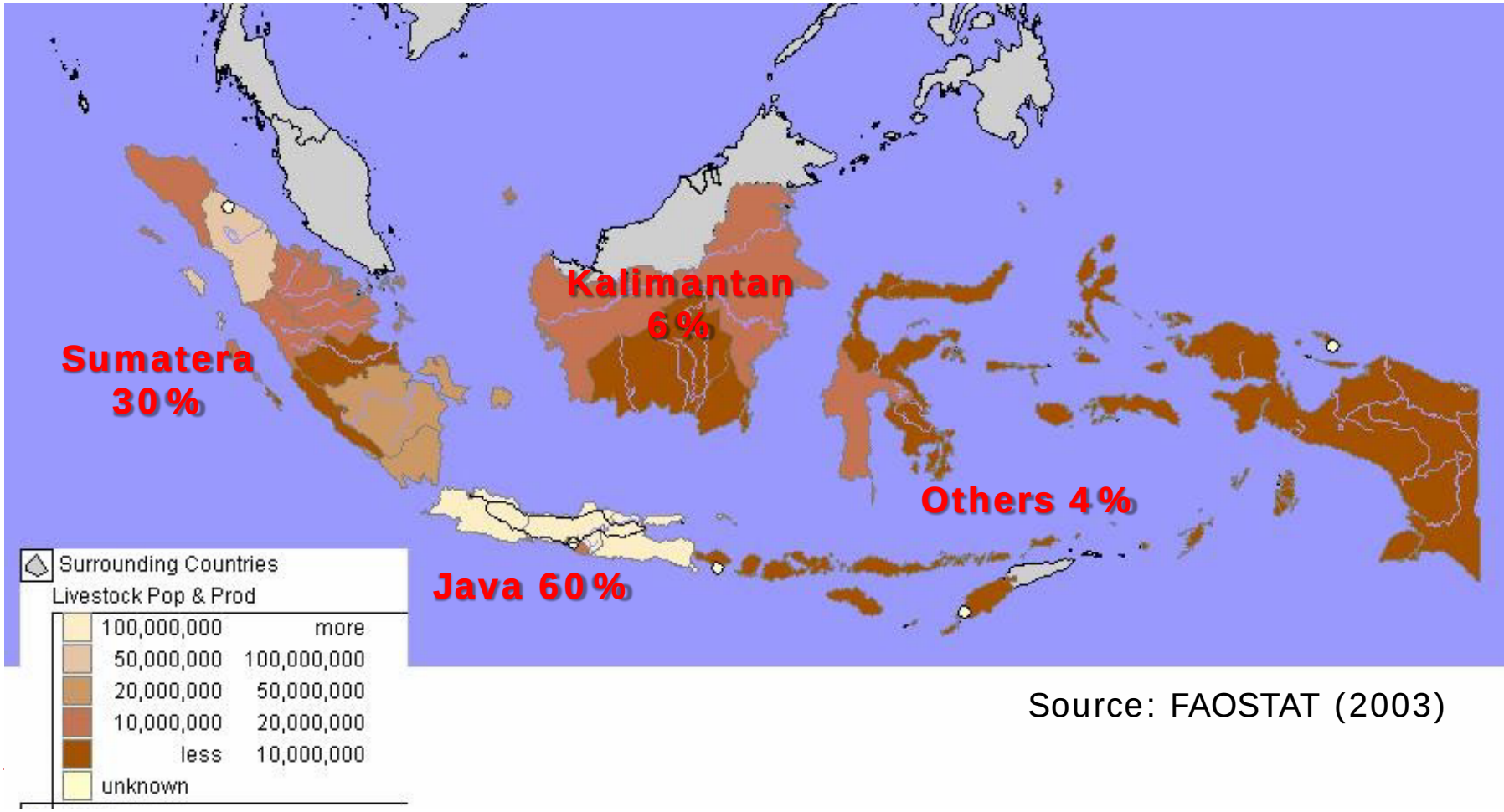


Distribution of Dairy Cattle in Indonesia



No	Provinsi	Populasi (ekor)
1	SUMUT	2.093
2	SUMBAR	713
3	BENGKULU	246
4	LAMPUNG	266
5	DKI JAKARTA	3.710
6	JABAR	117.060
7	JATENG	134.060
8	DI YOGYA	6.102
9	JATIM	141.199
10	SULSEL	1.784
	DITJEN PETERNAKAN	

