Livestock intensification

John Sheehan
Colorado State University
University of Campinas

Lee Lynd
Dartmouth College

Expanding resources

13.3 billion

hectares of our planet's surface is not underwater or covered in ice

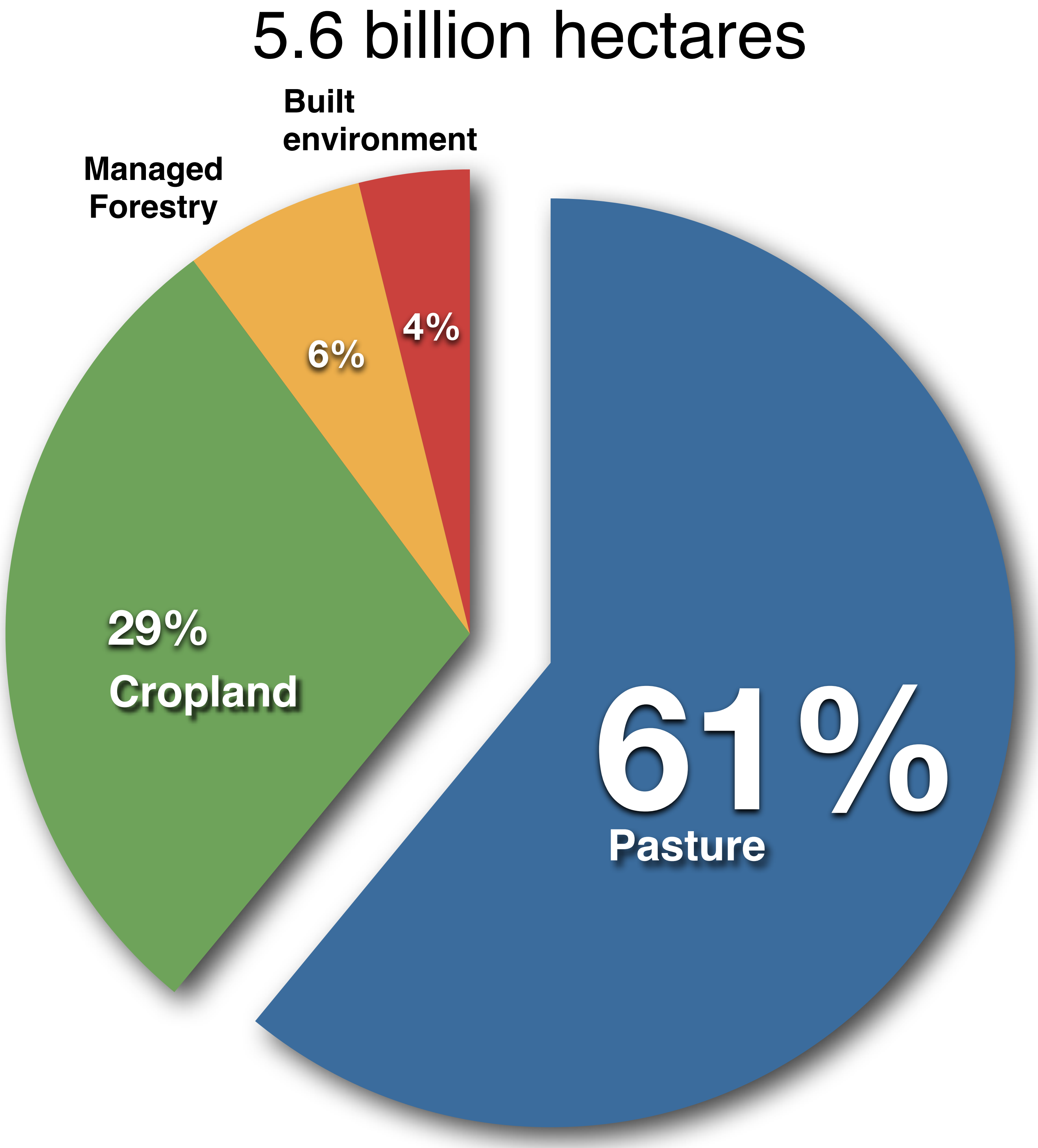
of that 13.3 billion hectares,

5.6 billion

is dominated

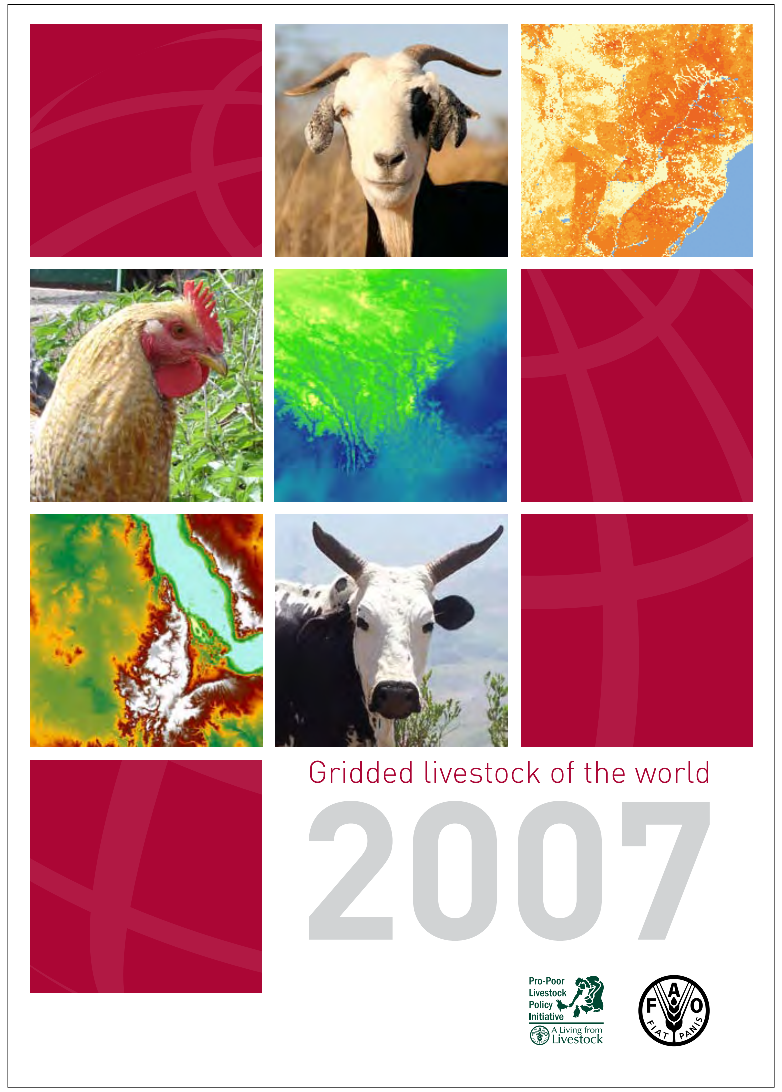
by human use

Pasture is the largest HUMAN USE of land on the planet



LIVESTOCK DATA

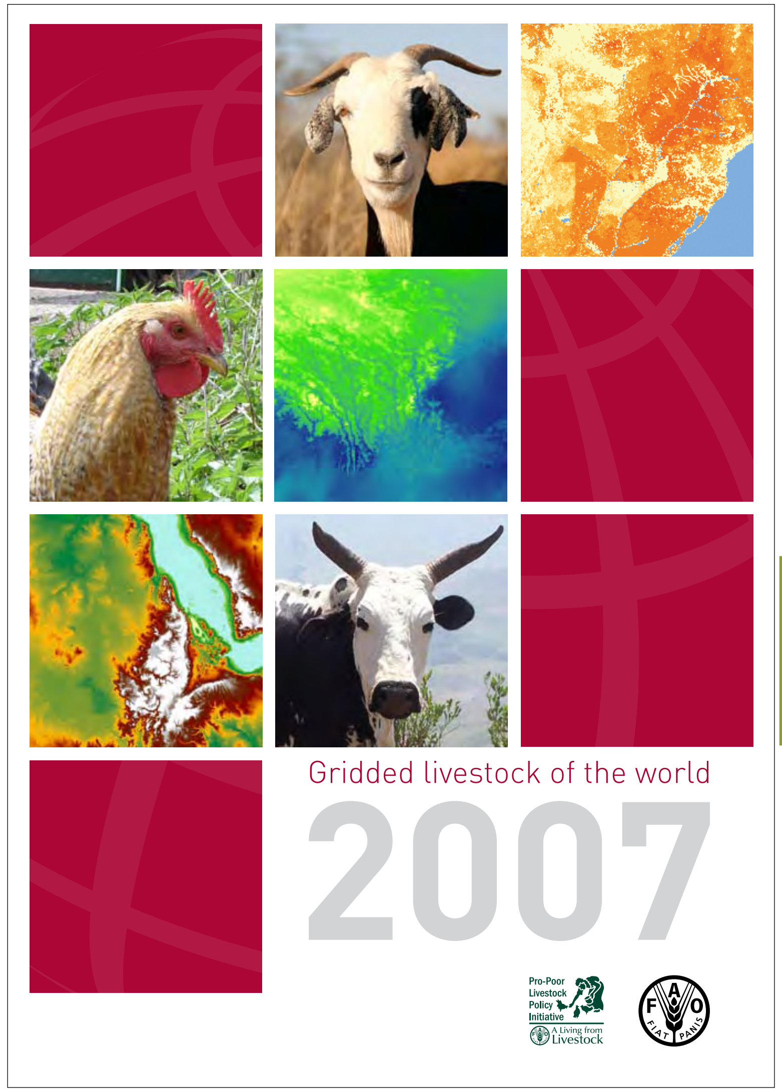
FAO census data
3 min x 3 min



THE MAJOR RUMINANTS

DATA PROCESSING

FAO census data
3 min x 3 min



Ramankutty pasture
5 min x 5 min

GLOBAL BIOGEOCHEMICAL CYCLES, VOL. 22, GB1003, doi:10.1029/2007GB002952, 2008

Farming the planet:
1. Geographic distribution of global agricultural lands in the year 2000

Navin Ramankutty,[1] Amato T. Evan,[2] Chad Monfreda,[3] and Jonathan A. Foley[3]

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0886-6236/08/2008GB002952

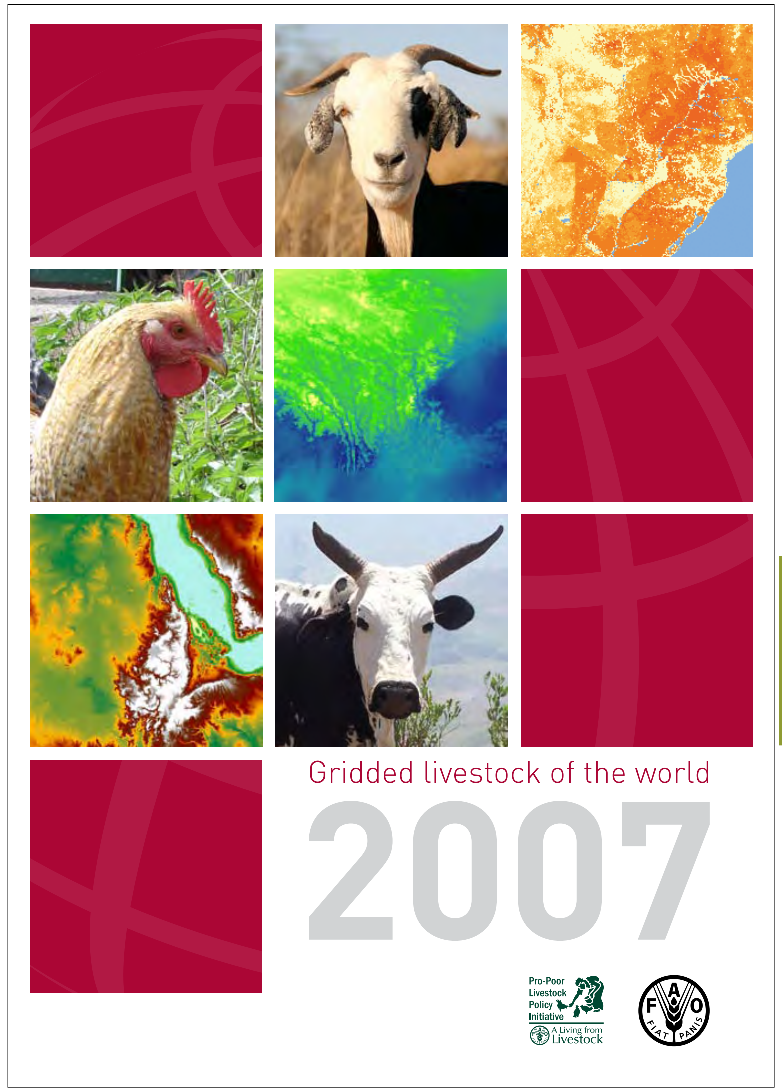
Remove CAFOs & mixed crop/livestock systems

