Impacts of Global Environmental Change on Human Nutrition

Sam Myers, MD, MPH

Harvard Food Research Symposium

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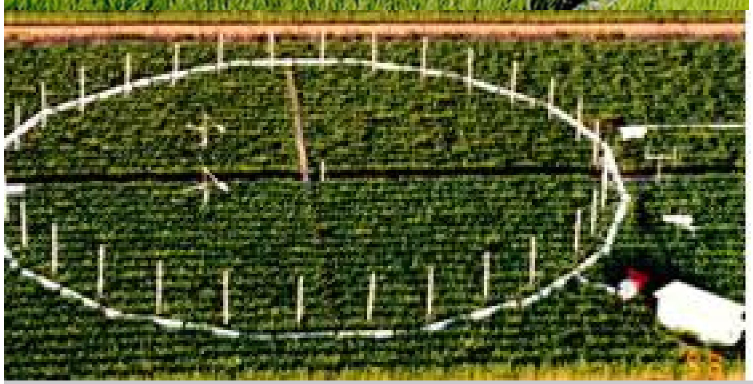
Harvard University Center for the Environment

HARVARD SCHOOL OF PUBLIC HEALTH

Rice, Japan

Field Peas, Australia

Wheat, Australia



Sorghum, Arizona

Maize, Illinois

Soybean, Illinois

Data Summary

Table 1: Characteristics of agricultural experiments

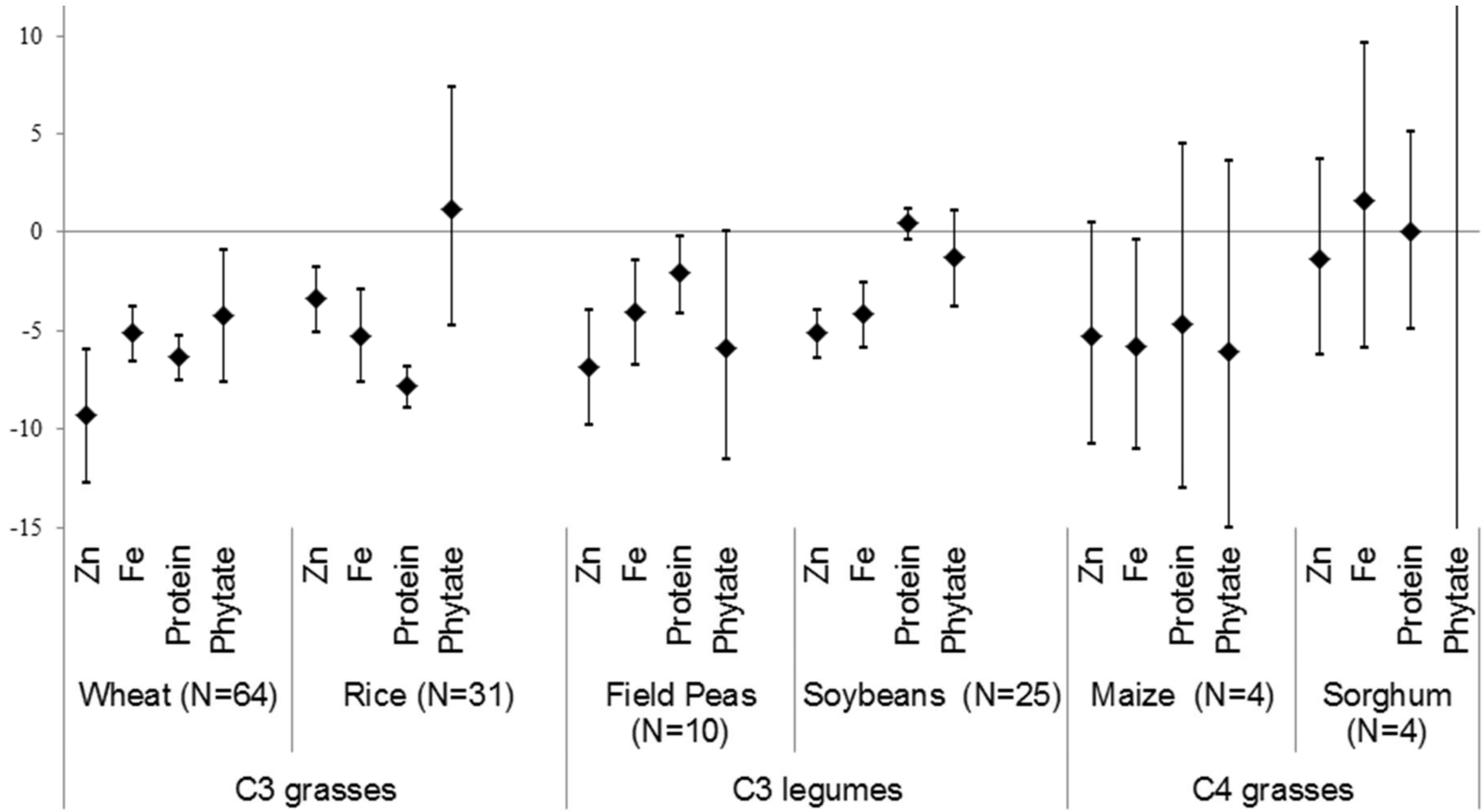
Crops	Country	Treatments used	Years grown	# of Replicates*	# of Cultivars	CO_2 ambient/elev (ppm)
Wheat						
Site 1:	Australia	2 water levels, 2 N treatments, 2 Sowing times	2007-10	4	8	382/546-550
Site 2:	Australia	1 Water level, 1 N treatment 2 Sowing times	2007-9	4	1	382/546-550
Field Peas	Australia	2 water levels	2010	4	4	382/546-550
Rice						
Site 1:	Japan	1 N treatment, 2 warming treatments	2007-8	3	3	376-379/570-576
Site 2:	Japan	3 N treatments, 2 warming treatments	2010	4	18	386/584
Maize	U.S.	2 N treatments	2008	4	2	385/550
Soybeans	U.S.	1 treatment	2001, 02, 04, 2006-08	4	7	372-385/550
Sorghum	U.S.	2 water levels,	1998-99	4	1	363-373/556-579

