Climate change, methane emission and livestock production- Indian perspective

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India Today…

17% of the world's population & 13% livestock and counting ----

4.2% of the world's water

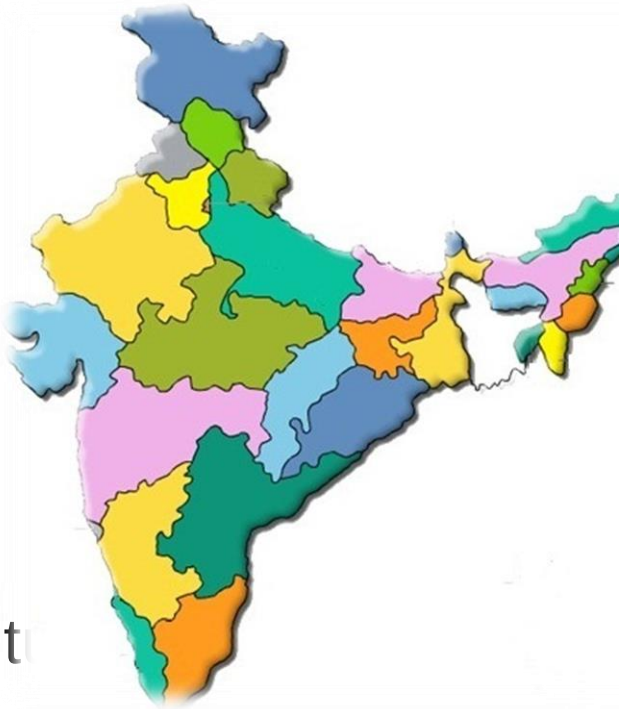
2.4% of the world's area

142 m ha cultivated & 55 m ha net irrigated

137 % cropping intensity

52 % of population earns livelihood in agricult

10.2% earning of total exports (~Rs. 86,000 crores)



India in World Food Basket

Commodity	Present Annual Production, mt	Rank in the World	Present Annual Growth Rate, %	Projected Annual Growth Rate, % (2020 – 21, on 7.3% GDP Growth)
Food grain	234	III	0.91	1.93
Sugar & Gur	23.8	II	1.36	1.91
Vegetables	126	II	4.68	2.11
Fresh Fruits	63.5	II	3.65	3.24
Milk & Milk Products	140	I	2.72	2.89
Meat	6.10	V	3.43	3.72
Eggs (billion)	**53.5**	**III**	**5.07**	**3.85**
Fish	7.13	III	2.68	4.25

Productivity Gains

Commodity	Productivity		
	1950	2014	Times
Food Grains, kg/ha	522	1898	3.6
Fruits, kg/ha	8600	13700	1.6
Vegetables, kg/ha	7500	15600	2.1
Fish, kg/ha (Aquaculture)	400	2700	6.8
Milk litre/lactation	583	1080	1.8
Eggs, No./bird	50	238	4.8

Food Demands (mt)

Commodity	Base year	Projection
	2004-05	2020-21
Cereals	192	262
Pulses	14.2	22.2
Food grains	207	284
Milk and milk products	91.0	151
Egg (number billion)	44.1	87.6
Meat	2.60	4.1
Fish	5.9	11.9
Oilseeds	35.5	68.6
Vegetables	90.6	159
Fresh fruits	52.9	96.5
Sugarcane	262	435

How important is livestock?

Indian Livestock

70 million dairy farmers

199 million (15 %) cattle and 105 million buffaloes (56%)

140 million goats (17 % : second after China)

