Obstacles towards global food security

Martin van Ittersum – Plant Production Systems group

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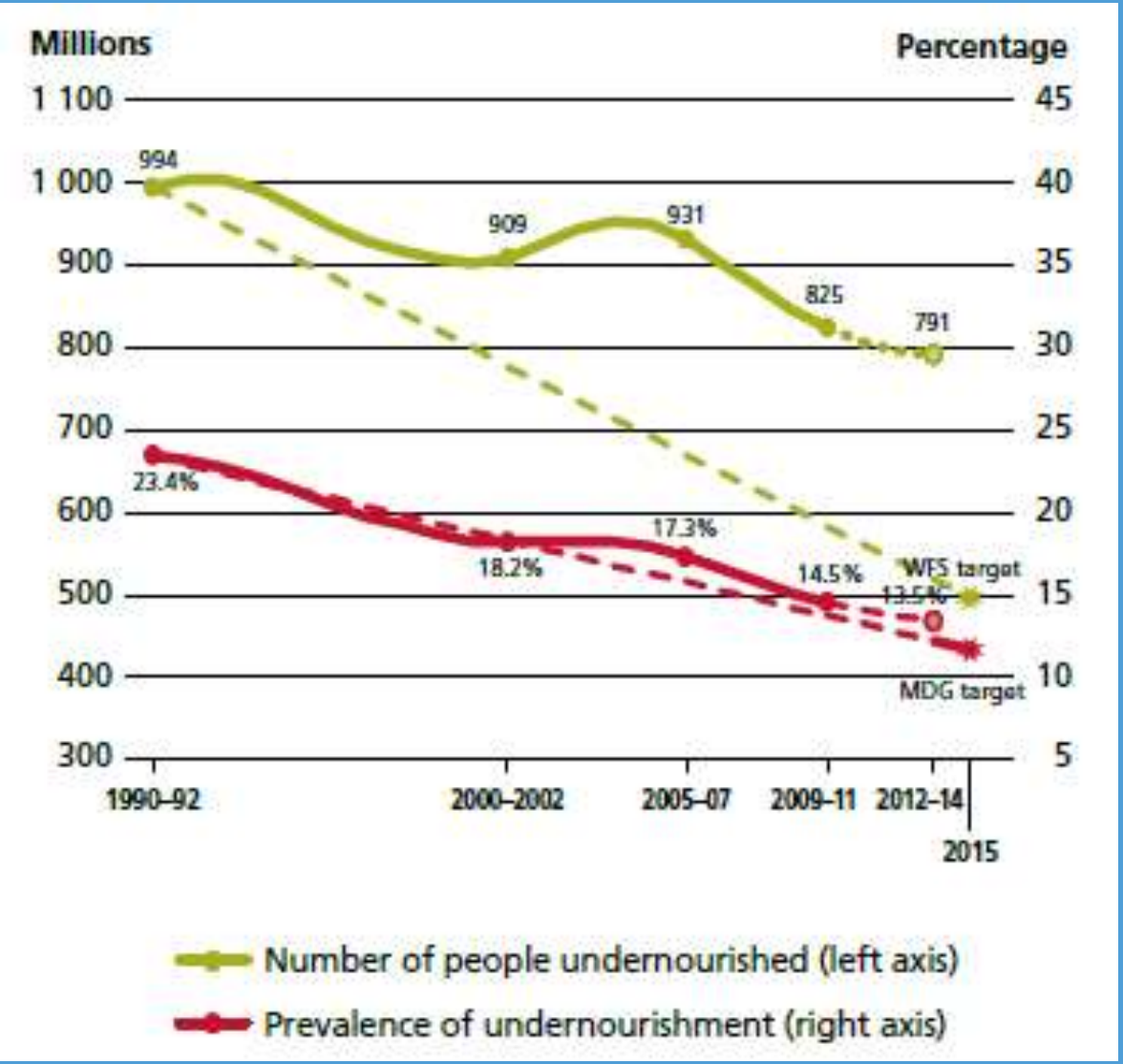
Millennium Development Goals (2000-2015)

- The Millennium Development Goals (MDGs) were eight goals with measurable targets and clear deadlines for improving the lives of the world's poorest people.

- Halving the number of hungry people

Number of hungry people



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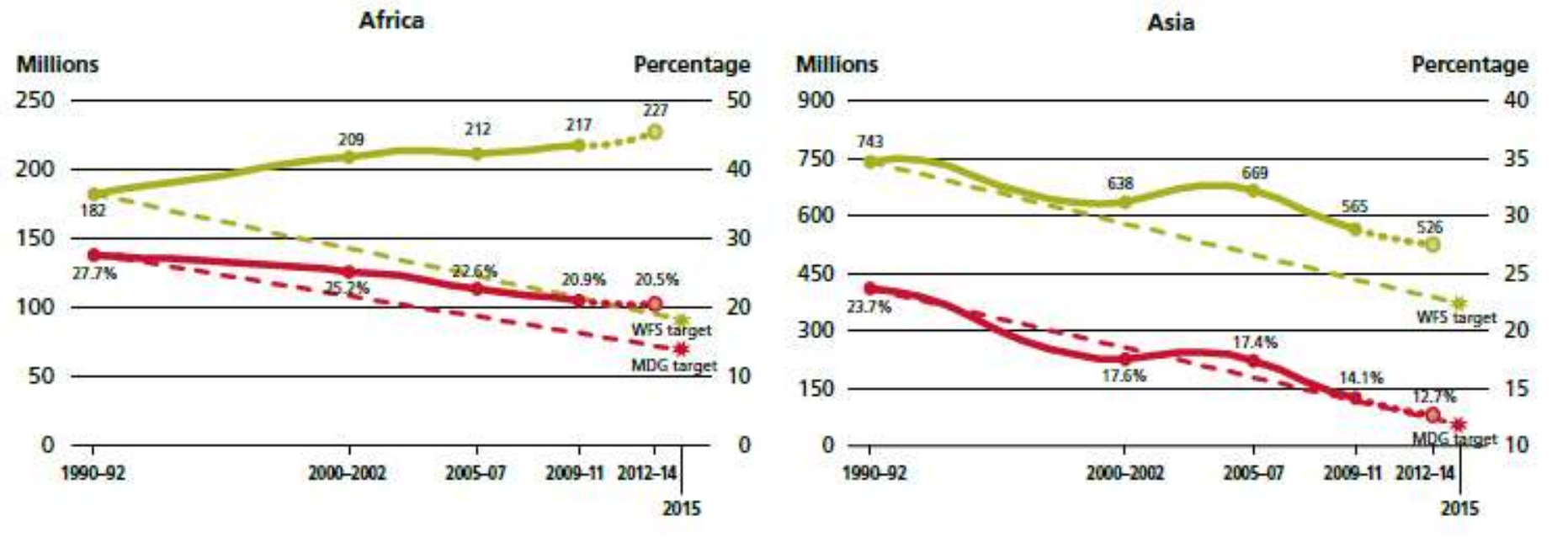
FAO, 2014

Where?



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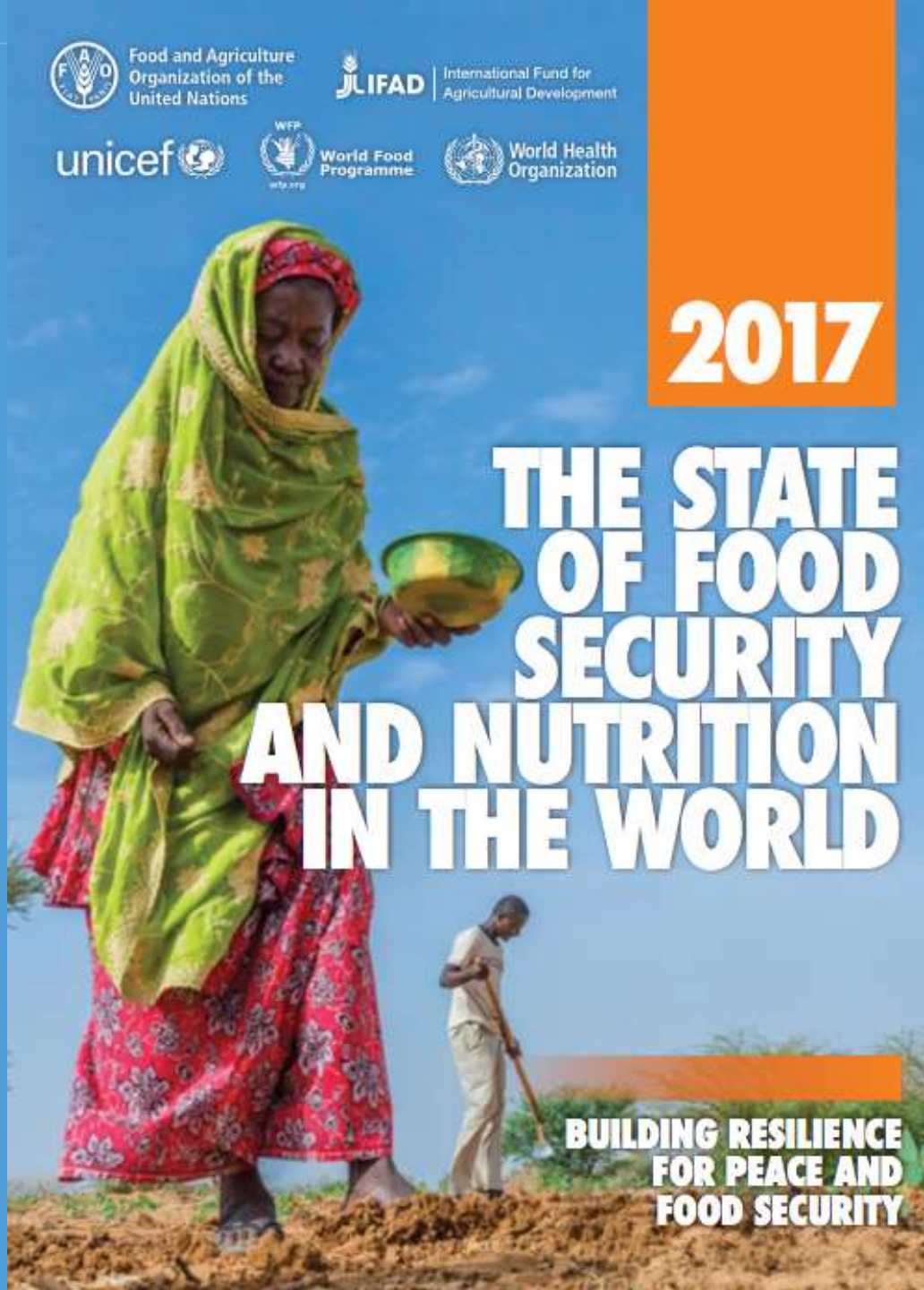
FAO, 2014