* “# of replicates” refers to the number of identical cultivars grown under identical conditions in the same year and location but in separate FACE rings

- 41 Cultivars across 7 sites on 3 continents for 6 crop types over 10yrsð 1152 crop samples
- 286 ñexperimentsò pooled replicates (ambient versus elevated CO2)
- > 10X all previously published data combined

Increasing CO_2 threatens human nutrition

Samuel S. Myers[1,2], Antonella Zanobetti[1], Itai Kloog[3], Peter Huybers[4], Andrew D. B. Leakey[5], Arnold J. Bloom[6], Eli Carlisle[6], Lee H. Dietterich[7], Glenn Fitzgerald[8], Toshihiro Hasegawa[9], N. Michele Holbrook[10], Randall L. Nelson[11], Michael J. Ottman[12], Victor Raboy[13], Hidemitsu Sakai[9], Karla A. Sartor[14], Joel Schwartz[1], Saman Seneweera[15], Michael Tausz[16] & Yasuhiro Usui[9]



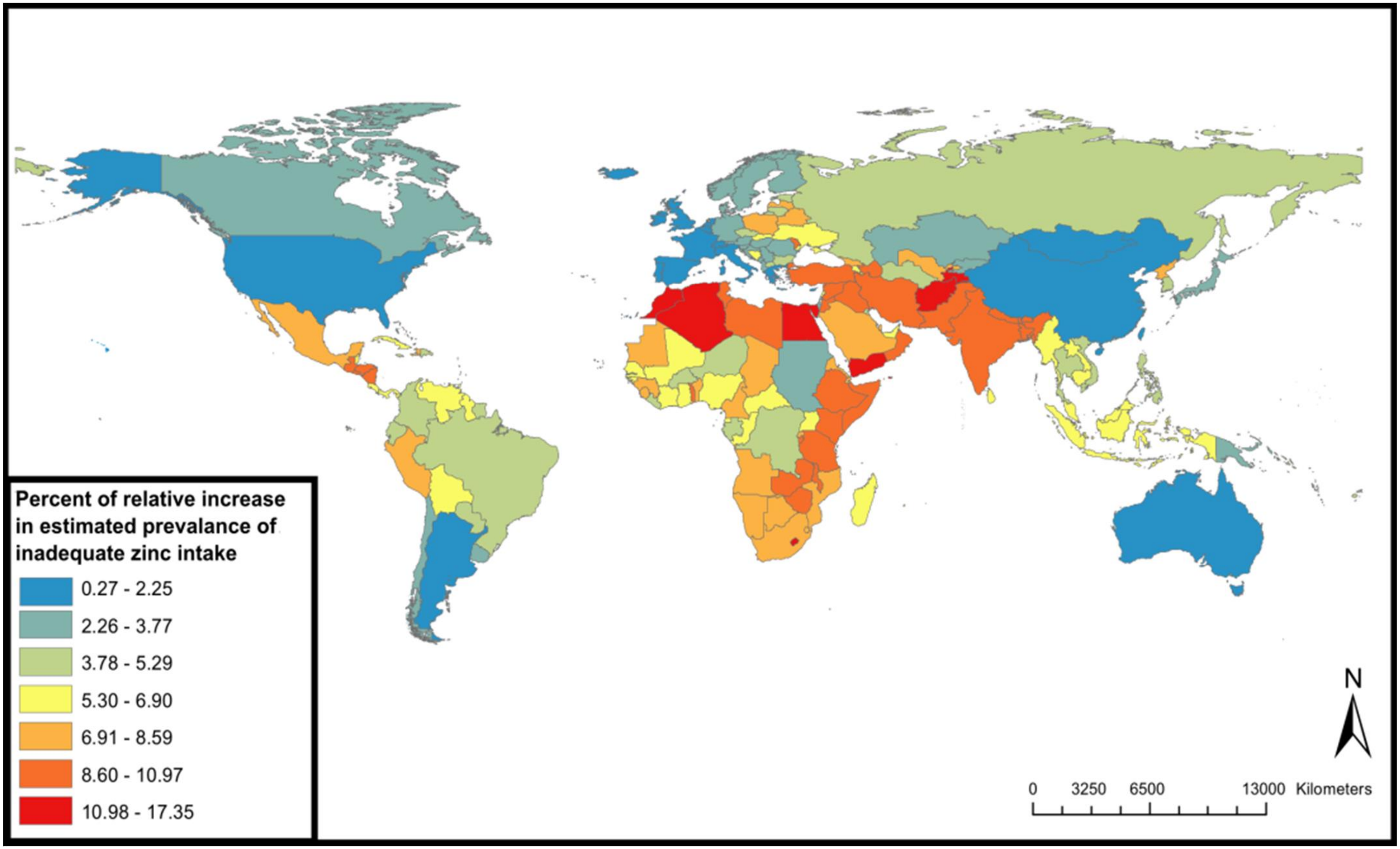
Results Summary

- All C_3 crops show significant reductions in iron and zinc
- C_3 grains show significant reductions in protein
- C_4 crops less affected
- **Roughly 2.75 billion people living in 50 countries receive at least 70% of their dietary zinc and/or iron from C3 crops and will be placed at significant risk**
- Baseline of 2 billion deficient 63 million LY lost