72 million sheep

0.52 million camel

0.26 million mithun

0.08 million yaks

11.1 million pigs

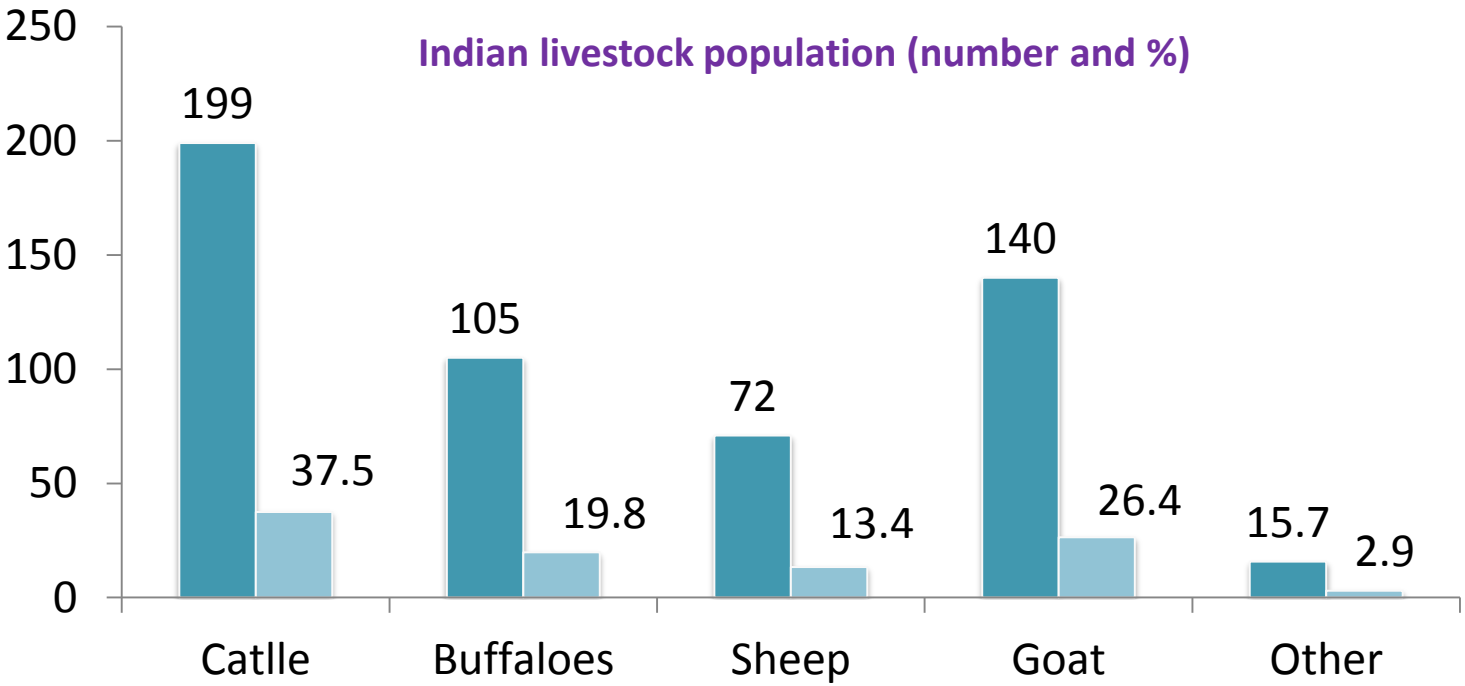
Gross Domestic Product livestock vis-a vis agriculture

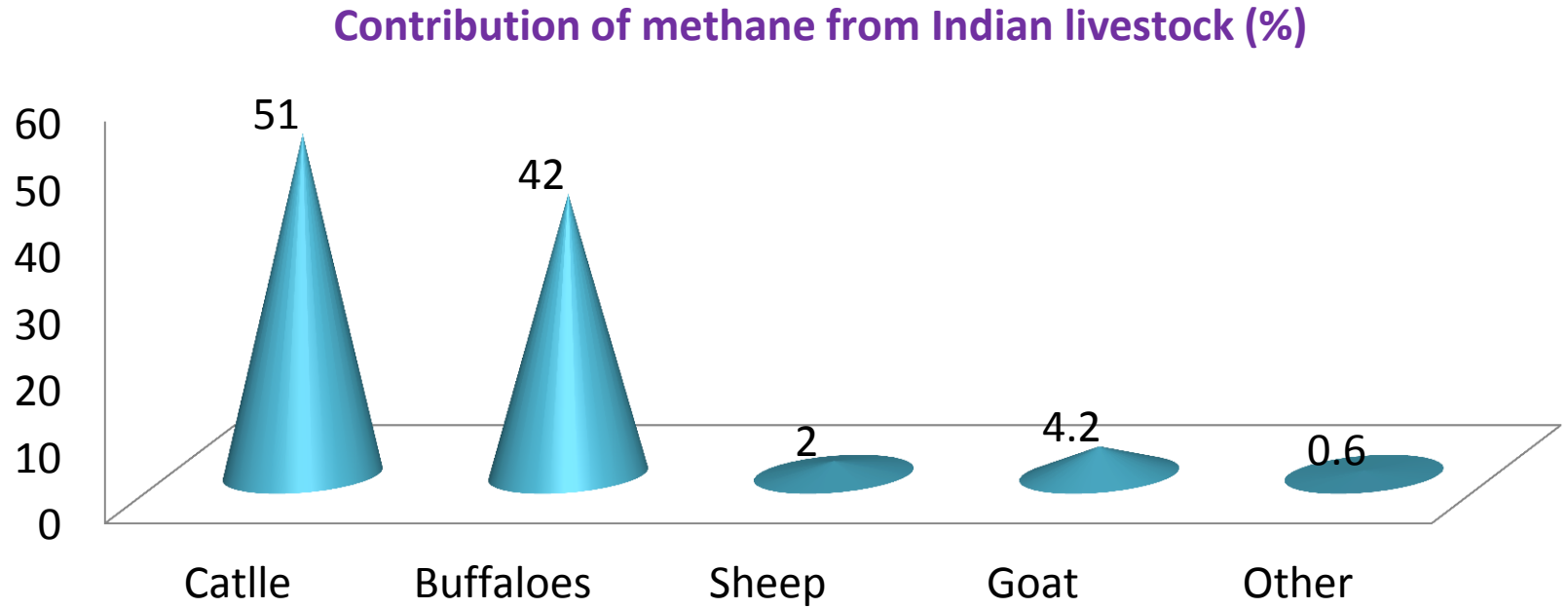
- Net Agriculture GDP (excluding livestock) : Rs. 5744 billion (93 billion US$)
- Livestock contribution : Rs. 1702 billion (29.6% of Agriculture GDP)
- Contribution of Livestock to National GDP : 3.26%

