Appendix H

Country Paper: Cambodia

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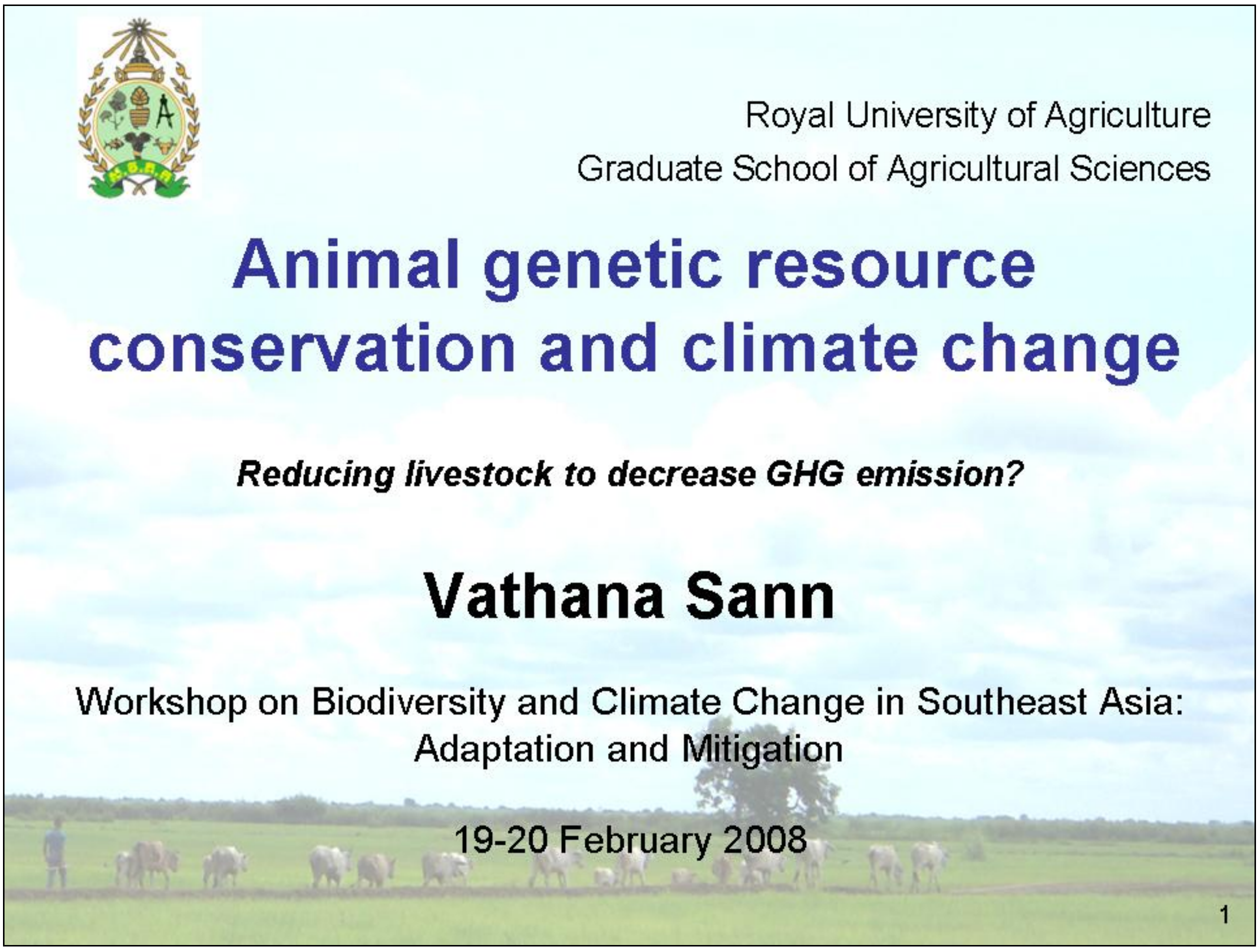
Dr. Vathana is the Coordinator of the MSc program at the Royal University of Agriculture in Cambodia. He holds a PhD in International Agriculture (major in Animal Science) from the Georg-August-University of Goettingen in Germany.

Dr. Vathana's research interest is on animal genetic resource conservation in current farming system.



Objectives of the presentation

- Identify the reason why local animal in the framework of indigenous animal genetic resource conservation is a subject of discussion in the context of climate change
- Describe how livestock production could influence global warming phenomenon
- Discuss the pathway of methane emission from cattle and possibility to reduce
- Assess the current situation of climate change in Cambodia in associated with agricultural sector
- Overview on the current involution of livestock production system

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Summary

- The continuous scheme of AGR conservation is its integration in the functionally farming activities
- CH_4 and CO_2 are the major GHG emitted from extensive livestock production system
- The change toward the intensive production system will threatening the existing AGR but alleviate GHG
- Different scenario to cope this dilemma must be addressed in the same time.

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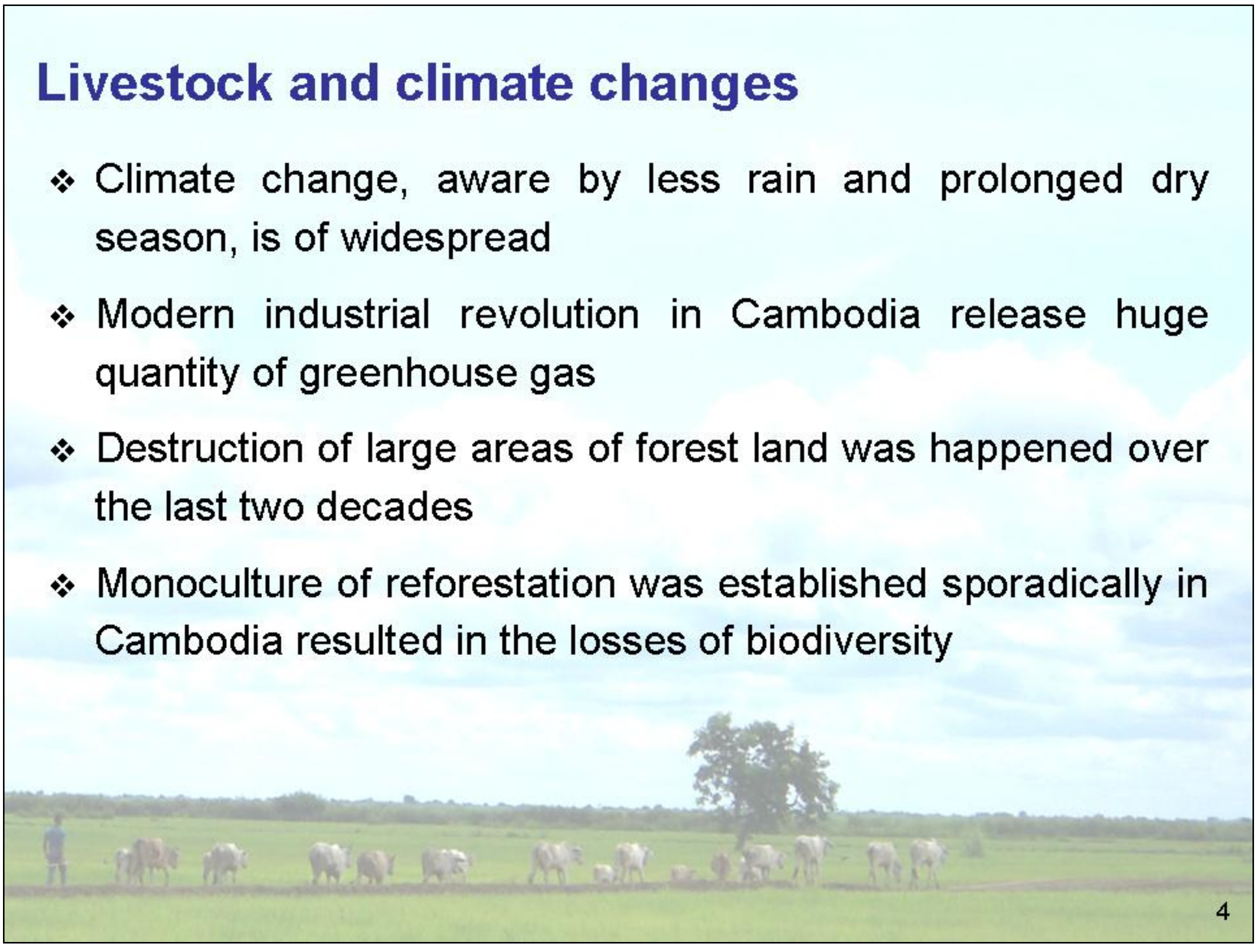
Livestock and climate changes
❖ Climate change, aware by less rain and prolonged dry season, is of widespread
❖ Modern industrial revolution in Cambodia release huge quantity of greenhouse gas
❖ Destruction of large areas of forest land was happened over the last two decades
❖ Monoculture of reforestation was established sporadically in Cambodia resulted in the losses of biodiversity
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Livestock and climate changes

- Agriculture is the most important sector of the Cambodian economy (GDP contribution and livelihood dependency)
- The GHG emissions from this sector come from various sub-sectors including domestic livestock production
- Livestock production play a victim role in production of CO_2 from deforested land
- The new accession of grass or plant species in the deforested land result in a new flux of C into the atmosphere
- The net CO_2 is assumed to be zero since it will be reabsorbed in the next growing season.