Food Security

- First time report focuses on conflict
- Worrying increase in food insecurity



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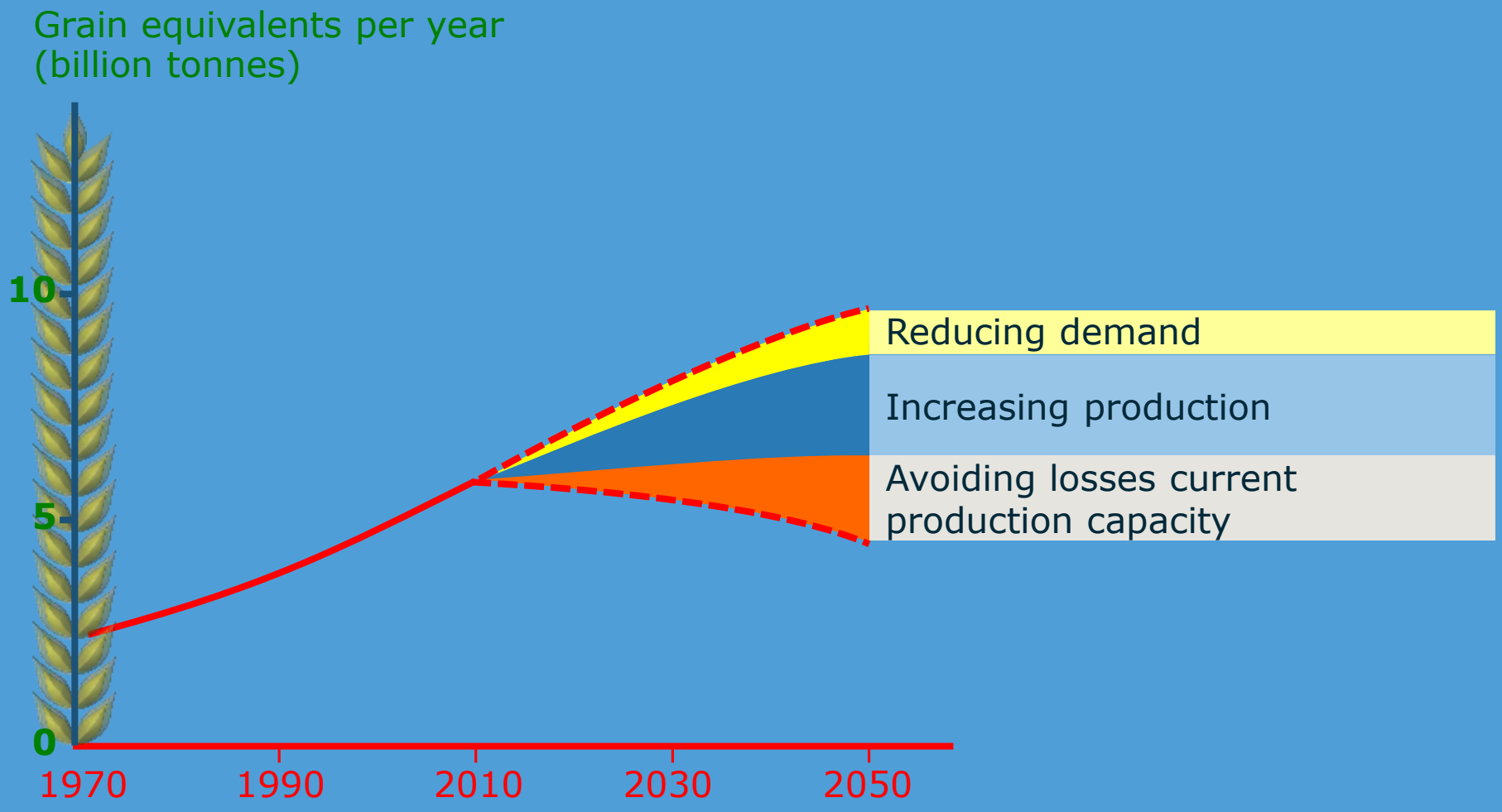
Sustainable Development Goals
2015–2030

SDG 2 End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Looking ahead: + 60% demand (FAO)



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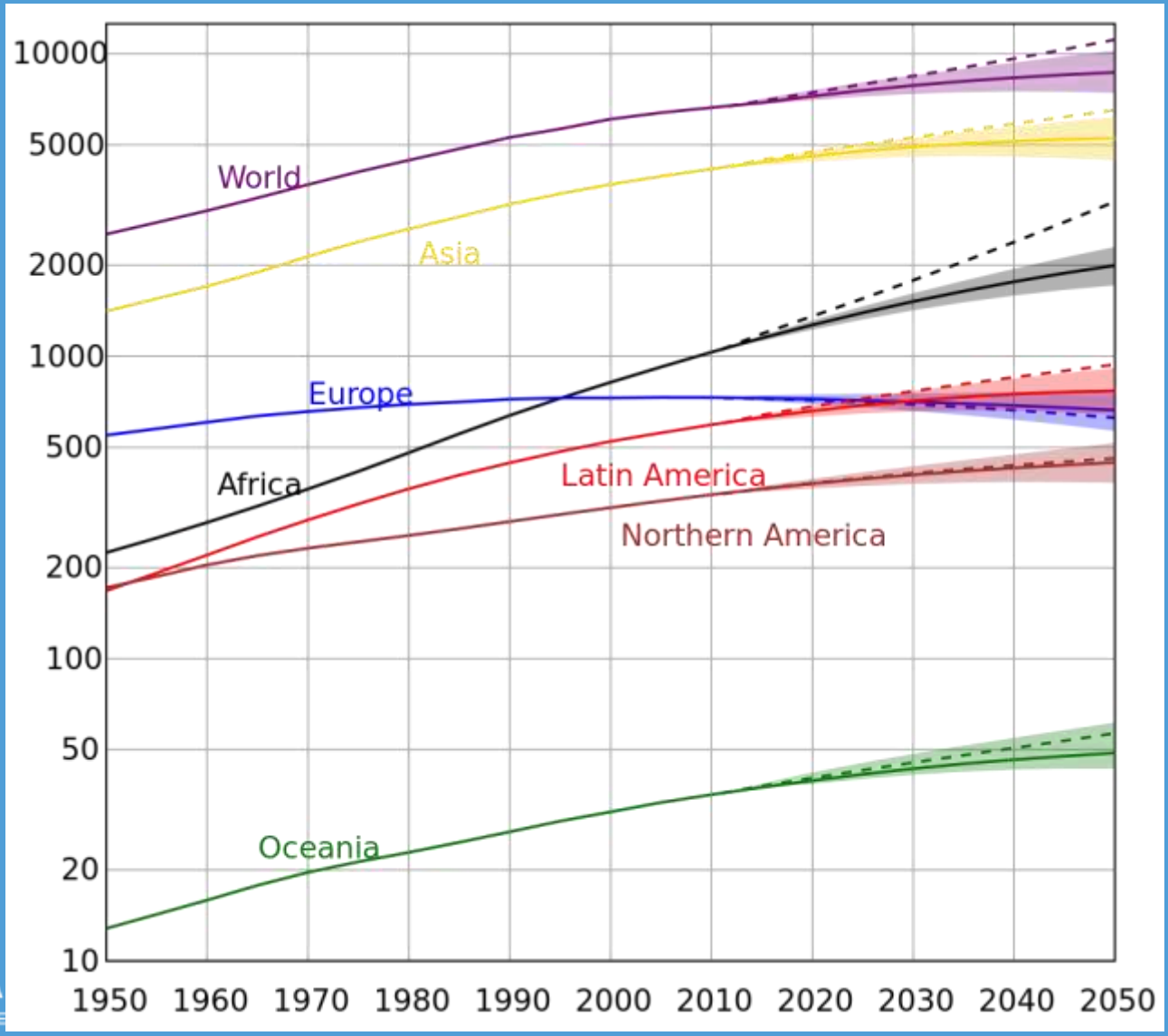
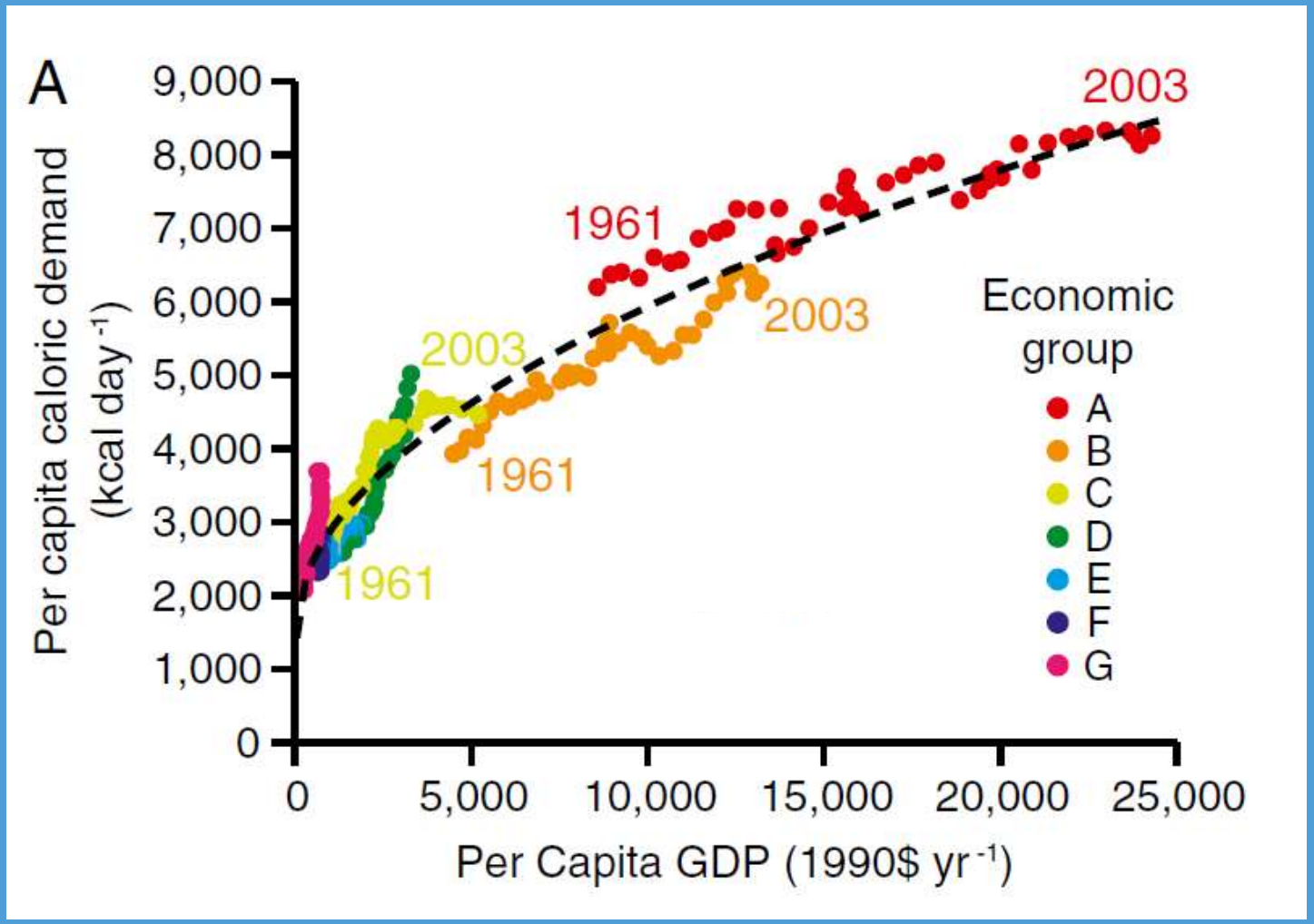
after Keating et al., 2014. Global Food Security

Population growth

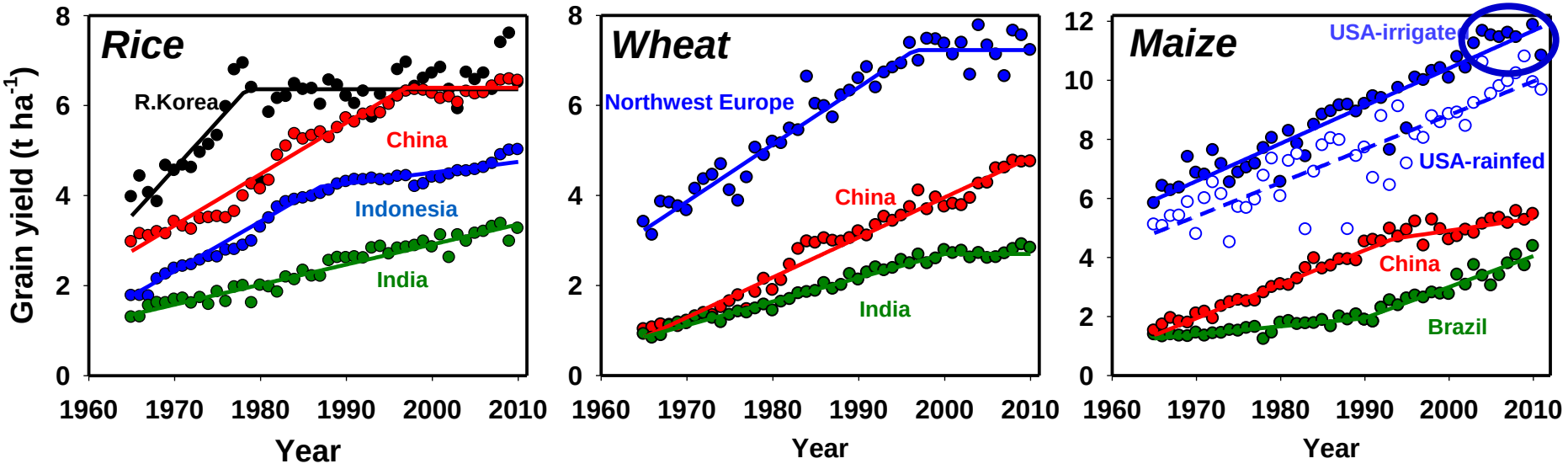


Demand versus income (per capita)