(DAHDF 2014)

What is the contribution of methane from Indian Livestock?

Approach for estimation	Methane emission (Tg)
Default methane emission factors	10.40
Using IPCC (1995) methodology	18.48
In vitro dry matter digestibility evaluation of feed resources in different regions	9.02
Emission estimates for enteric fermentation only and based on amount and quality of available feed resources	7.26-10.4
Country specific methane emission factors derived from Indian feed standards, IPCC energy equations and dry matter estimation	9.9
Dry matter intake approach under different agro-climatic regions	10.07
Country specific Indian feed standard –based methodology as a measure of gross energy intake and derived methane emission factors	9.00


Indian livestock population (number and %)
250
200
150
100
50
0
199
37.5
105
19.8
72
13.4
140
26.4
15.7
2.9
Catlle
Buffaloes
Sheep
Goat
Other


Contribution of methane from Indian livestock (%)
60
50
40
30
20
10
0
51
42
2
4.2
0.6
Catlle
Buffaloes
Sheep
Goat
Other

Livestock category-wise estimates of methane emission (Tg) from enteric fermentation based on different approaches

	Population	Enteric fermentation (Tg/yr)	Manure management (Tg/yr)	Total emissions (Tg/yr)	N2O emission (Gg/yr)	% contribution
Dairy cattle						
Indigenous	82.96	2.32	0.289	2.61	0.05	22.20
Crossbred	19.74	0.84	0.074	0.92	0.01	7.83
Total	102.70	3.17	0.363	3.54	0.06	**30.03**
Non-dairy cattle (I)	77.53	2.12	0.208	2.33	0.030	19.78
Non-dairy cattle (CB)	4.91	0.11	0.01	0.12	0.002	1.04
Dairy Buffaloes	80.03	4.06	0.371	4.441	-	**37.78**
Non-dairy buffaloes	17.88	0.44	0.055	0.490	-	4.17
Sheep	61.40	0.23	0.010	0.240	-	2.04
Goat	124.35	0.45	0.020	0.470	-	3.99
Horse/ Donkey	0.14	0.03	0.0003	0.033	-	0.28
Camel	0.63	0.03	0.001	0.031	-	0.26
Pig	13.52	0.01	0.060	0.070	0.10	0.59
Poultry	489.01	-	-	-	1.22	-
Total	485.00	10.65	1.09	11.75	1.42	-