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Livestock and climate changes

- Methane is an important greenhouse gas, being related to agricultural sources including storage of livestock wastes
- Reduction in methane emission would be 20–60 fold more effective in reducing global warming than of CO_2 emission
- Livestock manure significantly contributes to global methane emissions,
  - an increase in the farm animal population
  - the use of manure

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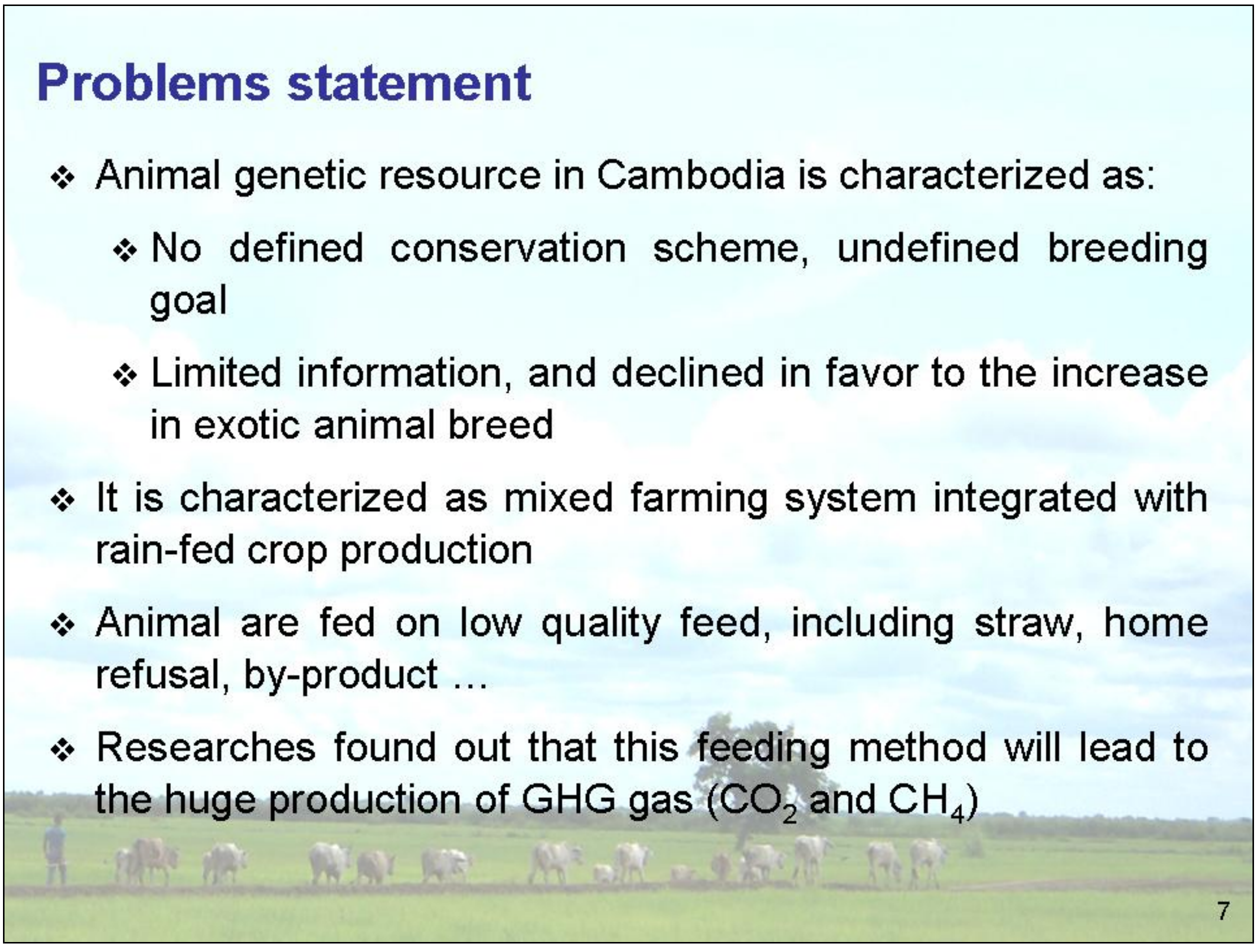
Problems statement
Animal genetic resource in Cambodia is characterized as:
No defined conservation scheme, undefined breeding goal
Limited information, and declined in favor to the increase in exotic animal breed
It is characterized as mixed farming system integrated with rain-fed crop production
Animal are fed on low quality feed, including straw, home refusal, by-product …
Researches found out that this feeding method will lead to the huge production of GHG gas (CO_2 and CH_4)
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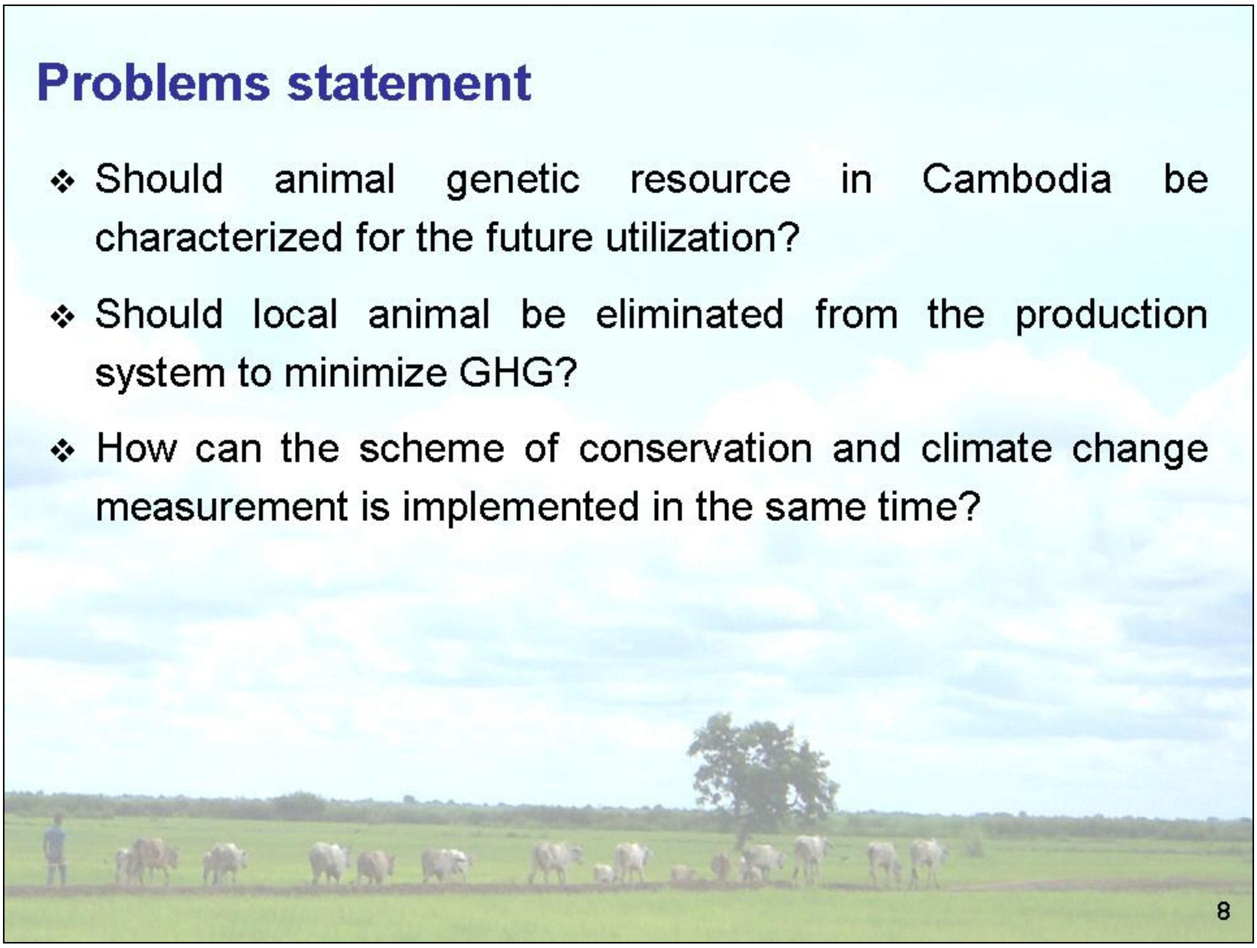
Problems statement
❖ Should animal genetic resource in Cambodia be characterized for the future utilization?
❖ Should local animal be eliminated from the production system to minimize GHG?
❖ How can the scheme of conservation and climate change measurement is implemented in the same time?
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Pathway of methane emission from Cattle

