Global Climate Change and Livestock Production
Culprit or Victim?

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Livestock Ecology Section
Prof. Dr. sc. agr. H. J. Schwartz

Global Climate Change and Livestock production: Relevance, Consequences & Perspectives

Why do we keep livestock?

Does livestock production contribute to climate change?

Is livestock production a victim of climate change?

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Main functions of livestock production for society

Food security

Services

Income generation

Numbers and biomass of domestic animals and humans

Species	Numbers (million)	Biomass (million t)
Cattle & Buffalo	1 480	740
Sheep	1 065	40
Goats	780	27
Equines	118	42
Camelids	24	8.5
Pigs	936	122
Poultry	14 711	15
Total		**994.5**
Humans	**6 800**	**374**

Main functions of the environment (nature) for livestock production

Production base

Production reserve

Emission depository

Global Climate Change

Is the contribution by “ruminant” livestock substantial?

YES

Inputs

large quantity of low nutrient density
plant materials
&
water

intake by ruminant

The ruminant as a production system

RUMEN

anaerobic fermentation

animal metabolism
reproduction
growth
activity

Heat losses
Material losses
Indirect losses

small
quantity

High nutrient density foods
Non-food products
Services

Outputs

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Climate affecting emissions from livestock production

Gaseous emissions

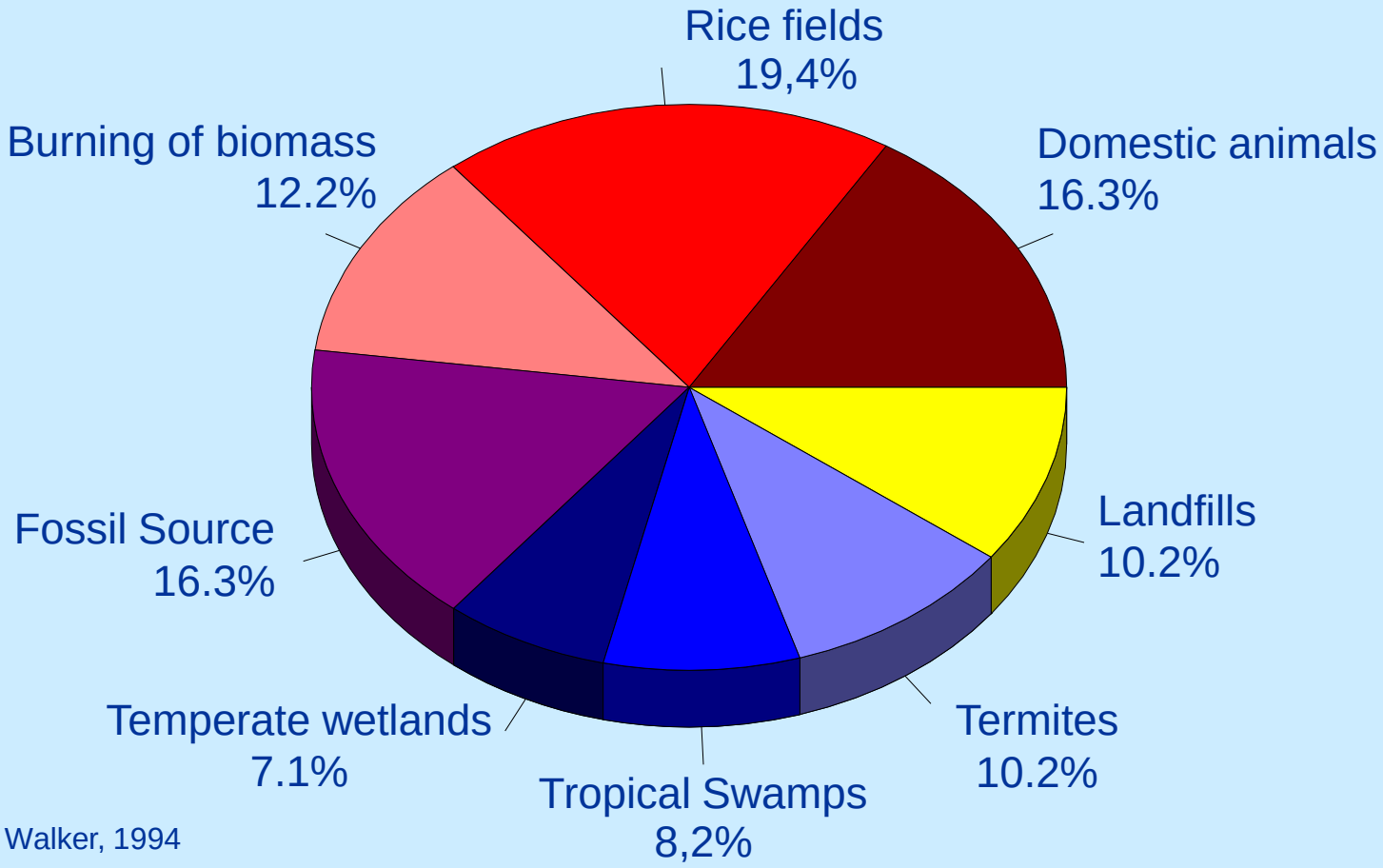
- CO_2, carbon-dioxide
- CH_4, methane
- NH_3, ammonia & nitrous oxides
- Sulphur compounds

Dust

Ash

Soot particles

Proportion of various sources in the global methane emission



Source: Walker, 1994

Climate affecting emissions out of livestock originate from:

Primary production: Carbon-dioxide, Methane, Nitrous Oxide

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Secondary Production: Carbon-dioxide, Methane, Ammonia, Sulphur Compounds, Dust

Annual methane losses from a model livestock production system: dairy farming in S.W. England

(102 cows, 110 others, stall feeding of silage and concentrate)

type of loss	total emission kg CH_4 - C $year^{-1}$
losses from ruminants	6775
losses from stored wastes	2285
losses from silage effluent	2596
losses from dirty water	332
total losses	11988

Source: after Jarvis & Pain, 1994

Cultivation of Virgin Land: Carbon Dioxide, Methane, Nitrous Oxides, Ozone, Ash, Black Soot