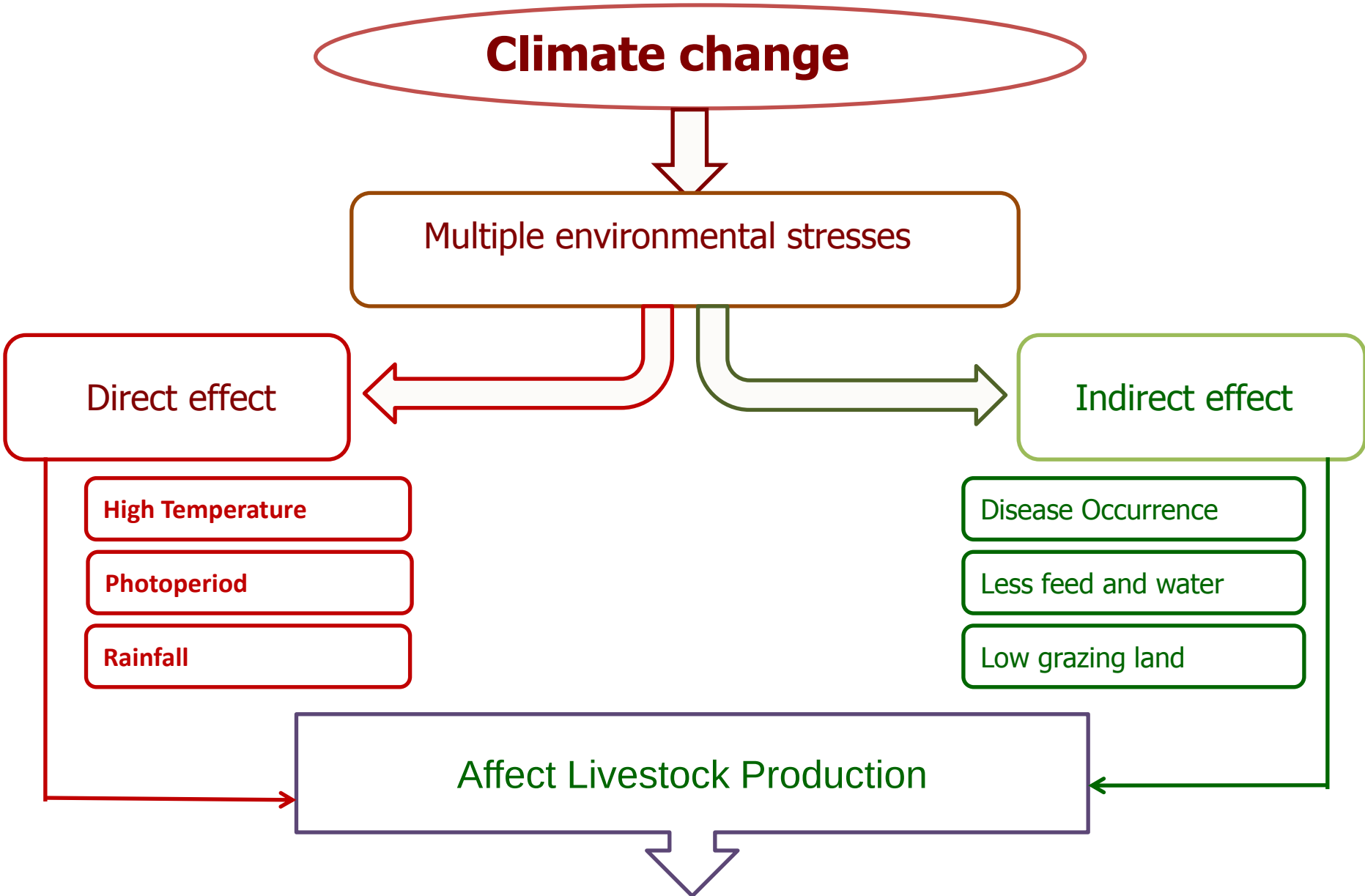
Climate Change and Livestock Production

Two way impact

Livestock contributes to climate change by emitting methane

Livestock getting affected by climate change

Impact of climate change on livestock production



Implications of climate change

Physiological effects on livestock

- Change in productivity pattern of livestock
- Decrease in quantity and quality of livestock products
- Increased weed and pest challenges, diseases
- Reduced GDP from Animal agriculture

Impact on Production

Decrease in milk production

either transitory or long term

depending on length and severity of heat stress

Decrease in reproductive performance

Decreased length and intensity of estrous period

Decreased conception rate

Increased risk of early embryonic losses

Decreased fetal growth and calf size

Economic loss due to climate change in dairy animals in India

- 2 % loss in total milk production
- Cash loss is estimated to a whopping Rs. 2,661 crores
- Uttar Pradesh - 25.4 million tons milk per year
- Tamil Nadu - 23.8 million tons per year
- Followed by Rajasthan, Bihar, Gujarat, Andhra Pradesh and Haryana

Challenges for livestock sector

- Decrease in production will cause fluctuation in market price of livestock products

- To determine what is the most suitable animal management for the changing climate?