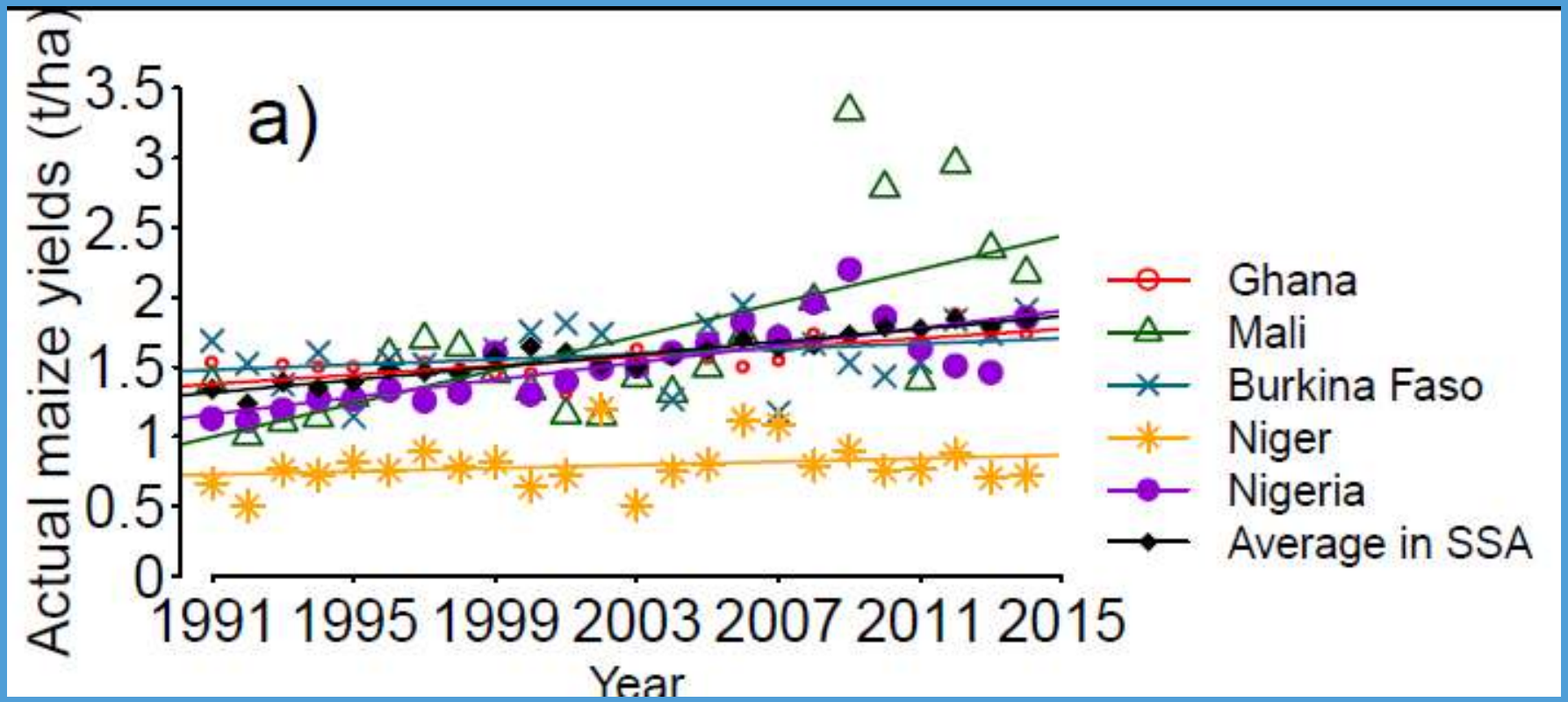
Tilman et al., 2011 (PNAS)

Slack in cereal yield increases?



Grassini et al., 2011 (Nature Communications)

Slack in cereal yield increases?

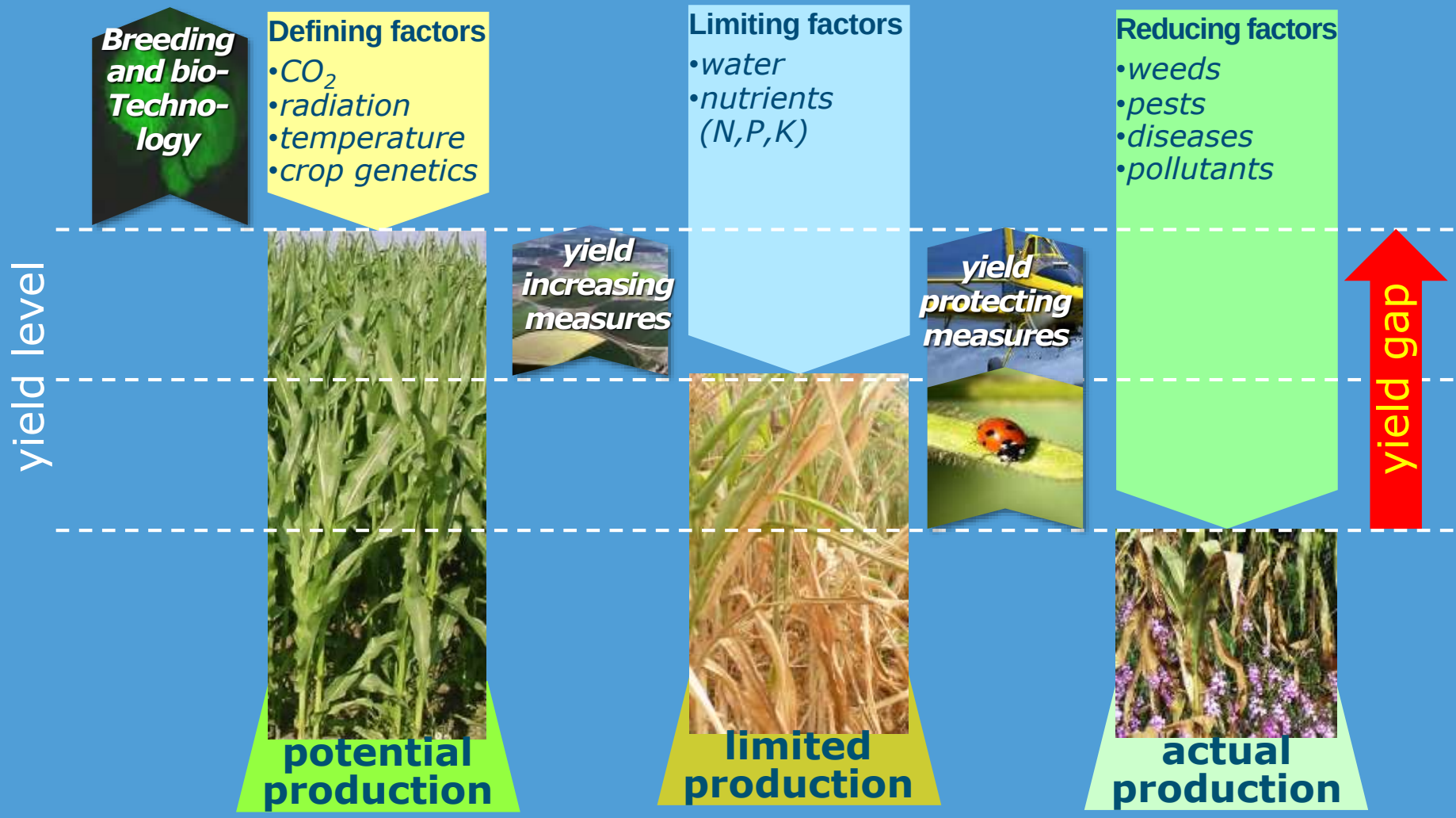


FAO and Van Ittersum et al., 2016 (PNAS)

The need and possibilities for extra food is very region-specific

So, it is crucial to know where production can be increased and how

Production-ecological principles & practice



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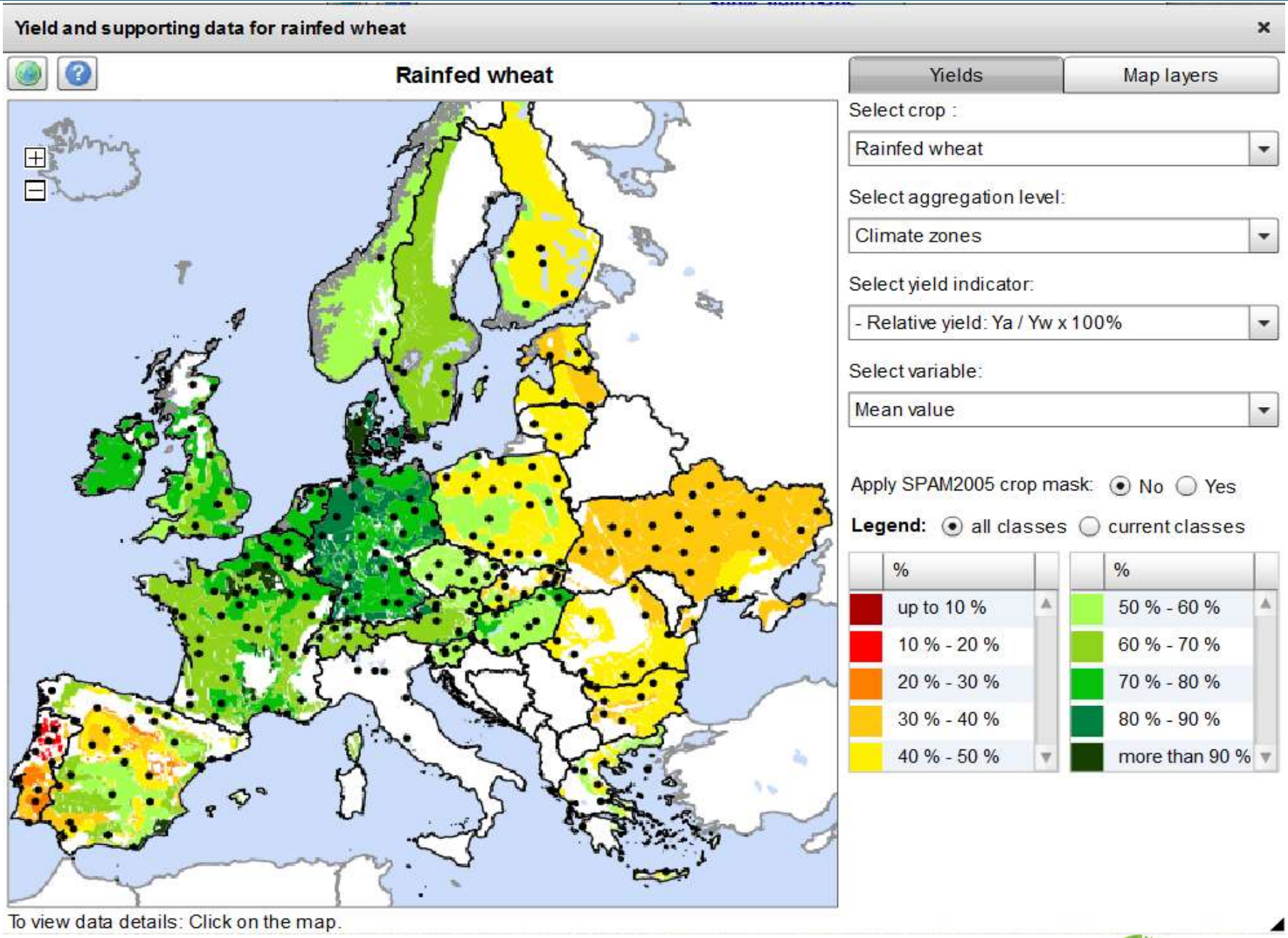
For quality of life