Distribution of Poultry in Indonesia



Source: FAOSTAT (2003)

Source of Data

- Livestock population data is from Statistic Centra Buro (2000-2006)
- Livestock Population Stucture of Animal is from Survey from Department of Agriculture –Statistic Central Statistic (2006)

METHODOLOGY

Estimation of Methane Emission from Enteric Fermentation

- Using IPCC 2006

$$N_{(T)\ in\ Animal\ Unit} = N_{(X)} * k_{(T)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where:

$N_{(T)}$ = The number of head of livestock species in *Animal Unit*
$N_{(X)}$ = The number of head of livestock species in *Head*
$k_{(T)}$ = Correction factors (beef cattle=0.72, dairy=0.75 and buffalo=0.72)
T = Species/category of livestock (beef, dairy and buffalo)

$$Emissions = EF_{(T)} * N_{(T)} * 10^{6} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Where:

Emissions = Methane emissions from enteric fermentation, Gg CH_4 yr^{-1}
$EF_{(T)}$ = Emission factor for the defined livestock population, kg CH_4 $head^{-1}$ yr^{-1}
$N_{(T)}$ = The number of head of livestock species / category T in the country
T = Species/category of livestock

Population Structure of Beef Cattle, Dairy and Buffalo

No.	Species Type	Calf	Growing	Mature
1.	Beef Cattle	18.13	28.99	52.88
2.	Dairy Cattle	19.66	20.33	59.71
3.	Buffalo	19.66	20.33	53.92

Source: Biro Pusat Statistik (2006)

Emission Factors for Enteric Fermentation

No	Species Type	Enteric Fermentation (kg CH_4/head/year)
1.	Beef Cattle	47
2.	Dairy Cattle	61
3.	Buffalo	55
4.	Sheep	5
5.	Goat	5
6.	Pig	1
7.	Horse	18

Estimation of Methane Emission From Manure Management

- Using IPCC 2006

$$\textit{Emissions} = EF_{(T)} * N_{(T)} * 10^6 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where:

Emissions = Methane emissions from manure management, Gg CH_4 yr^{-1}
$EF_{(T)}$ = Emission factor for the defined livestock population, kg CH_4 $head^{-1}$ yr^{-1}
$N_{(T)}$ = The number of head of livestock species / category T in the country
T = Species/category of livestock