≦2 AU per ha for ∑ cattle, goats, sheep

AU equivalents 1, 0.2, and 0.2 for cattle, sheep and goats

ESTIMATES OF LAND AREA

FAO census data
3 min x 3 min



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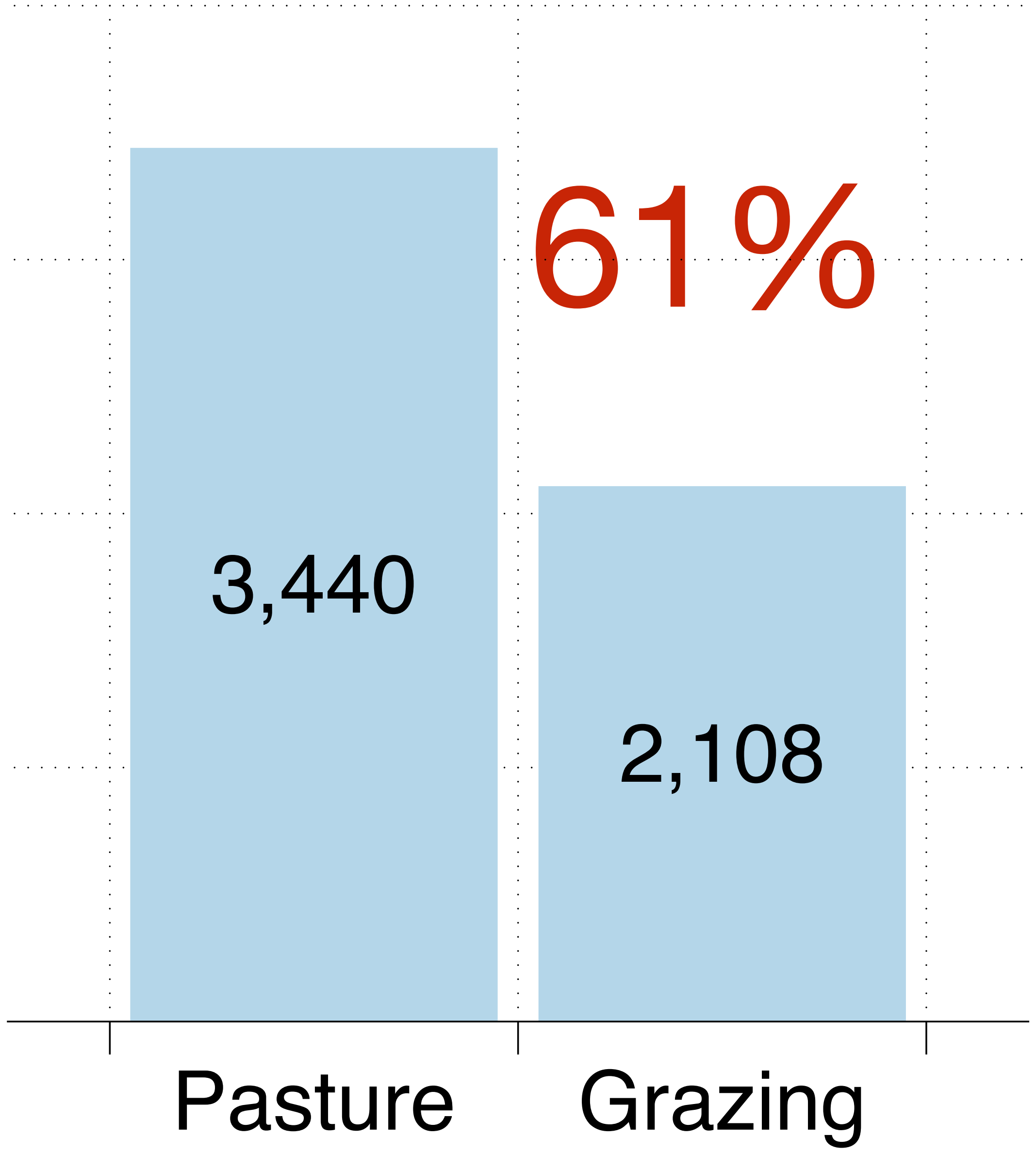
GB1003 1 of 19



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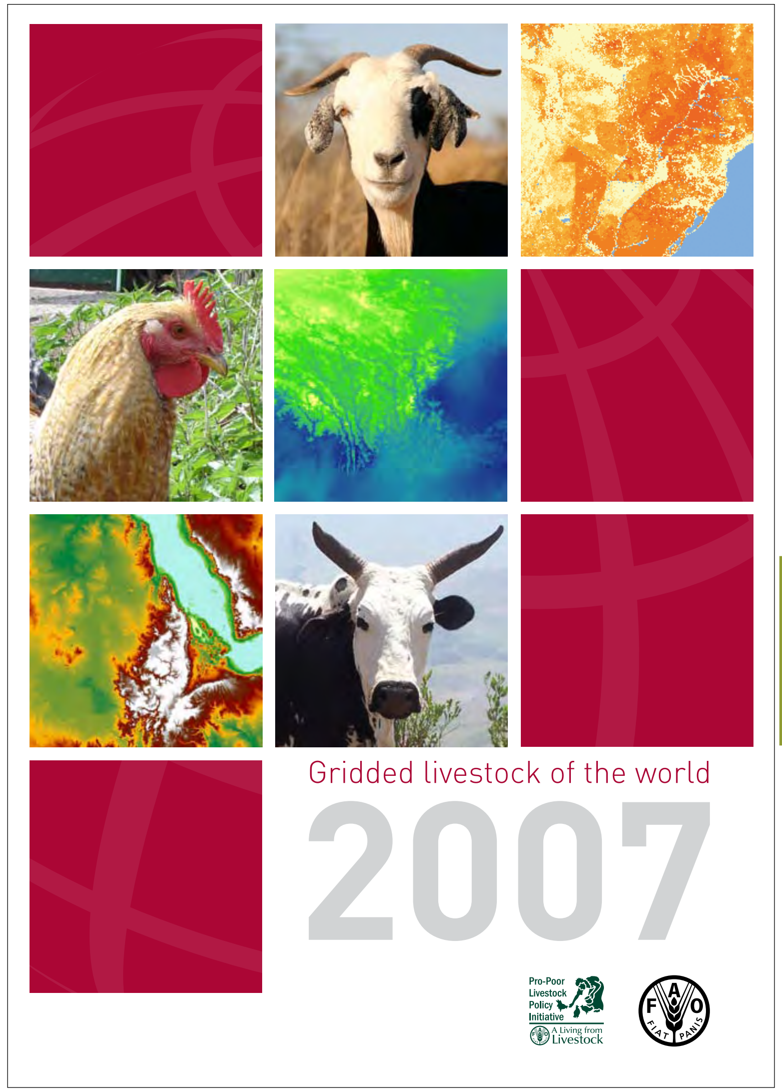

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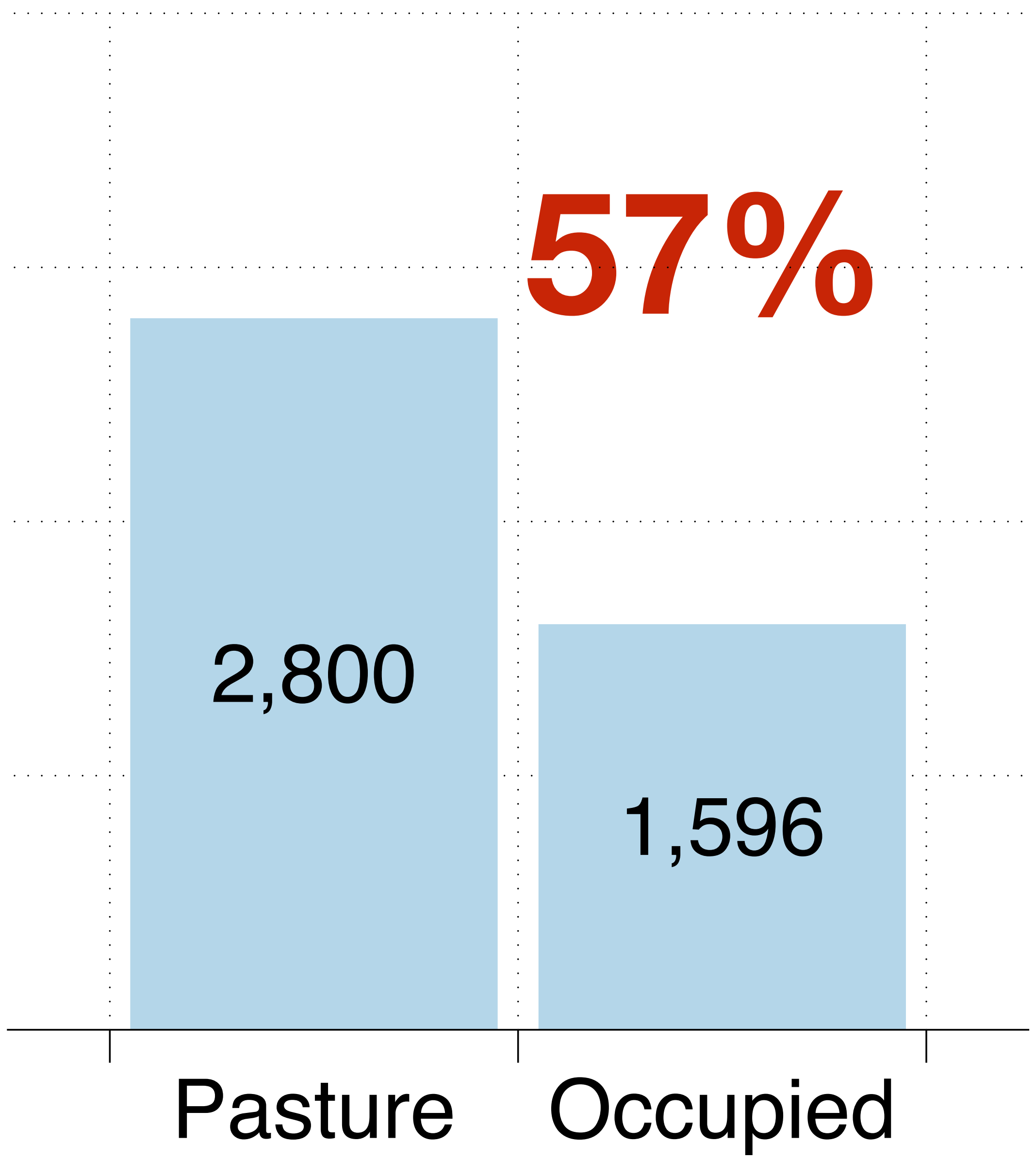

