FoodPlus Round Table

"Thought for Food"

Securing Better Health Through Nutrition

Crops for the Future Research Center (CFFRC)
The University of Nottingham Malaysia Campus

INCREASING THE AVAILABILITY OF MICRONUTRIENTS AS A PUBLIC HEALTH STRATEGY

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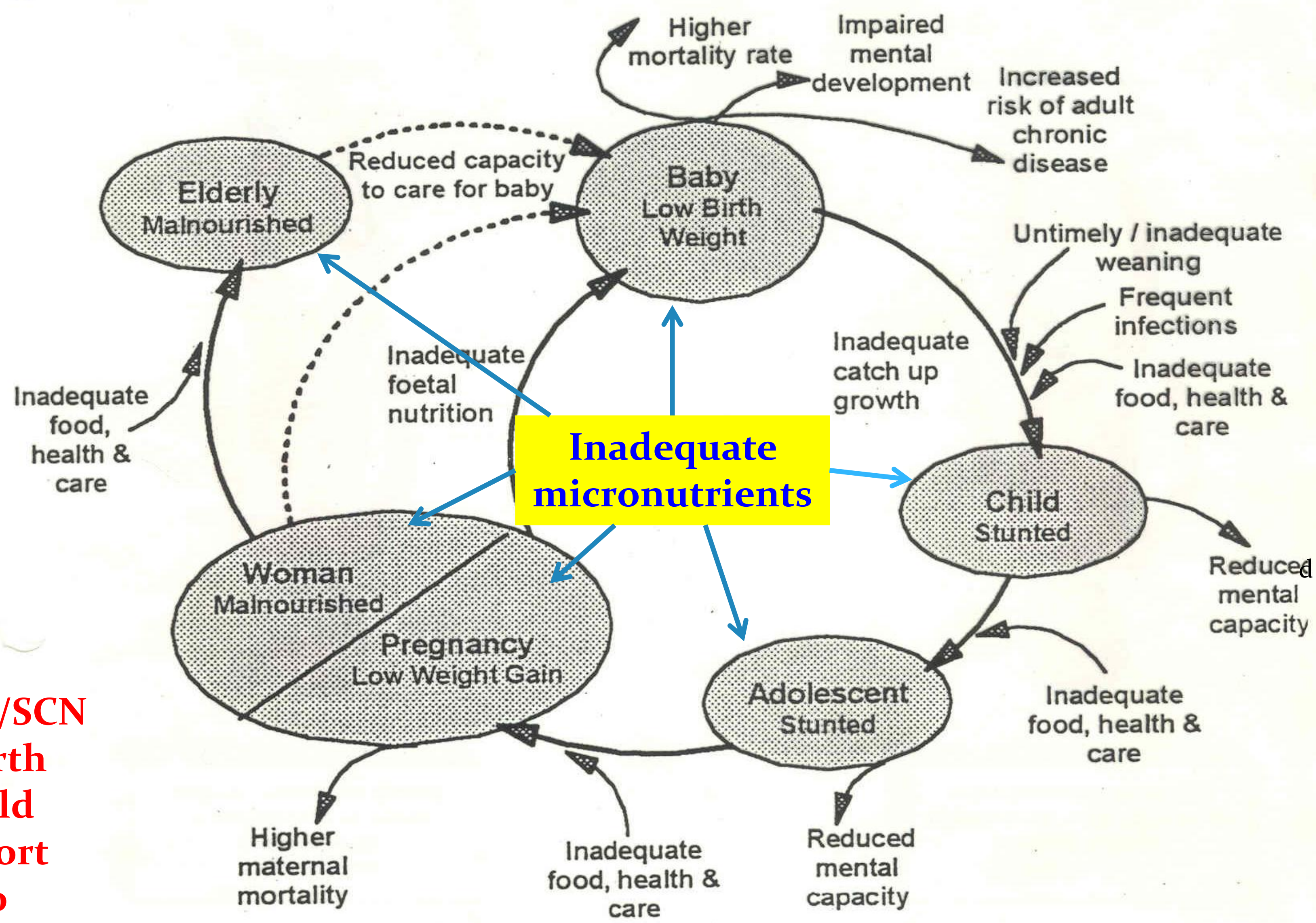
Outline of presentation

- Brief background on micronutrient deficiency globally and in Malaysia
- Approaches to increasing availability of micronutrients
- Challenges in relations to under-utilised plant species

INTERGENERATIONAL EFFECTS OF MALNUTRITION



ACC/SCN Fourth World Report 2000

- **“Good nutrition is the key to breaking intergenerational cycles of poverty, because good maternal nutrition produces healthier children, who grow into healthier adults.**
- ***Good nutrition reduces disease and raises labour productivity and incomes, including of those working in agriculture”.***

Priorities for Public Sector Research on Food Security and Nutrition
Howarth Bouis (IFPRI), Terri Raney (FAO), John McDermott (IFPRI), 2013

Micronutrients: at the core of survival, development and health

Micro nutrient	Impact through programmes
Vitamin A	23% reduction under-5 mortality rates 70% in childhood blindness
Iodine	13 point increase in IQ
Iron	20% reduction in maternal mortality
Zinc	6% reduction in child mortality 27% reduction in diarrhoea incidence in children
Folate	50% reduction in severe neural tube birth defects e.g. spinal bifida

Asia Pac J Clin Nutr 2007;16 (2):269-273

Red cell folate and predicted neural tube defect rate in three Asian cities

Timothy J Green, C Murray Skeaff, Bernard J Venn, Jennifer EP Rockell , Joanne M Todd, Geok L Khor, Su Peng Loh, G Duraisamy, Siti Muslimatun, Rina Agustina, Xu Ling and Xiaoping Xing

Results: Red cell folate concentrations were highest (*p*<0.001) in women from Jakarta at 872 nmol/L (95% CI; 833, 910) followed by Kuala Lumpur at 674 nmol/L (95% CI: 644, 704) and lowest in Beijing at 563 nmol/L (95% CI: 524, 601).