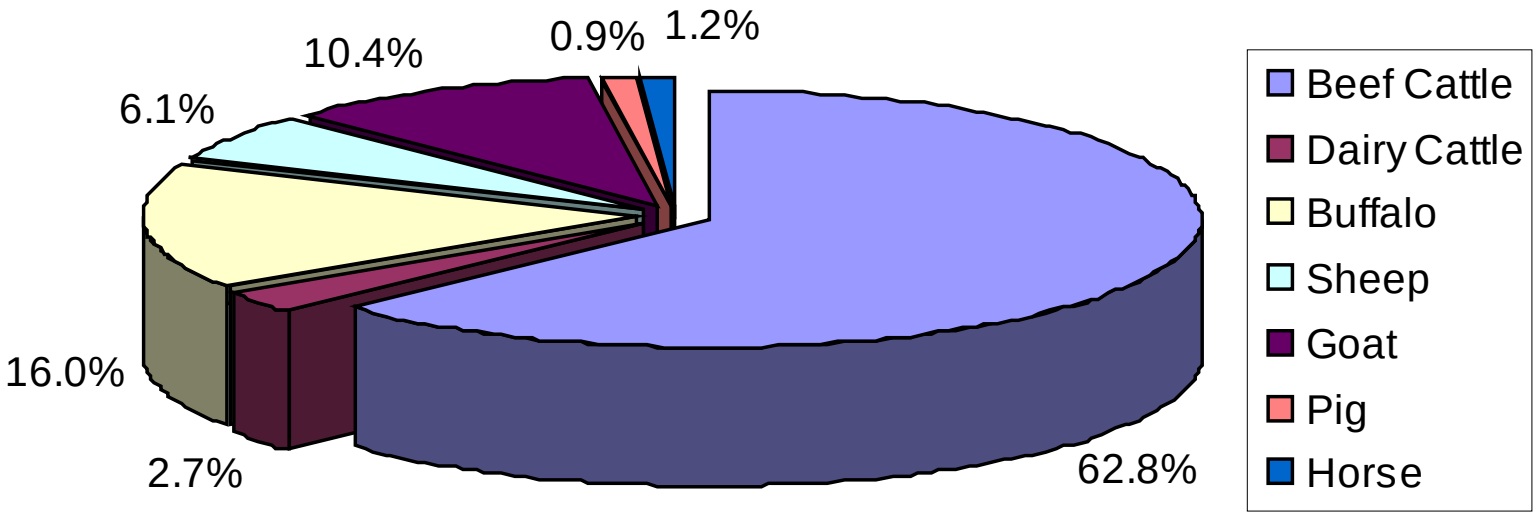
Emission Factors for Manure Management

No	Species Type	Manure Management (kg CH_4//head/year)
1.	Beef Cattle	1
2.	Dairy Cattle	31
3.	Buffalo	2
4.	Sheep	0.20
5.	Goat	0.22
6.	Pig	7
7.	Horse	2.19
8.	Local Chicken	0.02
9.	Broiler	0.02
10.	Layer	0.02
11.	Duck	0.02

