Human Health and the Environment

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WHO Global Disease Burden

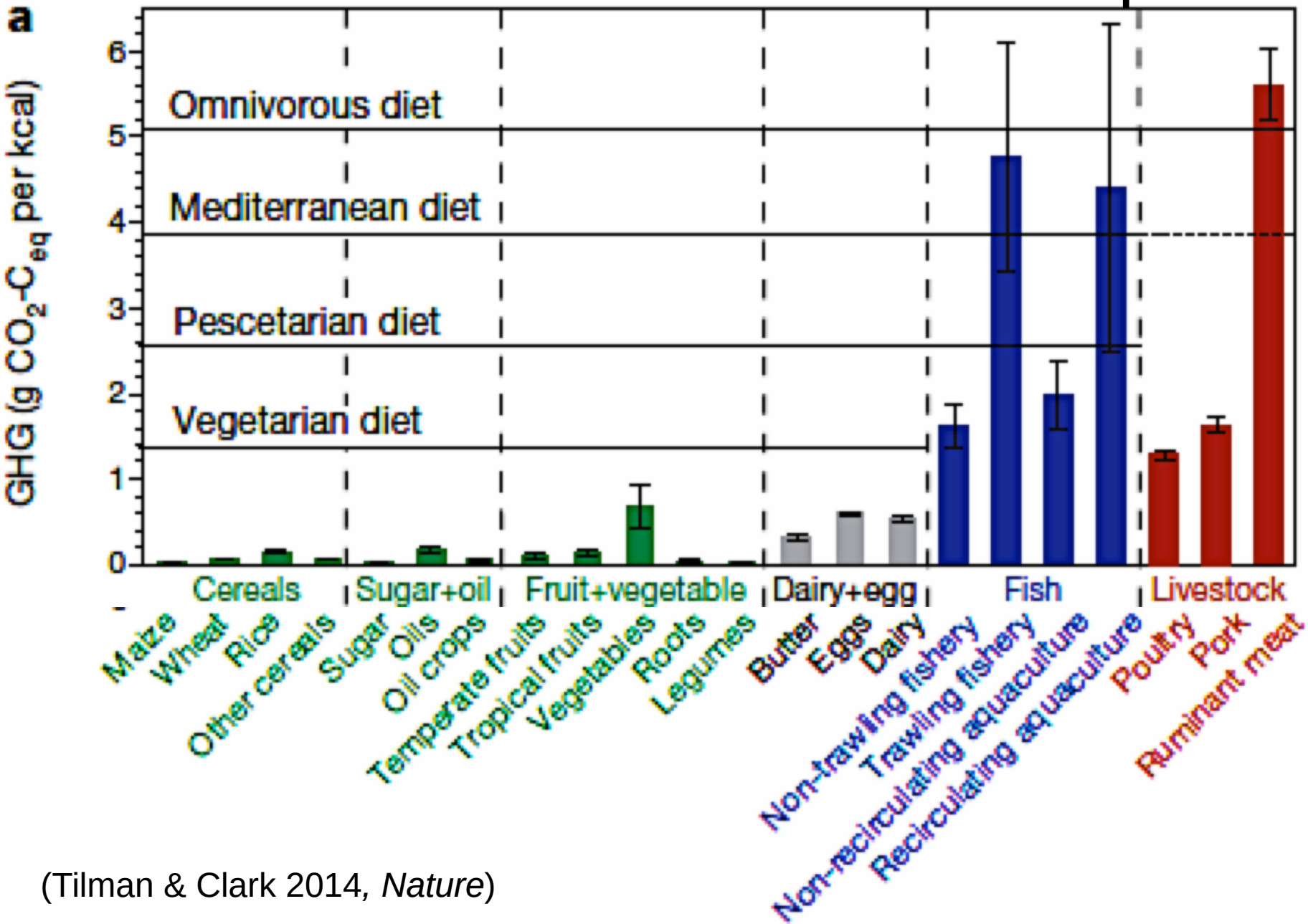
- In the USA, 8 of the Top 12 Risks to Health are Diet-Related
- For the World, 7 of the Top 12 Risks to Health are Diet-Related
- By 2030, WHO projects that Non-Communicable,often Diet-Dependent Diseases, such as Diabetes, Heart Disease and Stroke, will be the Globally-Dominant Disease Burden

Modern Food Systems

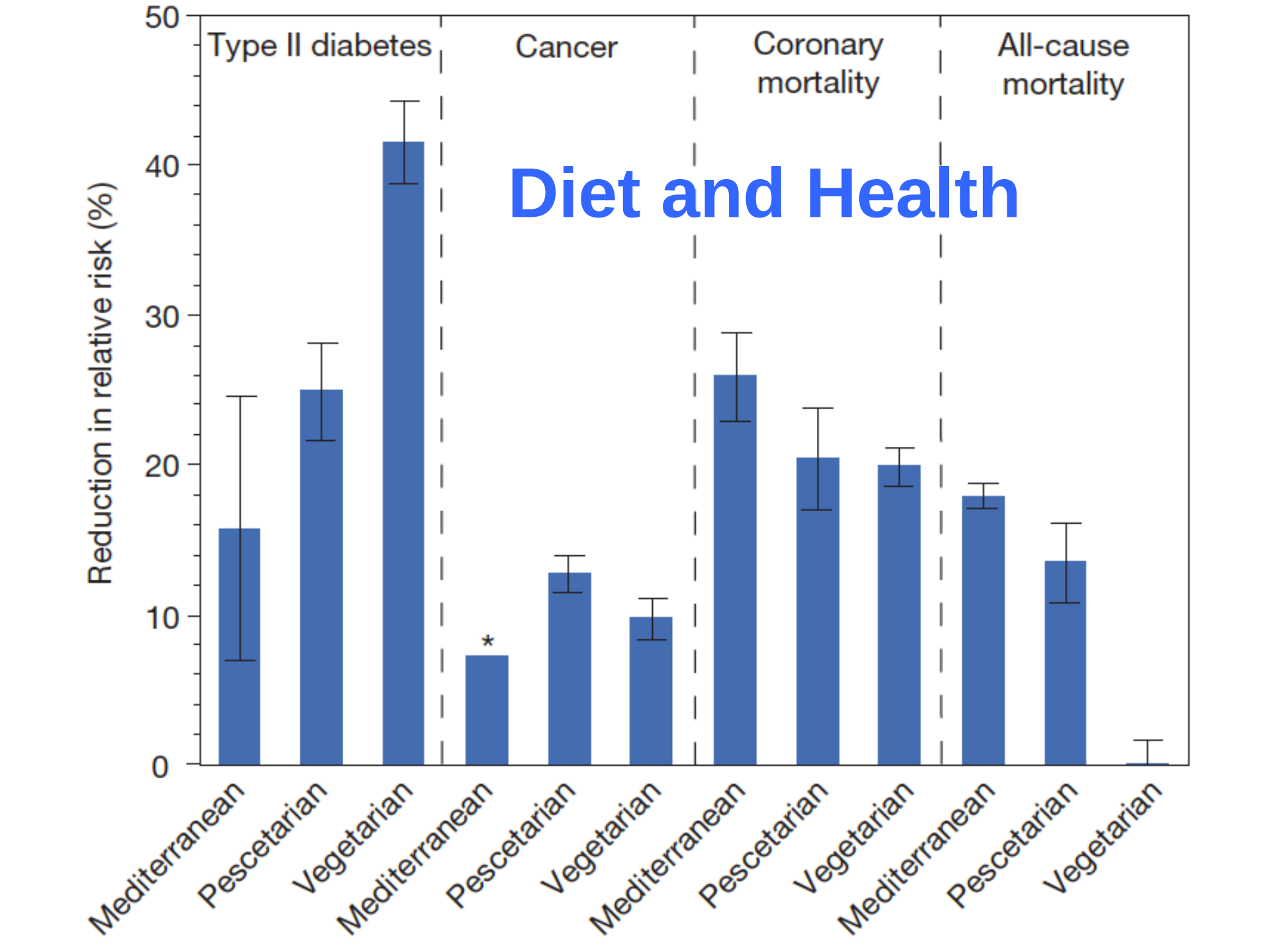
Essential for 7.6 Billion People, But Also a Major Cause of Harm to the Environment:

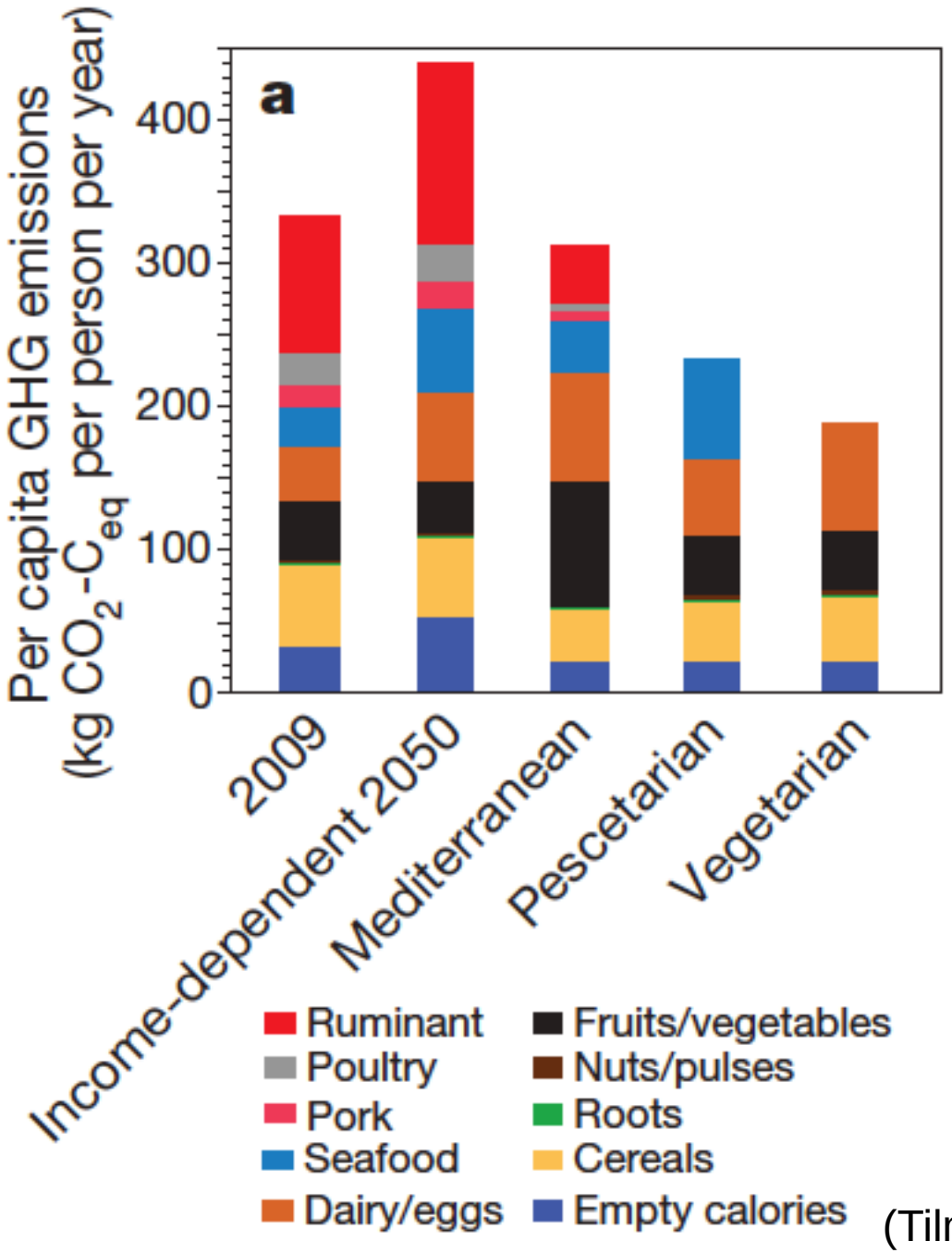
1. **30% of Global Greenhouse Gas Emissions**
2. **The Major Cause of Pollution of Lakes, Rivers, Oceans and Groundwaters**
3. **The Major Cause of Species Extinctions**
4. **Significant Harm to Health from PM2.5**
5. **Environmental Harms Will Greatly Increase Unless Major Changes Occur**

Food and Environment: Greenhouse Gas Impacts



(Tilman & Clark 2014, *Nature*)

