Session 5
Approaches to Improve Food and Nutritional Security – Part 1
Chair: Prof Julian Wiseman

GLOBAL FOOD SECURITY FORUM

'Meeting Nutritional Needs'

7 - 8 July, 2014

Putrajaya Marriott Hotel, Malaysia

CONTENTS

How should we look at underutilised crops?

Sayed Azam-Ali
CEO, Crops For the Future, Malaysia

Global Food Security Forum
Kuala Lumpur, 8 July 2014

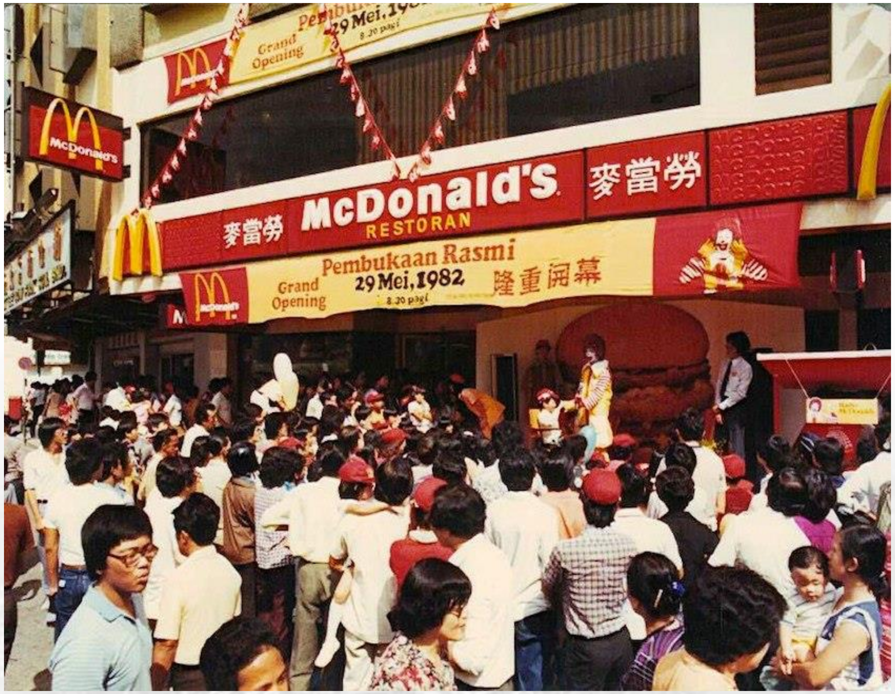
Plan A: Globalising the Food Supply Chain

Crops For the Future Research Centre

Kuala

ingham

Plan A: Globalising the Food Supply Chain



1982	2012
First branch in Malaysia	314 branches 144 million customers per year 42% quick-service market in KL

Plan A: Globalising the Food Supply Chain

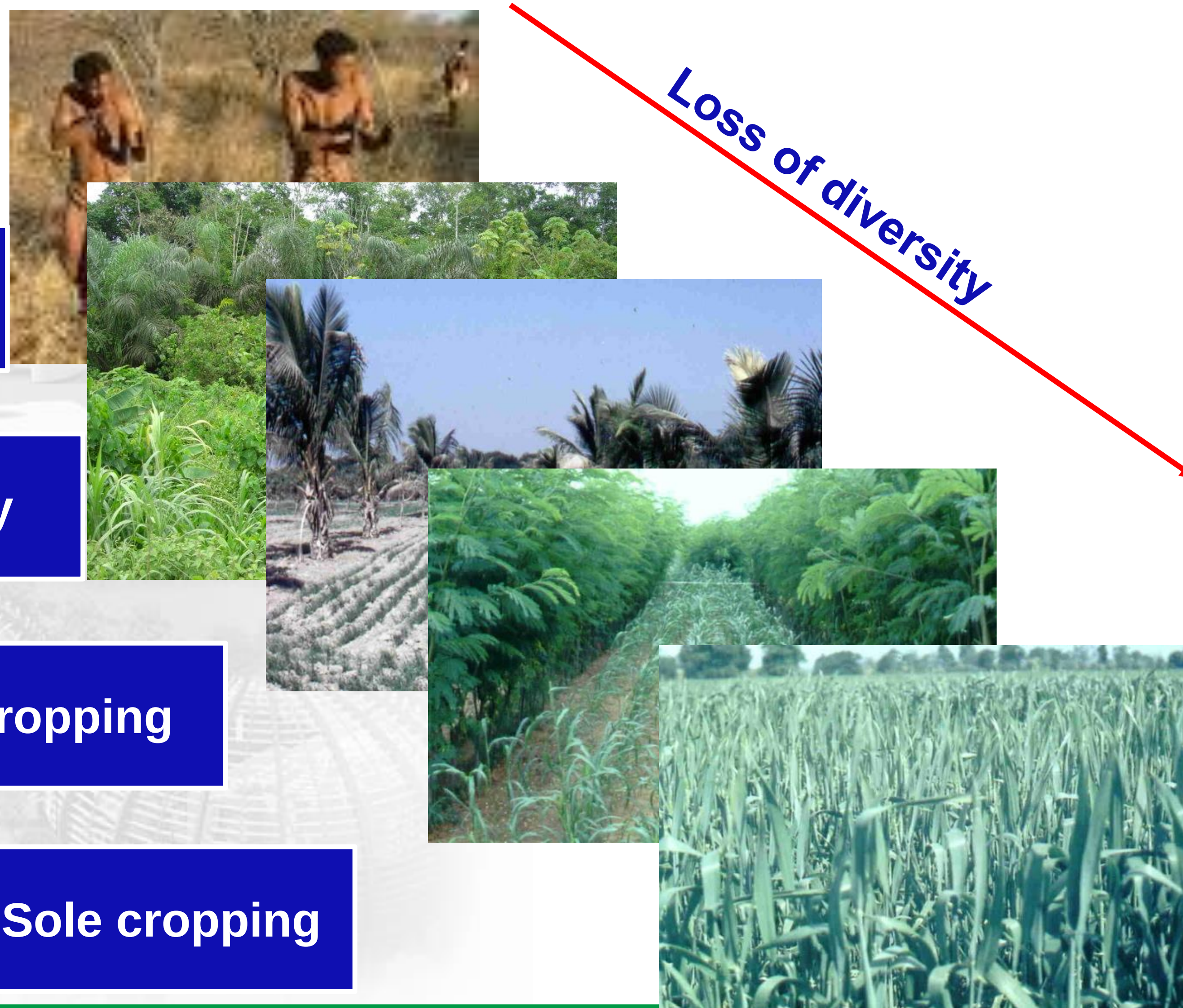
Hunter-Gatherers

Agri-silvo-pastoral

Agroforestry

Intercropping

Sole cropping



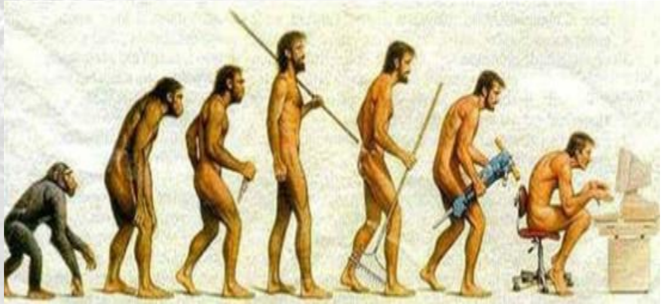
Loss of diversity

Plan A: Globalising the Food Supply Chain

CROPS FOR THE FUTURE RESEARCH CENTRE

6000 Languages

7 Languages
>50% Humanity



Mandarin
Spanish
English
Arabic
Hindi/Urdu
Portuguese
Bengali

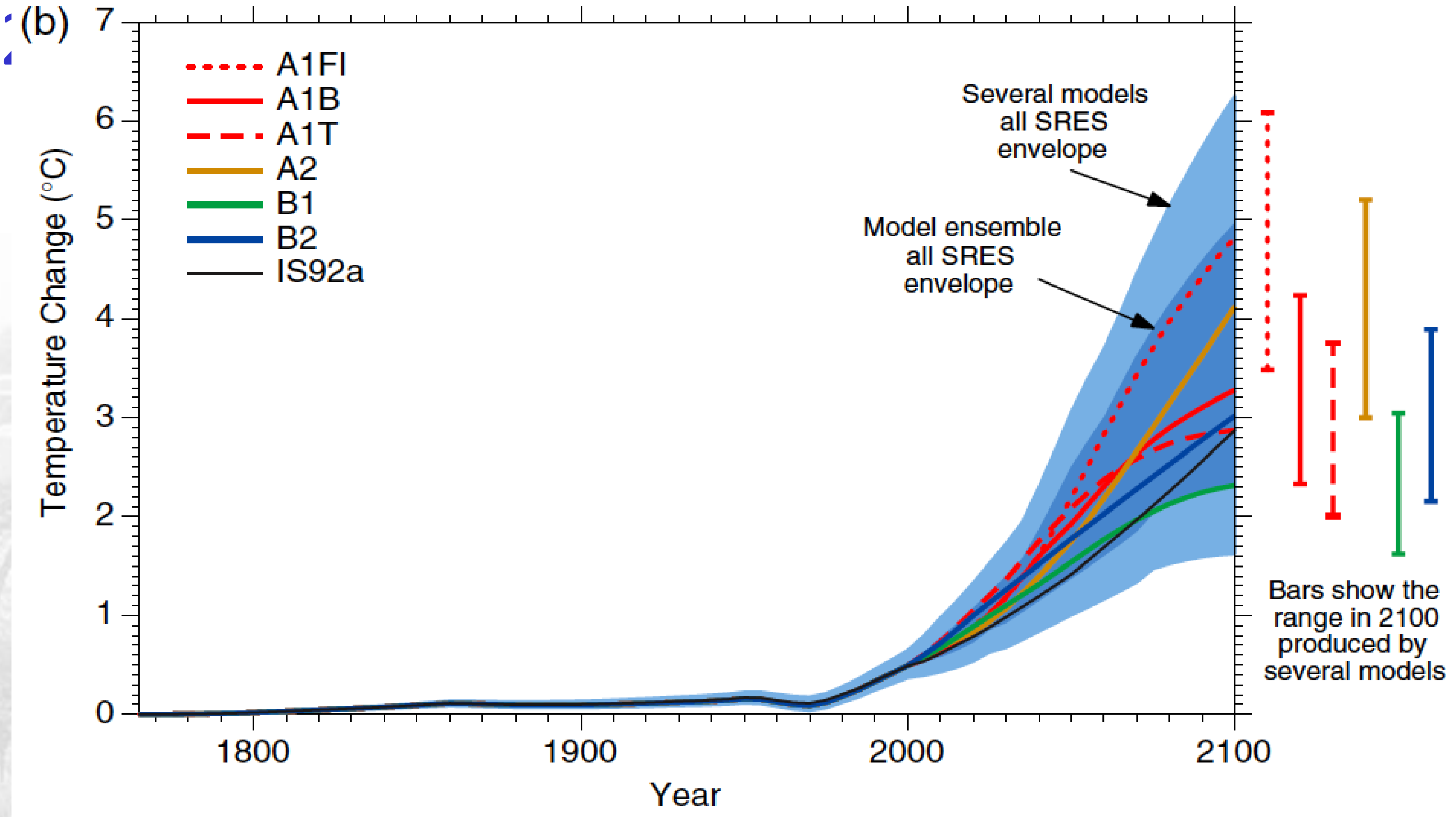
Plan A: Globalising the Human Food Chain

- Supply chains – long, complex, interdependent
- Species – a few species now feed 7 billion people
- Systems – only one cropping system – Monoculture
- Knowledge Systems – one predominant language



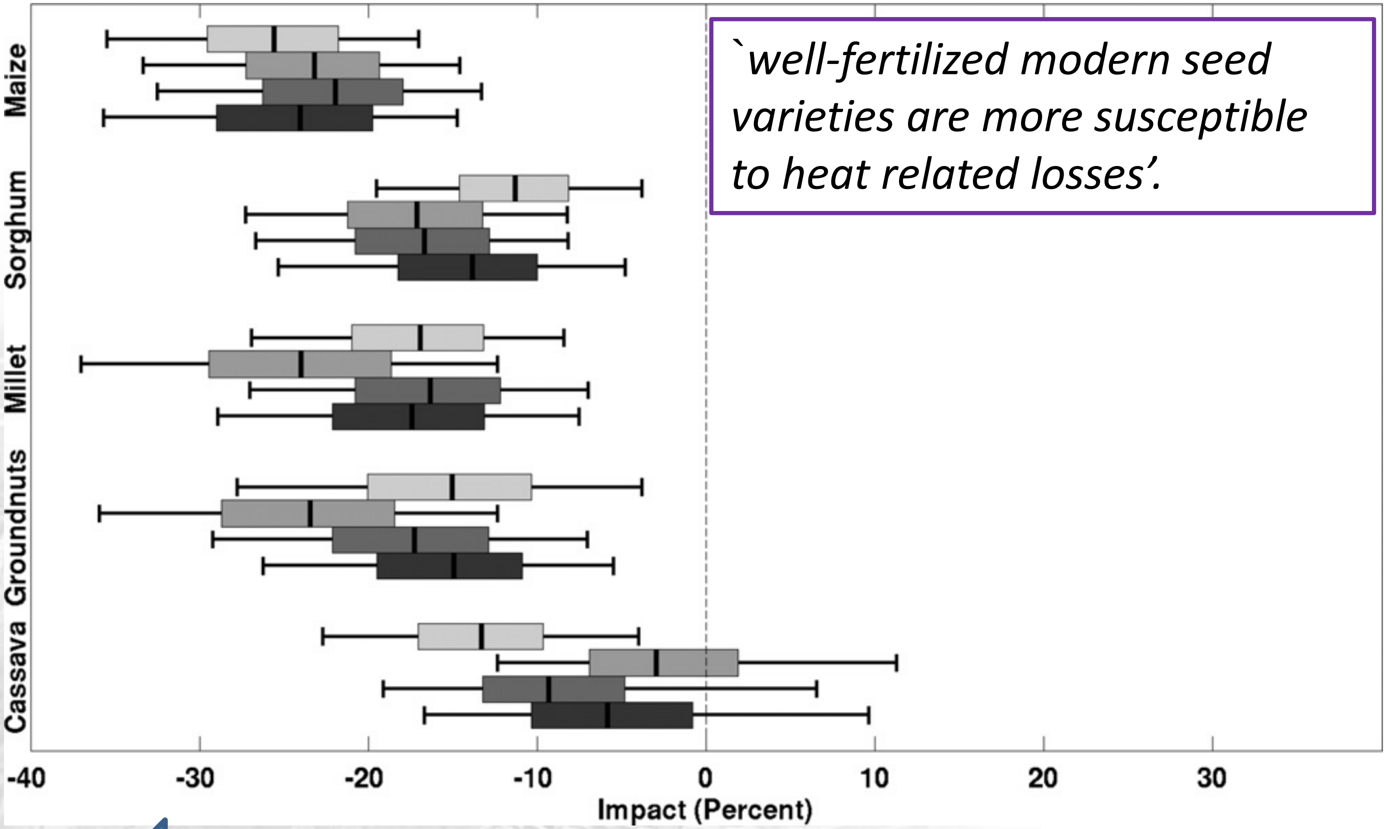

What could go wrong with Plan `A' ?

Ranges of modelled global temperatures (IPCC, 2



- ***Reduce median crop yields by 2 % per decade***
- ***Increase malnutrition by about 20%***

Climate Change and Crop Yields in Sub-Saharan Africa



`well-fertilized modern seed varieties are more susceptible to heat related losses'.

Yield

Predicted changes in total production (%) in SSA in 2046–2065 relative to 1961–2000

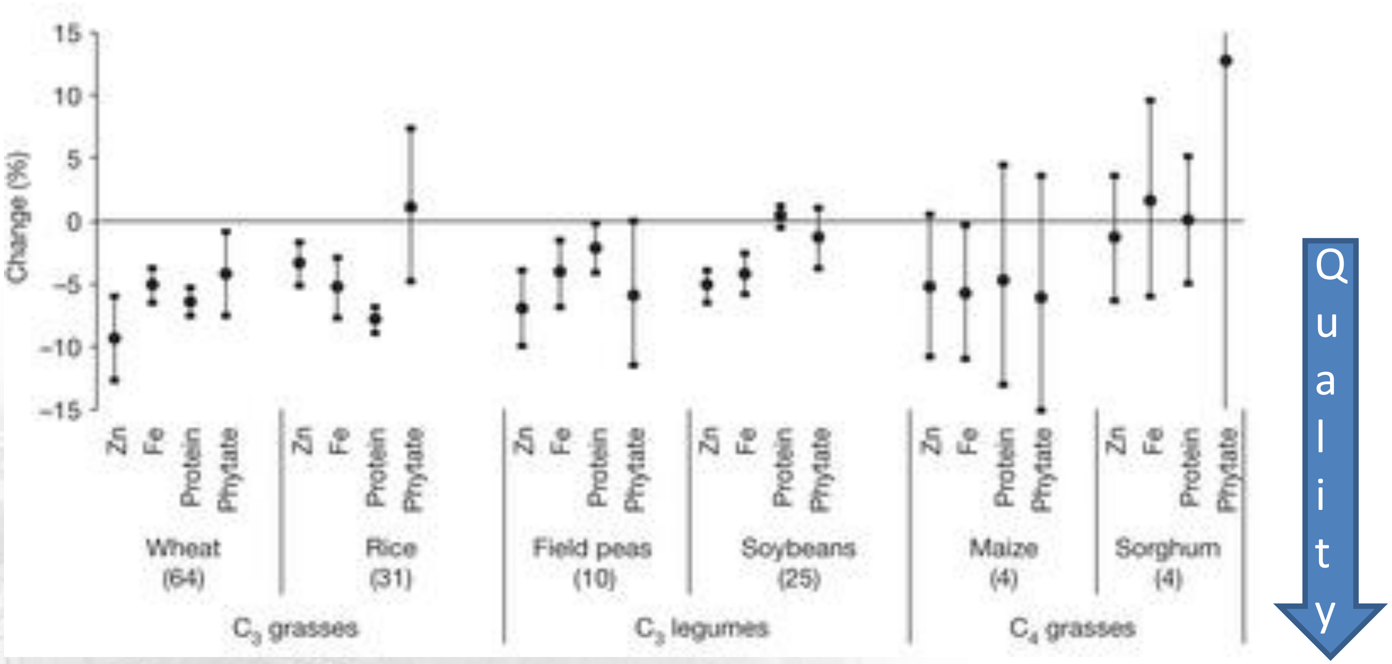
Schlenker and Lobell (Environ. Res. Lett. 5; 2010)

Increasing CO_2 threatens human nutrition

Largest data set from free-air CO_2 enrichment [FACE] experiments find that ***C_3 crops have reduced zinc and iron levels under CO_2 levels for middle of this century***.

Myers et.al., Nature, **510**,139–142 (05 June 2014)
doi:10.1038/nature13179

Increasing CO_2 threatens human nutrition

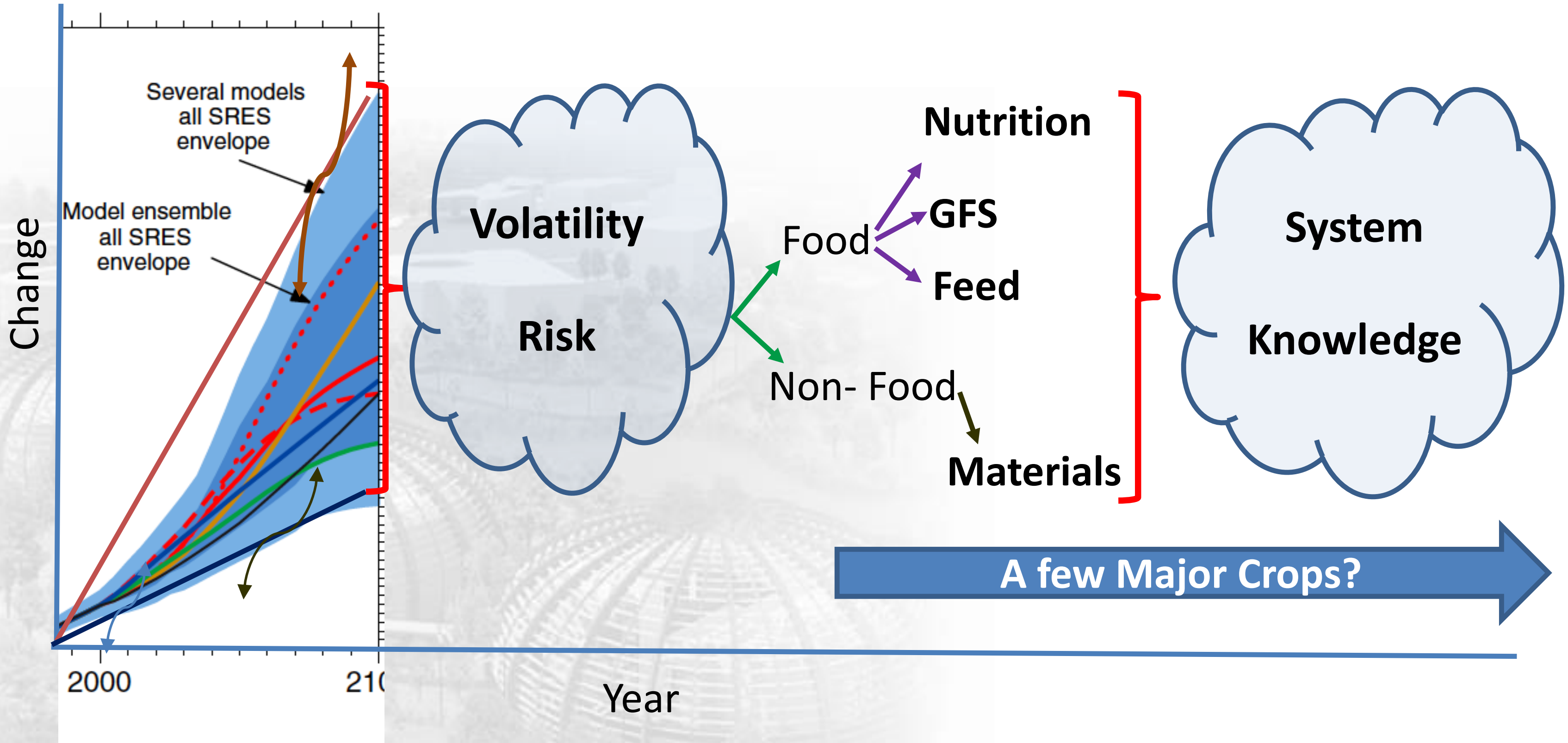


Myers noted that;

- *Inadequate zinc intake makes people more vulnerable to premature death from malaria, pneumonia and* diarrhoea.
- *Iron deficiency is linked to increases in maternal mortality, anaemia, reduced IQ and productivity.*

Myers et.al., Nature, **510**,139–142 (05 June 2014)

Implications of (Climate) Change for Plan A



The International Research System

No global institution responsible for research on underutilised crops

Plan B: Diversify the Human Food Chain

- **Partnerships/Facilities**
- **Research Value Chains**
- **Credibility**

Crops For the Future – Partnerships

48 partnerships established or in progress

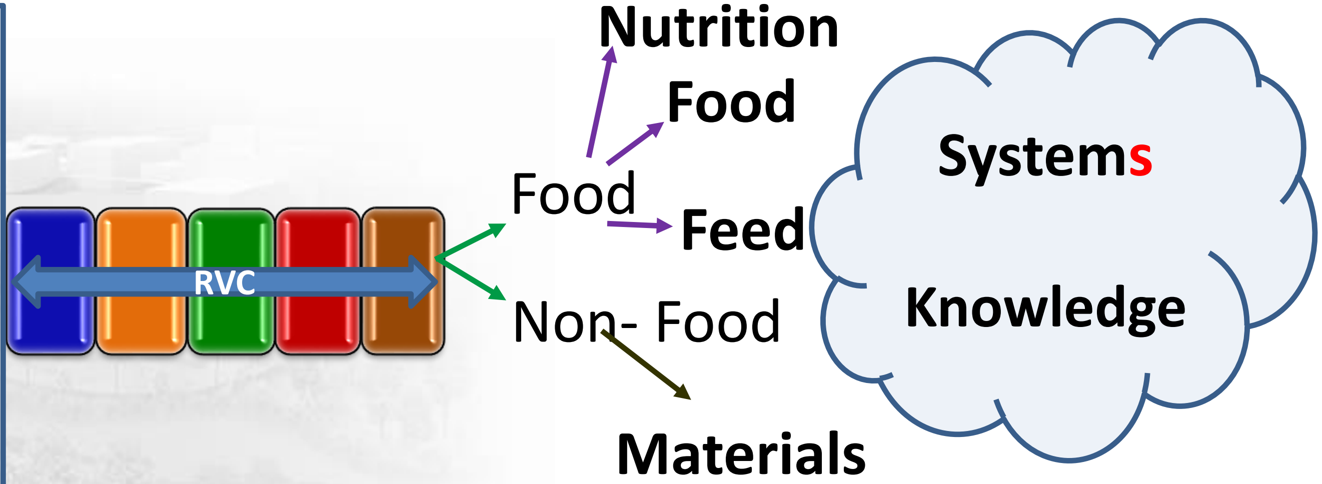
CFF - Facilities

CROPS FOR THE FUTURE RESEARCH CENTRE

CFFRC HQ

Crops For the Future Research Centre
www.cffresearch.org

Research Value Chains

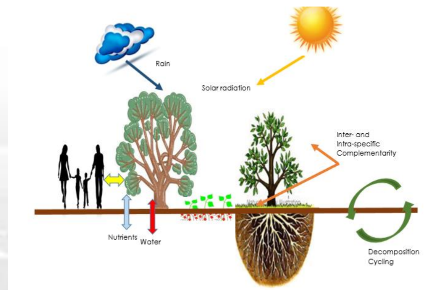


growers

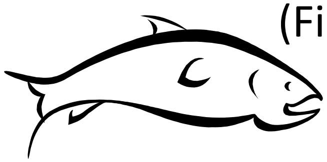
users

CFFRC:
Six Research Programmes

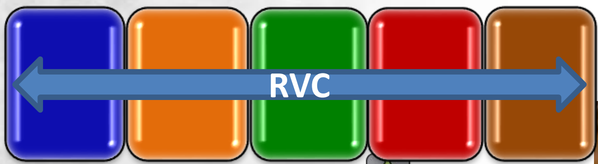
SYSTEMS
(SystemPLUS)



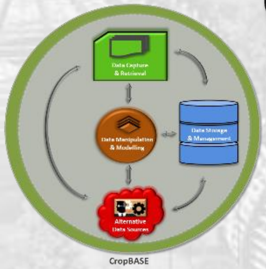
FEED
(FishPLUS)



NUTRITION
(FoodPLUS)



KNOWLEDGE
(CropBASE)

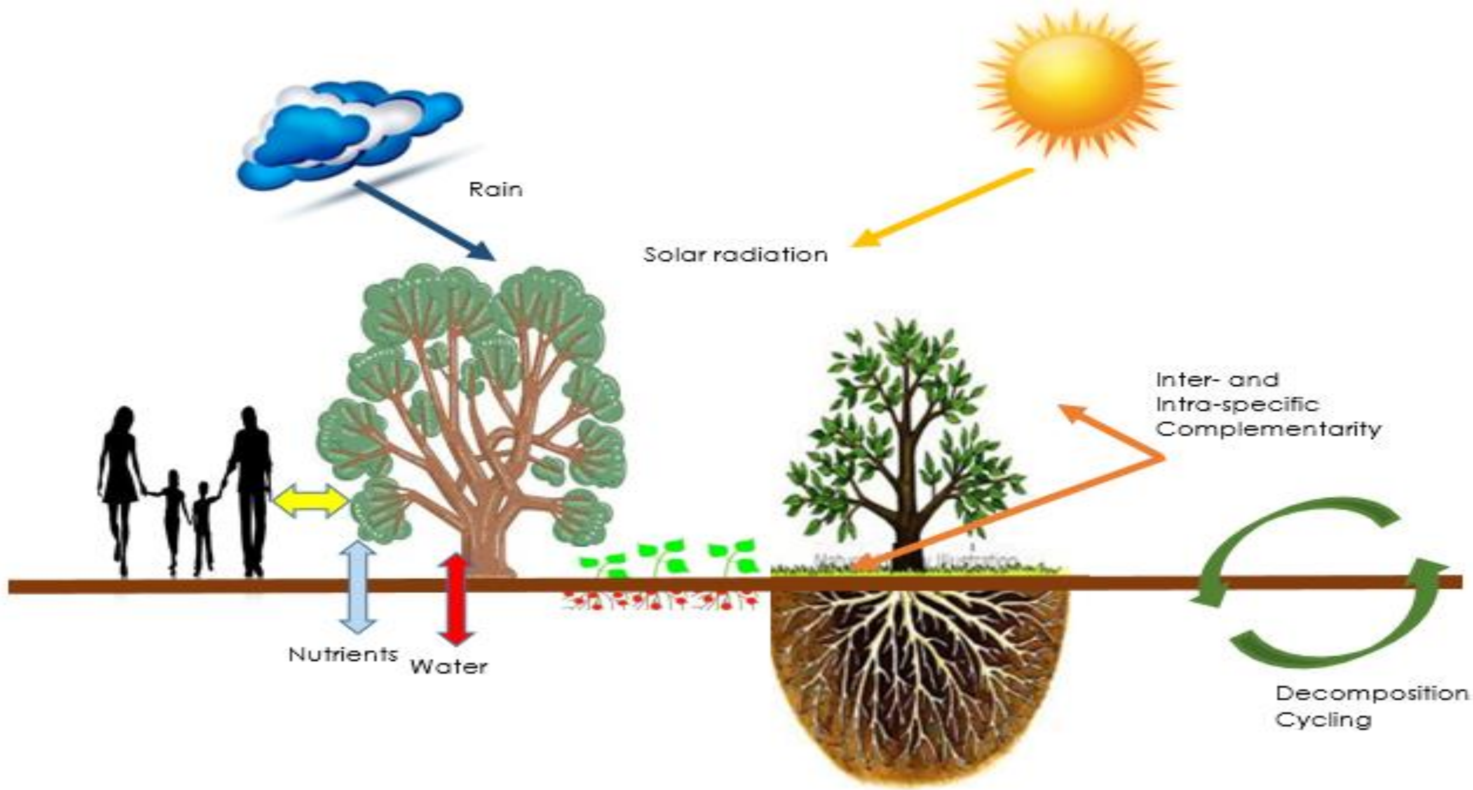


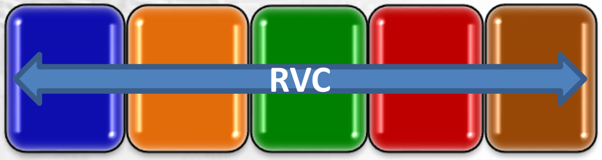
FOOD SECURITY
(BamYIELD)

MATERIALS
(BiomassPLUS)

Systems - SystemPLUS

Diversifying agriculture using underutilised crops and cropping systems





Materials - BiomassPLUS

Demonstrating multiple end uses of biomass

- Malaysian Oil Palm = 5 million ha
- Potential available space = 1 million ha

Hilly land

Early plantation

Space under oil palm

Small-scale rural power

Space below pylons

Nutrition - FoodPLUS

Traceability of nutrients through the human food chain

Improving & retaining micronutrient availability

Production | Postharvest | Processing | Bioavailability

RVC

Feed - FishPLUS

Incorporating functional ingredients into aquaculture feed

Impact :

Performance, sustainability and growth of aquaculture industry improved.

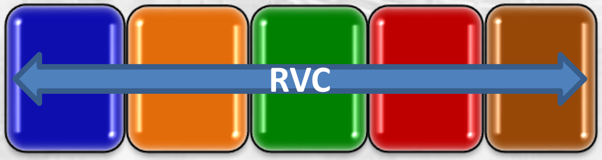
- Indigenous riverine fruits in the Empurau diet to replace or supplement fish meal and fish oil (FMFO)
- Dietary lipid from Dabai fruits to replace fish oil and improve flavour of high value fish like Empurau.
- FishPLUS and Sarawak partners investigating Dabai, Engkabang and other underutilised crops as replacements for FMFO as nutrient rich, cost effective fish feed.

Dabai
C.odontophyllum

Engkabang
S.macrophylla

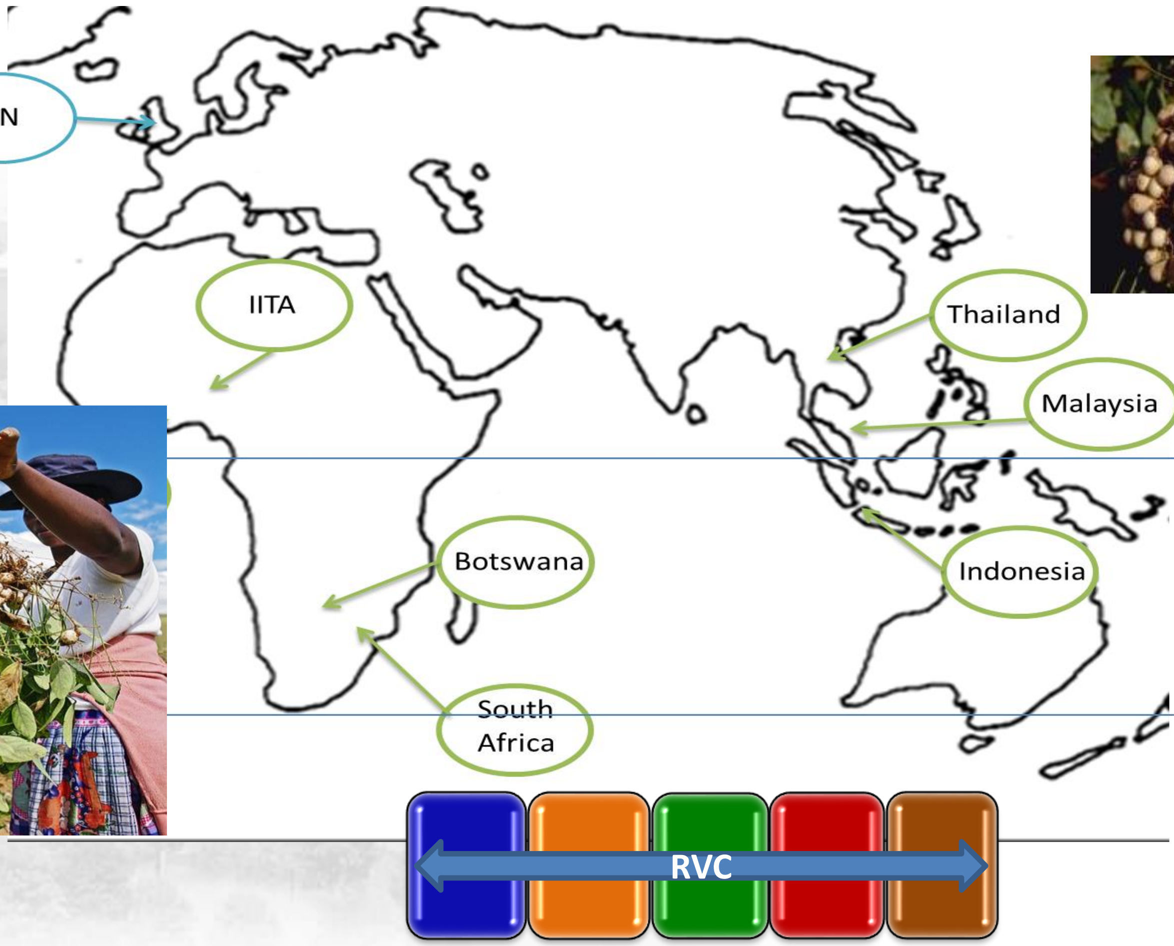
Buah melinjau
Gnetum gnemon

Buah kasai
Pometia pinnata



Food - BamYIELD

Model international underutilised legume research and breeding programme using Bambara groundnut as an exemplar



Knowledge - CropBASE

End-user service for underutilised crops & products for livelihoods

Underutilised crops information

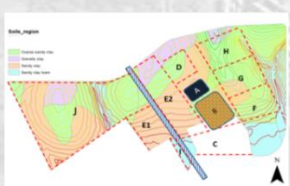
Partners

Databases

Interactive collaboration

Local Knowledge

Scientific Research



CropBASE

- **Develop a central knowledgebase**
- **Link social network interfaces**
- **Provide an interactive self-regulating platform**
- **Develop interrogation decision support system**

- **Facilitate research**
- **Model, monitor and predict future scenarios**
- **Social, economic and market implications**
- **Improve livelihoods and help alleviate poverty**

Plan B: Diversify the Human Food Chain

- **Partnerships/Facilities**
  - *No Ghettos*
- **Research Value Chains**
  - *No Silos*
- **Credibility**
  - *Trusted evidence*

AVRDC
The World Vegetable Center

Role of Indigenous Vegetables to Achieve Food and Nutritional Security

DR. VICTOR AFARI-SEFA

Agricultural Economist & Global Theme Leader - Consumption

at:

Global Food Security Forum

July 6-8,2014

Putrajaya Marriott Hotel, Malaysia

Outline of Presentation

- Importance of IVs in Food & Nutrition Security
- Brief Overview of AVRDC ‘s Operations
- Key Indigenous Vegetable R&D Intervention Approaches
- Challenges in Impact Attribution of IV Interventions
- Discussion Points

Imbalanced diets: Lack of micronutrients

Source: FAO; IFAD; WFP, 2012

Fortification & biofortification – or more diverse diets?

Iron and Zinc Biofortification

Iodization

Vitamin Supplementation

Food security: 15 crops...or 2,000 crops?!

Traditional treasures: diet diversity

Spider plant

African eggplant

Nightshade

Cowpea

Amaranth

Ethiopian kale

Why Indigenous Vegetables?

1. Rich in micronutrients (Fe, Zn, Vitamin A etc.), minerals and fibre, and are companions to all staple foods for a balance diet.
2. Key sources of health promoting phytochemicals and anti-oxidants.
3. Medicinal value. e.g., African eggplant possess protective properties against ulcers, bitter gourd is known have anti-diabetic properties while moringa reduces cholesterol levels.
4. Climate-resilient crops that fit into year round production system (and also for disaster response)

Traditional vegetables: Rich in nutrients

	Ranges	Tomato	Cabbage	Moringa	Amaranth	Aibika	Sweet potato leaf
β-Carotene,mg	0.0 - 22	0.40	0.00	15.28	9.23	5.11	6.82
Vit C, mg	1.1 - 353	19	22	459	113	82	81
Vit E, mg	0.0 - 71	1.16	0.05	25.25	3.44	4.51	4.69
Iron, mg	0.2 – 26	0.54	0.30	10.09	5.54	1.40	1.88
Folates, µg	2.8 – 175	5	ND	93	78	177	39
Antioxidant activity, TE	0.6 - 82,000	323	496	2858	394	560	870

Micronutrient content of common and indigenous vegetables

Source: AVRDC Nutrition Lab

* public sector

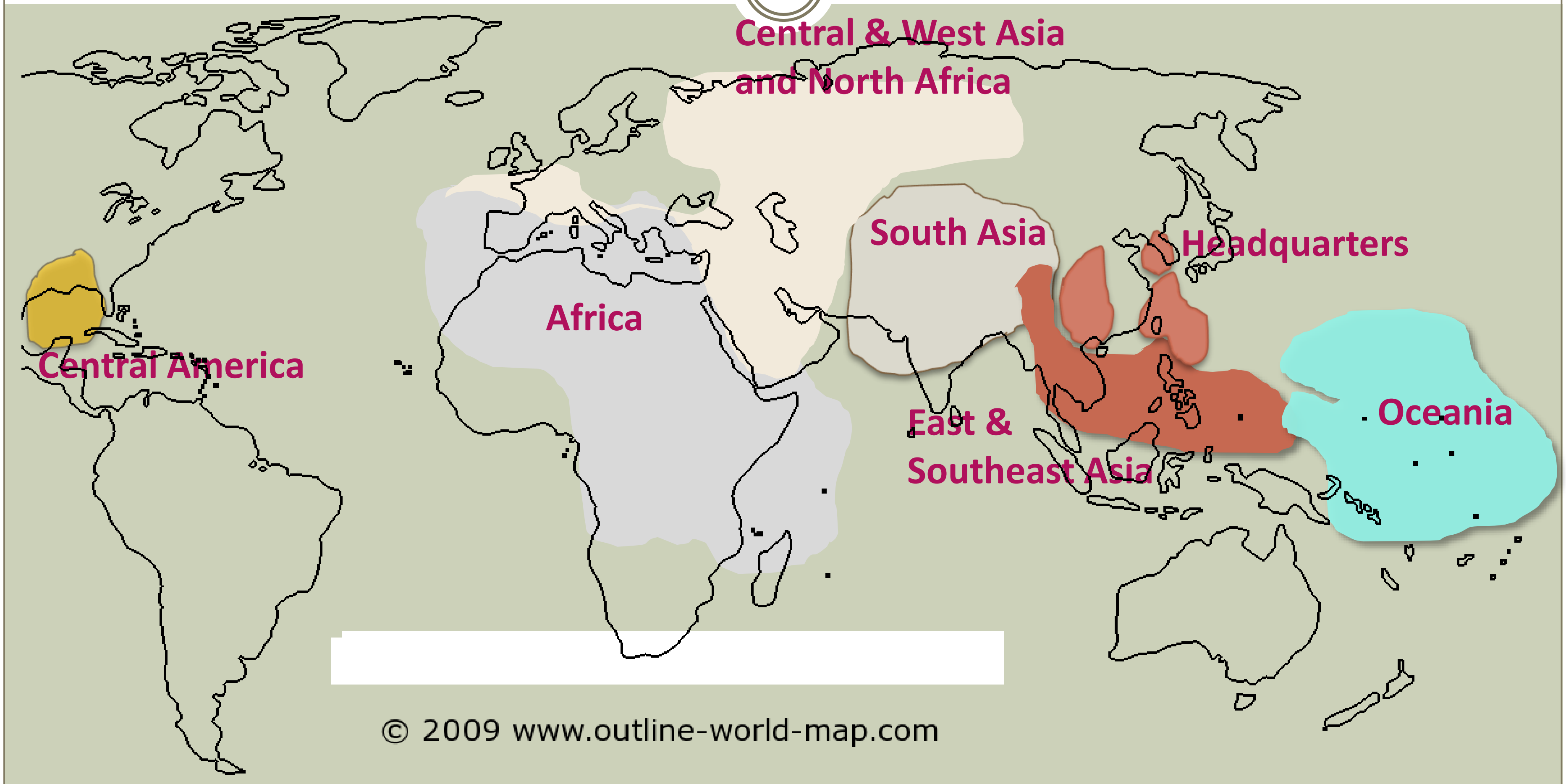
The world’s largest* collection of vegetable germplasm: AVRDC Genetic Resources and Seed Unit Genebank

Germplasm accessions conserved at AVRDC – 1/2014

	Principal crops	Other crops	Total
No. of accessions	56,664	4,235	60,899
No. of genera			172
No. of species			438
Countries of origin			156

Accessions at AVRDC’s East & Southern Africa hub : 2,351

AVRDC's Operational Regions



AVRDC – The **WORLD** Vegetable Center

Scope of AVRDC's R&D in Nutrition & Health

- AVRDC has no comparative advantage in
  - Medical sciences to provide evidence for reduction in risk of non-communicable diseases as a result of increased consumption of vegetables *per se*.
- AVRDC has comparative advantage in
  - Nutritional and functional analyses of vegetables
  - Improvement of food preparation methods
  - Dietary strategies to enhance local appeal and nutrient bioavailability of vegetables.
  - Nutrition-sensitive, community-based agricultural interventions and strategies to enhance access to nutritious food and health promoting diets.

Insects and pesticides: Eggplant fruit and shoot borer

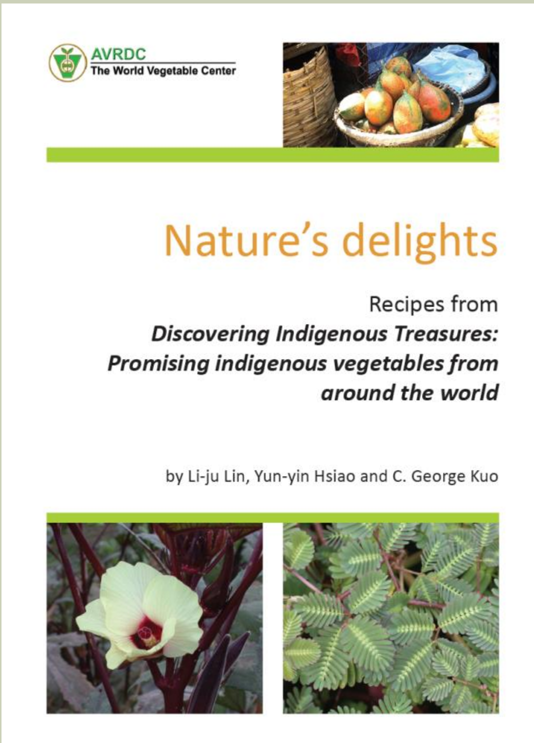
- Most severe pest of eggplant in Asia and East Africa today
- Heavy pesticide spraying (140 and more times during 6 month cropping period)
- Integrated pest management (IPM) solutions dramatically reduce pesticide use

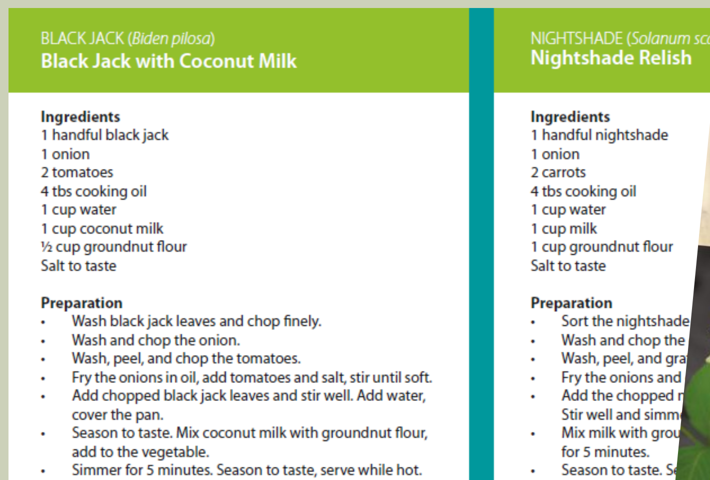


Building capacity for resilience

Healthy diets begin with knowledge

Recipes: Good Taste, Good Health





BLACK JACK (*Biden pilosa*)
Black Jack with Coconut Milk

Ingredients
1 handful black jack
1 onion
2 tomatoes
4 tbs cooking oil
1 cup water
1 cup coconut milk
½ cup groundnut flour
Salt to taste

Preparation
- Wash black jack leaves and chop finely.
- Wash and chop the onion.
- Wash, peel, and chop the tomatoes.
- Fry the onions in oil, add tomatoes and salt, stir until soft.
- Add chopped black jack leaves and stir well. Add water, cover the pan.
- Season to taste. Mix coconut milk with groundnut flour, add to the vegetable.
- Simmer for 5 minutes. Season to taste, serve while hot.