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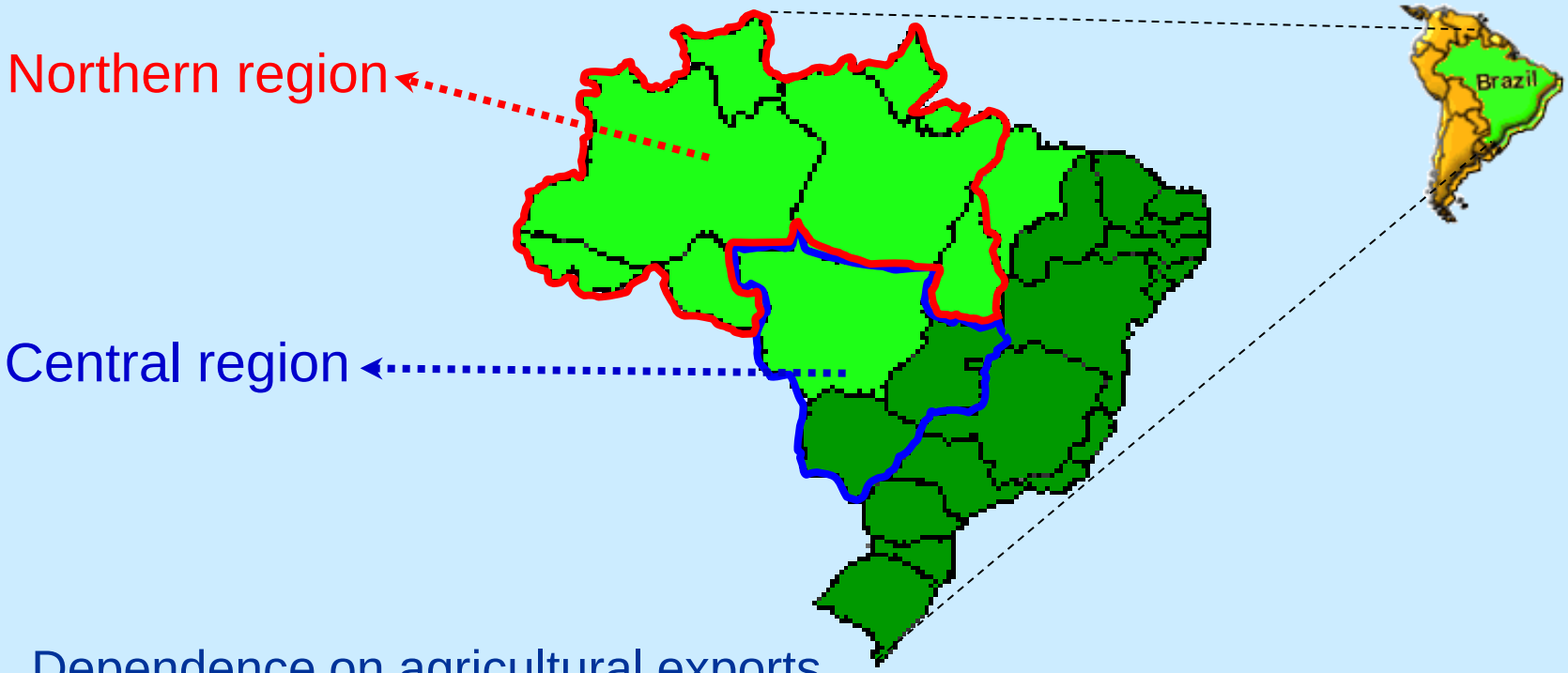
Agricultural expansion in Brazil