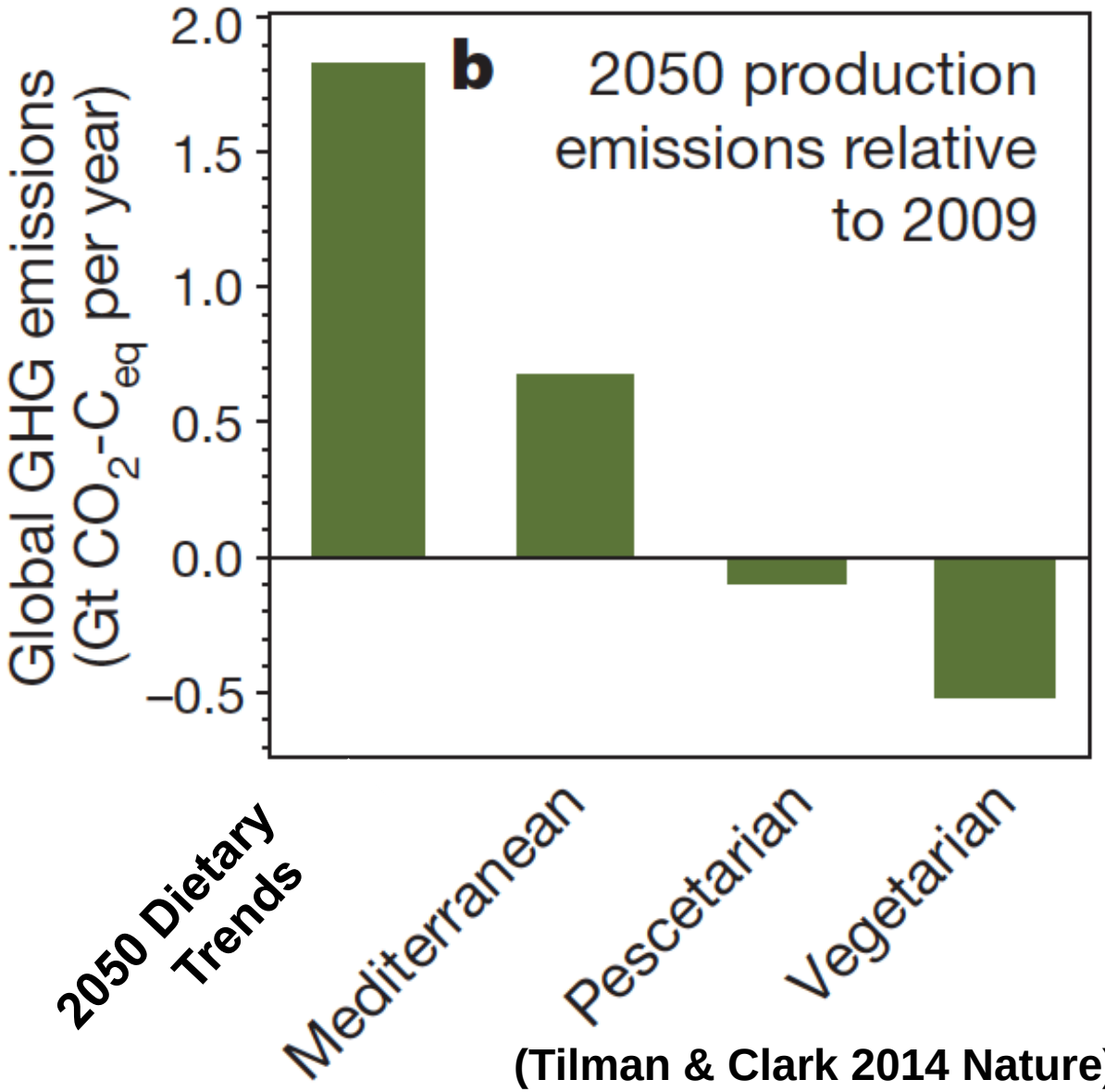

Diet and Health
Type II diabetes
Cancer
Coronary mortality
All-cause mortality
Reduction in relative risk (%)
50
40
30
20
10
0
*
Mediterranean
Pescetarian
Vegetarian
Mediterranean
Pescetarian
Vegetarian
Mediterranean
Pescetarian
Vegetarian
Mediterranean
Pescetarian
Vegetarian



GHG Impacts of Healthier Diets Are Lower.

Diets That Are More Plant-Based Have Lower GHG Emissions

(Tilman and Clark 2014 *Nature*)



(Tilman & Clark 2014 Nature)

Healthier Global Diets Could Reduce GHG Emissions As Much As Would Eliminating All Vehicles & Airplanes

Air and Water Pollution

Nitrogen Fertilizer & PM2.5

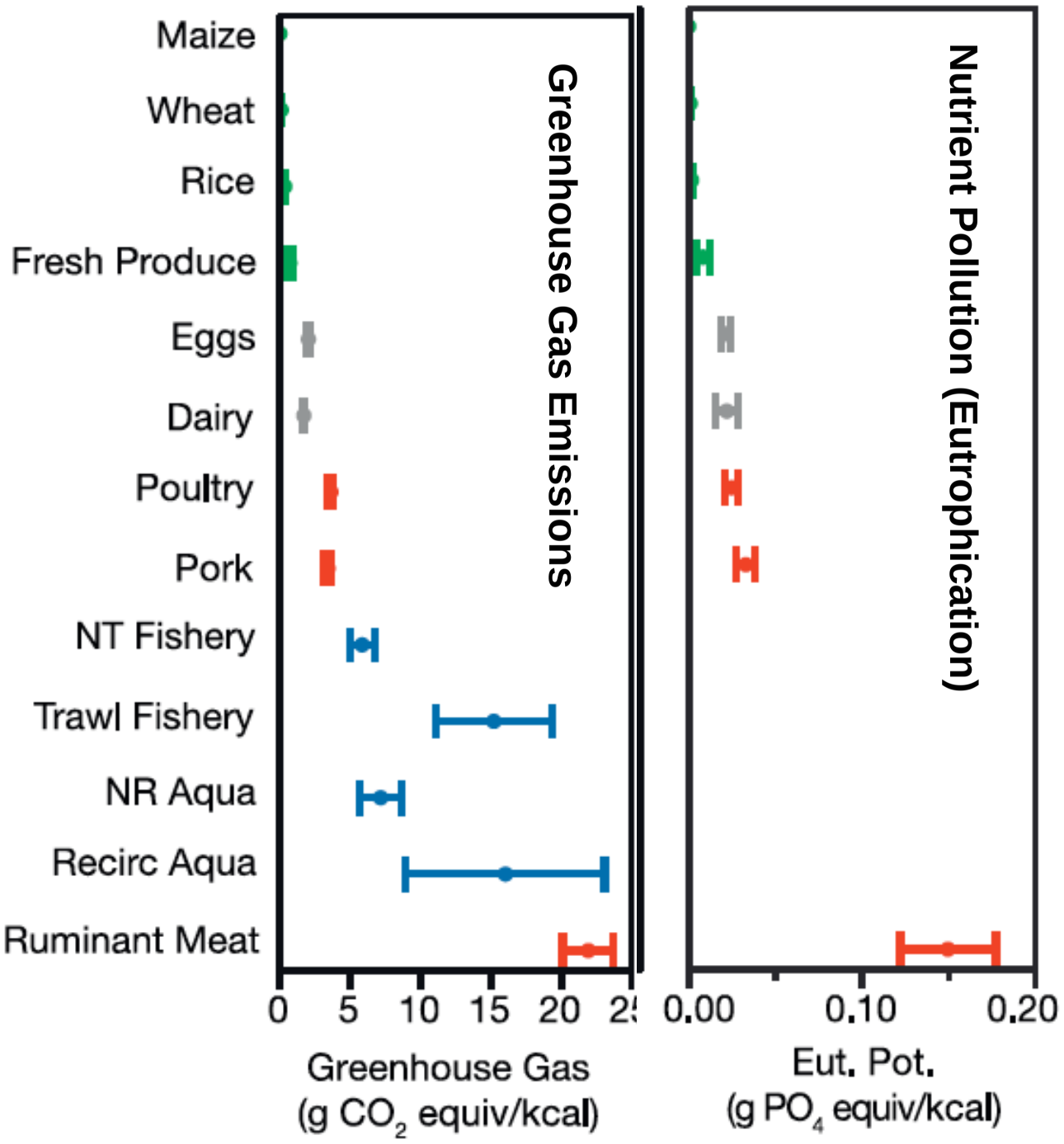
Pollution of Well Water, Rivers, Lakes and the Oceans