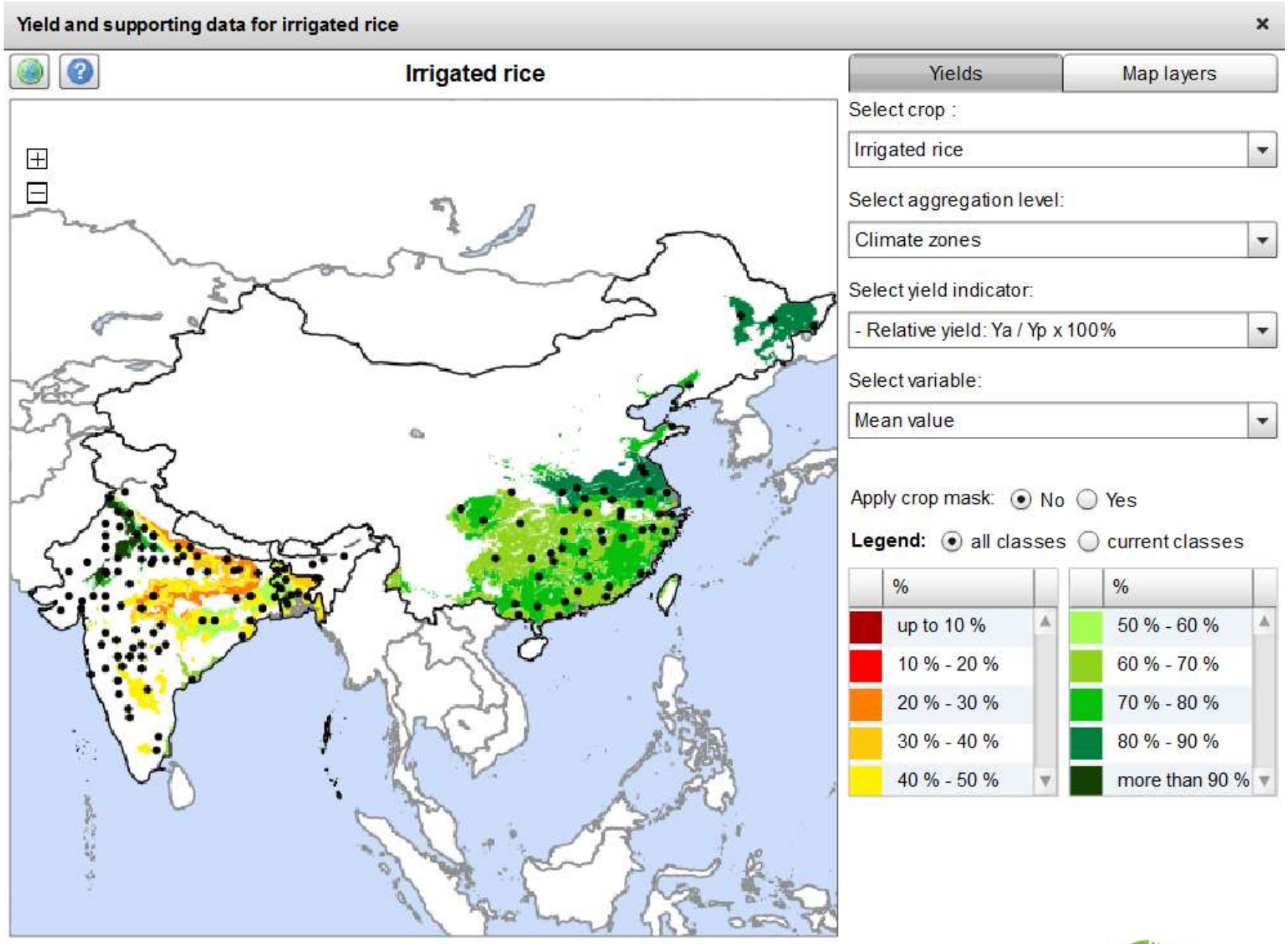
Van Ittersum and Rabbinge, 1997
Slide: Harrie Lovenstein

Yield gap analysis

Photo: Ken Giller

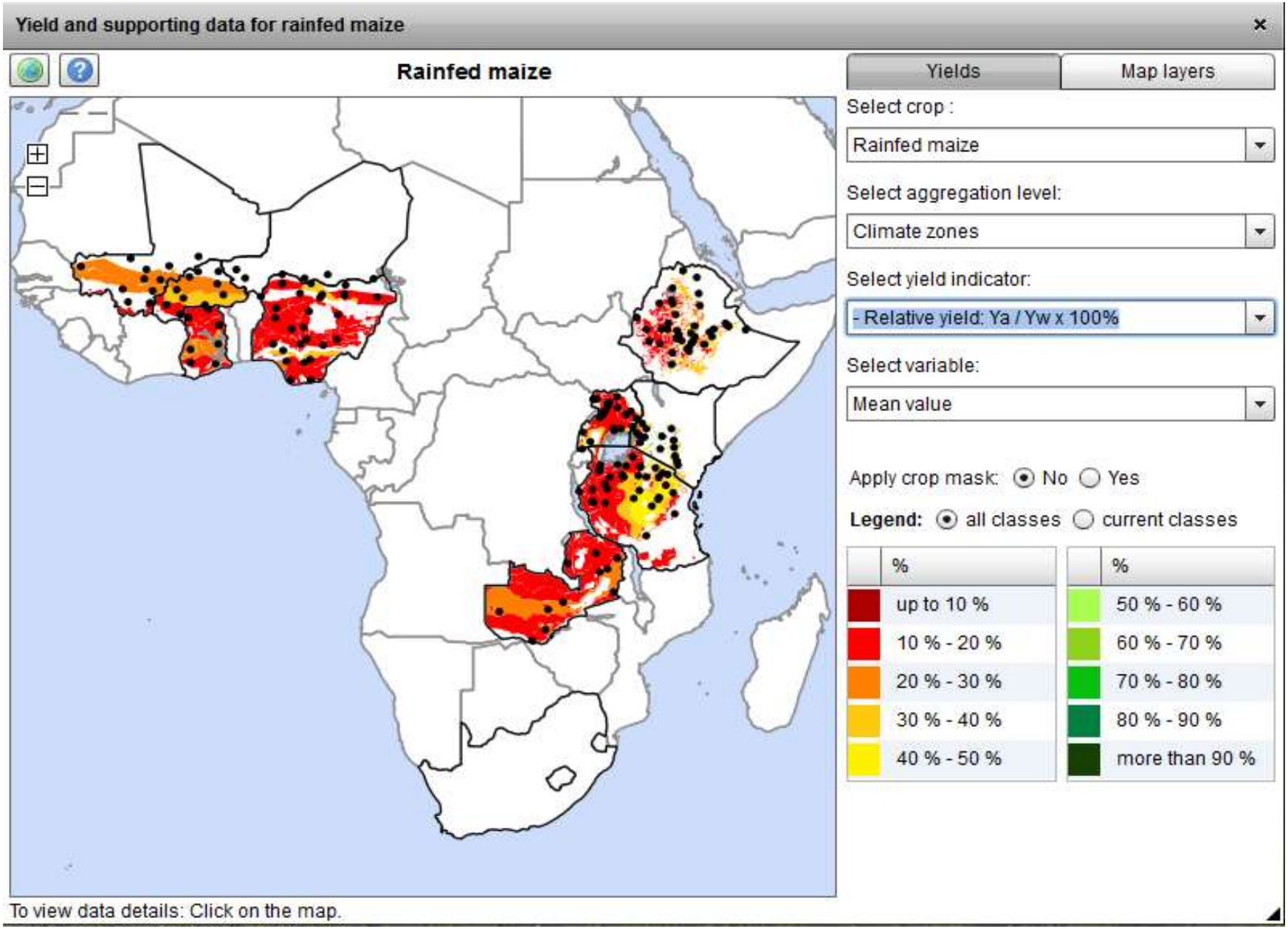
Global Yield Gap Atlas


Yield and supporting data for rainfed wheat
Rainfed wheat
Yields
Map layers
Select crop :
Rainfed wheat
Select aggregation level:
Climate zones
Select yield indicator:
- Relative yield: Ya / Yw x 100%
Select variable:
Mean value
Apply SPAM2005 crop mask: No Yes
Legend: all classes current classes
%
up to 10 %
10 % - 20 %
20 % - 30 %
30 % - 40 %
40 % - 50 %
%
50 % - 60 %
60 % - 70 %
70 % - 80 %
80 % - 90 %
more than 90 %
To view data details: Click on the map.



www.yieldgap.org

Global Yield Gap Atlas


Yield and supporting data for rainfed maize
Rainfed maize
Yields
Map layers
Select crop :
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Climate zones
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Global Yield Gap Atlas

Can sub-Saharan Africa feed itself?

Van Ittersum et al., 2016 (PNAS)

University of Nebraska Lincoln

Wageningen University Wageningen UR

Water for Food Robert B. Daugherty Institute University of Nebraska

ICRISAT Science with a human face

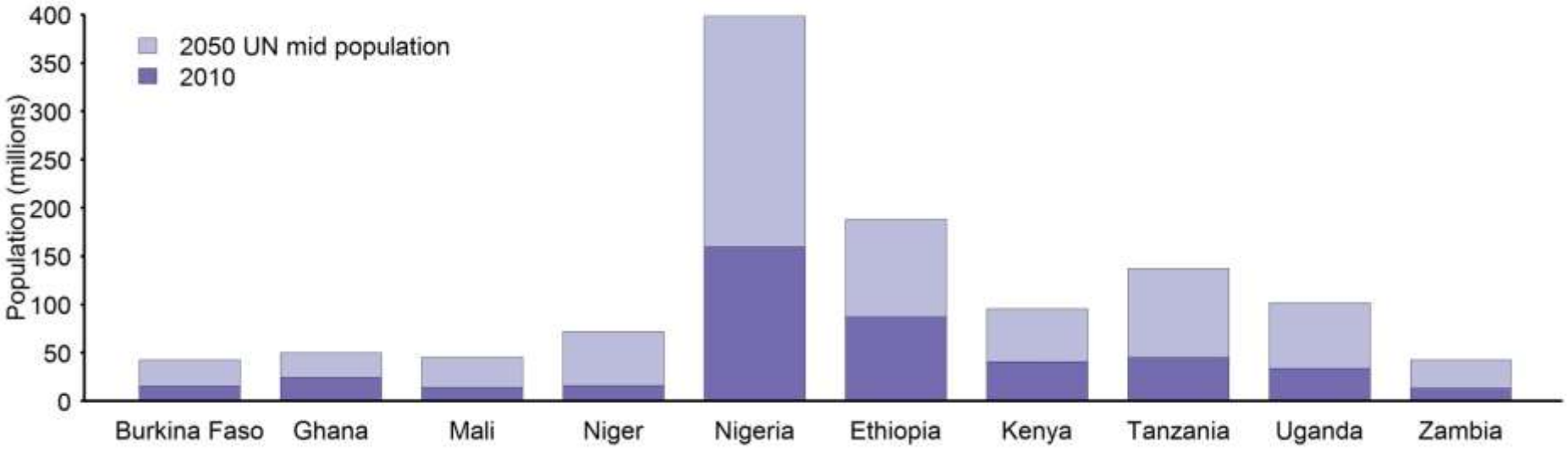
Growth in population: 2010-2050

Country	Population 2010 (million)	Population 2050 (million)	% Population increase
Burkina Faso	16	41	256
Ghana	24	46	192
Mali	14	45	321
Niger	16	69	431
Nigeria	159	440	277
Ethiopia	87	188	216
Kenya	41	97	237
Tanzania	45	129	287
Uganda	33	104	315
Zambia	13	44	338

UN, 2015

Global Yield Gap Atlas

Growth in population 2050

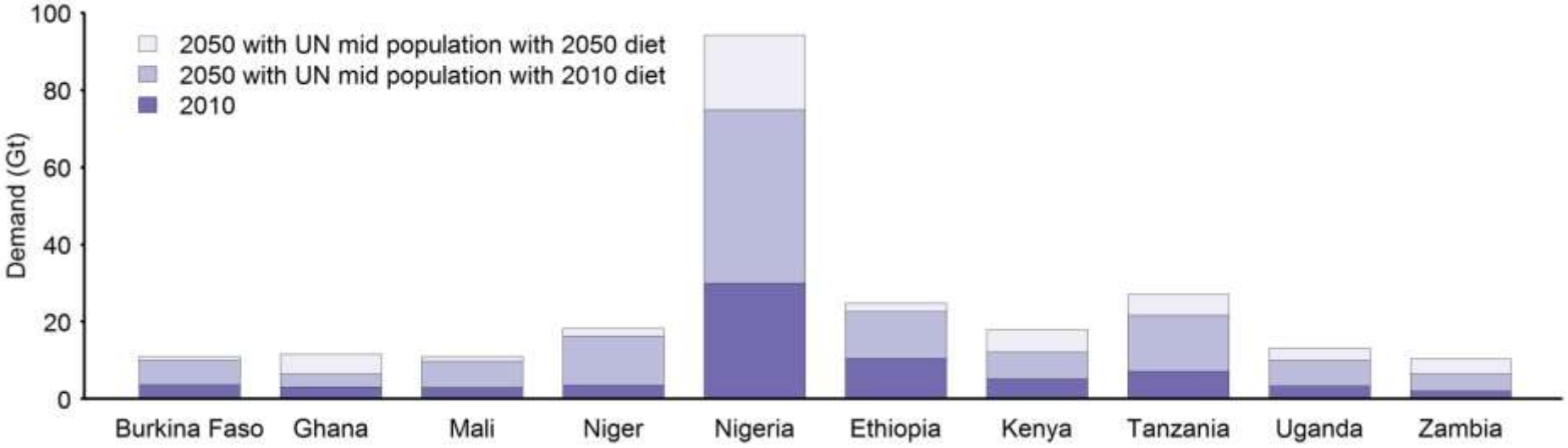


From 0.45 to 1.2 billion (2.6 times)