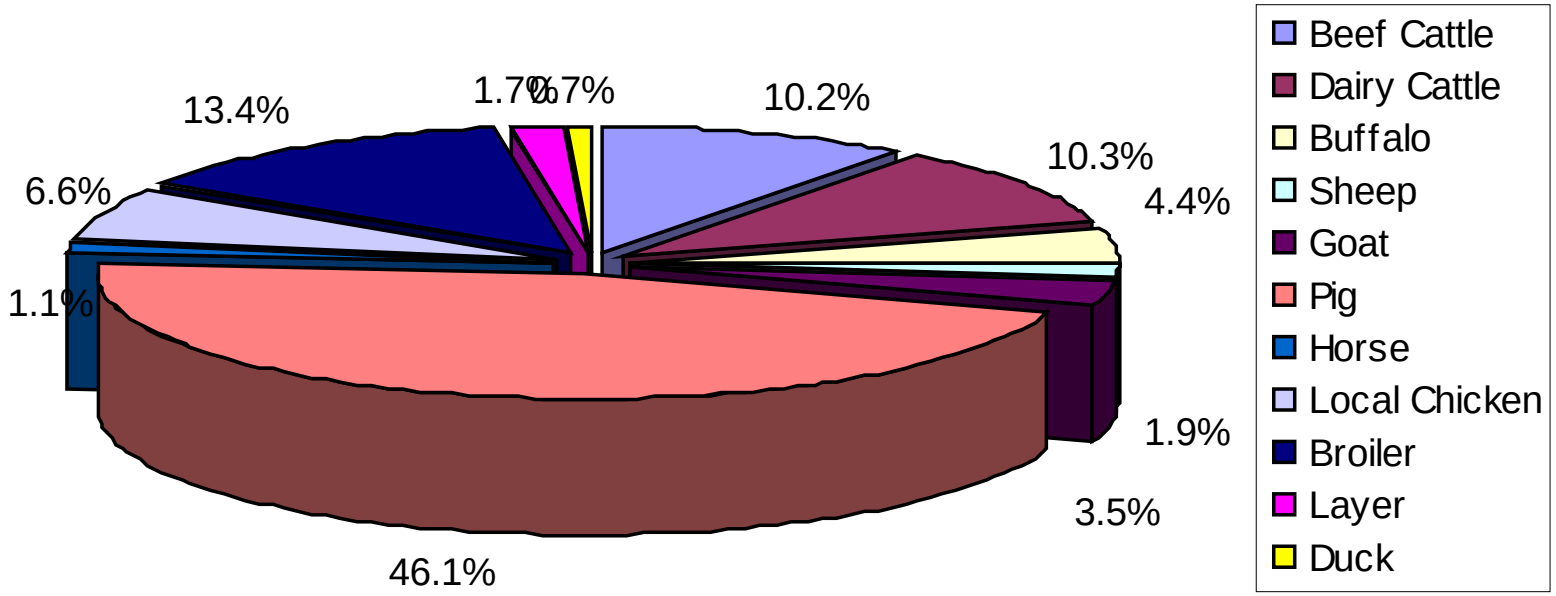
ESTIMATION OF GHG EMISSION

Distribution of Methane Emission by Animal Type

No.	Animal Types	Number of Animal	CH_4 emission by enteric fermentation (Gg)	CH_4 emission by manure management (Gg)	Total (Gg)
1.	Beef Cattle	8,121,691	381.72	8.12	**389.84**
2.	Dairy Cattle	265,744	16.21	8.24	**24.45**
3.	Buffalo	1,766,248	97.14	3.53	**100.68**
4.	Sheep	7,414,965	37.07	1.48	**38.56**
5.	Goat	12,613,108	63.07	2.77	**65.84**
6.	Pig	5,247,200	5.25	36.73	**41.98**
7.	Horse	412,919	7.43	0.90	**8.34**
8.	Poultry : Native Chicken	261,132,020	-	5.22	**5.22**
	Broiler	534,810,990	-	10.70	**10.70**
	Layer	69,702,890	-	1.39	**1.39**
	Duck	29,674,120	-	0.59	**0.59**
	TOTAL		**607.89**	**79.69**	**687.58**