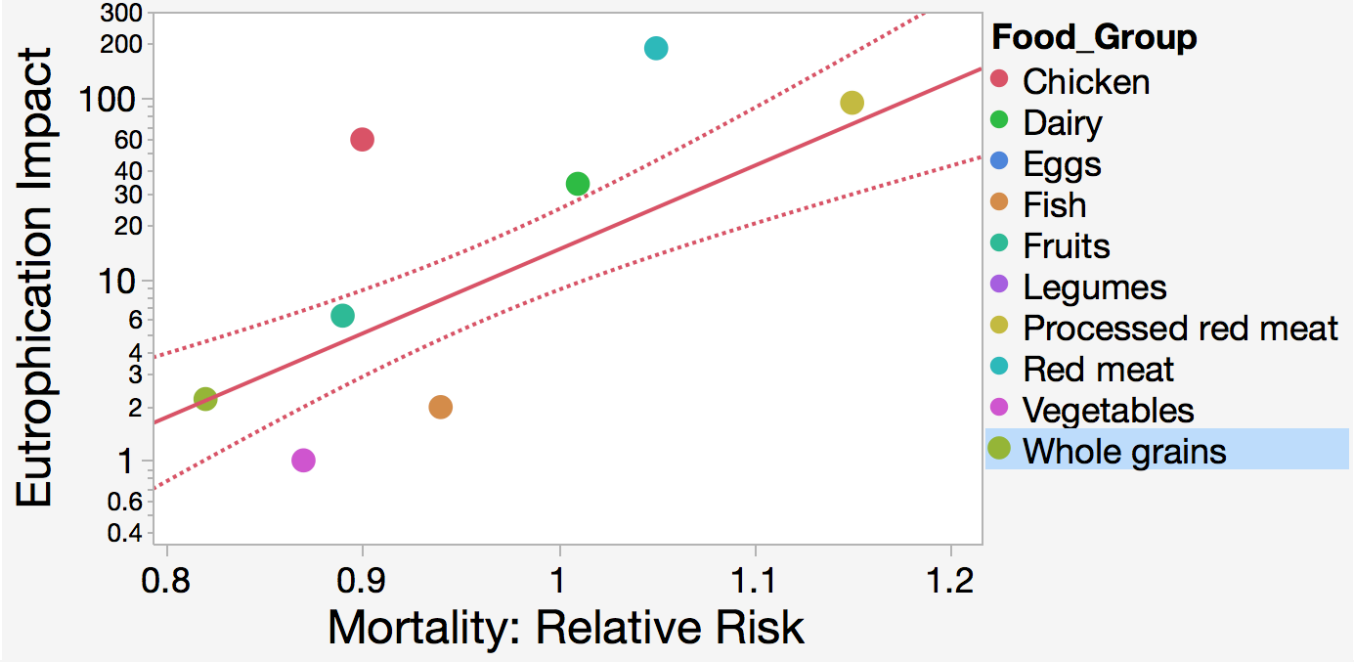
Could Increase by 70% or more from 2010 to 2060

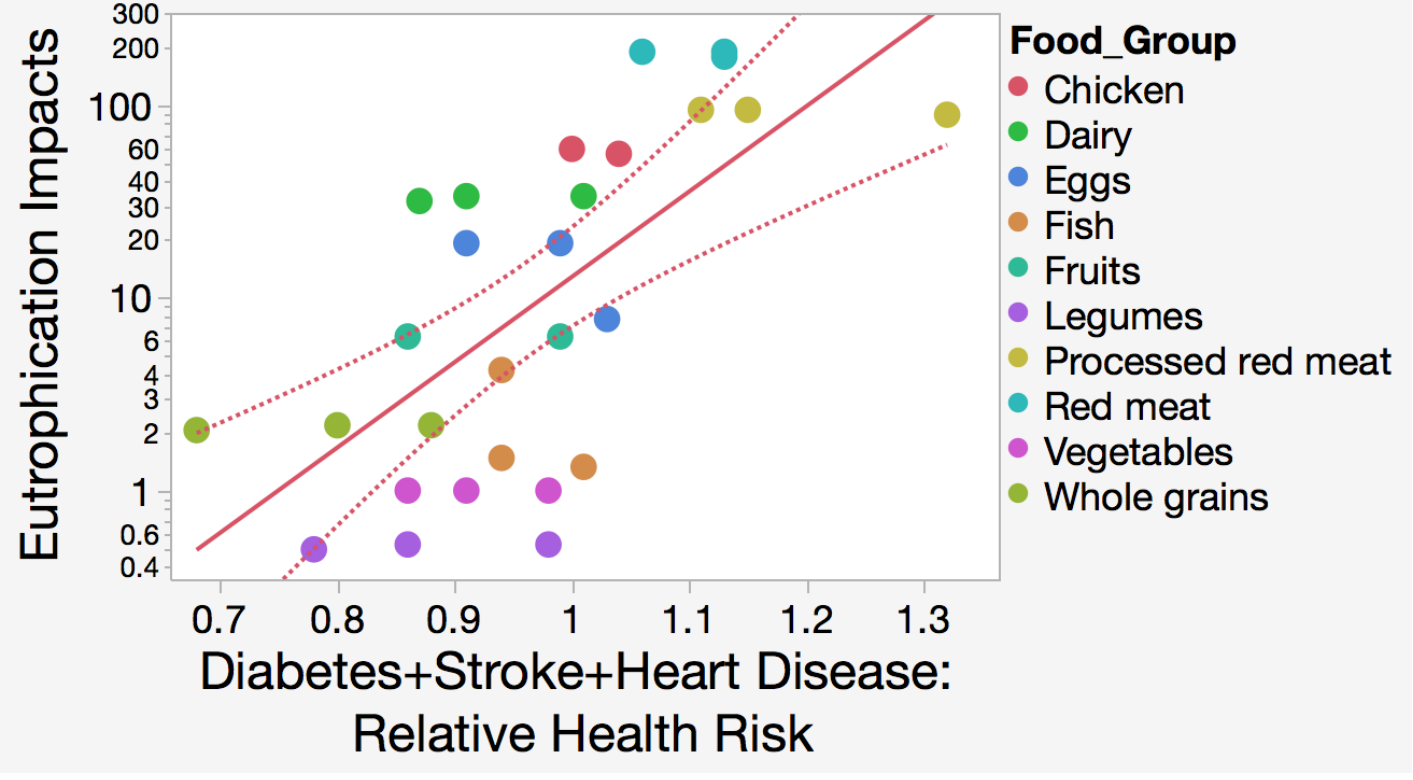
(Tilman et al. 2001 Science)

Possible Solutions?