  What are the most suitable breeds

Livestock adaptation strategies

Breeding strategies

- Identifying and strengthening local breeds
  - Adapted to local climatic stress and feed sources
  - Heat tolerant breeds
  - Disease tolerant breeds


6576

A 16 year old Vechur Cow with a six year old HF cross-bred cow.

- Benefits of temperature rise during cooler seasons will be less than that of negative impacts during hot and humid conditions

- Can we add value to the existing livestock based adaptation strategies?

- Climate change will affect landless and small farmers with less livestock holding

Challenges- Indian context

- Productivity as defined by developed world is not always applicable to Indian conditions

- Owning livestock is an indication of the socio-economic status of the owners (non-food product)

- Cattle and buffaloes are kept for religious and cultural reasons and thus economic productivity is not relevant

Many current research approaches taken by the developed countries to mitigate GHG from livestock are too sophisticated and of limited applications to the developing countries

eg. Feeding encapsulated formate

Emphasis must be given to search for practical solutions for the developing countries to effectively mitigate global emission of GHG from the livestock industry

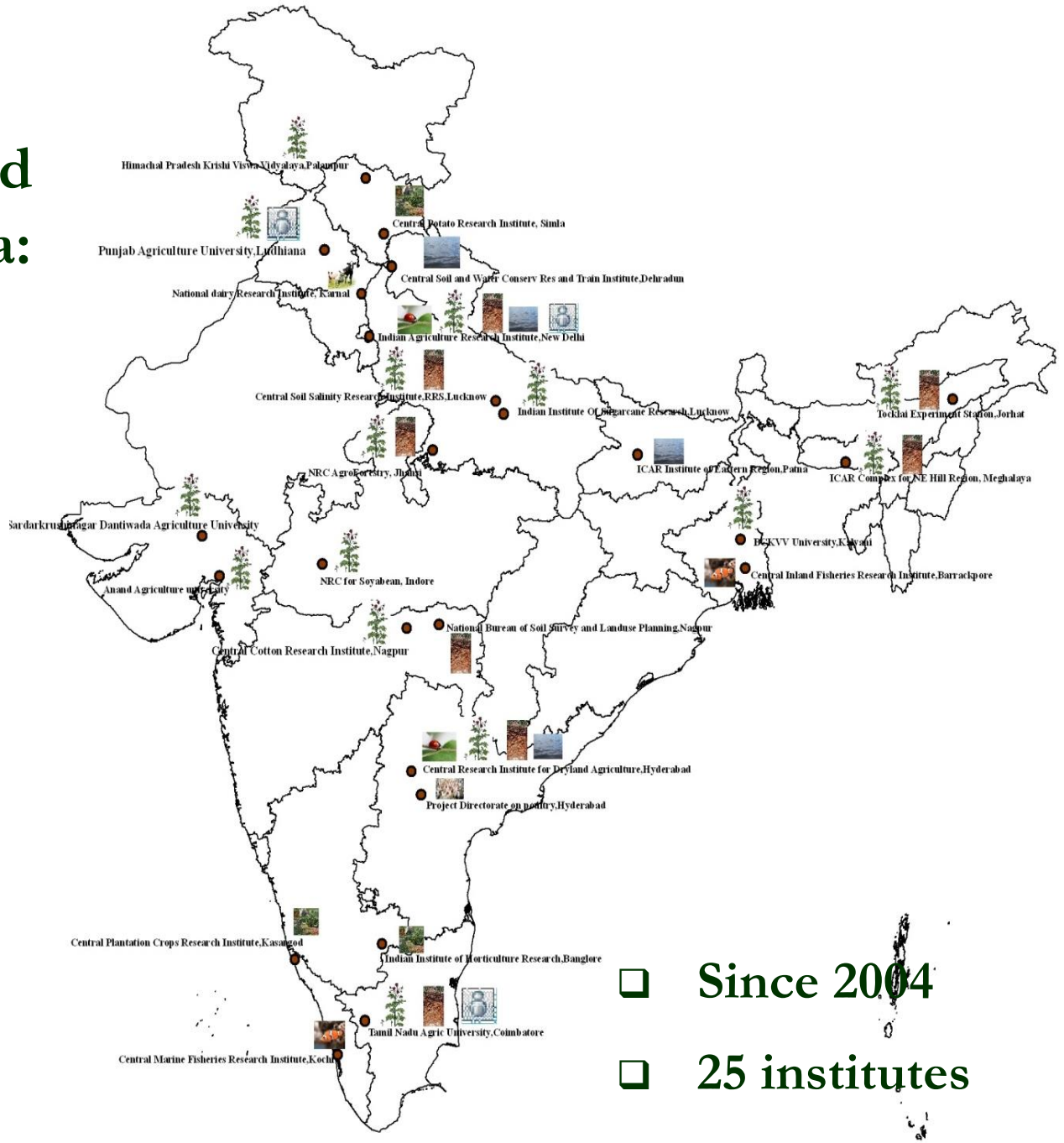
eg. Ration balancing techniques, use of tannin/ saponin