NIGHTSHADE (*Solanum sca*
Nightshade Relish

Ingredients
1 handful nightshade
1 onion
2 carrots
4 tbs cooking oil
1 cup water
1 cup milk
1 cup groundnut flour
Salt to taste

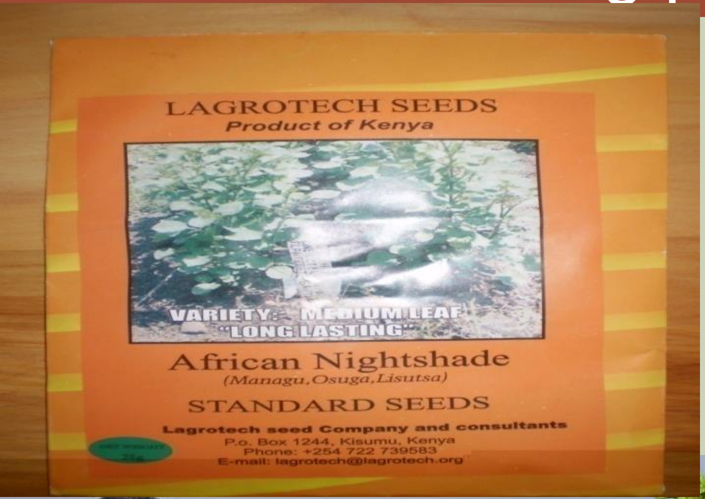
Preparation
- Sort the nightshade
- Wash and chop the
- Wash, peel, and gra
- Fry the onions and
- Add the chopped r Stir well and simm
- Mix milk with grou for 5 minutes.
- Season to taste. S

Healthy Home Garden Kits

- Developed by AVRDC for farmers, trainees, or any private individual and to public and private agencies upon request
- Each kit composed of up to 17 different kinds of high yielding & nutritious vegetables
- Enough seeds (2-50 g) of each crop to plant a home garden and sustain a healthy diet for a family of 4 for a year

Disaster Relief Seed Kits

Linking private and public sectors



Linking farmers to High value markets

Line DB3

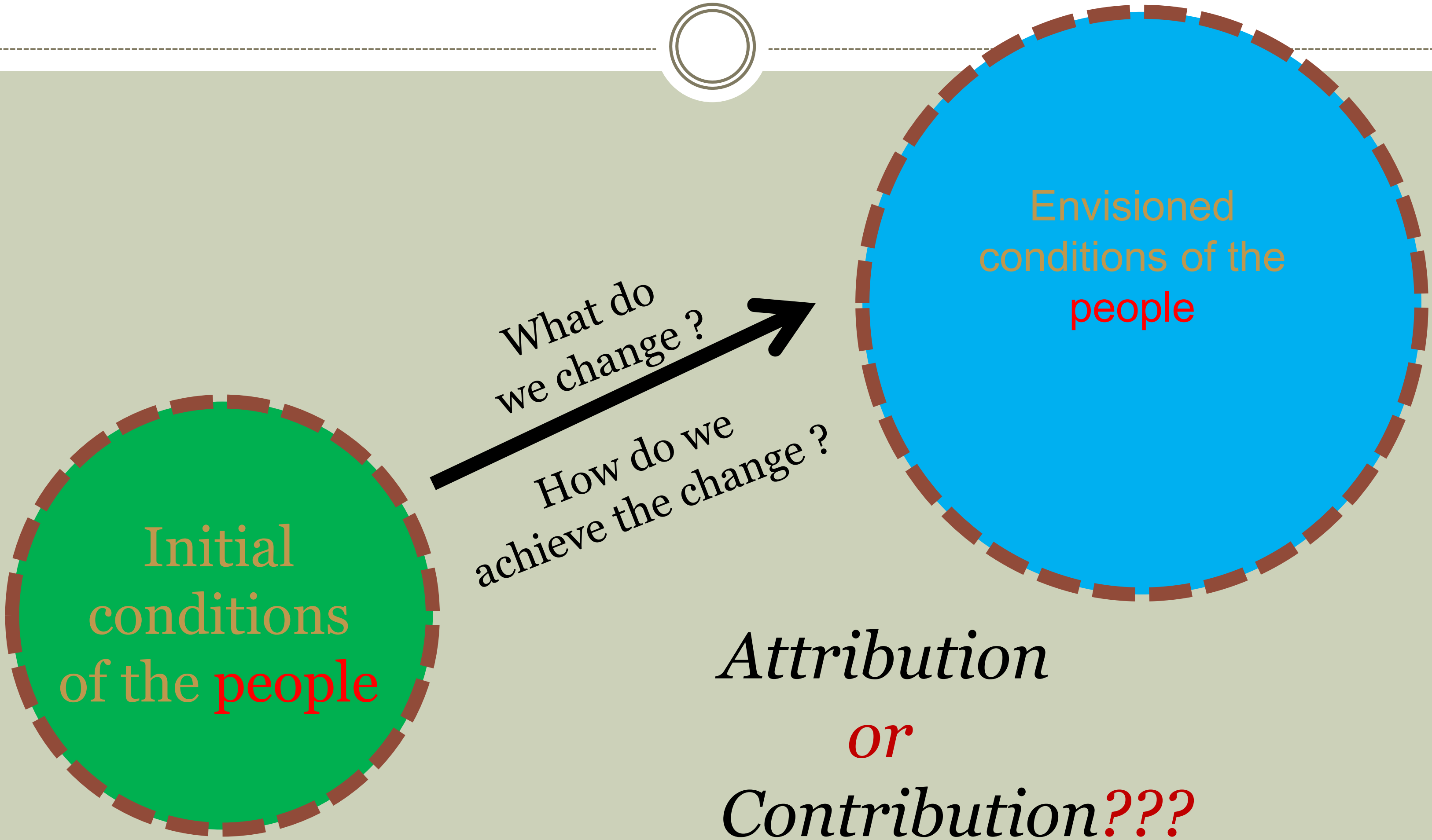
Linkage to high value markets

Demand Creation Activities

ACTIVITIES

- Field Days
- Agricultural Shows
- Seed fairs

Achieving Impact - Best Practices



Attribution

or

Contribution???

Income, dietary diversity, social capital

Output

Improved cultivars	Better methods for crop and pest management	Better methods for post-harvest management	Capacity Building (Cross cutting)	Increase Consumption

Outputs are adopted and used and change people's behavior

Target Populations

Outcomes

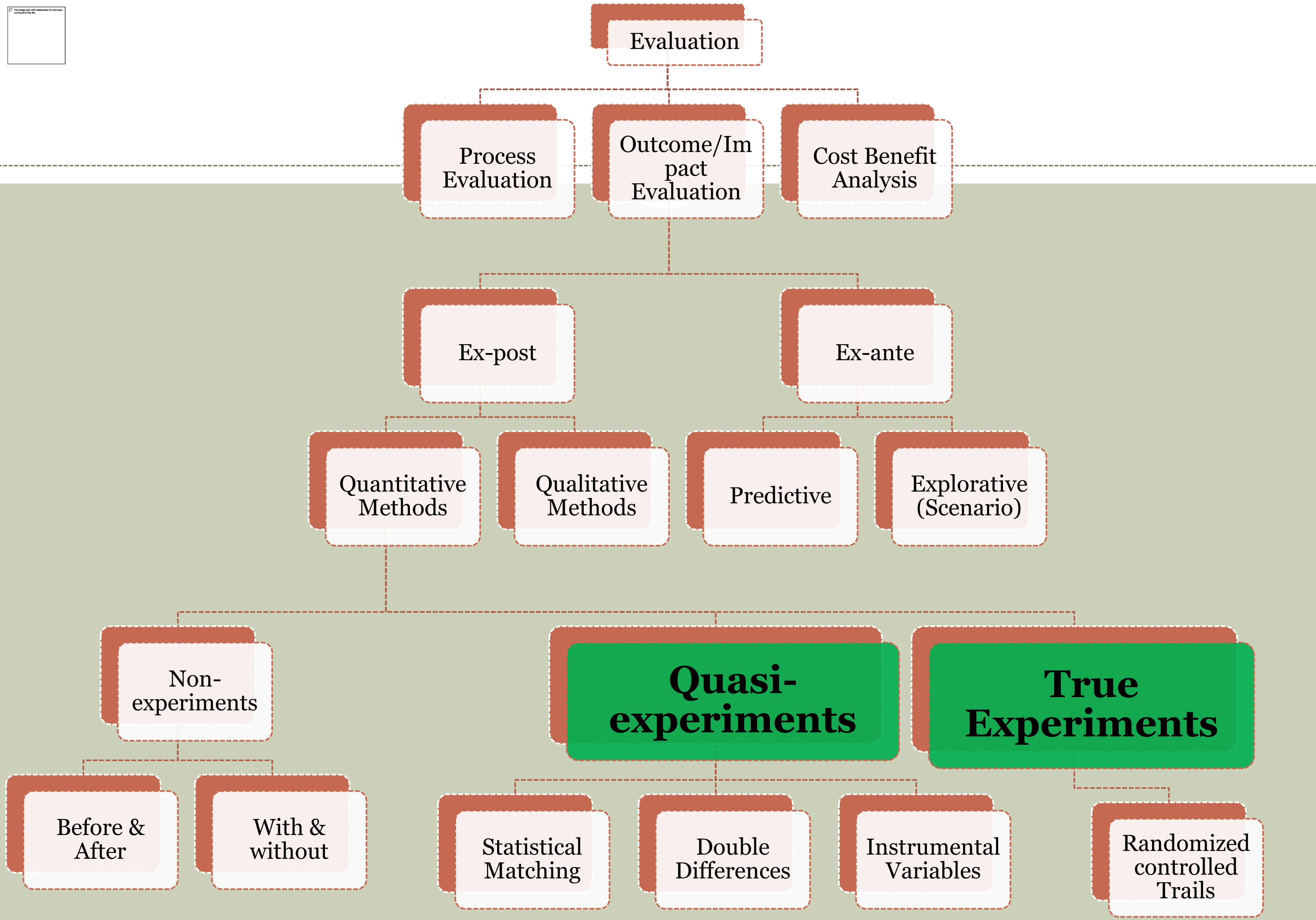
Improved productivity	efficient and sustainable resource use	Better produce quality	Gender transformation & equity	diversified food consumption

Outcomes lead to sustainable improvements in people's lives - progress in development

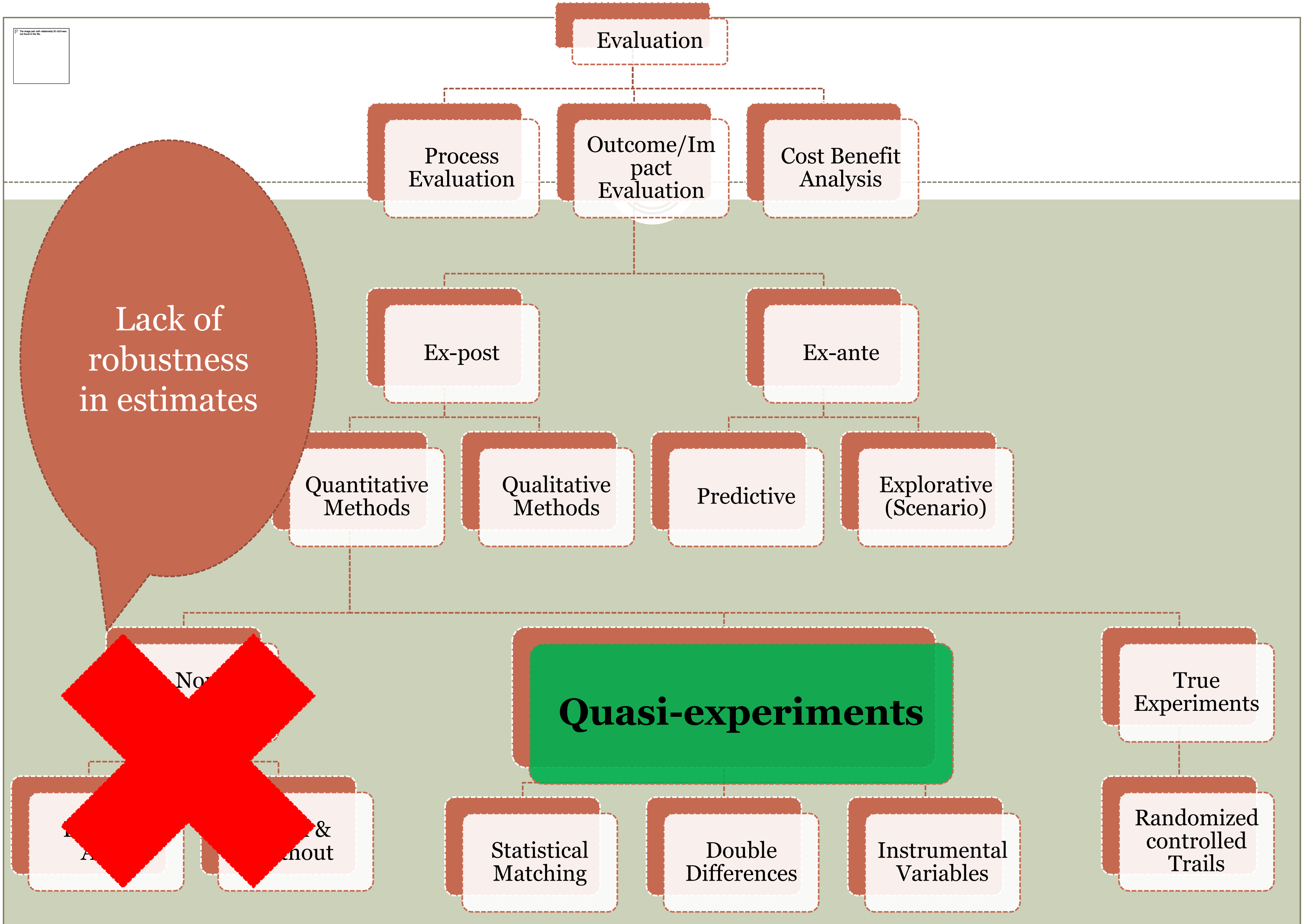
Target Populations

Impact (*Attribution!!*)

Improved Income	Improved Nutrition	Improved Social Capital (e.g., better access to high value markets	Improved vegetable production technologies



Evaluation
Process Evaluation
Outcome/Impact Evaluation
Cost Benefit Analysis
Ex-post
Ex-ante
Quantitative Methods
Qualitative Methods
Predictive
Explorative (Scenario)
Non-experiments
Quasi-experiments
True Experiments
Before & After
With & without
Statistical Matching
Double Differences
Instrumental Variables
Randomized controlled Trails


Evaluation
Process Evaluation
Outcome/Impact Evaluation
Cost Benefit Analysis
Ex-post
Ex-ante
Quantitative Methods
Qualitative Methods
Predictive
Explorative (Scenario)
Lack of robustness in estimates
Quasi-experiments
True Experiments
Statistical Matching
Double Differences
Instrumental Variables
Randomized controlled Trails

Discussion Points

- Defining very clear impact pathways (agriculture-nutrition-health linkages) nutrition improvement. Is it and Attribution or a contribution (considers other factors, e.g., WASH) to impact.
- Coordinating VC actor efforts and upgrading VCs for most IVs complemented with increased consumer demand creation. VC's for most IVs not are not structured.
- Addressing availability of good quality seeds, both at the national and regional level; Seed commercialization by the private sector.
- Improving business planning by farmers, improving market information and support systems.


Thank you for
your attention

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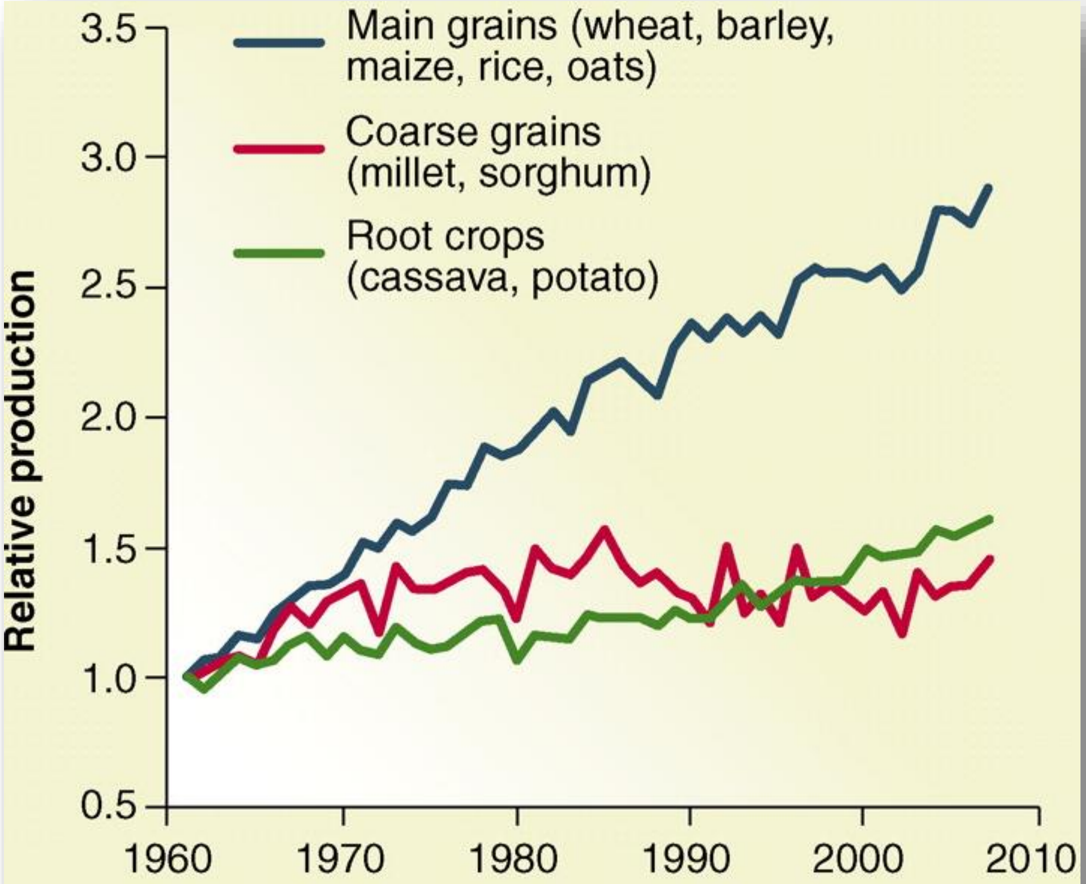
Diane Mather

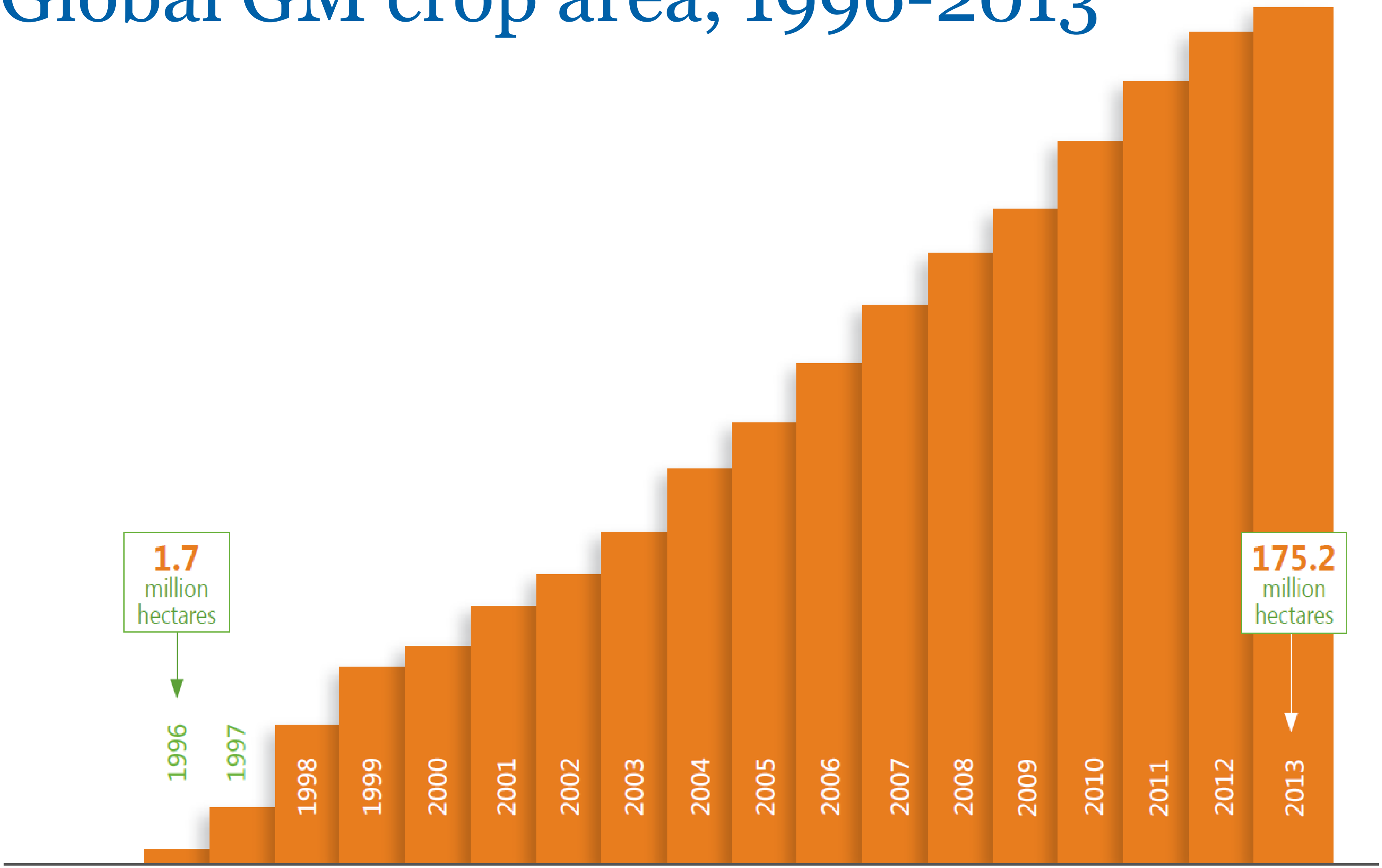
Plant Biotechnology for Food and Nutritional Security

Plant breeding: a significant contributor to productivity gains



From Godfray et al. (2010) Science 327: 812

Global GM crop area, 1996-2013



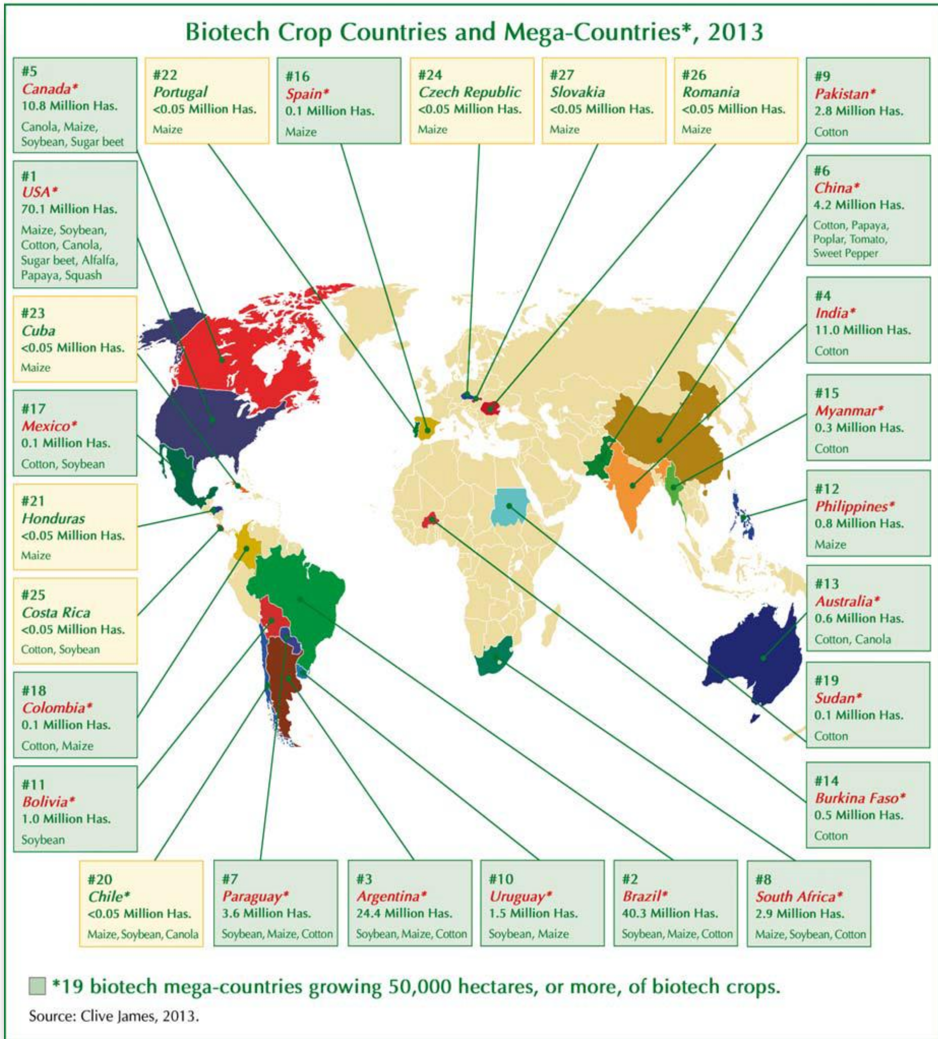
From www.isaaa.org

In 2013, 27 countries grew GM crops:

<u>The top 5</u>

1. USA
2. Brazil
3. Argentina
4. India
5. Canada

Developing countries grew more GM crops than industrial countries.



From www.isaaa.org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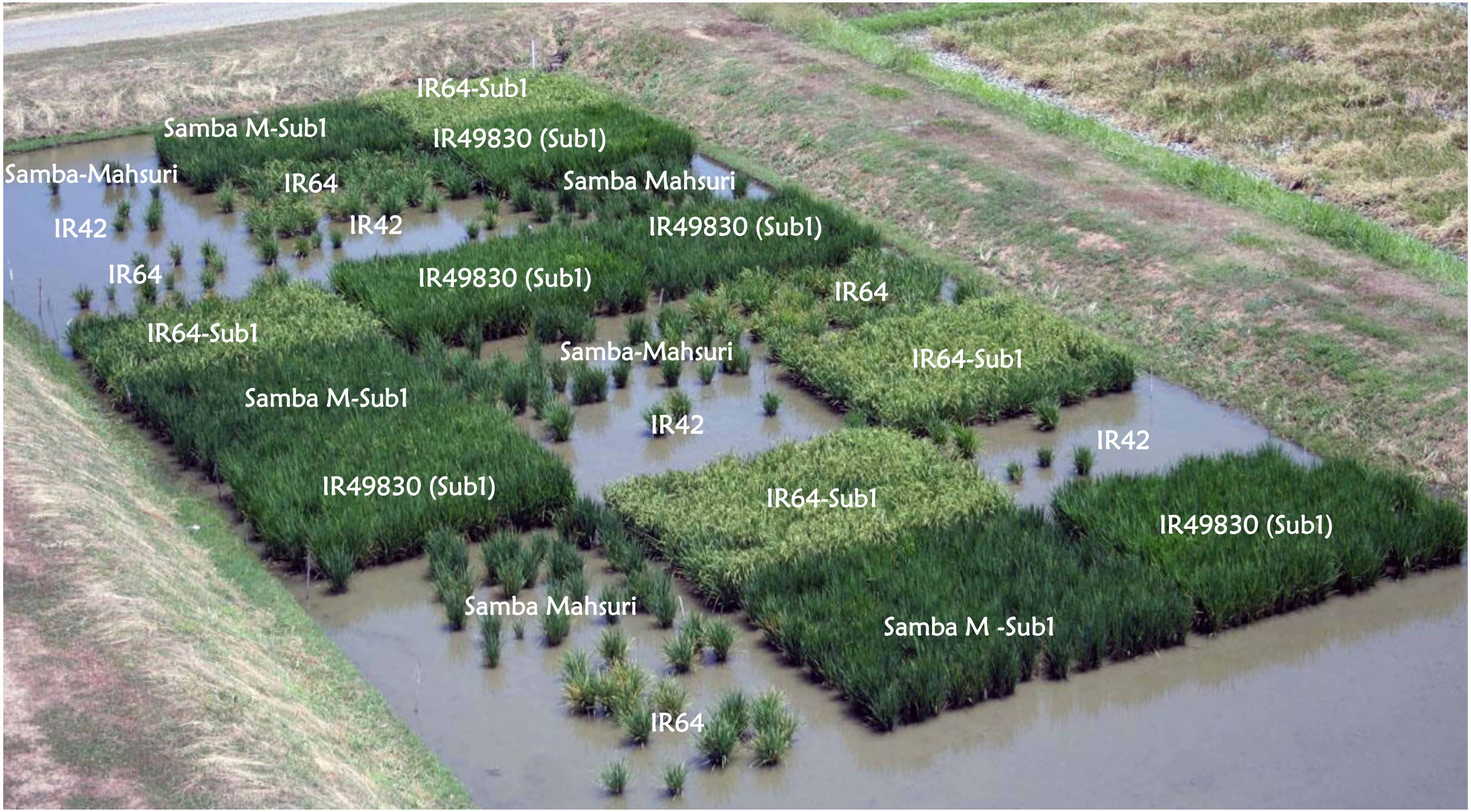
Control **Golden Rice 1** **Golden Rice 2**

From Paine et al. (2005)

Sub1 (submergence tolerant) rice



International Rice Research Institute

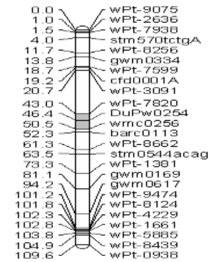
Genetic mapping and marker-assisted selection

Source of trait

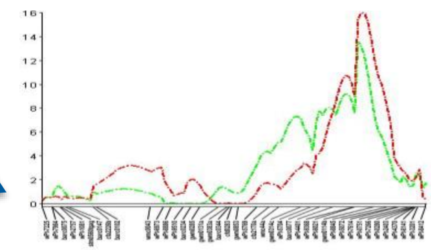
Mapping population

Assay DNA markers

Evaluate trait



DNA markers mapped

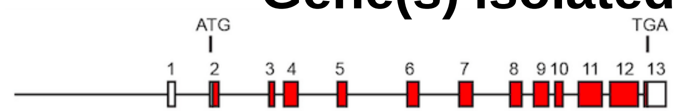


Gene(s) mapped

Assay DNA markers

Breeding populations

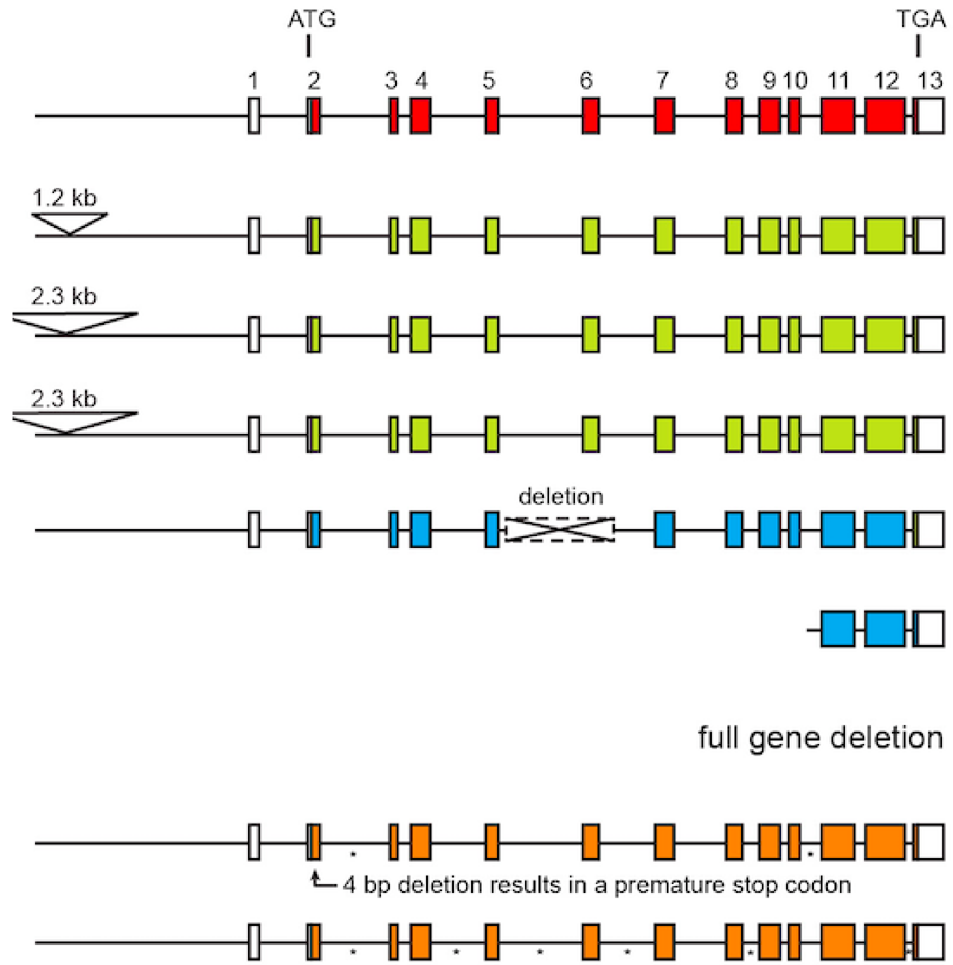
Gene(s) isolated



Varieties with the trait

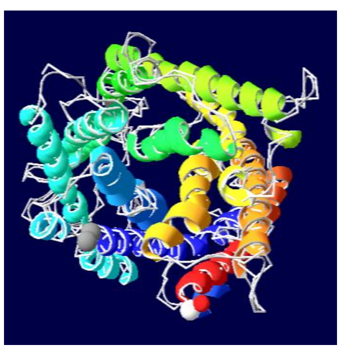
Abiotic stress example: tolerance to boron toxicity

Genes for boron tolerance isolated from barley and from wheat

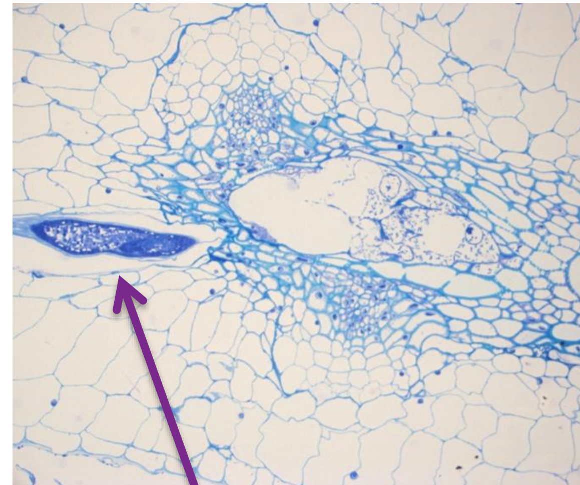


Sutton et al. (2007) *Science*

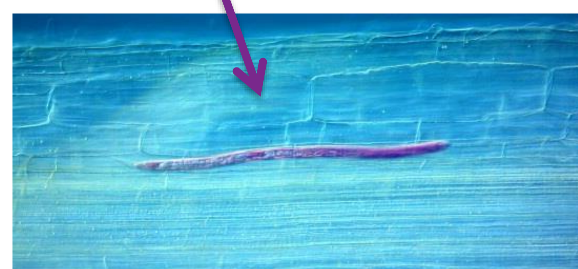
Pallotta et al. (2014) *Nature*

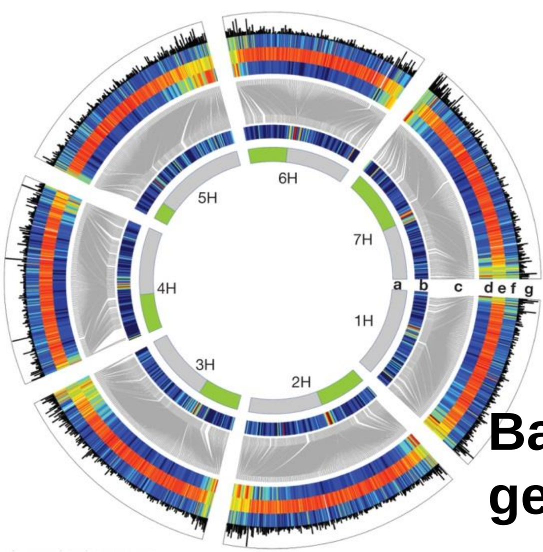


Biotic stress example: nematode resistance



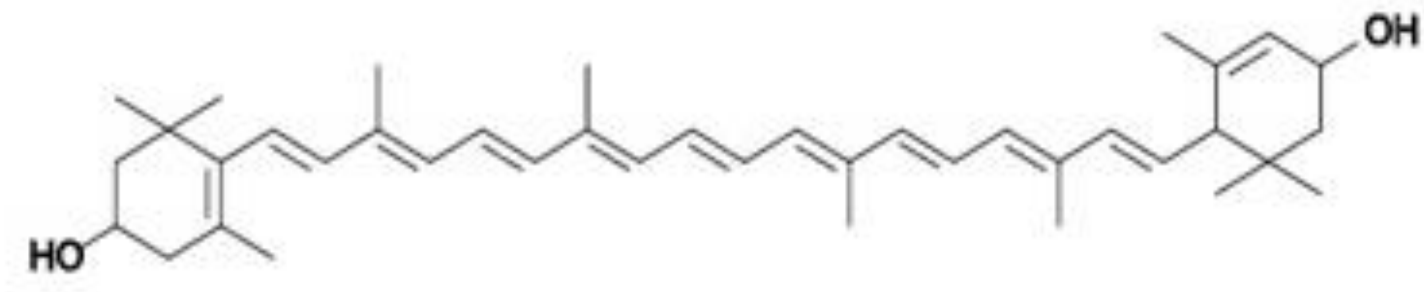
Nematodes in roots





Barley genome

Grain quality example: high-lutein wheat



HiLut wheat developed by Daryl Mares

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Technological advances

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Waite Research Institute

ACPFG
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AGRICULTURE
NUTRITION
FOOD
HEALTH

plant energy biology
ARC Centre of Excellence

Global Food Security Conference

7/8 July 2014, Kuala Lumpur

Spatial Aspects of Hidden Hunger

Edward Joy, Diriba Kumssa, Louise Ander, Michael Watts, Scott Young, Martin Broadley

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Hidden hunger: Background

Food security

"...physical, social and economic access to sufficient, safe and nutritious food to meet dietary needs and food preferences for an active and healthy life".