ESTIMATES OF LIVESTOCK

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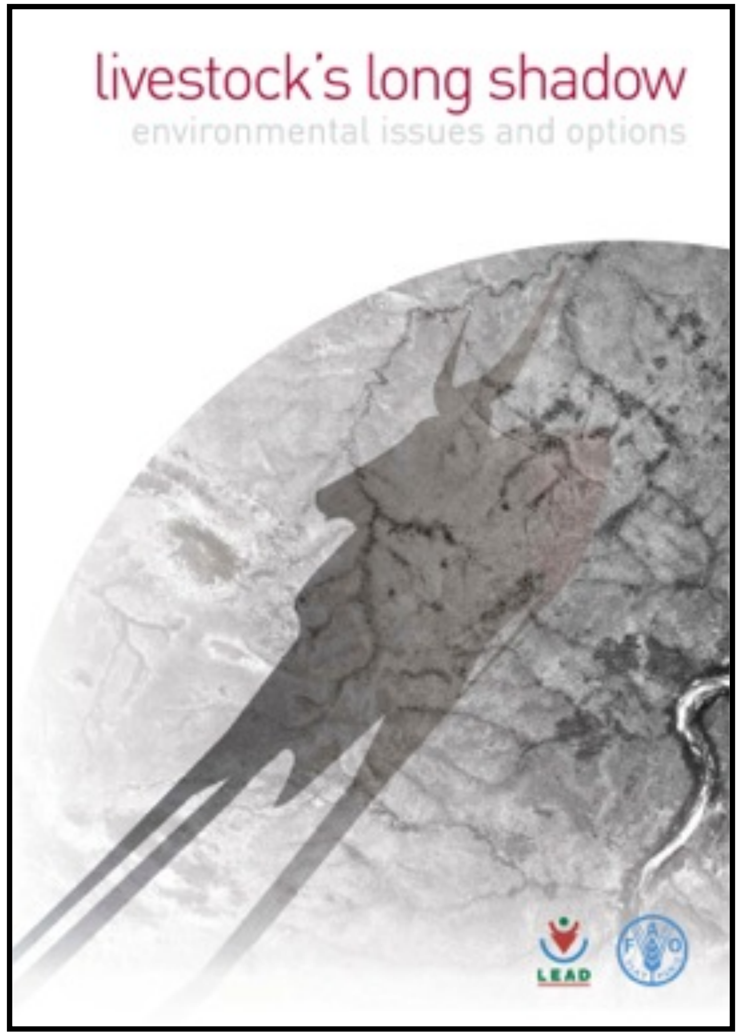
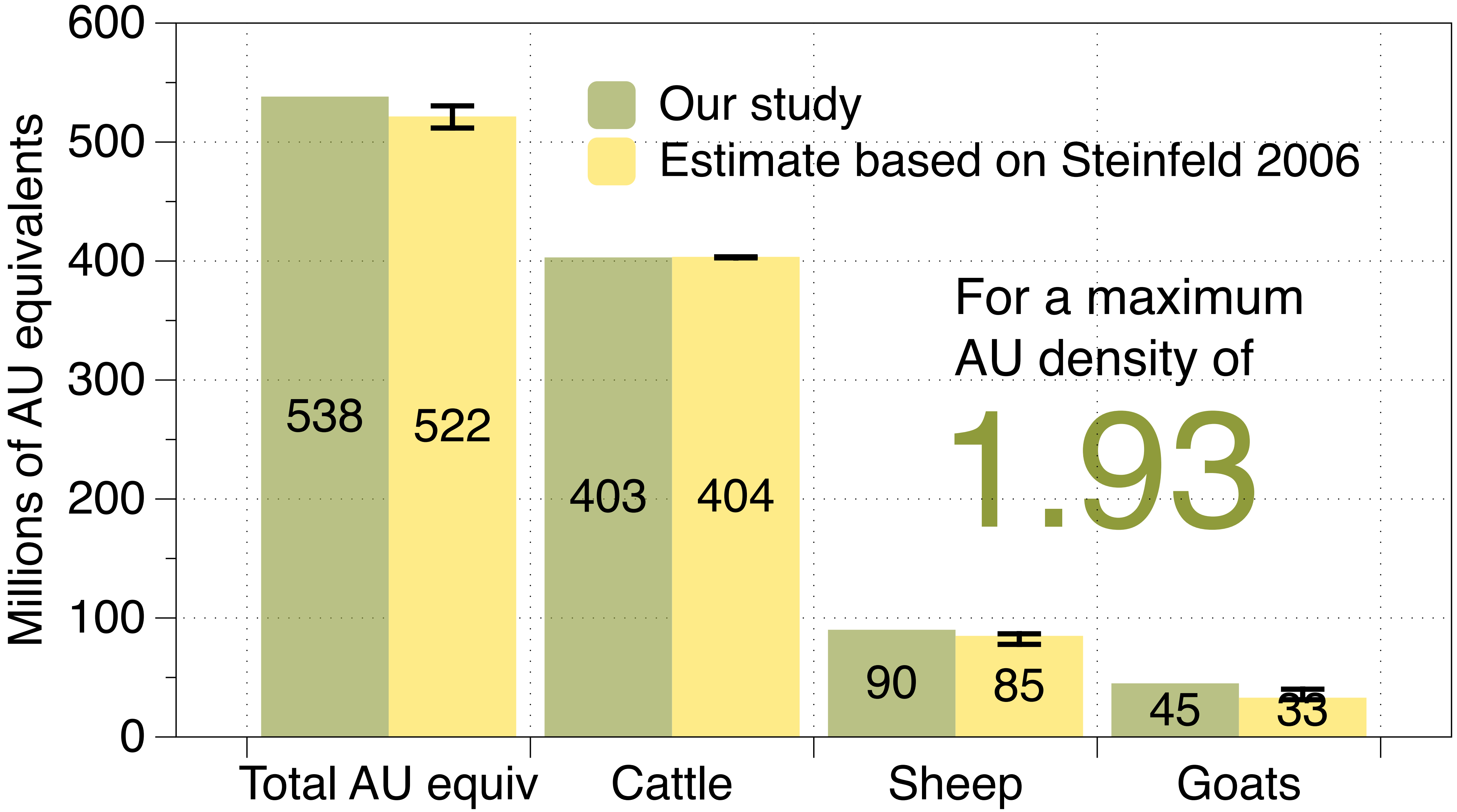
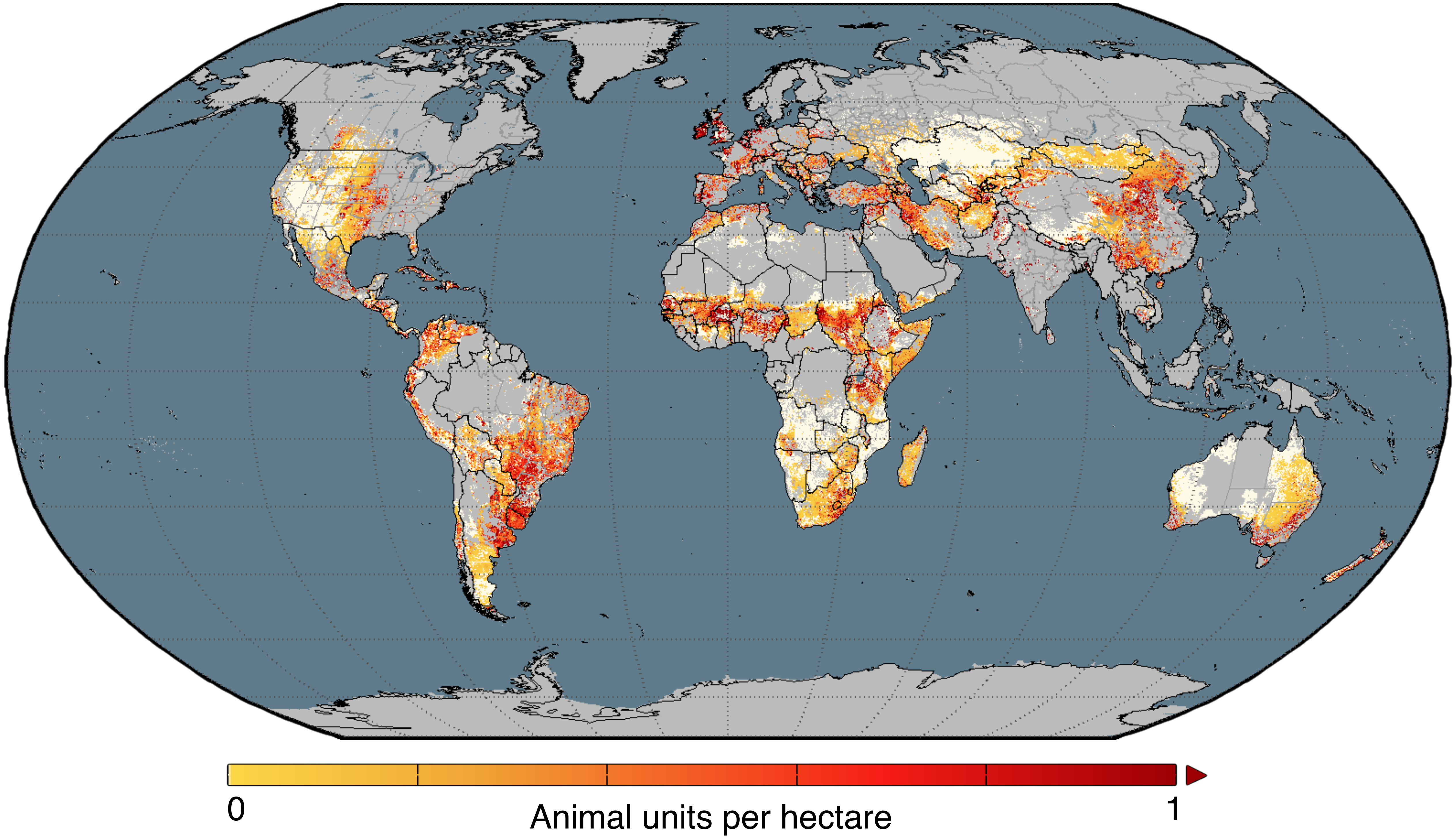
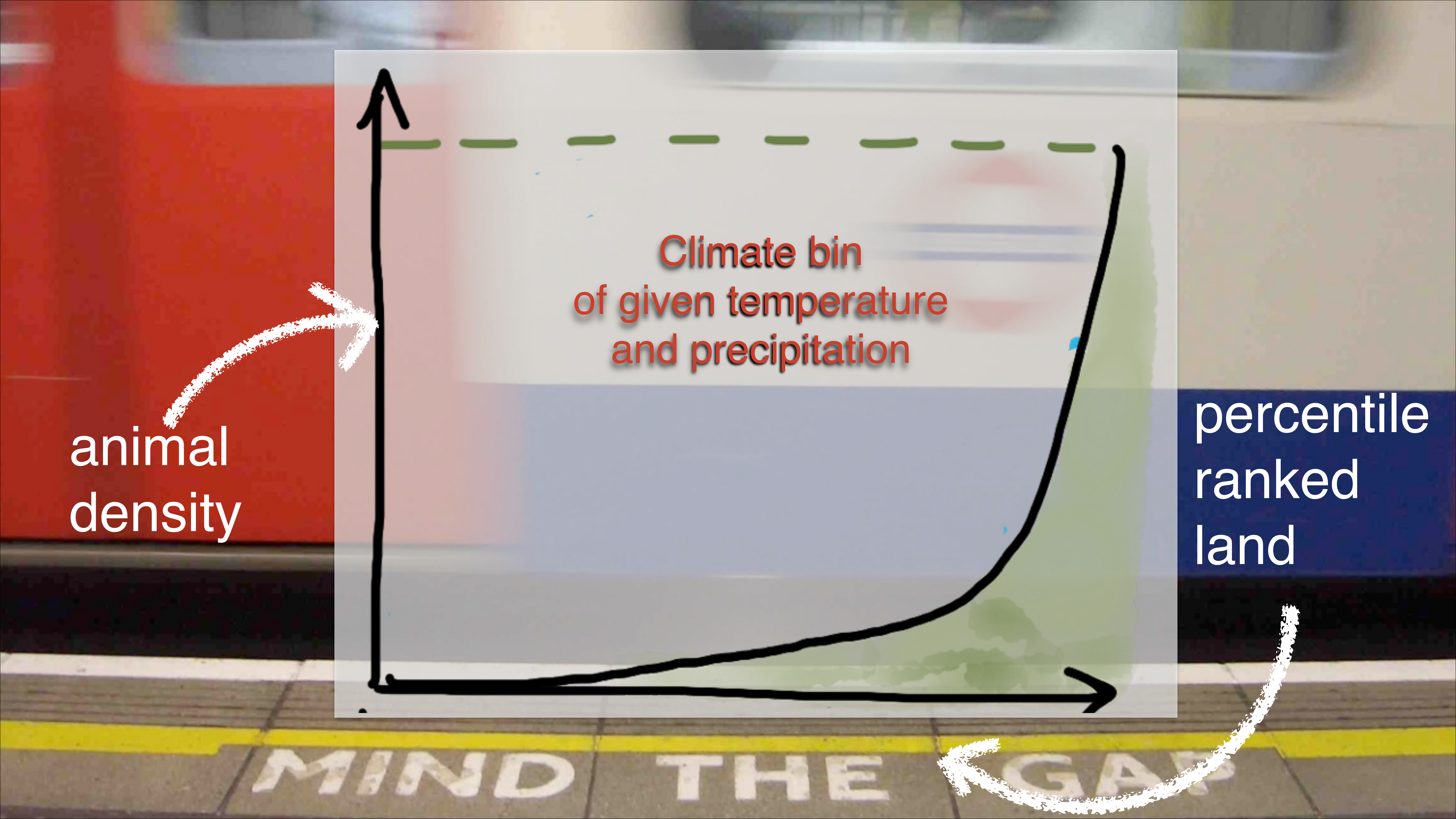
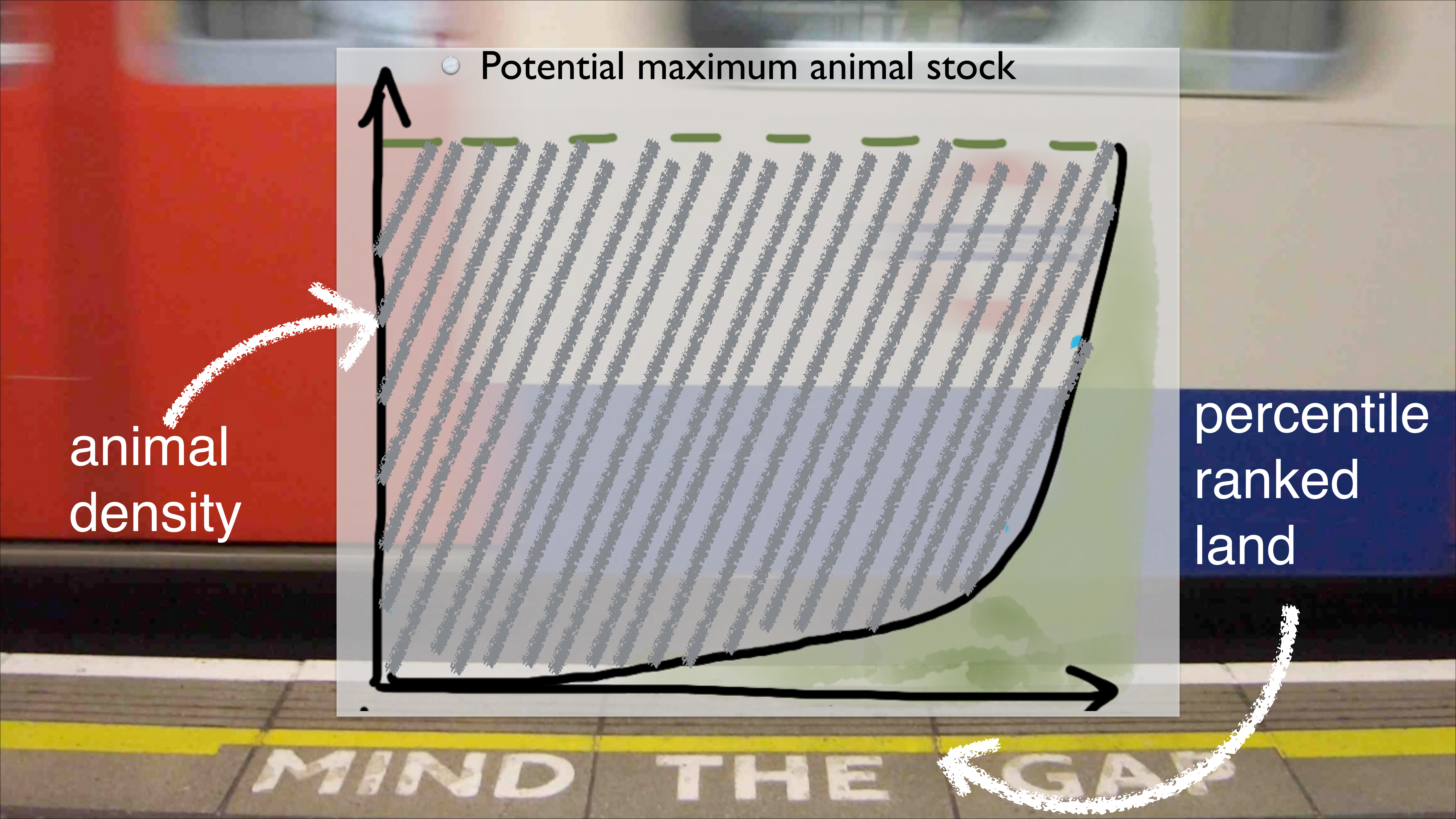