- Healthier Diets
- More Precise and Efficient Use of Fertilizer & Irrigation


Maize
Wheat
Rice
Fresh Produce
Eggs
Dairy
Poultry
Pork
NT Fishery
Trawl Fishery
NR Aqua
Recirc Aqua
Ruminant Meat
Greenhouse Gas Emissions
0
5
10
15
20
25
Greenhouse Gas
(g CO2 equiv/kcal)
Nutrient Pollution (Eutrophication)
0.00
0.10
0.20
Eut. Pot.
(g PO4 equiv/kcal)



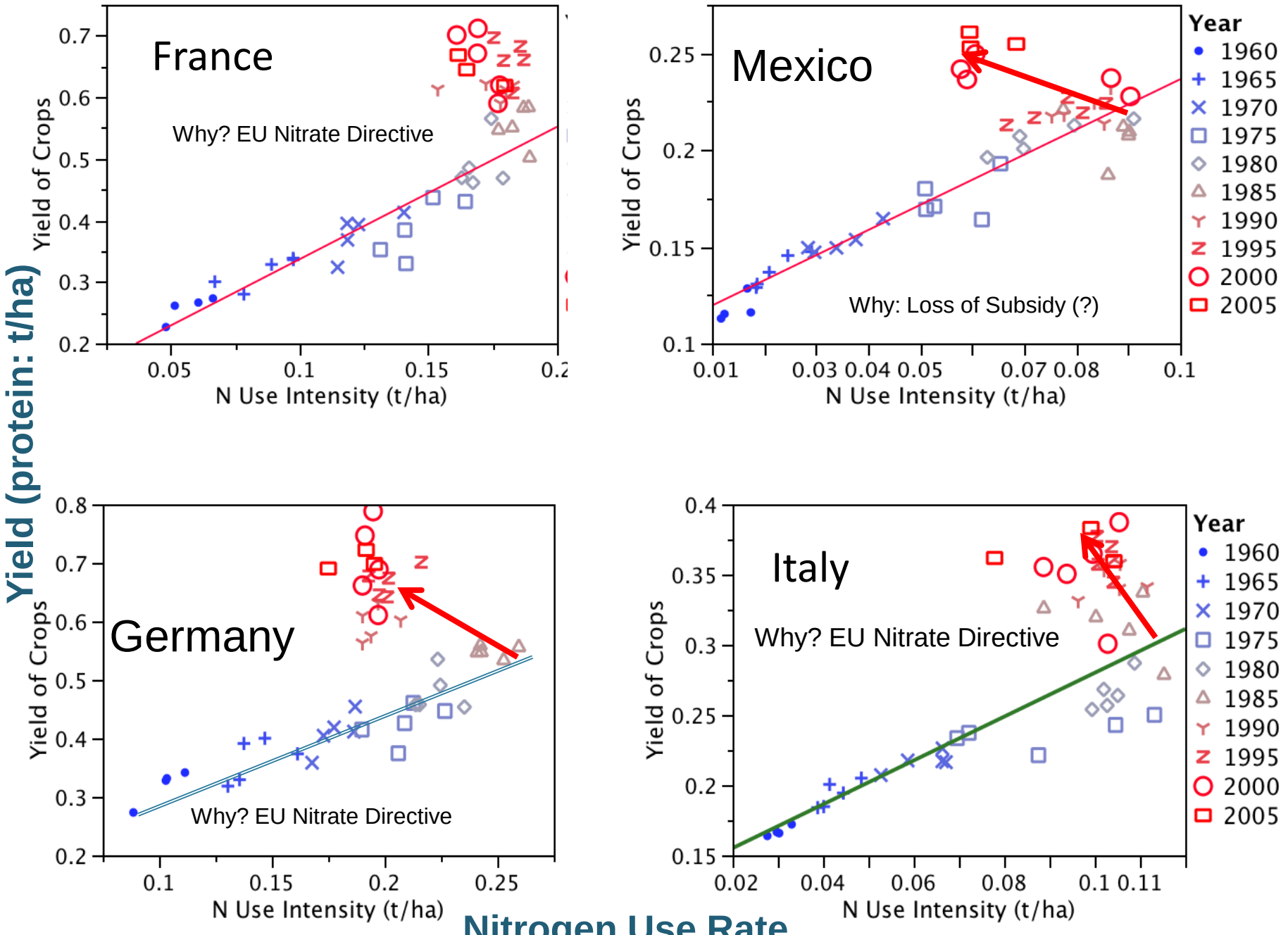


Impacts Per Serving:

Eutrophication And Health Risks

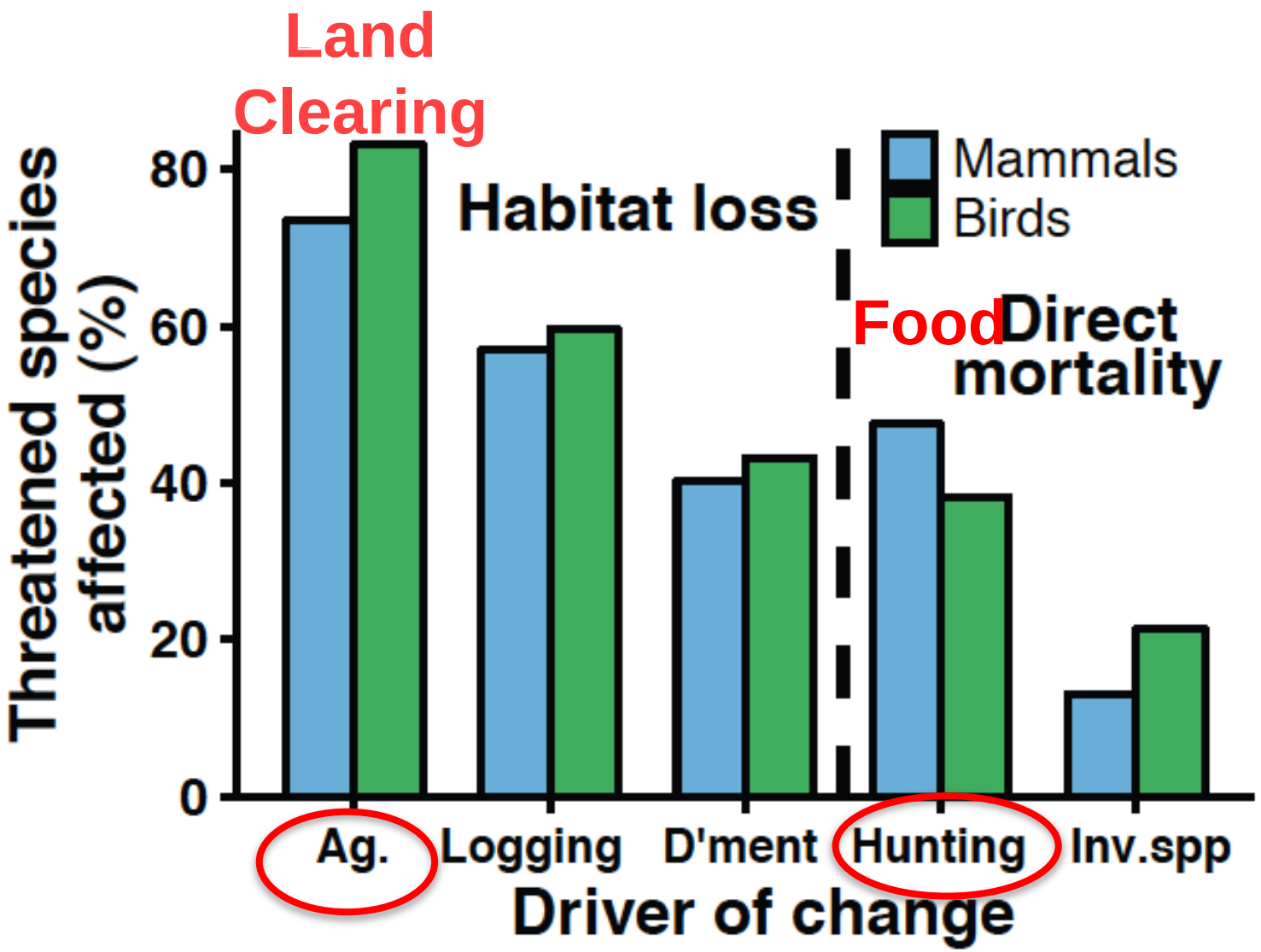
Precise & Efficient Fertilizer Use

- Reduces Water & Air Pollution
- Reduces Greenhouse Gas Emissions Because of Lower Nitrous Oxide Production
- But, If Yields Decrease, More Cropland Would Be Needed