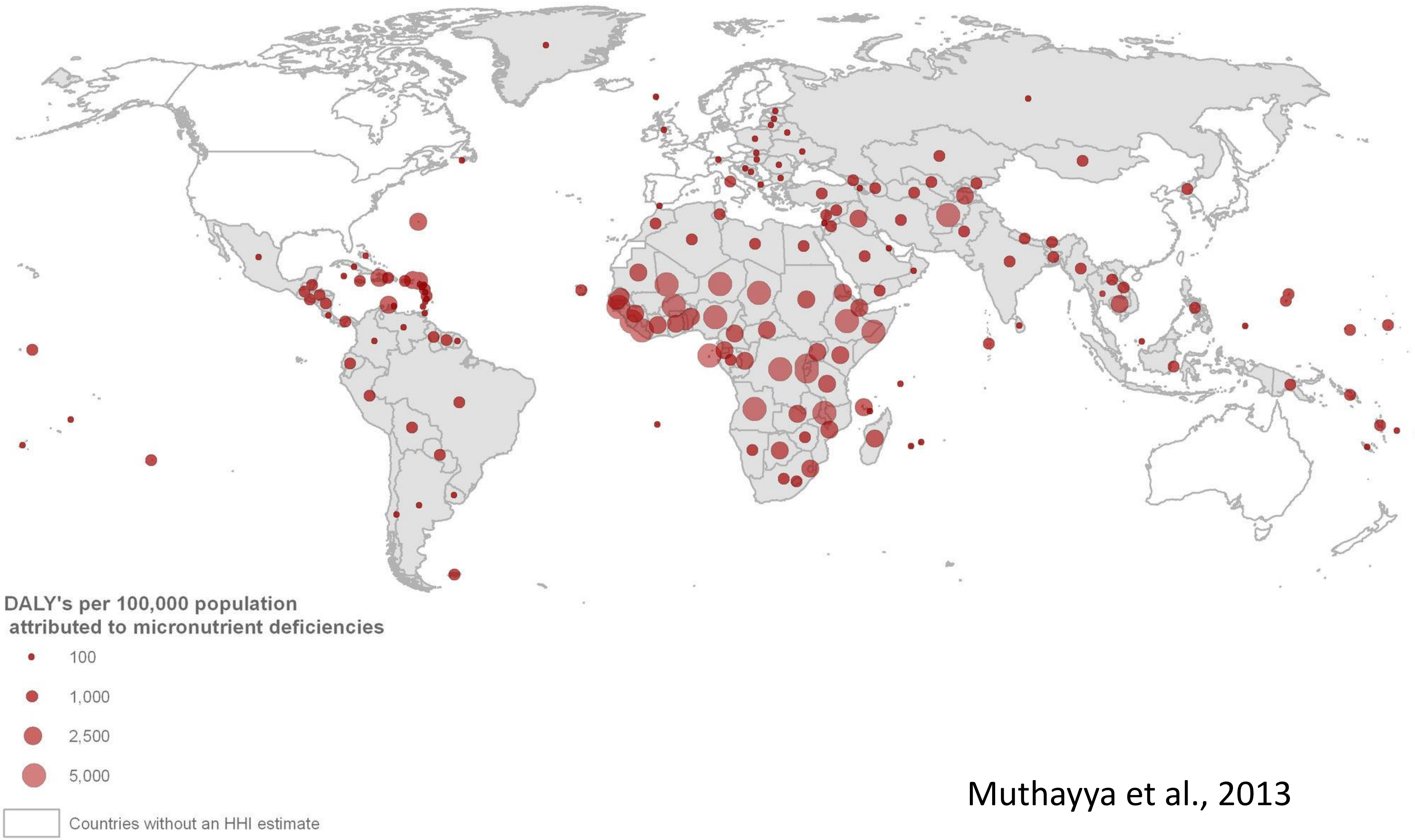
MDG 1c

Halve the proportion of people who suffer from hunger (1990-2015)

Post 2015

(a) End hunger and protect the right of everyone to have access to sufficient, safe, affordable, and nutritious food

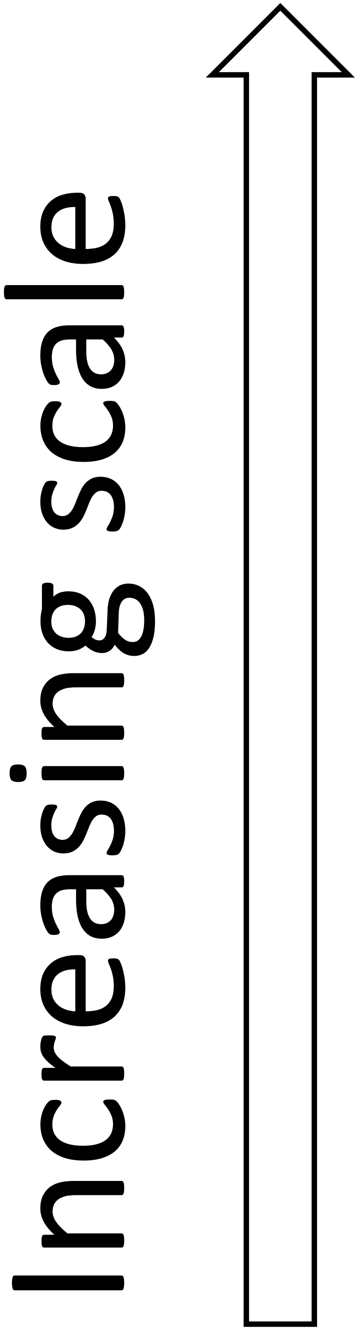
(b) Reduce by x% stunting, wasting by y% and anemia by z% for all children under 5

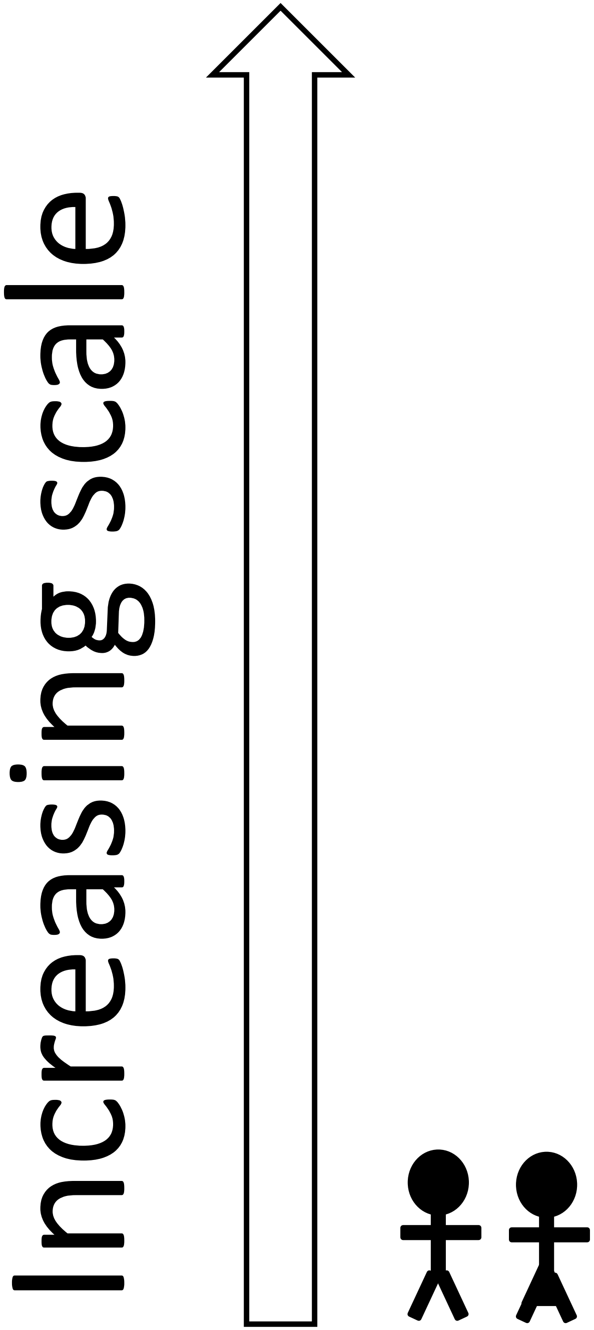


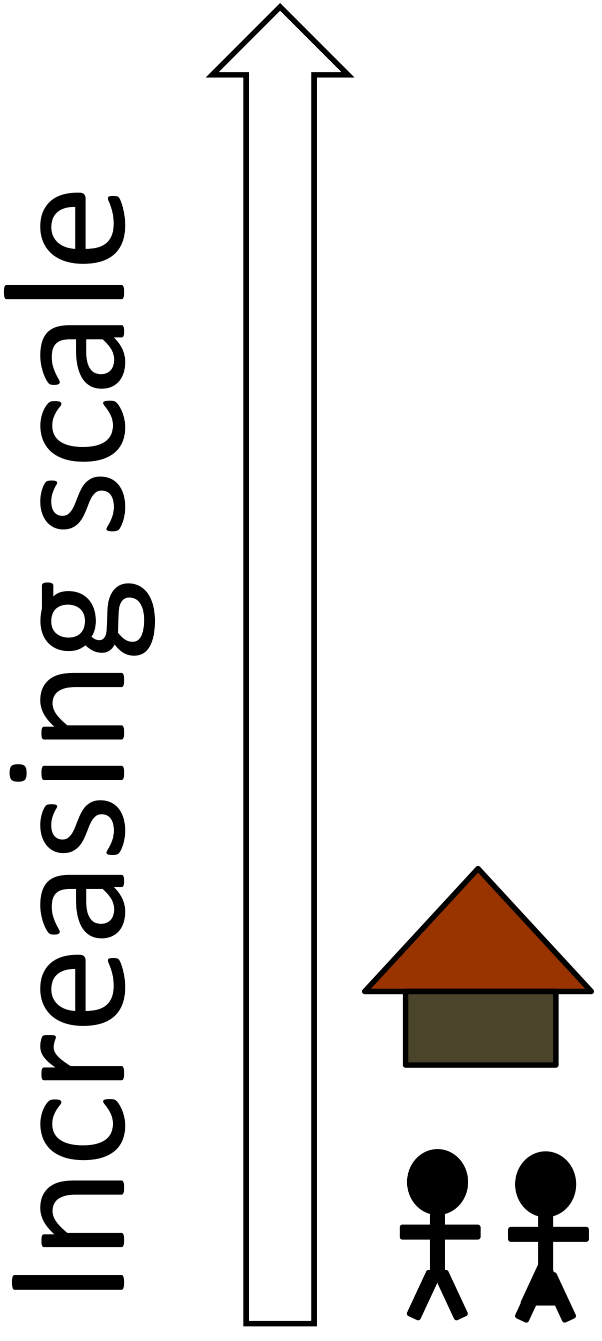
Muthayya et al., 2013

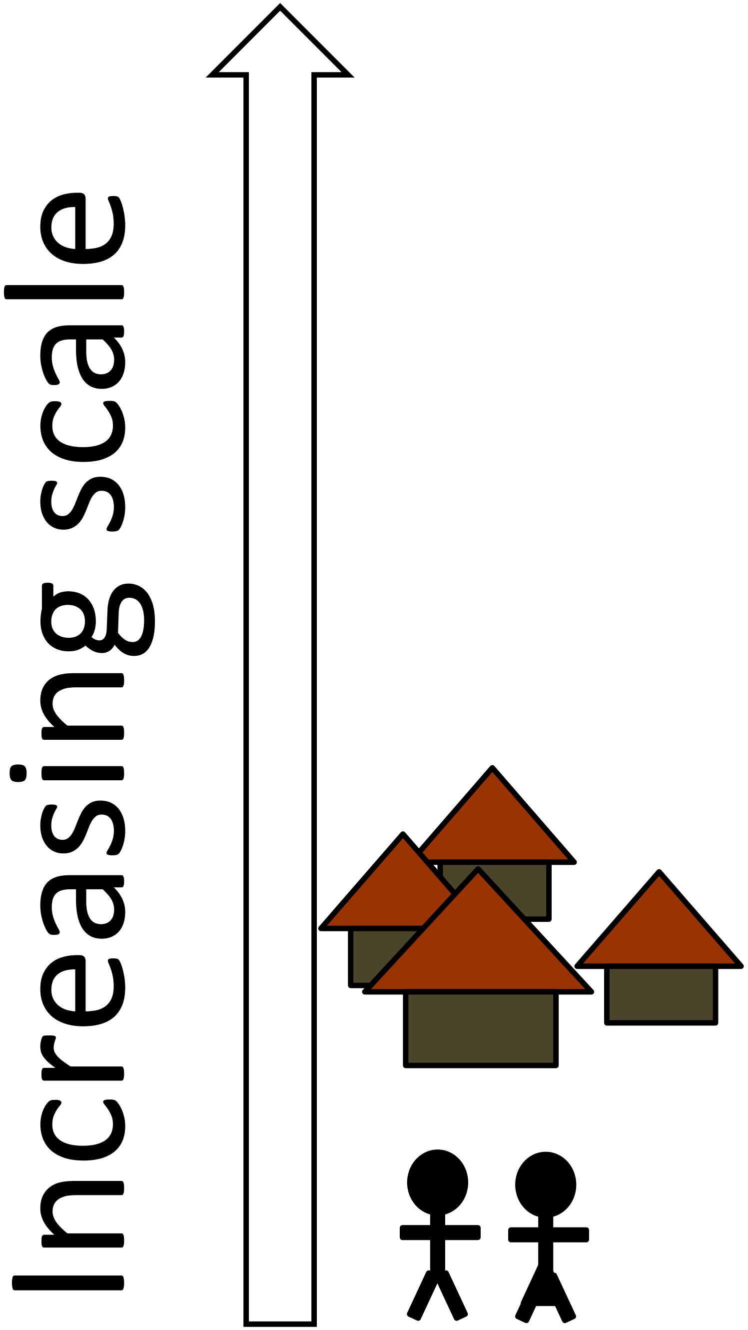
Aims

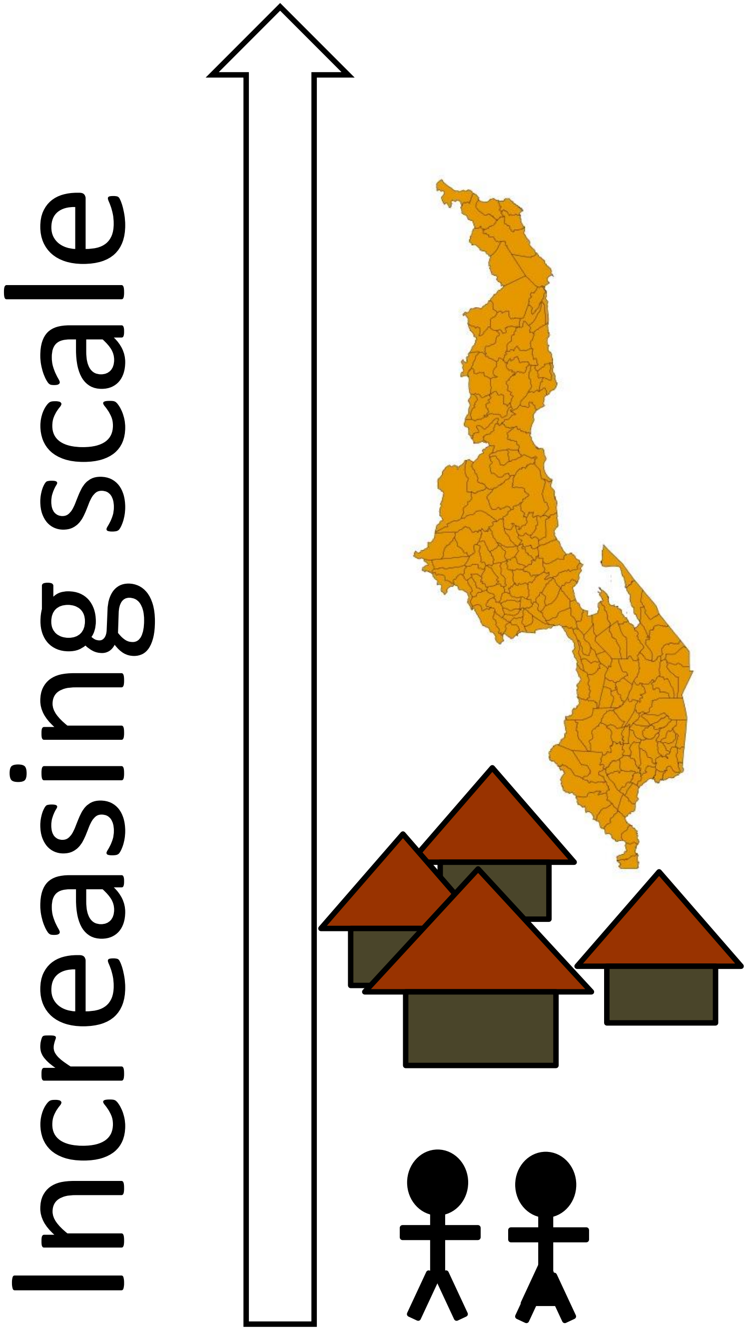
1. Quantify prevalence of hidden hunger.
   Investigate the importance of soil type.
2. What can agriculture contribute?

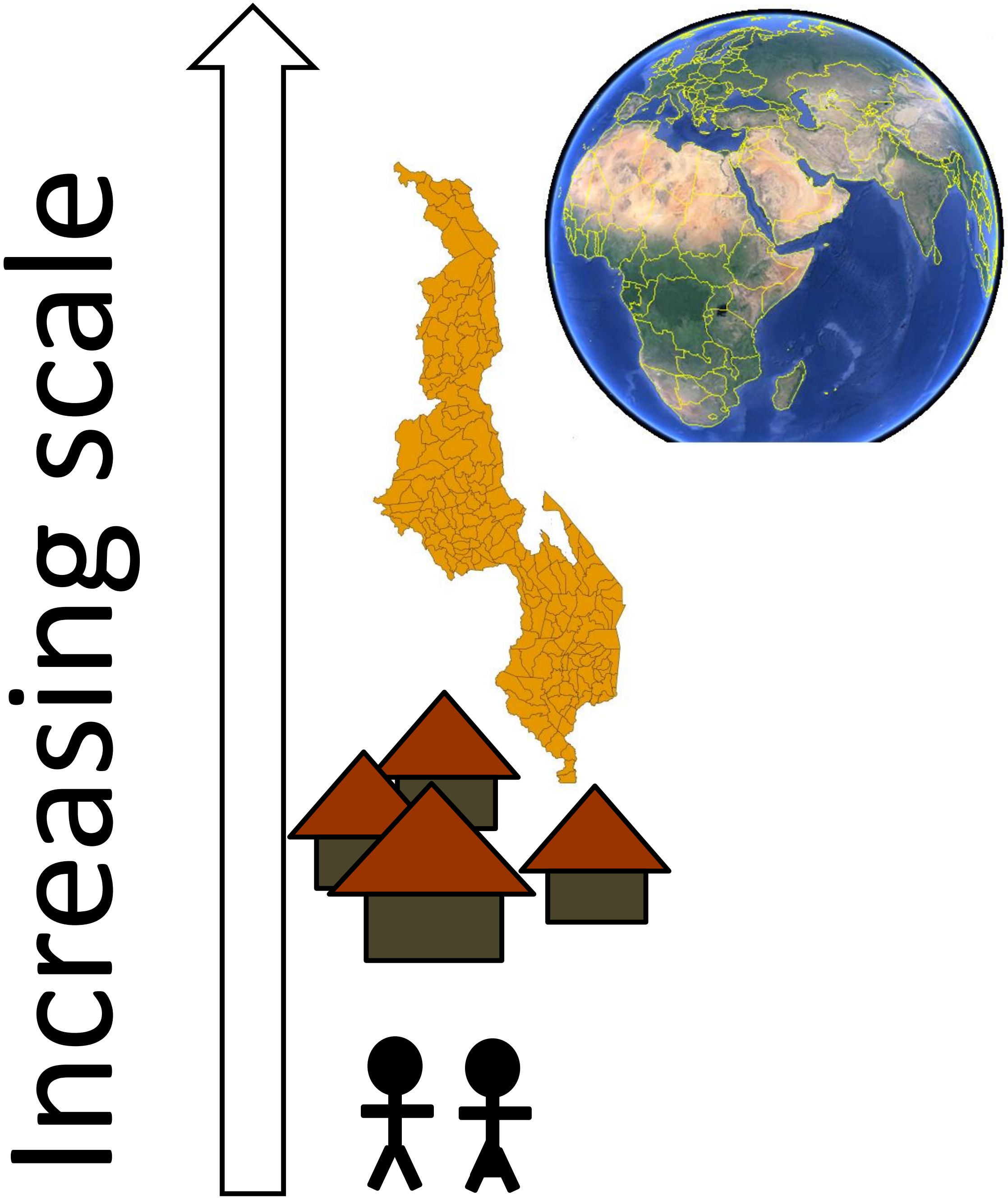

Increasing scale


Increasing scale


Increasing scale


Increasing scale

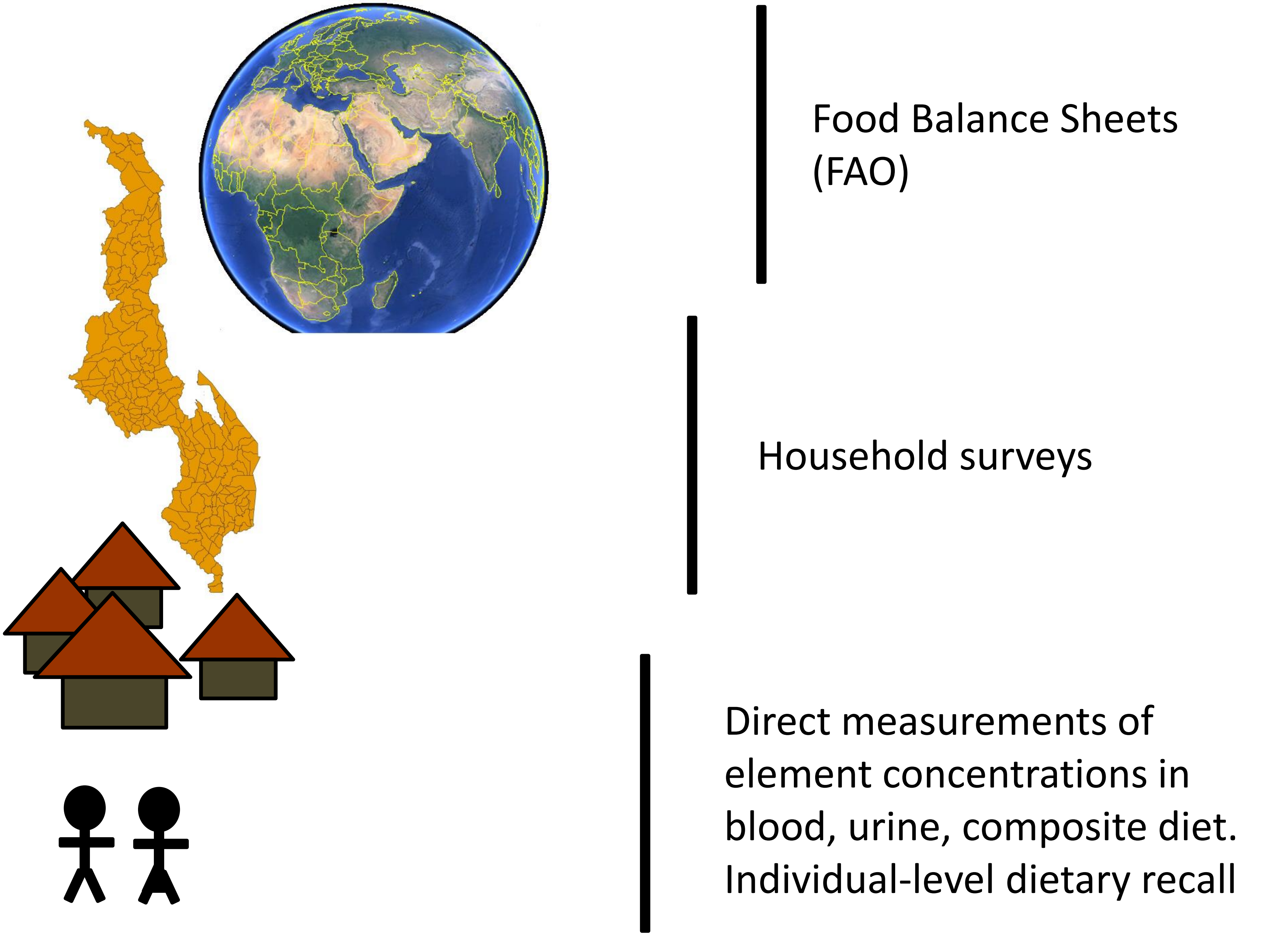

Increasing scale


Increasing scale

Direct measurements of element concentrations in blood, urine, composite diet. Individual-level dietary recall

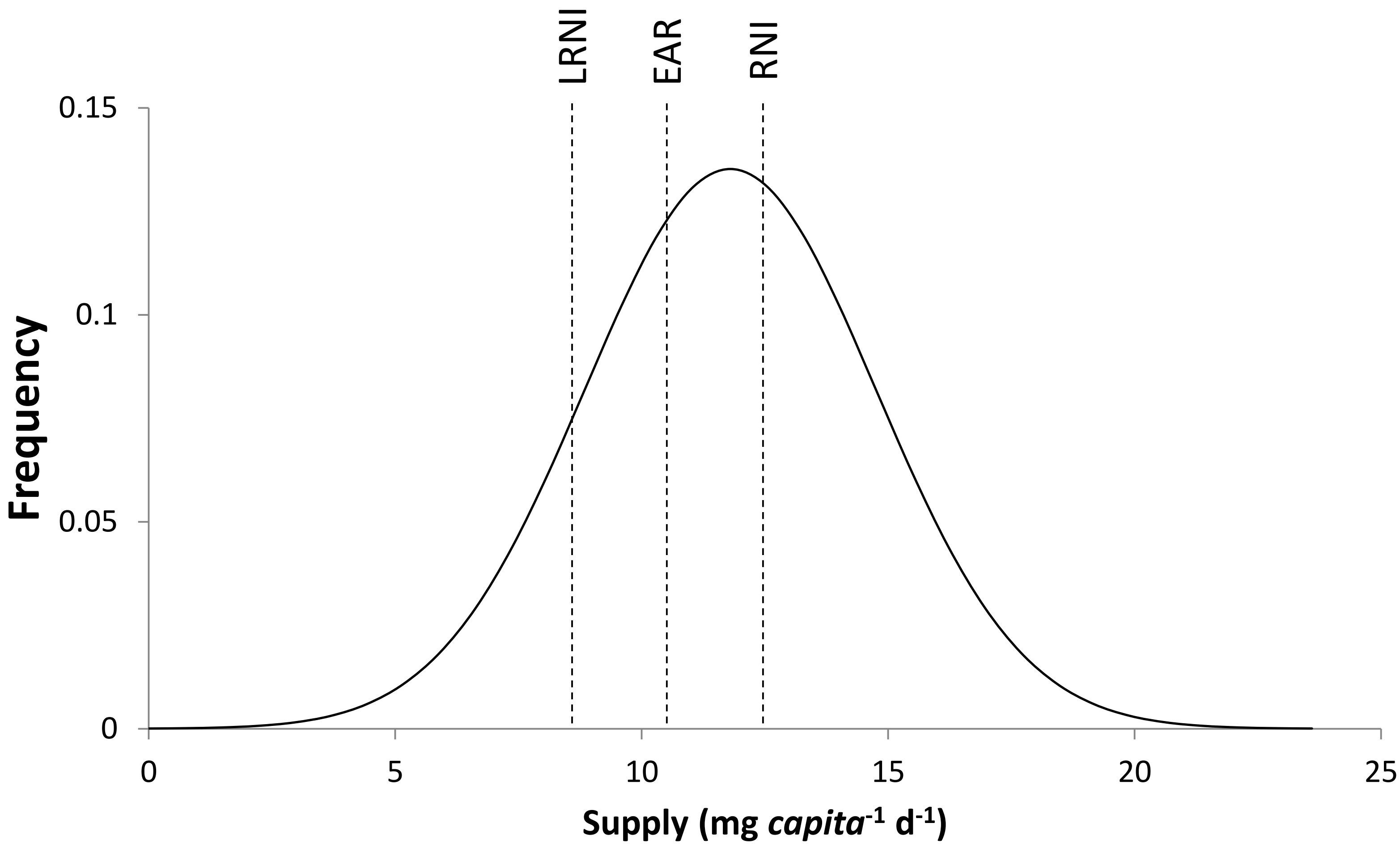
Household surveys

Direct measurements of element concentrations in blood, urine, composite diet. Individual-level dietary recall

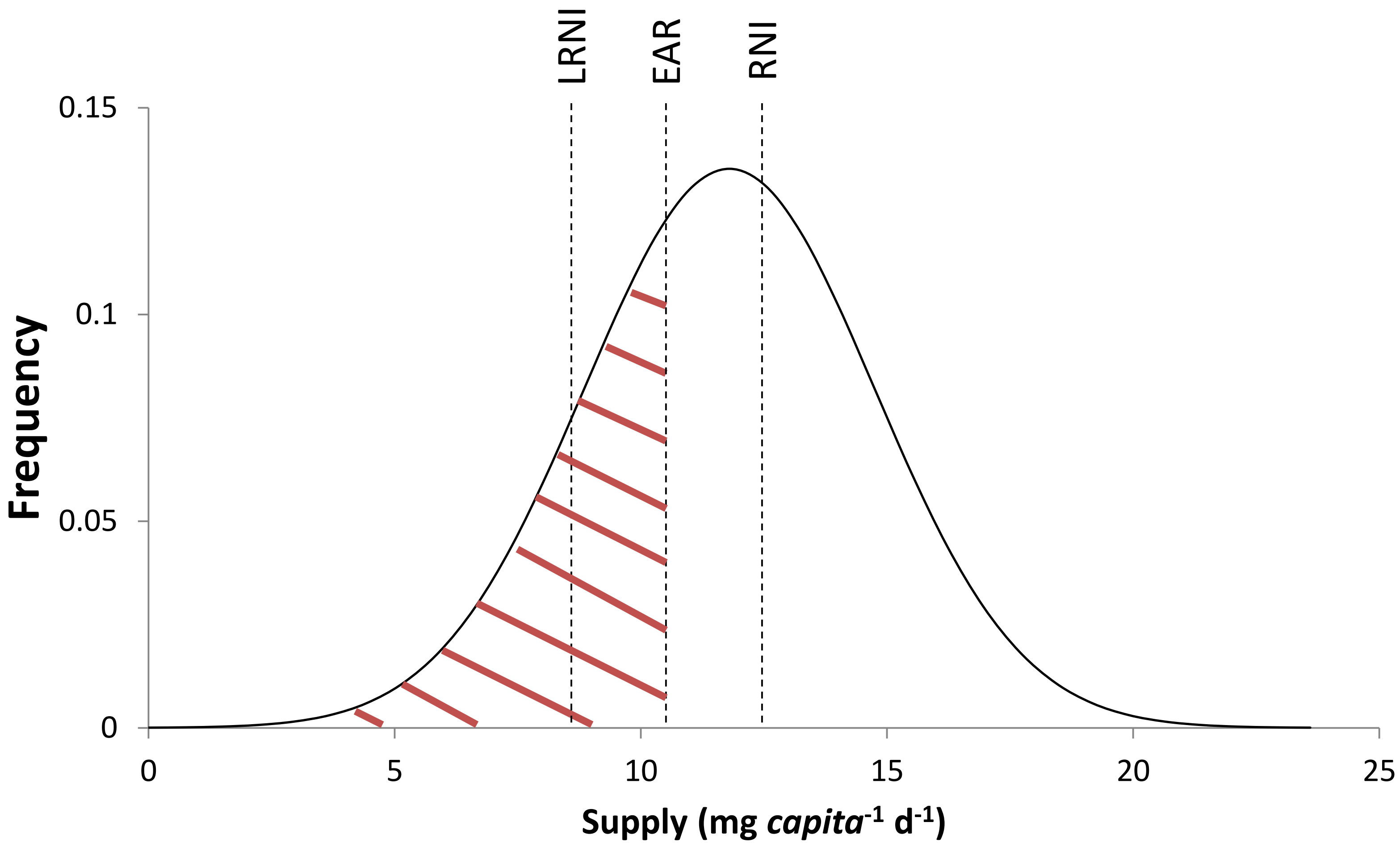


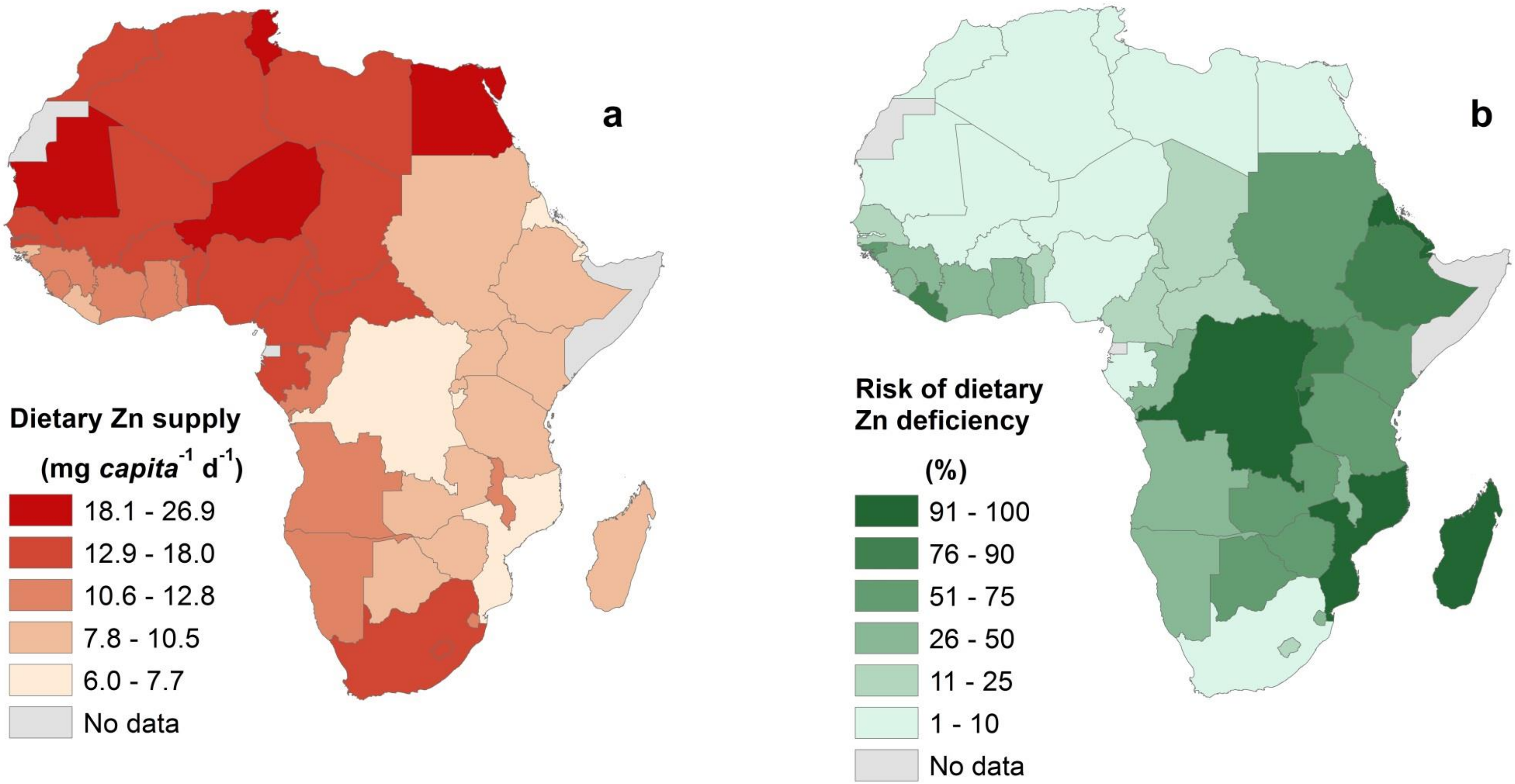
Food Balance Sheets (FAO)
Household surveys
Direct measurements of element concentrations in blood, urine, composite diet. Individual-level dietary recall

Dietary Zn supply in Malawi

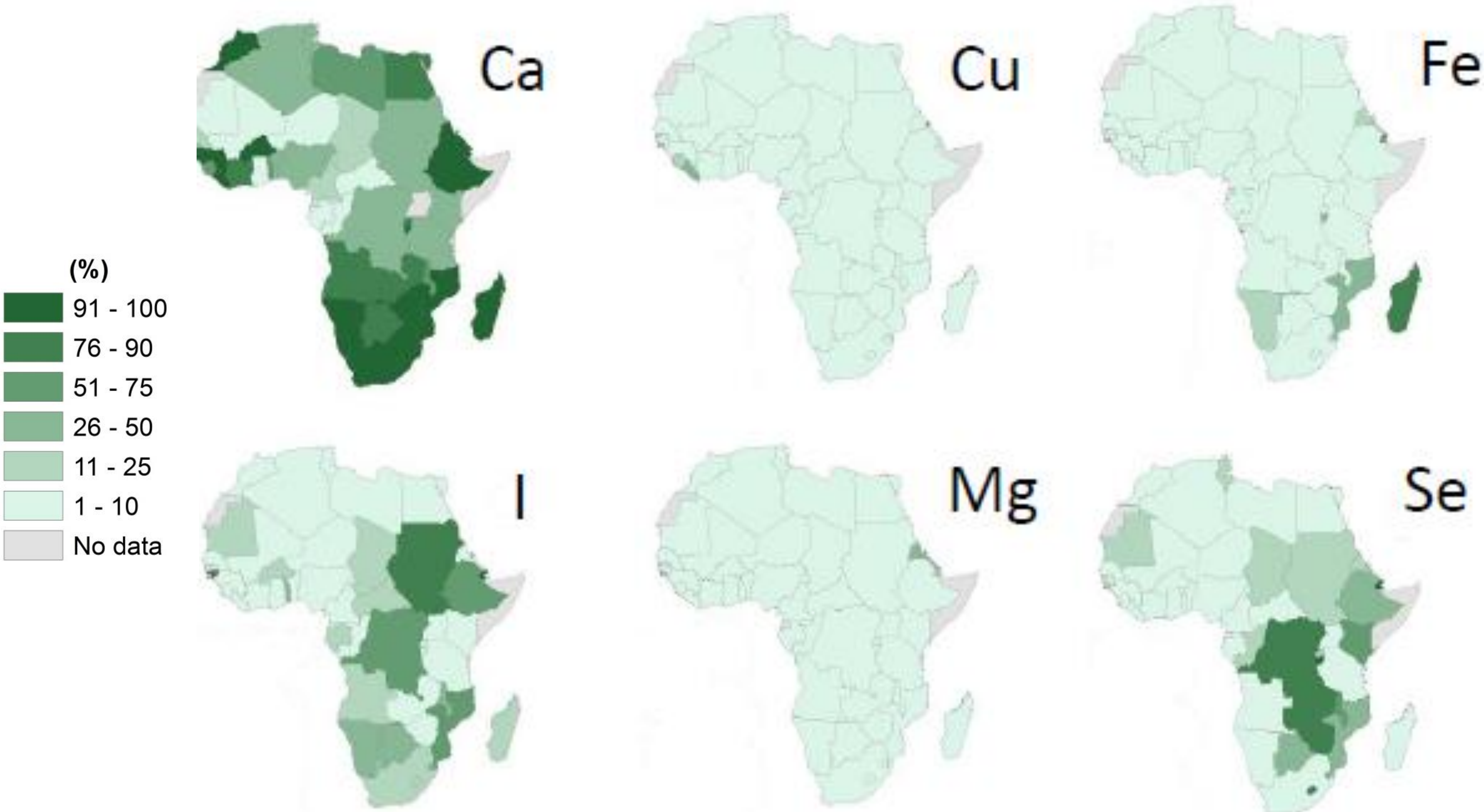


Dietary Zn supply in Malawi

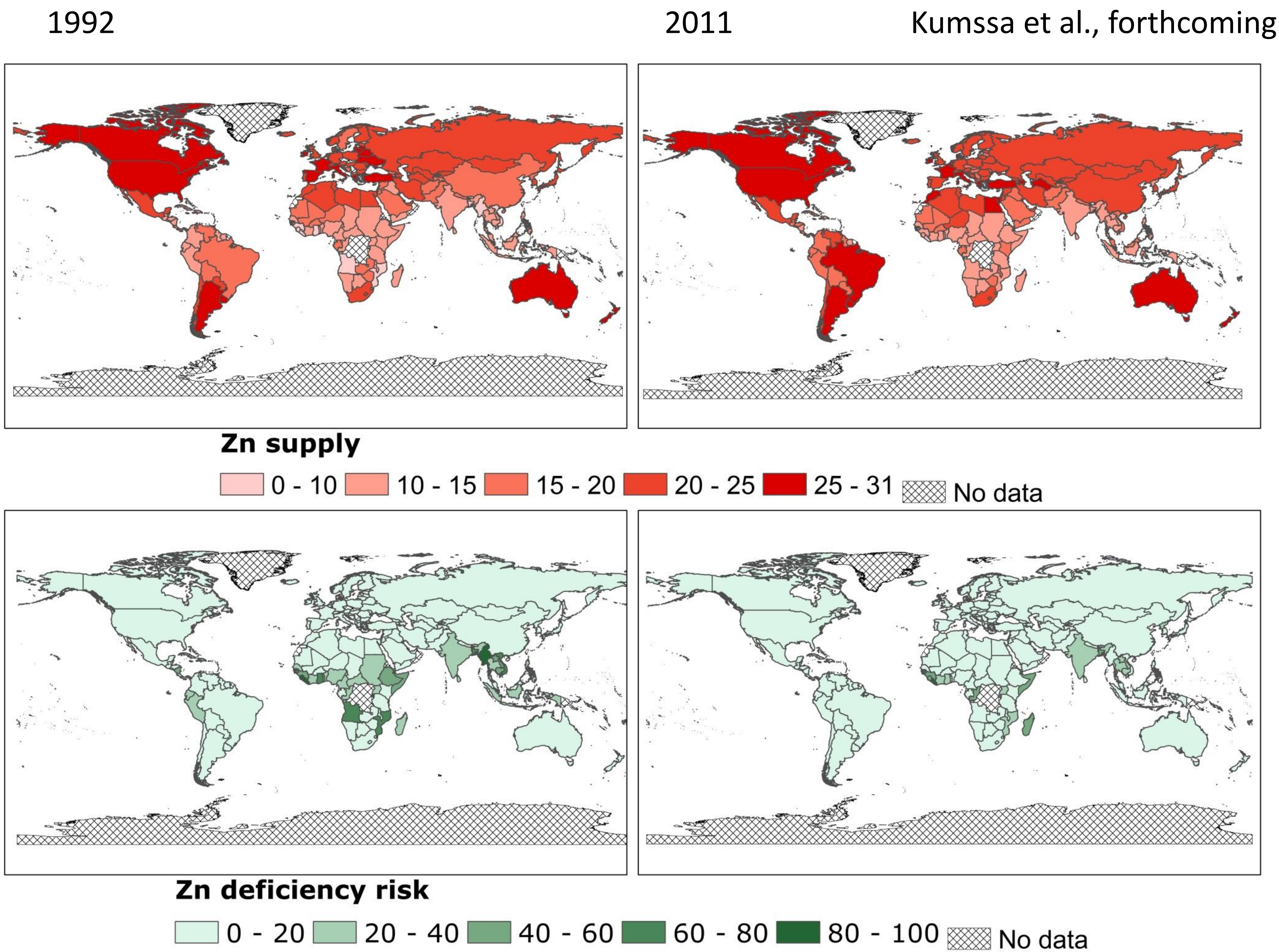


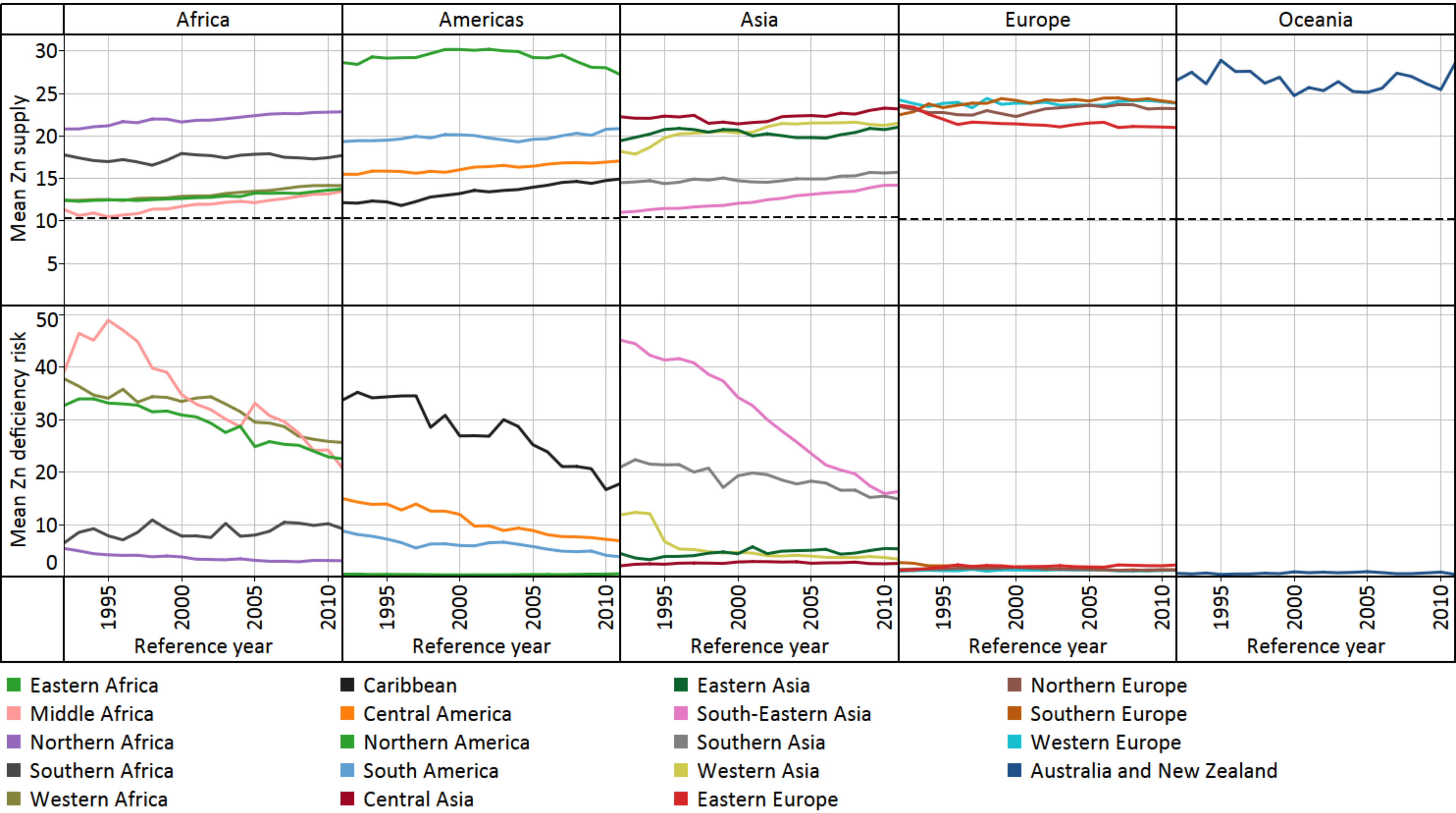


Joy et al., 2014

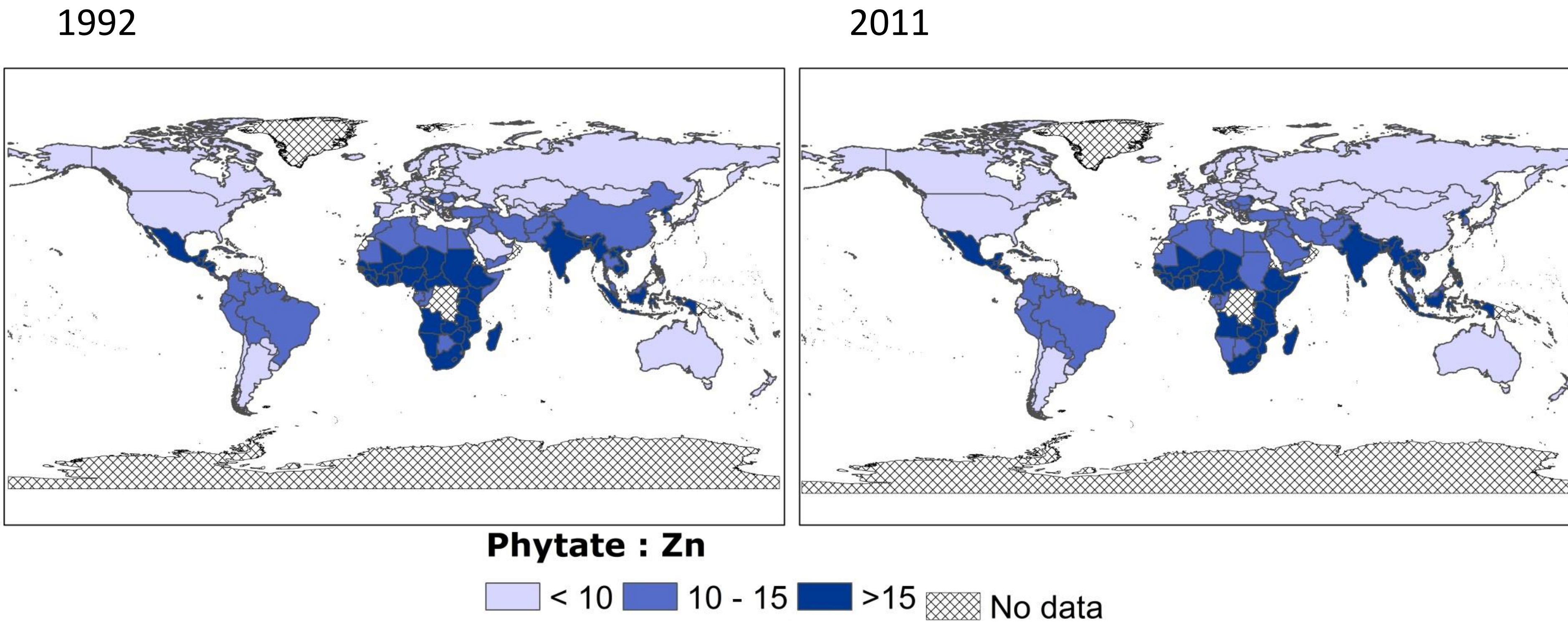

(%)
91 - 100
76 - 90
51 - 75
26 - 50
11 - 25
1 - 10
No data
Ca
Cu
Fe
I
Mg
Se

	Dietary deficiency risk (%)						
Region	**Ca**	**Cu**	**Fe**	**I**	**Mg**	**Se**	**Zn**
N	62	<1	2	19	<1	12	16
E	69	<1	14	26	1	52	75
S	99	<1	5	26	<1	26	10
W	36	1	<1	5	<1	6	17
M	31	4	2	33	1	49	64


1992
2011
Kumssa et al., forthcoming
Zn supply
0 - 10
10 - 15
15 - 20
20 - 25
25 - 31
No data
Zn deficiency risk
0 - 20
20 - 40
40 - 60
60 - 80
80 - 100
No data