Research Network

NICRA
Climate Change and Agriculture in India:

LEGEND

- Horticulture
- Water
- Soil
- Crop
- Pest
- Livestock
- Poultry
- Socio-Economics



- Since 2004
- 25 institutes
- >100 scientists

Climate Resilient Agriculture Initiative

1.	Fund for supporting research proposals targeted for increasing resilience of agriculture to climatic risks	Rs 100 crores
2.	Assessment of regional impacts on crops, livestock, fisheries, pests, and microbes: Establishment of controlled environment facilities	Rs 20 crores
3.	Adaptation plans for major states for the projected climatic risks	Rs 10 crores
4.	Applications of short, medium and long range weather forecasts in agriculture for reducing production risks, including weather derivatives based insurance for climatic risks	Rs 10 crores
5.	Robust pests and disease forecasting and surveillance system based on ground monitoring, simulation models and remote sensing	Rs 20 crores
6.	Characterizing germplasm for climatic stress tolerance, and strengthen breeding programmes to develop varieties adapted to climate change	Rs 10 crores
7.	Critical evaluation of various options for greenhouse gas mitigation potential, costs involved, and trade-offs with production	Rs 20 crores
8.	Science-based agricultural intelligence system for commodities of national interest using crop models, remote sensing and other relevant inputs	Rs 20 crores

Adapting to long-term changes

- Develop genotypes with greater tolerance to **multiple abiotic stresses** (drought/flood/salinity/heat)
- Greater characterization of germplasm and use of biotechnological tools for productivity enhancement
- Explore microbial world for genes for **adaptation to high temperature**
- Develop a long-term land use plan for ensuring food security and climatic resilience
- Develop mitigation strategies for reducing methanogenesis in livestock

- Shelter management studies for different species of livestock (**Collaborative mode**)
- Allele mining for biotic stress and development of biochemical markers like HSP (**Basic research**)
- Development of data base on animal response to different THI (**collaborative mode**)

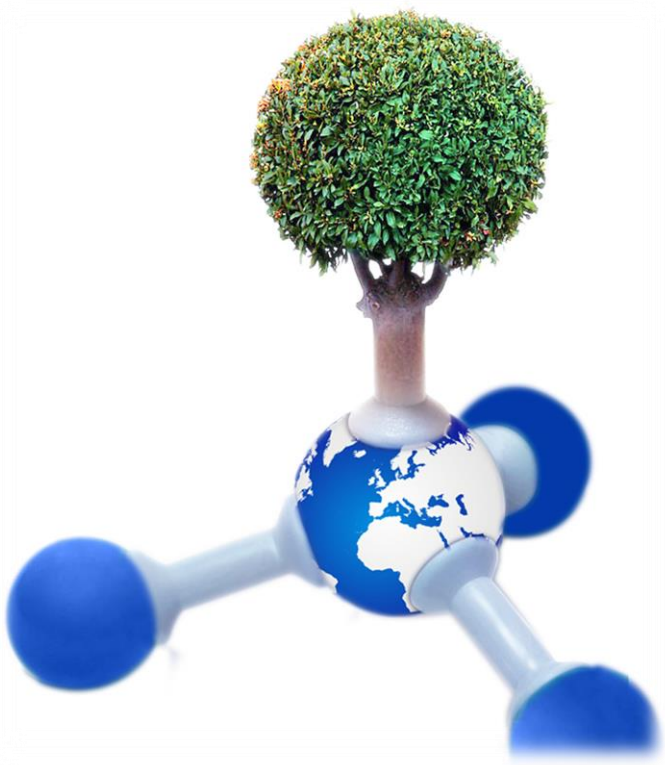
Estimation of methane emission under different feeding systems and Development of mitigation strategies