Accordingly, predicted NTD rates were highest in Beijing at 30/10000 (95% CI: 27, 33), followed by Kuala Lumpur at 24/10000 (95% CI: 22, 25), and lowest in Jakarta at 15/10000 (95% CI: 14, 15).

Summary of the micronutrient situation in Malaysia

Micronutrient	
Vitamin A	3.4% under-five: mild public health problem (MOH/UNICEF 2000)
Iodine	Borderline iodine sufficient with medial UIC of 109 µg/L (2nd National IDD survey, MOH 2008)
Iron	% RNI: women 33% (19-50 ys), 87% (51-59 ys); men (19-59 yrs) 86% (MANS, 2003)
Zinc	??
Folate	15% with RBC folate above 903 nmol/L (reduced risk of NTD) in sample survey of urban women 20-40 years (Khor et al., 2006)

Public health approaches for increasing the availability of micronutrients

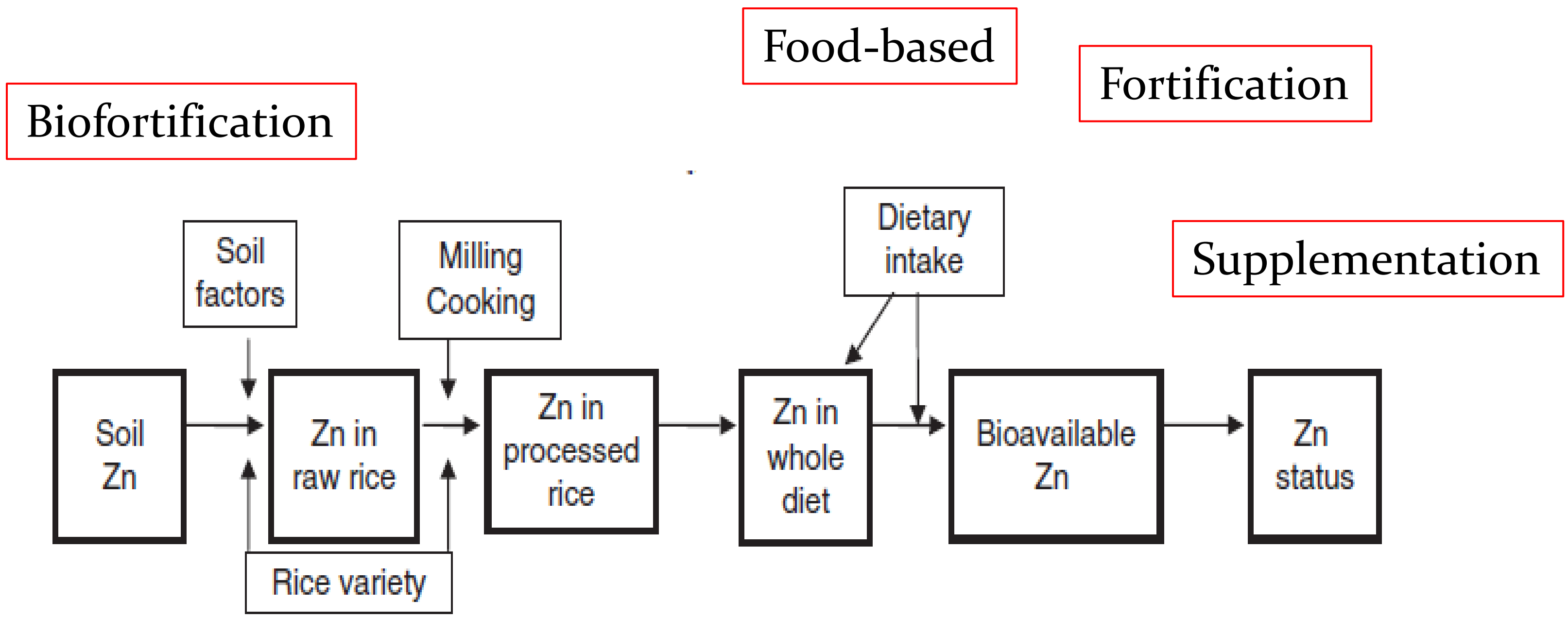
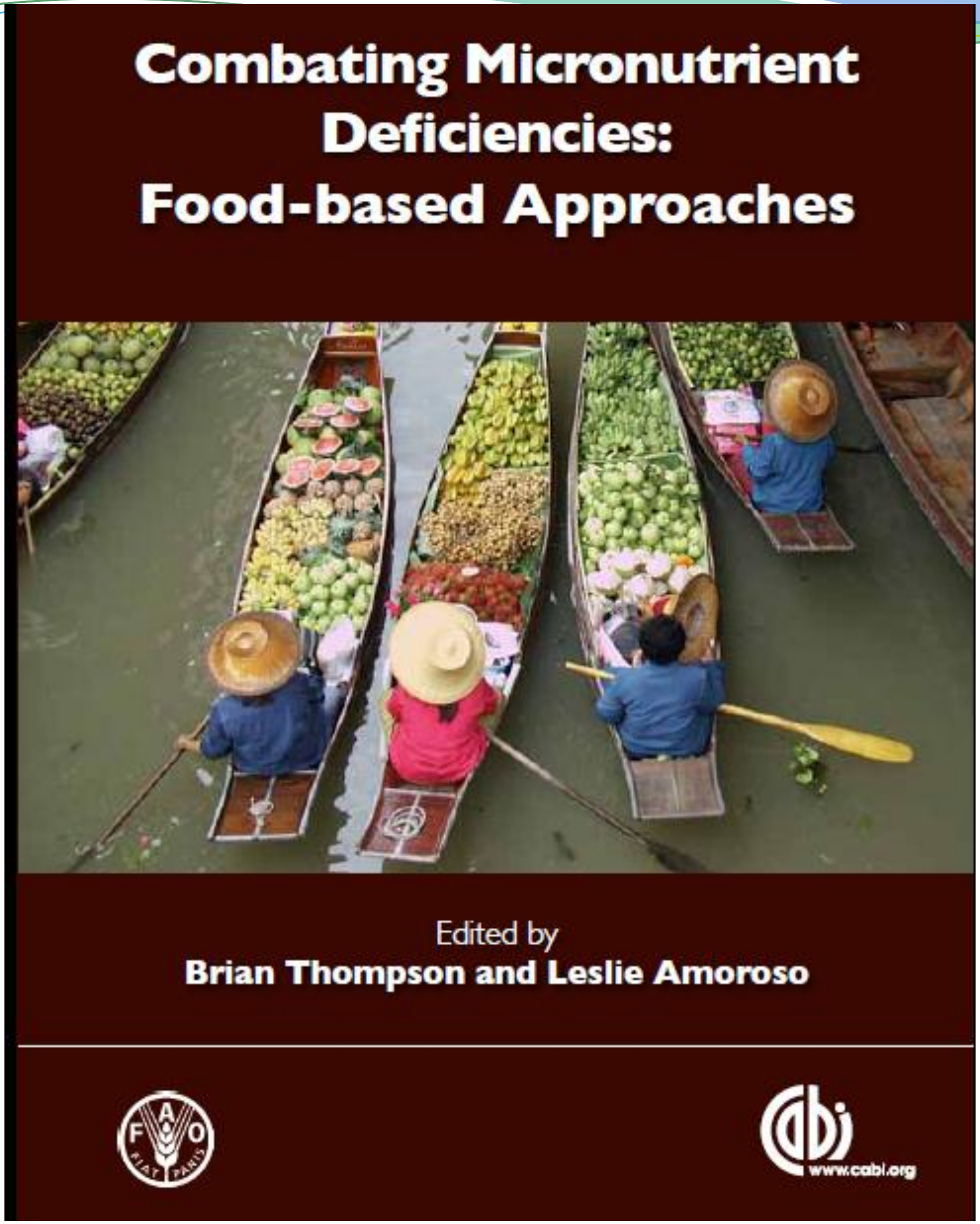
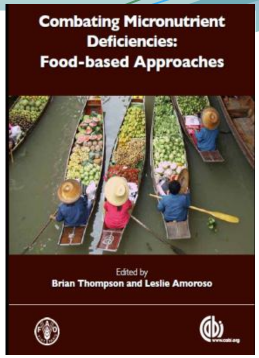
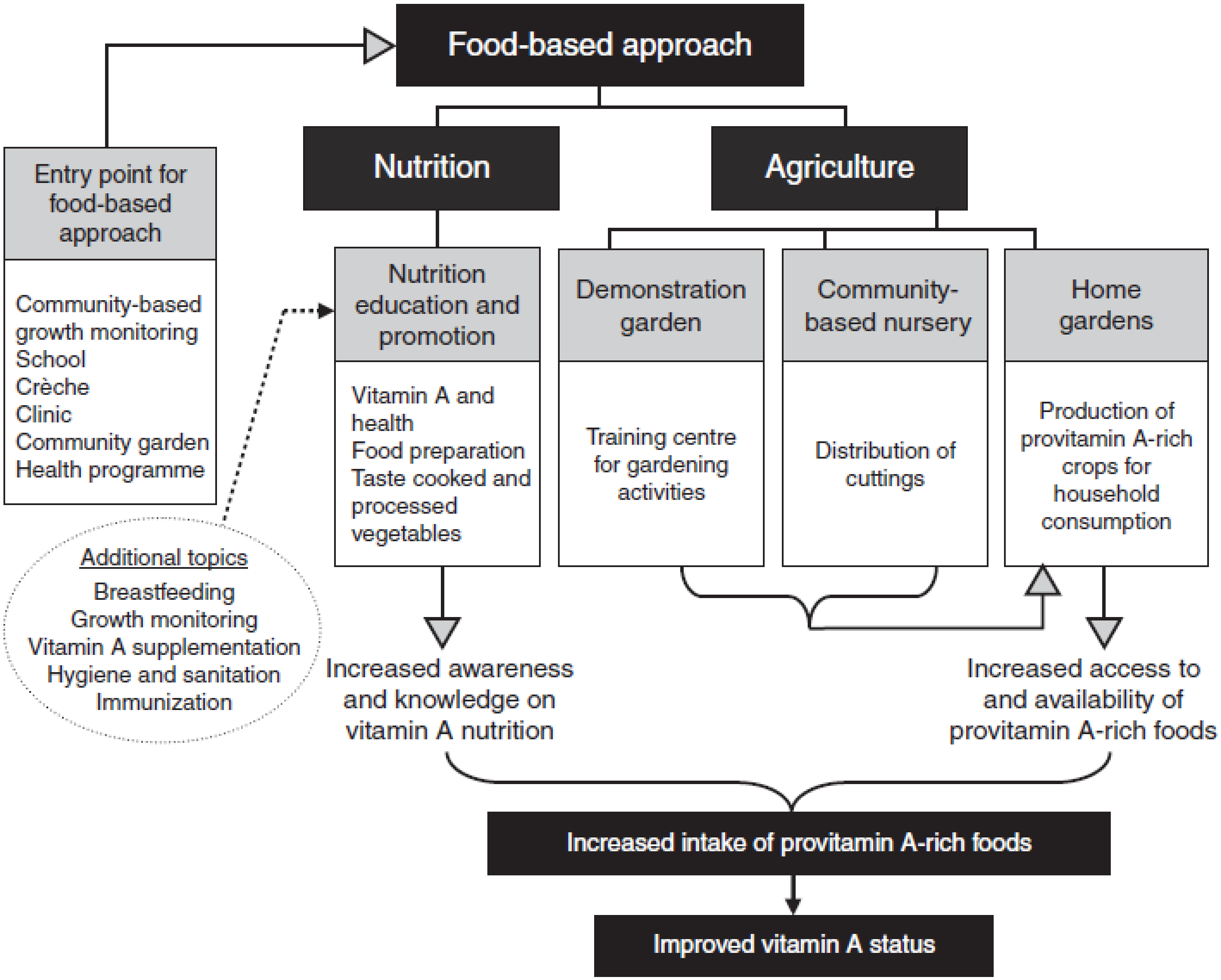


Fig. 14.1. Schematic depiction of the passage of zinc from soil to humans.