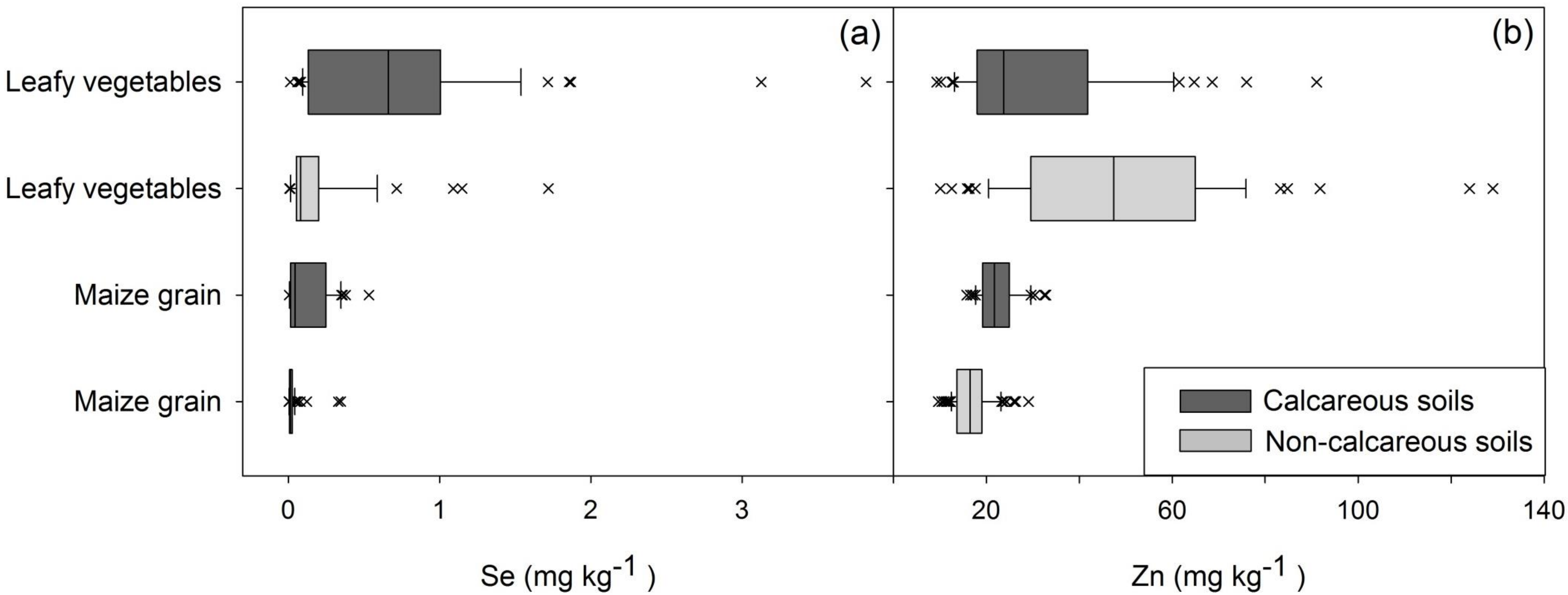
Africa
Americas
Asia
Europe
Oceania
Mean Zn supply
30
25
20
15
10
5
Mean Zn deficiency risk
50
40
30
20
10
0
1995
2000
2005
2010
Reference year
Eastern Africa
Middle Africa
Northern Africa
Southern Africa
Western Africa
Caribbean
Central America
Northern America
South America
Central Asia
Eastern Asia
South-Eastern Asia
Southern Asia
Western Asia
Eastern Europe
Northern Europe
Southern Europe
Western Europe
Australia and New Zealand

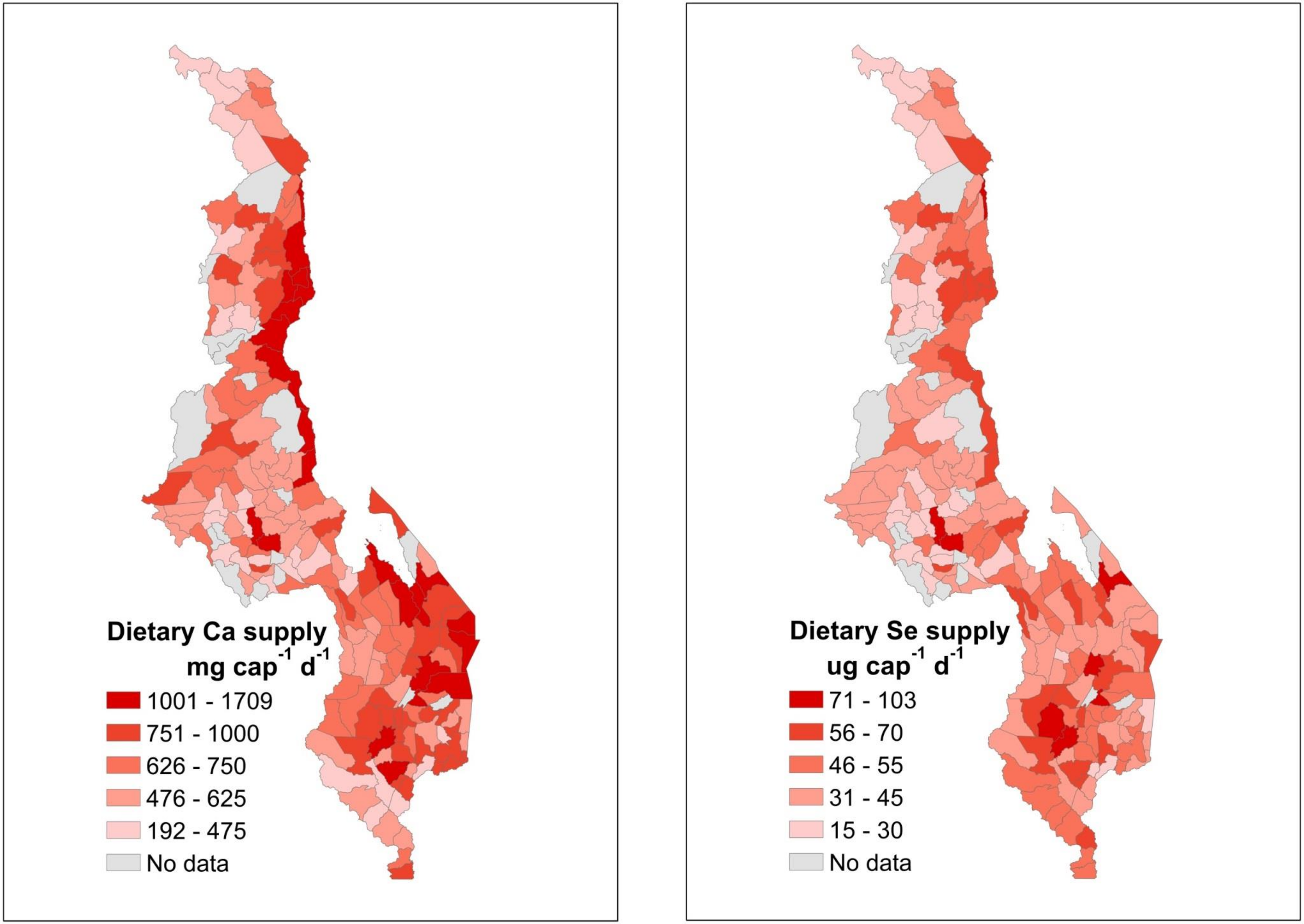

1992
2011
Phytate : Zn
< 10
10 - 15
>15
No data

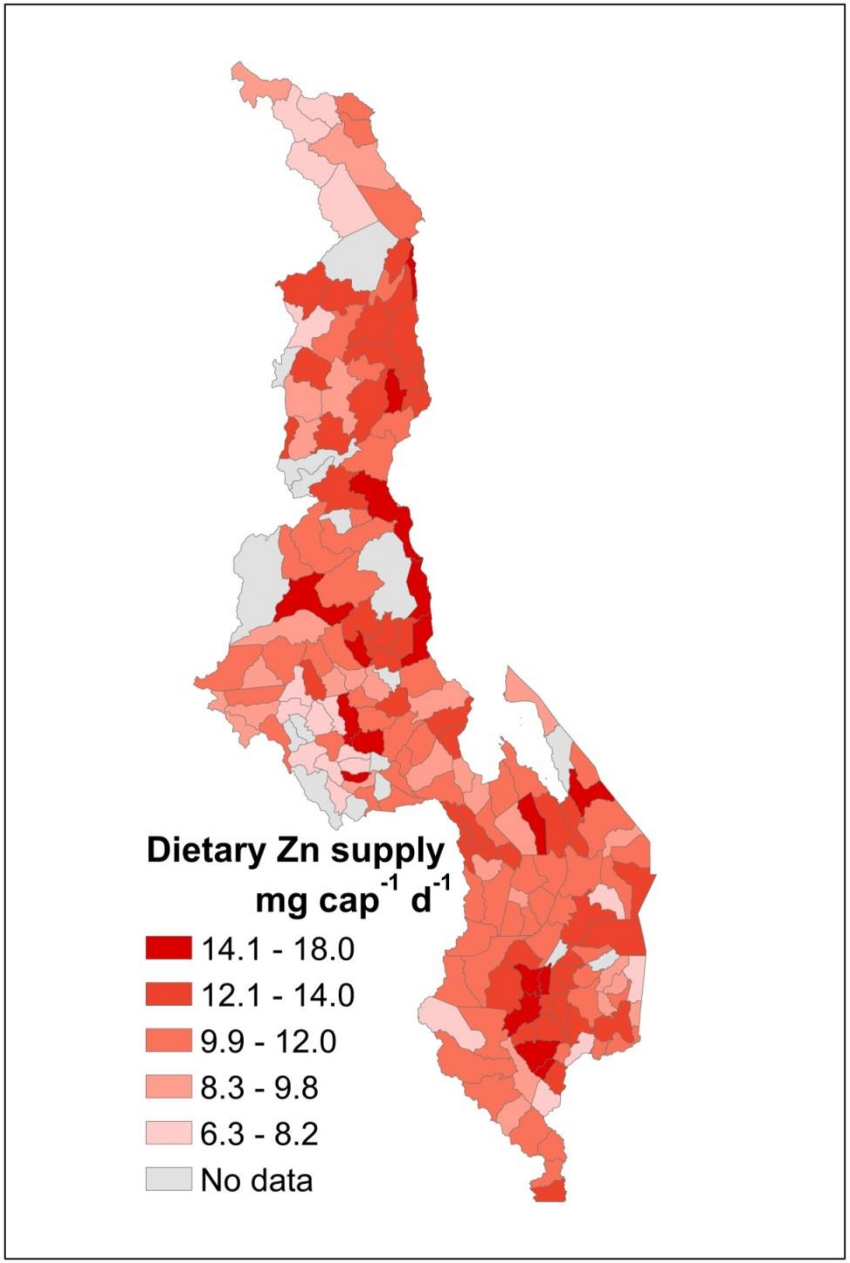
MODULE G: FOOD CONSUMPTION OVER PAST ONE WEEK

DATA ENTRY LINE NUMBER	Over the past one week (7 days), did you or others in your household consume any [. . .]? INCLUDE FOOD BOTH EATEN COMMUNALLY IN THE HOUSEHOLD AND THAT EATEN SEPARATELY BY INDIVIDUAL HOUSEHOLD MEMBERS.	G01 YES..1 NO...2>> NEXT ITEM	G02 ITEM CODE	G03 How much in total did your household consume in the past week?		G04 How much came from purchases?		G05 How much did you spend?	G06 How much came from own-production?		G07 How much came from gifts and other sources?	
				QUANTITY	UNIT	QUANTITY	UNIT	MK	QUANTITY	UNIT	QUANTITY	UNIT
1	**Cereals, Grains and Cereal Products**											
2	Maize *ufa mgaiwa* (normal flour)		101									
3	Maize *ufa* refined (fine flour)		102									
4	Maize *ufa madeya* (bran flour)		103									
5	Maize grain (not as *ufa*)		104									
6	Green maize		105									
7	Rice		106									
8	Finger millet (*mawere*)		107									
9	Sorghum (*mapira*)		108									
10	Pearl millet (*mchewere*)		109									
11	Wheat flour		110									
12	Bread		111									
13	Buns, scones		112									
14	Biscuits		113									
15	Spaghetti, macaroni, pasta		114									
16	Breakfast cereal		115									
17	Infant feeding cereals		116									
18	Other (specify)		117									
19	**Roots, Tubers, and Plantains**											
20	Cassava tubers		201									
21	Cassava flour		202									
22	White sweet potato		203									
23	Orange sweet potato		204									
24	Irish potato		205									
25	Potato crisps		206									
26	Plantain, cooking banana		207									
27	Cocoyam (*masimbi*)		208									
28	Other (specify)		209									

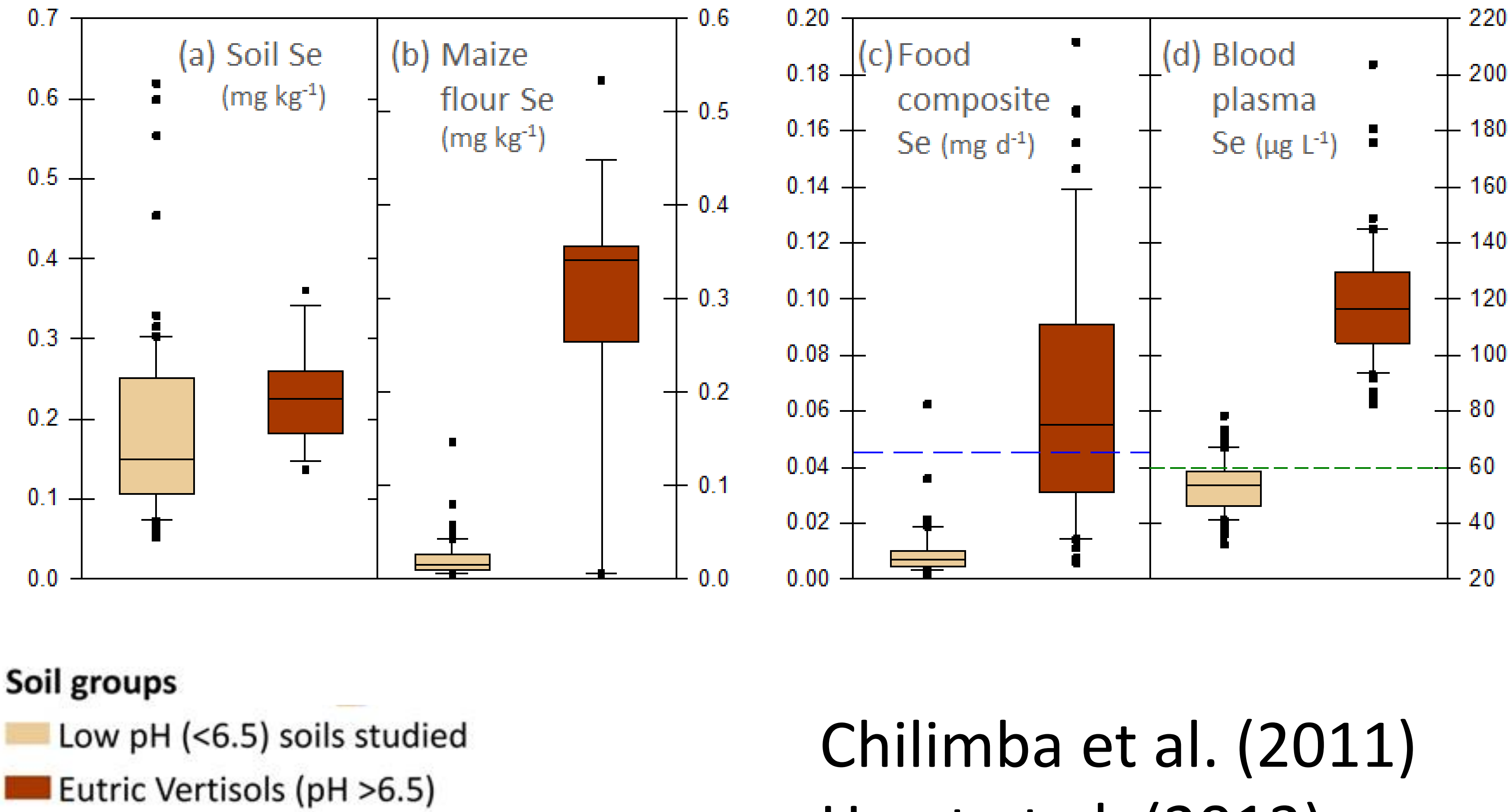
CODES FOR UNIT:
KILOGRAMME 1
50 KG. BAG 2
90 KG. BAG 3
PAIL (SMALL) . . .4
PAIL (LARGE) . . .5
No. 10 PLATE . . .6
No. 12 PLATE . . .7
BUNCH. 8
PIECE. 9
HEAP 10
BALE 11
BASKET (*DENGU*) (SHELLED). . . 12
BASKET (*DENGU*) (UNSHELLED) . . 13
OX-CART (UNSHELLED) . . 14
LITRE. 15
CUP. 16
TIN. 17
GRAM 18
MILLILITRE . . . 19
TEASPOON. 20
BASIN. 21
SATCHET/TUBE. . .22
OTHER (SPECIFY). 23


(a)
(b)
Leafy vegetables
Leafy vegetables
Maize grain
Maize grain
Calcareous soils
Non-calcareous soils
0
1
2
3
20
60
100
140
Se (mg kg-1)
Zn (mg kg-1)

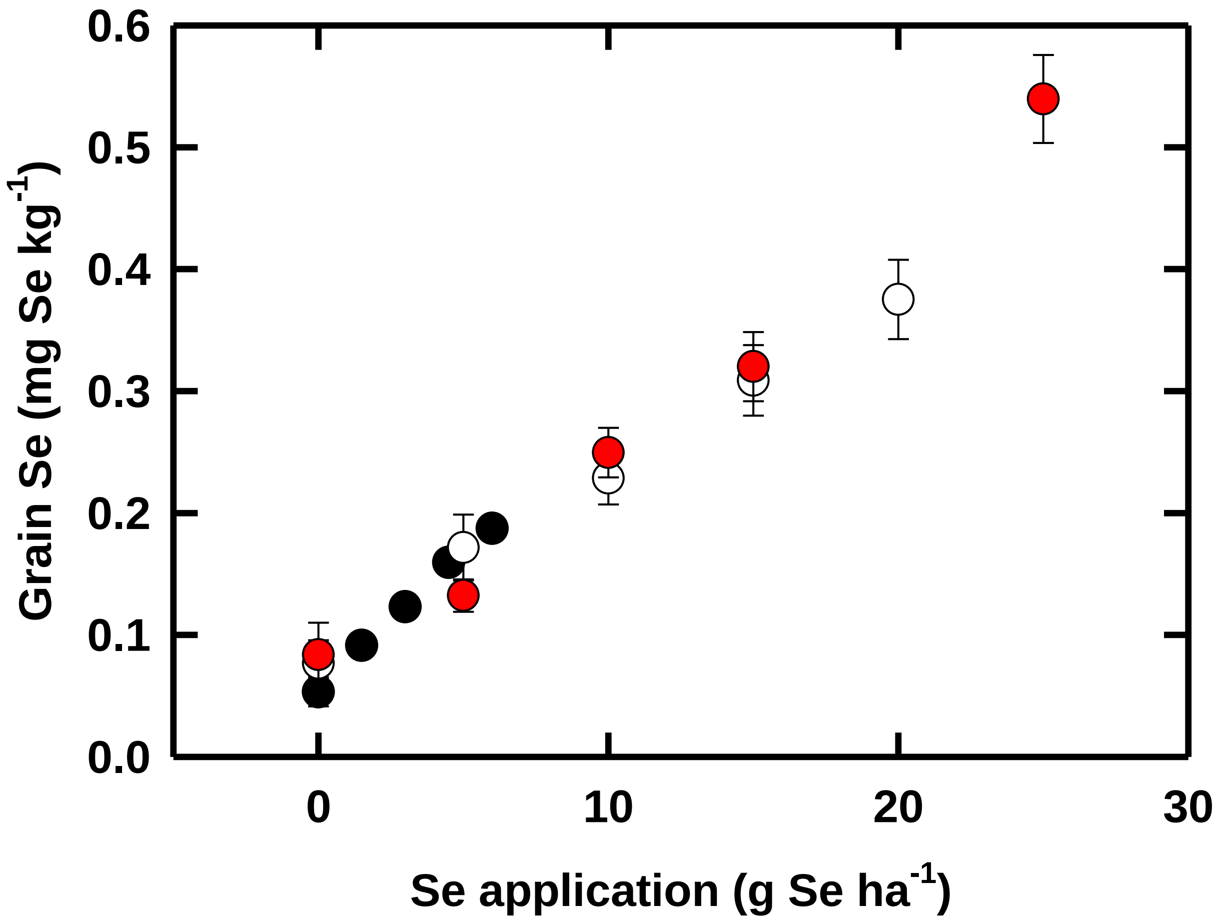

Dietary Ca supply
mg cap^{-1} d^{-1}
1001 - 1709
751 - 1000
626 - 750
476 - 625
192 - 475
No data
Dietary Se supply
ug cap^{-1} d^{-1}
71 - 103
56 - 70
46 - 55
31 - 45
15 - 30
No data


Dietary Zn supply
mg cap^{-1} d^{-1}
14.1 - 18.0
12.1 - 14.0
9.9 - 12.0
8.3 - 9.8
6.3 - 8.2
No data

Soil type and Se supply in Malawi



Chilimba et al. (2011)
Hurst et al. (2013)



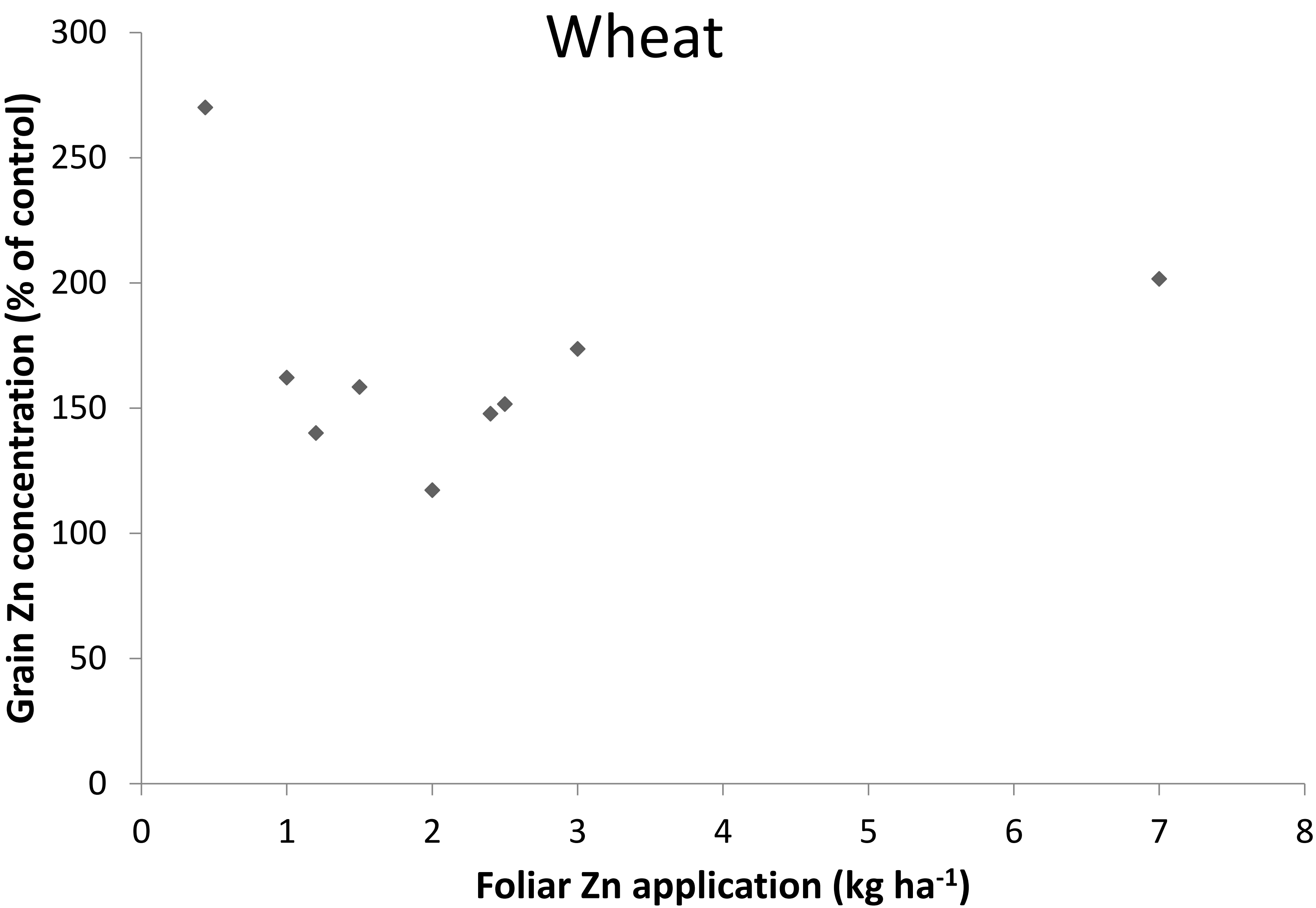
Liquid drench $y = 0.019x + 0.061$

CAN+Se (granular) $y = 0.015x + 0.085$

NPK+Se (granular) $y = 0.022x + 0.056$

15-22 µg Se kg^{-1} grain . g^{-1} Se ha^{-1}

Chilimba et al., 2012


Wheat
Grain Zn concentration (% of control)
300
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
Foliar Zn application (kg ha-1)

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Scott Young	University of Nottingham, UK

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The University of Nottingham

UNITED KINGDOM · CHINA · MALAYSIA

REDUCING POSTHARVEST LOSSES and IMPROVING FRUITS & VEGETABLES QUALITY

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theSun
TELLING IT AS IT IS
ON TUESDAY

Harvard don: Invest in agri technology

> Malaysia should also maintain productivity growth in estate sector

BY *EVA YEONG*
sunbiz@thesundaily.com

KUALA LUMPUR: The local agriculture sector needs to maintain its productivity growth and invest in technologies and systems, said a Harvard University professor.

C. Peter Timmer, Thomas D. Cabot Professor of Development Studies said Malaysia's agriculture sector is set to be highly diversified with the opportunity to be one of the global technology leaders in the sector.

Timmer is also the principal adviser of Asia Society/IRRI Task Force on Food Security and

Timmer speaking at the forum on managing volatile food prices

Food fears

At the recently hosted "Status, Impacts and Future Prospects of Agri-biotechnology in a Changing Climate: A Regional Workshop for Media Practitioners", in Jakarta, 35 journalists from eight Asian countries including *theSun's* JOSEPH MASILAMANY were skeptical that an impending "Food-Armageddon" could heavily impact world communities. But after listening to speaker, Prof Paul Teng, Senior Fellow (Food Security), Rajaratnam School of International Studies, Nanyang Technological University, Singapore – the journalists woke up to a sobering reality. On the sidelines of the workshop, *theSun* put these pointed questions to Teng who returned a salvo off the bat.

THE term "food security" seems to be the preferred term today. Just a few decades ago, journalists were more familiar with the term "food crisis". Who authored the change in terminology? Was the currently preferred term specially coined to be "politically correct" in context or "politically motivated" to accommodate a sinister agenda of institutional structures?

The term "food security" is not a new one but has recently gained prominent use by international organisations – such as the Food and Agricultural Organisation, the United Nations, the World Food Programme and the International Food Policy Research Institute – all of which increasingly recognise that food availability (supply) is only one aspect of a broader set of issues which need to be addressed to assure food security.

The other aspects include physical and economic access to food, and also food utilisation issues such as food safety and food nutrition. "Food crises" still exists and the term is used for specific incidents commonly associated with lack of food, such as the current food crisis causing famine in the "Horn of Africa".

This food crisis in the "Horn of Africa" is an example of a "food security" situation where local supply has been totally disrupted due to drought effects on agriculture.

Experts today use this term because it is not just crisis situations which cause "food insecurity" (i.e. lack of security). Almost a billion people go to bed hungry each day, according to the World Bank. Some of these people may live in countries which have food, but they cannot afford to buy the food, meaning, they have no economic access.

And this lack of ability may lead to a situation of "chronic food insecurity", which potentially affects the growth and development of young children, and thereby their ability to learn as well. There have

globalised supply chain, there will also need to be close agreement between international agreements and domestic policy and regulations.

An example is the significant global trade in GM products for food, feed and processing. Without domestic, science-based regulatory frameworks, it would not be possible to abide by the requirements of international biosafety or other agreements.

The other way to address this issue is to look at effects. One possible effect is the disruption or restriction in supply of food or agricultural raw products to the country concerned. For specific countries, local policies could be developed, and supported with adequate funding and technical support, to increase local production of a particular item. For example, a country response may be to increase local rice production in the face of a global reduction in the amount of rice traded.

How can the overall economic gains from trade benefit those who are most likely to be suffering from food insecurity?
I'm not qualified to comment on this.

Is it not true that gains from such trade benefits merely trickle down to those who are most deprived of food, and that means ... the poor still remain famished?

These frameworks must be backed up by well-supported and functional regulatory services, which have the latest equipment, trained personnel, and the capacity to enforce the regulations. Most countries have government agencies charged with applying food safety measures. The challenge is to ensure they are functional.

There is enough food in the world to meet everyone's needs, but not enough to accommodate everyone's greed. Should the world be in jitters over an impending "Food-Armageddon" that might not materialise – or should the international community address the tangible problem of wealth and food distribution more emphatically?
There is no single unilateral approach to ensuring food security! The demographics and projections issued by credible organisations show that the demand for food will increase in the coming years, accompanied by a shift in the types of food desired to more protein-based food. Hence, efforts will have to continue to assure increasing production in agriculture of the raw materials needed for food, and all thus done with acceptable environmental conservation.

Concurrently, the world population will become more urbanised, leading to fewer people farming. With urbanisation, it is also

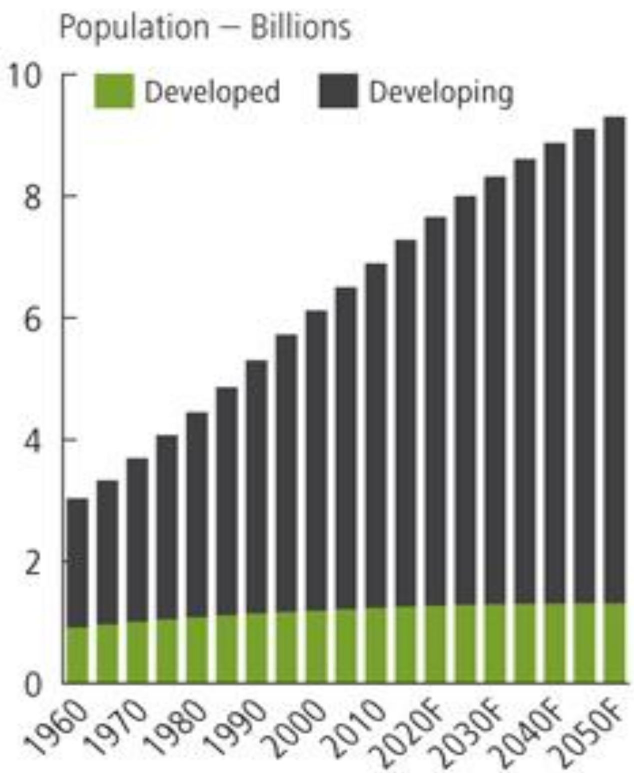
Concurrently, the world population will become more urbanised, leading to fewer people farming. With urbanisation, it is also predicted that the percentage of poor people who are food insecure in the cities will also increase."
– Dr Paul Teng

Growth of world population

World population projected to reach **9 billion** in 2050.

Increasing urbanisation

Loss of food



Source: (United Nations)

Problem with the distribution of food

Wasted

1.3 billion tonnes

Losses

40%

developing countries

Worth nearly one trillion USD

Source: Food Tank

World Scenario (FAO)

- Total fruit & vegetable production: 1,500 MMT
  (An increase of 43% over decade1994 to 2009)

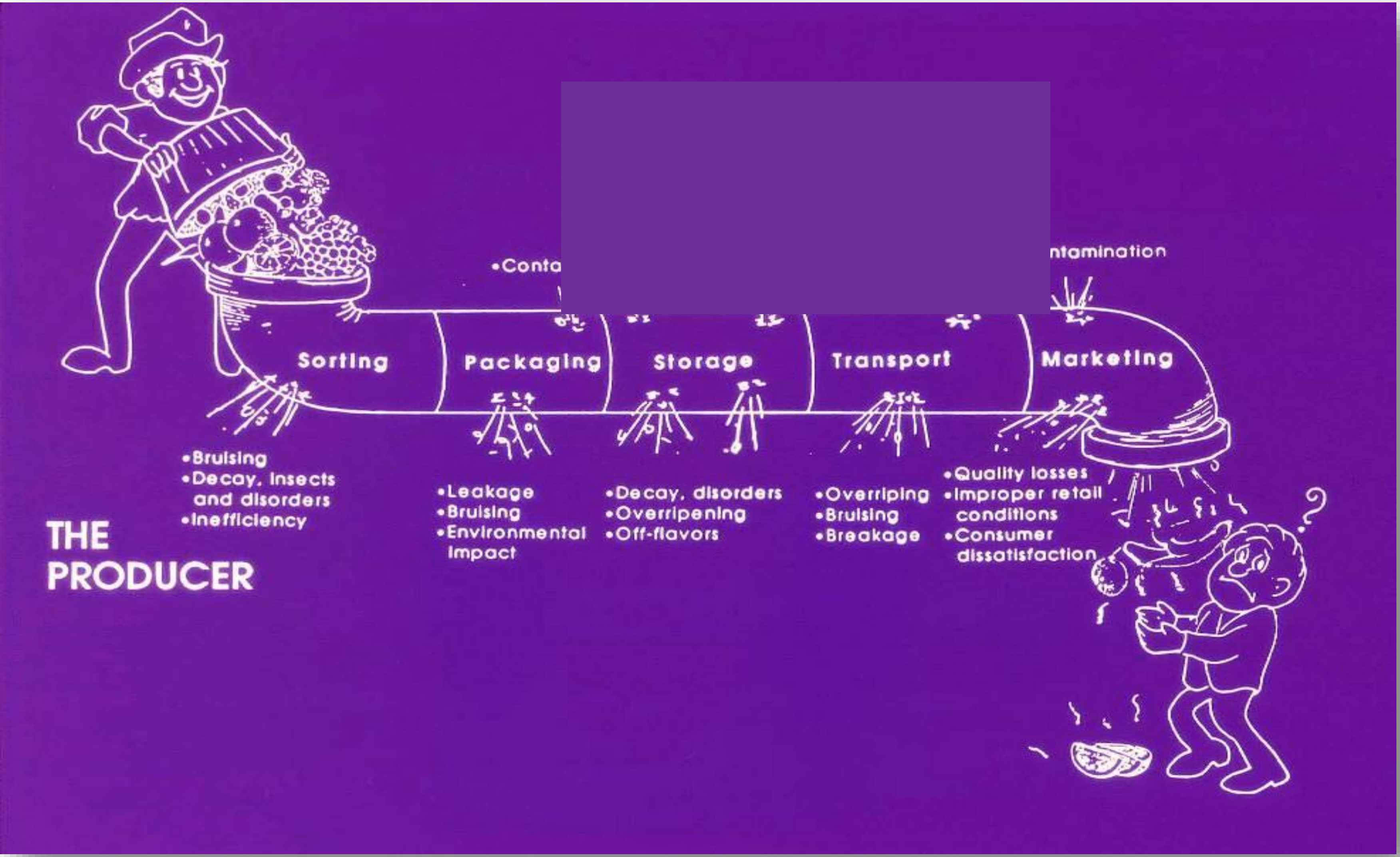
Recommended intake of a minimum of 400 g of fruit & vegetables per day (WHO/FAO)

Total population: 6000 Millions

To accomplish the avg. consumption of 400g/d (146kg/year/person) we need to have 876 MMT of F&V every year

35% extra production

Fresh Produce Pipeline



The Repaired Pipeline

Tragedy of wasted food

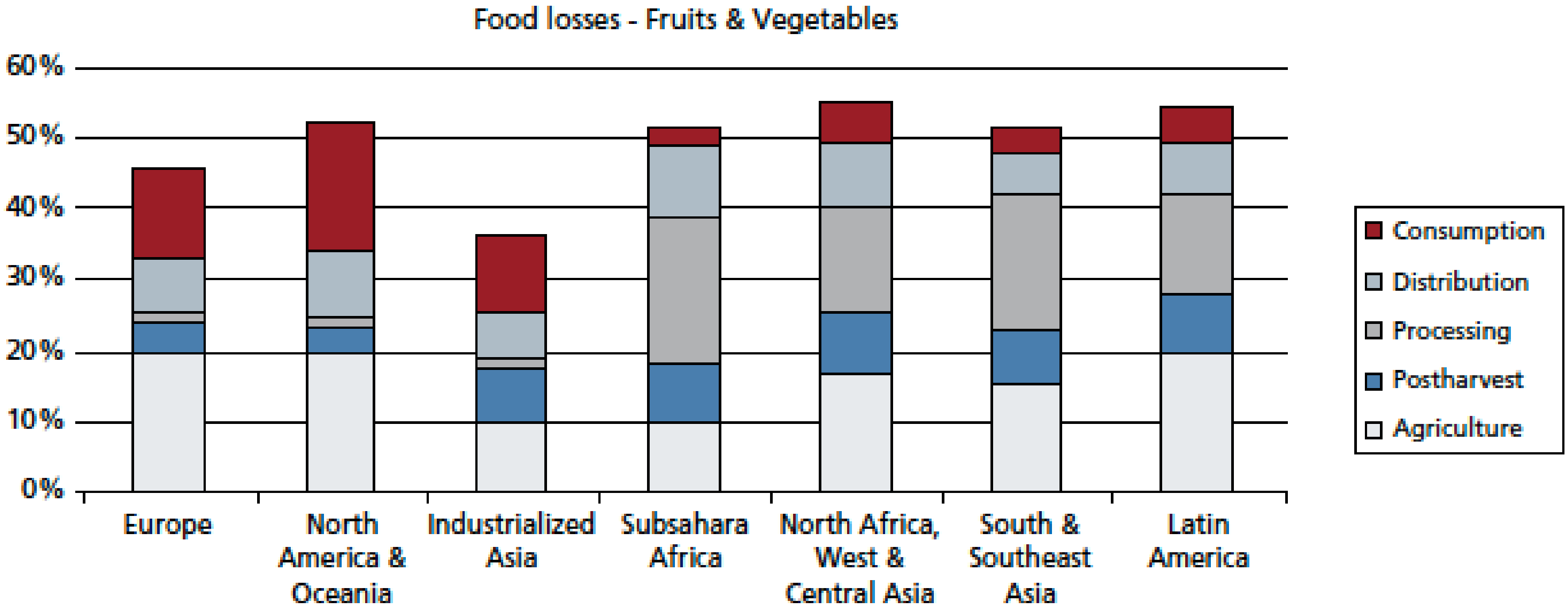
- The world produces enough food to feed itself
- Yet millions of people are still dying from malnutrition and starvation
- 1.3 billion tonnes of food are lost or wasted
- Paradoxically postharvest knowledge is available to prevent losses early in supply chain

Food losses versus Food waste

- **Food losses** – losses occurring at production, postharvest and processing stages at the beginning of the supply chain
- **Food waste** – wastage occurring at the retail, wholesale and consumer part at the end of the supply chain

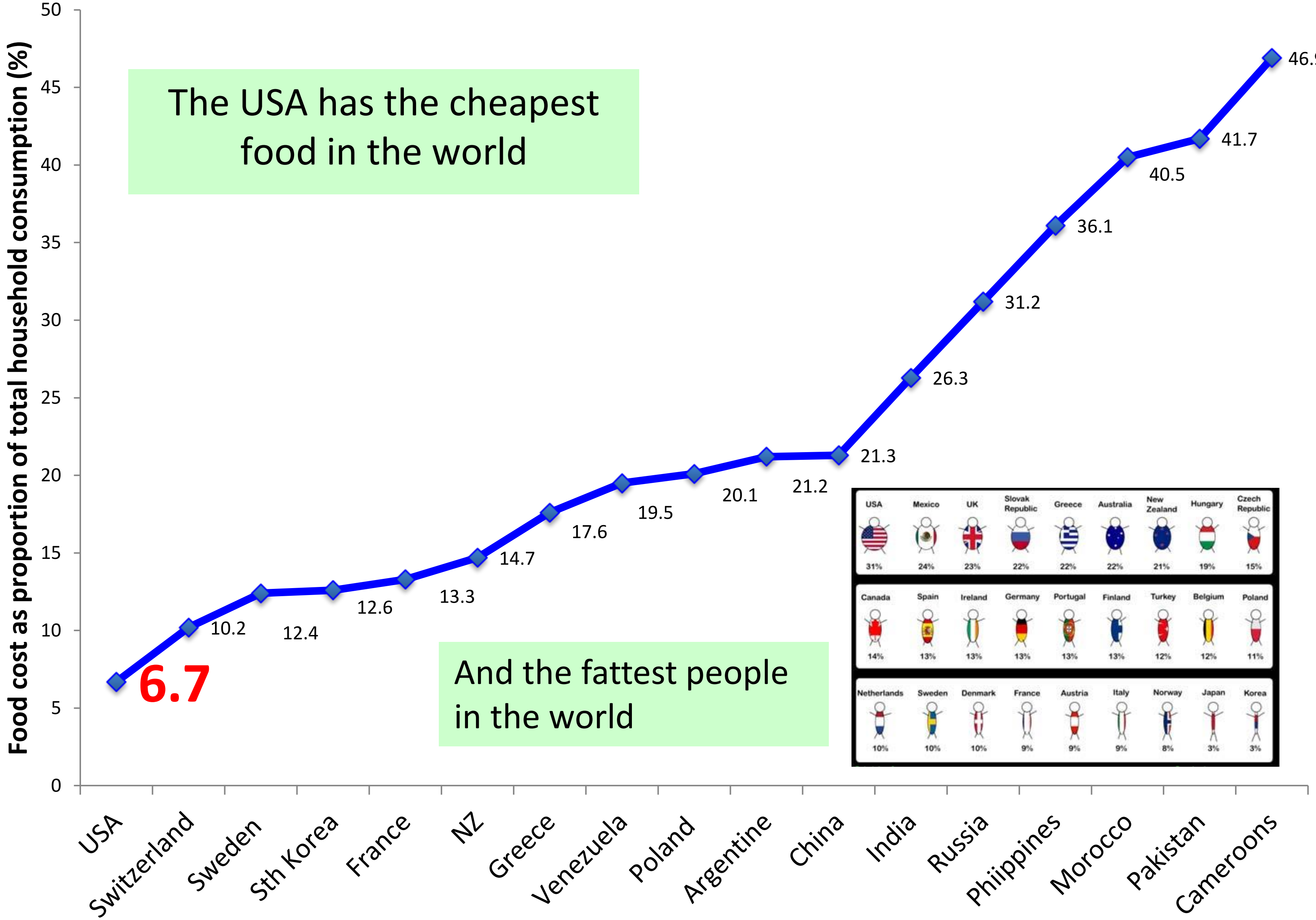
Food losses and wastage

33% [1.3 billion tons] of total food produced for human consumption is lost in the food chain (Gustavsson et al 2011)
~ 44% of losses occur in industrialised (developed) countries
~ 40% of food wasted in developing countries.



Industrialised countries – most wastage at retail/consumer end of chain
Developing countries – most losses at production, postharvest & processing end of chain

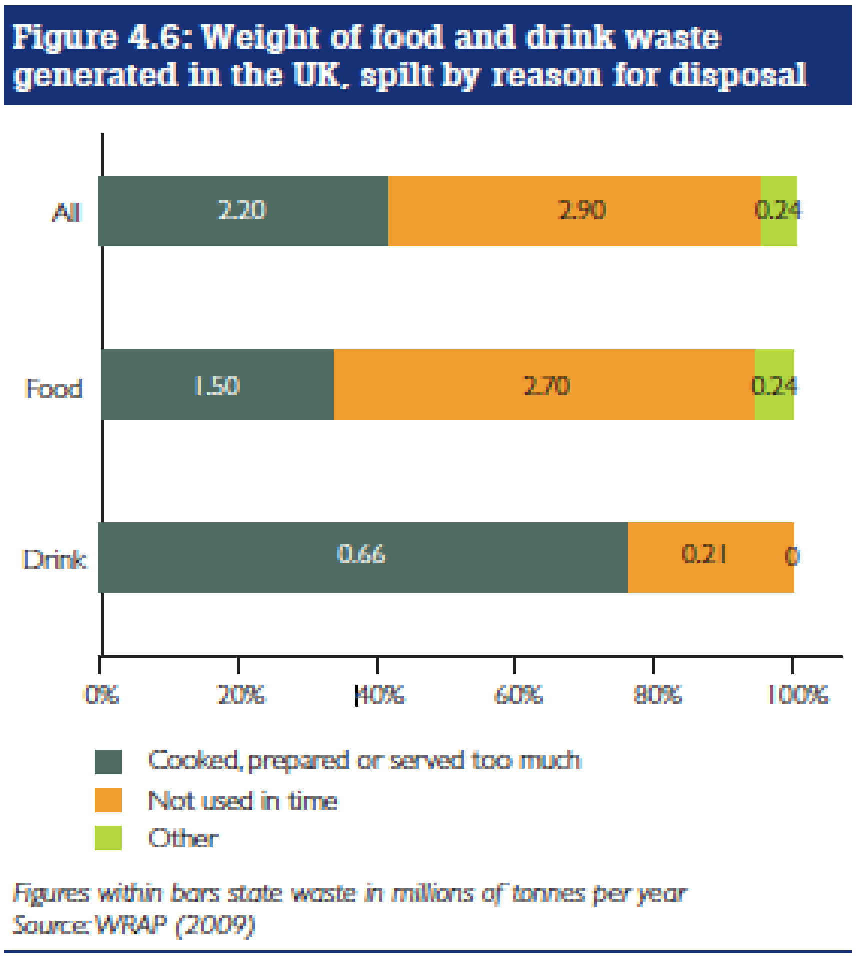
Food costs as % of total household consumption in selected countries 2011



Contrast: obese and starving children

Globally ~50% more people are overweight and obese (1.2 billion) than there are undernourished (870 million).

