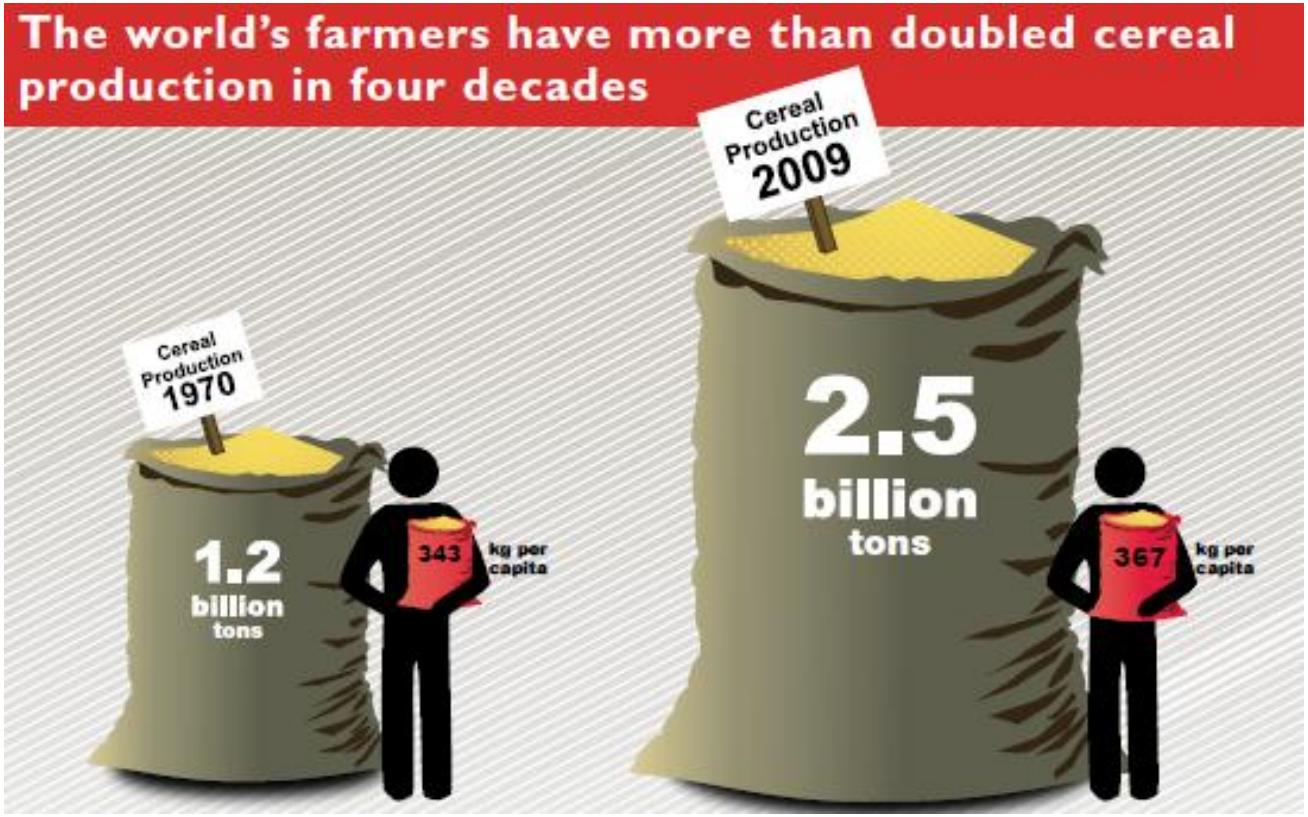
Nutrition Sensitive Agriculture

Why Does Agriculture Exist?