- Methane is a by-product of anaerobic fermentation in rumen, known as "hydrogen sink"
- Methane, nutritionally targeted to reduce from rumen fermentation due to its role in 4-10 % loss of energy intake
- Two major types of rumen fermentation: cellulolytic (acetic acid and its end-products) and amylolytic (propionic acid)

$$\text{Glucose} \xrightarrow{\text{amylolytic bacteria}} \text{2 Propionic acid}$$

$$\text{Glucose} \xrightarrow{\text{cellulolytic bacteria}} \text{2 Acetic acid} + CO_2 + CH_4$$

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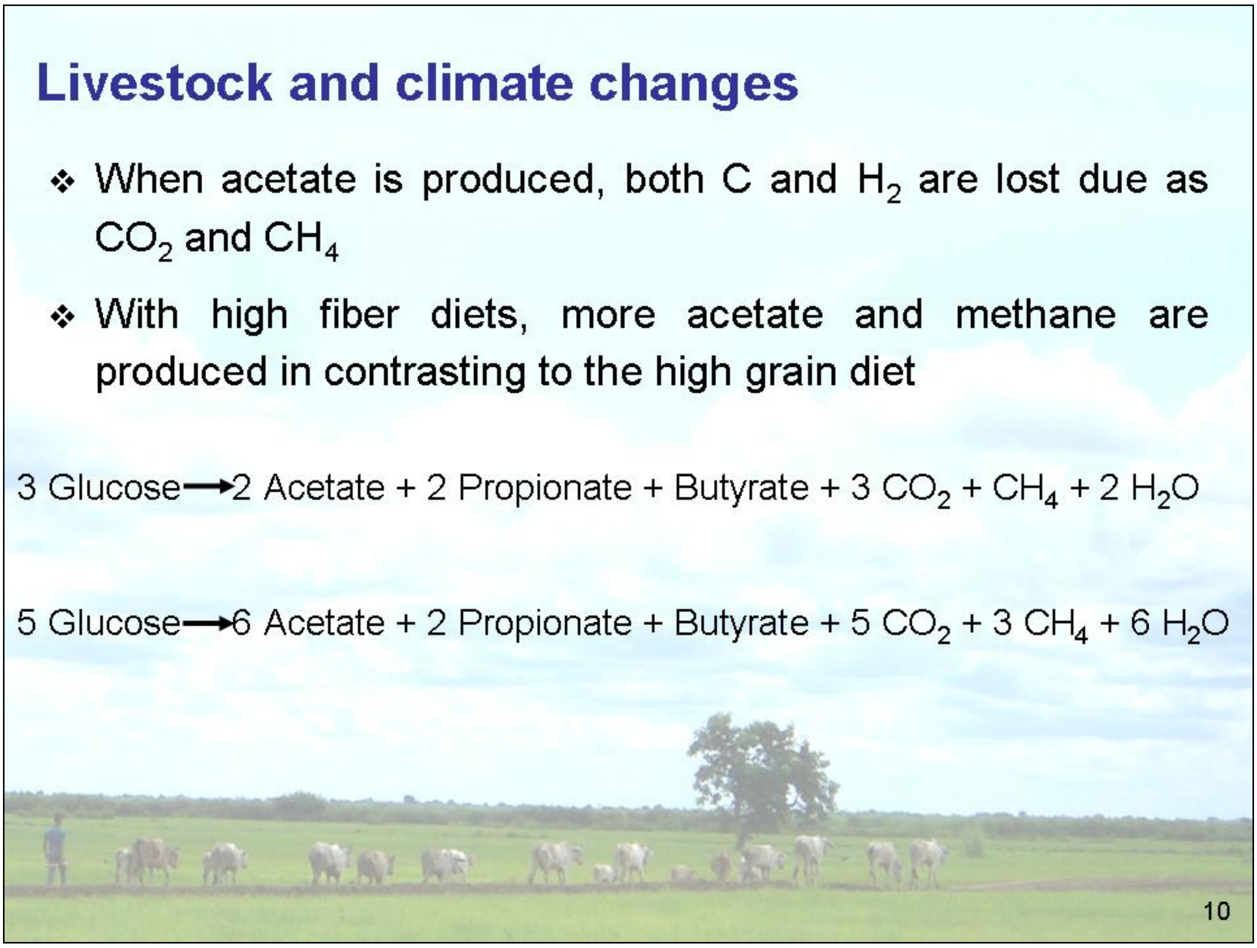
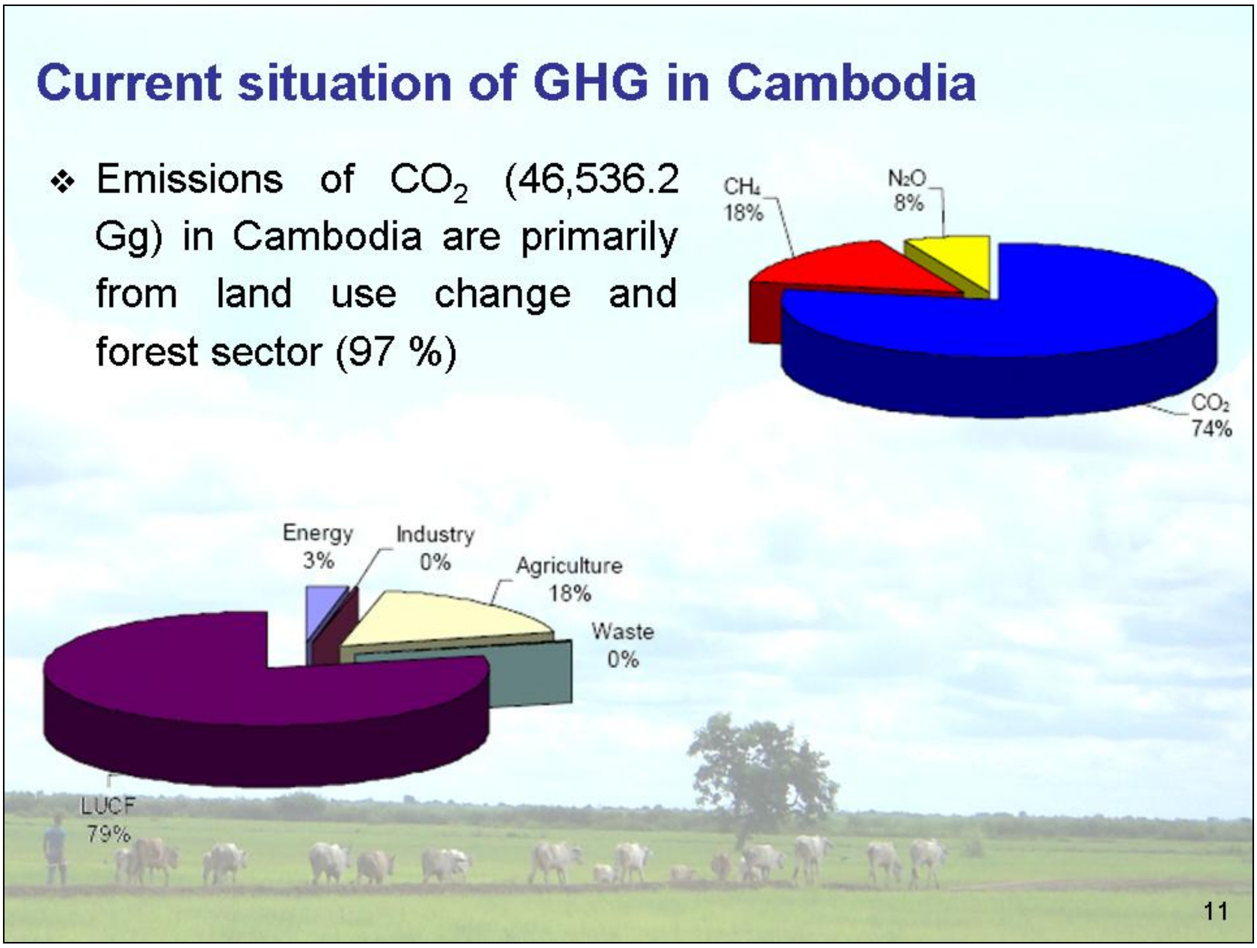