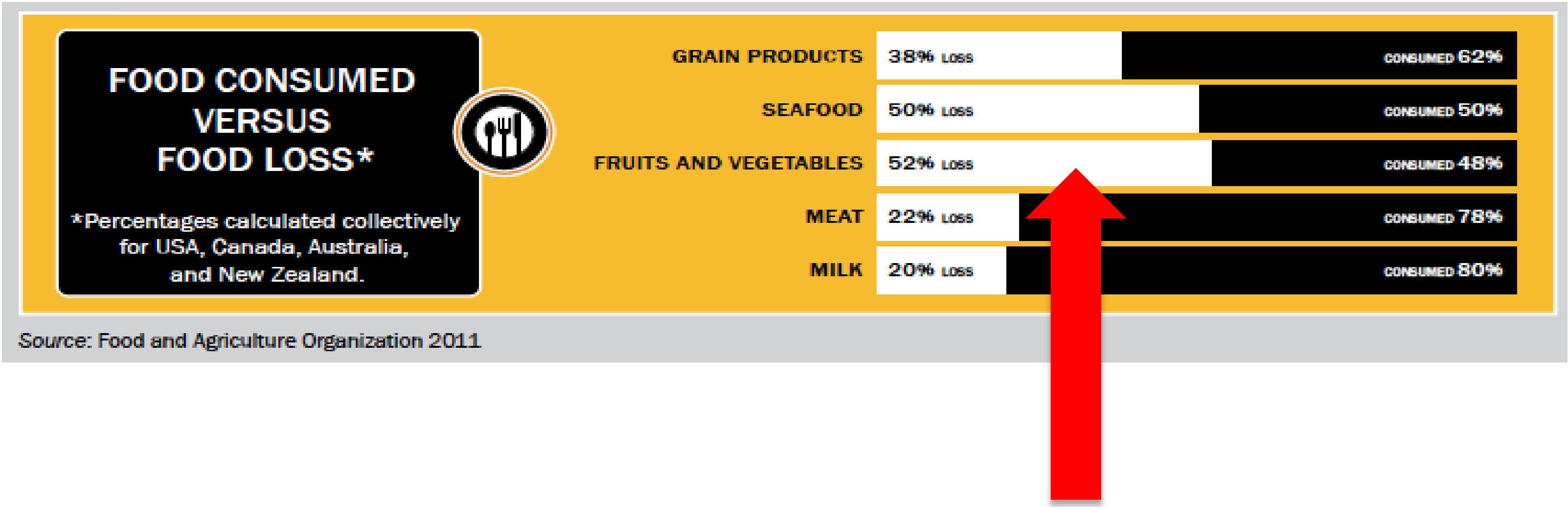
Wasted food in the UK



- 5.34 million tonnes of food and drink wasted in the UK annually.
- This is 85 Kg/capita/year, more than enough to feed 15 million people.
- Wasted resources of water, nutrition chemical and labor inputs for production

Fruits & Vegetables have most food loss in the chain

- Large variation is food lost in supply chain from farm to fork in Nth America
- Largest loss in fruit and vegetables closely followed by seafood- 52%.



Why is it important to reduce food losses and waste in developing countries

- Increase food security and livelihoods of farmer families.
- Increases family income, health and nutrition.
- Strengthen rural communities through increased employment.
- Safeguard environmental resilience through product diversification.
- Save energy and water resources –food lost means water and energy wasted.

What can we do?

- Education is the key
- Educate participants in the supply chain from farmers to consumers
- This part of the chain requires technical and marketing knowledge and understanding of the supply chain
- It requires educators with a degree in horticultural science and extension management –**on line education.**

Basic postharvest knowledge

- Preharvest factors affecting postharvest quality.
- Correct harvest maturity for specific markets.
- Temperature management – keep it cool.
- Avoid physical damage to minimize ethylene production and pathogen infection.
- Packaging to protect, preserve and promote.
- Control of %RH and atmosphere where appropriate.

Postharvest specialists still needed!

- High value horticultural crops are perishable
- Yet only 5% of agricultural aid funds allocated to postharvest activities
- Need for more specialists for research, education and training to reduce losses along the value chain.

Capacity building

Completely different education and training approaches required for different parts of the supply chain

The clients

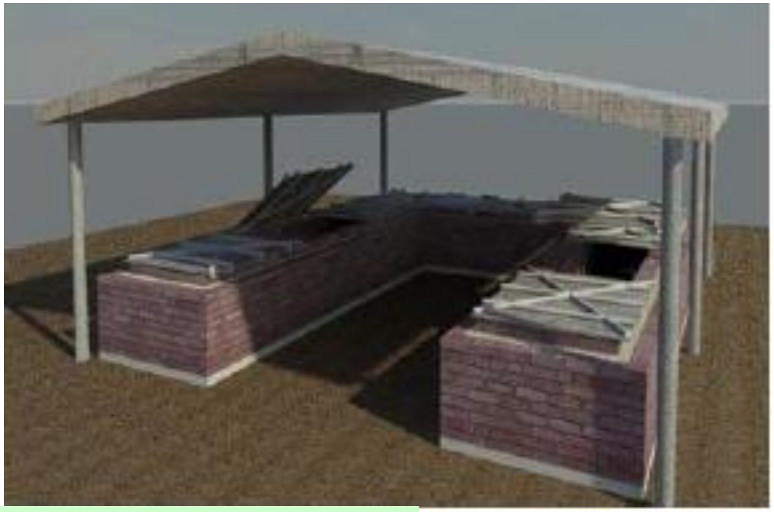
- Children
- Farmers
- Trainers
- Educational institutions
- Supply chain personnel
- Marketers; retailers
- Consumers

Knowledge and skills

- Plant/postharvest science
- 'Agronomy' of production
- Engineering and technology
- Systems management
- Supply chains and logistics
- Marketing
- Social/behavioral science

Education and training needs vary

- **Developing countries** – basic handling and harvesting concepts; information transfer and implementation advice needed.



Cool store for vegetables;
1 MT; cost US1,200.

- Optimum harvest maturity
- Harvesting aids
- Field packing systems.
- Shade from farm to market
- Improved containers
- Improved transportation systems.
- Low energy cool store methods
- Improved agro-processing; solar drying, canning, bottling and pickling
- Many agencies involved

Source: Kitinoja and Cantwell
http://ucce.ucdavis.edu/files/datastore/234-1848.pdf

Education and training needs vary

- **Developed countries** enhance quality through breeding; improve nutritional value; P/H life extension through temp and C_2H_4 management; packaging innovation; sorting efficiency for uniform quality; automation and robotics; supply chain system efficiencies; food safety.
- Education to maintain quality, reduce waste in supply chain, in stores and homes

ComPac Fruit Sorting Machine sorts 42,000 cherries/hr

Farmers

- Postharvest information essential for farmers
- Extension services critically important for information transfer
- Decline of such services in many countries
- What is the best postharvest education and training for extension personnel?
- **Who will prepare relevant training material?**

3. Training the Trainers

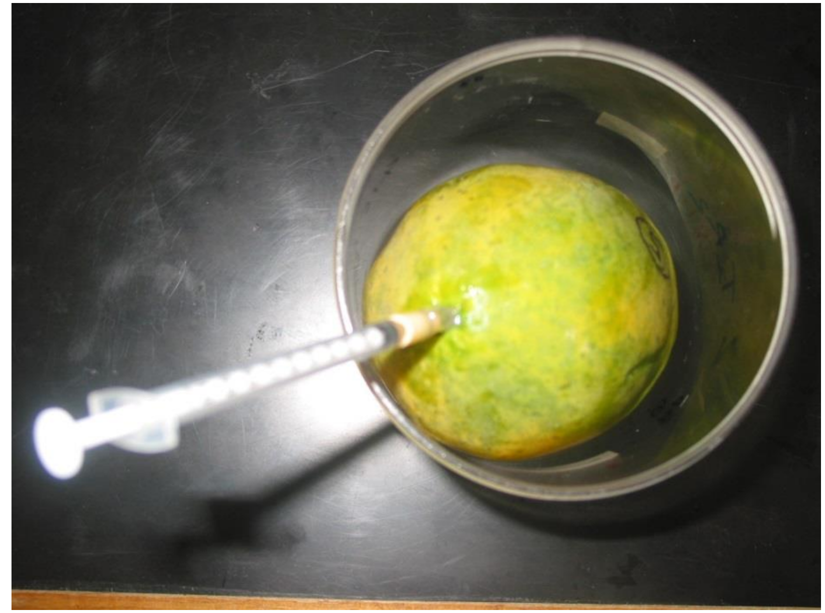
- Key players include: FAO/CFC; USAID Horticulture CRSP; Postharvest Education Foundation; Universities; NGOs; World Bank; Commonwealth of Learning; AVRDC; PHTRC; private consultants.
- Lack of coordinated programmes and collaboration among agencies.
- Many good resources available;
  e.g. UCDavis Produce Facts.

CEPB
Centre of Excellence for
Postharvest Biotechnology
The University of
Nottingham
CEPB

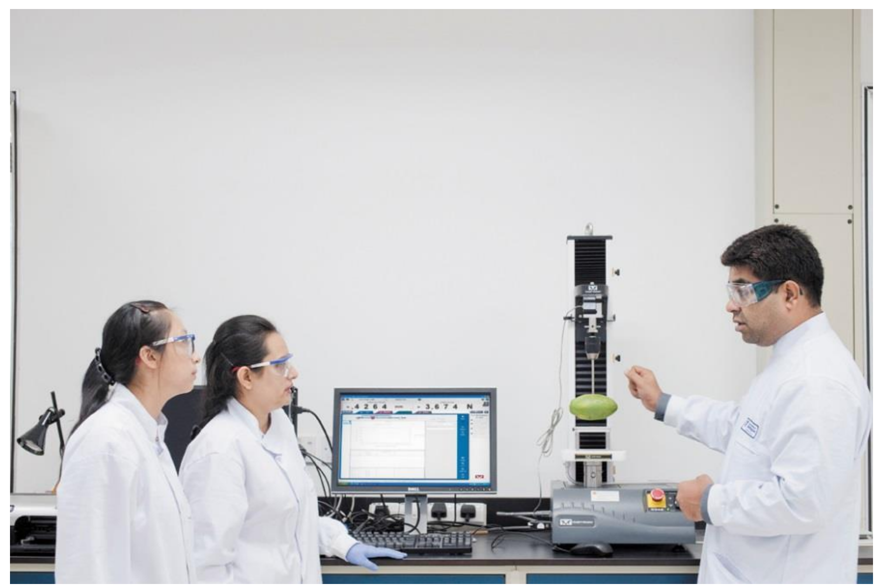
The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Techniques Used at CEPB

USE OF NATURAL PRODUCTS AS AN EDIBLE COATINGS




MARDI
PRODUCE OF MALAYSIA



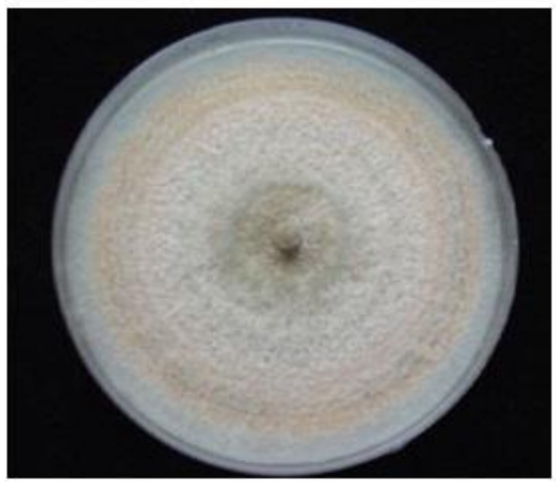
Anthracnose

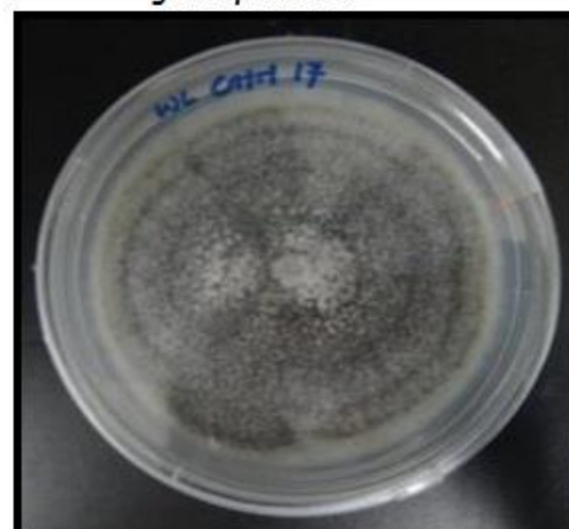
Anthracnose of papaya caused by *C. gloeosporioides*

Anthracnose of banana caused by *Colletotrichum musae*

Anthracnose of mango caused by *C. gloeosporioides*

Anthracnose of dragon fruit caused by *C. gloeosporioides*



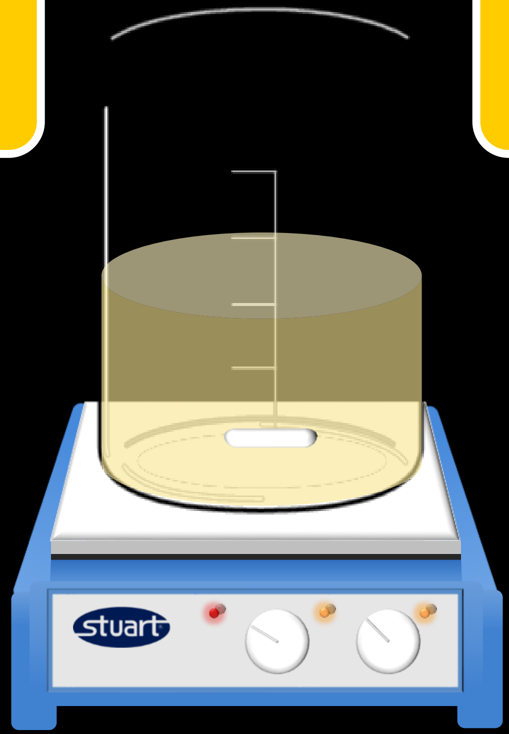


Benefits of edible coatings

Biodegradable

Antimicrobial properties e.g chitosan

Reduce water loss



Prevent mechanical injury

Delay ripening and reduce chilling injury

Slow gas exchange

Enhance organoleptic properties

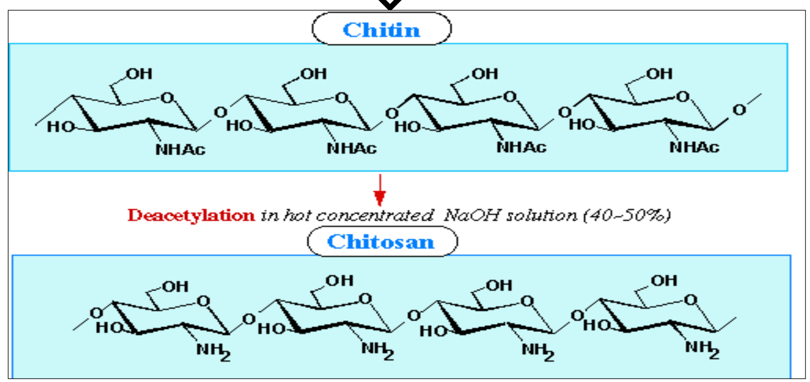
Chitosan

A natural biodegradable compound- **Polycationic nature**

Shellfish wastes from food processing

Induce resistance by eliciting the activities of antifungal hydrolases and total phenols

Applications – Soil and foliar plant pathogens



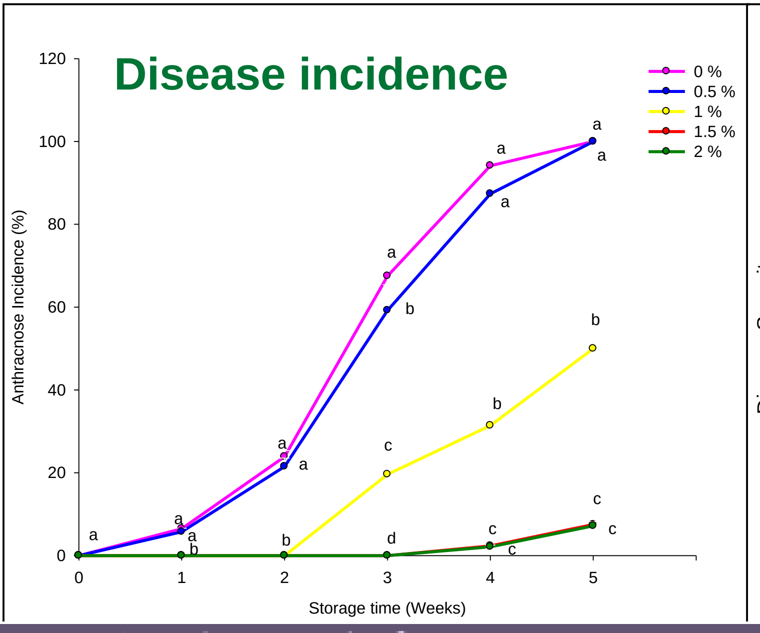
Induces structural barriers - by inducing the lignin materials for some horticultural plants

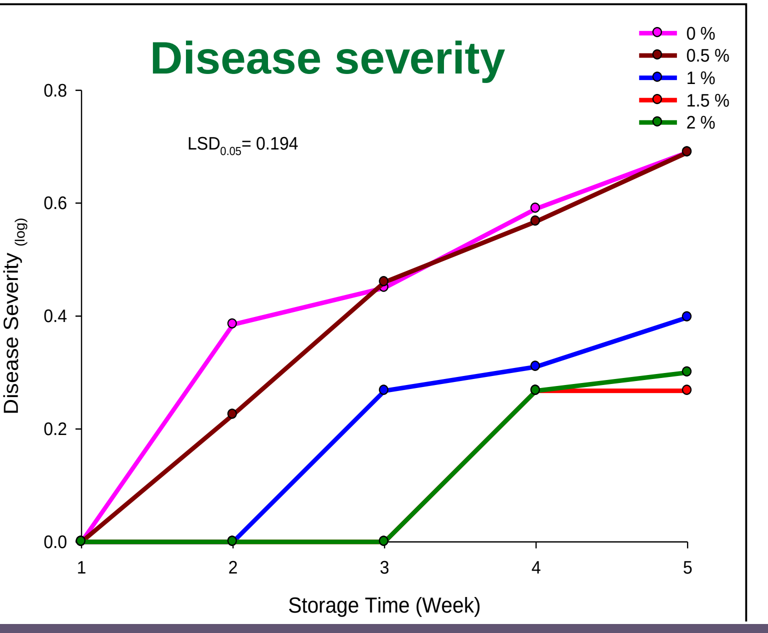
A direct effect on morphology of microorganisms – **fungistatic or fungicidal potential**

Semi-permeable coating – slow down the rate of respiration and water loss

Potential to become a new class of plant protectant – **sustainable agriculture**

Effect of chitosan on disease incidence and severity of papaya





International Journal of
Food Science & Technology

International Journal of Food Science and Technology 2010, 45, 2134–214

Original article

Potential of chitosan coating in delaying the postharvest anthracnose (*Colletotrichum gloeosporioides* Penz.) of Eksotika II papaya

Asgar Ali,[1]* Mahmud Tengku Muda Muhammad,[2] Kamaruzaman Sijam[3] & Yasmeen Siddiqui[4]

Antifungal effects of chitosan on papaya fruit

After 5 weeks of storage at 12° C

Incidence of Anthracnose in Control Fruit

7 % Anthracnose incidence in 1.5% chitosan treated papaya

International Journal of
Food Science & Technology

International Journal of Food Science and Technology 2010, 45, 2134–214

Original article

Potential of chitosan coating in delaying the postharvest anthracnose (*Colletotrichum gloeosporioides* Penz.) of Eksotika II papaya

Asgar Ali,[1]* Mahmud Tengku Muda Muhammad,[2] Kamaruzaman Sijam[3] & Yasmeen Siddiqui[4]

Quality of papaya fruit after 5 weeks of storage

Food Chemistry 124 (2011) 620–626

ELSEVIER

Contents lists available at ScienceDirect

Food Chemistry

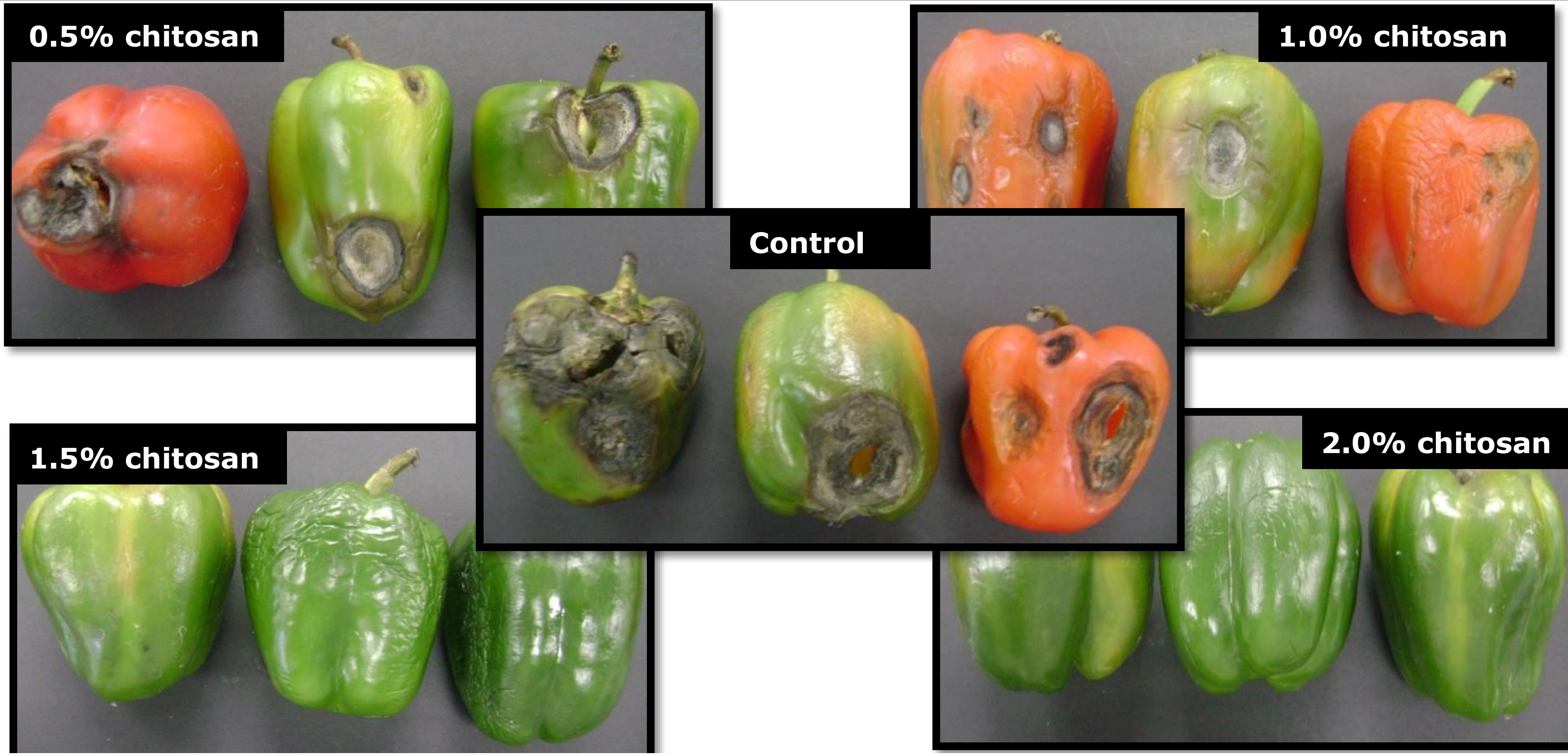
journal homepage: www.elsevier.com/locate/foodchem

FOOD CHEMISTRY

Effect of chitosan coatings on the physicochemical characteristics of Eksotika II papaya (*Carica papaya* L.) fruit during cold storage

Asgar Ali [a,*], Mahmud Tengku Muda Muhammad [b], Kamaruzaman Sijam [c], Yasmeen Siddiqui [d]

Antifungal effects of chitosan on bell pepper after 28 days



J Food Sci Technol
DOI 10.1007/s13197-012-0907-5

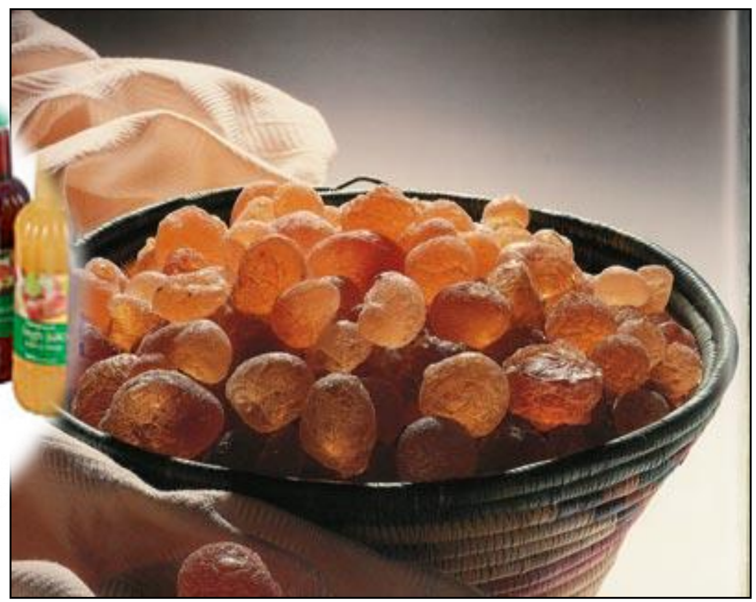
ORIGINAL ARTICLE

Chitosan controls postharvest anthracnose in bell pepper by activating defense-related enzymes

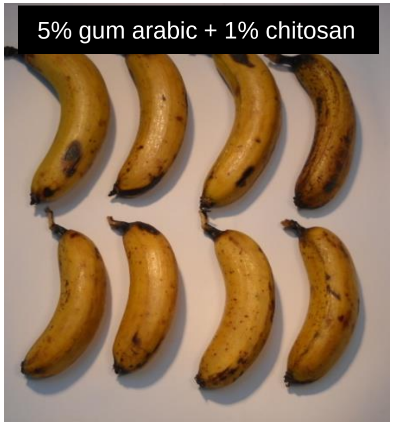
Madushani Edirisinghe · Asgar Ali · Mehdi Maqbool ·
Peter G. Alderson

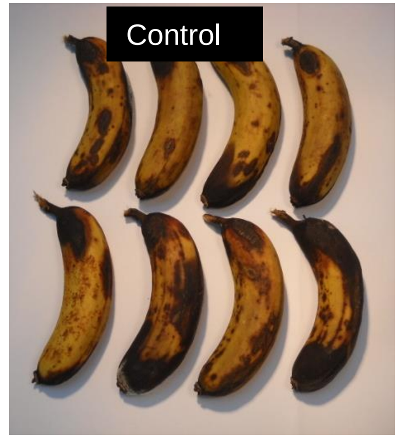
Gum Arabic

- **The oldest and the best-known of all natural gums.**
- **Gum arabic**: *Acacia senegal* and *Acacia seyal.*
- **Commercial harvesting:** Sudan to Somalia, Arabia and West Asia.




Composite effects of gum arabic + chitosan after 35 days





Crop Protection 29 (2010) 1136–1141

Contents lists available at ScienceD

Crop Protection

journal homepage: www.elsevier.com/locate/cropro

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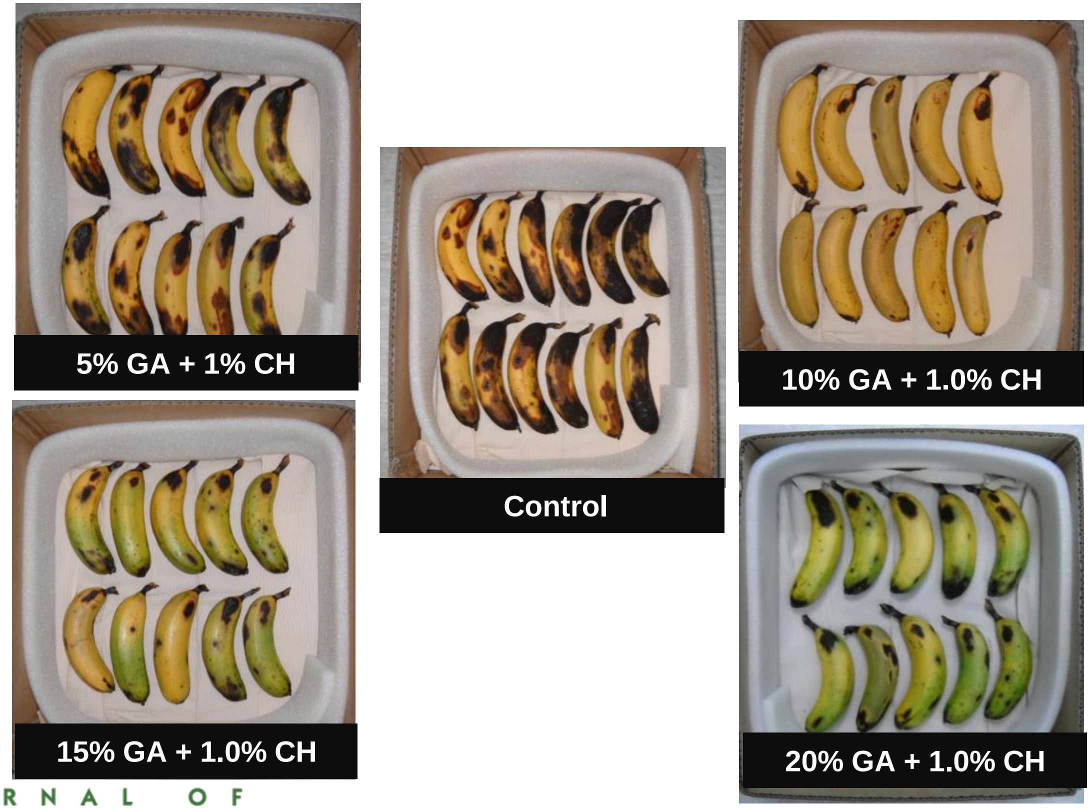
Control of postharvest anthracnose of banana using a new edible composite coating

Mehdi Maqbool, Asgar Ali*, Senthil Ramachandran, Daniel R. Smith, Peter G. Alderson

School of Biosciences, Faculty of Science, The University of Nottingham Malaysia Campus, Jalan Broga, 43500 Semenyih, Selangor Darul Ehsan, Malaysia

Banana after 33 days of storage



JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY

ARTICLE

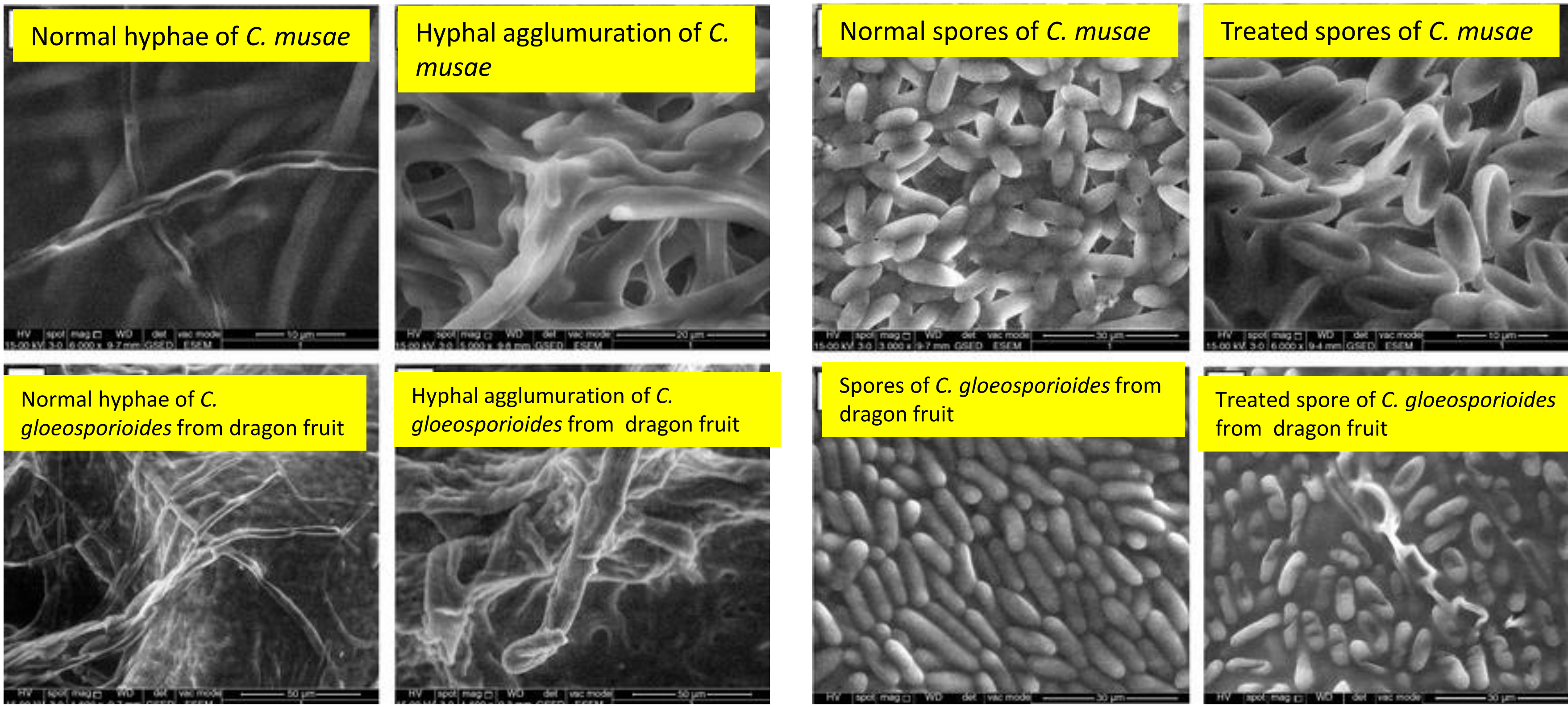
pubs.acs.org/JAFC

Effect of a Novel Edible Composite Coating Based on Gum Arabic and Chitosan on Biochemical and Physiological Responses of Banana Fruits during Cold Storage

Mehdi Maqbool,[†] Asgar Ali,[*,†] Peter G. Alderson,[†] Noosheen Zahid,[†] and Yasmeen Siddiqui[‡]

Chitosan Submicron Dispersion

Effect of submicron chitosan dispersions on hyphae and conidial morphology of *Colletotrichum* spp.



Journal of Applied Microbiology

Journal of Applied Microbiology ISSN 1364-5072

ORIGINAL ARTICLE

Potential of chitosan-loaded nanoemulsions to control different *Colletotrichum* spp. and maintain quality of tropical fruits during cold storage

N. Zahid[1], A. Ali[1], S. Manickam[2], Y. Siddiqui[3] and M. Maqbool[1]

Submicron chitosan dispersions

Control fruits

Fruits treated with 600 nm at 1.0% chitosan

Quality of dragon fruit treated with submicron dispersions after 28 days of storage at 10 °C

Postharvest Biology and Technology 86 (2013) 147–153

Contents lists available at ScienceDirect

Postharvest Biology and Technology

journal homepage: www.elsevier.com/locate/postharvbio

Effectiveness of submicron chitosan dispersions in controlling anthracnose and maintaining quality of dragon fruit

Asgar Ali [a,*], Noosheen Zahid [a], Sivakumar Manickam [b], Yasmeen Siddiqui [c], Peter G. Alderson [d], Mehdi Maqbool [a]

Submicron chitosan dispersions

Control fruits

Fruits treated with 400 nm at 1.0% chitosan

Quality of dragon fruit treated with submicron dispersions after 15 days of storage at 10 °C

Food Bioprocess Technol (2014) 7:2102–2111
DOI 10.1007/s11947-013-1173-x

ORIGINAL PAPER

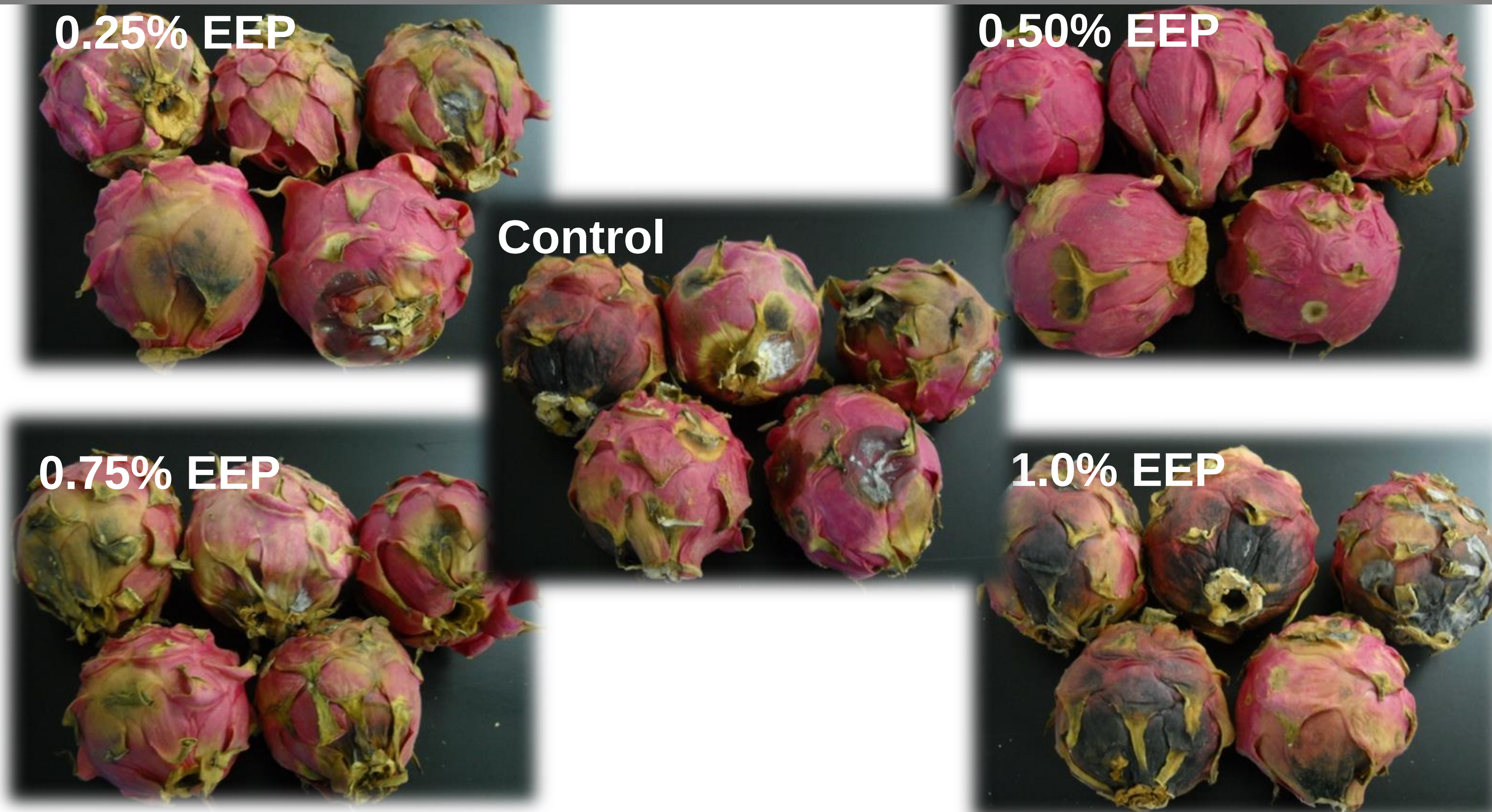
Ultrasound-Assisted Chitosan–Surfactant Nanostructure Assemblies: Towards Maintaining Postharvest Quality of Tomatoes

Maysoun A. Mustafa · Asgar Ali · Sivakumar Manickam · Yasmeen Siddiqui

Propolis

- Natural glue
- Collected by honey bees
- Used in pharmacy
- Used as food additive in candies
- High antioxidants
- Antimicrobial properties

Antifungal effects of propolis against C. gloeosporioides of dragon fruit after 20 days of storage at 20 ± °C



Postharvest Biology and Technology 79 (2013) 69–72

Contents lists available at SciVerse ScienceDirect

Postharvest Biology and Technology

journal homepage: www.elsevier.com/locate/postharvbio

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POSTHARVEST BIOLOGY AND TECHNOLOGY

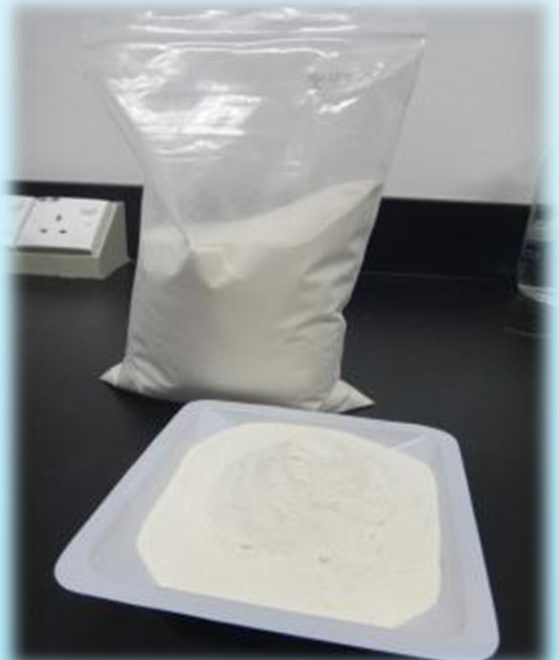
Research note

Efficacy of ethanolic extract of propolis in maintaining postharvest quality of dragon fruit during storage

Noosheen Zahid[a], Asgar Ali[a,*], Yasmeen Siddiqui[b], Mehdi Maqbool[a]

Gum Arabic

- From *Acacia Senegal*



- Proven to be able to preserve the quality of postharvest fruits
  (Ali *et al.*, 2010)
- No antifungal property

Cinnamon oil

- From plant extracts

- Proven role in antifungal property
  (Maqbool *et al.*, 2011)
- Active component: Cinnamaldehyde

Propolis

- Beewax collected by honeybees

- Proven role in antifungal property
  (**Zahid *et al.*, 2013**)
- Active components: Flavonoids
  Artepillin-C

Effect of gum arabic + propolis + cinnamon oil on chilli

Antifungal assay (At the end of storage)

Control	5% Gum Arabic	5% Gum Arabic+ 5% Propolis	5% Gum Arabic+ 0.1% Cinnamon oil	5% Gum Arabic+ 5% Propolis+ 0.1% Cinnamon oil

Quality assay (At the end of storage)

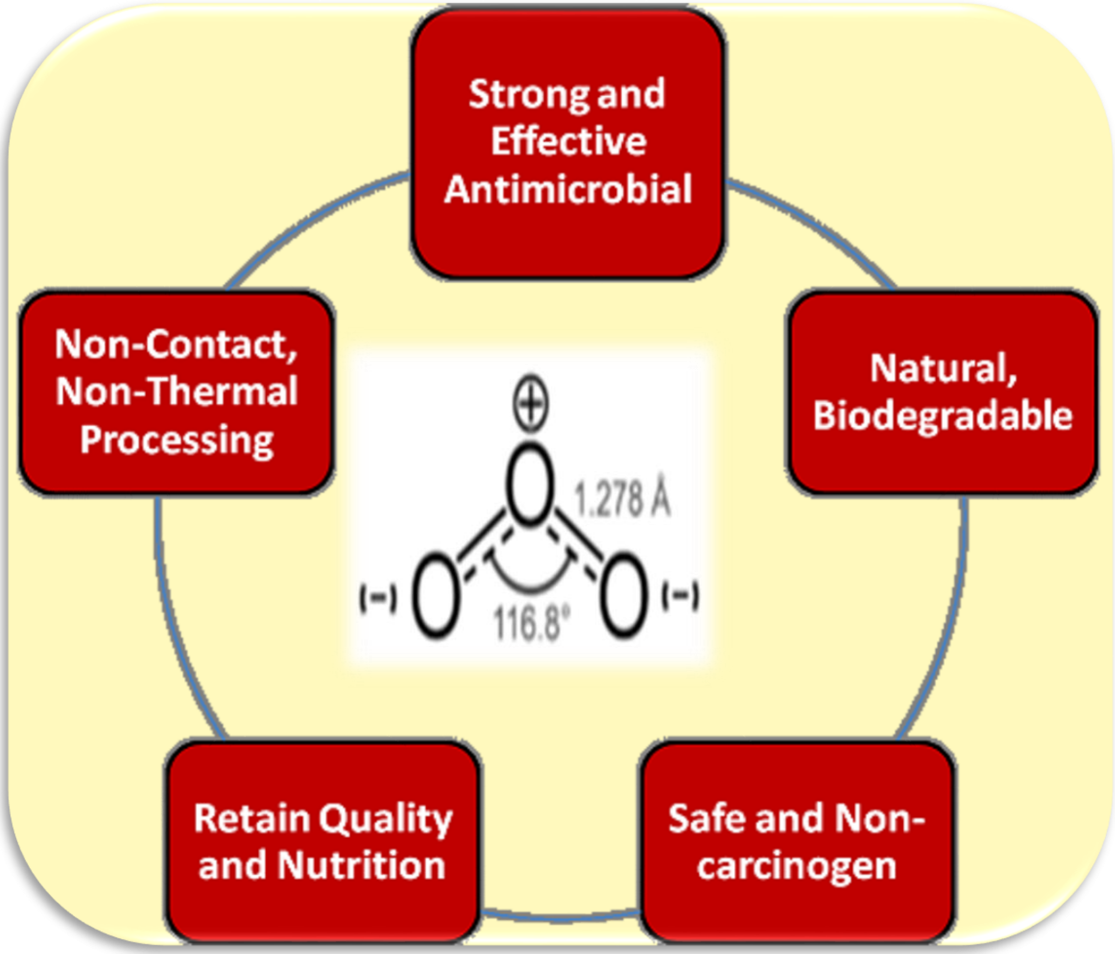
Food Bioprocess Technol
DOI 10.1007/s11947-013-1237-y

ORIGINAL PAPER

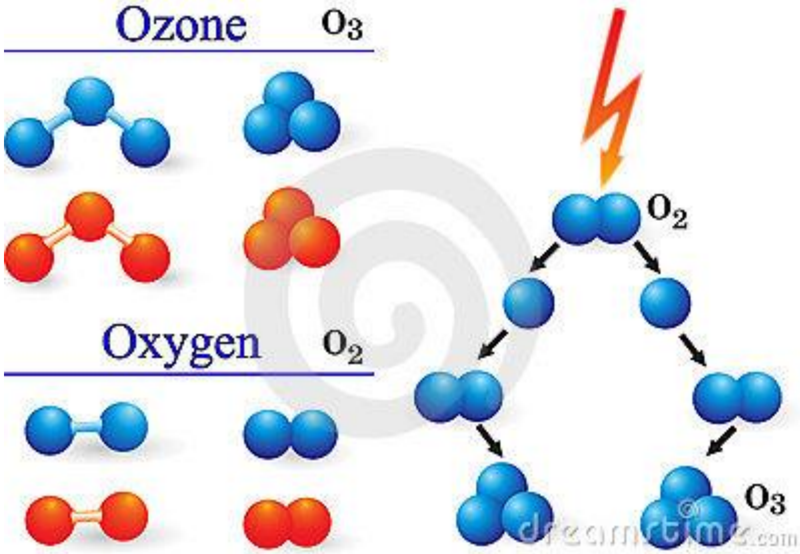
Efficacy of Propolis and Cinnamon Oil Coating in Controlling Post-Harvest Anthracnose and Quality of Chilli (*Capsicum annuum* L.) during Cold Storage