(Meyer et al., 2011)


Combating Micronutrient
Deficiencies:
Food-based Approaches
Edited by
Brian Thompson and Leslie Amoroso
www.cabi.org





Raising of small animals for milk, meat, and eggs for household consumption

Fig. 9.4. Overview of the food-based approach to address vitamin A deficiency developed in South Africa.

(Faber & Laurie, 2011)

Food-Based Approach

Dietary Diversity or Dietary Variety

- defined as the number of different foods or food groups consumed over a given reference period – as a key indicator of a high quality diet.
- Evidence indicates that dietary diversity is strongly and positively associated with child nutritional status and growth, even after socioeconomic factors have been controlled for.

Food-Based Approach

Dietary Diversification

- "increasing the production and consumption of micronutrient-dense foods;
- incorporating enhancers of micronutrient absorption in household diets;
- employing germination, fermentation and/or soaking to reduce the phytate content of unrefined cereals and legumes by enzyme-induced hydrolysis of phytate and/or passive diffusion of water-soluble phytate".

(RS Gibson, 2011)

Antinutrients in plant foods that reduce Fe and Zn bioavailability, and examples of major dietary sources (from Graham et al., 2001)

Antinutrients	Major dietary sources
Phytic acid or phytin	Whole legume seeds and cereal grains
Fibre (e.g. cellulose, hemicellulose, lignin, cutin, suberin, etc.)	Whole cereal grain products (e.g. wheat, rice, maize, oat, barley, rye)
Certain tannins and other polyphenolics	Tea, coffee, beans, sorghum
Oxalic acid	Spinach leaves, rhubarb
Haemagglutinins (e.g. lectins)	Most legumes and wheat
Goitrogens	*Brassicas* and *Alliums*
Heavy metals (e.g. Cd, Hg, Pb, etc.)	Contaminated leafy vegetables and roots

Nutrient Supplements

Toward reducing micronutrient inadequacies e.g. during the complementary feeding period and for young children

- Crushable or water-soluble micronutrient tablets – termed foodlets;
- Micronutrient powders – termed sprinkles;
- Micronutrient lipid-based fortified spreads – termed lipid-based nutrient supplements .

(RS Gibson 2011)

Food Fortification

Micronutrient fortification of food products on a mandatory or voluntary basis aimed at the population level

Mandatory fortification

- fortifying wheat flour with folic acid and iron in Indonesia
- fortifying all cereal products with folic acid in USA

Voluntary fortification

- fortifying milk and other beverages, biscuits, sugar, flour, margarine, spreads, edible oils, seasonings with various micronutrients

Biofortification

- "Biofortification of staple cereals is a strategy for improving the micronutrient status of the entire household and across generations in poor resource settings".

- Biofortification differs from ordinary fortification because it focuses on making plant foods more nutritious as the plants are growing, rather than having nutrients added to the foods when they are being processed.

Biofortification

Biofortification can be achieved by

(1) traditional agricultural practices:

- Agronomic practices
- Conventional plant breeding

(2) modern biotechnology:

- Genetic modifications involving gene insertions or induced mutations.

Agronomic practices

Fertilizers can be applied to the foliage to enhance its iron content and to the soil to improve the content of zinc, selenium and iodine content of staple food crops (e.g. wheat, maize, rice, sorghum, beans) when grown in trace-element deficient soils, as has been practised for low-zinc soils in Turkey and India and low-selenium soils in Finland.

Conventional plant breeding

- Plant breeders search seed banks for existing varieties of crops which are naturally high in nutrients. They then crossbreed these high-nutrient varieties with high-yielding varieties of crops, to provide a seed with high yields

Examples

- Seeds of common beans, rice and wheat with increased iron and zinc concentrations
- varieties of cassava roots, sweet potatoes, maize and bananas with high β-carotene using selective plant breeding.

The use of biotechnological methods

- Genetic modification is the direct manipulation of an organism's genome.
- Genetic modification of the DNA is more precise than induced mutations or mutation breeding, where an organism is exposed to radiation or chemicals to create a non-specific but stable change.
- An organism that is generated through genetic engineering is a genetically modified organism (GMO).
- Genetically modified foods (GM foods) are foods derived from GMOs.

The use of biotechnological methods

- Involves inserting a gene which codes for the nutrients into the seed. Example: genetically modified Golden Rice contains a yellow daffodil gene that is rich in β-carotene
- This seed is then bred with a high yield quality crop, resulting in the production of crops rich in micronutrients.
- New varieties of cereal grains produced with an increased content of methionine and cystine to promote zinc absorption, and a reduced phytic acid content.

Relative Costs: Supplementation

Vitamin A Supplementation:

- $0.50 per person
- treat 100 million children and women in South Asia
  (1 in every12.5 persons)
- $50 million each year, $500 million over a decade

(Biofortification Challenge of Program: Rationale and Progress. Bouis (IFPRI)

Relative Costs : Biofortification

Commercial Iron Fortification:

- $0.10 per person per year
- 1.25 billion people in South Asia
- to reach 40% of this population each year costs $50 million, $500 million each decade

(Biofortification Challenge of Program: Rationale and Progress. Bouis (IFPRI

Costs: Plant Breeding

- $14 million over ten years to develop and test each crop and for nutritious varieties to be adopted in a limited number of countries
- **Fixed**, **one-time** investment at a **central** location
- Maintenance breeding is a relatively minor costs
- Iron and zinc content are highly correlated so other trace minerals may be added at little extra cost