Livestock and climate changes
When acetate is produced, both C and H_2 are lost due as CO_2 and CH_4
With high fiber diets, more acetate and methane are produced in contrasting to the high grain diet
3 Glucose → 2 Acetate + 2 Propionate + Butyrate + 3 CO_2 + CH_4 + 2 H_2O
5 Glucose → 6 Acetate + 2 Propionate + Butyrate + 5 CO_2 + 3 CH_4 + 6 H_2O
10


Current situation of GHG in Cambodia
❖ Emissions of CO2 (46,536.2 Gg) in Cambodia are primarily from land use change and forest sector (97 %)
CH4
18%
N2O
8%
CO2
74%
Energy
3%
Industry
0%
Agriculture
18%
Waste
0%
LUCF
79%
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Current situation of GHG in Cambodia

	Emission type				CO_2	%
	CH_4	N_2O	NO_x	CO	equiv.	share
Domestic livestock	**184.8**	**3.9**			**5,084**	**48.1**
Rice cultivation		150.4			3,158	29.9
Grassland burning	2	0	0.9	51.9	49	0.5
Agr. residue burning	2.1	0.1	1.8	43.9	59	0.6
Agricultural soil		7.1			2,209	20.9
Total			**339.3**	**11.1**	**2.7**	**95.8**
Total CO_2 equiv.					**10,560**	**100**

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Current situation of GHG in Cambodia

Source	1994	2000	2010	2020
Energy	1,881 (2.8%)	2,622 (3.6%)	4,780 (5.9%)	8,761 (9.0%)
Industry	50	-	-	-
Agr.	**10,560 (15.5%)**	**12,030 (16.4%)**	**17,789 (22.1%)**	**26,821 (27.5%)**
Waste	273 (0.4%)	331 (0.4%)	425 (0.5%)	523 (0.5%)
LUCF	55,216 (81.2%)	58,379 (79.6%)	57,627 (71.5%)	61,512 (63.0%)
Total	**67,980**	**73,362**	**80,621**	**97,617**