Asgar Ali · Wei Ling Chow · Noosheen Zahid ·
Mei Kying Ong

Benefits of ozone

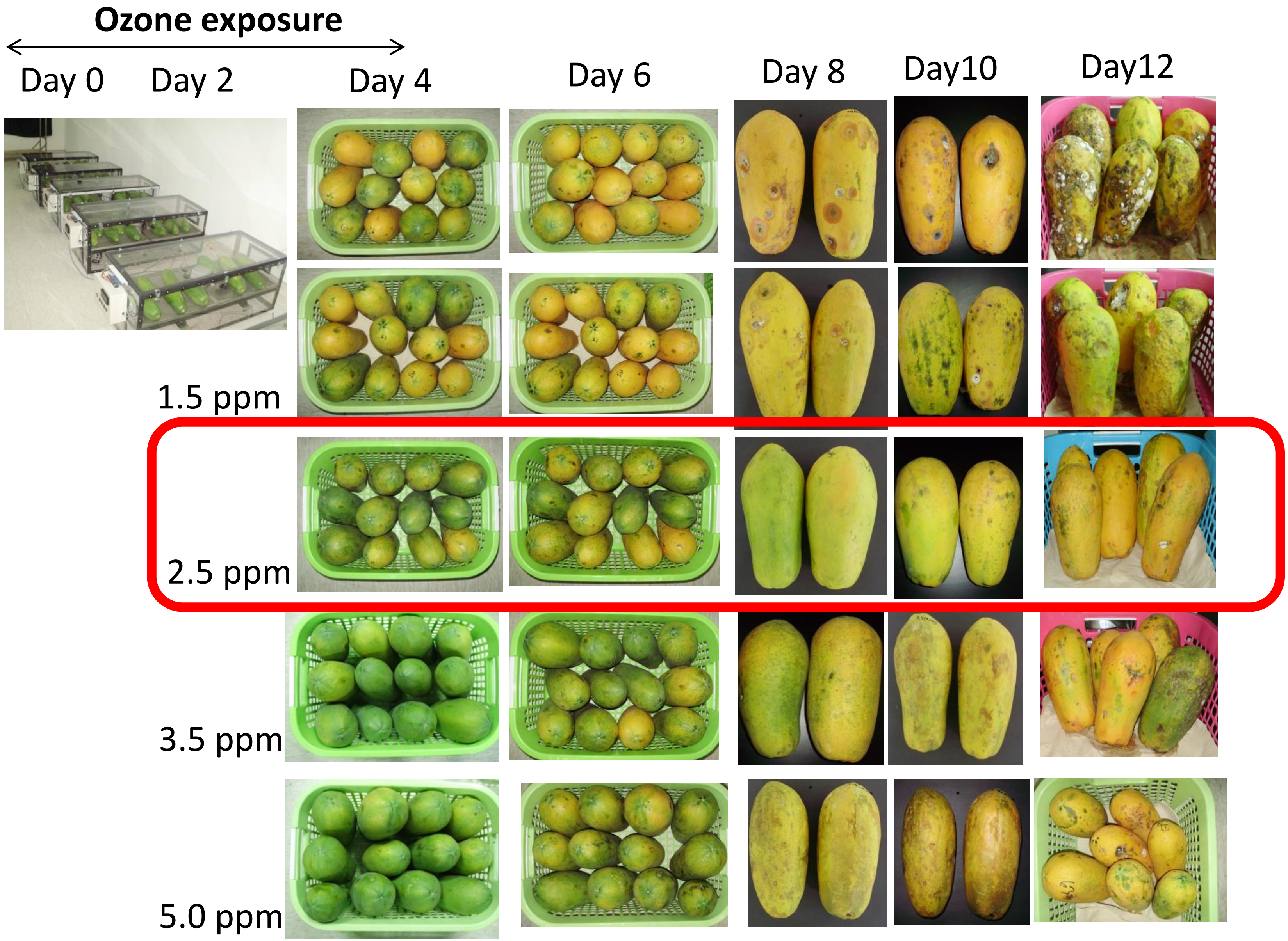


Ozone treatments

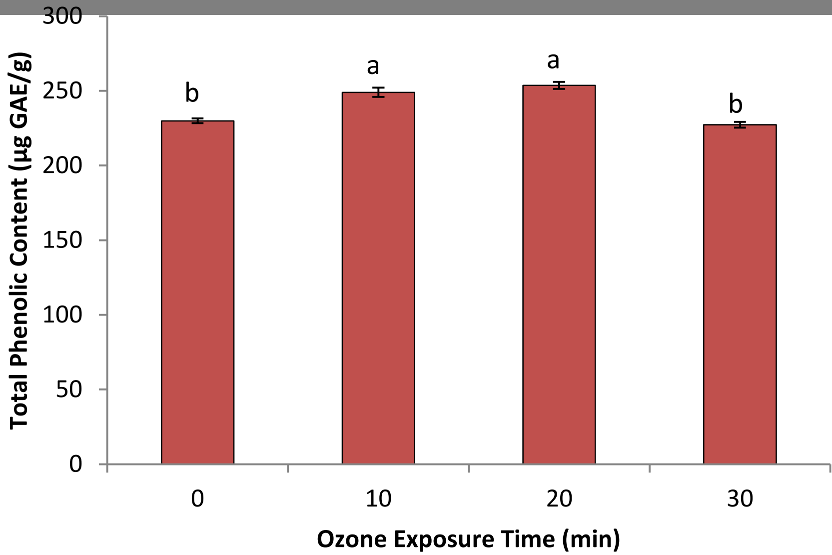


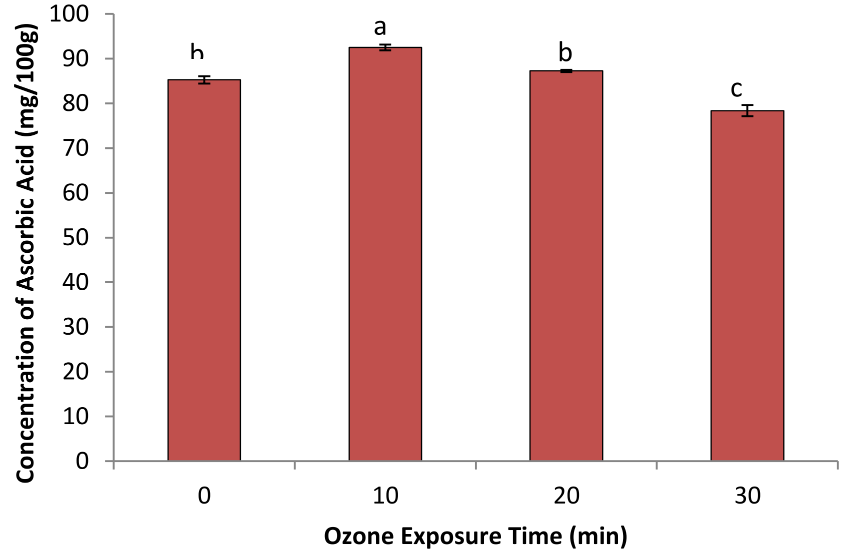
Fruits on 8th day after treatment with ozone at room temperature

Colour development of papaya fruits



Antioxidant capacity of fresh cut papaya after exposure to 9 ppm of ozone





Postharvest Biology and Technology 89 (2014) 56–58

Contents lists available at ScienceDirect

Postharvest Biology and Technology

journal homepage: www.elsevier.com/locate/postharvbio

ELSEVIER

Effects of ozone on major antioxidants and microbial populations of fresh-cut papaya

CrossMark

Wei Keat Yeoh[a], Asgar Ali[a,*], Charles F. Forney[b]

Top 25 Hottest Articles

Agricultural and Biological Sciences > Postharvest Biology and Technology
July to September 2011

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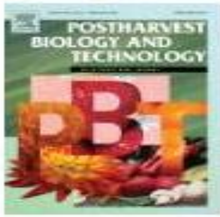

1. **Metabolic characterization of tomato fruit during preharvest development, ripening, and postharvest shelf-life**
   Postharvest Biology and Technology, Volume 62, Issue 1, October 2011, -16
   Oms-Oliu, G.; Hertog, M.L.A.T.M.; Van de Poel, B.; Ampofo-Asiama, J.; Geeraerd, A.H.; Nicolai, B.M.
2. **Recent approaches using chemical treatments to preserve quality fresh-cut fruit: A review** - Review article
   Postharvest Biology and Technology, Volume 57, Issue 3, September 201 Pages 139-146
   Oms-Oliu, G.; Rojas-Grau, M.A.; Gonzalez, L.A.; Varela, P.; Soliva-Fort Hernando, M.I.H.; Munuera, I.P.; Fiszman, S.; Martin-Belloso, O.
   Cited by SciVerse Scopus (8)
3. **Nondestructive measurement of fruit and vegetable quality by means of NIR spectroscopy: review** - Review article
   Postharvest Biology and Technology, Volume 46, Issue 2, November 2007, Pages 99-118
   Nicolai, B.M.; Beullens, K.; Bobelyn, E.; Peirs, A.; Saeys, W.; Theron, K.I.; Lammertyn, J.
   Cited by SciVerse Scopus (125)
4. **1-Methylcyclopropene: a review** - Review article
   Postharvest Biology and Technology, Volume 28, Issue 1, April 2003, Pages 1 - 25
   Blankenship, S.M.; Dole, J.M.
   Cited by SciVerse Scopus (416)
5. **Preharvest and postharvest factors influencing vitamin C content of horticultural crops** - Review article
   Postharvest Biology and Technology, Volume 20, Issue 3, November 2000, Pages 207 - 220
   Lee, S.K.; Kader, A.A.
   Cited by SciVerse Scopus (384)
6. **Biochemical bases of appearance and texture changes in fresh-cut fruit and vegetables** - Review article
   Postharvest Biology and Technology, Volume 48, Issue 1, April 2008, Pages 1-14
   Toivonen, P.M.A.; Brummell, D.A.
   Cited by SciVerse Scopus (55)
7. **Activity of extracts from wild edible herbs against postharvest fungal diseases of fruit and vegetables**
   Postharvest Biology and Technology, Volume 61, Issue 1, July 2011, Pages 72-82
   Gatto, M.A.; Ippolito, A.; Linsalata, V.; Cascarano, N.A.; Nigro, F.; Vanadia, S.; Di Venere, D.
8. **Quality measurement of fruits and vegetables**
   Postharvest Biology and Technology, Volume 15, Issue 3, March 1999, Pages 207-225
   Abbott, J.A.
   Cited by SciVerse Scopus (189)
9. **Where systems biology meets postharvest** - Review article
   Postharvest Biology and Technology, Volume 62, Issue 3, December 2011, Pages 223-237
   Hertog, M.L.A.T.M.; Rudell, D.R.; Pedreschi, R.; Schaffer, R.J.; Geeraerd, A.H.; Nicolai, B.M.; Ferg
10. **Postharvest quality of cut lily flowers** - Review article
    Postharvest Biology and Technology, Volume 62, Issue 1, October 2011, Pages 1-6
    van Doorn, W.G.; Han, S.S.
11. **Exploitation of natural products as an alternative strategy to control postharvest fungal rotting of fruit and vegetables** - Review article
    Postharvest Biology and Technology, Volume 32, Issue 3, June 2004, Pages 235-245
    Tripathi, P.; Dubey, N.K.
    Cited by SciVerse Scopus (134)
12. **Postharvest application of gum arabic and essential oils for controlling anthracnose and quality of banana and papaya during cold storage**
    Postharvest Biology and Technology, Volume 62, Issue 1, October 2011, Pages 71-76
    Maqbool, M.; Ali, A.; Alderson, P.G.; Mohamed, M.T.M.; Siddiqui, Y.; Zahid, N.
13. **Expression of ripening-related genes in cold-stored tomato fruit**
    Postharvest Biology and Technology, Volume 61, Issue 1, July 2011, Pages 1-14
    Rugkong, A.; McQuinn, R.; Giovannoni, J.J.; Rose, J.K.C.; Watkins, C.B.

Top 25 Hottest Articles

Agricultural and Biological Sciences > Food Chemistry
July to September 2010

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1. **Dietary fibre and fibre-rich by-products of food processing: Characterisation, technological functionality and commercial applications: A review** - Review article
   Food Chemistry, Volume 124, Issue 2, January 2011, Pages 411-421
   Elleuch, M.; Bedigian, D.; Roiseux, O.; Besbes, S.; Blecker, C.; Attia, H.
   Cited by SciVerse Scopus (1)
2. **DPPH antioxidant assay revisited**
   Food Chemistry, Volume 113, Issue 4, April 2009, Pages 1202-1205
   Sharma, O.P.; Bhat, T.K.
   Cited by SciVerse Scopus (28)
3. **Natural antioxidants from residual sources** - Review article
   Food Chemistry, Volume 72, Issue 2, February 2001, Pages 145-171
   Moure, A.; Cruz, J.M.; Franco, D.; Dominguez, J.M.; Sineiro, J.; Dominguez, H.; Jose Nunez, M.; Parajo, J.C.
   Cited by SciVerse Scopus (280)
4. **Chemical studies of anthocyanins: A review** - Review article
   Food Chemistry, Volume 113, Issue 4, April 2009, Pages 859-871
   Castaneda-Ovando, A.; Pacheco-Hernandez, Ma.d.L.; Paez-Hernandez, Ma.E.; Rodriguez, J.A.; Galan-Vidal, C.A.
   Cited by SciVerse Scopus (32)
5. **Phenolic compounds in plants and agri-industrial by-products: Antioxidant activity, occurrence, and potential uses**
   Food Chemistry, Volume 99, Issue 1, January 2006, Pages 191-203
   Balasundram, N.; Sundram, K.; Samman, S.
   Cited by SciVerse Scopus (162)
6. **Antioxidant capacity, phenolics and isoflavones in soybean by-products**
   Food Chemistry, Volume 123, Issue 3, December 2010, Pages 583-589
   Tyug, T.S.; Prasad, K.N.; Ismail, A.
7. **Anti-inflammatory activity of extracts from fruits, herbs and spices**
   Food Chemistry, Volume 122, Issue 4, October 2010, Pages 987-996
   Mueller, M.; Hobiger, S.; Jungbauer, A.
   Cited by SciVerse Scopus (1)
8. **Isolation, identification, and antioxidant activity of anthocyanin compounds in Camarosa strawberry**
   Food Chemistry, Volume 123, Issue 3, December 2010, Pages 574-582
   Cerezo, A.B.; Cuevas, E.; Winterhalter, P.; Garcia-Parrilla, M.C.; Troncoso, A.M.
9. **Antioxidant activity and profiles of common fruits in Singapore**
   Food Chemistry, Volume 123, Issue 1, November 2010, Pages 77-84
   Isabelle, M.; Lee, B.L.; Lim, M.T.; Koh, W.P.; Huang, D.; Ong, C.N.
   Cited by SciVerse Scopus (1)
10. **Perspectives for chitosan based antimicrobial films in food applications** - Review article
    Food Chemistry, Volume 114, Issue 4, June 2009, Pages 1173-1182
    Dutta, P.K.; Tripathi, S.; Mehrotra, G.K.; Dutta, J.
    Cited by SciVerse Scopus (47)
11. **Functional and nutritional characteristics of proteins and lipids recovered by isoelectric processing of fish by-products and low-value fish: A review** - Review article
    Food Chemistry, Volume 124, Issue 2, January 2011, Pages 422-431
    Gehring, C.K.; Gigliotti, J.C.; Moritz, J.S.; Tou, J.C.; Jaczynski, J.
    Cited by SciVerse Scopus (2)
12. **Effect of chitosan coatings on the physicochemical characteristics of Eksotika II papaya (Carica papaya L.) fruit during cold storage**
    Food Chemistry, Volume 124, Issue 2, January 2011, Pages 620-626
    Ali, A.; Muhammad, M.T.M.; Sijam, K.; Siddiqui, Y.
13. **Inhibition of polyphenol oxidase and peroxidase activities on fresh-cut apple by simultaneous**

Top 25 Hottest Articles

Agricultural and Biological Sciences > Postharvest Biology and Technology

January to December 2013 full year

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25. **Effect of gum arabic as an edible coating on antioxidant capacity of tomato (Solanum lycopersicum L.) fruit during storage**
Postharvest Biology and Technology, Volume 76, February 2013, Pages 119-124
Ali, A.; Maqbool, M.; Alderson, P.G.; Zahid, N.

Top 25 Hottest Articles

Agricultural and Biological Sciences > Postharvest Biology and Technology

July to September 2013

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21. **Postharvest application of gum arabic and essential oils for controlling anthracnose and quality of banana and papaya during cold storage**
Postharvest Biology and Technology, Volume 62, Issue 1, October 2011, Pages 71-76
Maqbool, M.; Ali, A.; Alderson, P.G.; Mohamed, M.T.M.; Siddiqui, Y.; Zahid, N.
Cited by Scopus (11)

Acknowledgement

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THE UNIVERSITY OF WESTERN AUSTRALIA

Curtin University

Agriculture et Agroalimentaire Canada
Agriculture and Agri-Food Canada
Canada

"Alone we can do so little,

Together we can do so much"

Roundtable discussion with international leading postharvest researchers at UNMC

Asgar.Ali@nottingham.edu.my

FFNRC

Aquaculture – Diversifying Nutrition Through Fish

Sungchul C. Bai, Hyeonho Yun & Kumar Katya

Dept. of Marine Bio Materials & Aquaculture / FFNRC (www.ffnrc.com)
Pukyong National University, Rep. of Korea

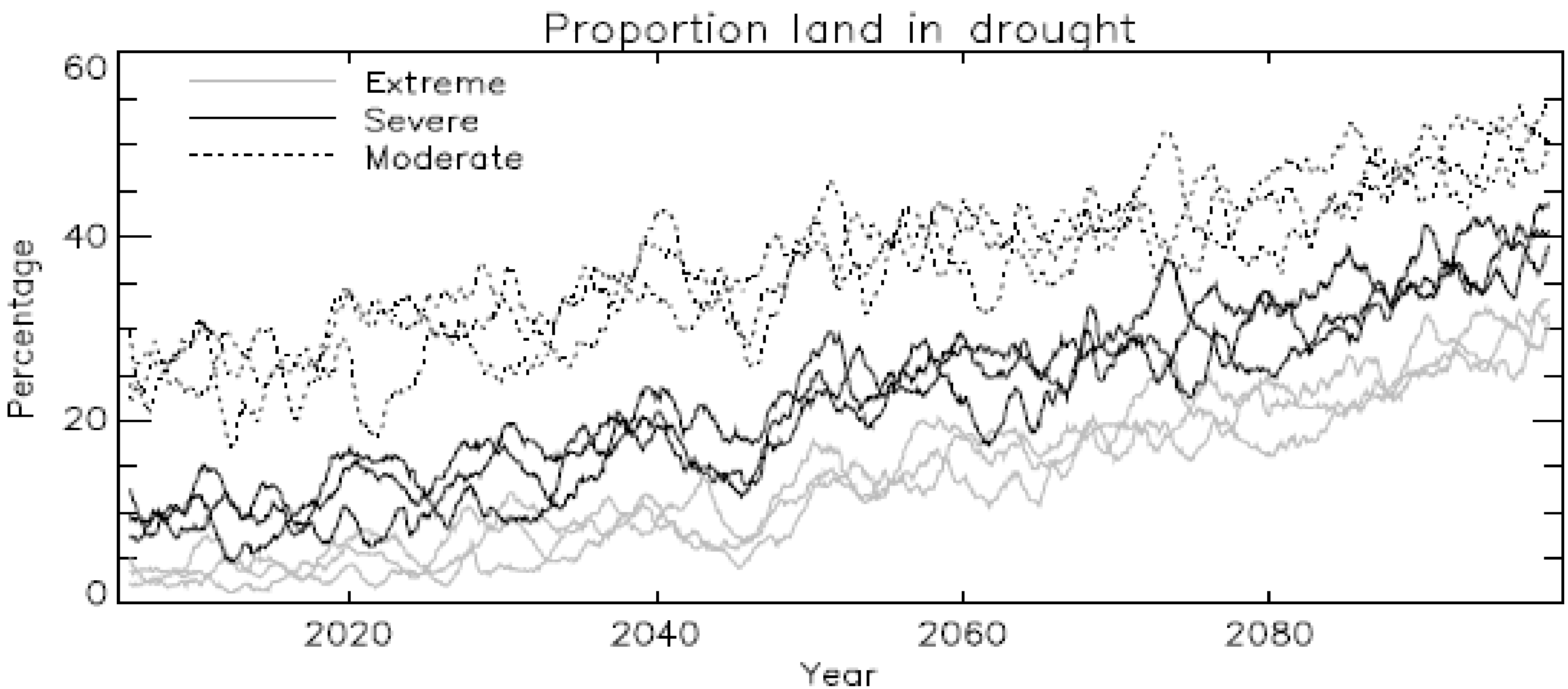
Green Revolution, Climate Change & Food Crisis

Green revolution supplied calorie not proper nutrients, chronic malnutrition around the world

"The Earth is losing topsoil at a rate of 75 to 100 GT per year. If soil loss continues at present rates, it is estimated that there is only another 48 years of topsoil left."

- Marler & Wallin, Nutrition Security Institute, USA, 2006

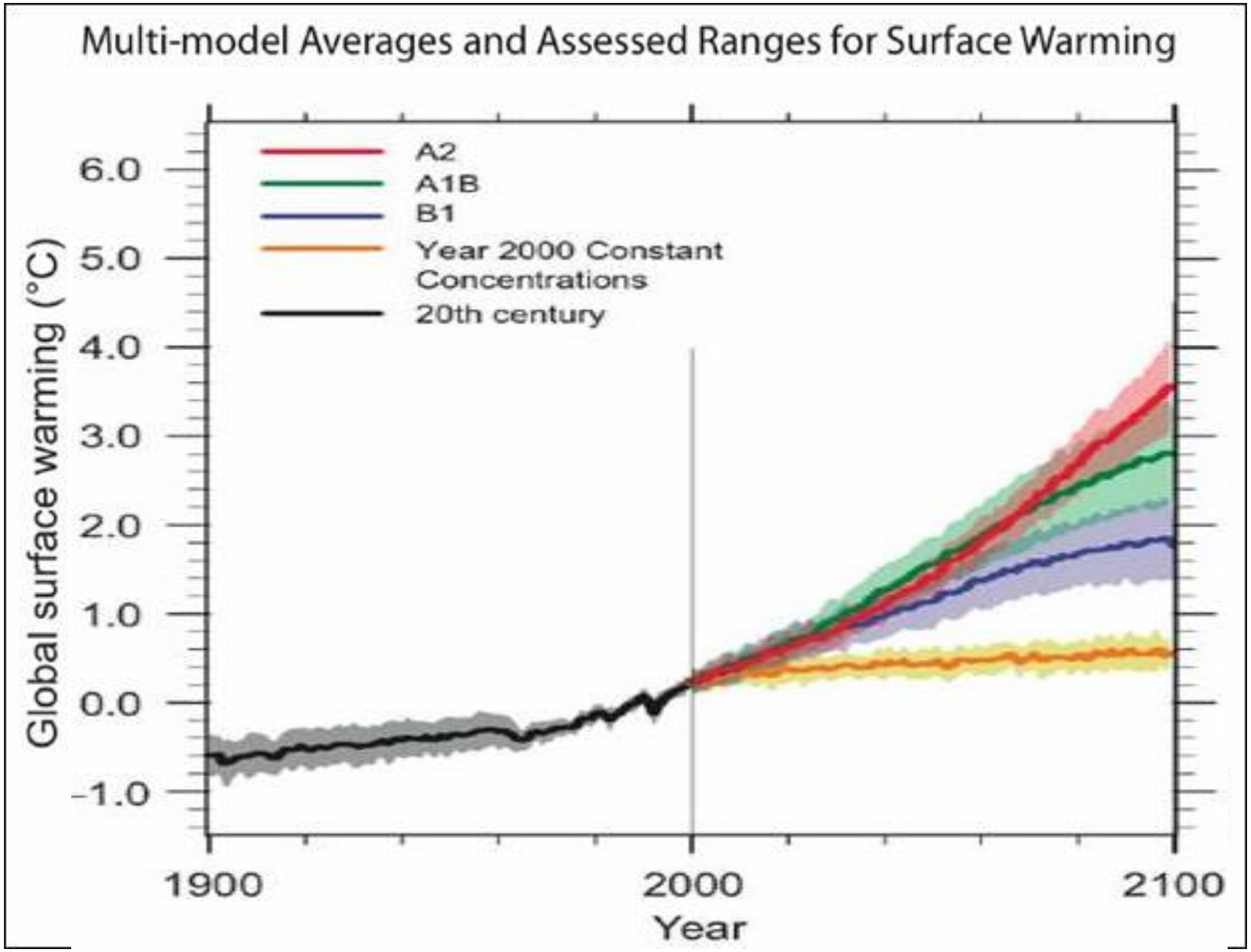
Climate Change

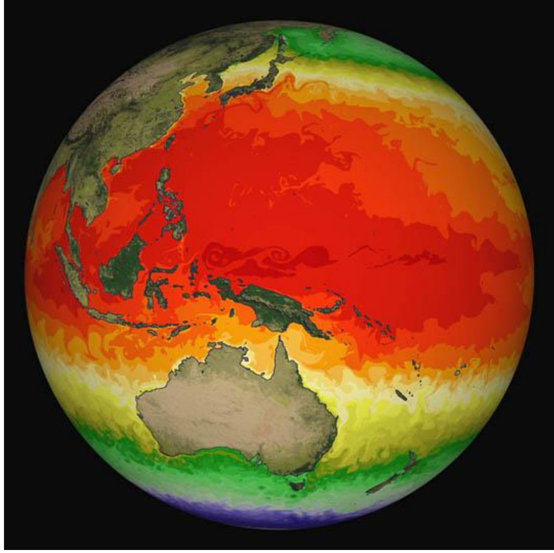


40 percent of Earth's surface left over by 2100, and we need 150% more food than today!

“The war over water “

Global Warming, ↑ 4-5° by 2100



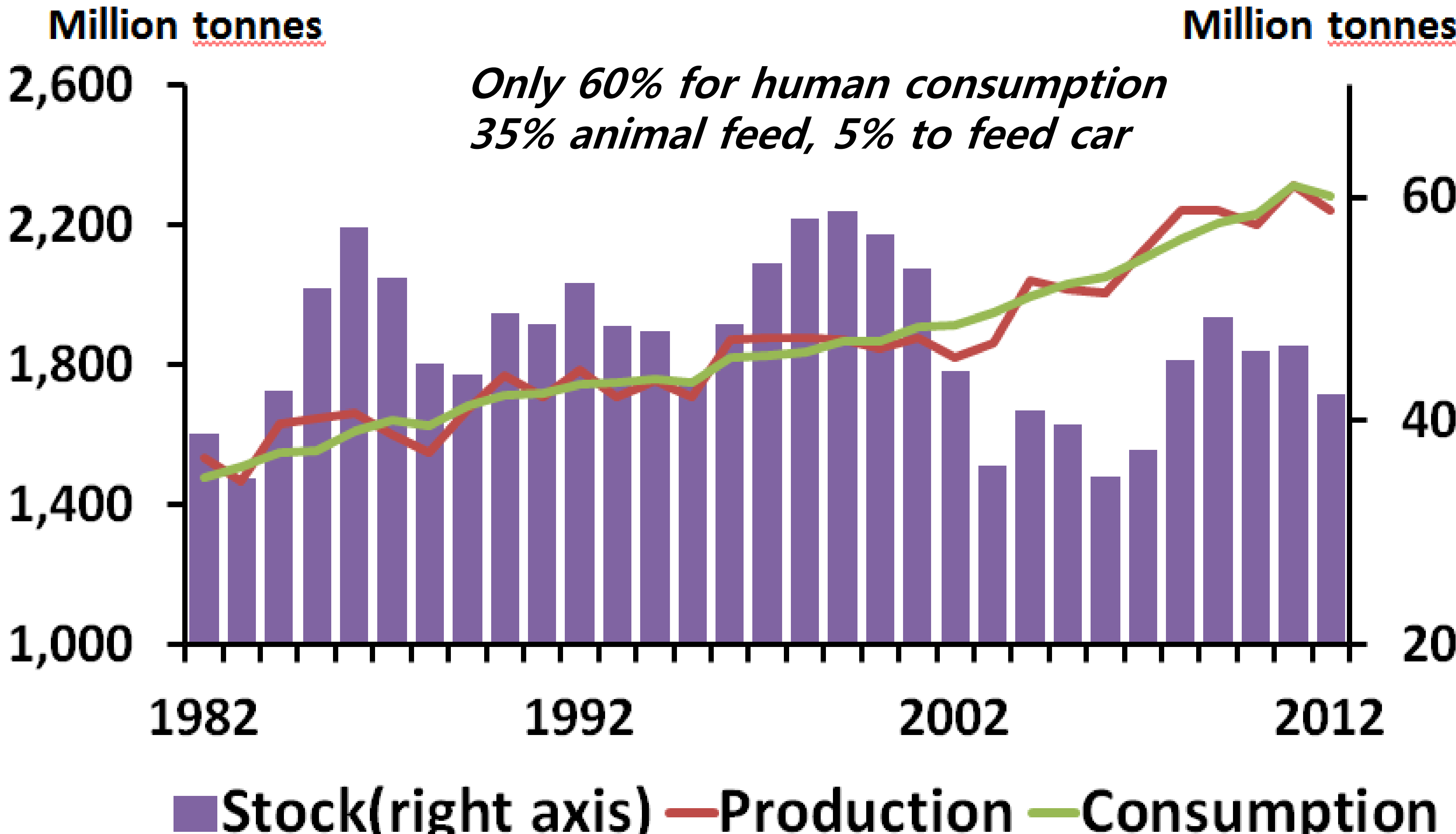


- **2°** of warming by 2050
- **5°** of warming by 2100

Source: IPCC

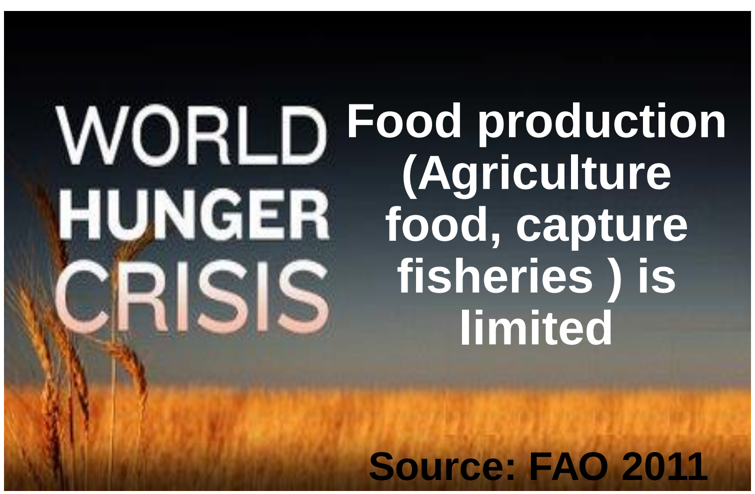
Each 1° of global warming ↓10% food Prod.

Global grain production, consumption and stocks

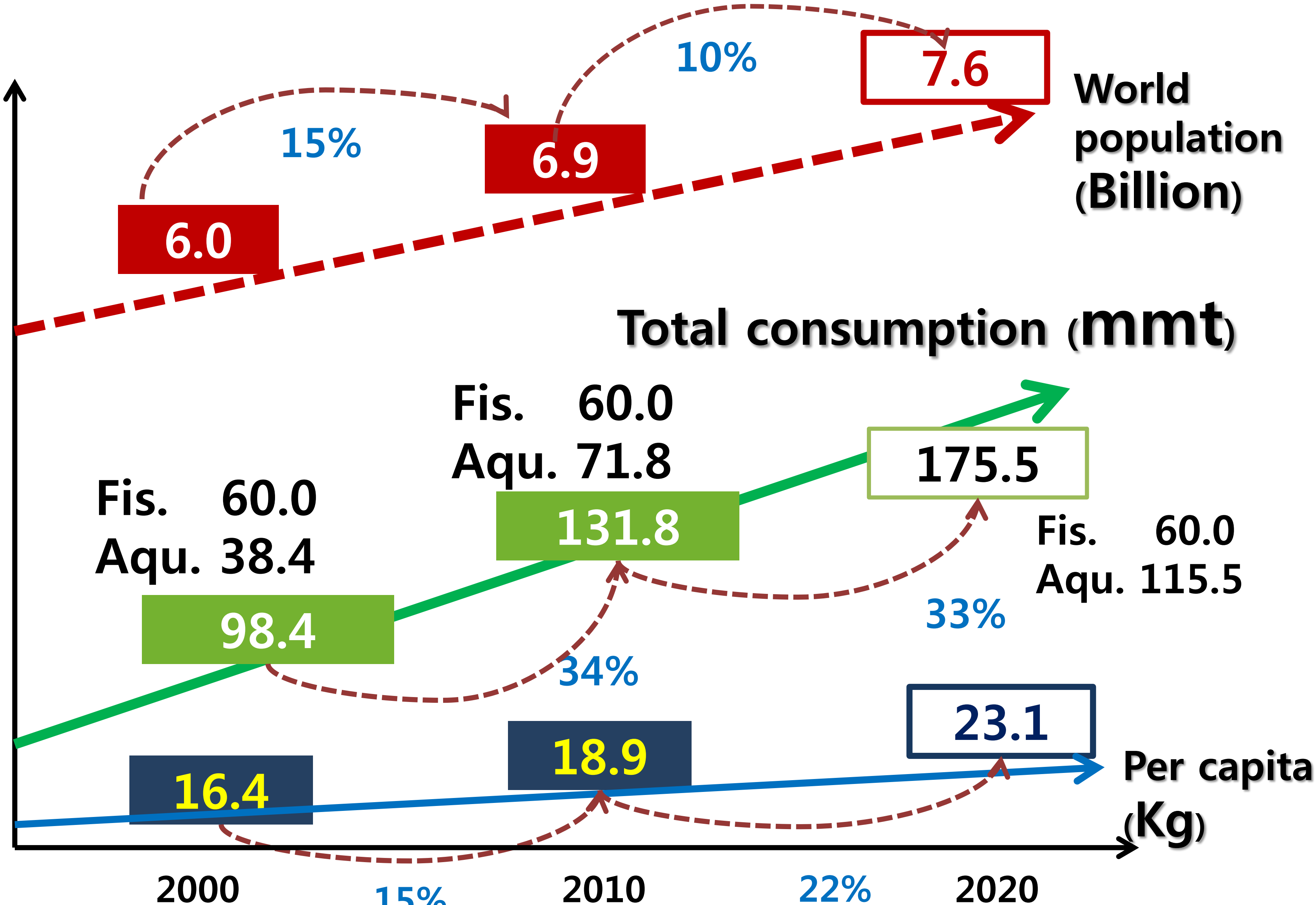


Source: FAO 2014

Food crisis & Aquaculture

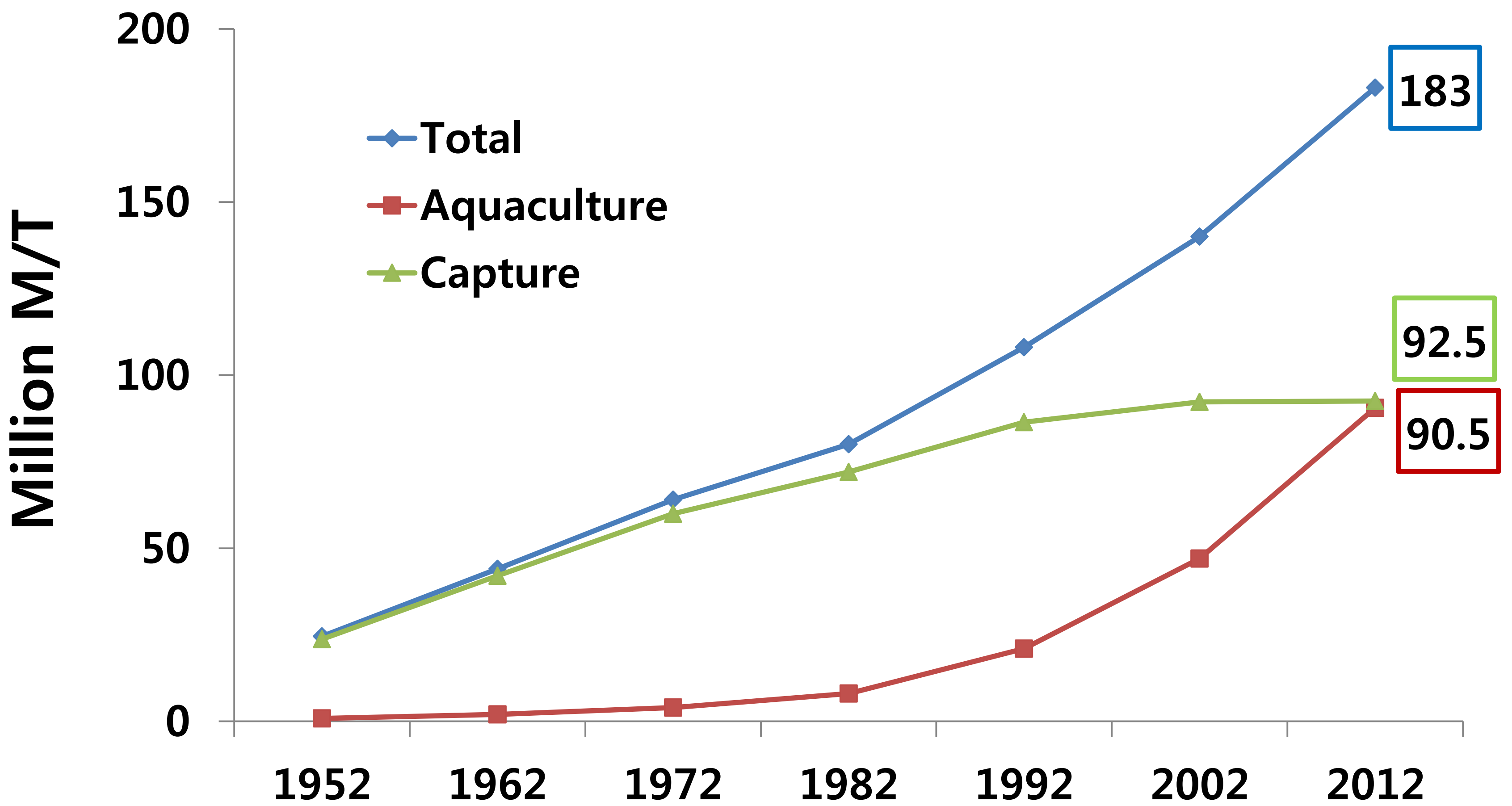


Consumption of fisheries product



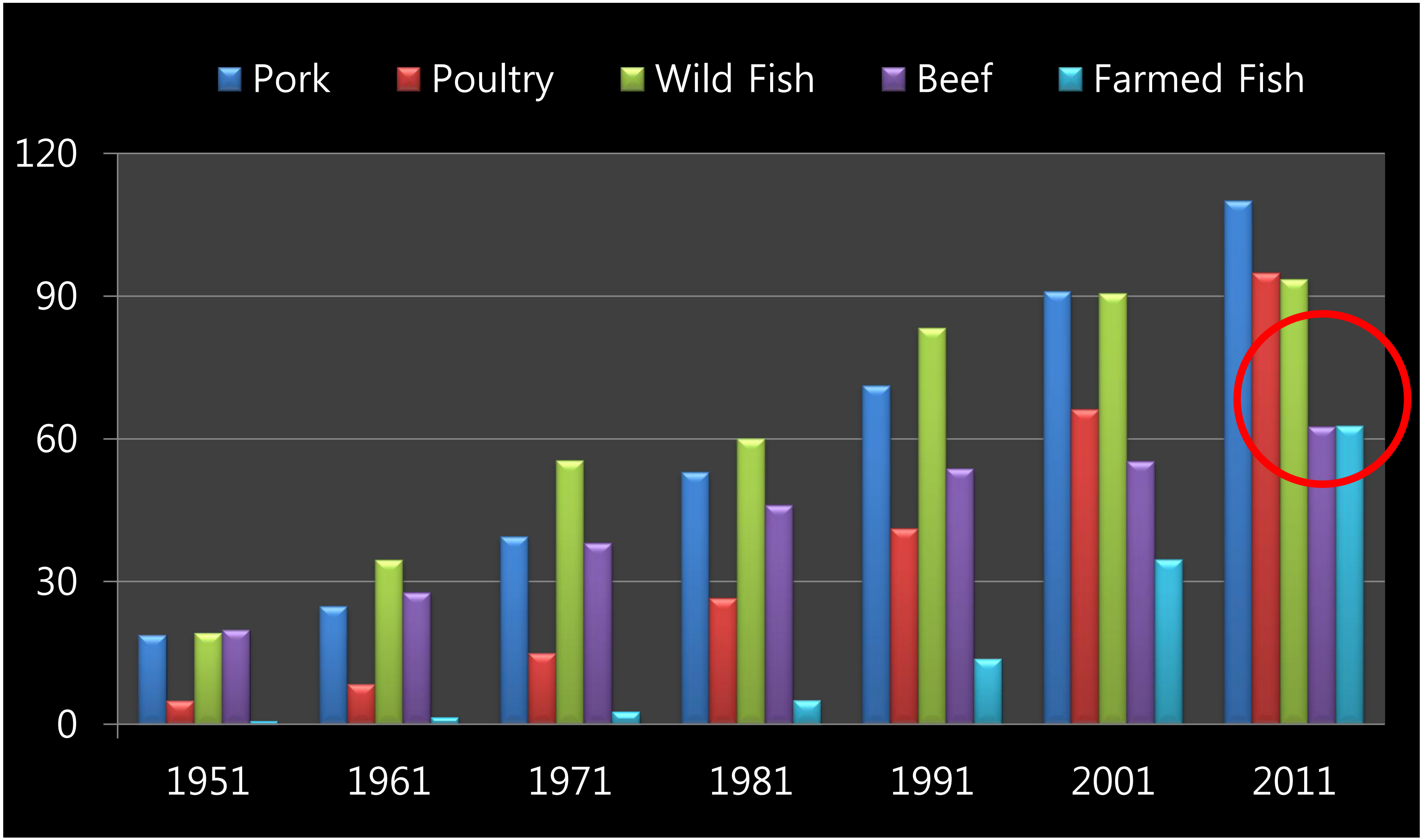
FAO 2014

Global capture fisheries & Aquaculture production



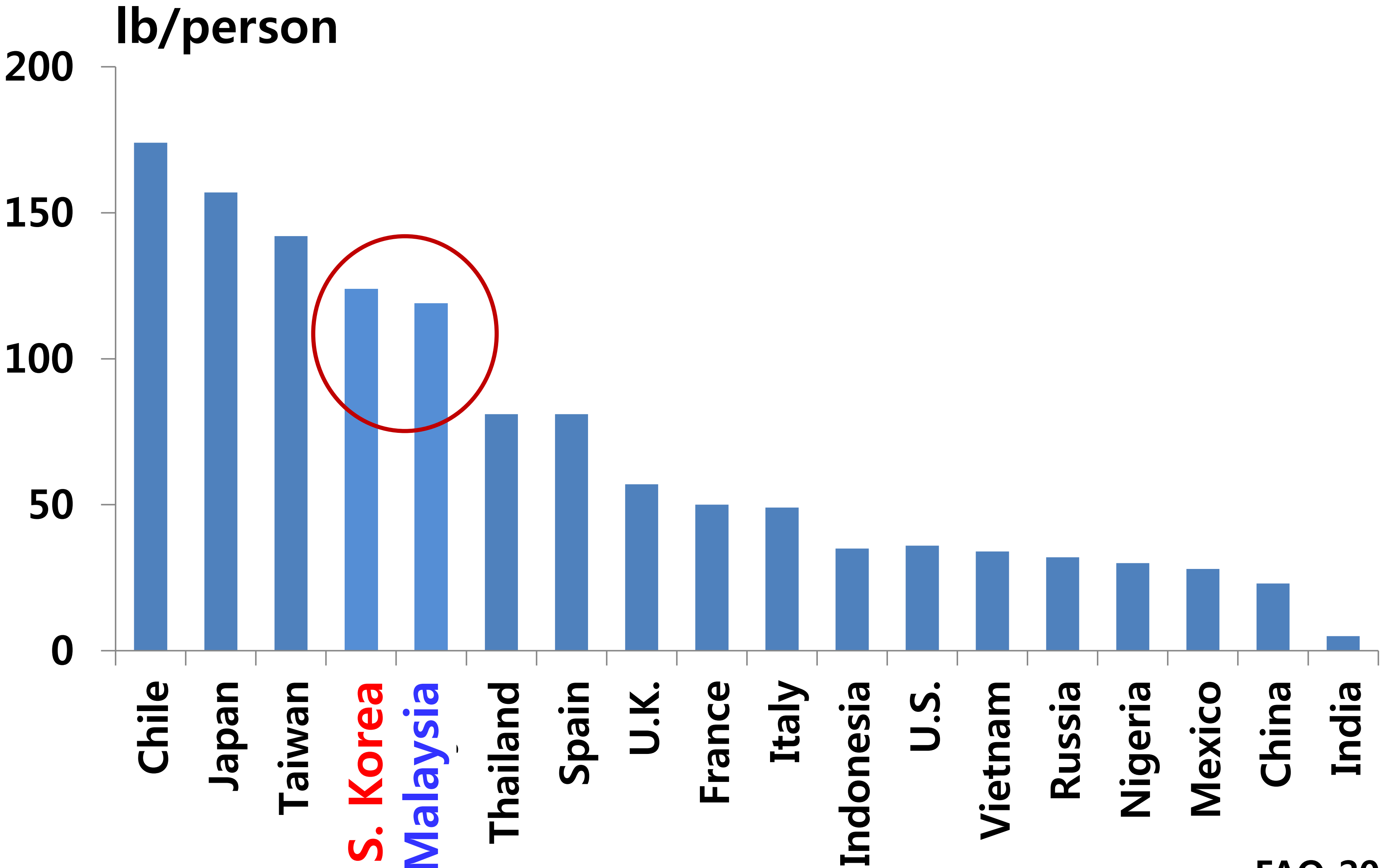
Source: FAO FISHSTAT Plus statistic database,2014