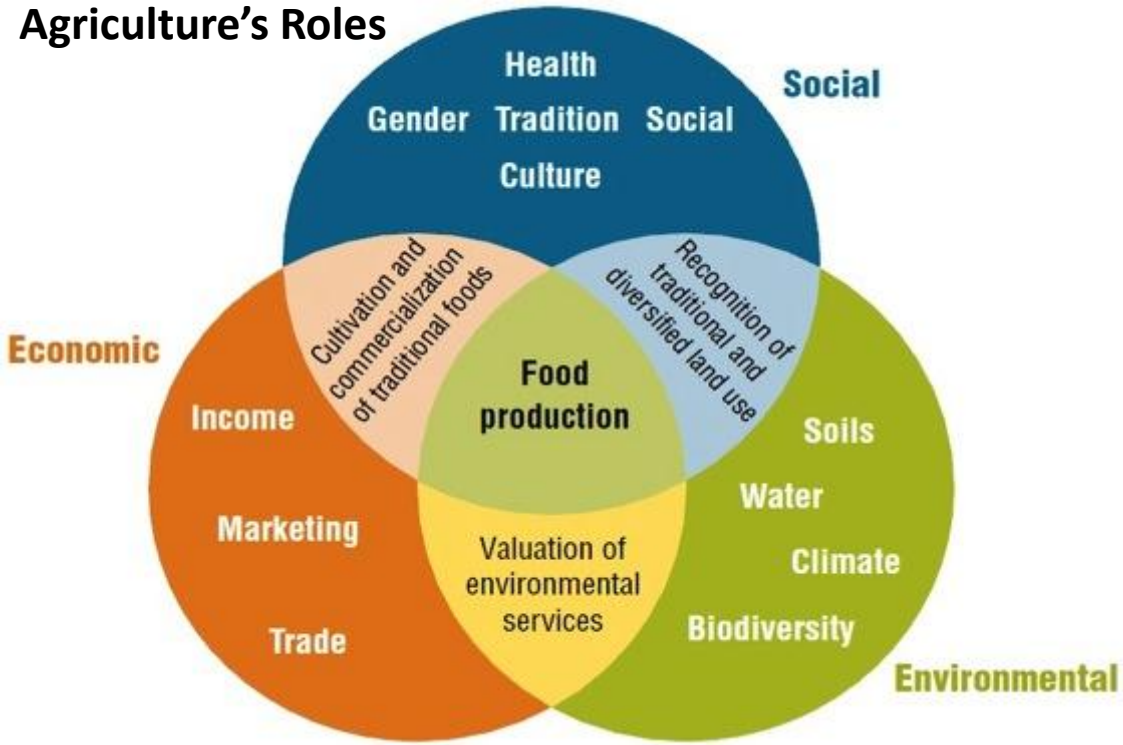
- To produce food and fiber
- To provide incomes and livelihoods for farmers
- To provide nutrients!

Agriculture has focused mainly on production



Source: IFPRI

But Agriculture Plays Many Roles



Bread for the world, 2010

Nutrition Sensitive Agriculture

- Agriculture is the sector best placed to affect food production and consumption of nutritious foods needed for healthy and active lives.
- Agriculture has the most direct influence and contact with the majority of households in the world where undernourished individuals reside.
- A large percentage of rural women are employed in the formal or informal agriculture sector.