Distribution of Methane Emission from Enteric Fermentation by Animal Type

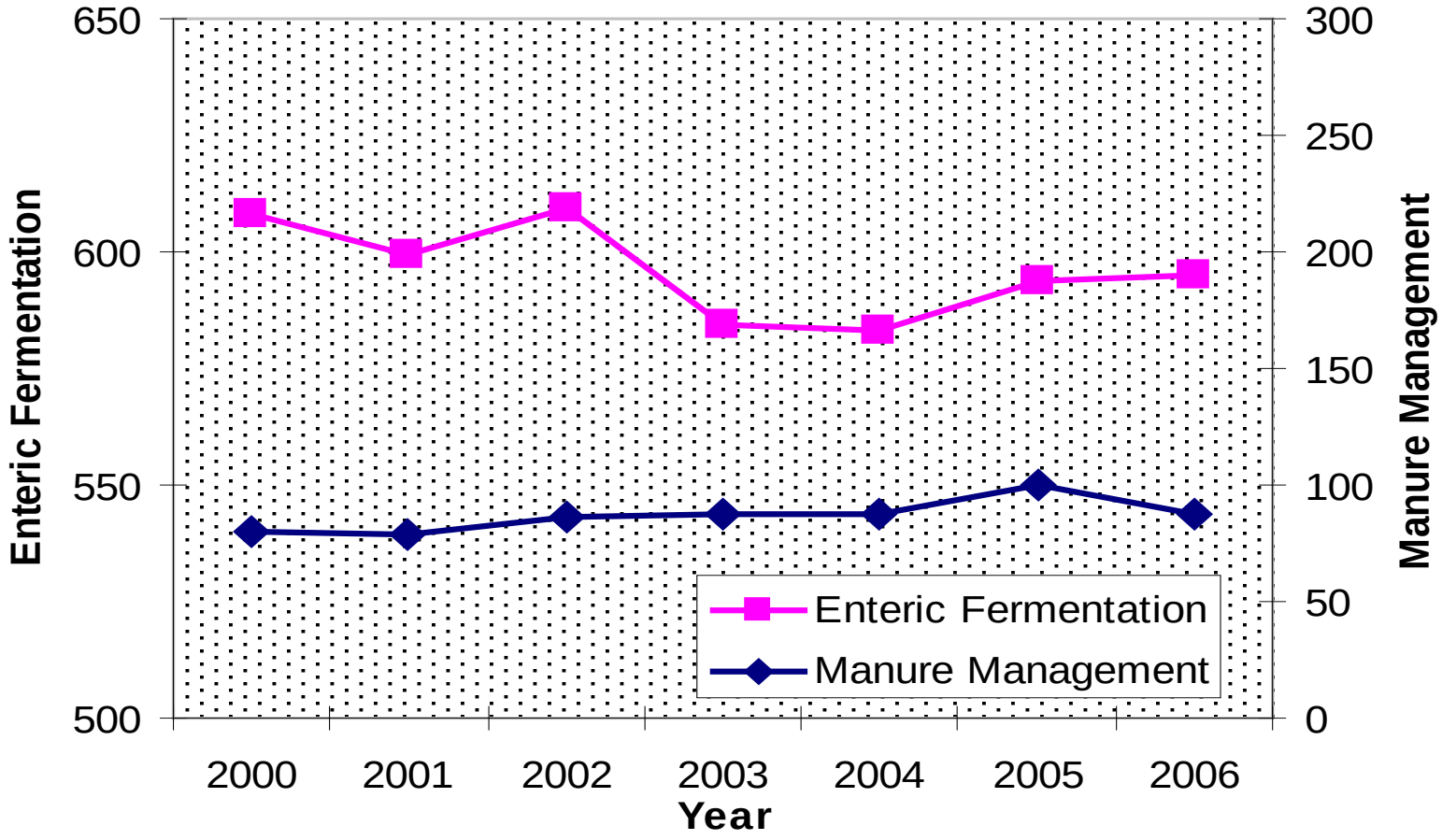


Distribution of Methane Emission from Manure Management by Animal Type

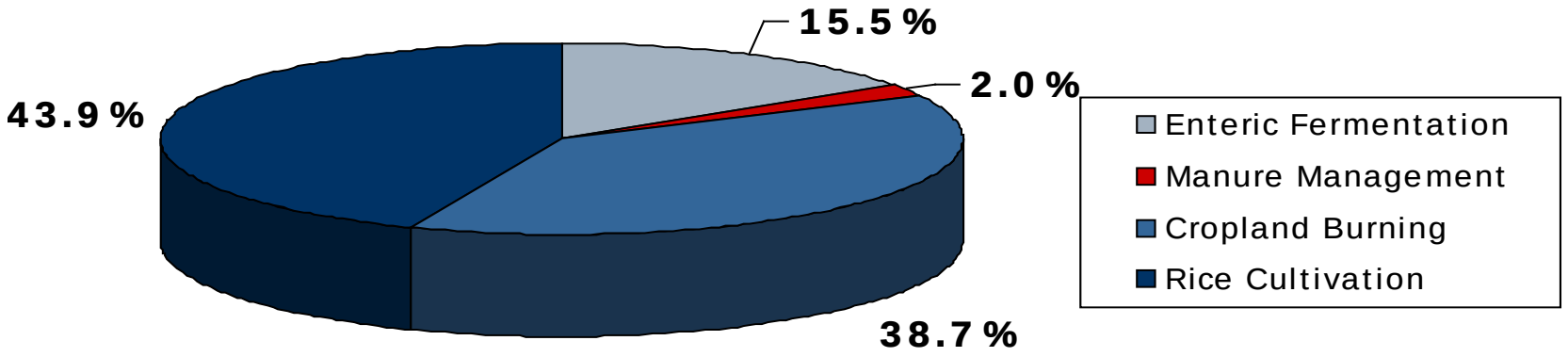
Distribution of Methane Emission by Province

No.	Province	CH_4 emission by enteric fermentation (Gg)	CH_4 emission by manure management (Gg)
1.	East Java	141.96	9.74
2.	Central Java	82.20	8.00
3.	West Java	48.82	8.71
4.	Nangro Aceh Darusalam	41.92	1.63
5.	South Sulawesi	37.36	4.88
6.	West Sumatera	25.05	1.51
7.	North Sumatera	24.28	7.72
8.	West Nusa Tenggara	21.77	1.07
9.	East Nusa Tenggara	21.77	1.07
10	South Sumatera	20.13	1.63
11	Other Province	142.63	33.73
	TOTAL	**607.89**	**79.69**