World major livestock, wild fish and farmed fish production (Million M/T)



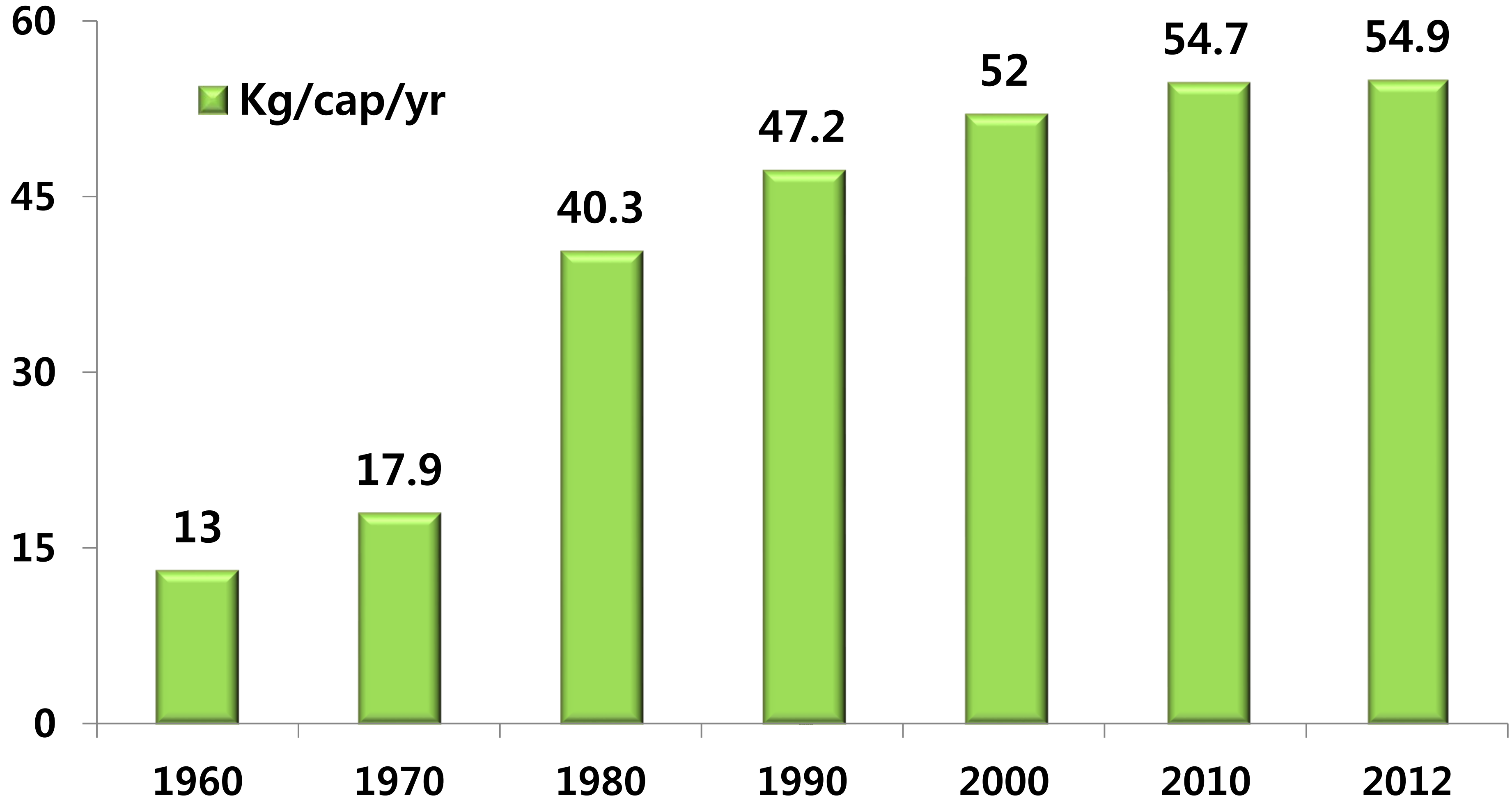
FAO 2014

Annual Seafood Consumption



FAO 2014

Trend in per capita seafood consumption in Korea



Source: KREI 2013

Seafood: Safer Human Food

Red Meat

- L – carnitine-> Trimethylamine-N-oxide in blood accelerates clogging of artery wall
- Heme Fe reported to damage cell and cause cloaca cancer
- Consumption cause obesity
- Frequent use of Growth hormones

White Meat

- 10 times lower L-carnitine
- Omega 3 FA prevent cancer
- Lowering triglyceride in blood
- Quality meat via feed hygiene

Reference: Journal of Nature Medicine

Nutrients Profile

Per 100g meat

Nutrients	Olive flounder	Beef
Protein (g)	18	23.2
Fat (g)	0.54	2.8
Polyunsaturated Fat (g)	3.5 (Muscle)	0.448
Vitamin E (mg)	1.65	0.63

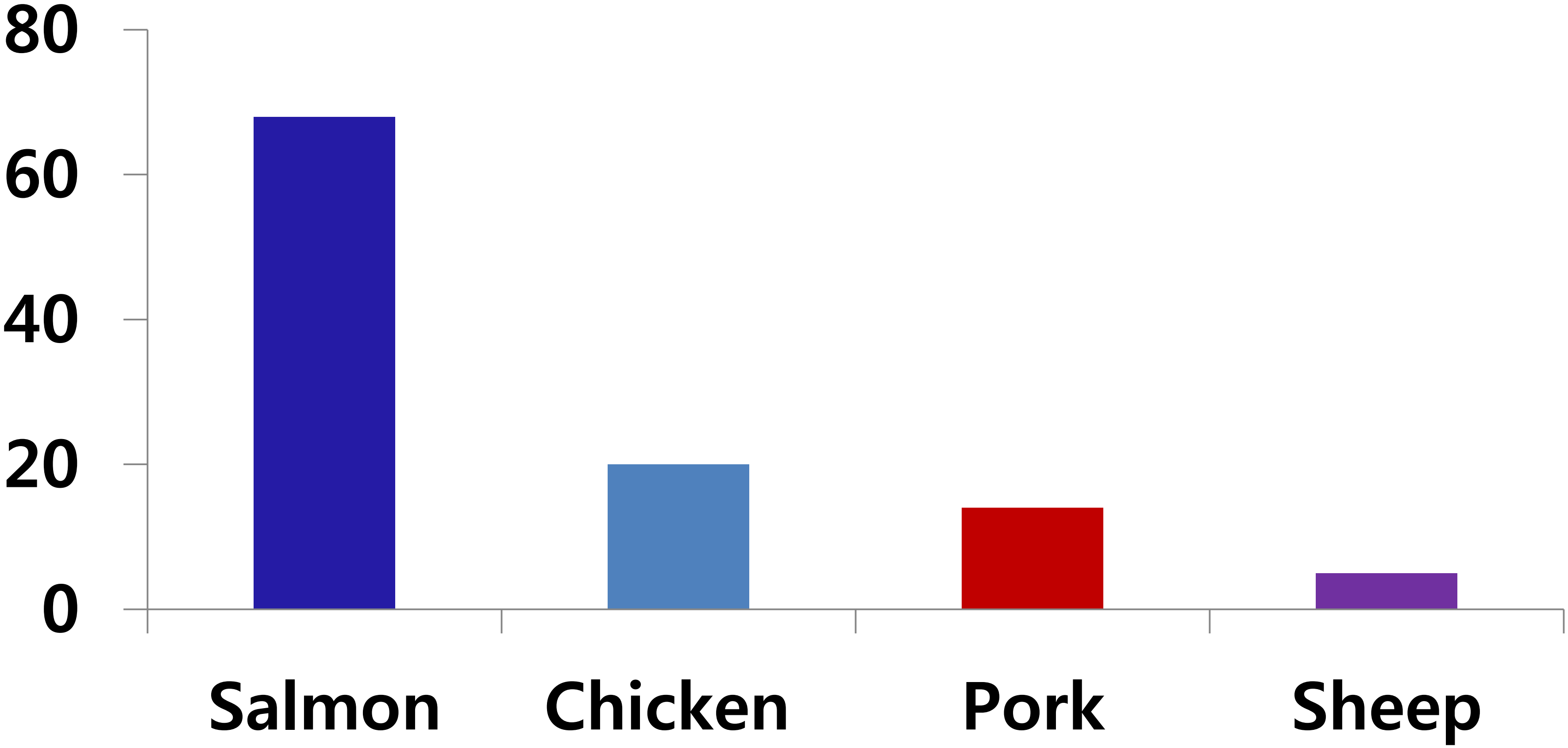
Source: Olive flounder data analyzed at FFNRC; Beef data, Williams 2007

Seafood: Healthy Human Food

- **American Heart Association recommend fish at least twice a week.**
- **Plant omega-3s (ALA) is converted to EPA & DHA in the limited amount**
- **Exclusive source of n-3 fatty acids**
- **Vitamin B-12 (3 ounce chicken breast 0.3 µg *vs 5* µg Salmon)**
- **Rich source of vitamin A, D & E**

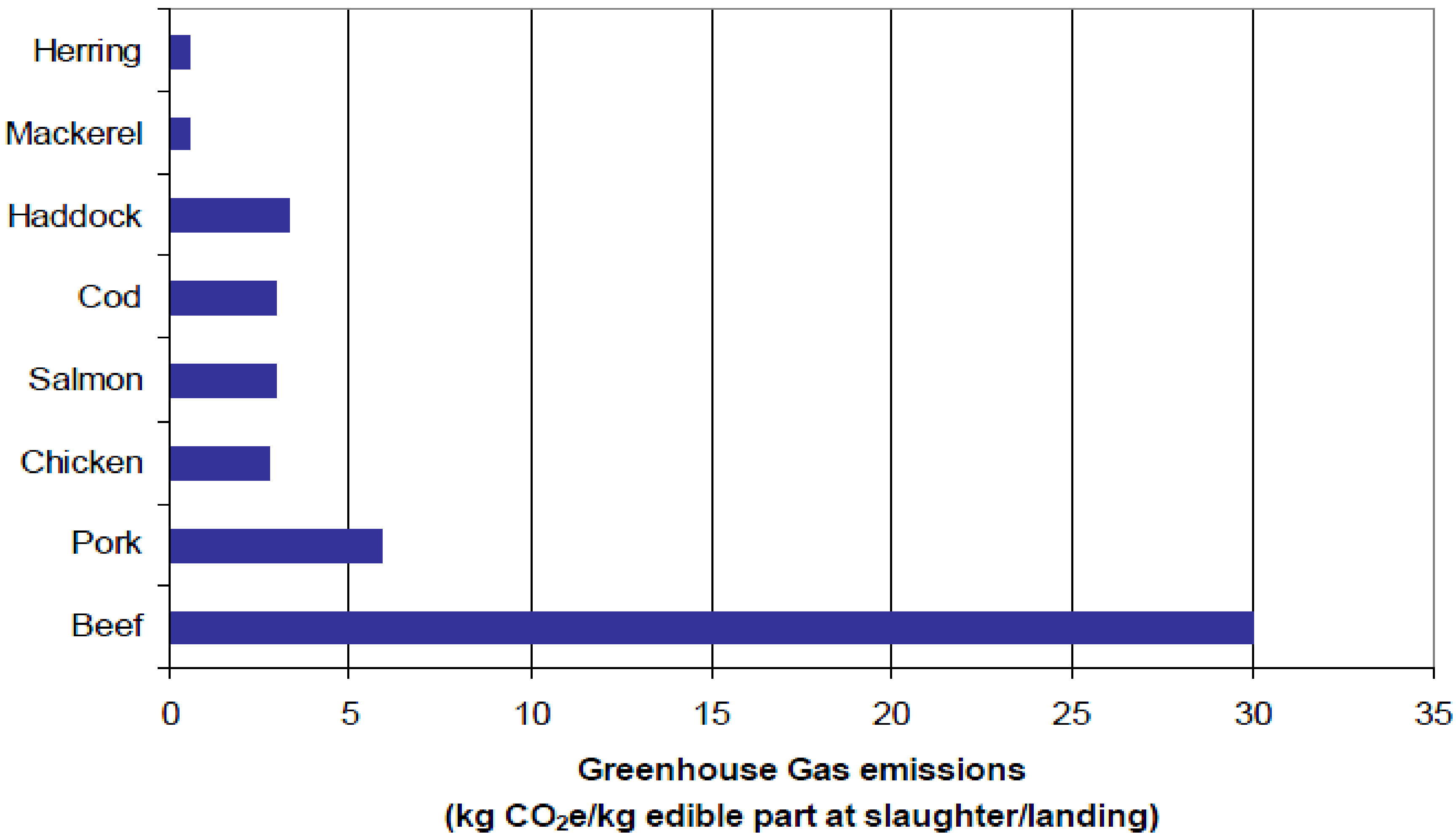
Source: Hravard school of public health

Edible Farmed Meat prod. by 100 kg grain



Source: BIOMAR 2012

Aquaculture & Greenhouse Gas emission issue



Aquaculture 272 (2007) 399-416

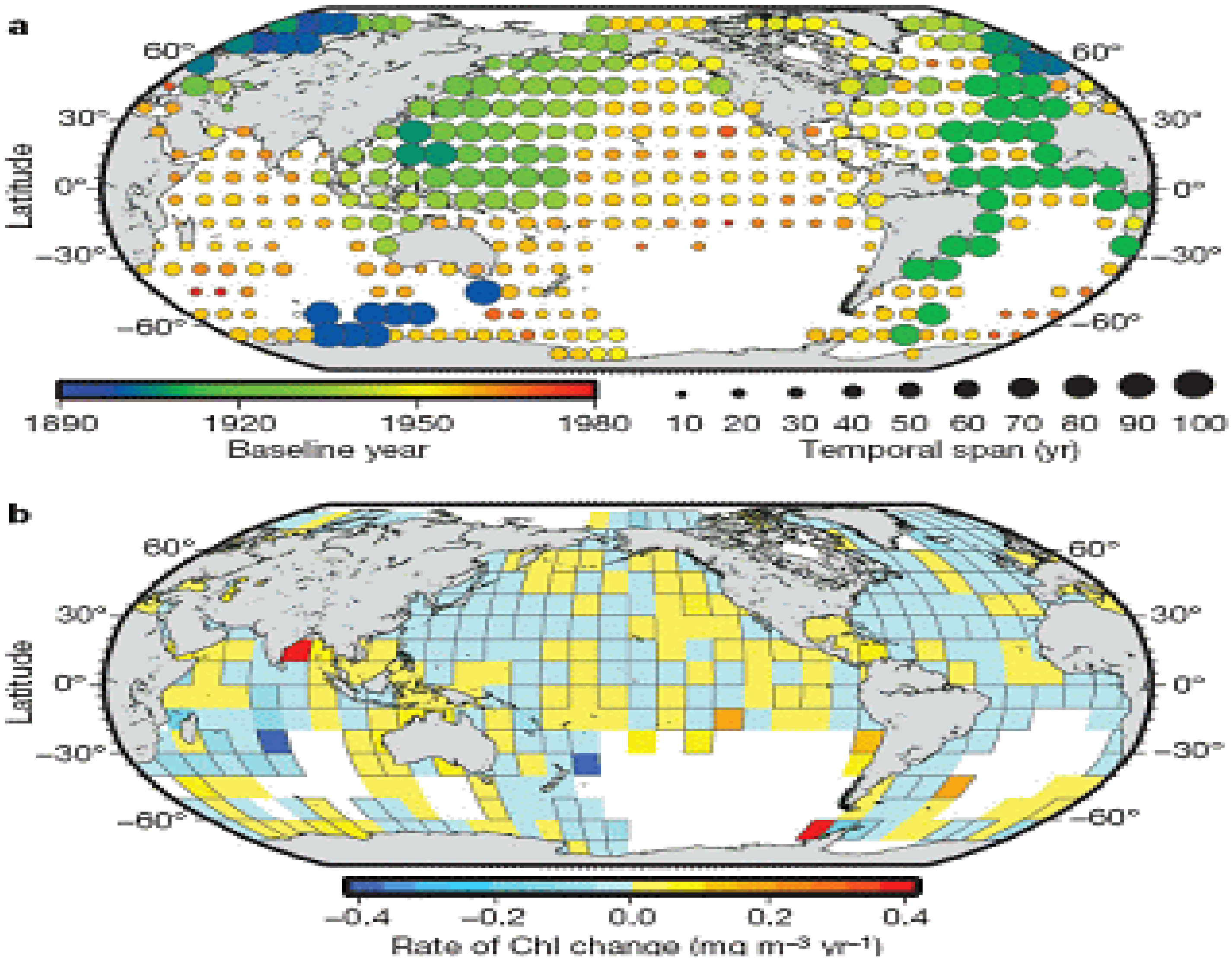
Climate Change and Aquaculture

- Average global temperature has **risen about 0.8°C** in the last two centuries with almost two-thirds of that warming having occurred in just the last 50 years

- Some scientists predict that global temperature will be increased **from 1.8°C to 6.4°C** during the 21st century

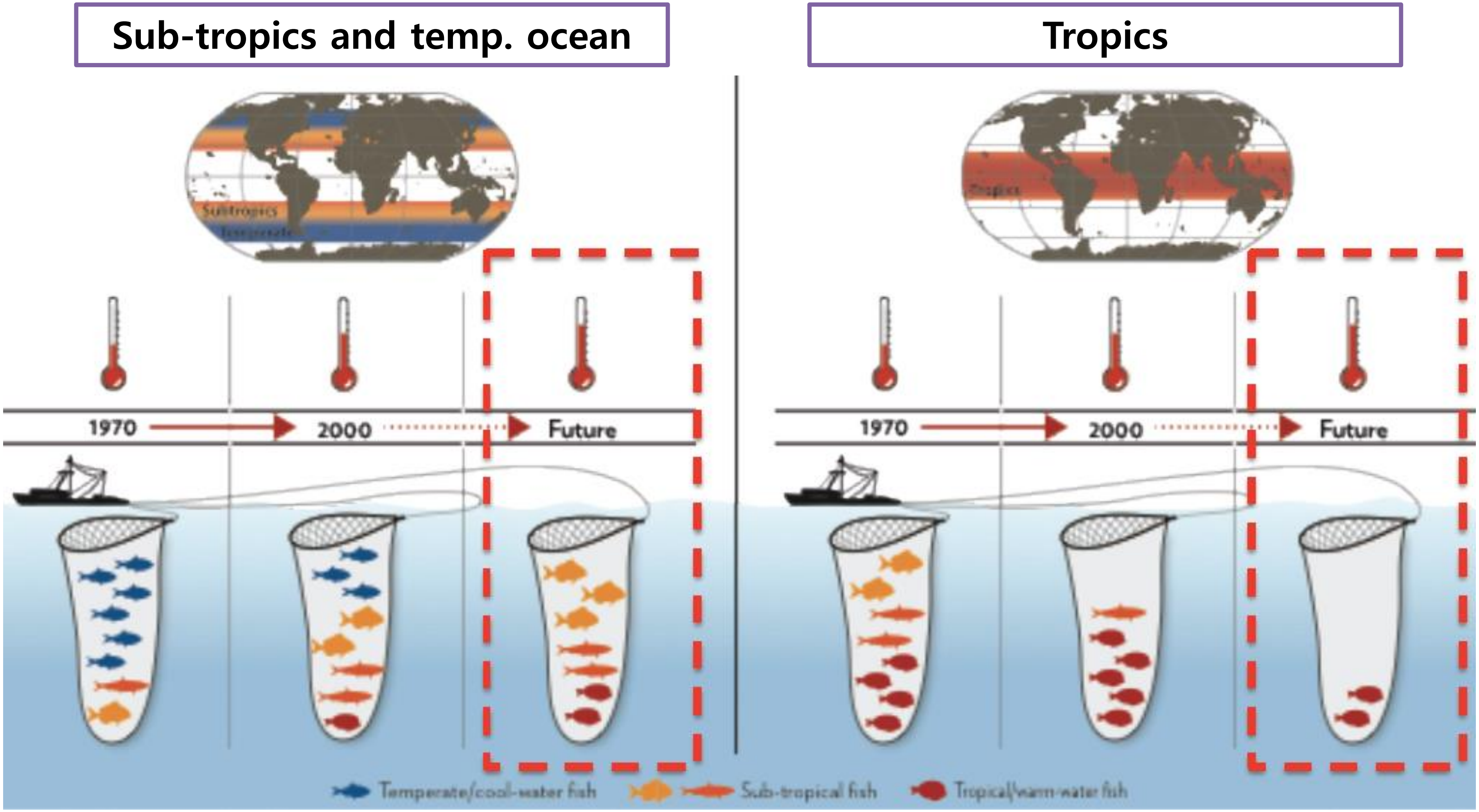
Barry Brook. 2010 "The Global Warming Art Project" Bravenewclimate

Global phytoplankton decline over the past century



Phytoplankton decline (Nature, 2010)

Hypothesis of changes in catch composition

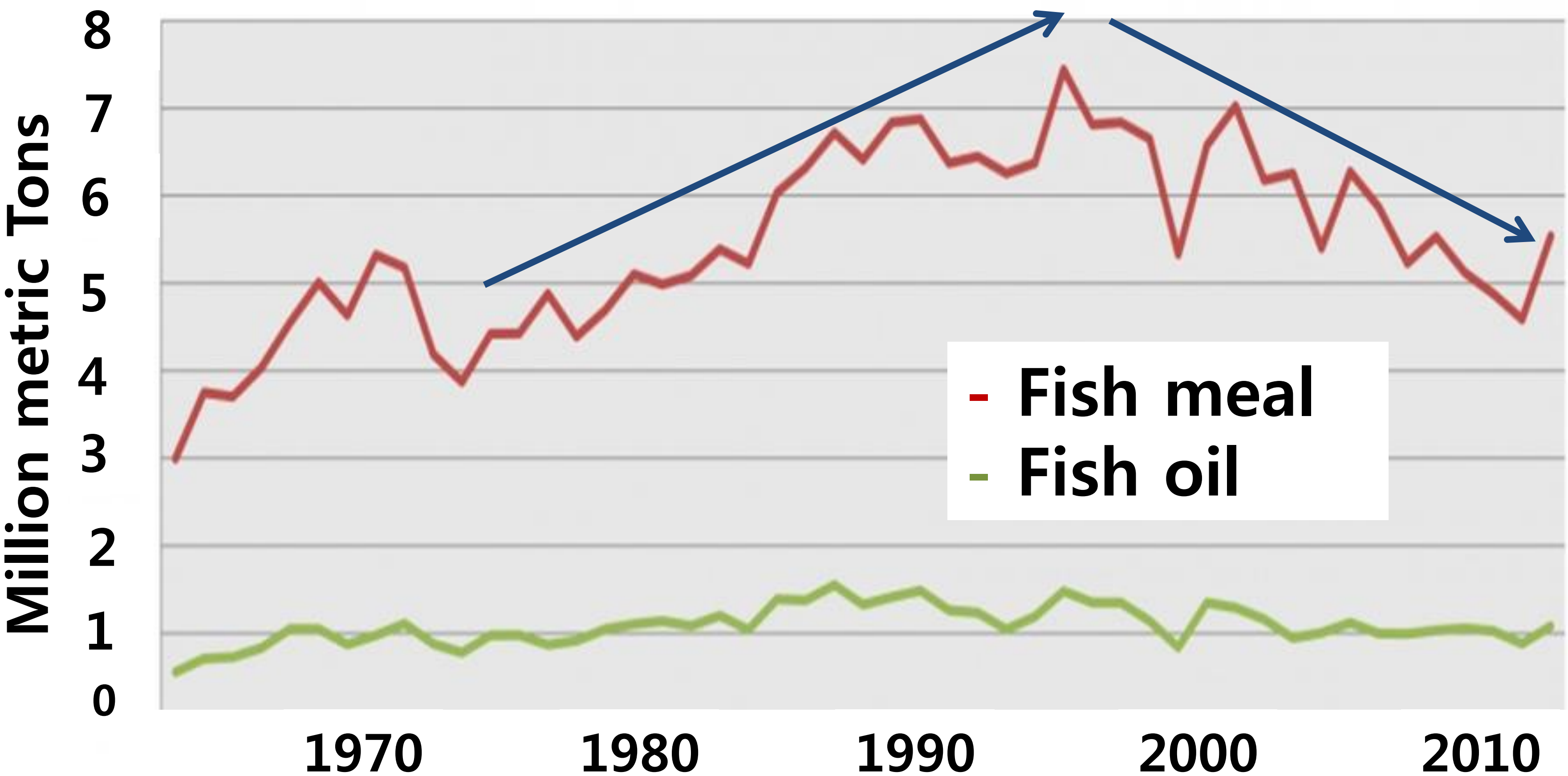


Cheung et al. 2013, Nature

Aquafeeds & Aquaculture

- Parallel growth in aquafeed production as the driving force
- Feeds account for 60~70% of total operational cost in any aquaculture venture
- Opt. feeds & feeding regime play a central role
- Confounded by a broad spectrum of challenges
- Sustainable dev. of aquaculture will depend on the sustainability of aquafeed (Bai, 1997)

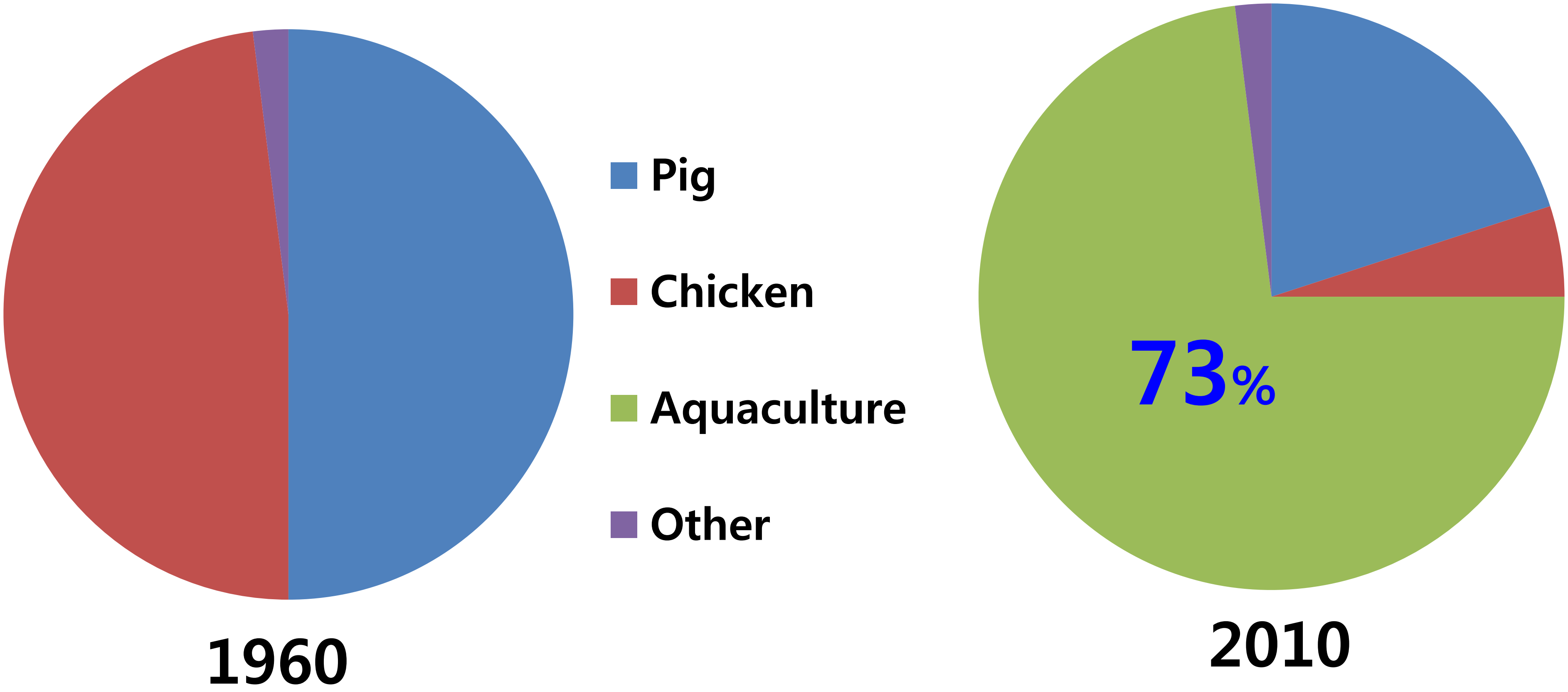
Fish meal & Fish oil Production Trend



Source: IFFO

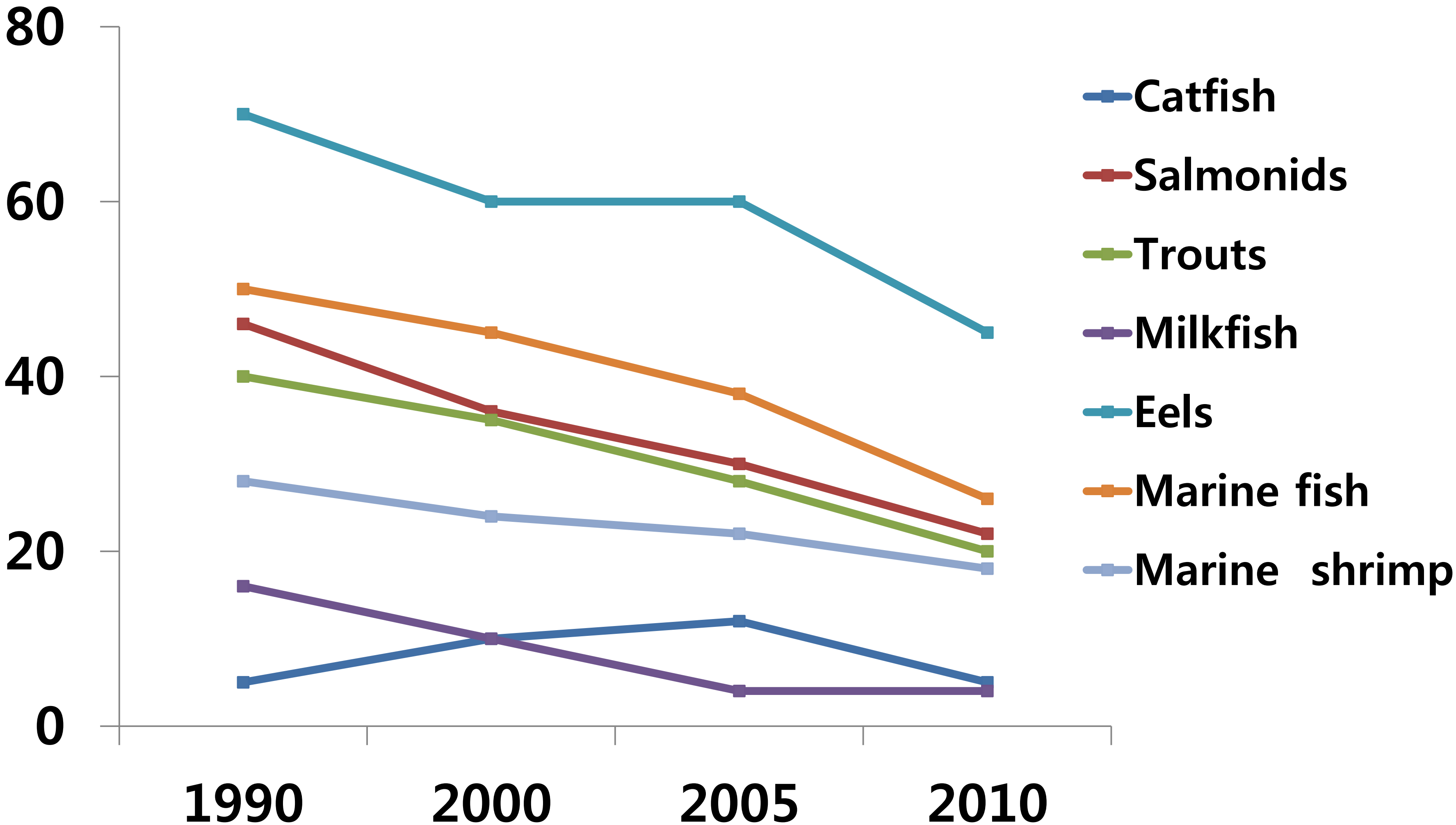
Fish meal Trap

: Formidable Issue



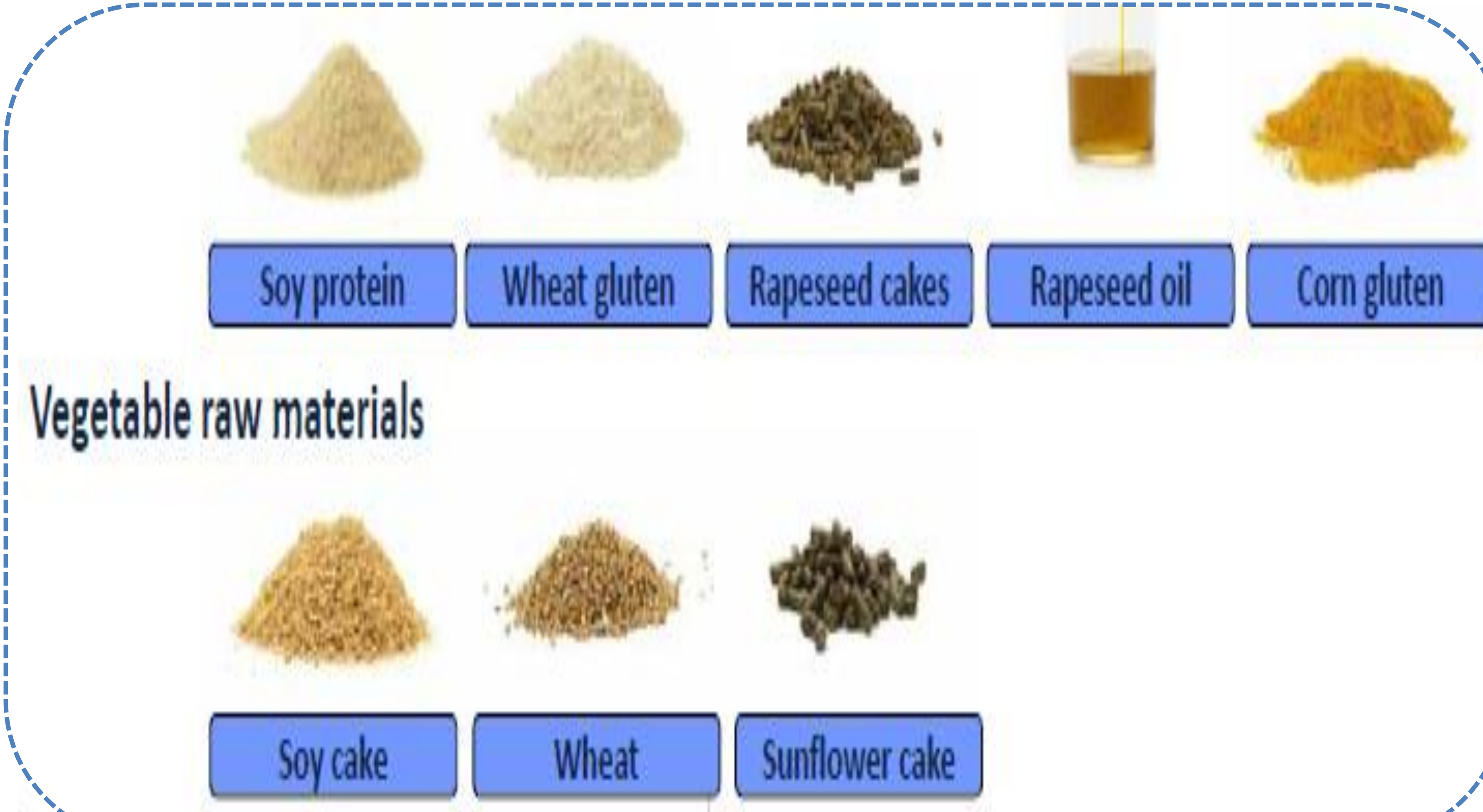
Source: IFFO 2012

Fish meal Level in Fish Diet (%)



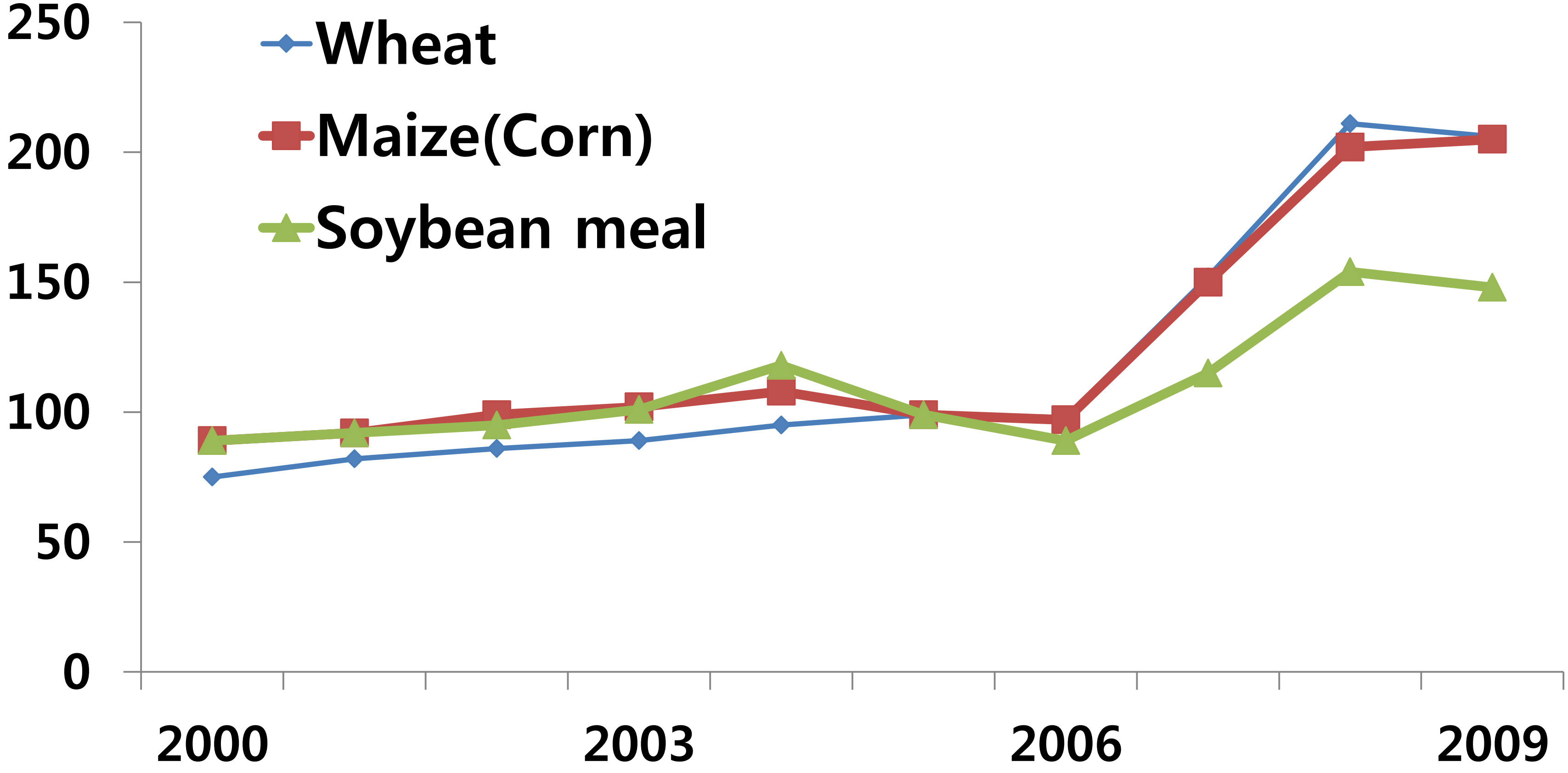
Source: IFFO 2011

Alternative Plant base Feed Ingredients to Replace Fish meal



Adopted from Tacon, 2013

Price (USD/ton): Fish meal alternatives



Source: Adopted from FAO 2010

Underutilized crops in Fish Feeds
: Unexplored alternatives

- *Canarium odontophyllum* (Dabai), *Anona muricata* (Soursop), *Phyllanthus acidus* (Cermai), and many others have been reported to have promising nutrient profile
- Limited and scattered knowledge

Space under oil palm
50, 000 ha

Space below pylons
80, 000 ha

Underutilized Crops:
Roots of the Future

- Information exchange and Tech. transfer
- Strategic framework to explore the unexplored plant alternative
- Promising area of research for sustainable aquafeed and aquaculture
- Diversified and flexible utilization
- Extension and demonstration

CFFRC & FFNRC collaboration


Thank you !
Thank You
C U @ WA 2015 Jeju
May 26-30, 2015, Jeju ICC, Jeju, Rep. of Korea


Food Security – meeting Nutritional Needs
"Alternative food sources for aquaculture"
Dr George M Hall
Senior Research Fellow
Centre for Sustainable Development
University of Central Lancashire, UK

Our by-words

- **QUALITY**
- **SAFETY**
- **SUSTAINABILITY**
- **SOCIAL RESPONSIBILITY**

World Capture & Aquaculture Production

	2006	2007	2008	2009	2010	2011
Capture	90.0	90.3	89.7	89.6	88.6	90.4
Aquaculture	47.3	49.9	52.9	55.7	59.9	63.6
Total	137.3	140.2	142.6	145.3	148.5	154.0
DHC	114.3	117.3	119.7	123.6	128.3	130.8
NFU	23.0	23.0	22.9	21.8	20.2	23.2
Per capita (kg)	17.4	17.6	17.8	18.1	18.6	18.8

Source: FAO 2012

Production: million tonnes
Per capita: food fish supply
DHC: Direct Human Consumption
NFU: Non-Food Use

Top ten World Aquaculture producers 2010

Source: FAO 2012

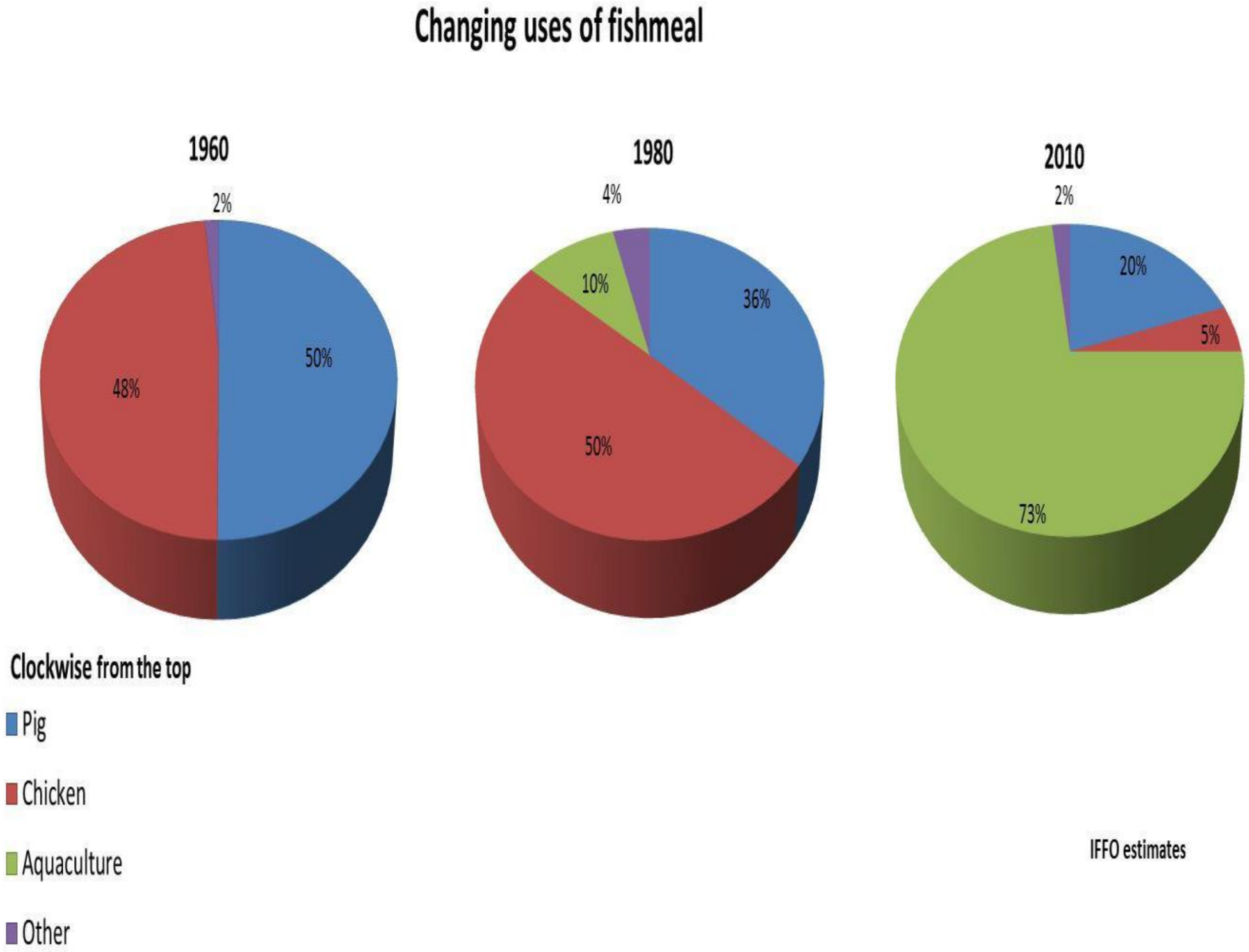
Country	Tonnes (million)	Percentage
China	36.73	61.4
India	4.65	7.8
Vietnam	2.67	4.5
Indonesia	2.30	3.9
Bangladesh	1.30	2.2
Thailand	1.29	2.1
Norway	1.01	1.7
Egypt	0.92	1.5
Myanmar	0.85	1.4
Philippines	0.75	1.2
Other	7.40	12.3
Total	59.87	100