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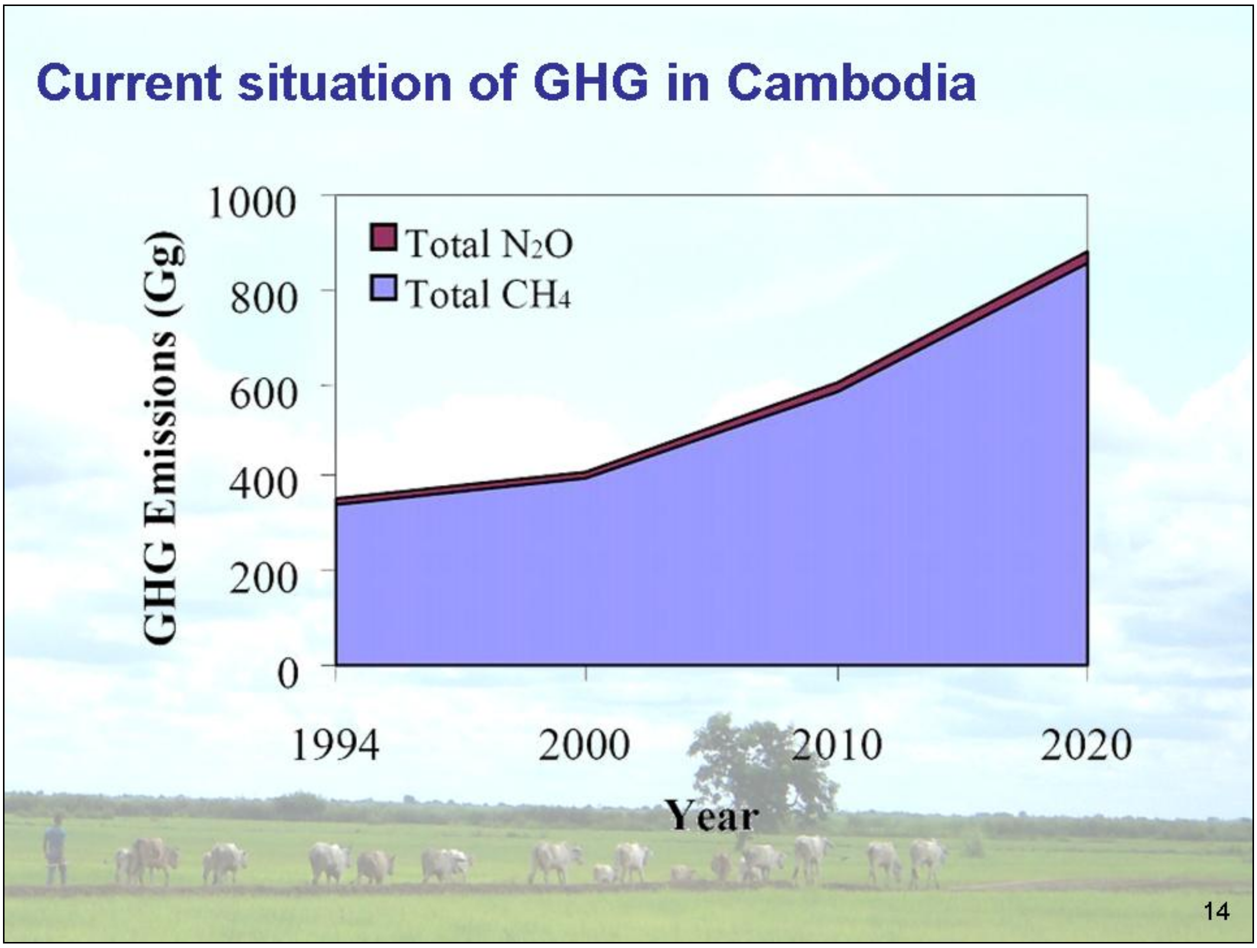
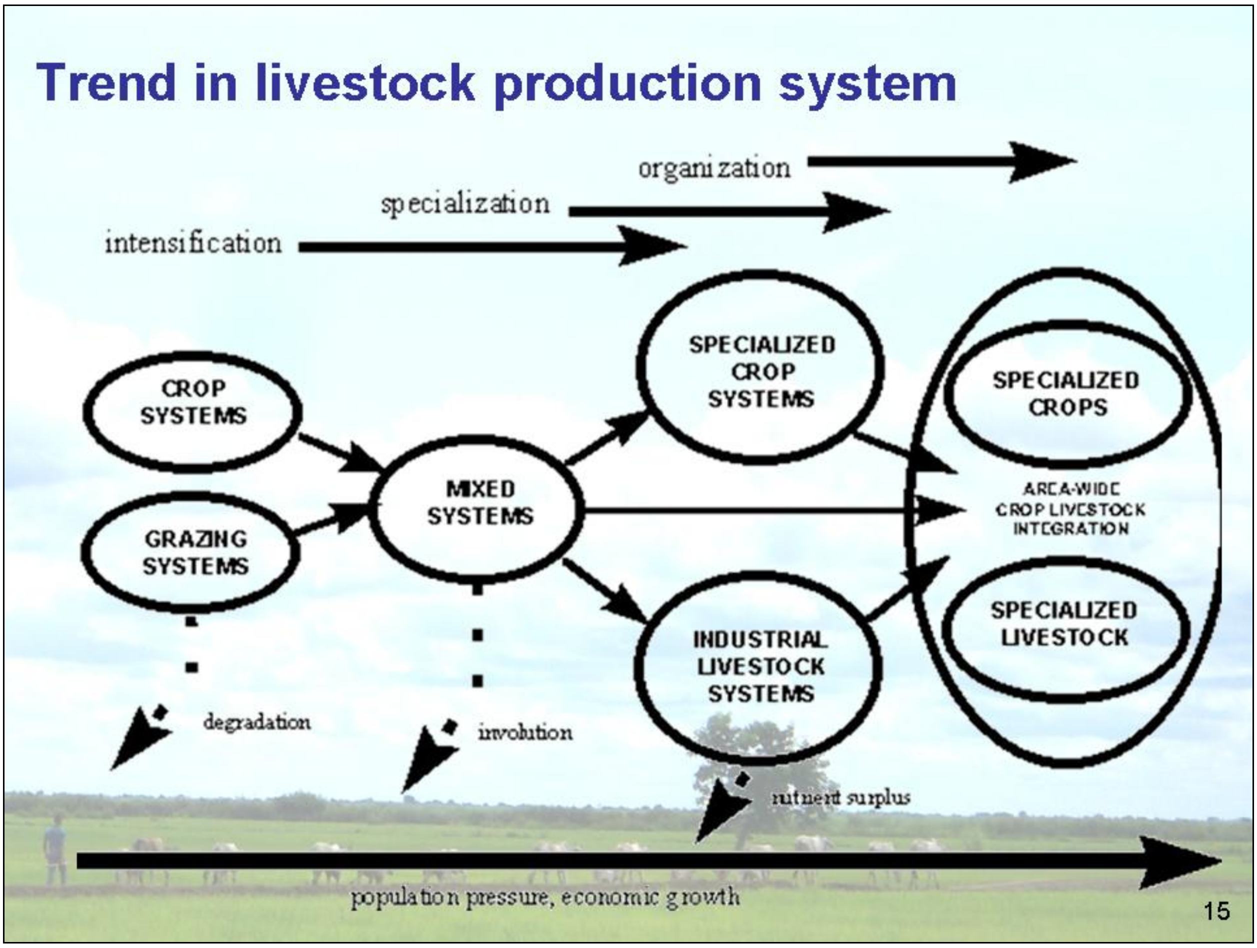