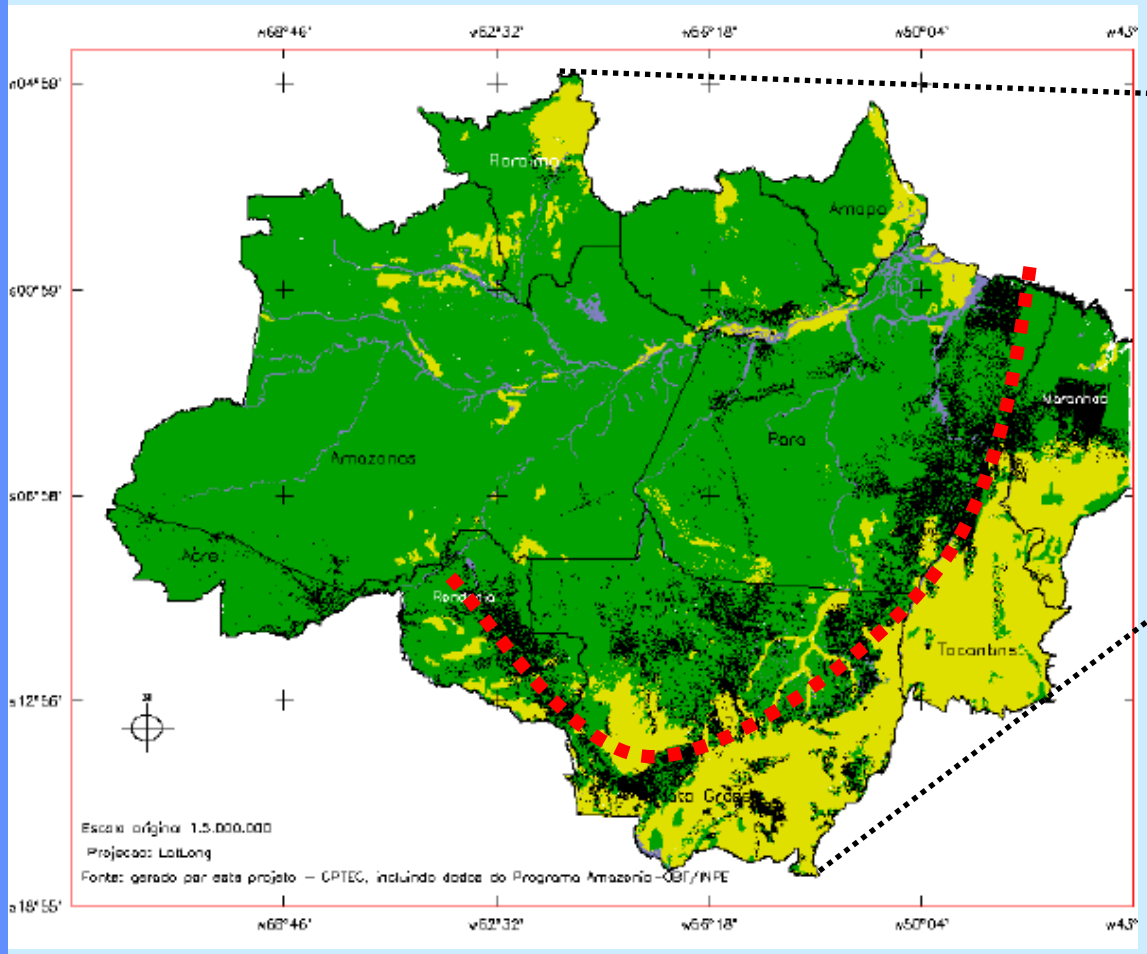


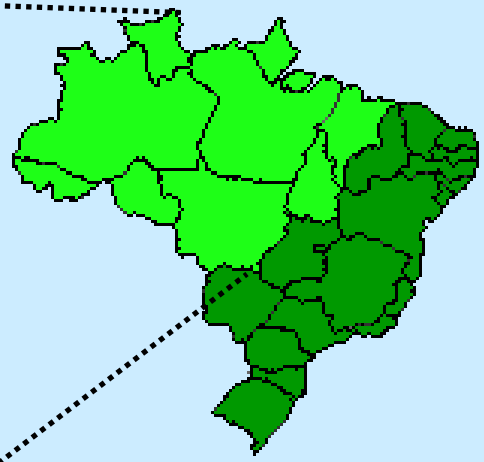
Dependence on agricultural exports

Beef exports are fastest growing commodity

Herd growth concentrated in Central and Northern Brazil

Source: D. Bungenstab, 2004





Deforestation:
20000 km² • yr^{-1}
50 to 60% for cattle ranching

Rainforest Cerrado Deforestation

Source: D. Bungenstab, 2004

Burning of Agricultural Biomass: Carbon Dioxide, Methane, Nitrous Oxides, Ozone, Ash, Black Soot

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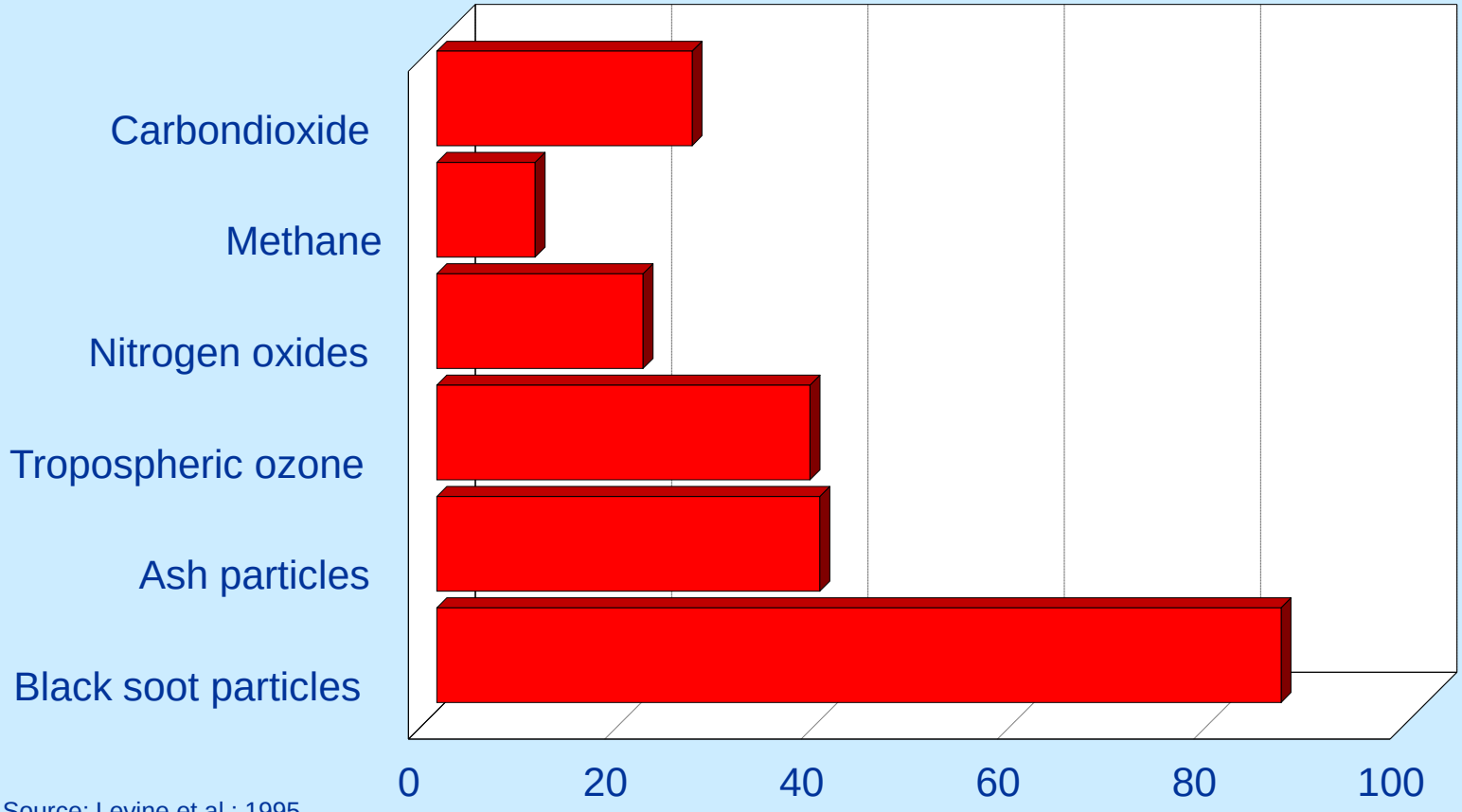
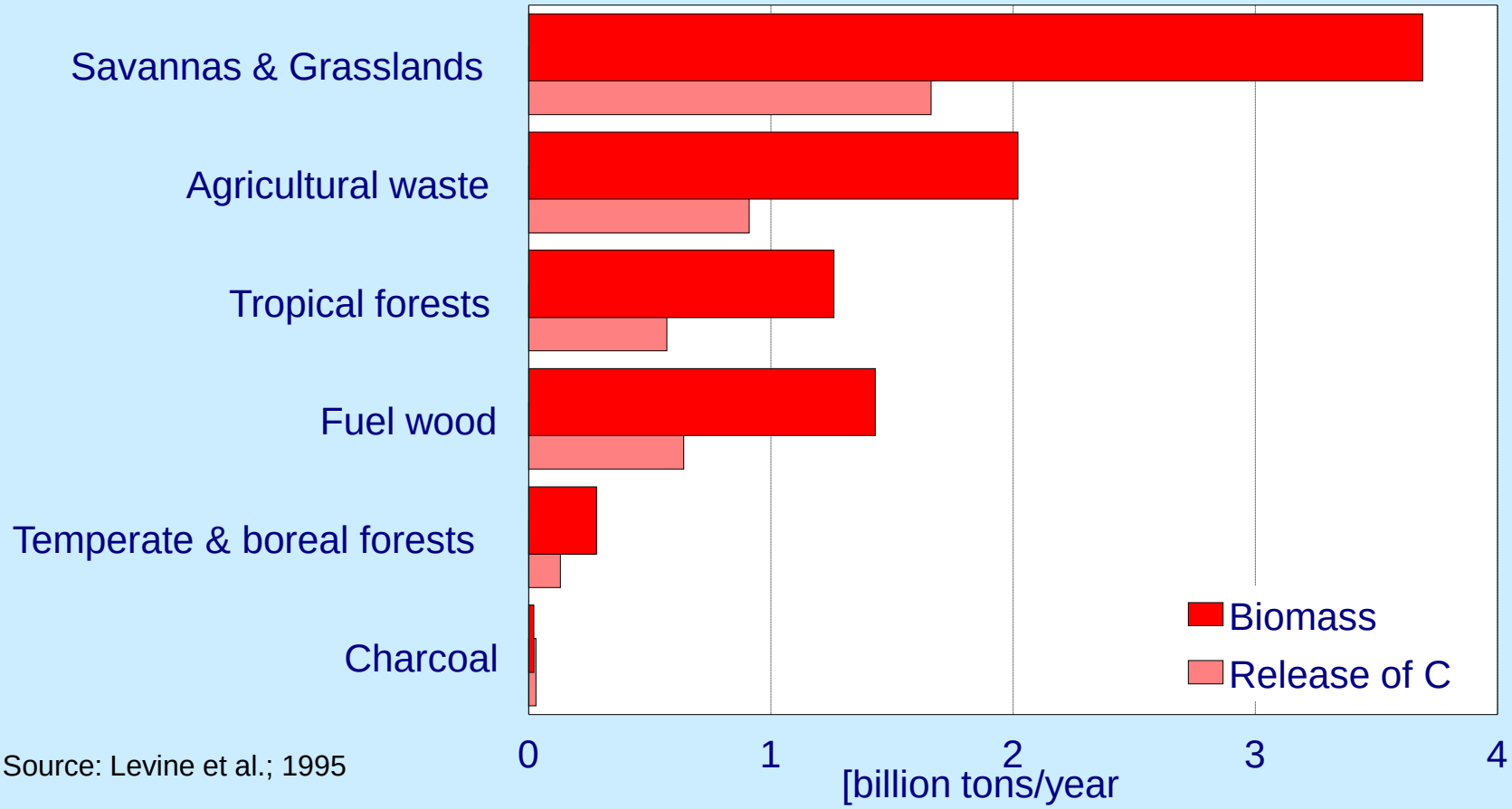
Relative contribution of biomass burning to various climate affecting emissions [% of all emissions]