(Biofortification Challenge of Program: Rationale and Progress. Bouis (IFPRI

In principle

Approaches to increasing availability of micronutrients

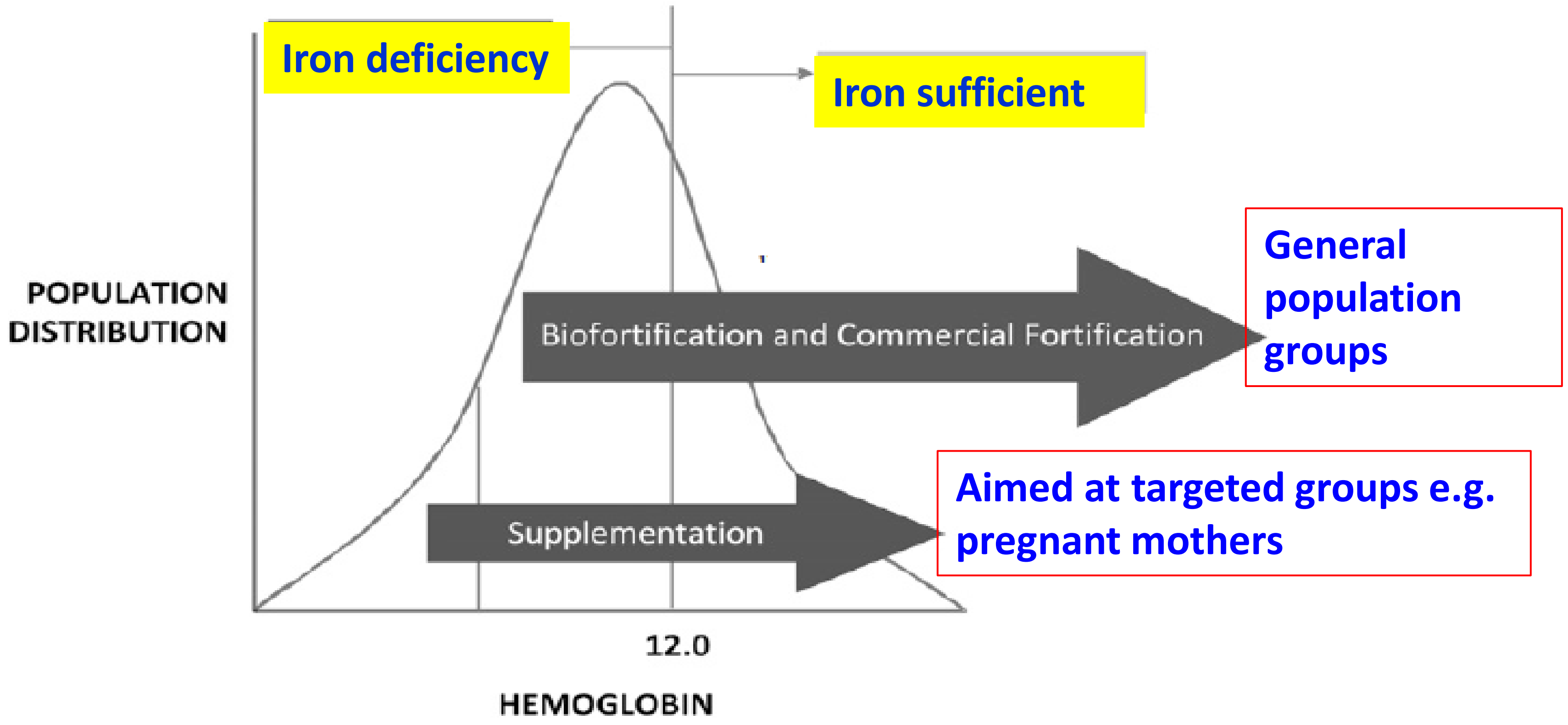
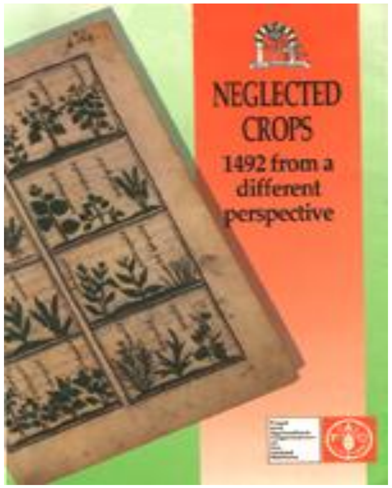


Figure 1. Frequency distribution of Fe adequacy in a population.

Bouis and Welch, 2010

Challenges in relations to under-utilised plant species

Much have been written about underutilised plant species



Neglected crops 1492 from a different perspective
Edited by **J.E. Hernández Bermejo and J. León. FAO, Rome, 1994**

Pro USo DIVERSITAS
grpi
THE GENETIC RESOURCES POLICY INITIATIVE
SPDA
Sociedad Peruana de Derecho Ambiental
Global Facilitation Unit for Underutilized Species

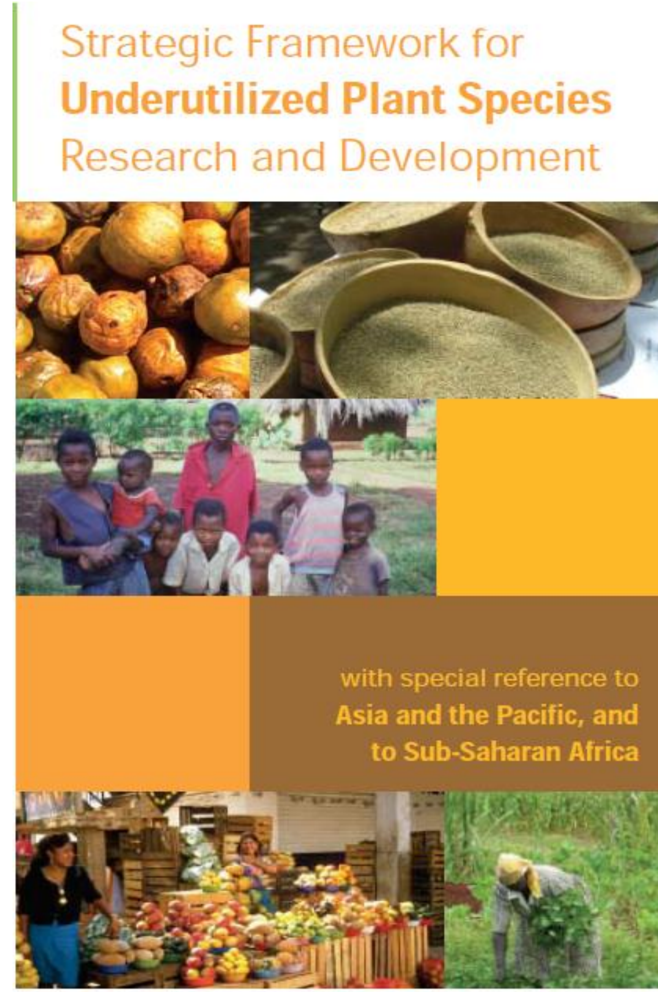
UNDERUTILIZED SPECIES

POLICIES AND STRATEGIES

Underutilized crops in Peru:

Some conceptual and political considerations

2006



2006

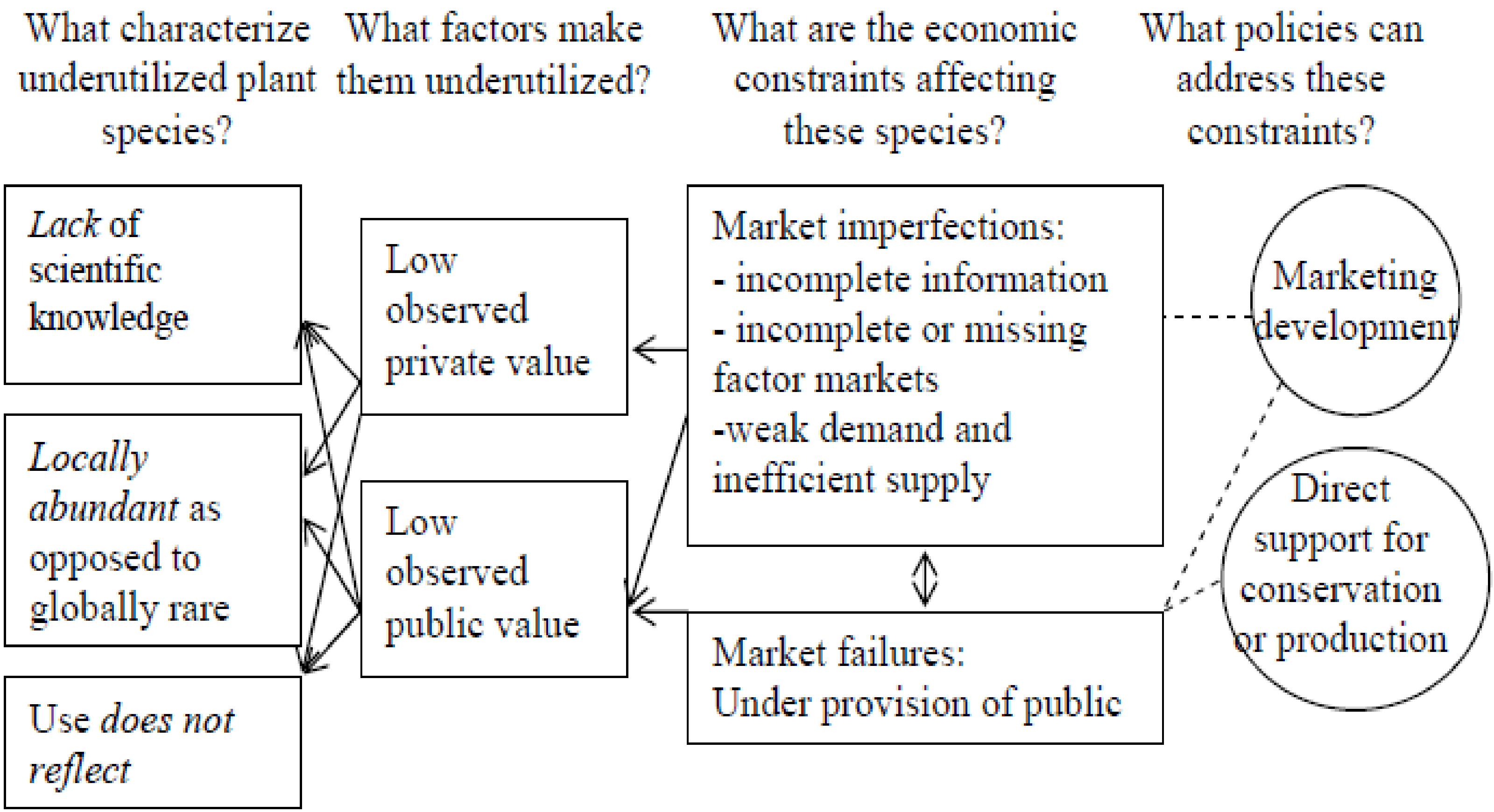
Global Facilitation Unit for Underutilized Species
IPGRI

Box 3: **Some factors influencing today's increased interest in underutilized plants**

(Jaenicke & Höschle-Zeledon (eds) 2006)