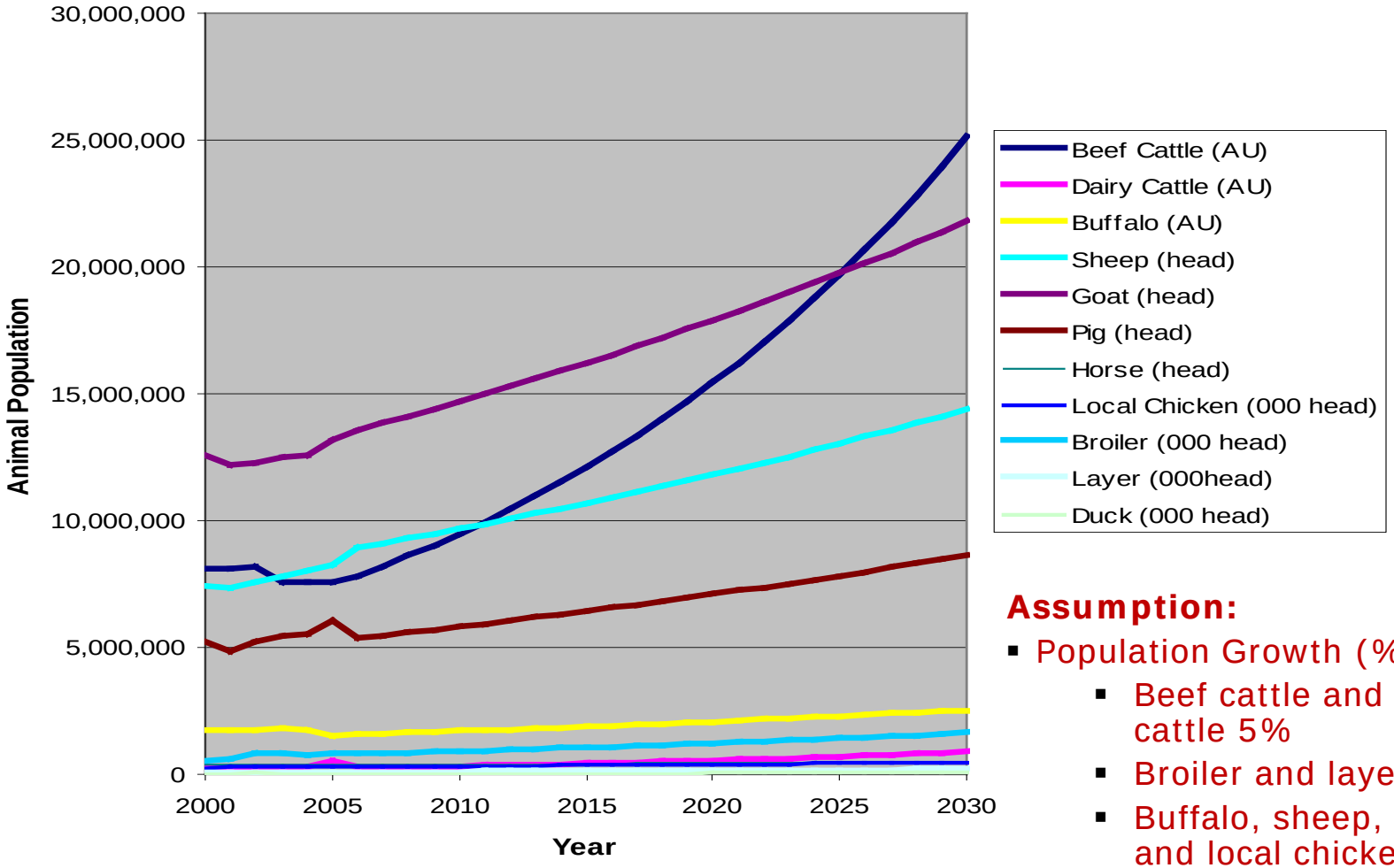
Indonesian Methane Emission from Livestock (2000-2006)