XI –XII Plan 2007-2012-2017

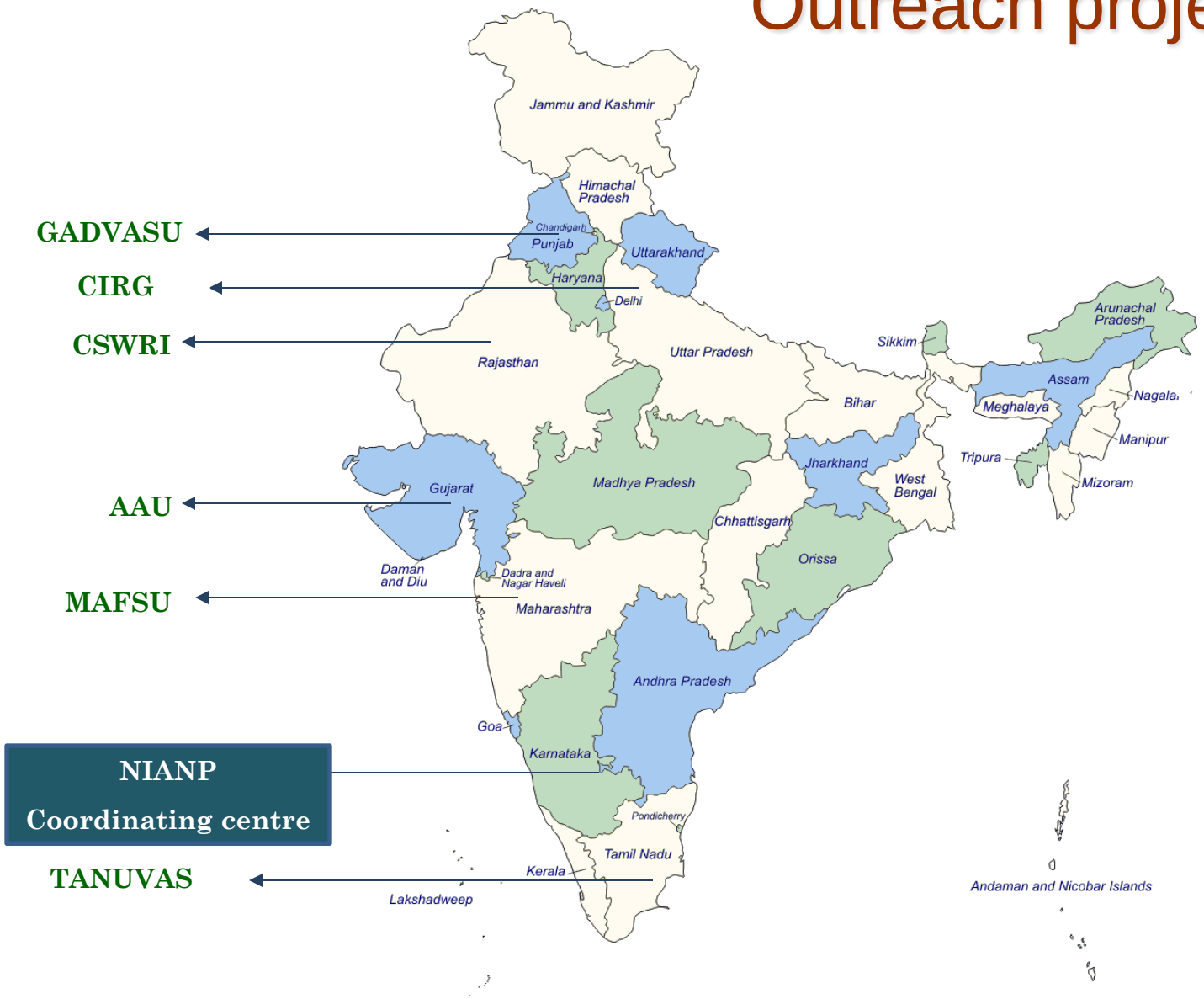
(started in March 2009)