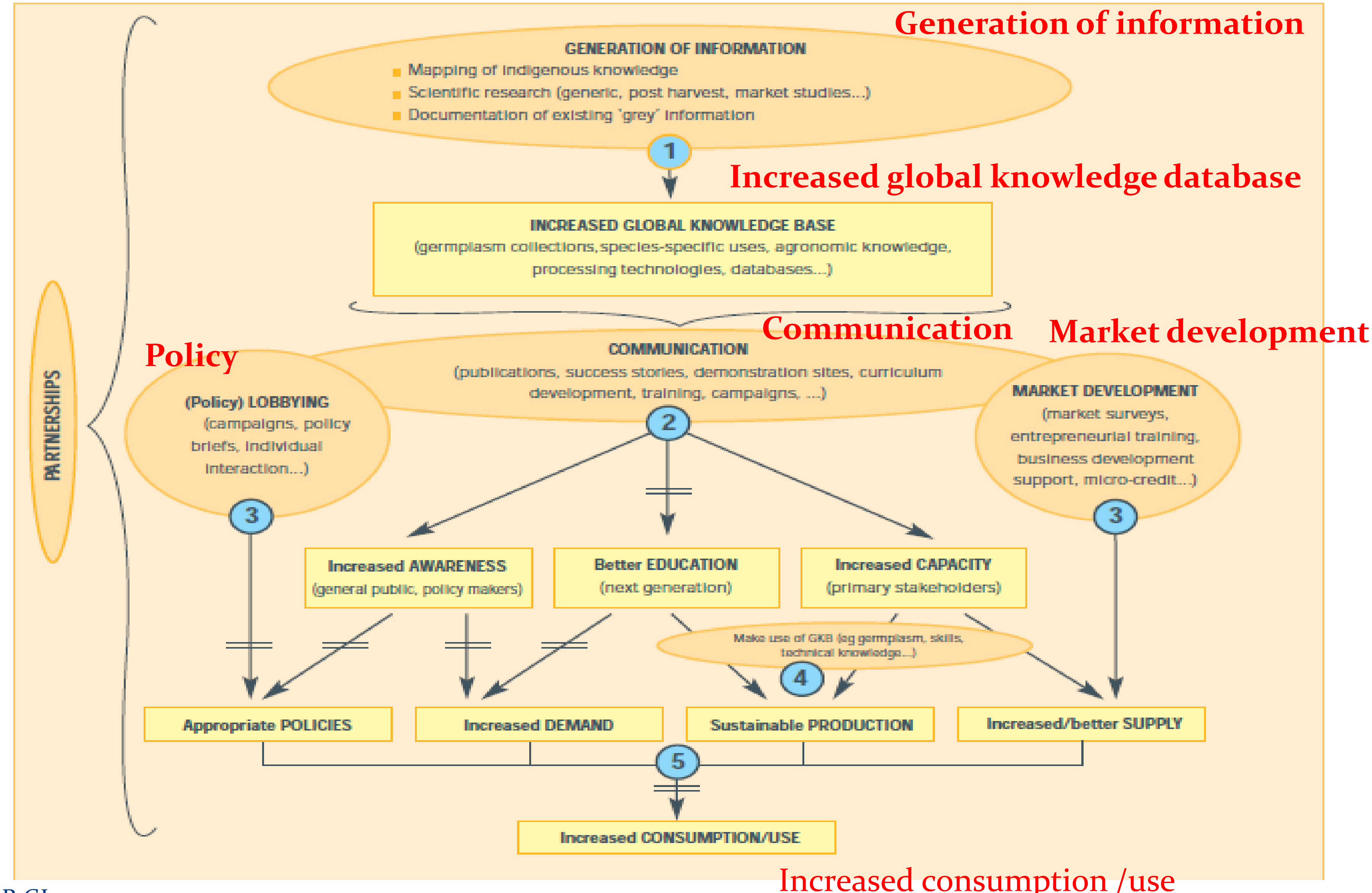
- Their role as alternative sources of income
- Collapse of commodity prices
- Greater appreciation of biodiversity's role in enhancing livelihoods
- Increased participation of communities in setting research agendas
- Stronger national agricultural research systems, willing to invest beyond primary commodities
- Search for cultural identities in a globalised, more mobile world
- Demand for traditional food in large multi-ethnic cities
- Better understanding of the limits of the Green Revolution
- Greater attention to gender-sensitive research

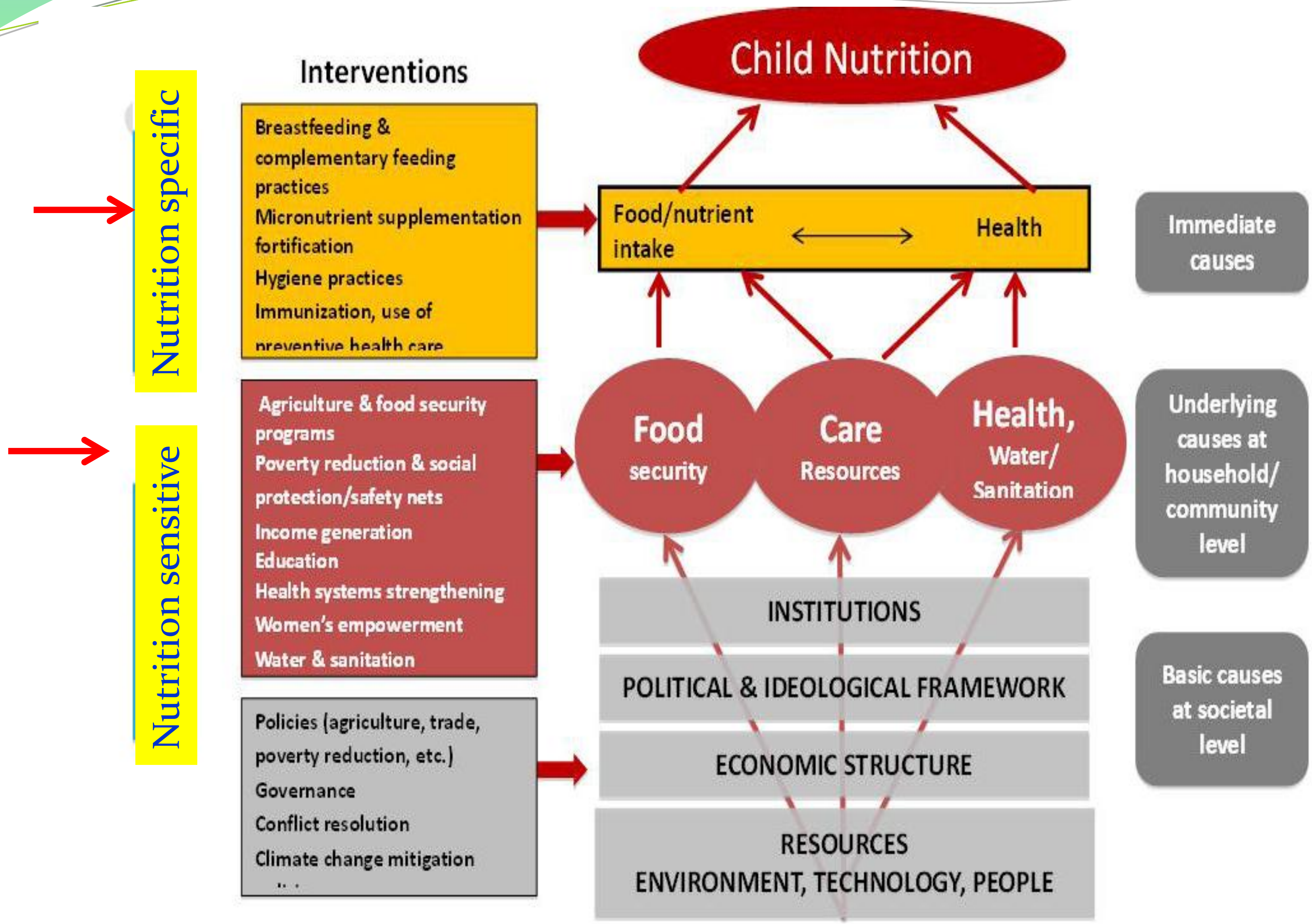
Figure 4--Underutilized plant species: from a characterization to policy solutions