Distribution of Methane Emission by Sources in Indonesia



Projection of Livestock Growth



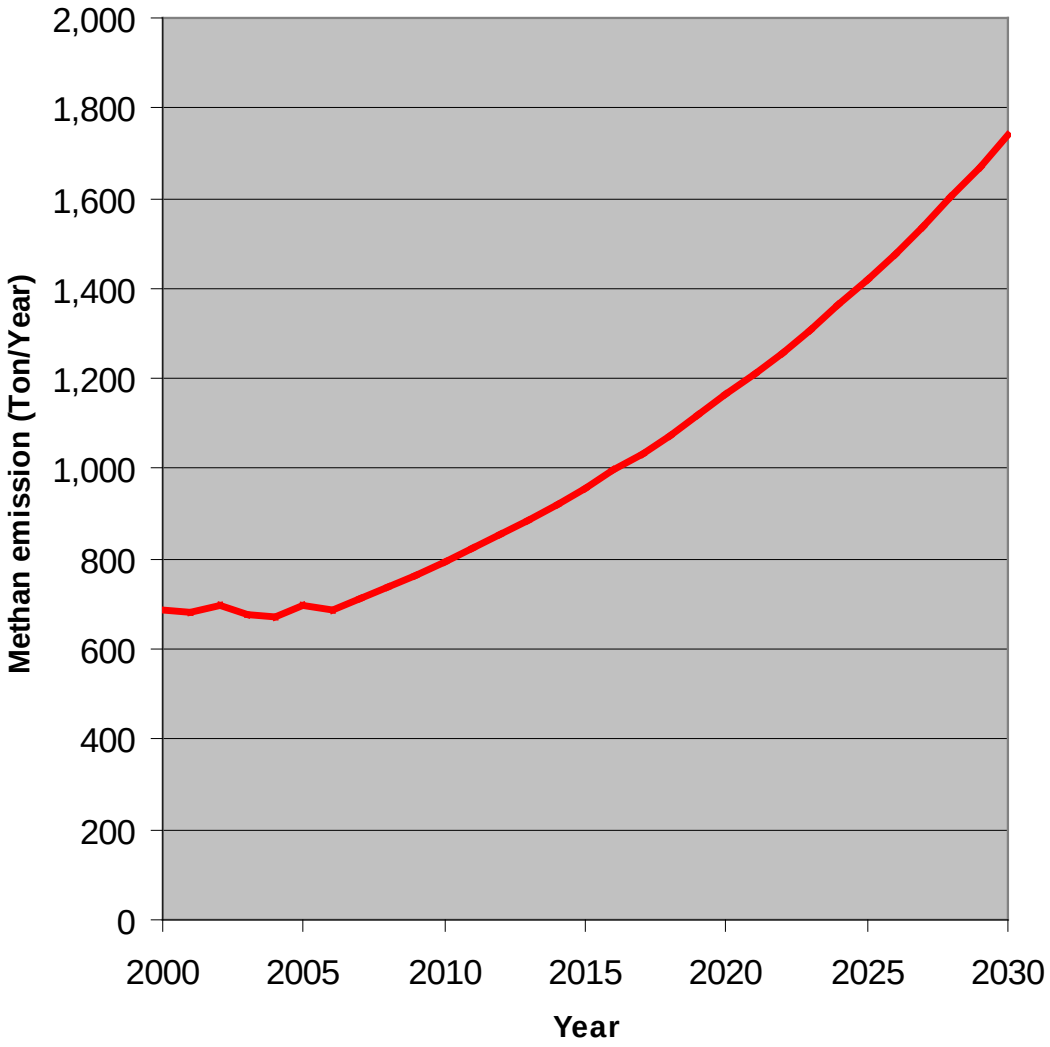
Assumption:

- Population Growth (%/year):
  - Beef cattle and dairy cattle 5%
  - Broiler and layer 3%
  - Buffalo, sheep, goat, pig and local chicken 2%
  - Other animals 1%

Methane Emission Projection under Baseline (2000-2030)

Projection:

- The methane emission projection depend on livestock population growth.
- In 2000, methane emission was **687.58 ton/year**.
- If there is no mitigation program, in 2030 methane emission is estimated by **1,732 ton/year**.



Priority of Mitigation Technology:

a. Technology should be applicable, low cost and have direct benefit to the farmer;
b. Simple for its arrangement;
c. Technology can be conducted by local institution such as cooperative;
d. Effective in increasing agriculture productivity as well as mitigating GHG emission;
e. Integration to other agriculture development program.

Mitigation Technologies in Livestock Sector

No	Mitigation Options	Advantage	Barrier
1.	Supplementation	Increase productivity, reduce methane emission, low cost	Need investment and extension program
2.	Improvement feeding practices	Effective program with local feed resources	Need revitalization mini feed industry
3.	Manure management / Biogas	Produce low cost bioenergy, applied technology	Need capital investment, and village institution arrangement
4.	Long term breeding program	Government priority program	Need capital investment
5.	Pasture management	Low cost	Need extension program

Thank You