ary Analysis of Implications for Global Zinc Deficiency

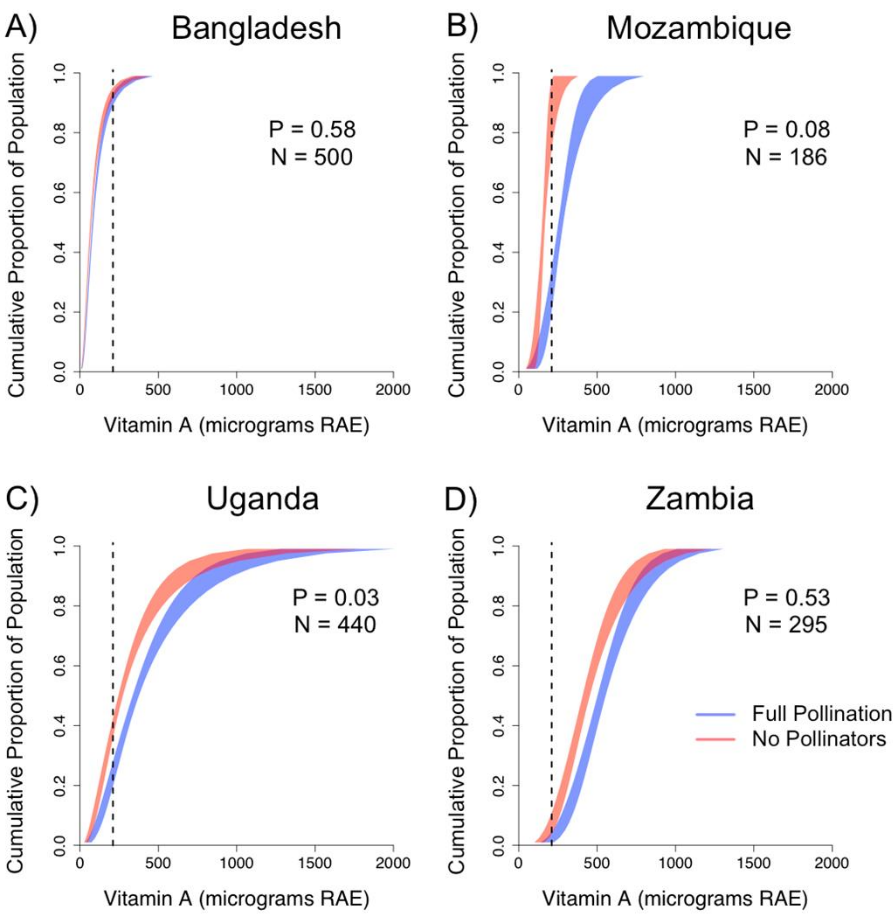
(Paper in Review: Not for Dissemination)



RESEARCH ARTICLE

Do Pollinators Contribute to Nutritional Health?

Alicia M. Ellis[1], Samuel S. Myers[2,3], Taylor H. Ricketts[1]*



Altered risk of vitamin A deficiency in populations from four countries as a result of pollinator declines

Preliminary Estimates for Complete Pollinator Loss:

- Å 51M people in developing countries would become newly deficient in Vitamin A, 194M vulnerable people already below EAR would lose over 5% of vitamin A supply

- Å 168M people would become newly deficient in folate while 515M people would become more vulnerable

- Å Pollinator loss would result in declines in fruit, vegetables and nuts and seeds of 24%, 20%, and 22% respectivelyð 1.4 million excess deaths annually

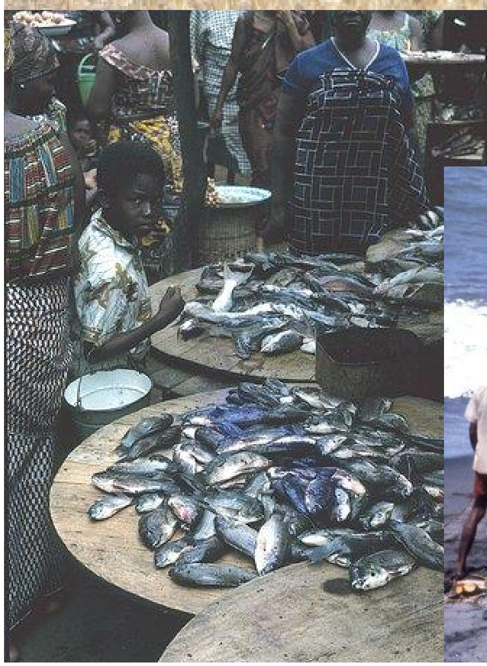
- Å Roughly 27 million DALYs annually >1% increase in GBD





Biodiversity Loss and Human Nutrition

Greater than a 50% reduction in Earthôs vertebrate populations over past 40 years

car: Makira Protected Area

Wildlife Populations

Å Transect-based surveys

Å Grid-arrays of camera traps

Nutritional Status

Å What people eat: dietary calendars and intra-household allocation, 750 subjects

Å Whatôs in the food: food composition analysis

Å How children grow: anthropometry

Å Whatôs in the people: biomarkers (iron, zinc, vitamin A, omega-3, vitamin B12, calcium etc)