France
Why? EU Nitrate Directive
Yield of Crops
N Use Intensity (t/ha)
Mexico
Why: Loss of Subsidy (?)
Yield of Crops
N Use Intensity (t/ha)
Year
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Germany
Why? EU Nitrate Directive
Yield of Crops
N Use Intensity (t/ha)
Italy
Why? EU Nitrate Directive
Yield of Crops
N Use Intensity (t/ha)
Yield (protein: t/ha)
Nitrogen Use Rate

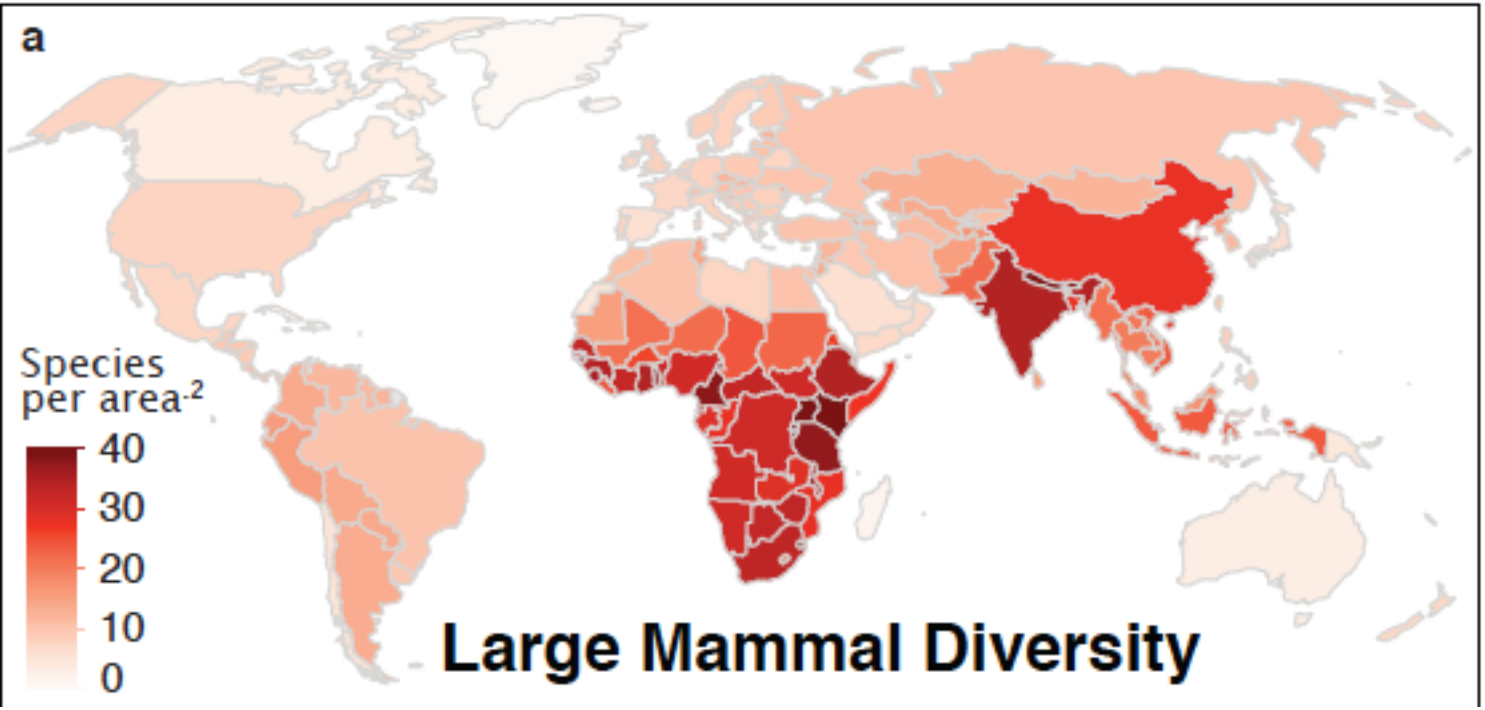
Causes of Extinction Risks:

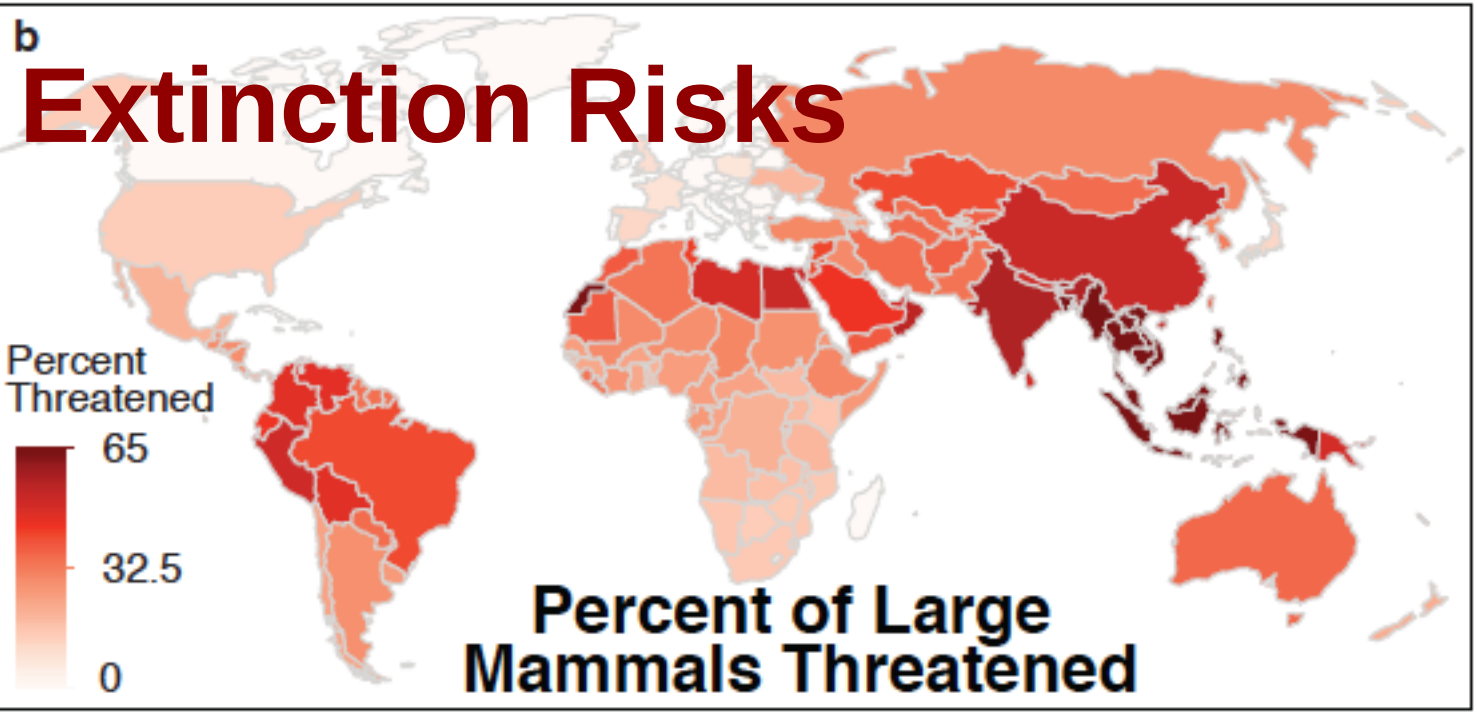
Land Clearing Is Greatest Threat



Extinction Threats from IUCN

Tilman et al 2017 Nature





Sub-Saharan Africa is Home to Earth's Remaining Large Mammals

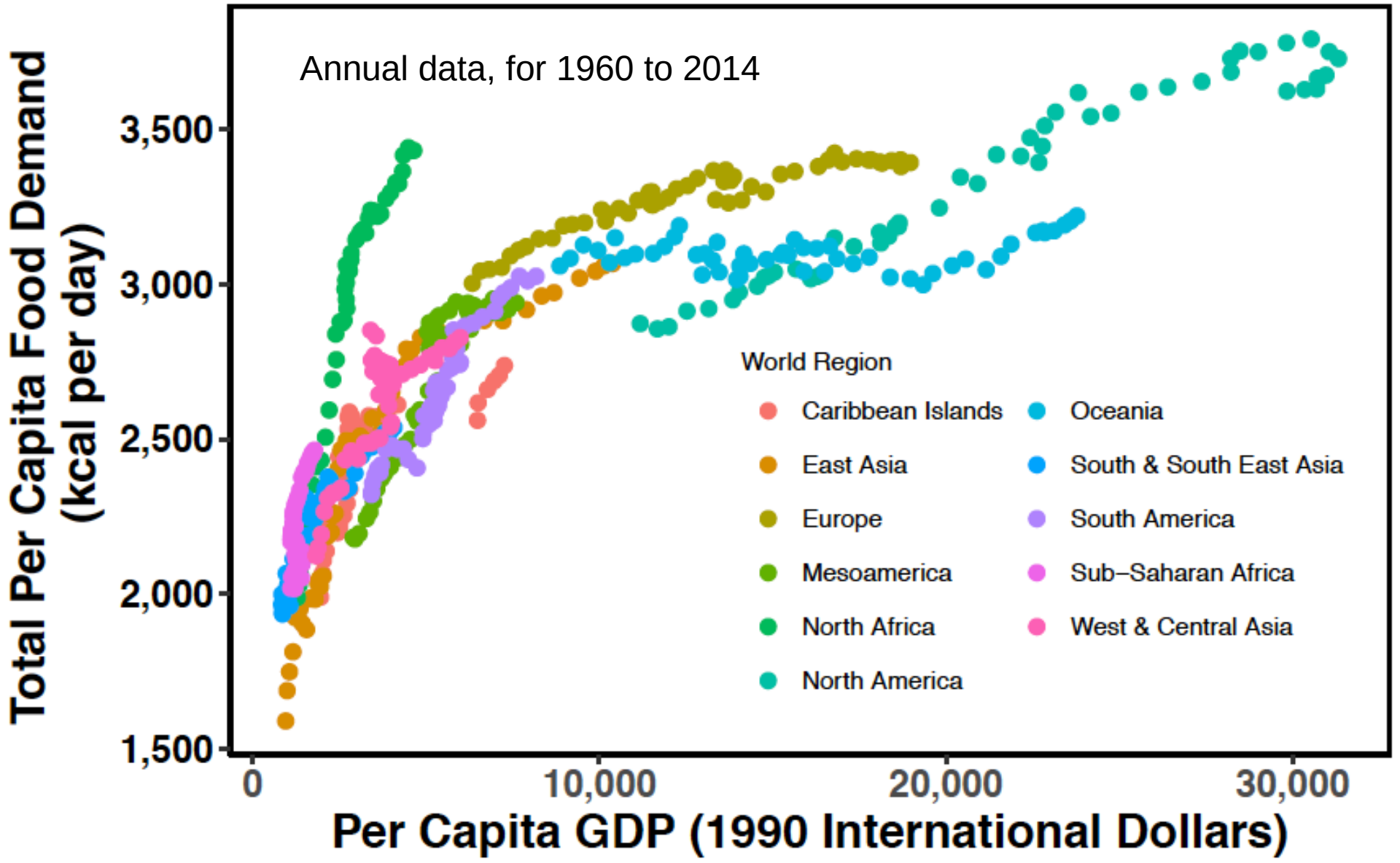
Extinction Threats Based on IUCN Analyses

"Large" > 10 kg

From 2010 to 2060:

2 Billion More People On a Richer World

Potential Impacts of Feeding the 2060 World?



(updated from Tilman et al. 2011 *PNAS*)