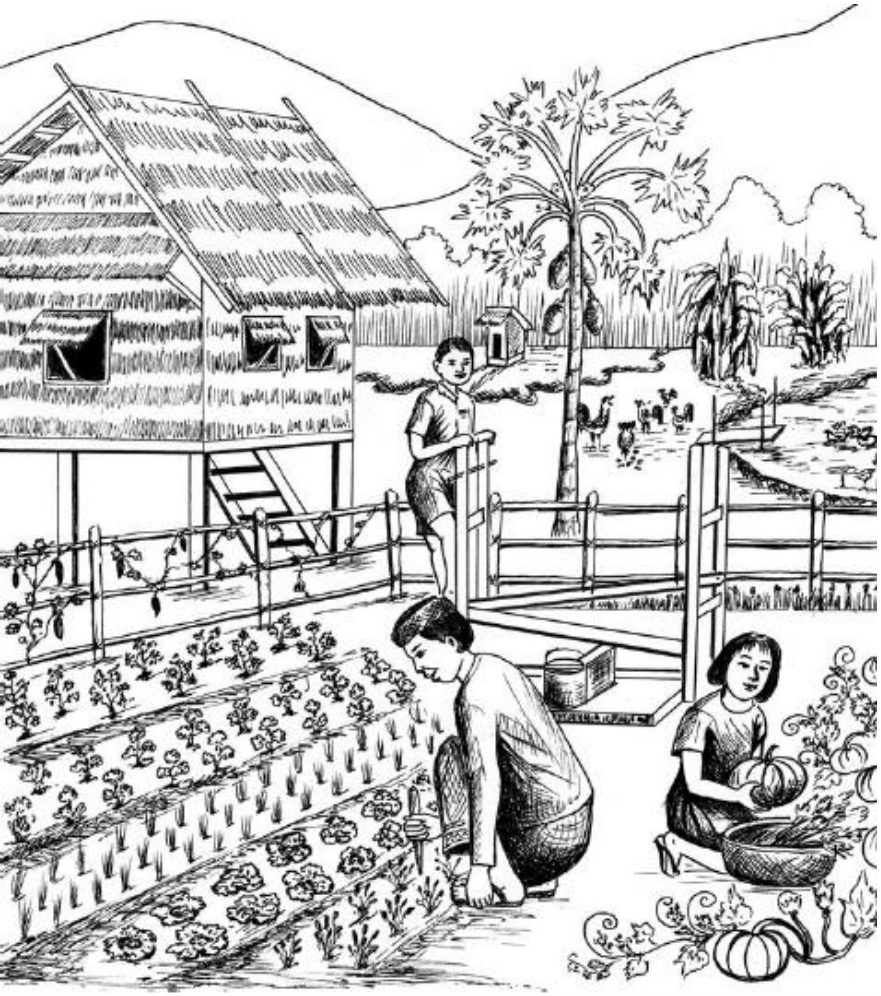
Examples of *nutrition sensitive* agriculture

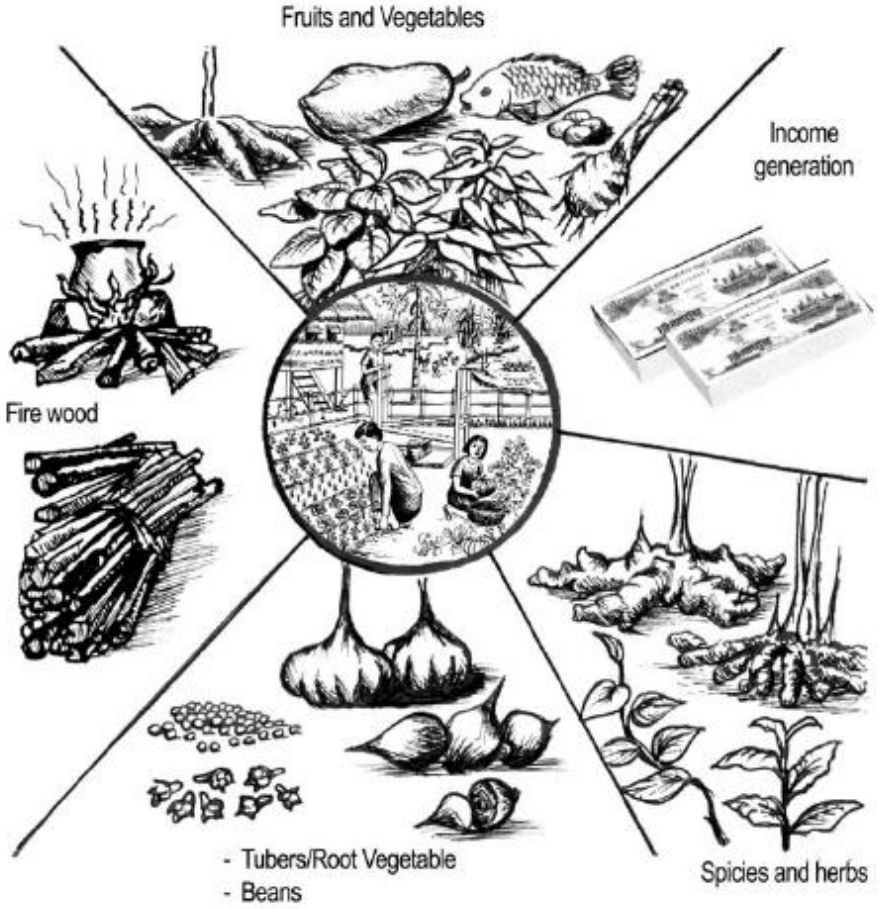
- Diversifying Homestead Food Production
- Utilizing biodiversity
- Fortifying staple crops: Biofortification
- Fortifying major foods post harvest
- Processing foods post-harvest
- Sensitizing value chains for nutrition
- Focusing on women