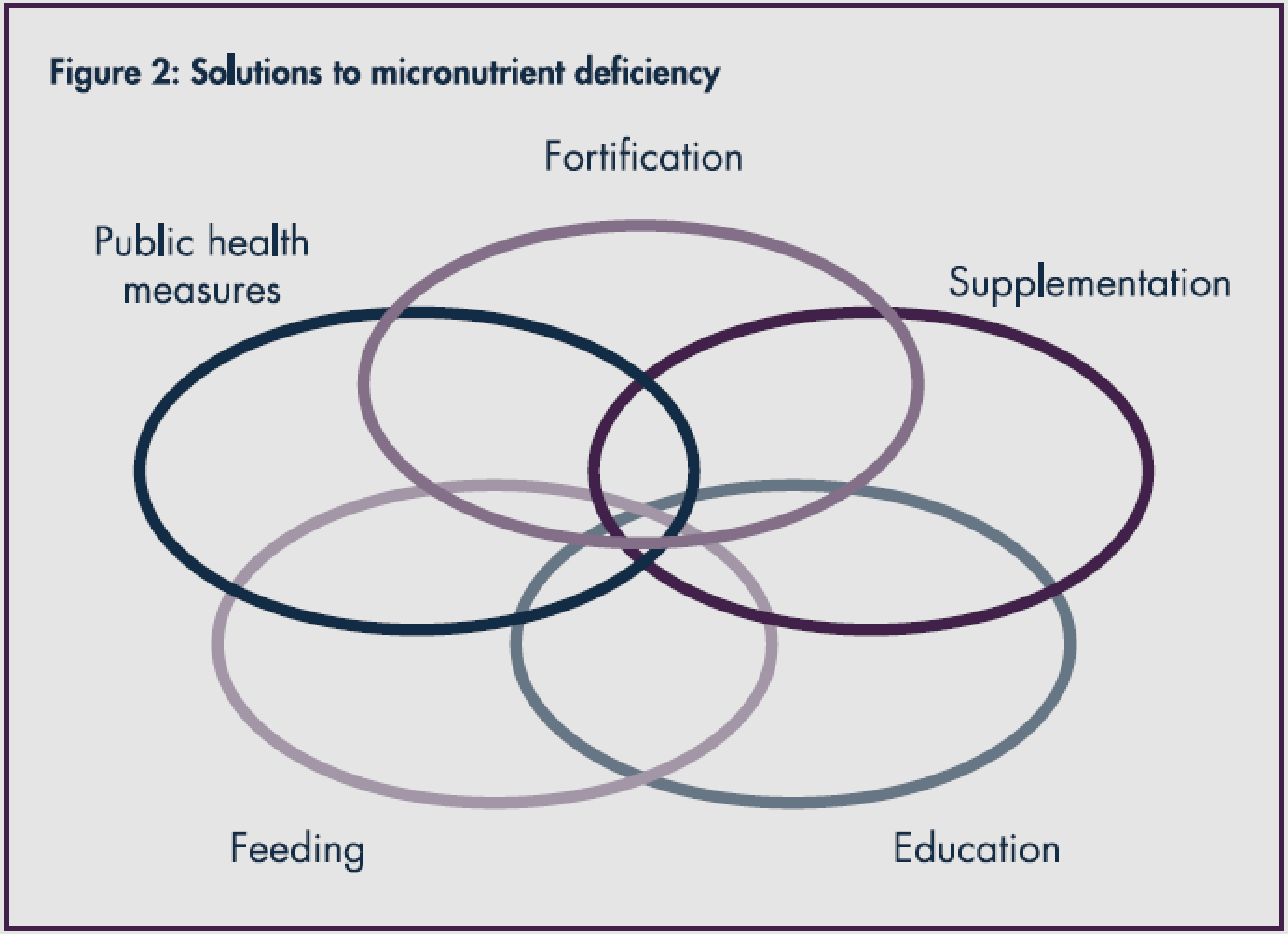
(IFPRI, 2006)

Figure 1: ***Intervention areas for the promotion of underutilized plant species***





Nutrition specific
Nutrition sensitive
Interventions
Breastfeeding & complementary feeding practices
Micronutrient supplementation fortification
Hygiene practices
Immunization, use of preventive health care
Agriculture & food security programs
Poverty reduction & social protection/safety nets
Income generation
Education
Health systems strengthening
Women's empowerment
Water & sanitation
Policies (agriculture, trade, poverty reduction, etc.)
Governance
Conflict resolution
Climate change mitigation
Child Nutrition
Food/nutrient intake
Health
Food security
Care Resources
Health, Water/ Sanitation
INSTITUTIONS
POLITICAL & IDEOLOGICAL FRAMEWORK
ECONOMIC STRUCTURE
RESOURCES
ENVIRONMENT, TECHNOLOGY, PEOPLE
Immediate causes
Underlying causes at household/ community level
Basic causes at societal level



Business action to fight micronutrient deficiency (2006)

"The fundamental purpose of agriculture is not just to produce food and raw materials, but also to grow healthy, well-nourished people".

Reshaping Agriculture for Nutrition and Health
Fan, Shenggen and Pandya –Lorch, Rajul (Eds). IFPRI, 2012, Washington DC, USA

Thank you