Global Demand For Agricultural Crops May Increase

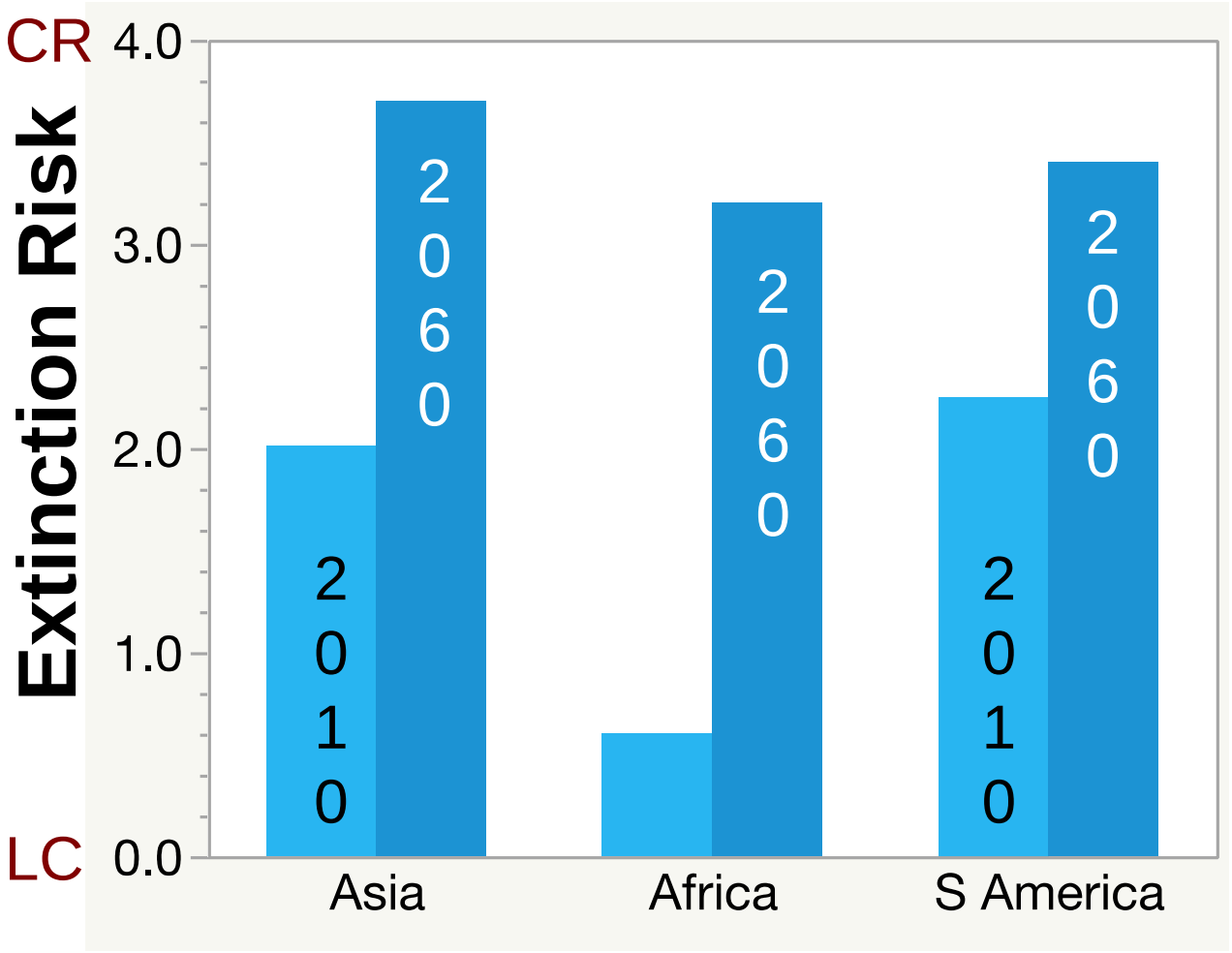
By About

70% -100%

during the next 50 years

~30% from population & ~70% from income-dependent dietary shifts toward greater per capita meat and caloric consumption

2060 Mammal Extinction Risks

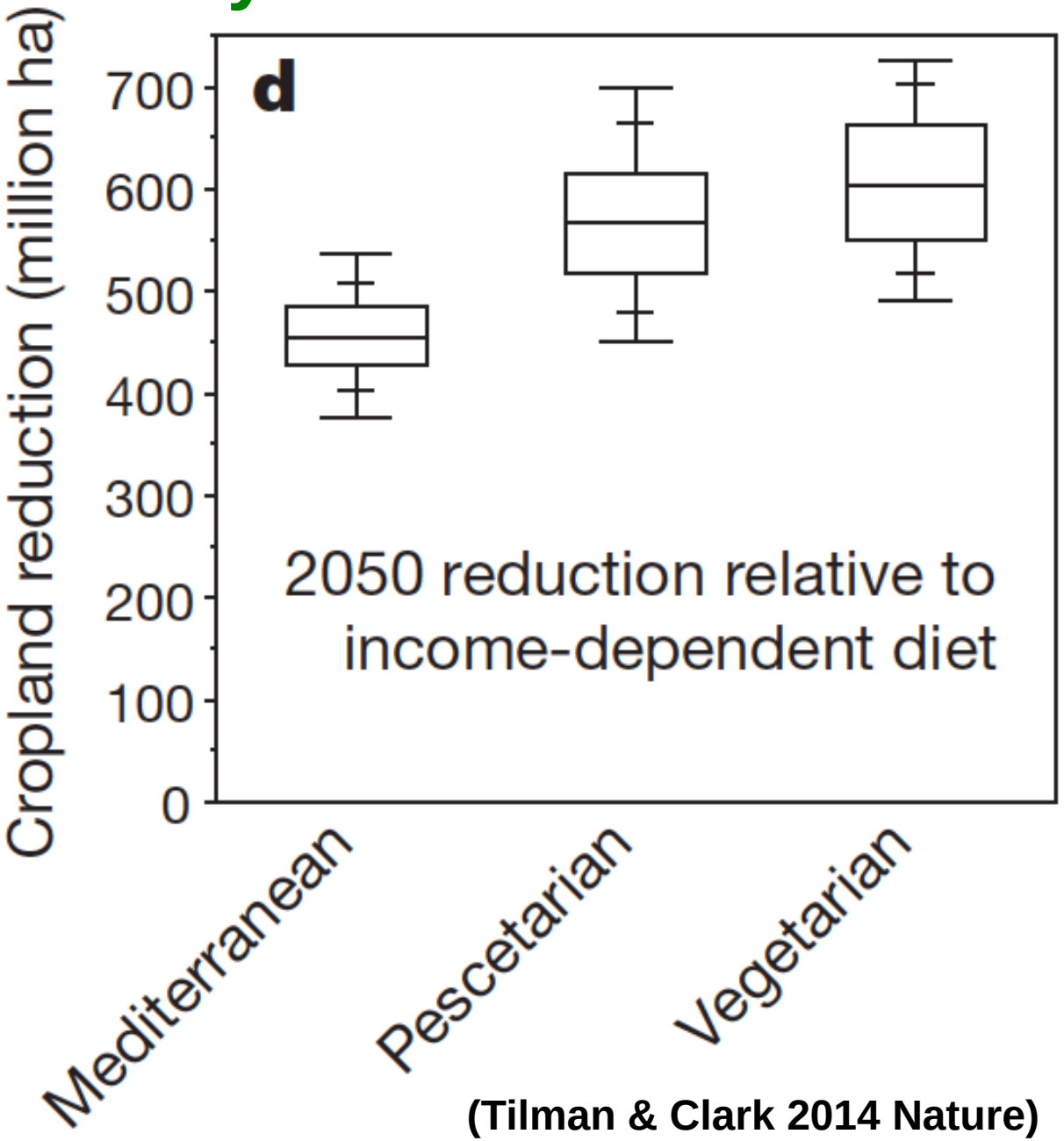


Land Clearing Would Put Most Of The Earth's Large Mammals On The Brink Of Extinction

(Tilman et al. 2017 Nature)

Other Species Face Similar Increases in Extinction Risks

Ecosystem Area Saved from Destruction



(Tilman & Clark 2014 Nature)

Healthier Diets Could Reduce or Eliminate Destruction Of Ecosystems To Create New Cropland

Healthier Diets

Agricultural Trade

And

Increasing Crop Yields

All Reduce Extinction Risks

On Average,
Healthier Foods
Offer Large
Environmental Benefits

(but sugars, trans-fats, and starchy processed foods are outliers)