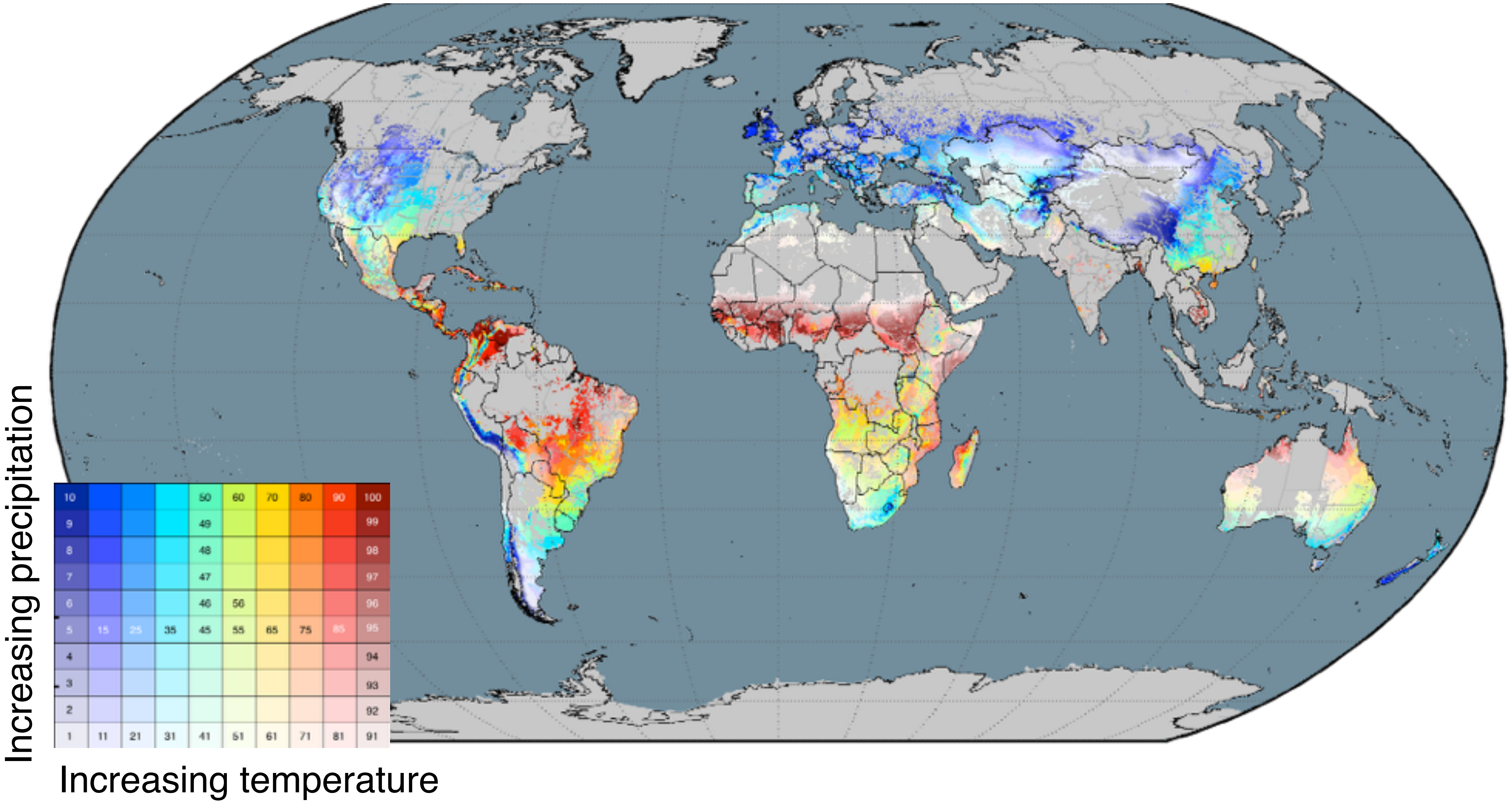
Distribution of cattle, sheep and goats on global pasture




Climate bin
of given temperature
and precipitation
animal density
percentile ranked land
MIND THE GAP


Potential maximum animal stock
animal density
percentile ranked land
MIND THE GAP

Distribution of 100 climate-defined bins of pasture



GLOBAL POTENTIAL

$$P(x) = \sum_{i=1}^{N_{bins}} A_i p_i(x)$$

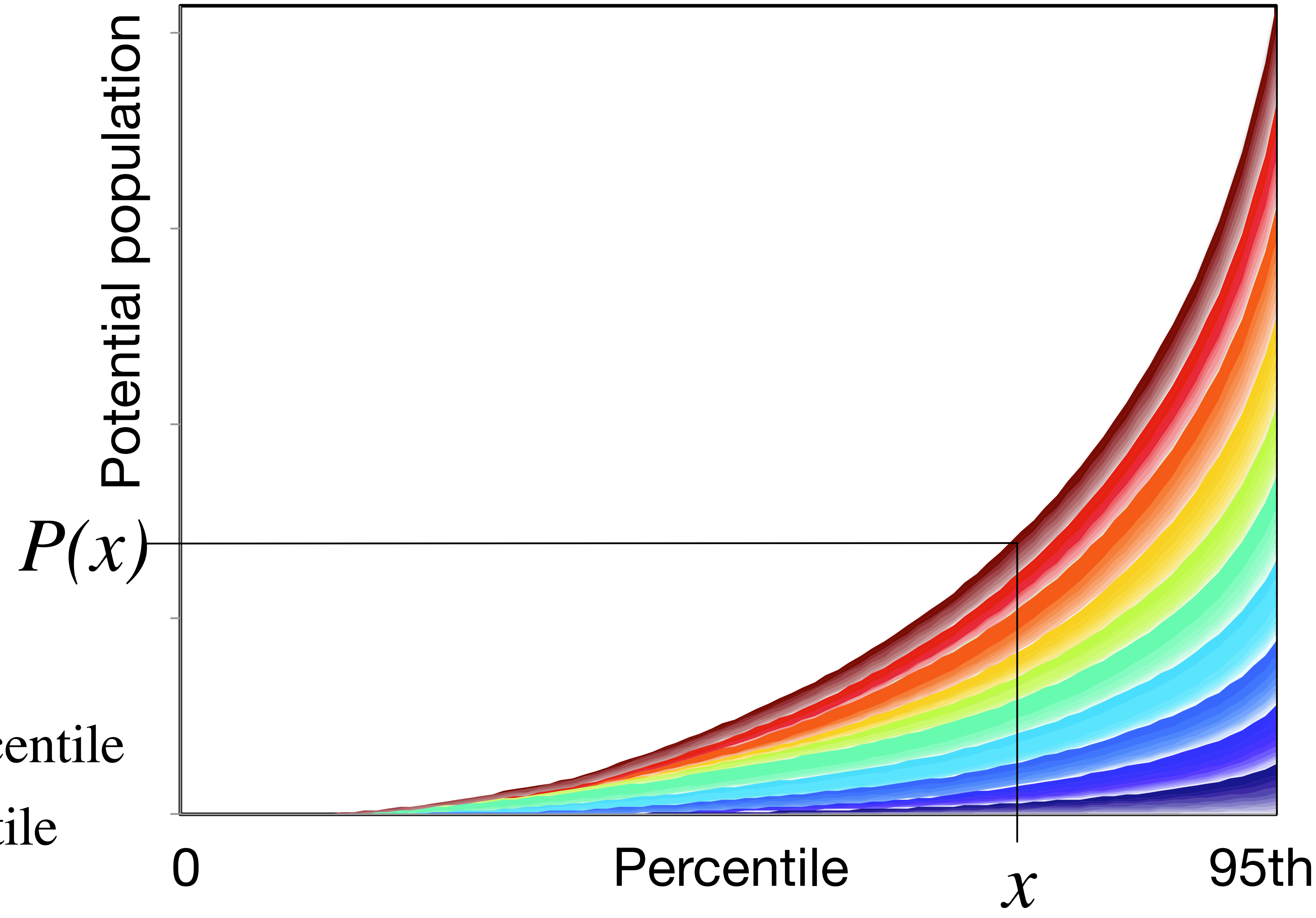
$$P_c = \int_{x=0}^{95th} P(x)\,dx$$

$P(x)$ is potential global population at xth percentile

$p_i(x)$ is animal density in bin i for xth percentile

A_i is the area in bin i

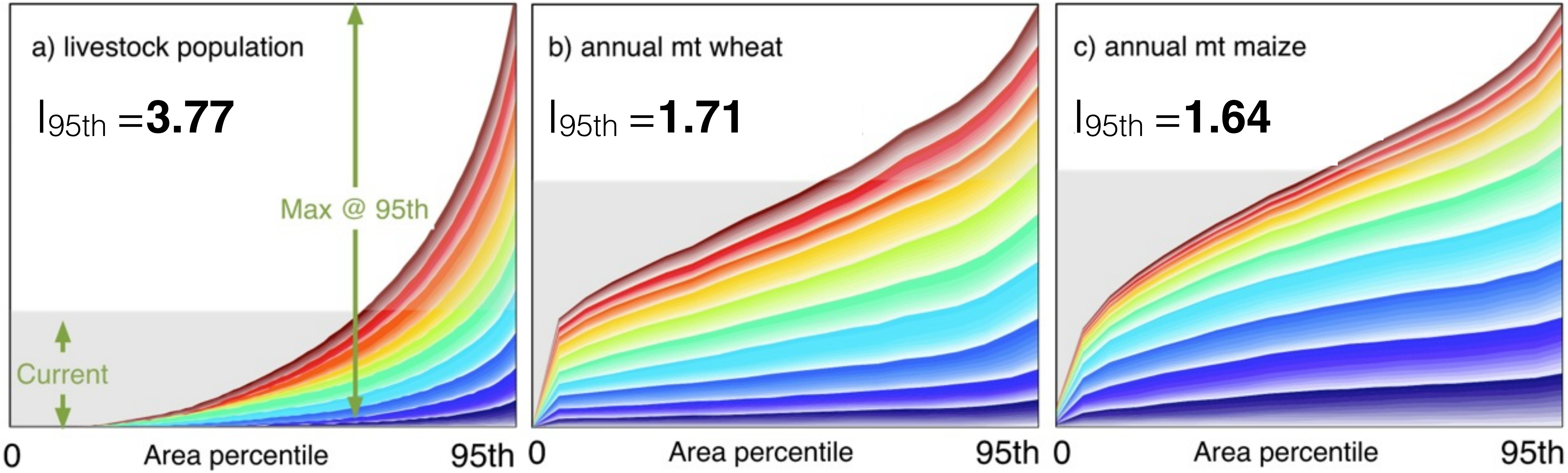
P_c is current animal population (ca 2005)



INTENSIFICATION RATIO

$$I(x) = \frac{P(x)}{P_c} = \frac{\sum_{i=1}^{N_{bins}} A_i P_i(x)}{\int_{x=0}^{95th} P(x)\,dx}$$