Number of centres 7

Total Budget 600 + 449.52 lakhs



Outreach project centres



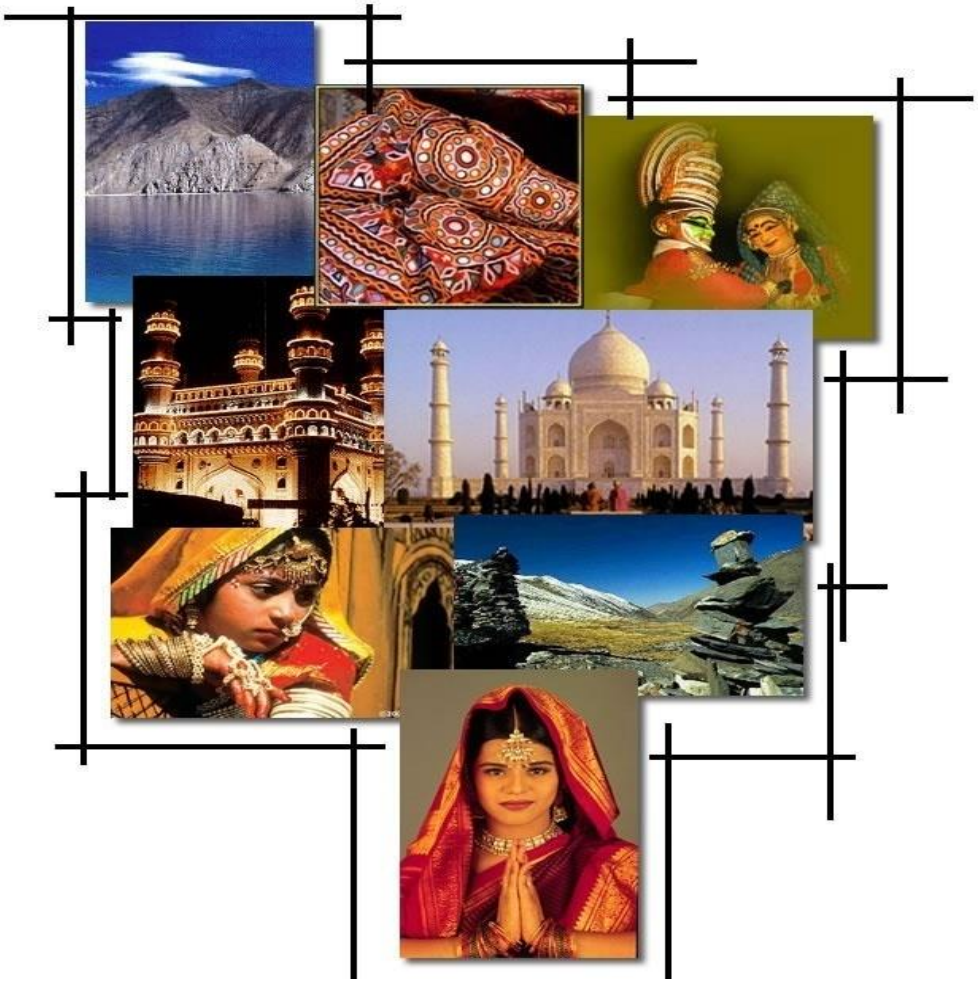
Centre wise details

Name of the centre	Species to be working with	Basal diet	Approach for methane amelioration
NIANP Bangalore	Crossbred cattle 	Ragi (finger millet) straw based diets	Plant secondary metabolites
CSWRI Avikanagar	Sheep 	Grazing resources	Supplementation of limiting nutrients
CIRG Makhdoom	Goat 	Browsing resources	Supplementation of limiting nutrients

Name of the centre	Species to be working with	Basal diet	Approach for methane amelioration
TANUVAS Chennai	Indigenous cattle 	Paddy straw based diets	Feed additives
MAFSU Akola	Buffalo 	Coarse cereal straw (sorghum) based diets	Complete feed blocks
GADVASU Ludhiana	Buffalo/ crossbred cattle  	Wheat straw based diets	Secondary plant metabolites
AAU Anand	Buffalo/ crossbred cattle  	Pulse straw based diets	Total mixed ration/complete feed blocks

OBJECTIVES

- To assess the methane emission from livestock under different production systems
- To develop a database on methane production from livestock
- To develop nutritional/biotechnological strategies to mitigate methane production



Thank You

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