Van Ittersum et al., 2016 (PNAS)

Global Yield Gap Atlas

Growth in population and cereal demand - 2050

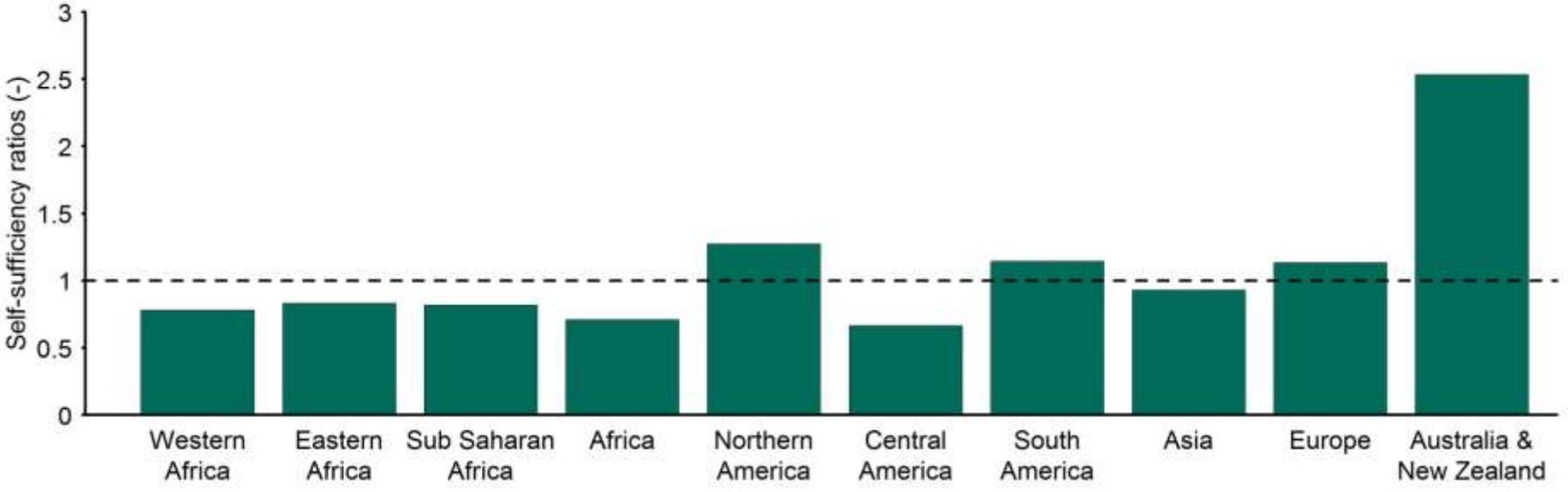


A factor 3.4 increase!

Van Ittersum et al., 2016 (PNAS)

Global Yield Gap Atlas

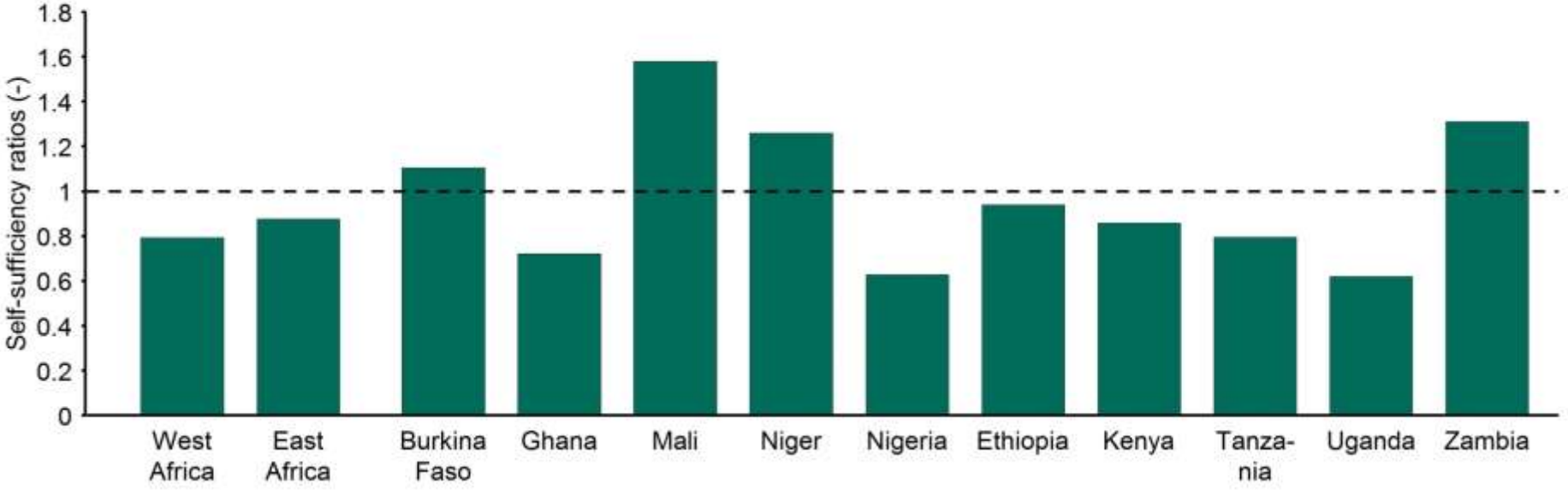
Current self-sufficiency ratios cereals - 2010