Source: Levine et al.; 1995

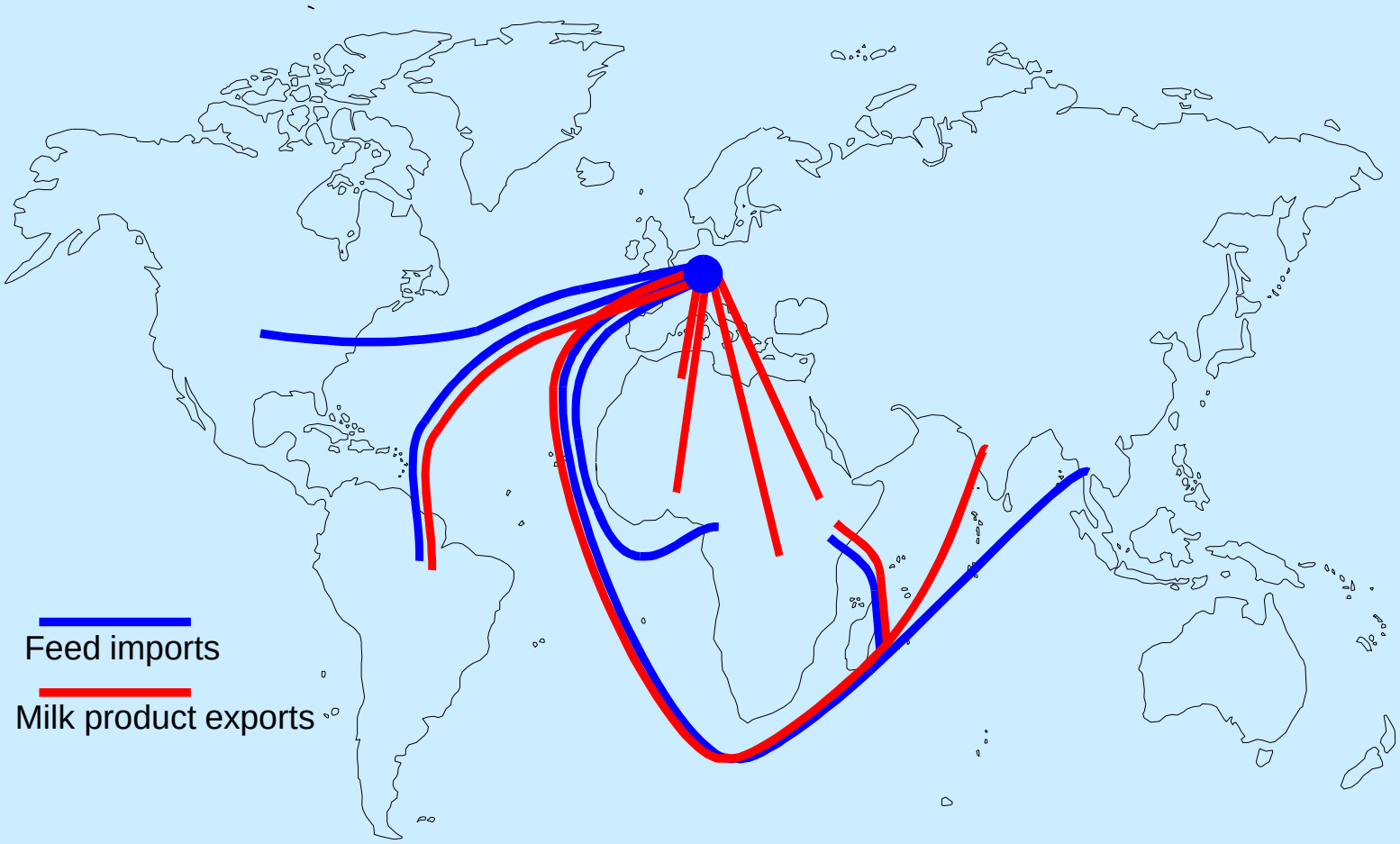
Contribution of burning various types biomass and the resulting release of carbon into the atmosphere