LIVESTOCK VS CROP POTENTIAL



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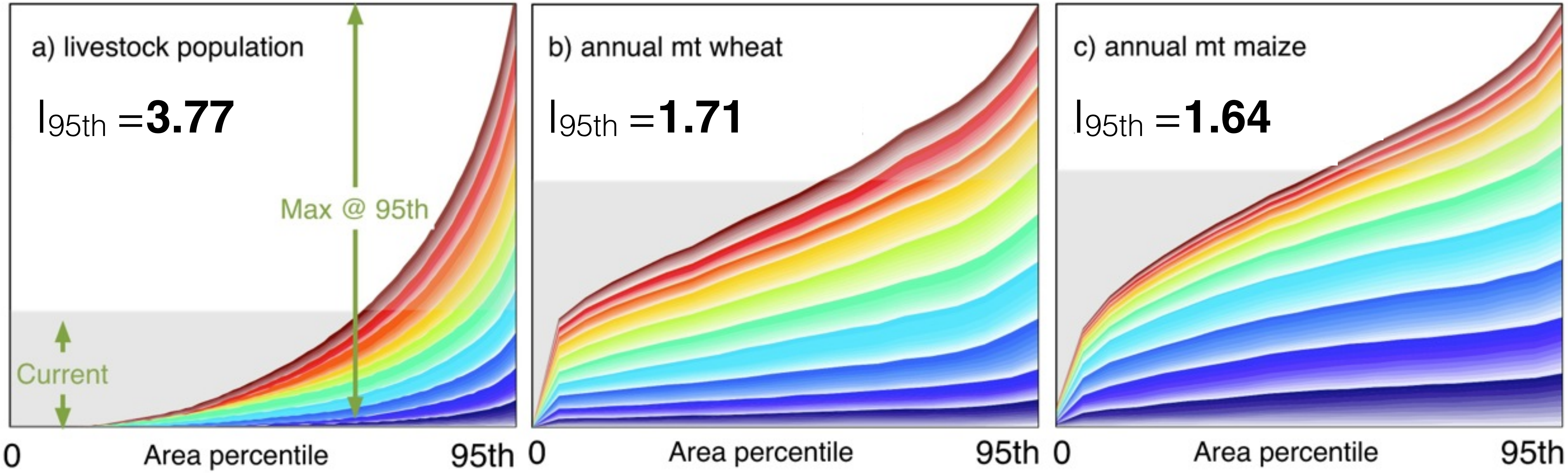
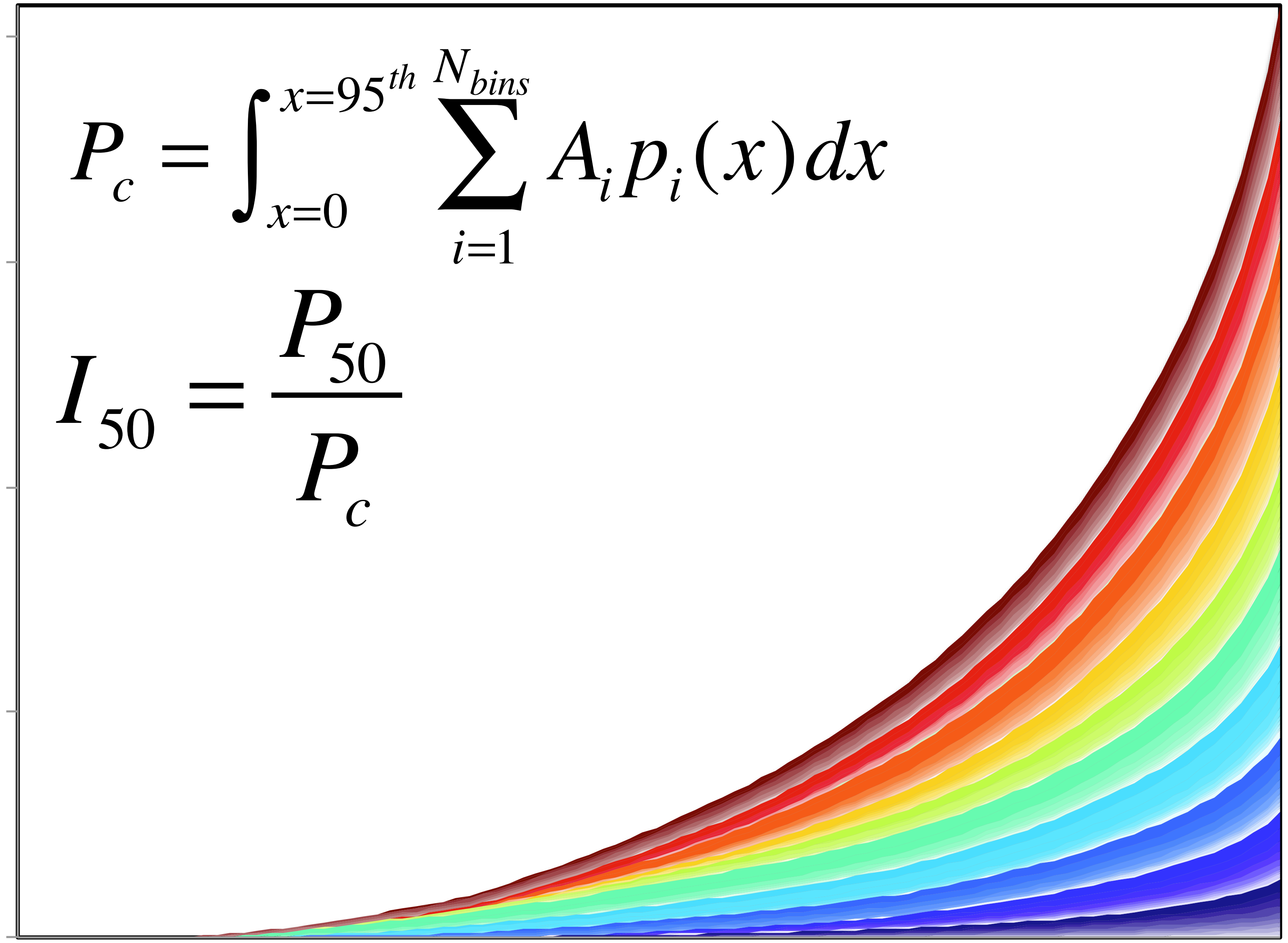
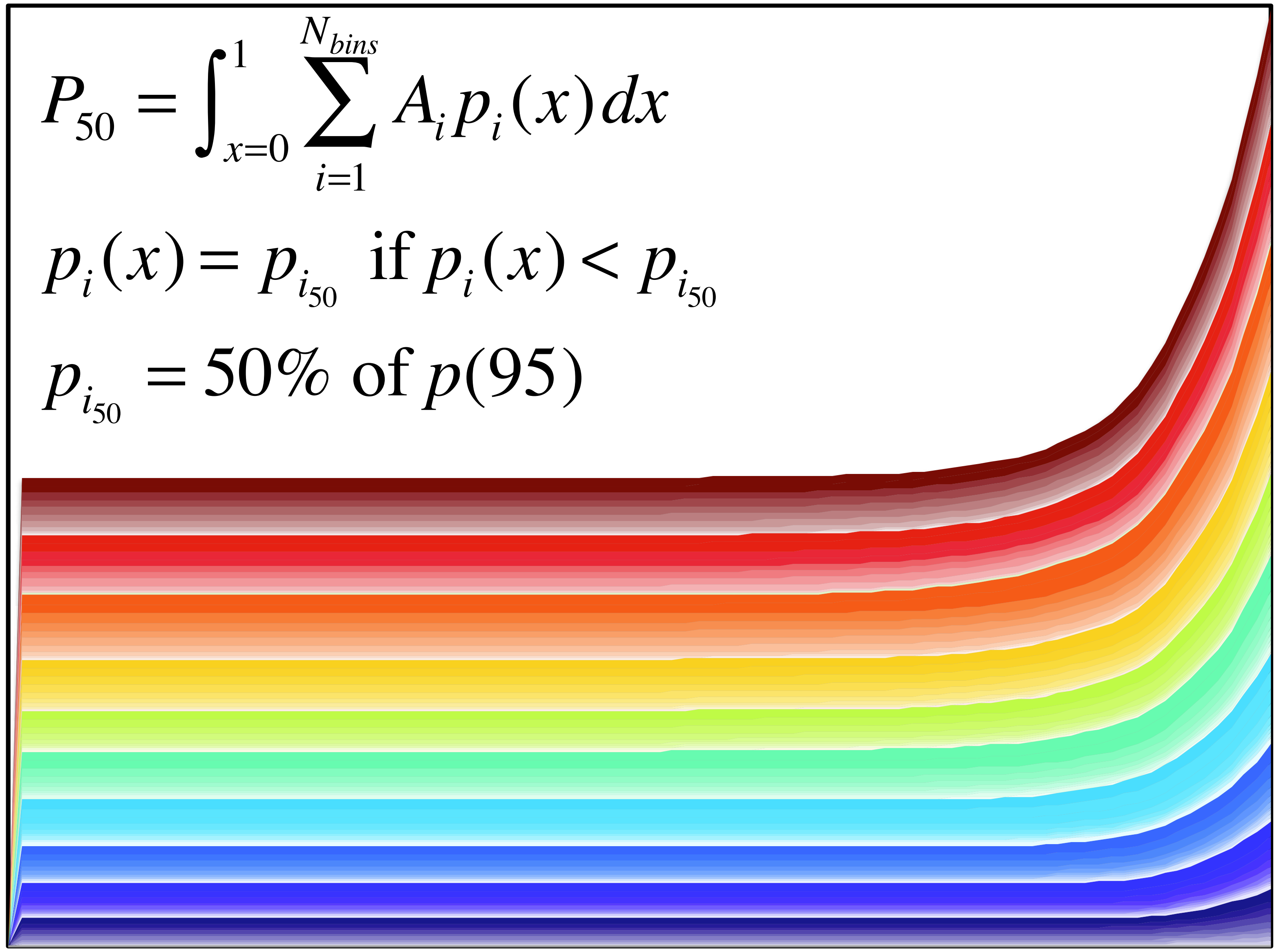


SETTING A FLOOR



$$P_c = \int_{x=0}^{x=95^{th}} \sum_{i=1}^{N_{bins}} A_i p_i(x)\,dx$$

$$I_{50} = \frac{P_{50}}{P_c}$$

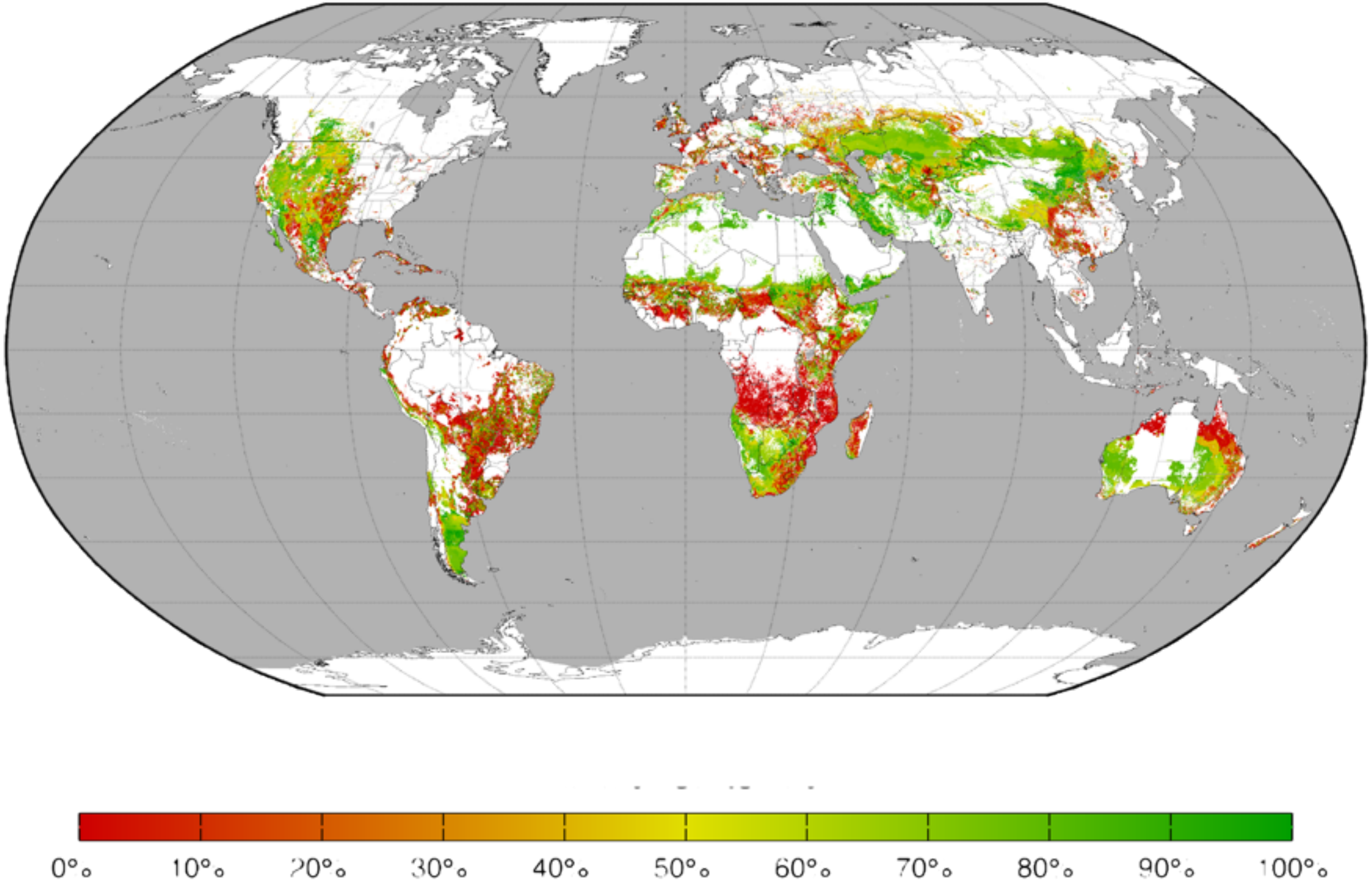


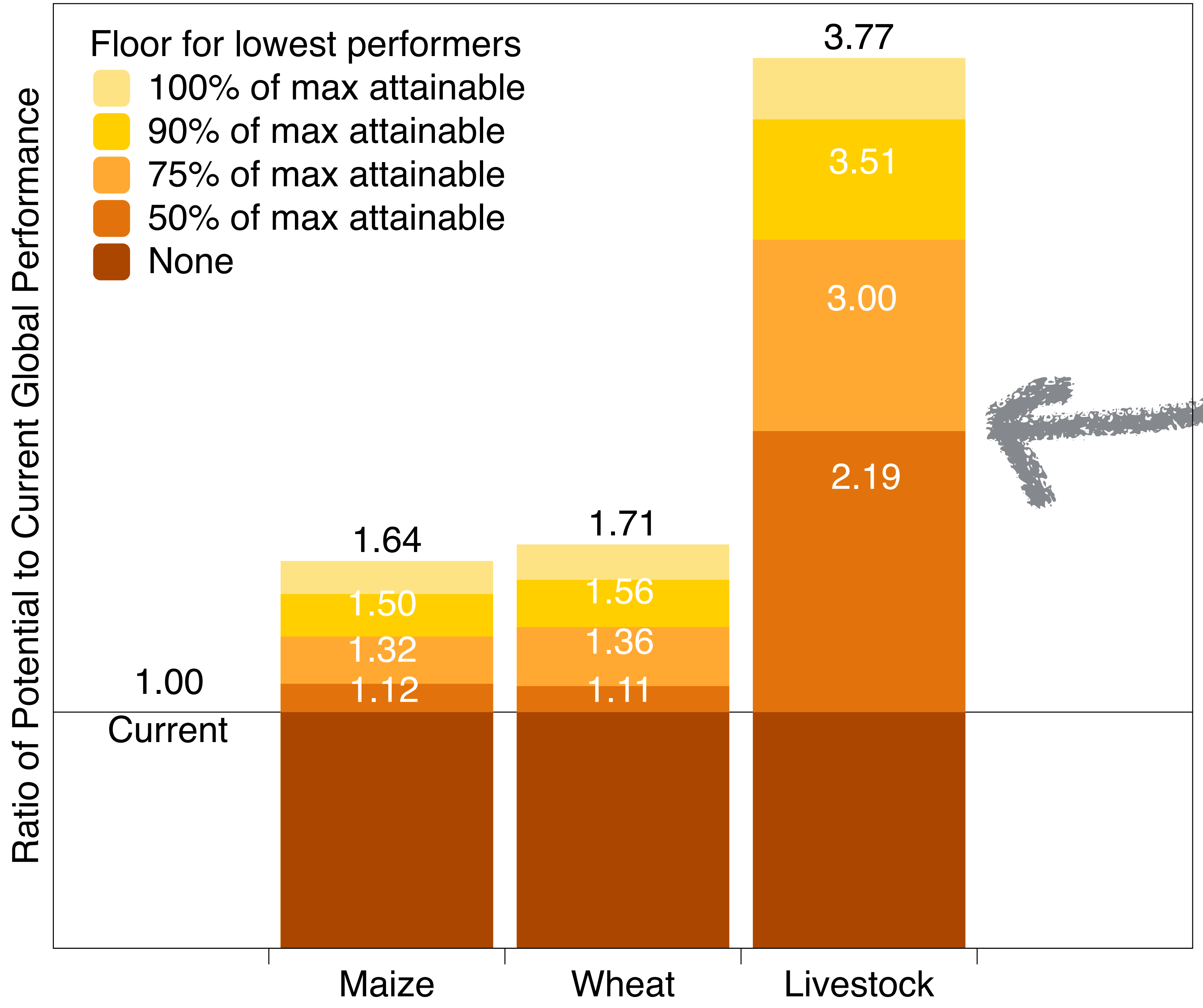
$$P_{50} = \int_{x=0}^{1} \sum_{i=1}^{N_{bins}} A_i p_i(x)\,dx$$