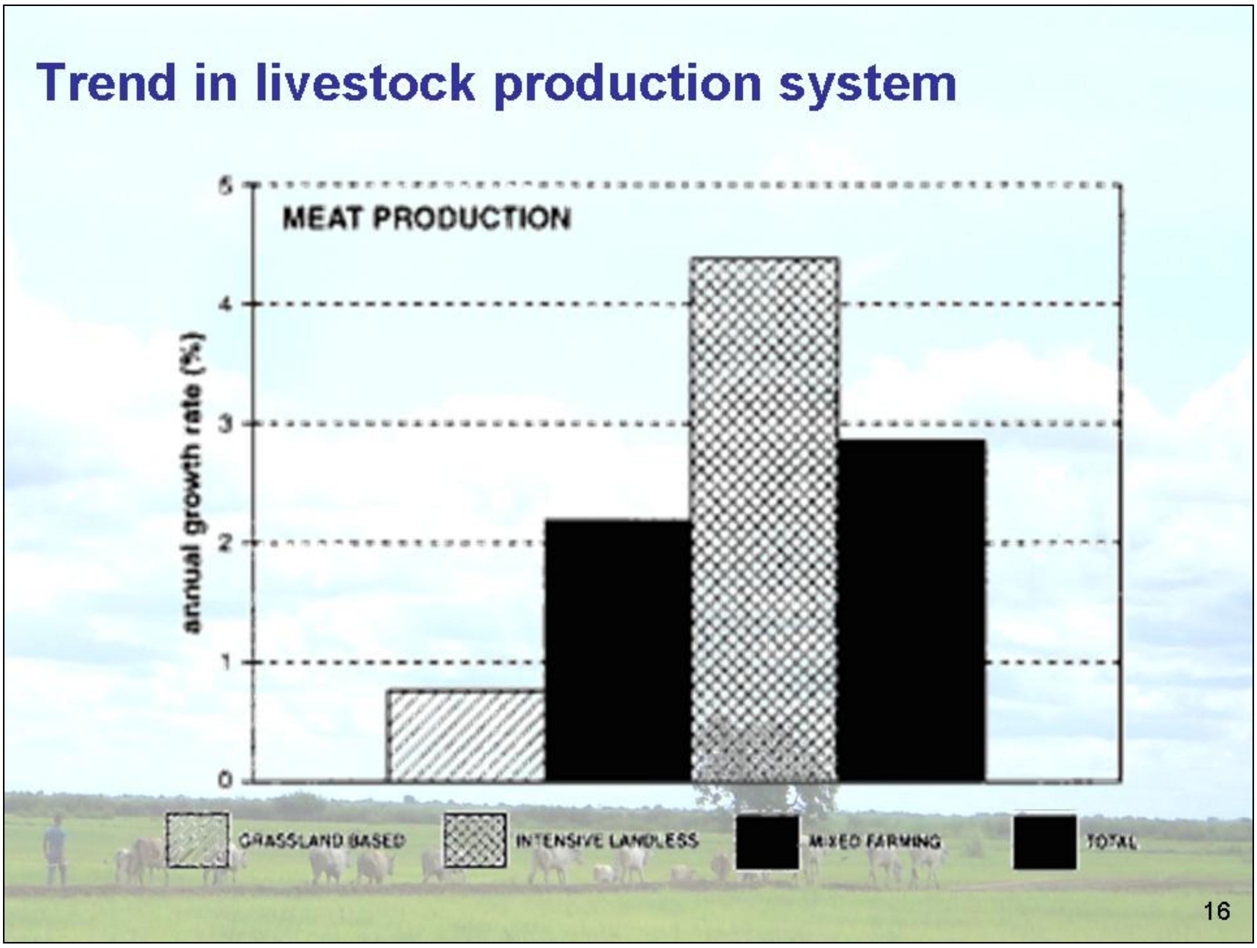
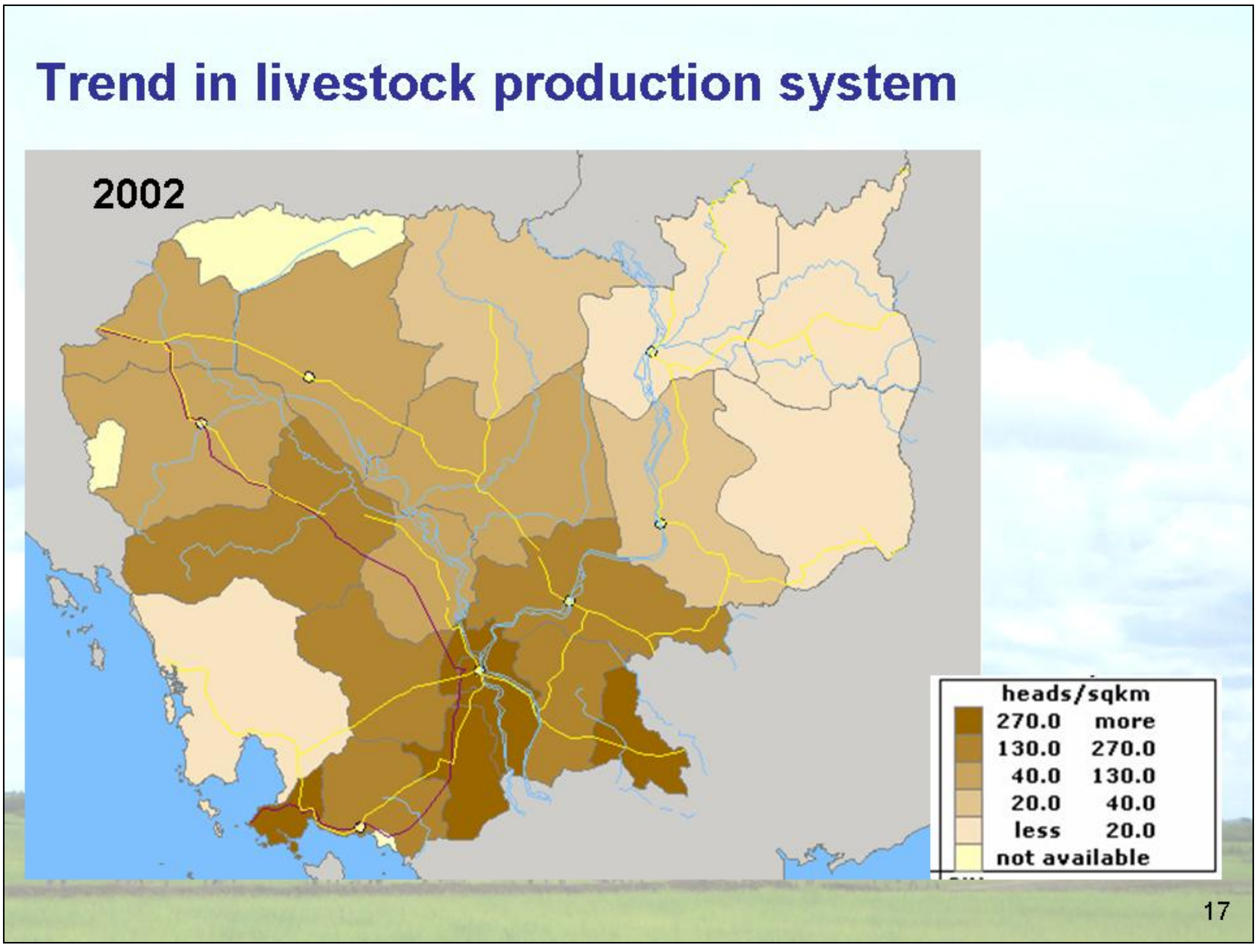
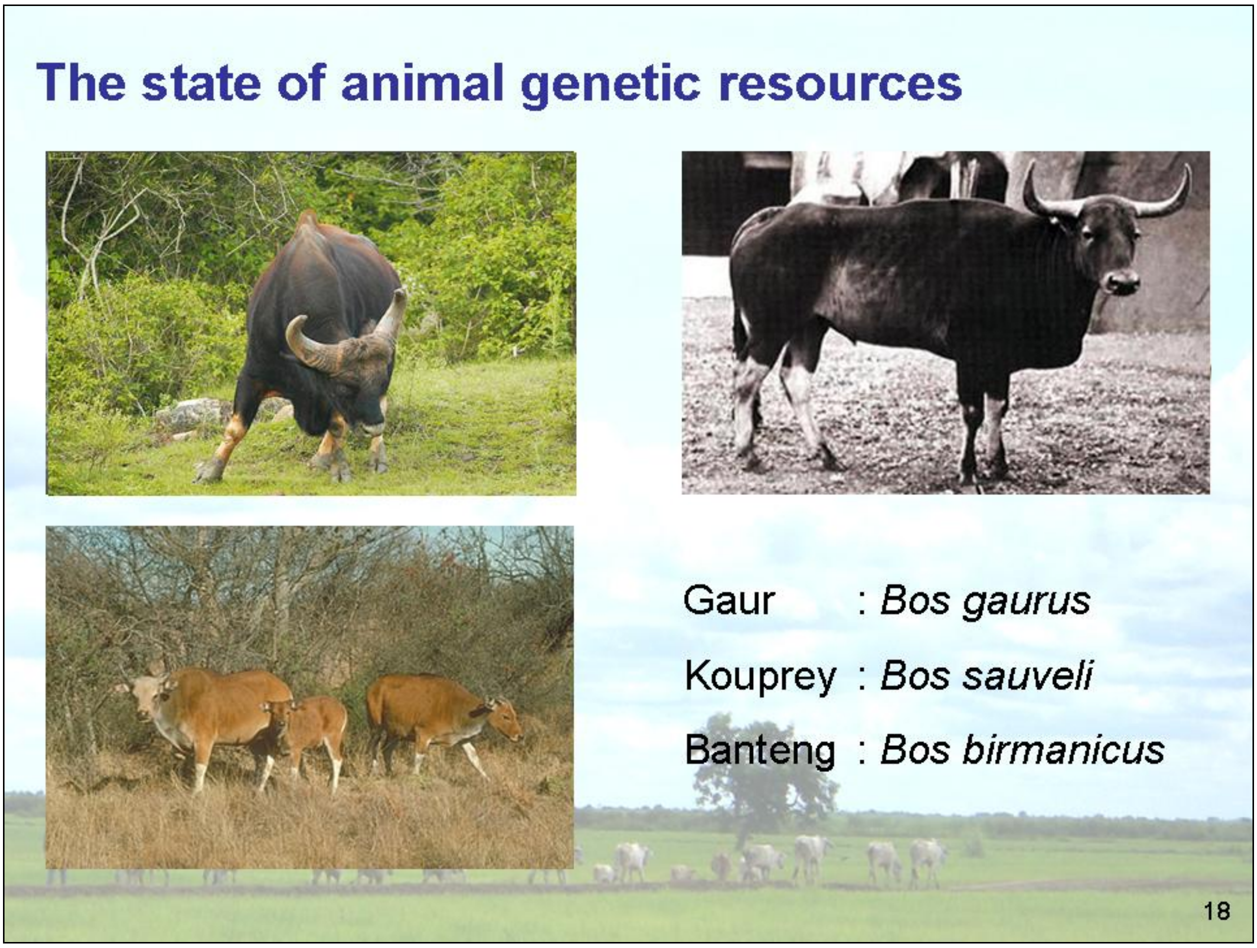