Van Ittersum et al., 2016 (PNAS), based on FAOSTAT

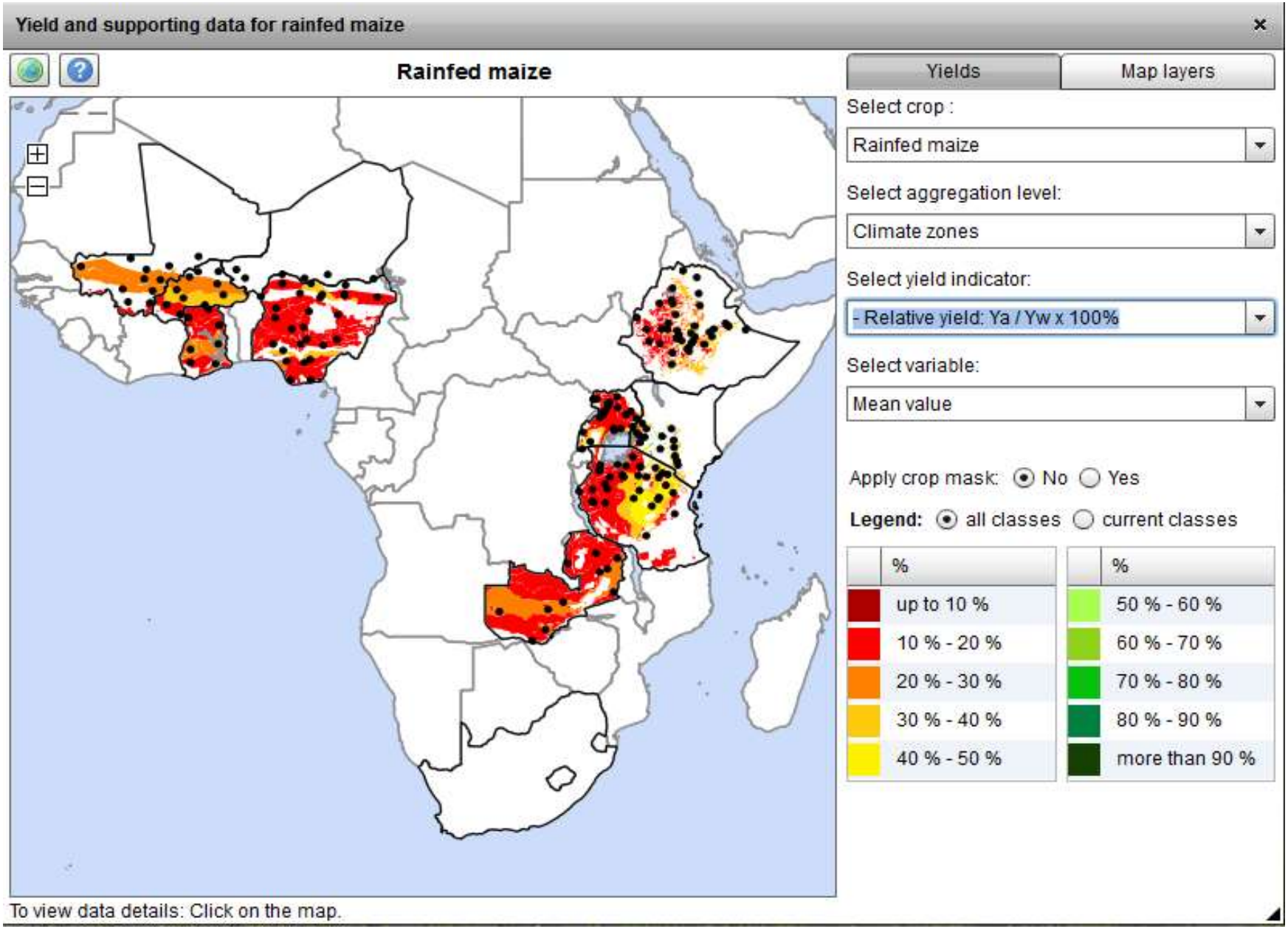
Global Yield Gap Atlas

Current self-sufficiency cereals SSA - 2010



Van Ittersum et al., 2016 (PNAS), based on IMPACT model

Global Yield Gap Atlas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%
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60 % - 70 %
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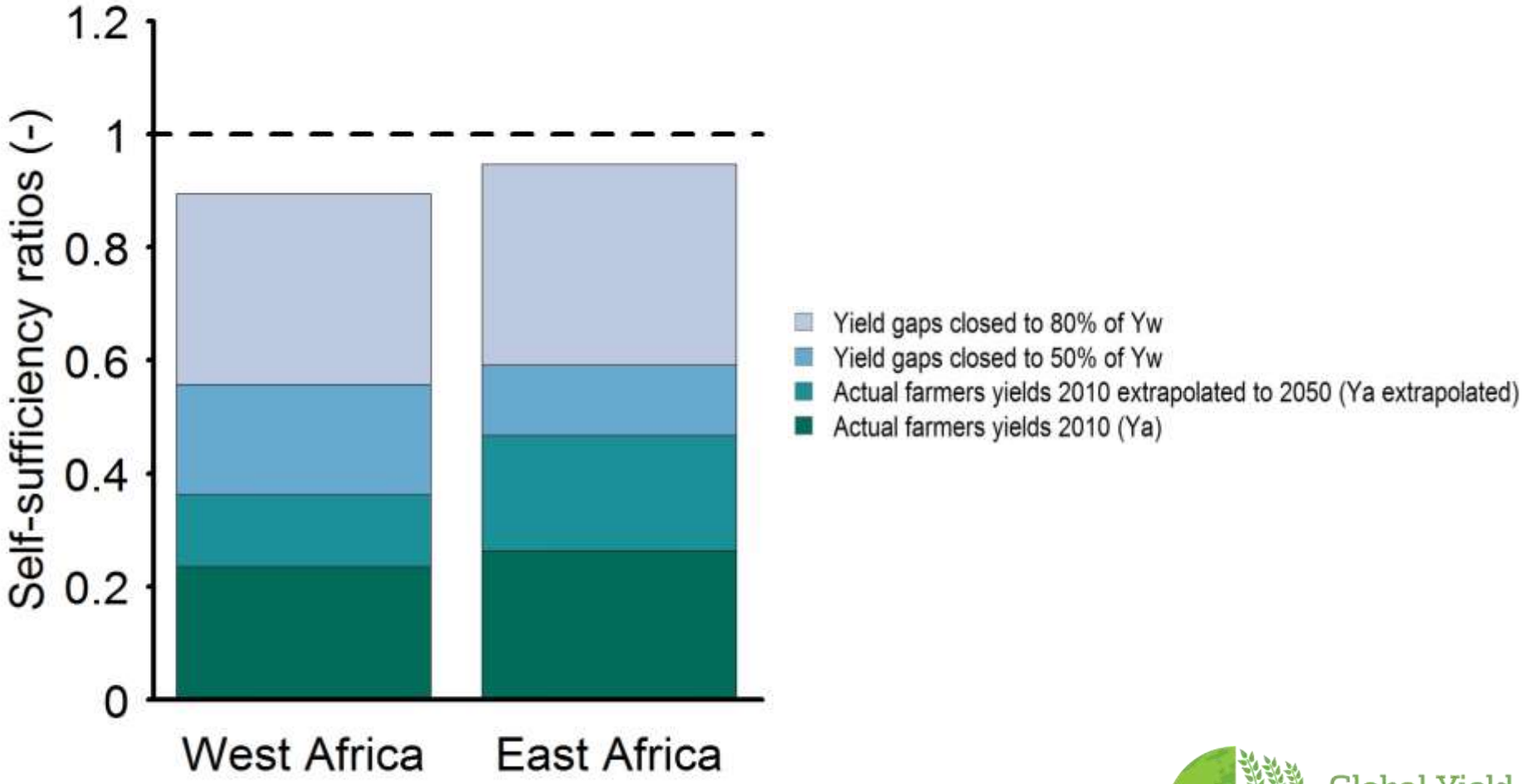
more than 90 %
To view data details: Click on the map.

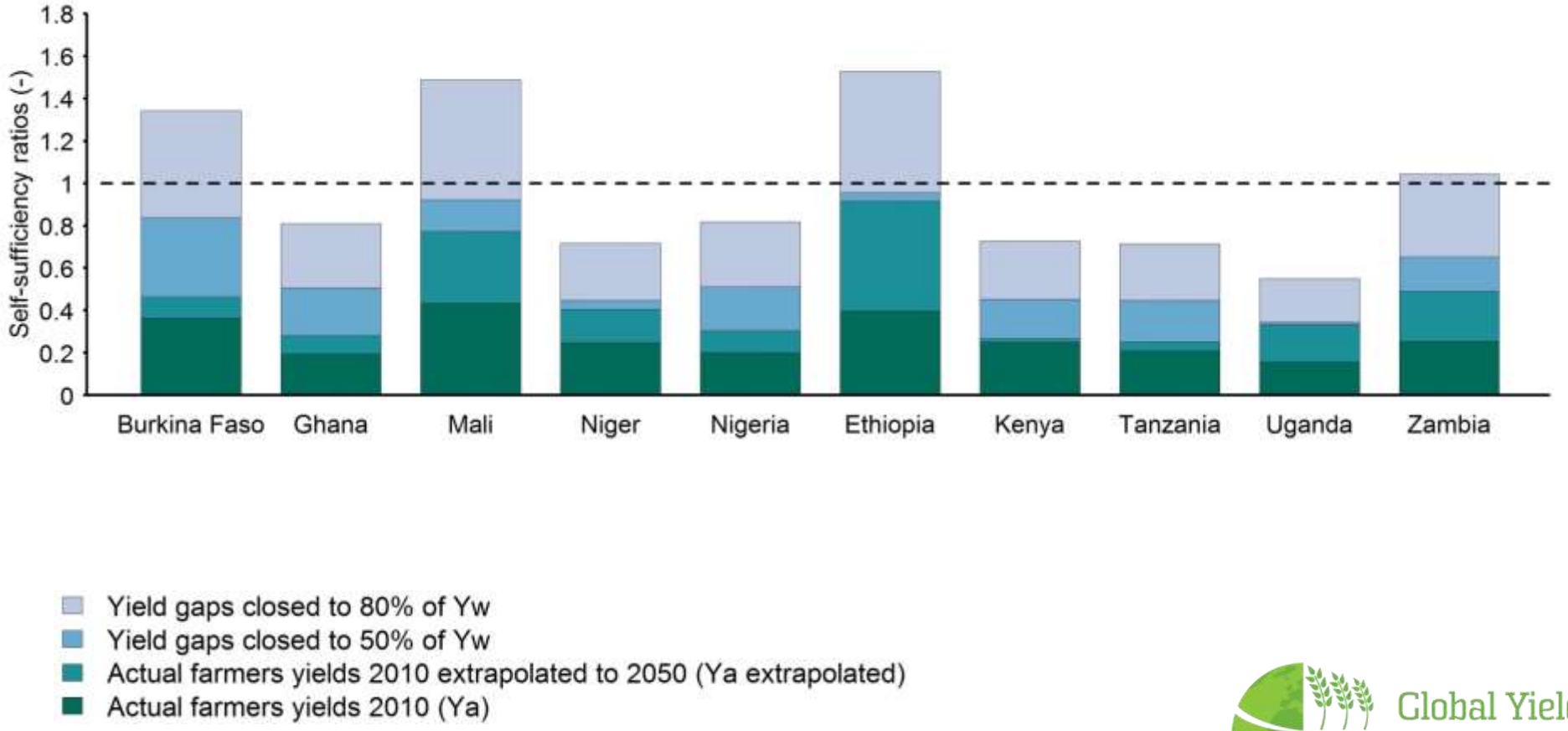
West and East Africa aggregated



Van Ittersum et al., 2016 (PNAS)

Global Yield Gap Atlas

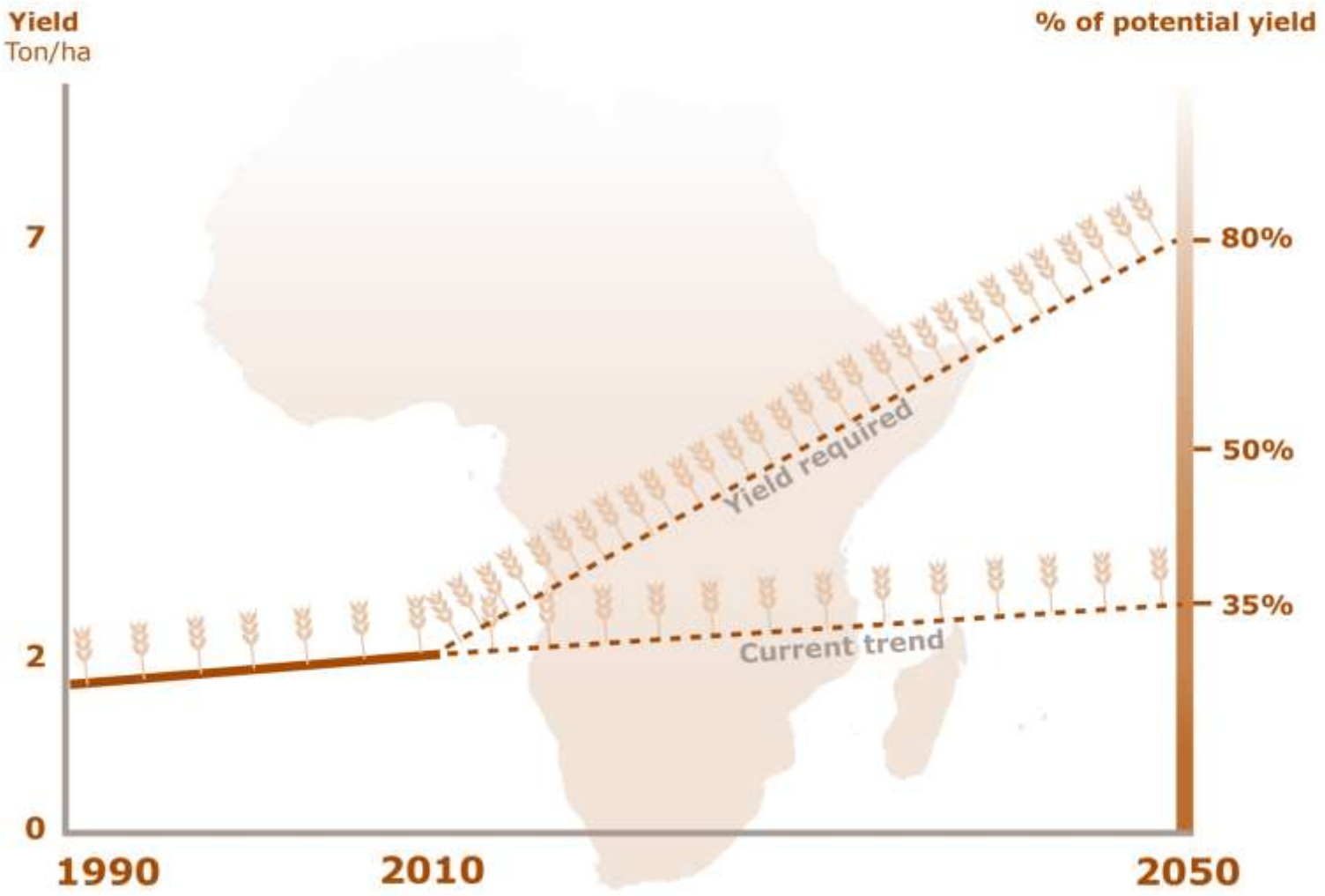
Self-sufficiency 2050: 10 countries



Van Ittersum et al., 2016 (PNAS)

Global Yield Gap Atlas

Food production in Africa in 2050



Global Yield Gap Atlas

Historical maize yield increases (kg/ha/year)

Country	1961-1990	1991-2013
Argentina	68	131
Brazil	25	122
China	107	56
Ethiopia	n.a.	79
France	130	61
Ghana	0.7	17
India	15	48
Indonesia	43	130
Kenya	26	6
Nigeria	21	39
Spain	168	196
USA	112	111

Based on FAOSTAT

Global Yield Gap Atlas

If a successful intensification is not achieved ....

The consequences in terms of:

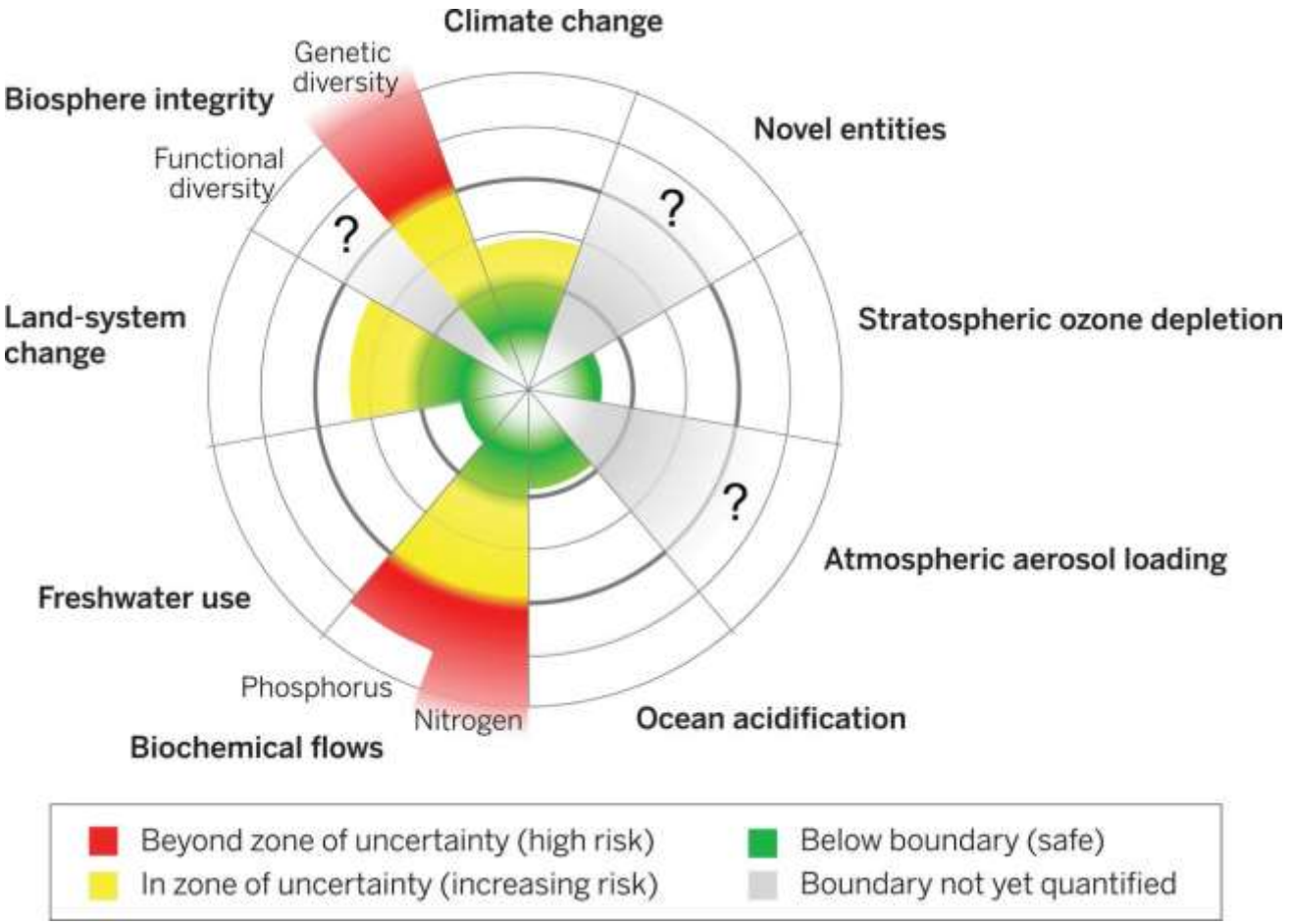
- cereal self-sufficiency and/or
- area expansion (GHG, biodiversity!)