Production by Culture Environment

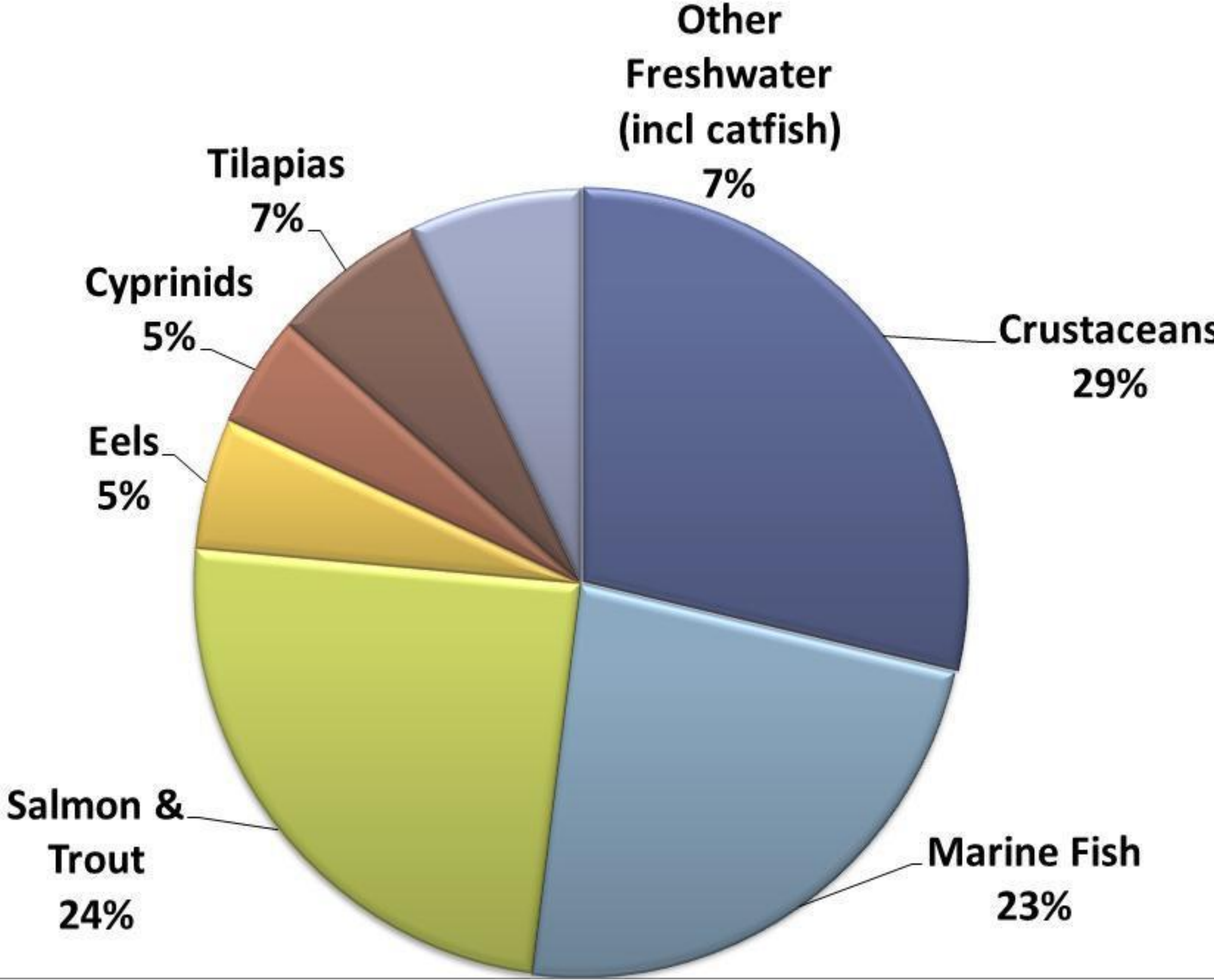
Source: FAO 2012

Parameter	Freshwater	Brackish water	Marine water
Production (million tonne)	36.9	4.7	18.3
Production %	62	8	30
Value %	58	13	29
Dominant types	Finfish (92%)	Crustaceans (57%)	Molluscs (76%)
Important species	Carp *spp*, Pangasius (catfish)	White leg shrimp, Giant tiger prawn, milkfish, tilapia	Oysters, mussels, clams, salmon

Fishmeal use 1960 - 2010



Use of Fishmeal in Aquaculture 2010



Non-Fed Aquaculture

- **Non-Fed:** 33% (20 mill tonne)

  molluscs: natural in culture medium

  filter feeding carps: plankton by fertilisation & residues from polyculture systems
- **Food security**: helped by such low trophic level species

Feed –based aquaculture

- **Feed-based:** 60% (32 mill tonne) by farm-made or industrially-made aquafeed & increasing in practice

    omnivores (tilapia, catfish, carps, milkfish)

    carnivores (salmon, sea bass)

    crustaceans (shrimps, prawns)

Farm-made and raw fish feed difficult to estimate but important

Practice of 'fed' omnivores demands more fishmeal

The "Fishmeal Trap"

- Reduce Inclusion Level
- Salmon (45 to 12% by 2020)
- Marine fish (50 to 12% by 2020)
- Crustaceans (27 to 8% by 2020)
- Increase the use of fisheries by-products (capture & aquaculture) in fishmeal: about 25% currently
- Increase the use of plant-based aqua feeds in appropriate diets

Plant proteins used for Aquaculture

Plant protein	Inclusion level in Aqua feed (%)
Soybean meal	3-60
Wheat gluten meal	2-13
Maize gluten meal	2-40
Cottonseed meal	1-25
Lupin kernel meal	5-30
Canola protein concentrate	10-15
Groundnut meal	c. 30
Mustard oil cake	c. 10

Source: FAO 2012

Anti-nutritionals in PBAF

Plant	NSP	Oligo's	Anti-Metabolites	Antigens	Protease inhibitor	Lectins	Oestrogens	Phytic acid	EAA (lacking)	Saponins
Soya	¬ 20%	Raffinose Stachyose	e.g. lipoxygenases	e.g. to proteins	X	X	X	X	Lys, Thr Met	X
Barley									Lys Arg	
Canola			Glucosinolates Erucic acid					X		
Maize			Pigments (xanthophylls)						Lys	
Cottonseed			gossypol							
Peas/lupins		Stachyose Alpha-Galactosides	Alkaloids (heat stable)						Lys Met	
Wheat									Lys	

NSP = non starch polysaccharides; oligo's = oligosacharides;
EAA = essential amino acids for fish

From: Gatlin *et al*, 2007, Aquaculture Res, 38, 551-579

Criteria for PBAF

- No new land for cultivation – marginal land use
- No competition with crops for DHC
- Competition from crops for livestock and for biofuels (currently)
- Processability - simple processes & equipment farm-based - for multiple products & nutritional improvement

Recommendations for Aquafeed Selection

Source: Tacon, Hasan & Metian, 2011

- Reduce dependence on imports
- Select ingredients which can be supplied sustainability & low environmental impact
- Reduce the environmental impact of the aquaculture system by high nutrient density and digestibility (wider issues e.g. energy)
- Support small-scale farming systems and farm-made aquafeeds – not raw trash fish?
- Maintain quality and safety of aquafeeds

The Asian Perspective

- Low trophic species - herbivores & omnivores to be encouraged
- Culture environment – fresh, brackish, salt water
- Fed or Non-fed systems (low, moderate, high intensity)
- Local technology e.g. fish fermentations and appropriate crops

Fish Oil in Aquafeeds

Species	% (total usage)
Salmon	36.6
Marine fish	24.7
Trout	16.9
Marine shrimp	12.9
Fed carp, tilapia, catfish	0

Source: FAO 2012

Fish oil usage set to double by 2020 (to 908,000 tonnes) c.f. 2007.
Due to increased marine fish and crustacean production and lack of alternative sources of EPA (C20:5) and DHA (C22:6) fatty acids.
Increased use of fish oils for DHC.

Our by-words

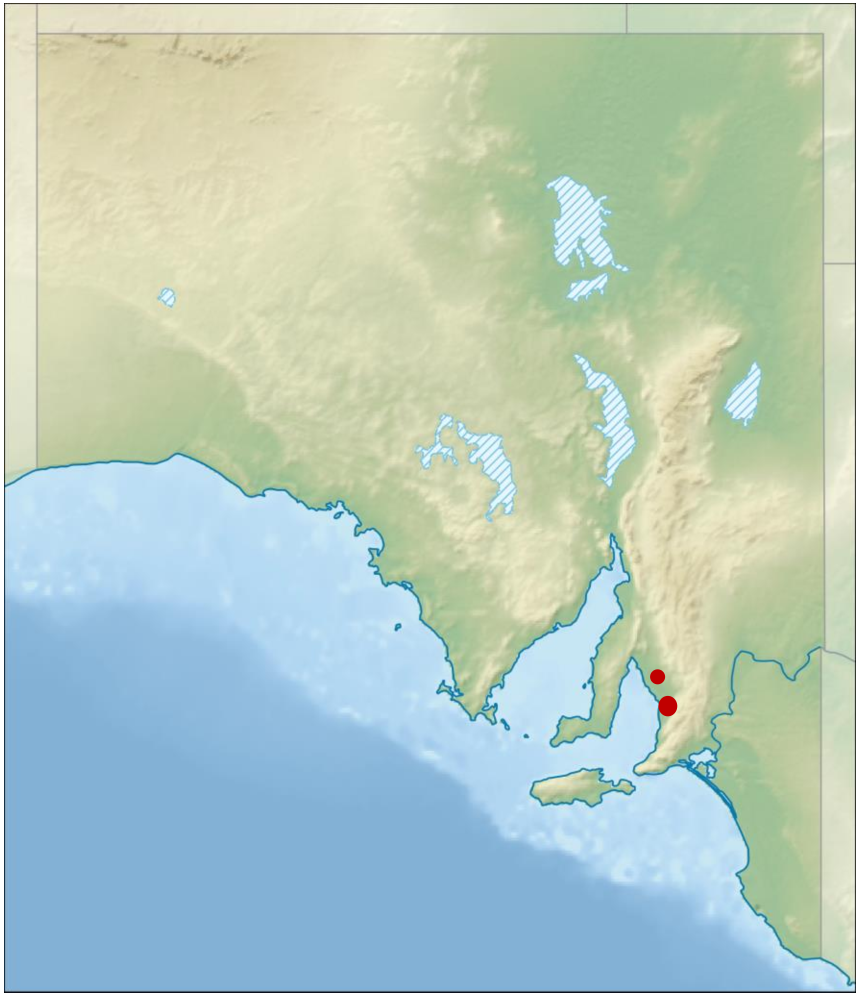
- **QUALITY**
- **SAFETY**
- **SUSTAINABILITY**
- **SOCIAL RESPONSIBILITY**

Global Food Security Conference, Kuala Lumpur, 7-8 July 2014

Strategies for improved Animal Production. Research at Roseworthy.

Prof Kym Abbott

Roseworthy campus



School of Animal & Veterinary Sciences

Research at Roseworthy

Improving Animal Production

- Beef and dairy cattle
- Sheep
- Poultry
- Pigs

Cattle industry research

- Professor Phil Hynd
- Professor Peter Cockcroft
- Professor Michael Reichel
- Professor Stefan Hiendleder
- Associate Prof Darren Trott
- Associate Prof Wayne Pitchford
- Associate Prof Cindy Bottema
- Dr Karen Kind
- Links with SARDI in Ruminant Production alliance

Improving disease detection by using colostrum samples in enzyme-linked immuno-sorbent assay tests

Professor Peter Cockcroft

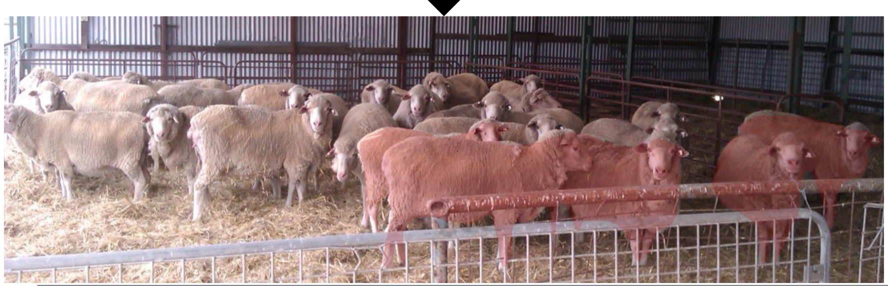
Professor Michael Riechel

Ms Caitlin Jenvey

26 sheep vaccinated against Johne's disease

Blood sample

Colostrum sample



5/26 tested positive

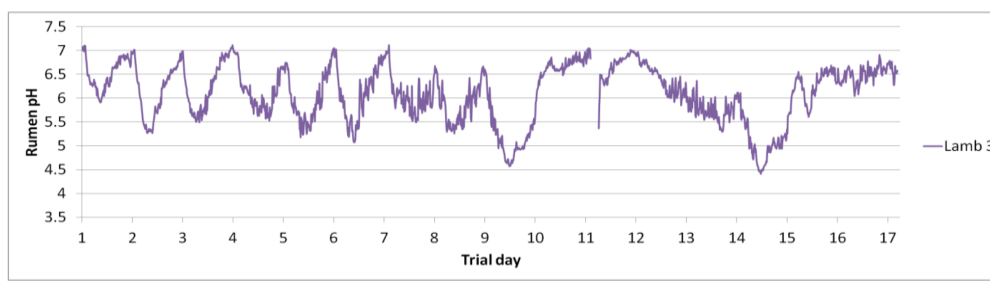
20/26 tested positive

Professor Peter Cockcroft

Professor Phil Hynd

Mr Joshua Fanning

The relative importance of rumen fluid and rumen epithelium adaptations in the transitional sheep

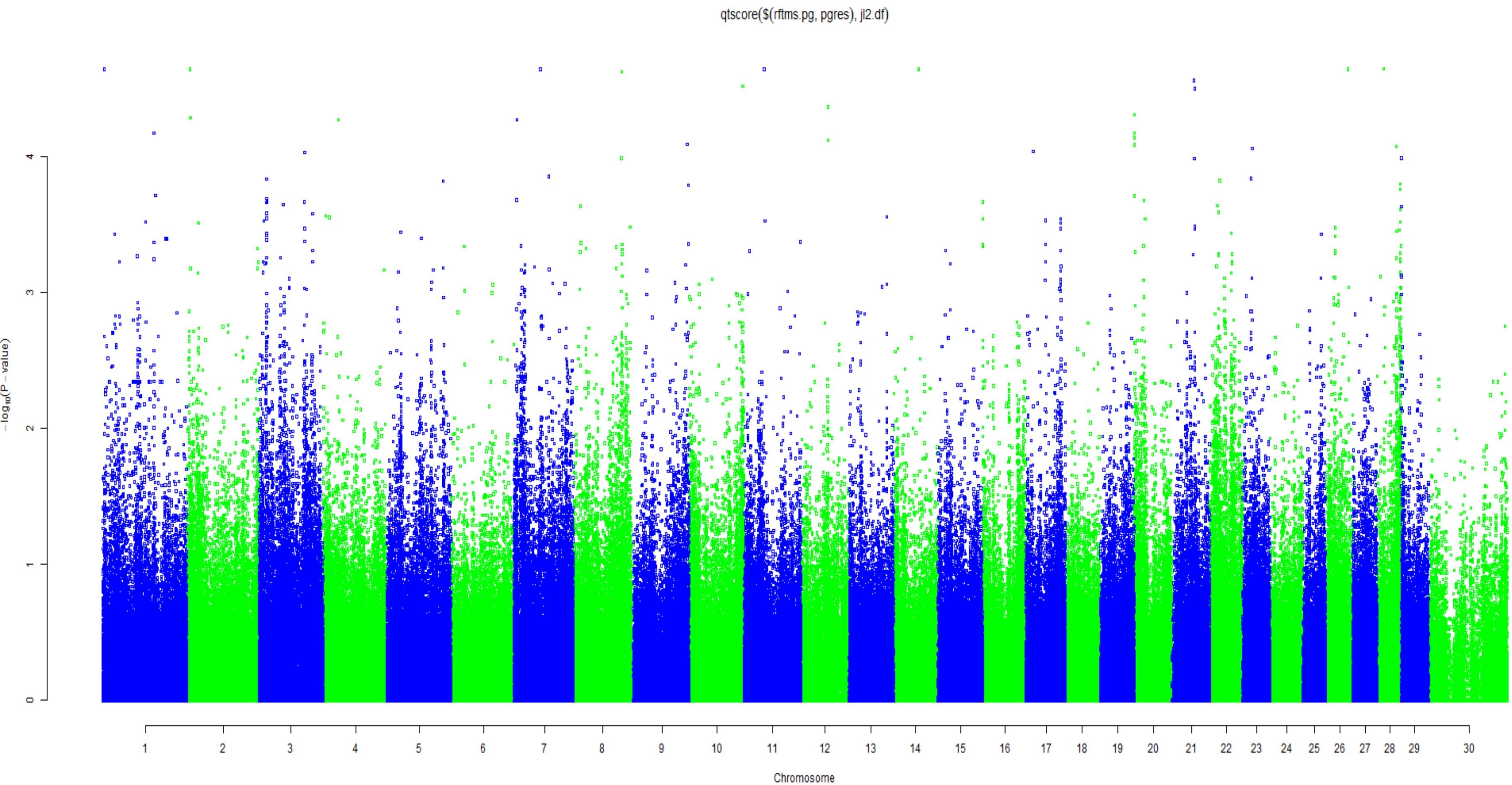


Beef cattle CRC

Assoc Prof Wayne Pitchford

Selecting for reduced feed intake

Mapping genes for feed intake

Working with feedlots to improve efficiency and meat quality

	High Efficiency	Low Efficiency
Start wt, kg	435	432
Slaughter wt, kg	714	701
Carcass wt, kg	417	406
Dressing %	58.5	58.0
Marbling score	3.0	3.0
Rib fat depth, mm	16	21

CONCLUSIONS

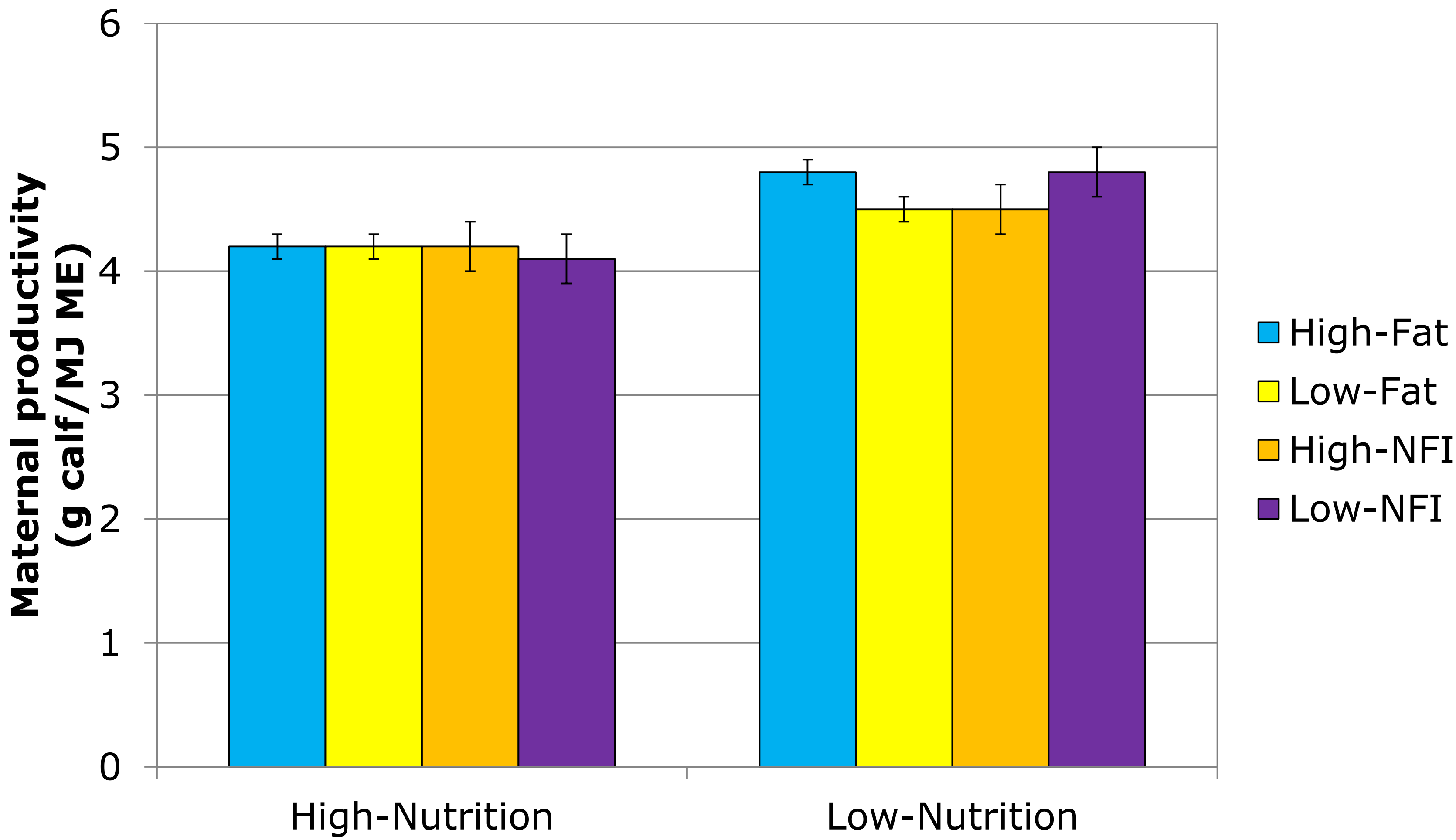
The study demonstrated that genetic superiority for RFI had a favourable impact on the performance of Angus steers in a commercial feedlot, by reducing the amount of feed consumed with no adverse effect on final turn off weight.

High efficiency steers consumed 2.60 t of feed per head compared to 2.87 t by their Low efficiency contemporaries.

High efficiency steers finished with a higher dressing percentage, less subcutaneous fat, and similar level of marbling fat relative to their Low efficiency counterparts

Improved pasture management and cow productivity

Maternal productivity



Partnering to improve international livestock production

Food safety, public health

Prof Michael P Reichel

Projects

Food safety and production, Indonesia

- Mr Widi Nugrohu

BVD (pestivirus)

- Ms Sasha R Lanyon, BSc (Hon)
- Ms Caitlin A Evans, BSc (Hon)
- Ms Caitlin Jenvey, BSc (Hon)

Neospora caninum, Pakistan, Argentina, NZ

Poultry industry research

Dr Kapil Chousalkar
Dr Farhid Hemmatzadeh
Professor Phil Hynd
Dr Rebecca Forder
Links to SARDI through the Southern Star Poultry Alliance

Strengthening food security and safety in poultry industry
(Dr Kapil Chousalkar)

With over a billion people going to bed hungry every night, in future world will need to produce as much food as we have consumed in the last 500 years (CSIRO, 2011). At the same time, we also need to ensure that the food produced is safe for human consumption. Poultry industry can make an increasing contribution to sustainable food security being a major animal protein source.

Dr Phil Glatz Project Leader, SARDI
Dr Workneh Ayleu Scientist and Director, NARI, *PNG*
Ms Janet Pandi PhD student

- Use of local feed resources in the Pacific for feeding village and commercial poultry

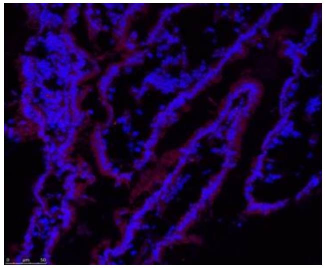
Rising feed prices for inclusion in livestock feed remains a significant problem in developing countries. Imported feed grains can be replaced with locally available alternatives. This project is being conducted in Papua New Guinea (PNG). Local sweet potato varieties are being tested as an available alternative for village, semi commercial and commercial poultry in PNG to increase income and reduce poverty.

Funding

Australian Council for International Agricultural Research (ACIAR)

Food safety in the poultry industry (Dr Kapil Chousalkar)

Dr Andrea McWhorter Post doctoral Fellow
Dr Vaibhav Gole Post doctoral Fellow
Mr Vivek Pande PhD student
Mr Pardeep Sharma PhD student
Ms Rebecca Devon PhD student



- Epidemiology of *Salmonella* spp in the poultry industry and monitoring the antibiotic resistance and virulence.

  This work largely involves longitudinal or point in time surveys of poultry farms (cage and free range), monitoring antibiotic resistance and virulence typing for developing risk matrices.

- Identify the intervention strategies to control *Salmonella* on farm and in supply chain.

  This work involves controlled and field experiments for strategic use of prebiotics and probiotics for Salmonella control in egg industry.

- Offer cost effective *Salmonella* diagnostic services

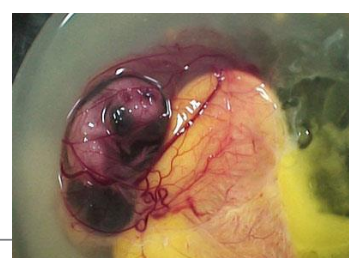
  Design and optimisation of rapid and cost effective *Salmonella* diagnostics for discrimination of poultry industry relevant *Salmonella* serovars.

- Training of egg producers and health department officials for safe food handling practises

Funding -
Poultry CRC & Australian Egg Corporation Ltd

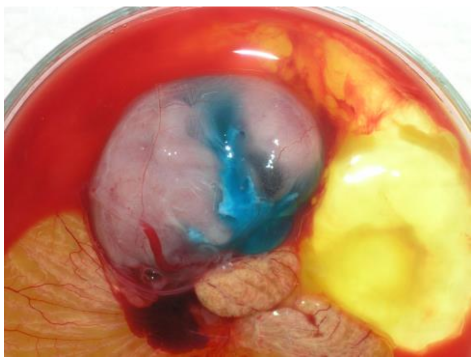
Foetal programming *in ovo* to improve the health, growth and efficiency of broiler chickens

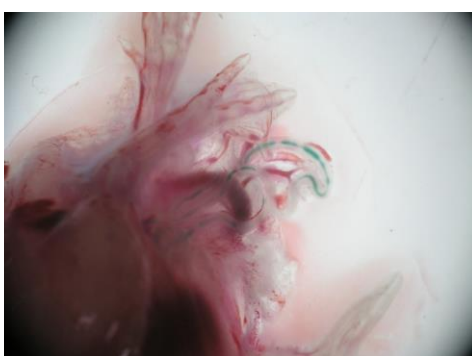
Phil Hynd (Project Leader)
Bob Hughes (Senior Research Scientist)
Rebecca Forder (Nutritional Physiology)
Nicole Heberle (Research scientist)
Natasha Edwards (Research Scientist)
Sarah Weaver (PhD student)
Mandy Bowling (PhD student)

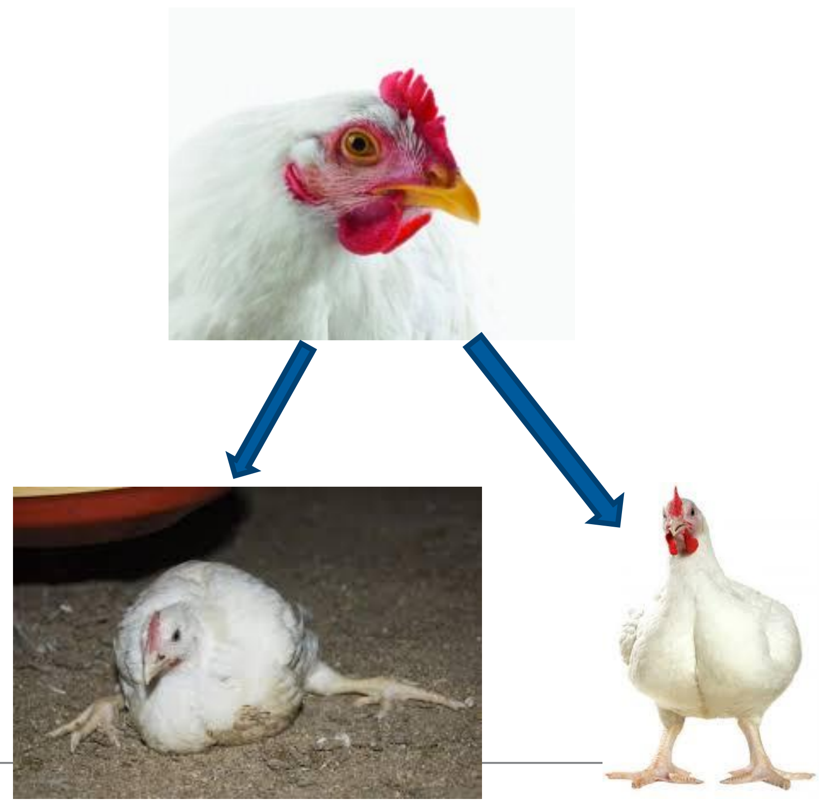


Manipulation of the foetal environment *in ovo*

1. *In ovo* injection
2. Manipulate the breeder hen diet to alter the *in ovo* environment







Pork industry research

Dr Will van Wettere
Associate Prof Roy Kirkwood
Links with SARDI through the Southern Pork Alliance

Towards optimising productivity and welfare of the breeding herd

Dr Will van Wettere
Dr Karen Kind
Ms Robyn Terry
Ms Alice Weaver
Ms Brooke Dearlove
Ms Patricia Condous
Ms Emma Greenwood
Mr Anthony Martynuik
Ms Nicole Cruickshank
Ms Lauren Staveley

Stimulating sows to ovulate during lactation

Reasons:

- Weaning would no longer be necessary for reproductive activity to resume
  - Enabling piglets to be weaned at the best age for them
  - Resulting in no negative impact on reproductive efficiency

Methods and Results

- Daily contact with a mature boar has proven effective
  - 70 – 80% of sows ovulated during lactation, and conceiving when mating (commercial and ‘research’ trials)

Improving piglet viability and survival at birth

Reasons:

- High incidences of early piglet mortality are caused by
  - Pre-natal growth restriction
  - Low viability at birth due to conditions in utero
  - Oxygen deprivation during the birthing process

- Current research to alleviate the problem
  - Dietary supplements for the sow during the last 5 days of gestation to
    - Protect the neonatal brain from the impact of oxygen deprivation
    - Increase neonatal viability (ability to cope with extra-uterine conditions)

  - Dietary manipulation during days 20 to 50 of gestation to improve nutrient supply to the developing conceptuses

Improved reproductive performance

Assoc Prof Roy Kirkwood

Dr Pieter Langendijk

Ms Nutthee Am-in*

Ms Wichai Tantasuparuk*

Dr Robert Friendship**

- Seasonal infertility and sow longevity are problems globally. We are examining:
  - hormone treatments to help maintain pregnancy
  - gilt introduction management
  - effects of litter size suckled in parity 1 on litter performance in parity 2
  - effects of mixing management on sow fertility

Improving piglet health

Assoc Prof Roy Kirkwood

Dr Sam Abraham

Assoc Prof Darren Trott

- Neonatal piglets have relatively poor enteric defences
  - We are examining effects of reducing gastric pH on enteric colonisation patterns and piglet health
  - Antibiotic resistance is a growing global concern. We are looking effects of antibiotics on enteric microbiota population structure and at ways to counter antibiotic resistance
- Piglets weaned from young sows can destabilise nursery health
  - We are attempting to make these piglets microbiologically more like piglets from older sows

THE UNIVERSITY *of* ADELAIDE

entofood
A NEW SOURCE OF FEED

Insects : a sustainable development model for food/feed security

Mr Franck Ducharne

BIOTECHCORP
BIONEXUS STATUS COMPANY

BUSINESS MODEL

PROTEIN & FAT FOR FOOD SECURITY THROUGH ORGANIC SIDE STREAM RECYCLING

STAKES

DEVELOP SUSTAINABLE SOLUTIONS TO FEED THE GROWING POPULATION

PROTEIN DEMAND

70% urbain

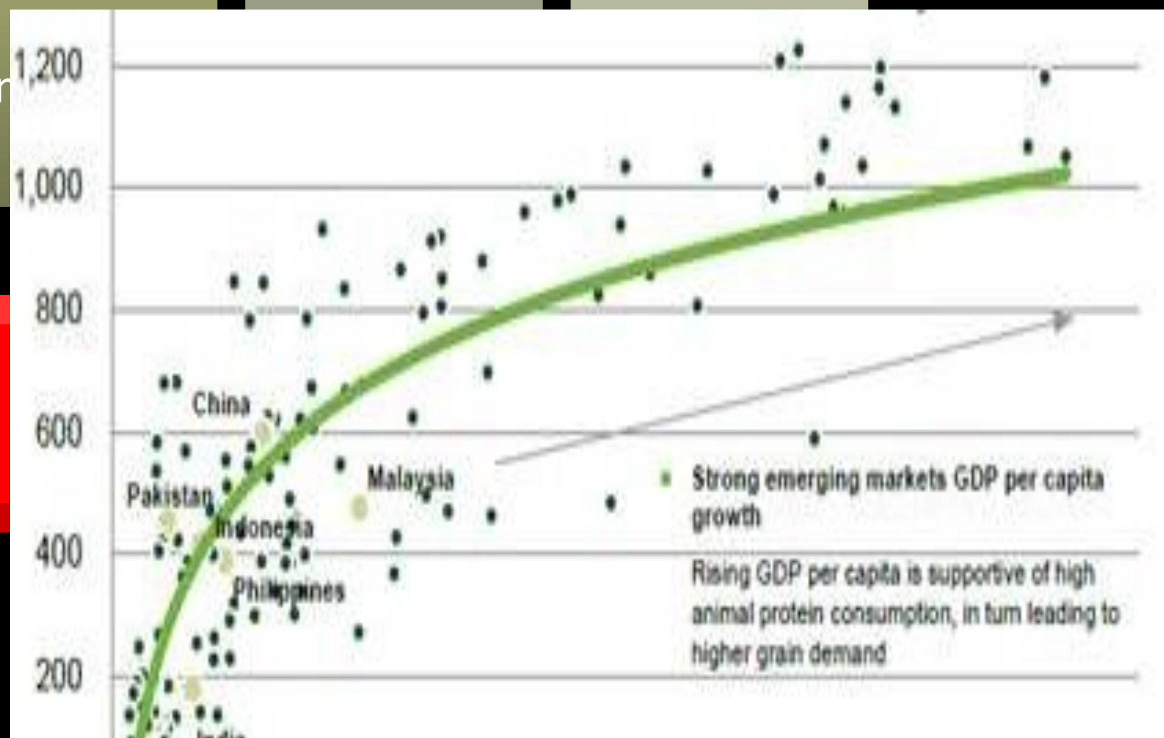
Urbanization

9.10^9 2050

Den

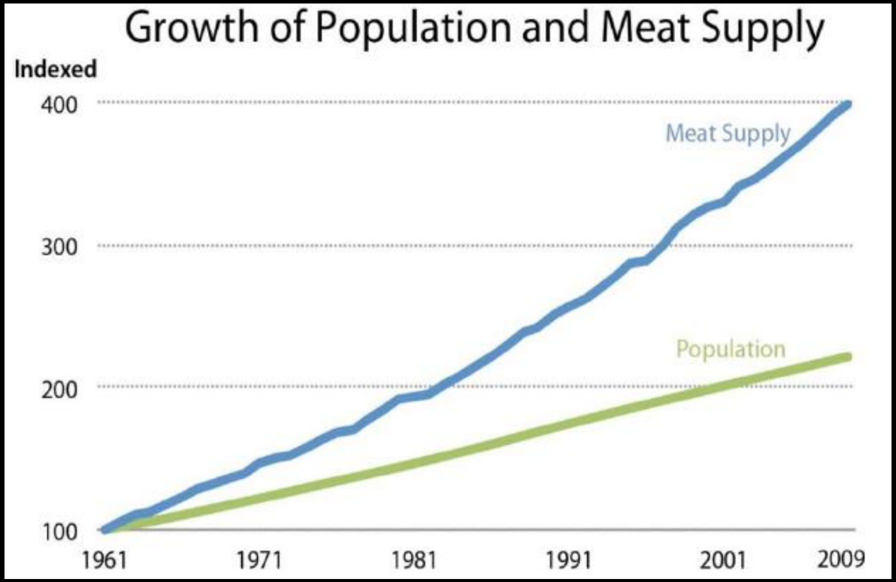
Food

+70 %



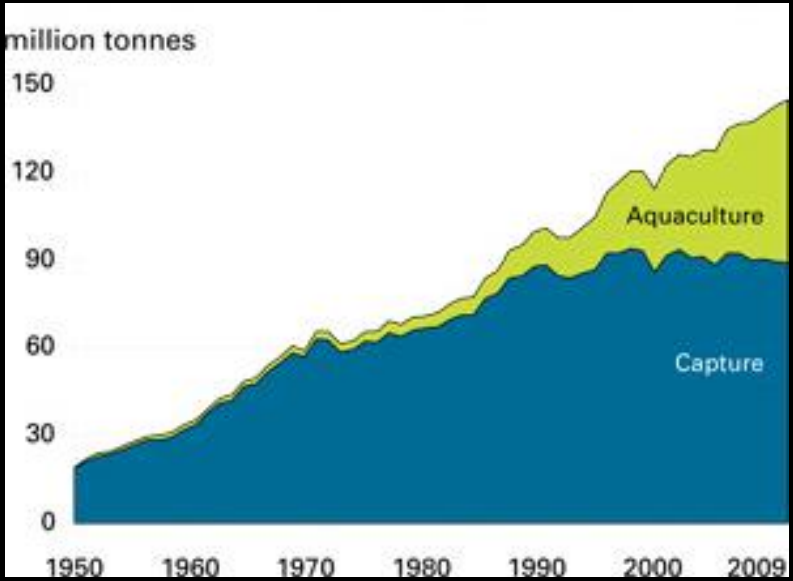
PROTEIN : SUPPLY

MEAT



Index 1961 = 100 (FAO, UN)

SEAFOOD



SEAFOOD

2012: 17 kg/hab./y= 120 M T

2050: w/out evolution = 150 M T

Feed industry's requirements

Today

- $^{1}/_{3}$ cereal production
- 400 M T oilseed cake
- 20-30% sea catches

Further growth

- From fisheries: 0
- From crops=

  Increase production
  - Surface
  - Yields

STUMBLING BLOCKS

- Protection of forest & biodiversity
- Development infrastructures
- Competition w/ non-food crops
- Soil degradation
- Water scarcity
- Global warming




PROTEIN SOURCES

entofood
A NEW SOURCE OF FEED

SOYBEAN MEAL

+80% world production in 4 countries

Fishmeal

Resource getting scarce

CONCLUSION

URGENT NEED TO FIND SUSTAINABLE AND ENVIRONMENTAL FRIENDLY SOLUTIONS

ENTOFOOD

PROTEIN PRODUCTION FROM DETRITIVOROUS INSECTS

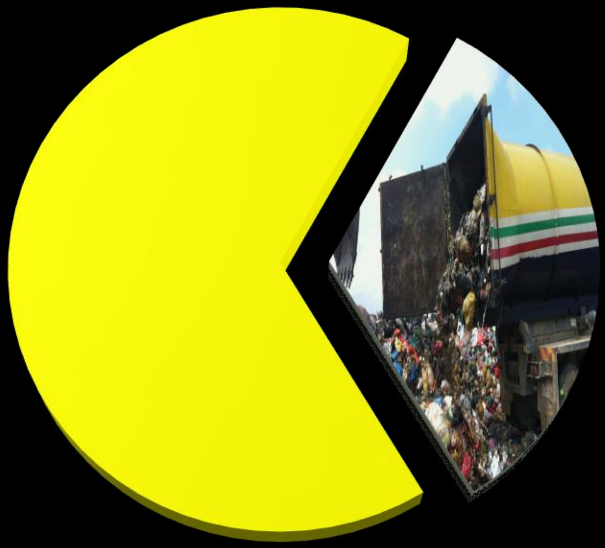
2ND STAKE

A WORLD OF WASTAGE

FOOD WASTES

$^1/_3$ food produced wasted

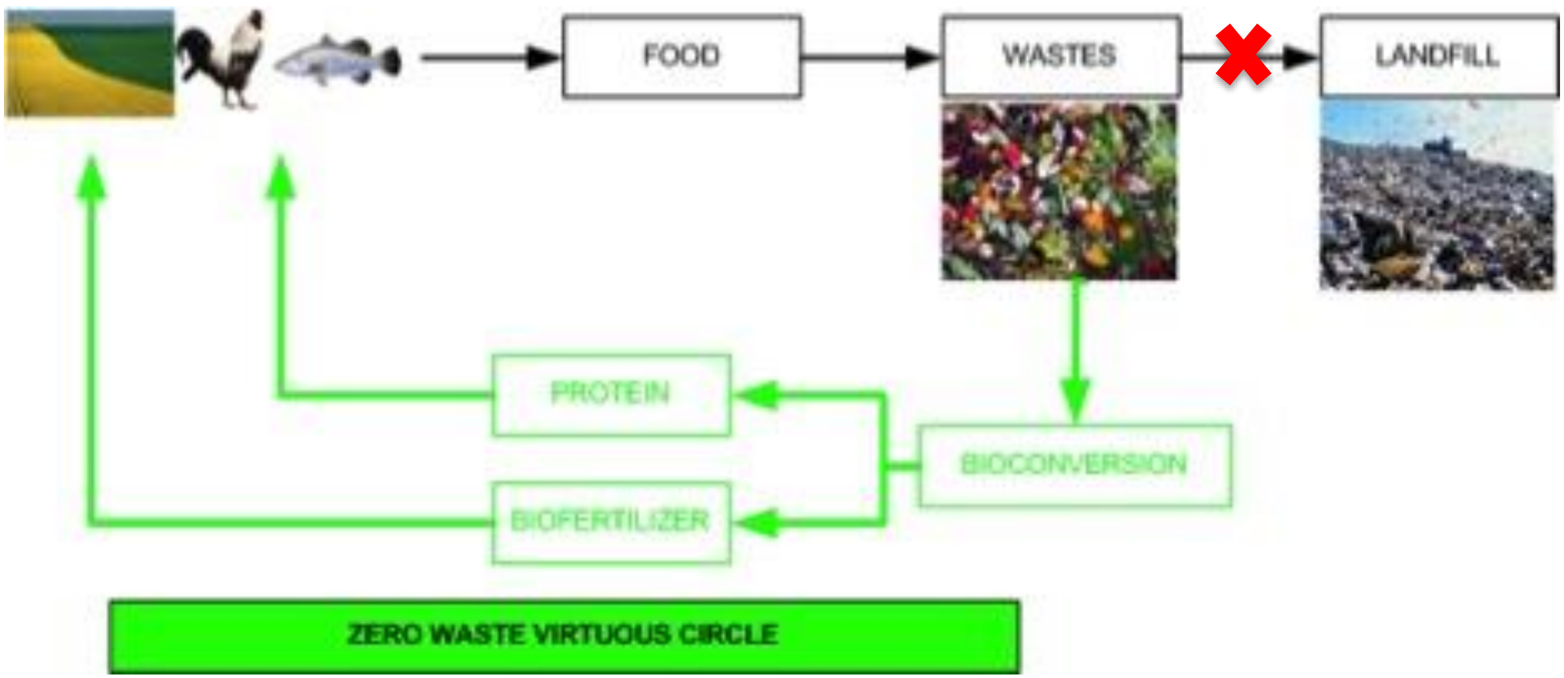
3rd producer of CO_2



A nutrient mine

Entofood technology

A biological model: bioconversion



BIOCONVERSION

BIOCONVERSION FLOW CHART

MOW → **Process MOW** → **Feeding larvae** → **Bioconversion**

Reduction OW by larval activiy

Generation of frass

↓

Products → **Process** → **Markets**

Insect biomass

Biocompost

Aquaculture
Animal Feed

Agriculture

Species

Hermetia illucens (Black soldier fly)

Non-invasive nor disease vector

Very wide feeding regime (ideal tool for food wastes bioconversion process)

Bioconversion

Larval stage

Extremely fast growth

FCR < 1

The ratio

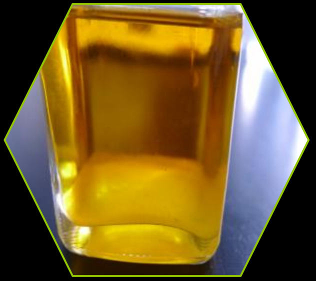
Organic wastes transformation:
few hours

Larval g/out: 6 days

Forecast







15,000/day	**3,750**	**3,000**	**930**	**370**
5,500,000/year	1,400,000	1,000,000	340,000	135,000
10-20%	210,000	150,000	50,000	20,000





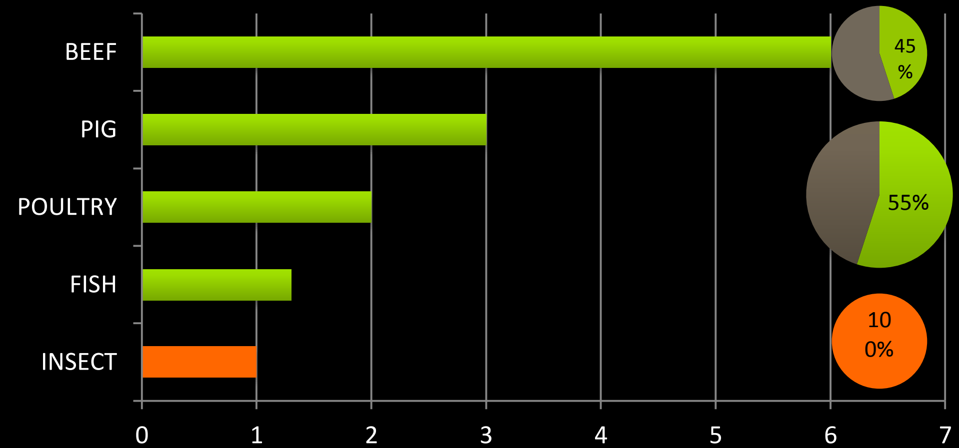

Performances

Animal production

Yield tonnes/ha/y

Shrimp	Pangasius	Broiler	Entofood
30	1 000	2 000	15 000

FCR **% edible**



Benefits

- 100% biological
- Low carbon footprint
- Extremely fast process
- Easy roll out in the tropical belt, no introduction of exotic species
- Sustainable source of protein while alleviating environmental impact of organic wastes management

Extension of insect bioconversion

- ASSET: limitless possibilities from the world largest group of animal
- Agro-industry organic sidestream
  - Slaughtery
  - Palm-oil industry
  - …

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Thank you

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STATUS COMPANY