Å Blood spots for zoonotic disease transmission

Å Malaria parasitology

Å Fecal samples for parasites, microbiome

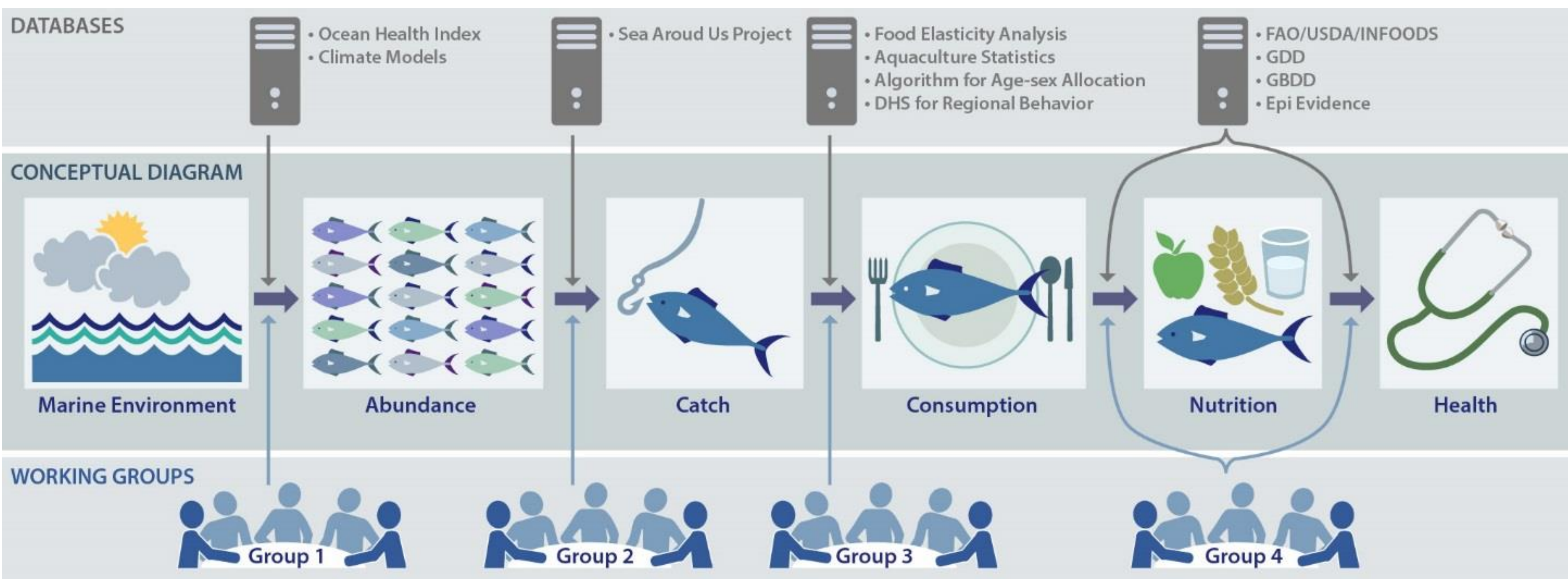
Å Breast milk samples for nutrients

he importance of access to seafood for micronutrient nutrition in Madagascar

Darwin Initiative Project

Marine fish consumption may comprise, under certain circumstances in certain nations, as much as 55% of protein intake, 16% of caloric intake, 16% of iron intake, 19% of zinc intake, 66% of vitamin A intake, 91% of vitamin B12 intake and 100% of omega-3 fatty acid intake.

Connecting Environmental Change and Fisheries Management to Health Outcomes: Global Study—Wellcome Trust



THANK YOU!

Biology Land Use | Plant Physiology | Ecology | Nutritional Epidemiology | Atmospheric Chemistry | Climate Modeling | Veterinary Medicine

Agronomy-Rice | Marine Biology | Biogeoscience | Parasitology | Agronomy Maize/Soy | Malaria Immunology | Epidemiology Statistics | Marine Science

Nutritional Epidemiology | Micronutrient Deficiency | Ecology Modeling | Environment & Health | Climate Science | Global health Epidemiology | Statistics | Plant physiology Health