Source: Levine et al.; 1995

Local machine times and agricultural transports

Transport routes of importance for Western European dairy production



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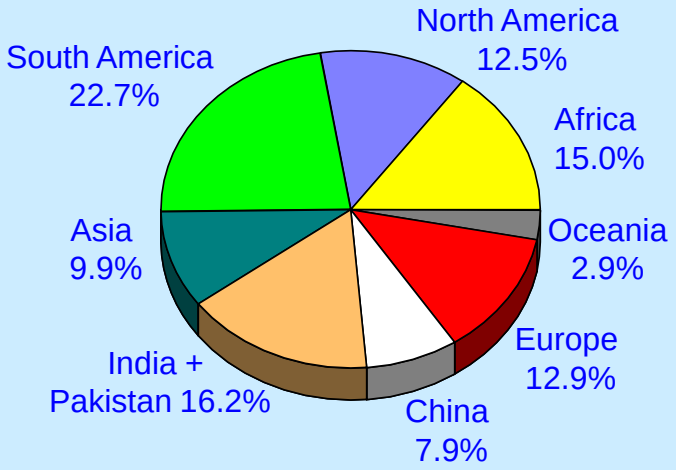
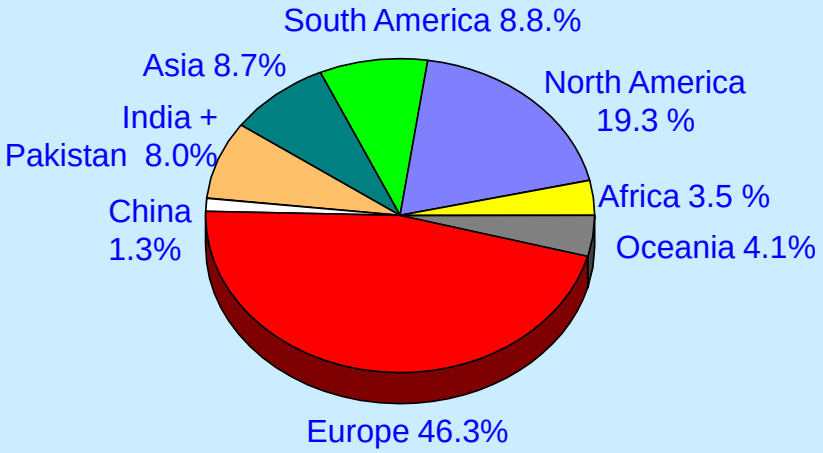
Regional distribution of CATTLE populations and proportion of regional production of meat and milk

Source: FAO Production Yearbook 2004

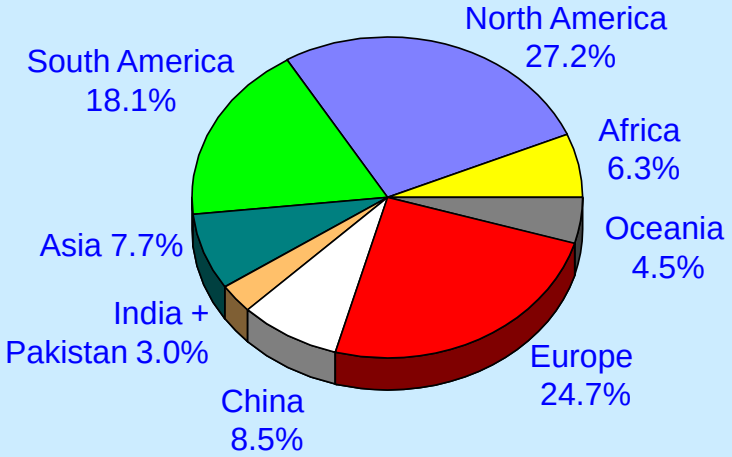
Populations



Milk



Meat



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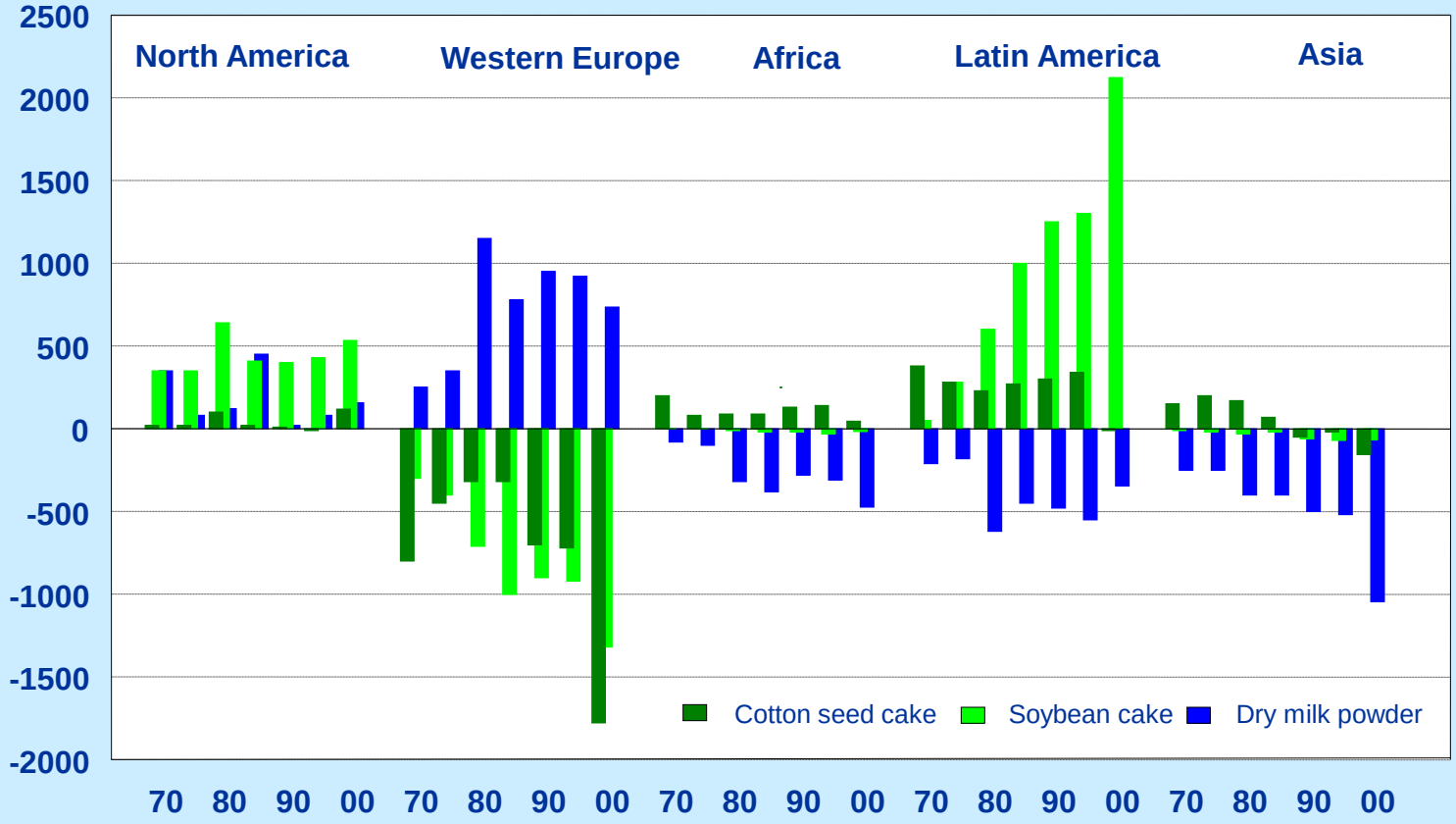
Black-and-white dairy cattle yielding from 6000 to 10000 litres of milk in a lactation of 9 months