will be huge!

Global Yield Gap Atlas

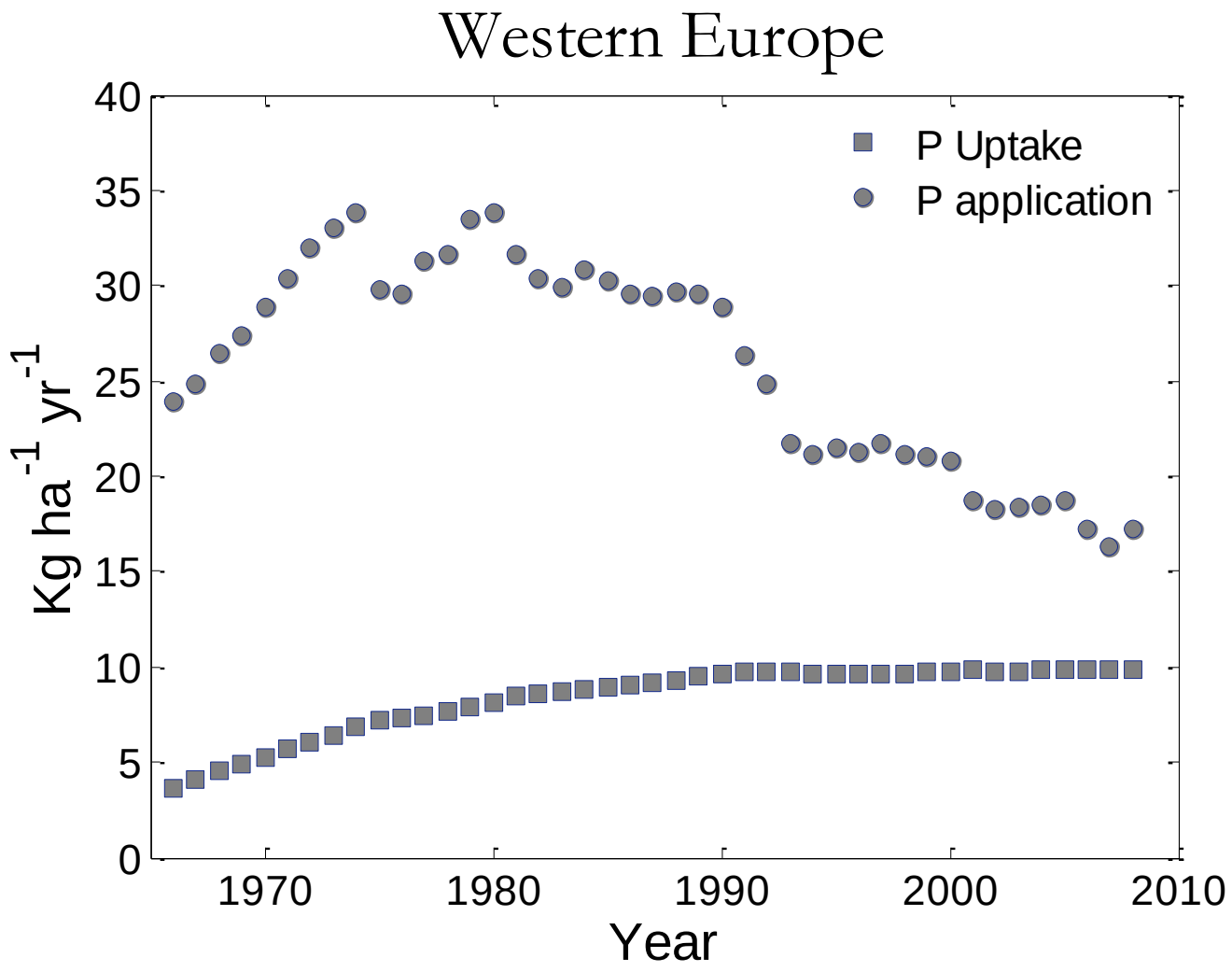
Sustainable Development Goals - challenges

Planetary boundaries



Steffen et al., 2015 (Science)

P application and P uptake



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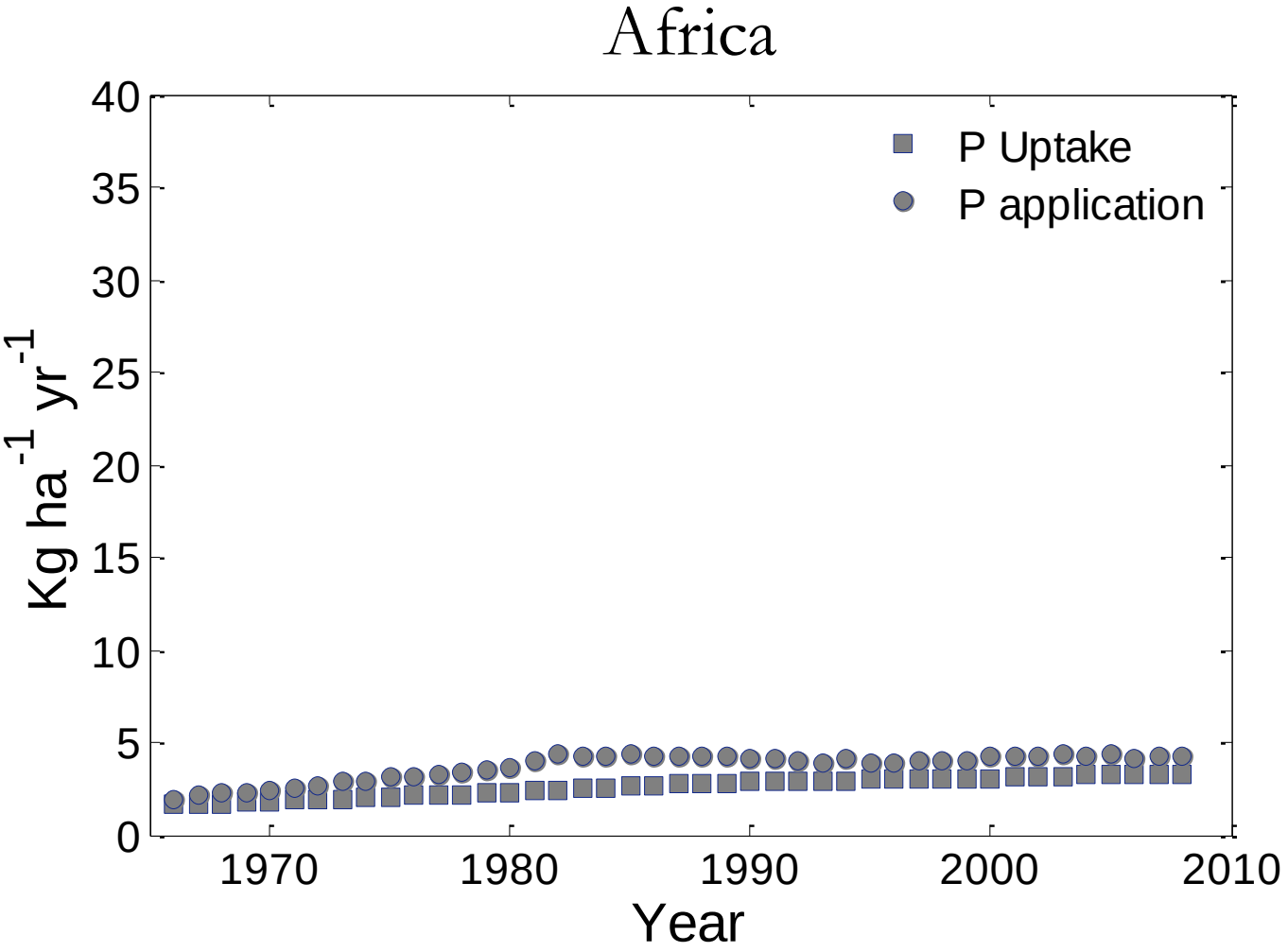
Sattari, Bouwman, Giller and Van Ittersum, 2012 (PNAS)

P application and P uptake



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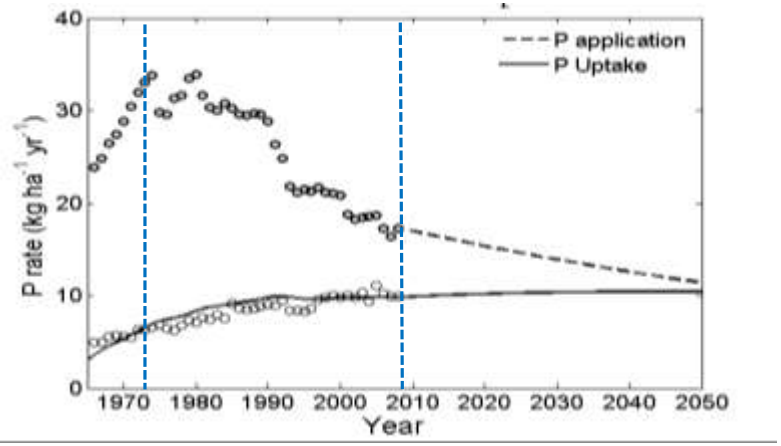
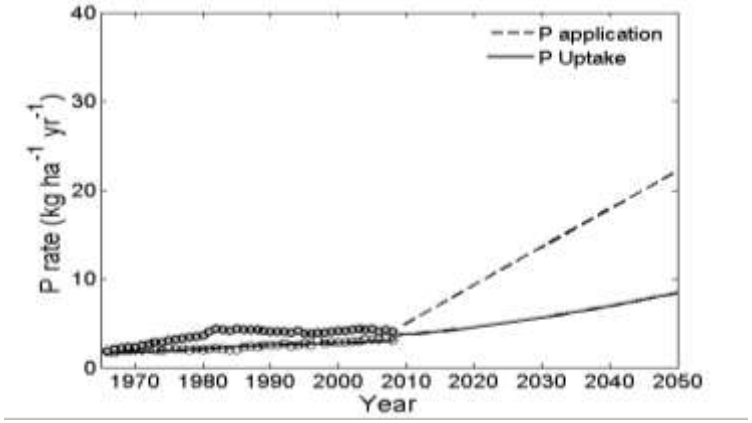
Sattari, Bouwman, Giller and Van Ittersum, 2012 (PNAS)

A learning curve!