$$p_i(x) = p_{i_{50}} \text{ if } p_i(x) < p_{i_{50}}$$

$$p_{i_{50}} = 50\% \text{ of } p(95)$$

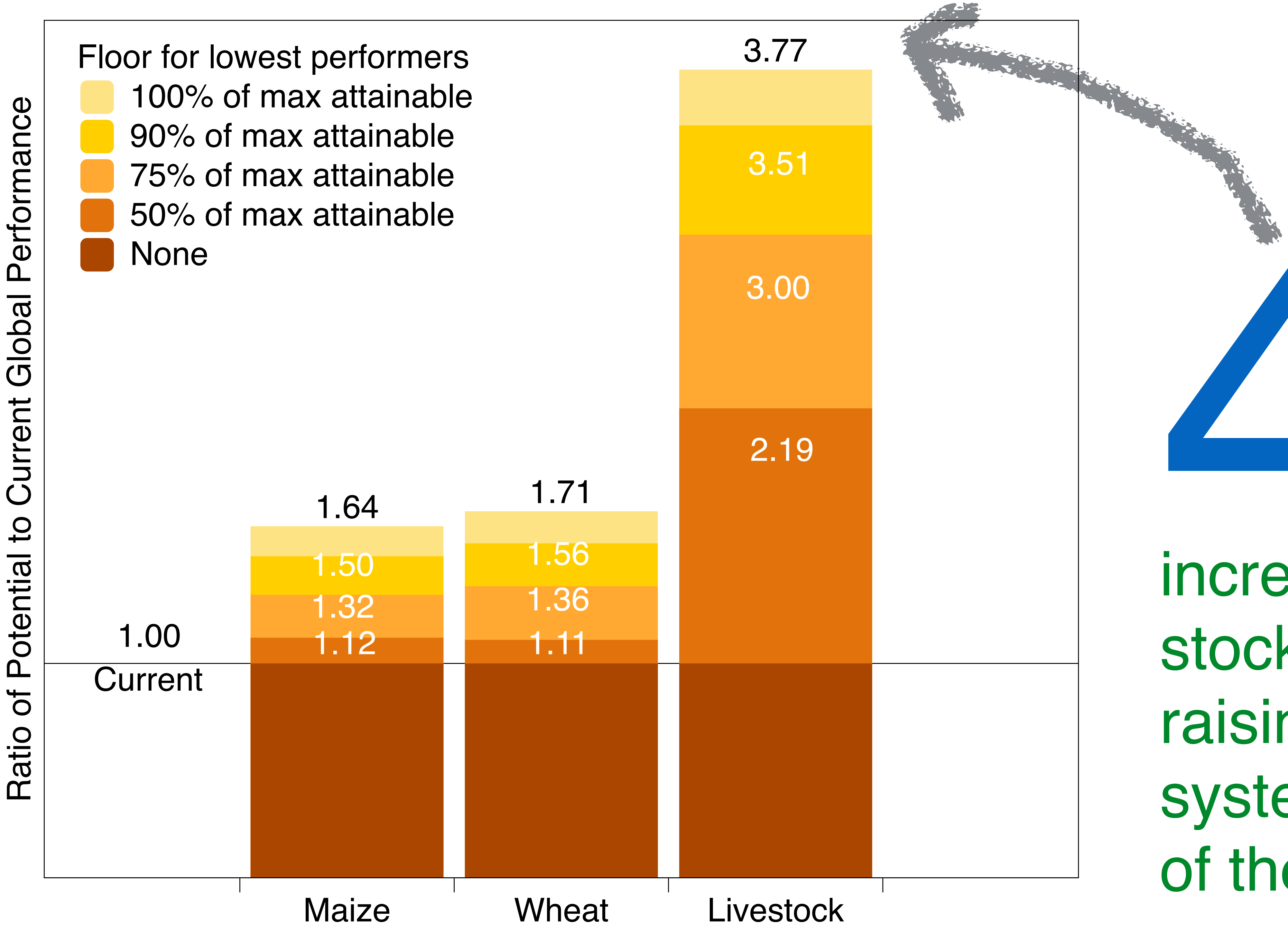
GLOBAL YIELD GAPS





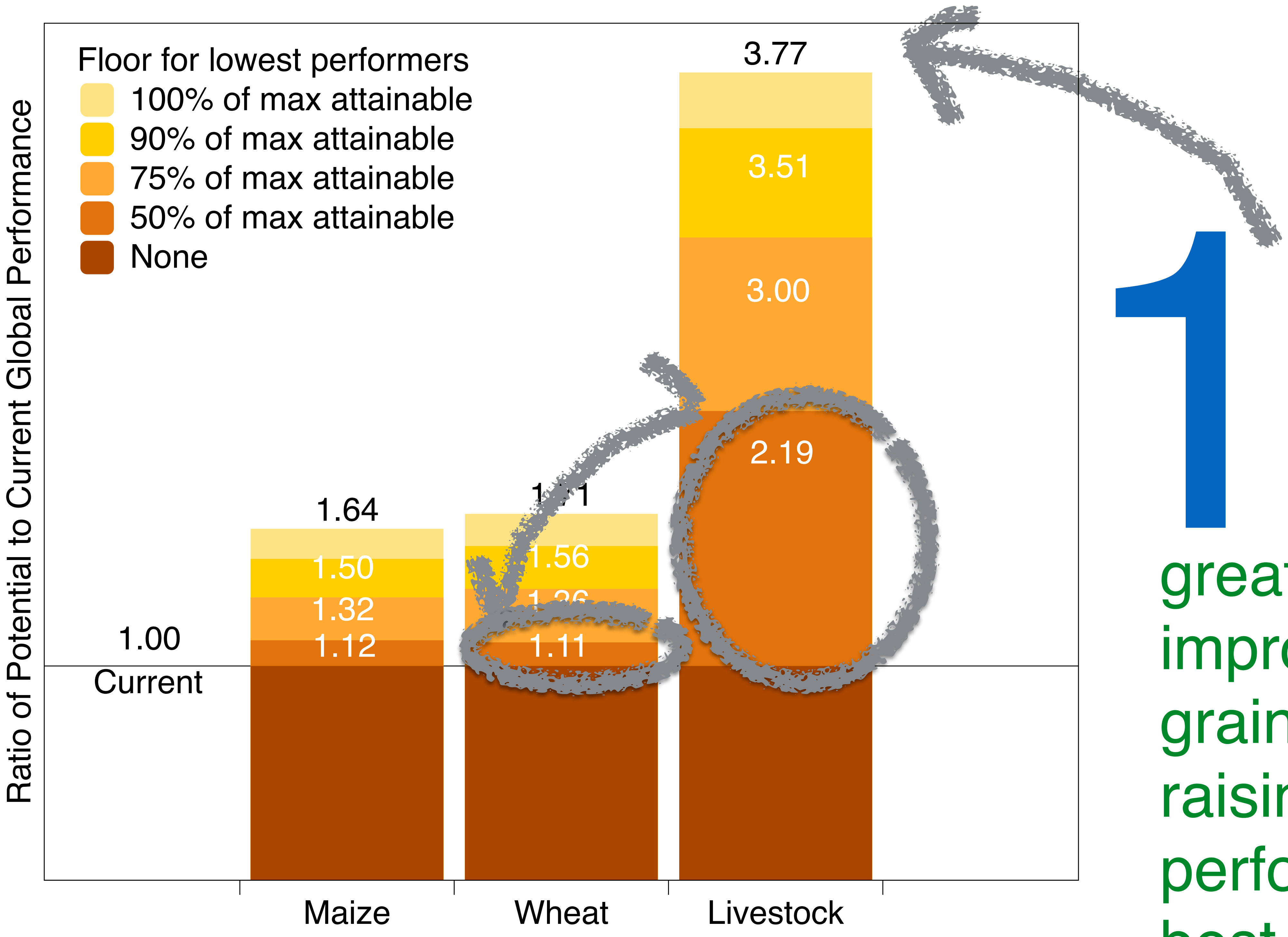
2x

increase in animal stock when the target is raising the bottom performers to 50% of best performing pastures



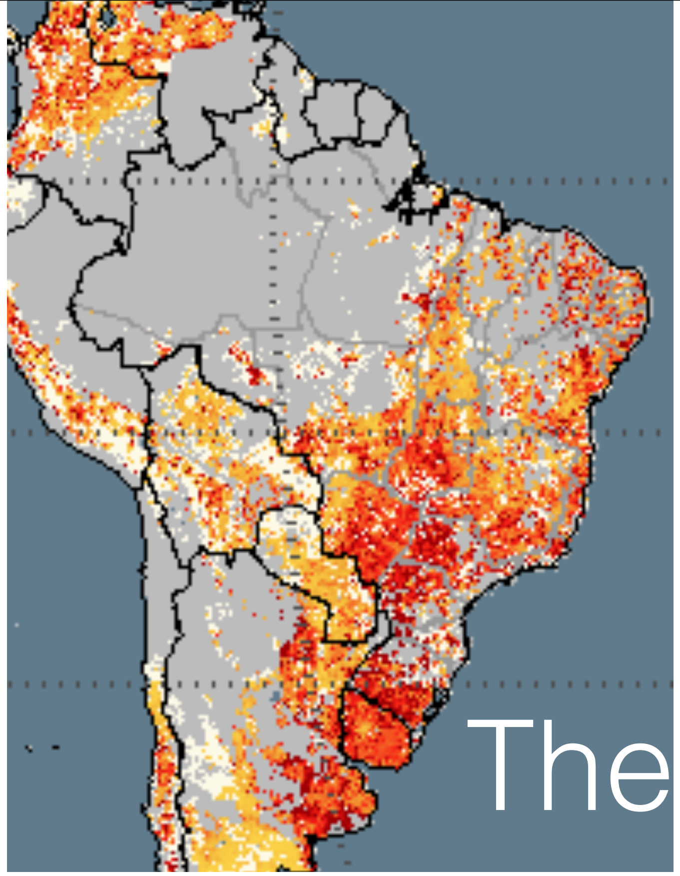
4x

increase in animal stock when target is raising all pasture systems to the level of the top performers



10x

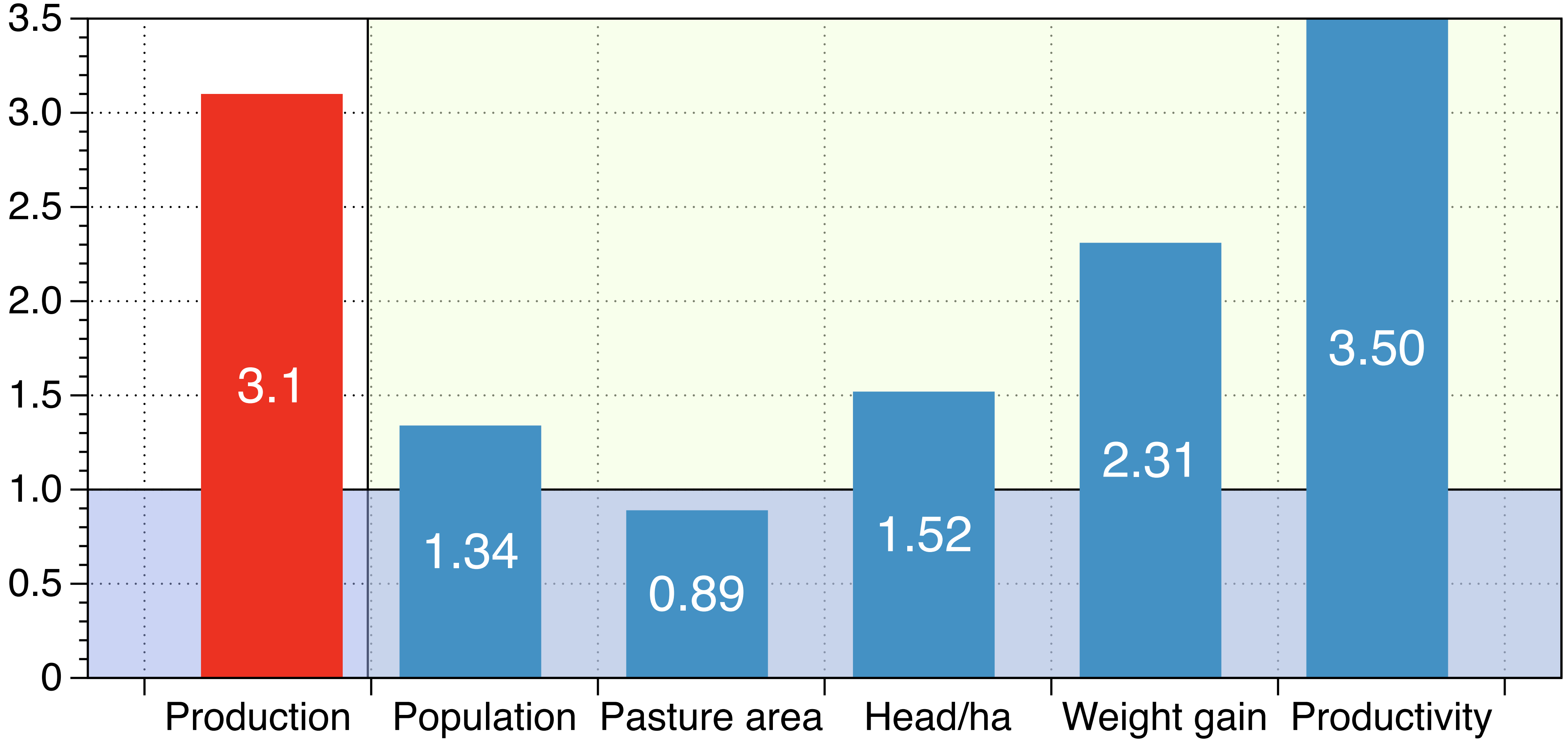
greater potential for improvement compared to grains when the target is raising the bottom performers to 50% of the best performers