Annual net trade ['000 t] of feeds and dry milk powder between the major economic regions of the world from 1970 to 2000



Source: FAO Trade Yearbooks 1970-2000

Enteric fermentation CH_4 emission levels of ruminants are affected by:

- animal species and genotype
- animal age and nutritional status
- animal performance level

- feed availability and intake level

- feed quality
  - nutrient density, digestibility, protein-energy ratio
  - seasonal variation
  - botanical composition
  - pasture and range management

Enteric fermentation CH_4 emission for dairy cattle in relation to average milk yield per cow

Region	Kg CH_4/head/year	Kg Milk/head/year	Kg Milk/Kg CH_4
North America	118	6700	57
Western Europe	100	4200	42
Eastern Europe	81	2550	32
Oceania	68	1700	25
Latin America	57	800	14
Asia	56	1650	29
Indian Subcontinent	46	900	20
Africa and Middle East	36	475	13

Source: IPCC Guidelines for National Greenhouse Gas Inventories and Authors' Calculations

Manure management systems affecting loss of CH_4, N_2O, trace gases

Liquid systems

- with storage lagoons
- with storage pits or silos
- with forced drying and grinding
- with biogas production

Manure management systems affecting loss of CH_4, N_2O, trace gases

Solid systems

- with or without bedding, dry stockpiling
- with or without bedding, composting
- with fuel use

Manure management systems affecting loss of CH_4, N_2O, trace gases

Pastoral systems

- with partial collection for fuel use
- with complete spreading by grazing stock

Manure management systems affecting loss of CH_4, N_2O, trace gases

losses

Liquid systems
- with storage lagoons
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Solid systems
- with or without bedding, dry stockpiling
- with or without bedding, composting
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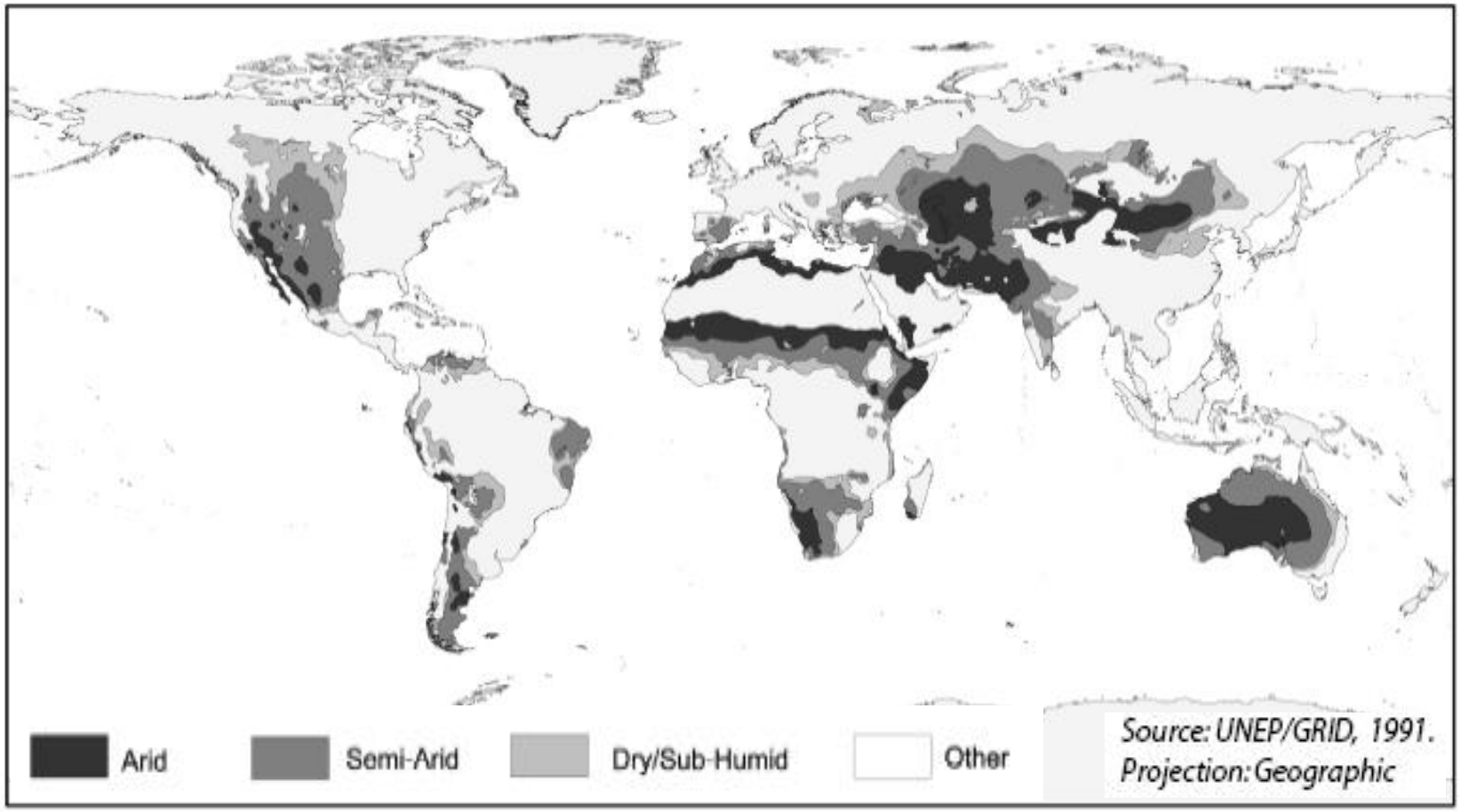
Pastoral systems
- with partial collection for fuel use
- with complete spreading by grazing stock