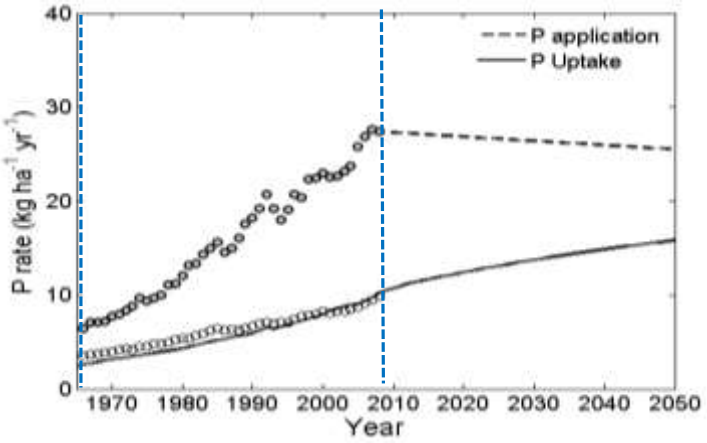
W-Europe



Africa



Asia



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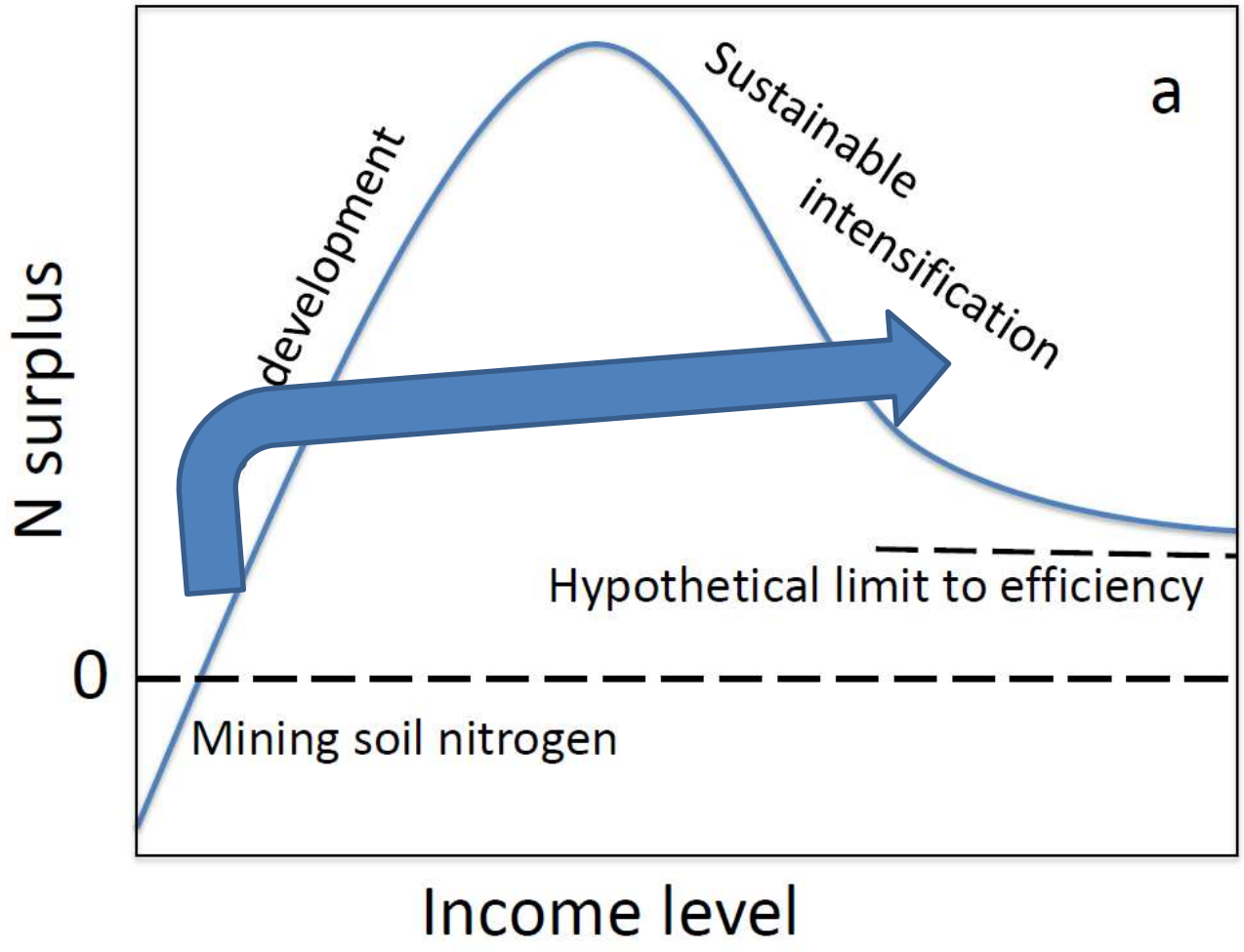
Sattari, Bouwman, Giller and Van Ittersum, 2012 (PNAS)

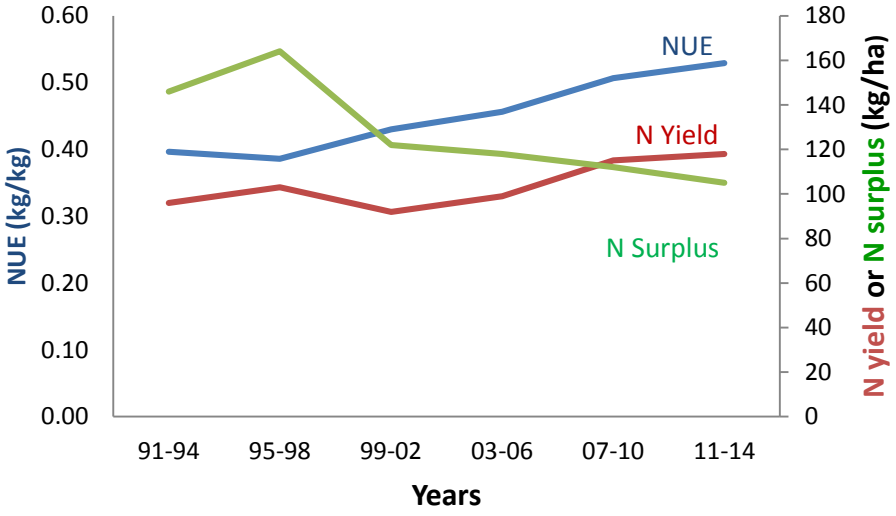
The challenge: tunnelling through

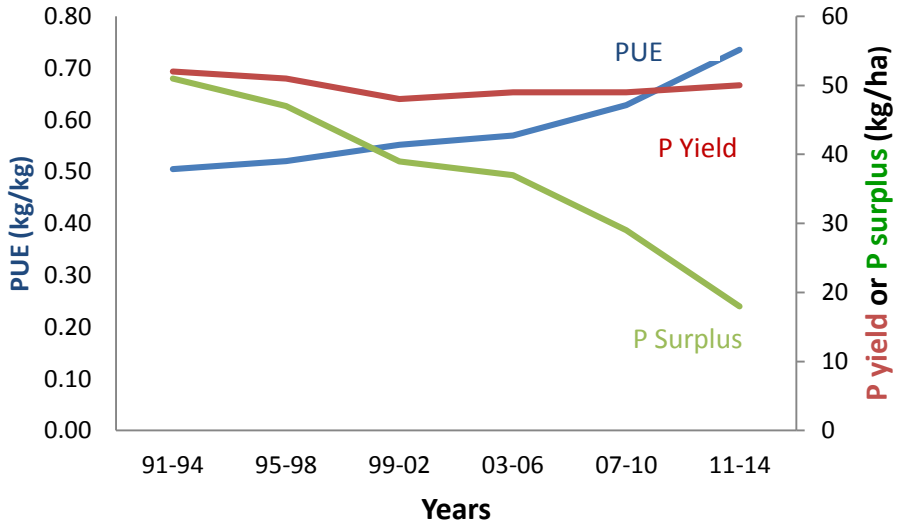


Zhang et al., 2015 (Nature)

Global Yield Gap Atlas

Yield – Use efficiency – Surplus (the Netherlands)





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Drawn by M. Van Ittersum based on Prins, H., C. Daatselaar & T. de Koeijer (2016) Wageningen Economic Research.

So what does sustainable intensification mean:

- Globally: More with less
- Locally: More with more
  Same with less

Future harvest

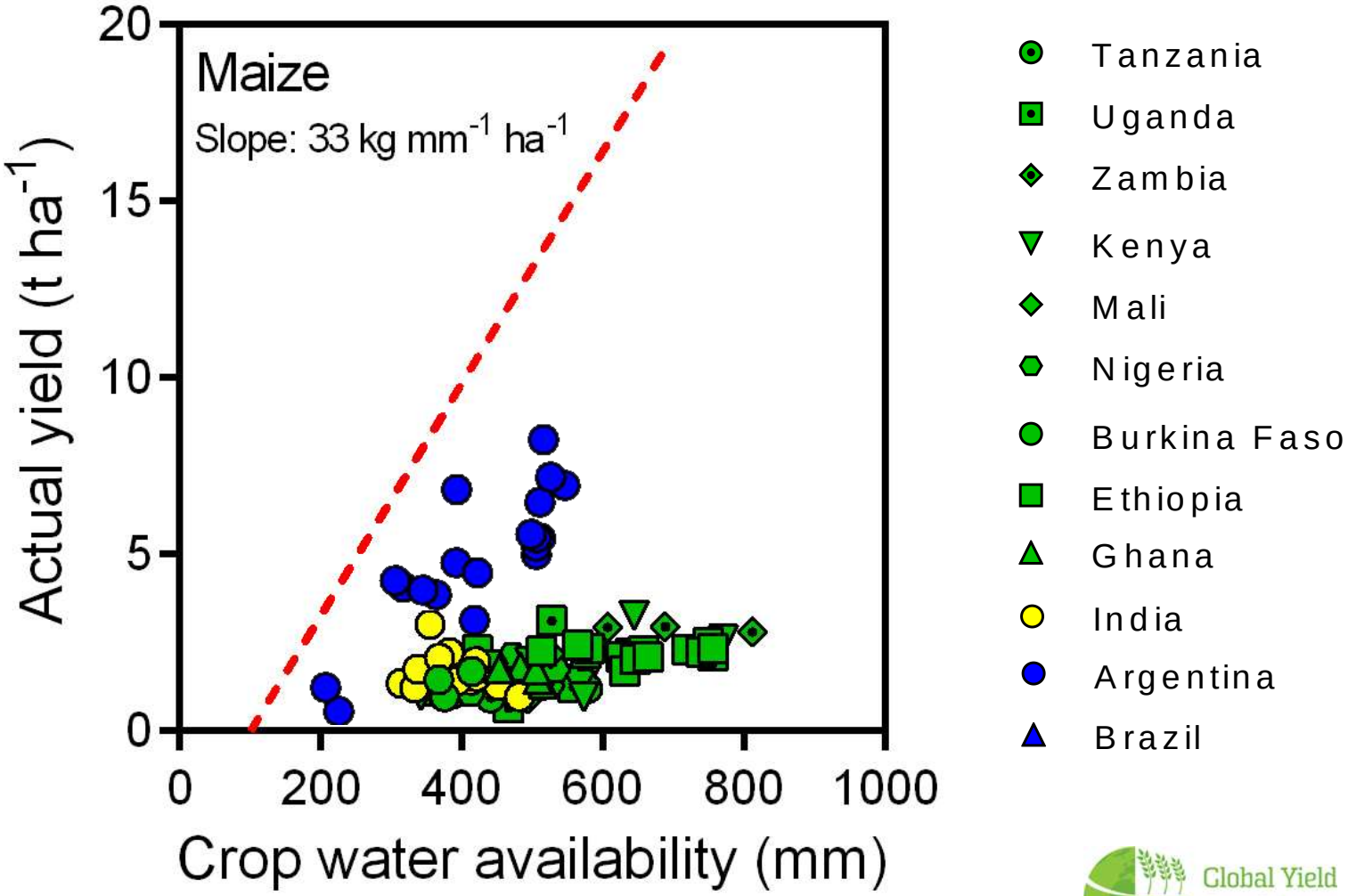
Thank you for your attention!

And what about sustainable intensification?

Global Yield Gap Atlas

Actual Maize Water Productivity

Each point represents a long-term average for rainfed maize for a given climate zone. Crop water availability was calculated as total water supply (stored soil water at sowing plus rainfall) minus soil water left at maturity and water losses through runoff and deep drainage



Source: Grassini and Rattalino Edreira

Global Yield Gap Atlas