Current situation of GHG in Cambodia
1000
800
600
400
200
0
GHG Emissions (Gg)
Total N2O
Total CH4
1994
2000
2010
2020
Year
14


Trend in livestock production system
organization
specialization
intensification
CROP SYSTEMS
GRAZING SYSTEMS
MIXED SYSTEMS
SPECIALIZED CROP SYSTEMS
INDUSTRIAL LIVESTOCK SYSTEMS
SPECIALIZED CROPS
AREA-WIDE CROP LIVESTOCK INTEGRATION
SPECIALIZED LIVESTOCK
degradation
involution
nutrient surplus
population pressure, economic growth
15


Trend in livestock production system
MEAT PRODUCTION
annual growth rate (%)
0
1
2
3
4
5
GRASSLAND BASED
INTENSIVE LANDLESS
MIXED FARMING
TOTAL
16


Trend in livestock production system
2002
heads/sqkm
270.0 more
130.0 270.0
40.0 130.0
20.0 40.0
less 20.0
not available
17


The state of animal genetic resources
Gaur : Bos gaurus
Kouprey : Bos sauveli
Banteng : Bos birmanicus
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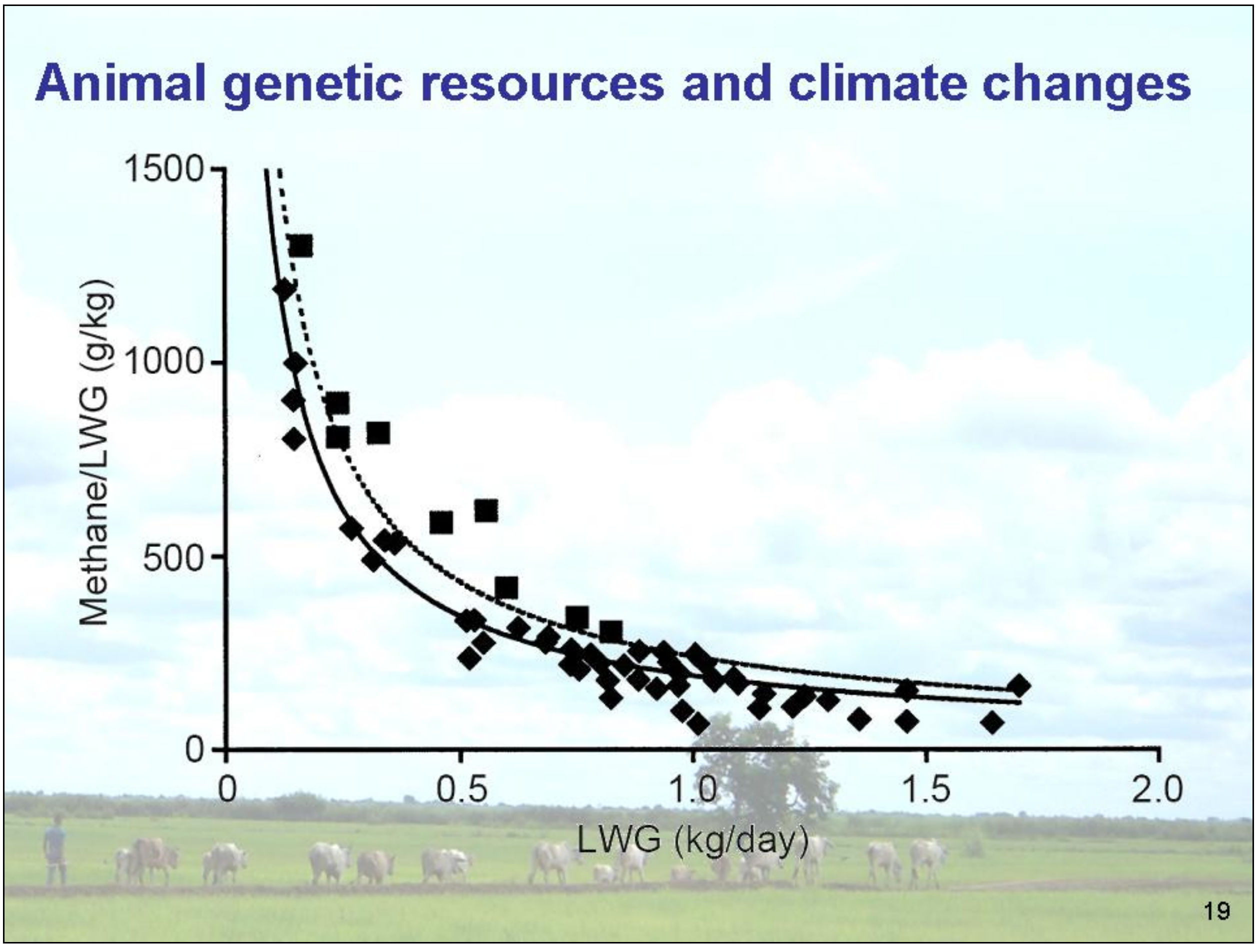
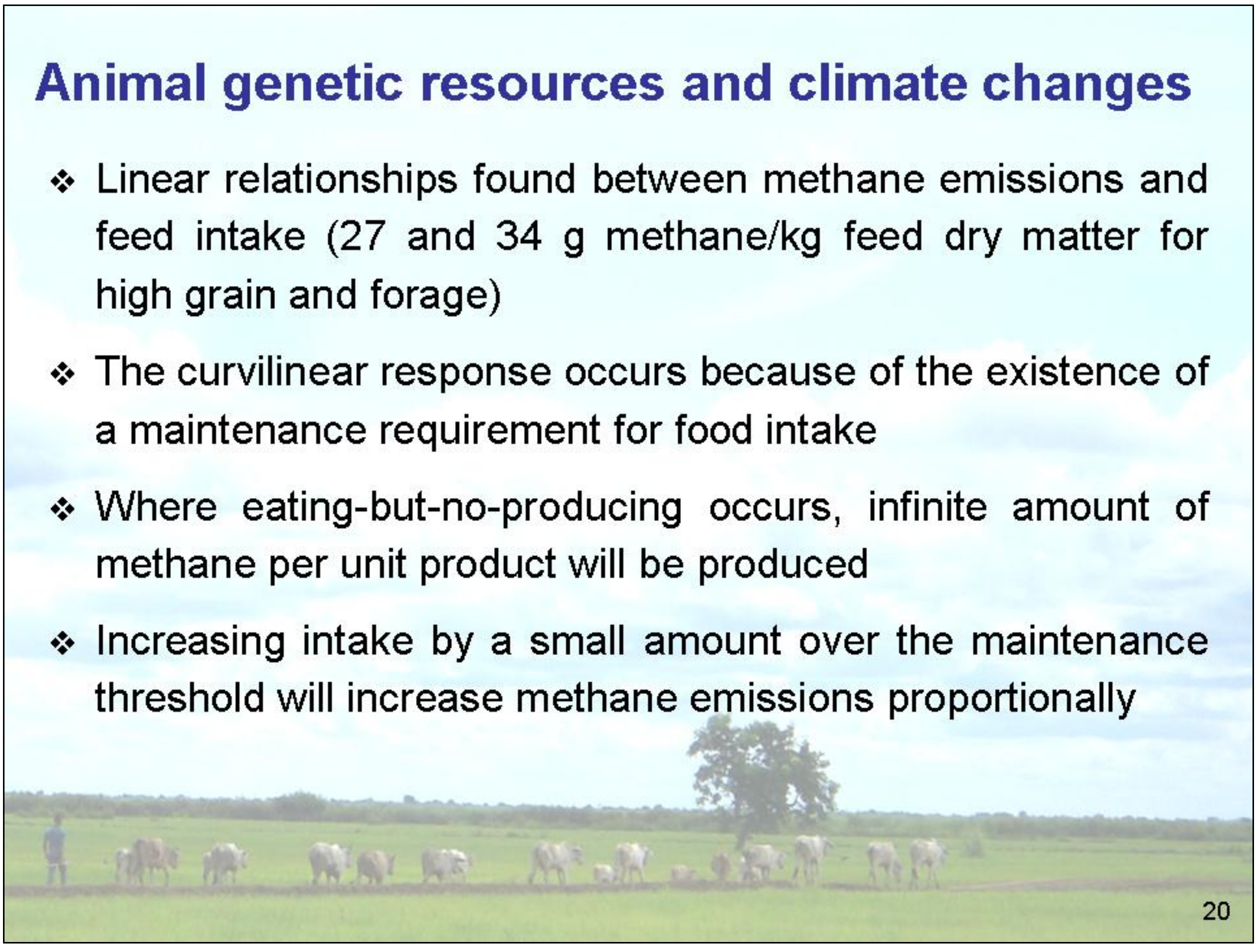


Animal genetic resources and climate changes
1500
1000
500
0
Methane/LWG (g/kg)
0
0.5
1.0
1.5
2.0
LWG (kg/day)
19