Manure management CH_4 emission factors [kg CH4/head/year] for dairy cattle in relation to region and climate type

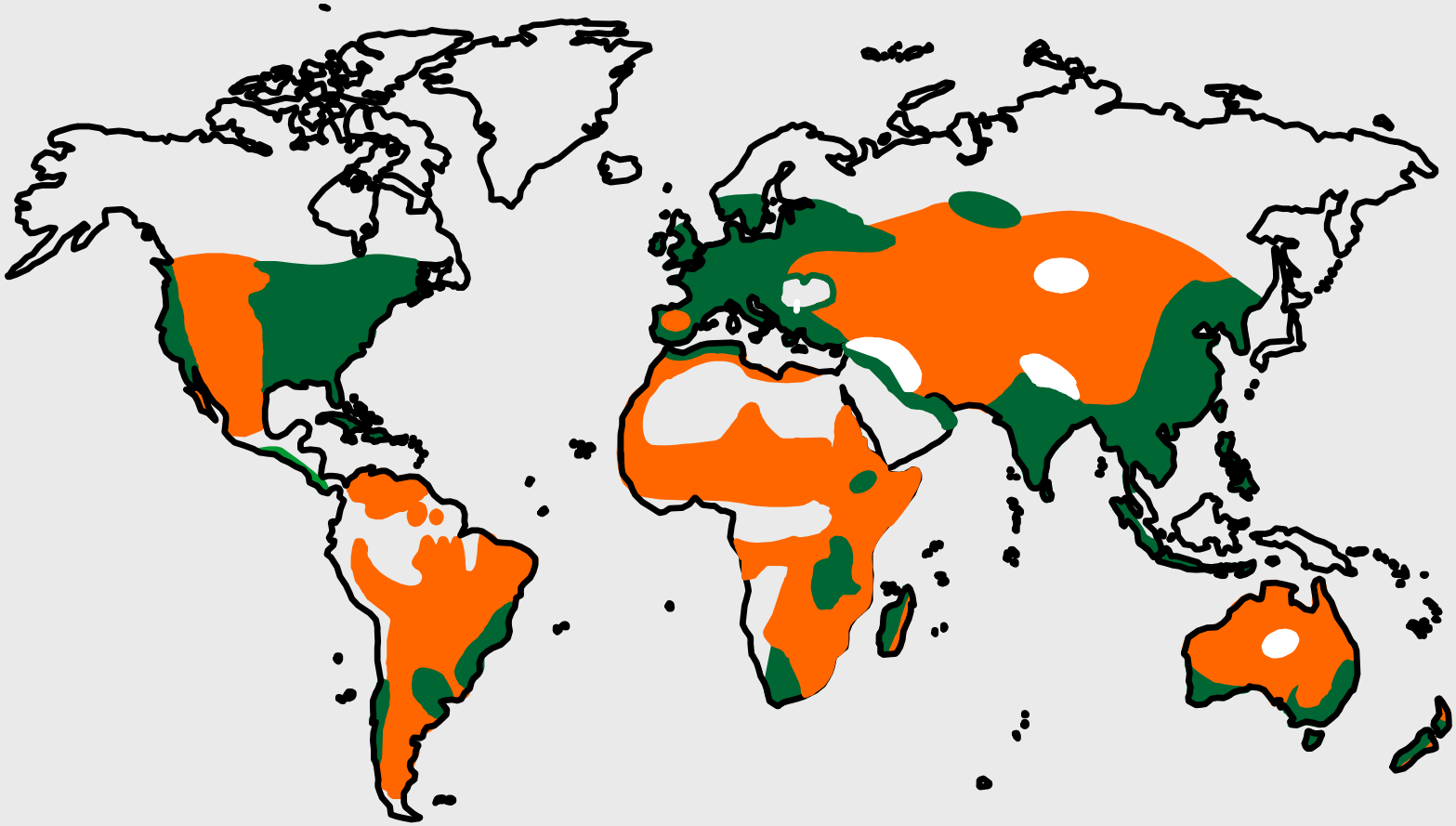
Climate type Region	Cool	Temperate	Warm
North America	36	54	76
Western Europe	14	44	81
Eastern Europe	6	19	33
Oceania	31	32	33
Latin America	0	1	2
Asia	7	16	27
Africa and Middle East	1	1	2
Indian Subcontinent	5	5	6

Source: IPCC Guidelines for National Greenhouse Gas Inventories

Aridity zones worldwide



Worldwide distribution of crops and pastures as the base for livestock production systems