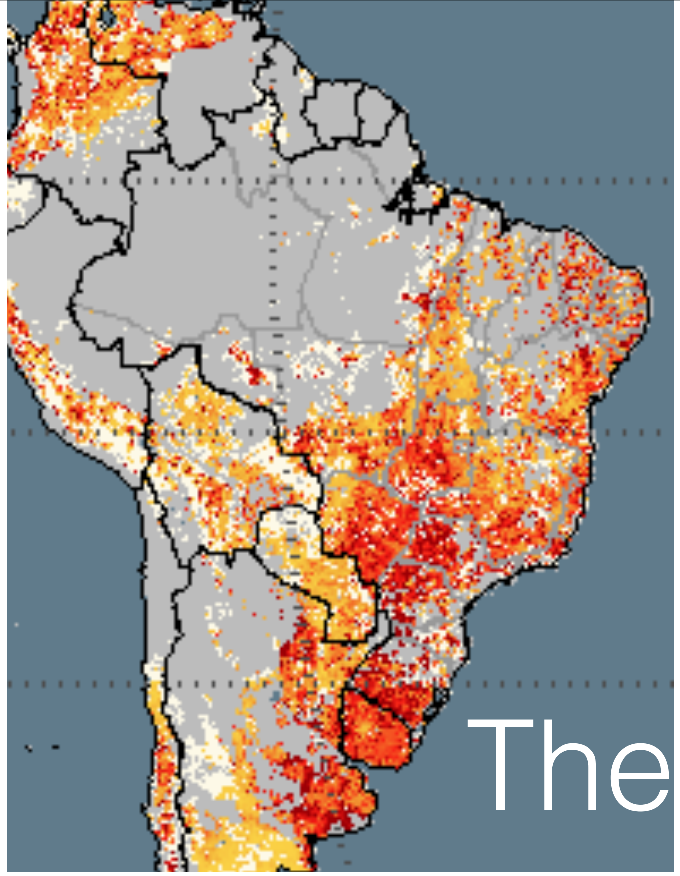


The
Brazil
Livestock story

Embrapa 40 anos

The power of
GAPS
1985-2006



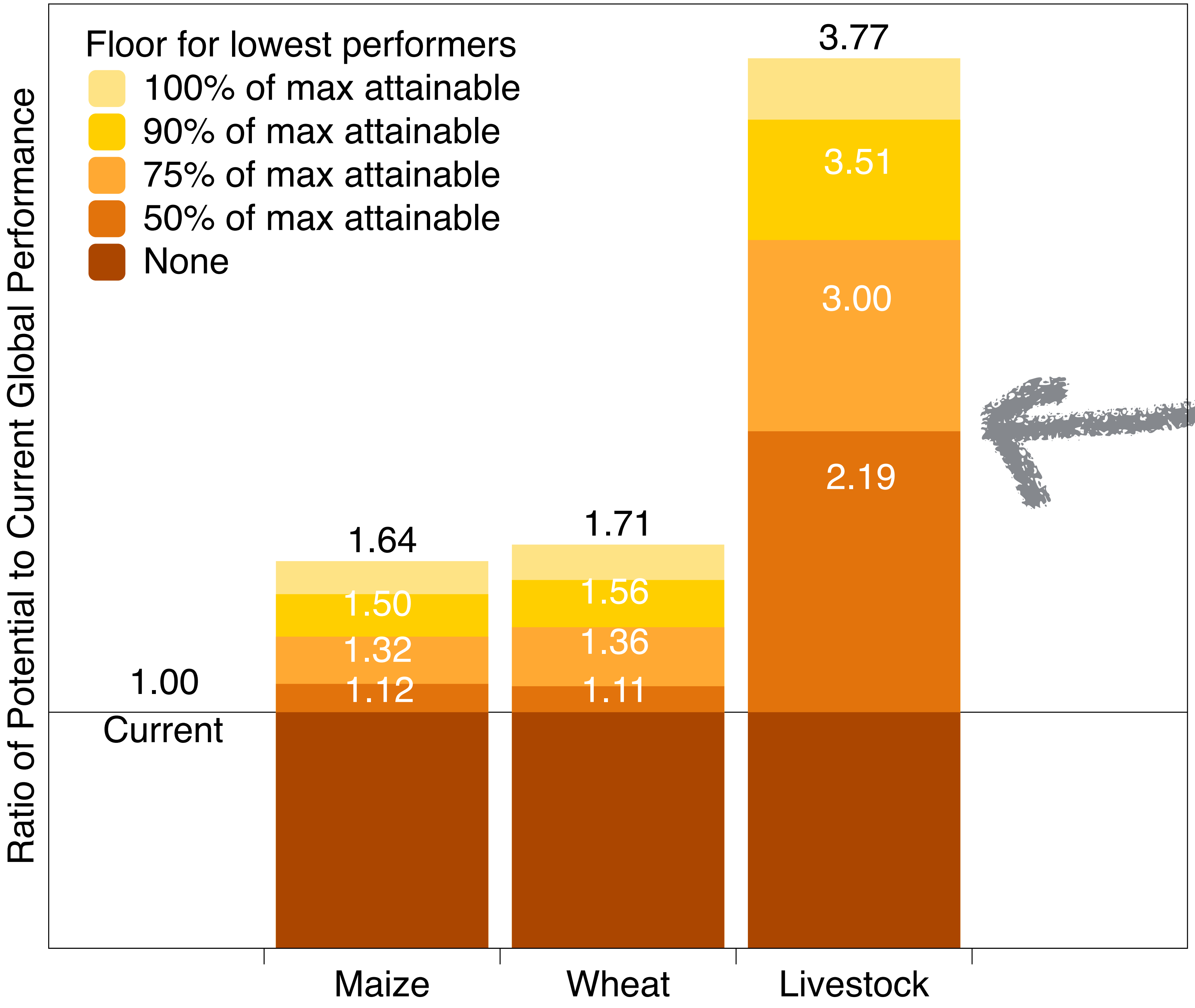


Brazil
Livestock
story

The power of GAPS

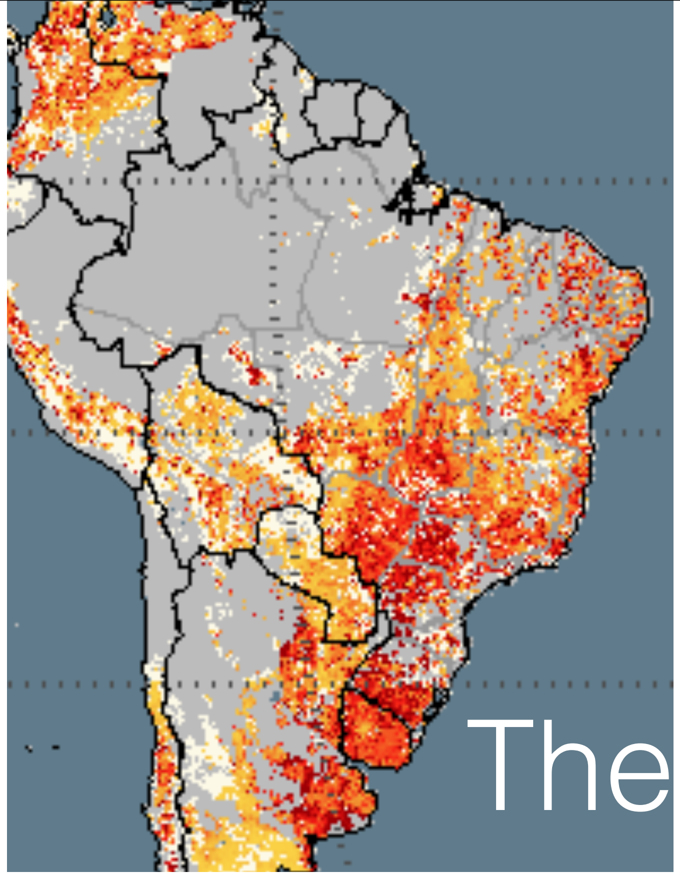
Bottom line

Raise poorest performers to 50%		Improve animal performance per Brazil		Net global intensification potential
2.19	x	2.31	=	5.06



2x

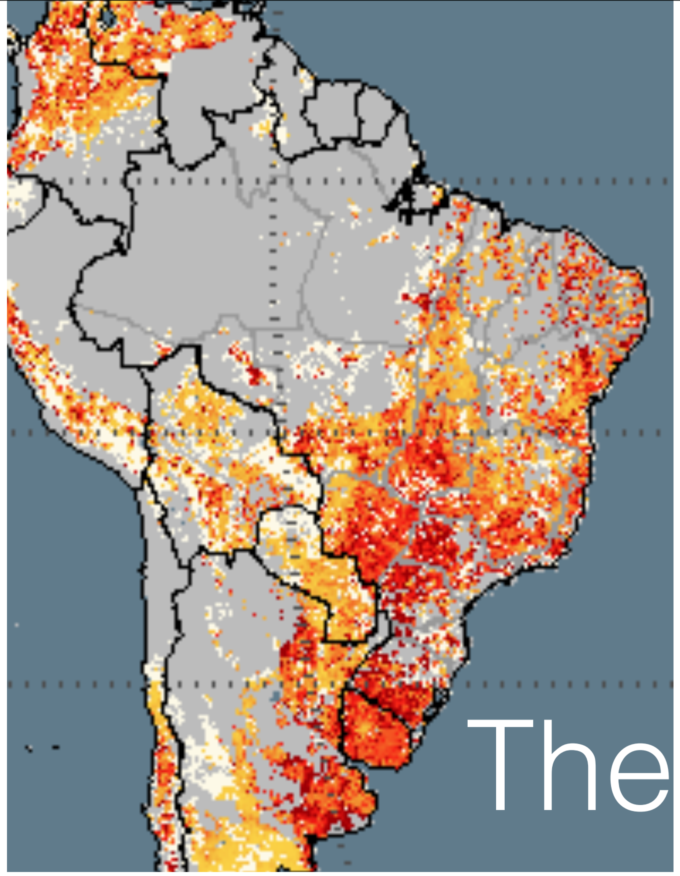
increase in animal stock when the target is raising the bottom performers to 50% of best performing pastures



The Brazil Livestock story

THE Bottom line

	Reduce livestock density gap to 50%	Same with improved animal performance
Pasture	2.19	2.19 x 2.3 = **5-fold**
Grain	1.12	na