Animal genetic resources and climate changes
❖ Linear relationships found between methane emissions and feed intake (27 and 34 g methane/kg feed dry matter for high grain and forage)
❖ The curvilinear response occurs because of the existence of a maintenance requirement for food intake
❖ Where eating-but-no-producing occurs, infinite amount of methane per unit product will be produced
❖ Increasing intake by a small amount over the maintenance threshold will increase methane emissions proportionally
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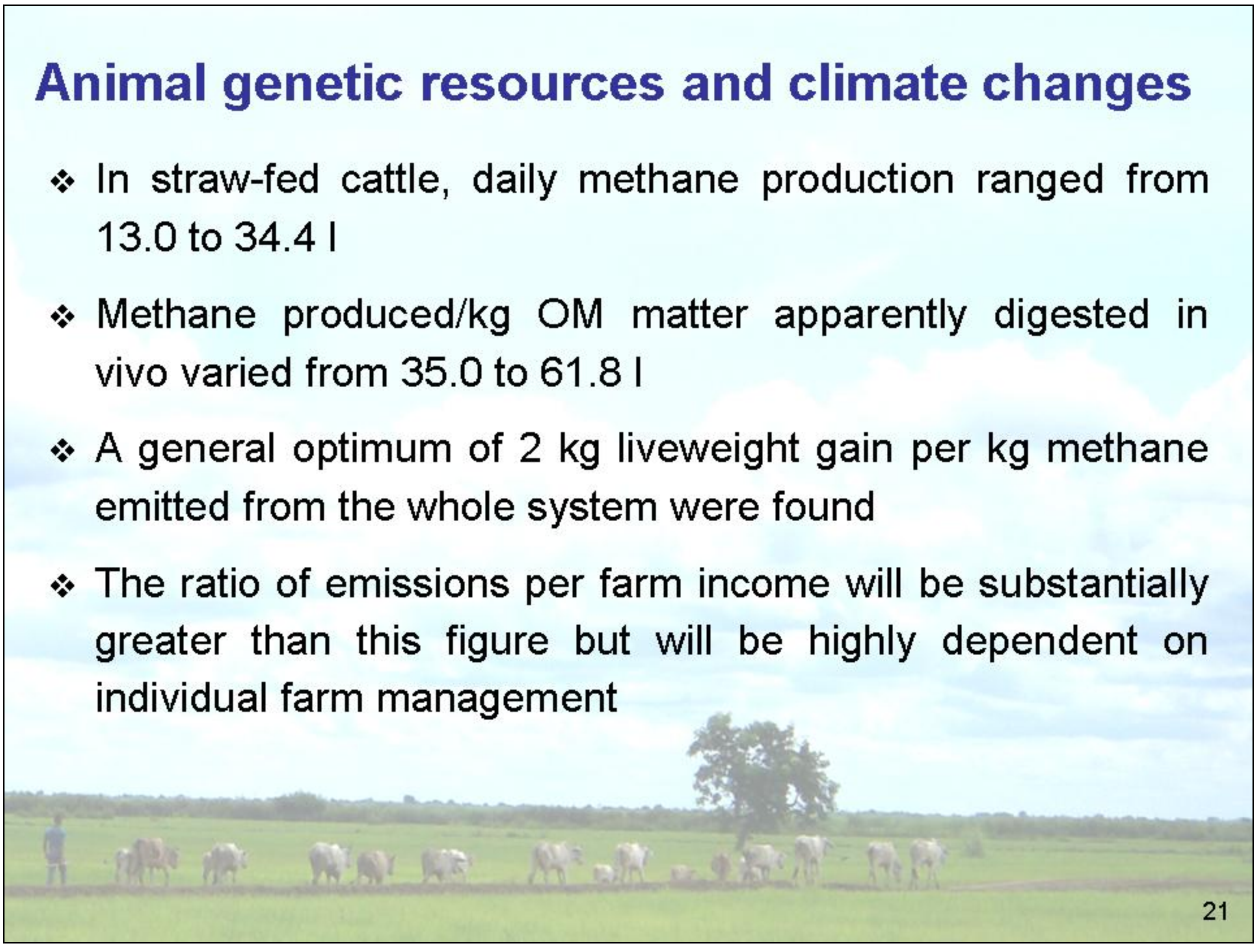
Animal genetic resources and climate changes
❖ In straw-fed cattle, daily methane production ranged from 13.0 to 34.4 l
❖ Methane produced/kg OM matter apparently digested in vivo varied from 35.0 to 61.8 l
❖ A general optimum of 2 kg liveweight gain per kg methane emitted from the whole system were found
❖ The ratio of emissions per farm income will be substantially greater than this figure but will be highly dependent on individual farm management
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Research implication

- The sustainable way to conserve AGR and climate change protection in the farm level is to ensure that AGR remain functional parts of production systems
- Scenarios should be defined in different approaches: short (farm), medium (national) and long term (international level)

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Research implication

- Present dietary situation result in inefficient rumen fermentation and maximization of methane production
- Wild ruminant and other herbivores are more efficient in methane production in comparing with domestic ruminant
- Modern intensive ruminant production with high energy diets and feed additives minimize methane generation
- Confinement systems using improved local feed resources (sugar cane, tree foliage) will be the alternative system
- The manure produced by livestock in the confinement can be more effectively managed and utilized in crop production

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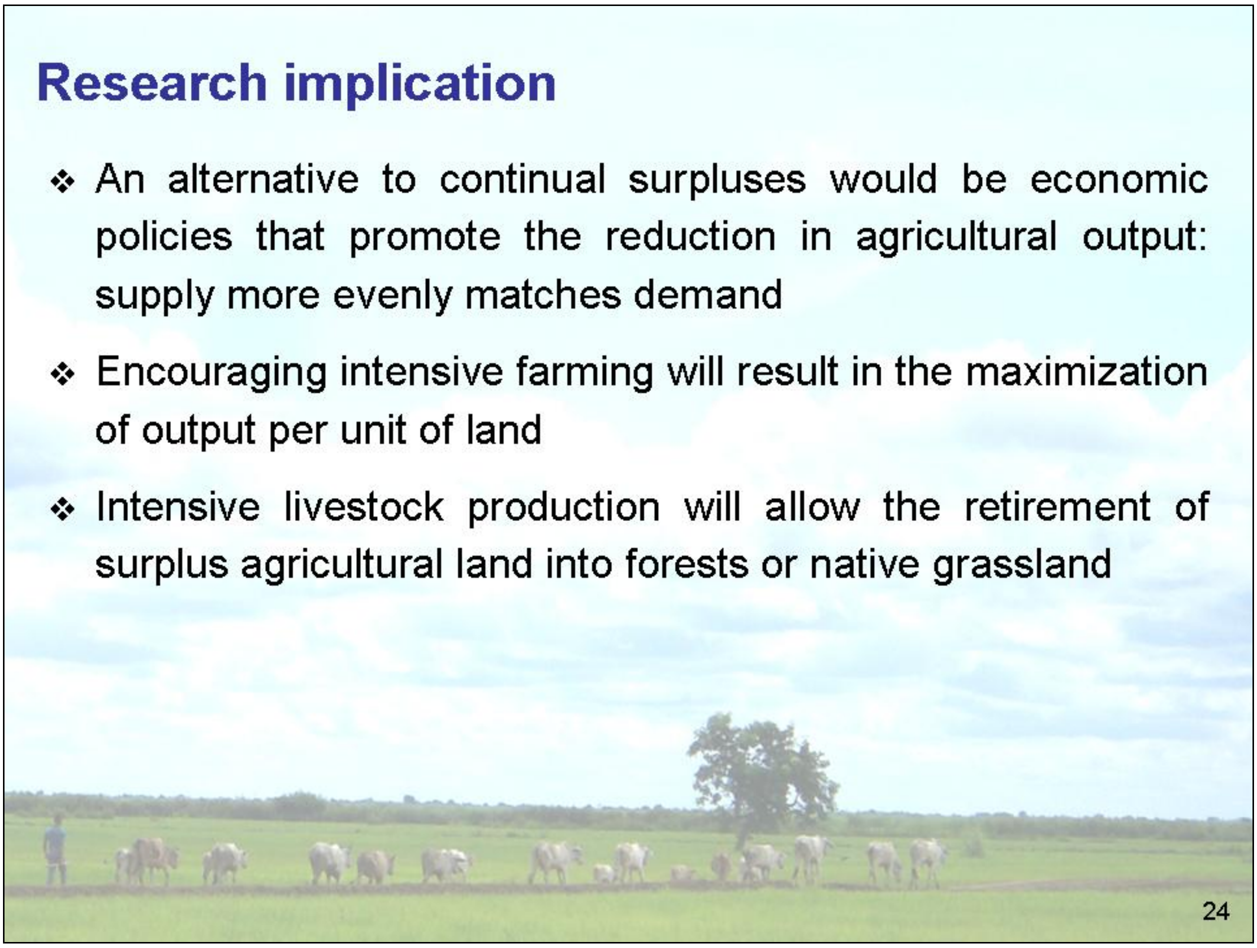
Research implication
An alternative to continual surpluses would be economic policies that promote the reduction in agricultural output: supply more evenly matches demand
Encouraging intensive farming will result in the maximization of output per unit of land
Intensive livestock production will allow the retirement of surplus agricultural land into forests or native grassland
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Criteria for the proposal development
❖ The identification of the role of indigenous breeds in:
❖ Land degradation and deforestation protection
❖ Involution of mixed farming
❖ Environmental pollution reduction
❖ Association with the "global warming" issue
❖ Areas to be included
❖ Tropical animal welfare and animal right
❖ Organic animal production
❖ Community-based management
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Take the risk, take the lead