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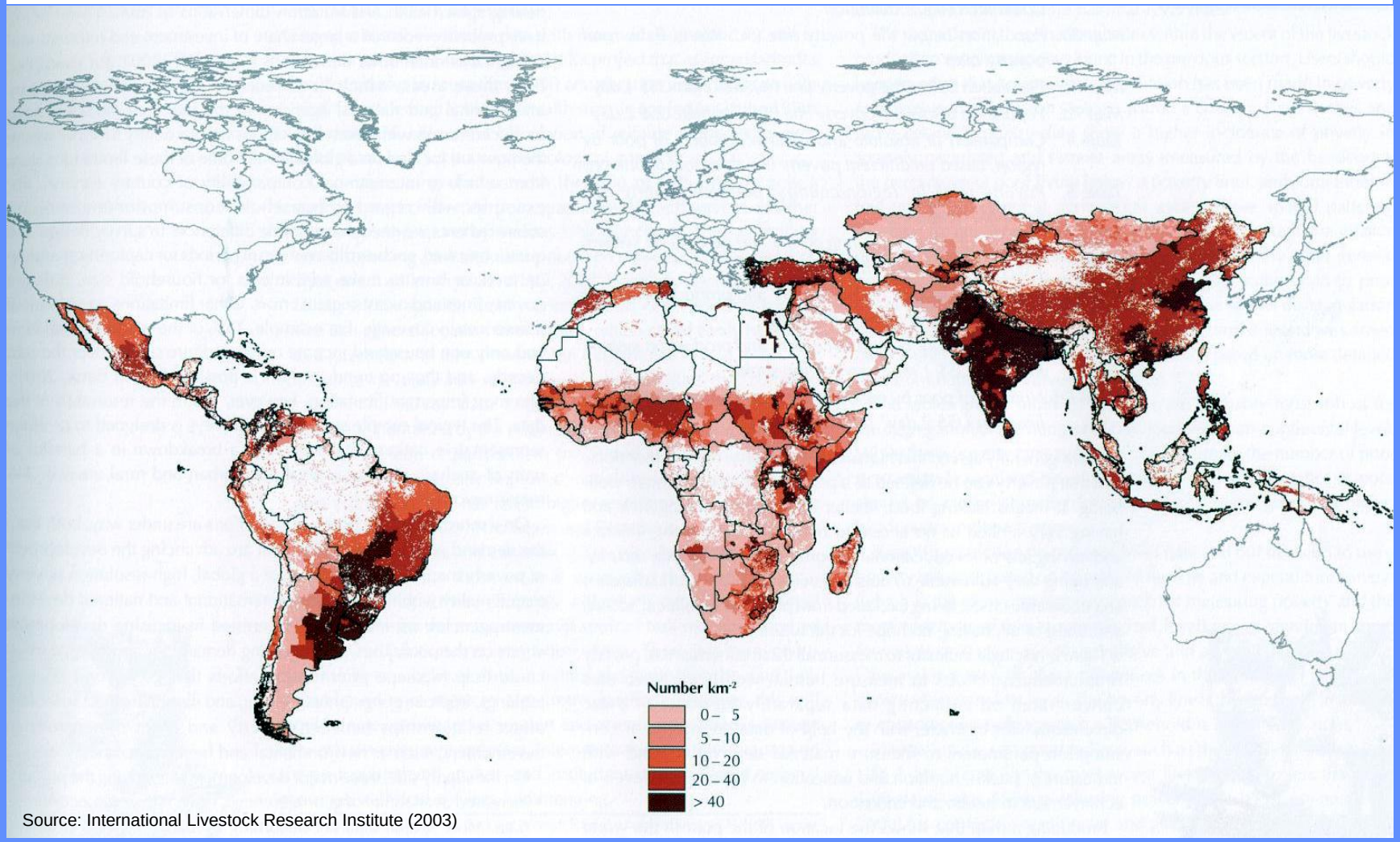
Density of total ruminant livestock [TLU]



Source: International Livestock Research Institute (2003)

Projected climate changes in the arid and semi-arid tropics

- Increasing aridity
- Increasing inter-annual variability
- More frequent extreme weather events

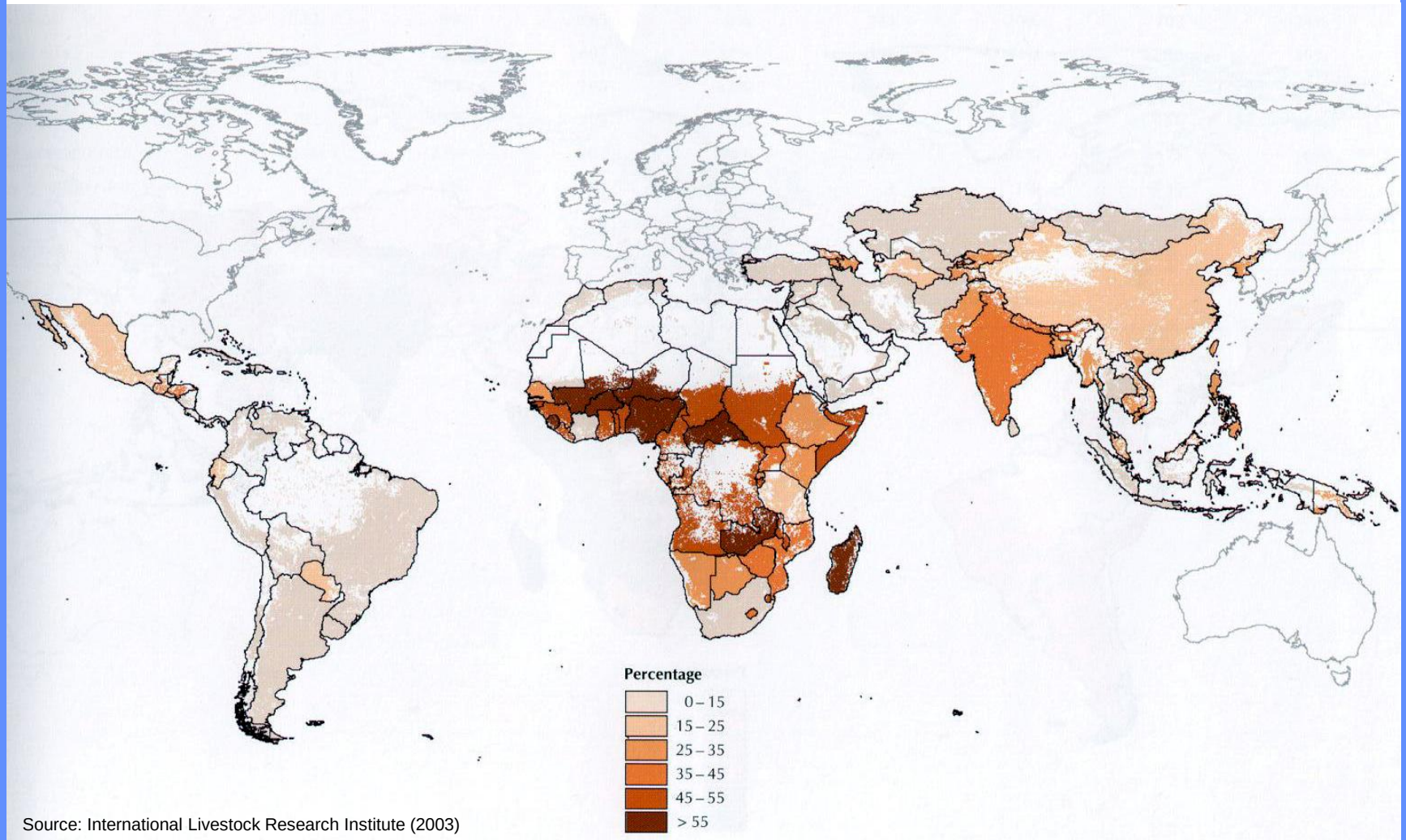
F2 back crosses of zebu to Holstein Friesian, genetic potential for 4500 kg milk, specialised dairy farm, improved pastures and maize silage, after a failed rainy season, marginal highlands in Kenya

Tropical grassland at late dry season, beginning drought condition


Too late
Semi-arid annual grassland two days after the first rain of the new season


too much
Recent floods in semi-arid Western Kenya, also affecting 12 more countries of the African Sahel Belt

Distribution of poverty [% of population with income below 1US$/day]



Source: International Livestock Research Institute (2003)

The emerging threat

BIOFUELS

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