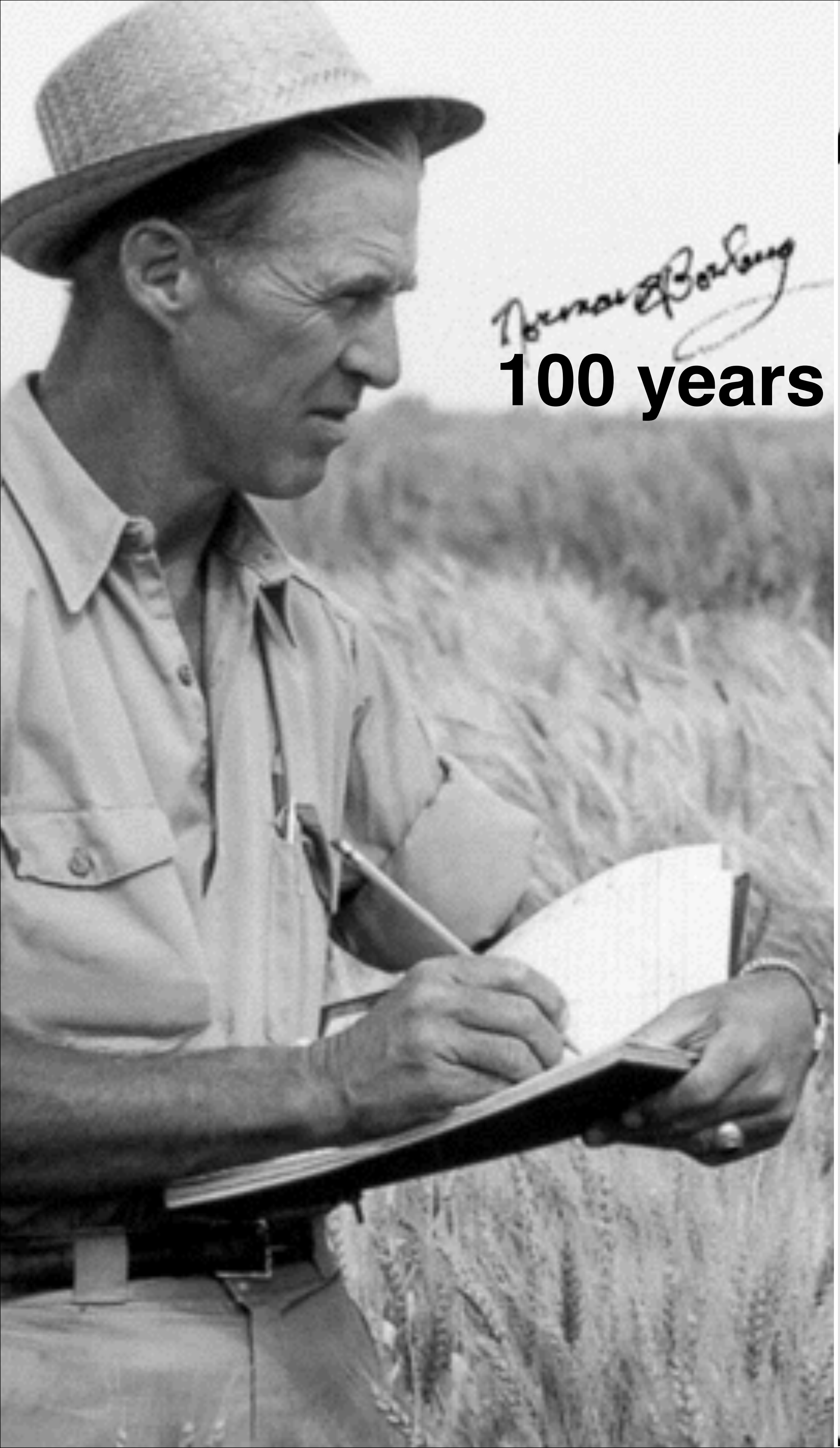


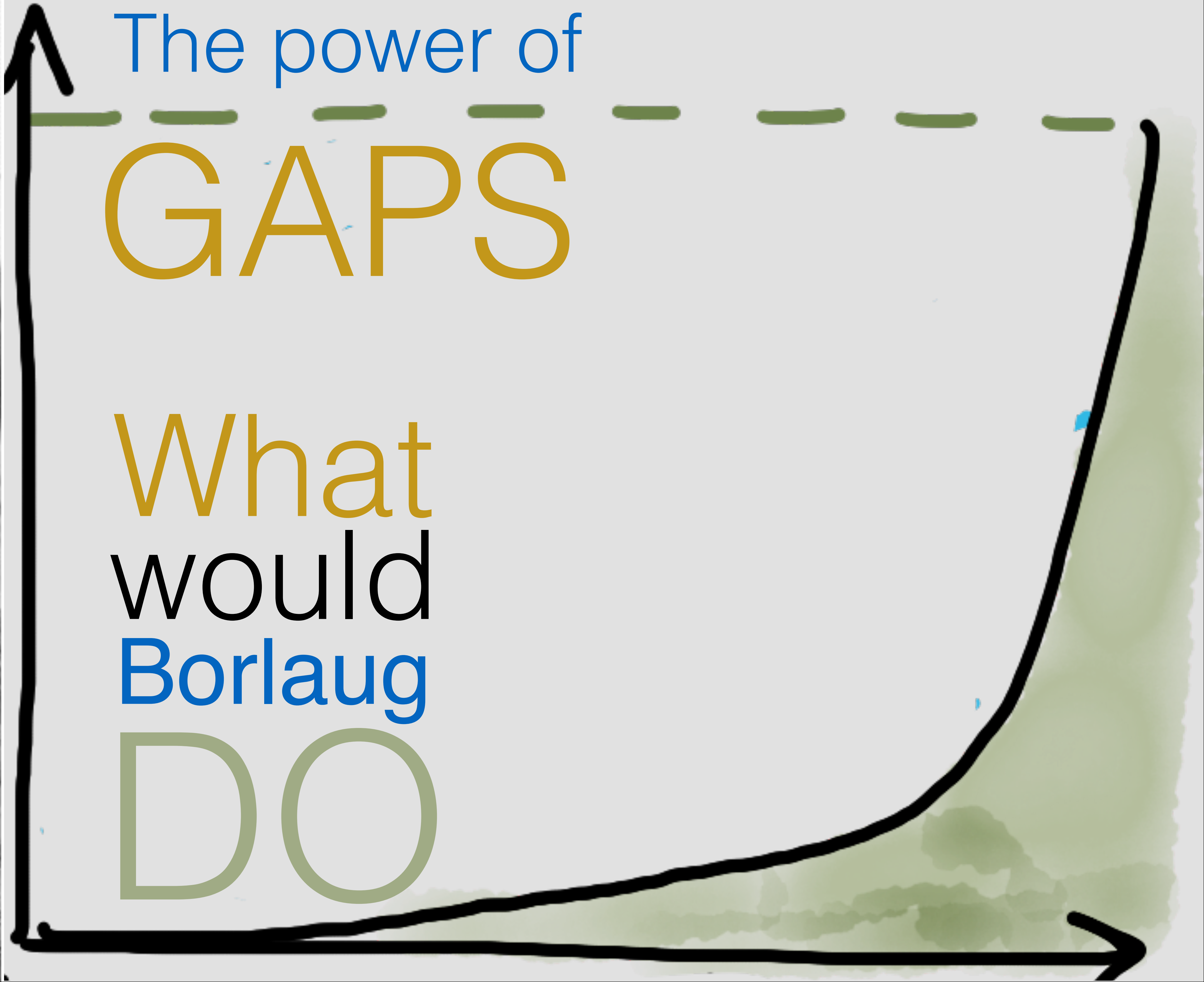
Brazil
Livestock story

Embrapa 40 anos

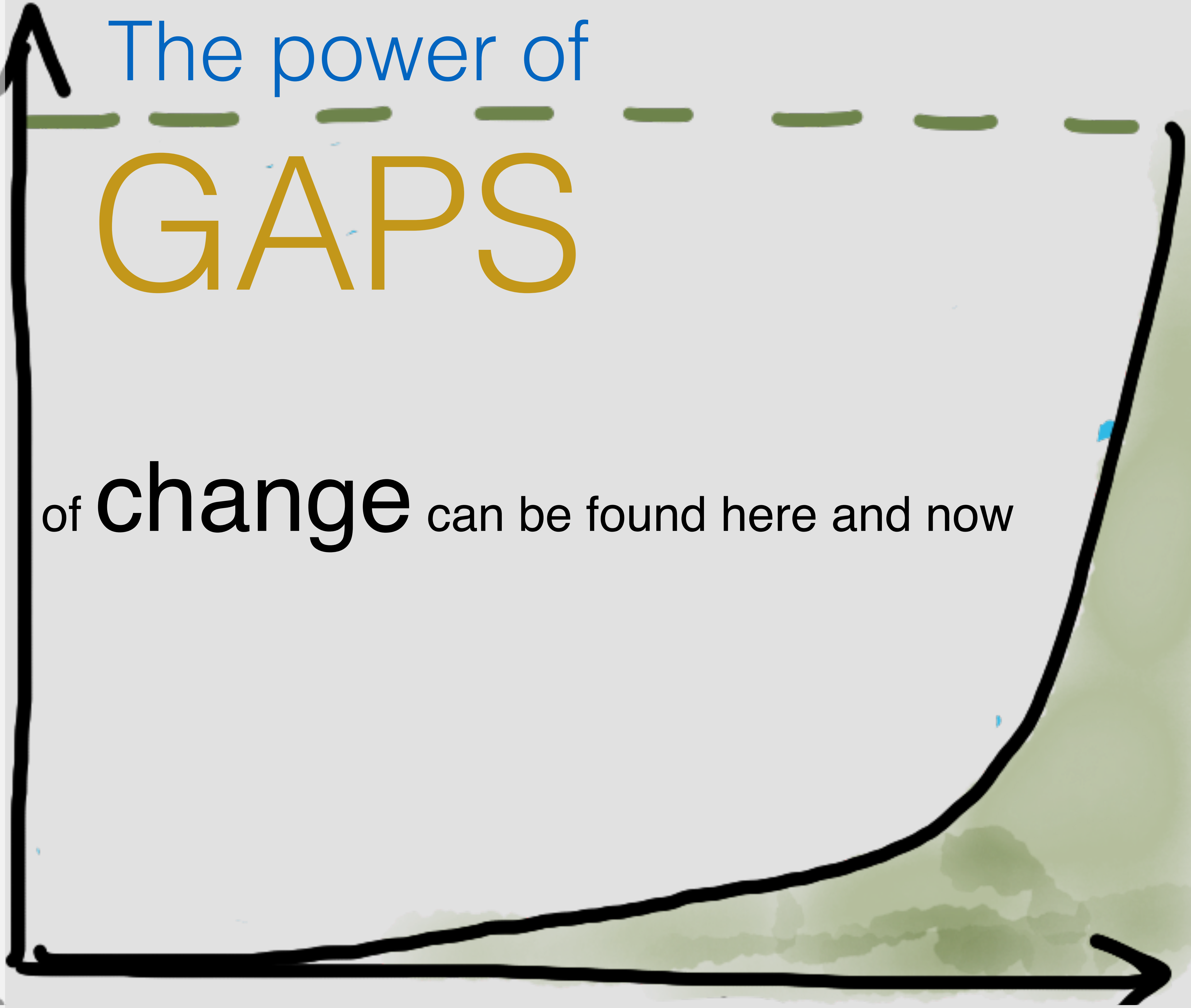
THE Bottom line

	Reduce livestock density gap to 100%	Same with improved animal performance
Pasture	3.77	3.77 x 2.3 = **9-fold**
Grain	1.64	na


100 years


The power of
GAPS
What
would
Borlaug
DO

The power of GAPS

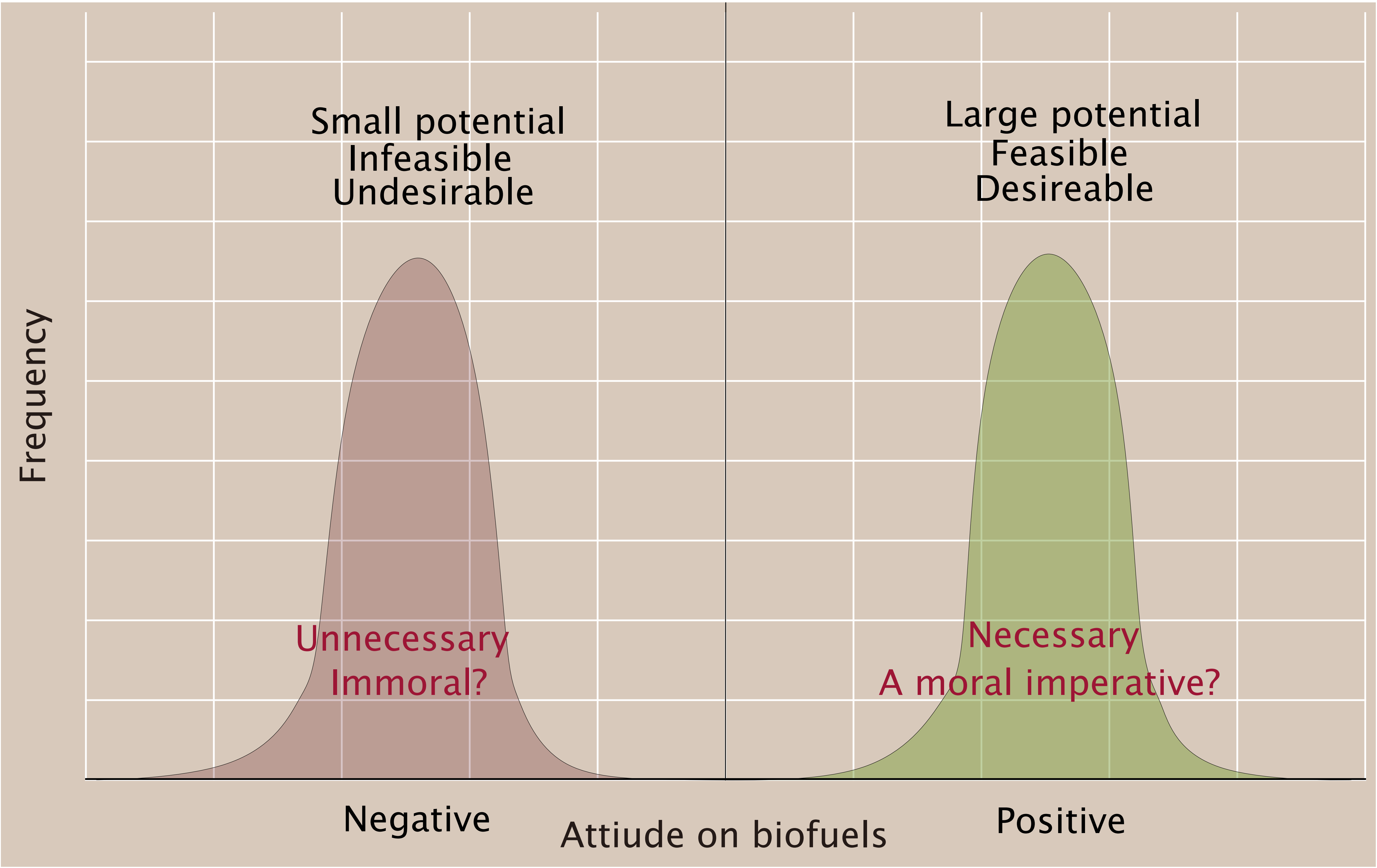


The **SEEDS** of change can be found here and now

THE BIOFUELS DILEMMA

When experts disagree, I always assume it's time for ordinary folks to find out what's going on.

Donella H. Meadows
The Global Citizen



THE POWER OF GAPS

The implicit assumption of *ceteris paribus*

The ethic of sustainable development

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thank you