Homestead Food Production

- Usually through diversification of crops and animals being grown and raised on land
- Often done through community or home gardens (kitchen gardens)
- Nutrition and income can improve but with an education component
- Done mainly in Asia and women are targeted
- Vitamin A and iron status improves
- When livestock and small animal rearing and fish farming are incorporated, increased income generation and nutrition improvements

Gardens




Fruits and Vegetables
Income generation
Fire wood
- Tubers/Root Vegetable
- Beans
Spicies and herbs

Animal Source Proteins make huge contributions to improving nutrition

Fruits and Vegetables

Rich in micronutrients – vitamins and minerals as well as health promoting properties

BUT….

Need to consume an abundance

Utilizing local foods and biodiversity

- Agrobiodiversity contain wide varieties of species and within species, diverse varieties that contain different levels of nutrients
- These local foods are often underutilized or neglected or communities are not aware of their nutritional value
- For rural farming populations, can provide diverse foods straight from the source
- Important to utilize local knowledge

Biofortification

- Biofortification is the development of staple crops with increased micronutrient density through crop management, breeding and genetic approaches
- Orange fleshed sweet potato
- Golden Rice in the Phillippines

Legumes are important for Nutrition: Protein content of cereals, tubers and legumes

Cereals and Tubers (100g)	*Protein content (%)*
Maize	9.4
Rice (white	7.1
Wheat flour	10.3
Millet	11
Cassava	1.3
Potato	2.1
Legumes (100 g)	*Protein content (%)*
Kidney beans	23.6
Cowpea	23.5
Peanut	25.8
Soy	33.7

Improving Nutrient Content

- **COOKING**
  - Oil to help absorb fat soluble vitamins
  - Vitamin C increases availability of iron
- **PROCESSING**
  - Thermal processing, mechanical processing, soaking, fermentation, and germination/malting
    - Increase the physicochemical accessibility of micronutrients
    - decrease the content of antinutrients, such as phytate, or
    - increase the content of compounds that improve bioavailability
  - Parboiling
  - Yogurt, jams etc
- **STORING**
  - Solar drying
  - Better storage

A Woman's Burden

- Nutritional benefits increase when women can strike a balance between the time they give to agricultural tasks and the time they give to child and family care.
- Child nutrition often improves when income is put in the hands of a woman.

Rural Extension Services for Nutrition

- Great idea, but practical?
- Who should take responsibility to deliver nutrition at the community level?

Education and Engaging Communities

- Dietary diversity strategies are more effective when paired with education and messaging.
- Engage communities through participatory approaches and transferring knowledge
- Breaking social norms and behavior change are challenging but not impossible!

Momentum was produced by the United Nations Integrated Mission in Timor-Leste (UNMIT) in 2012

Nutrient Composition of Foods

Cereal Crop Nutrition

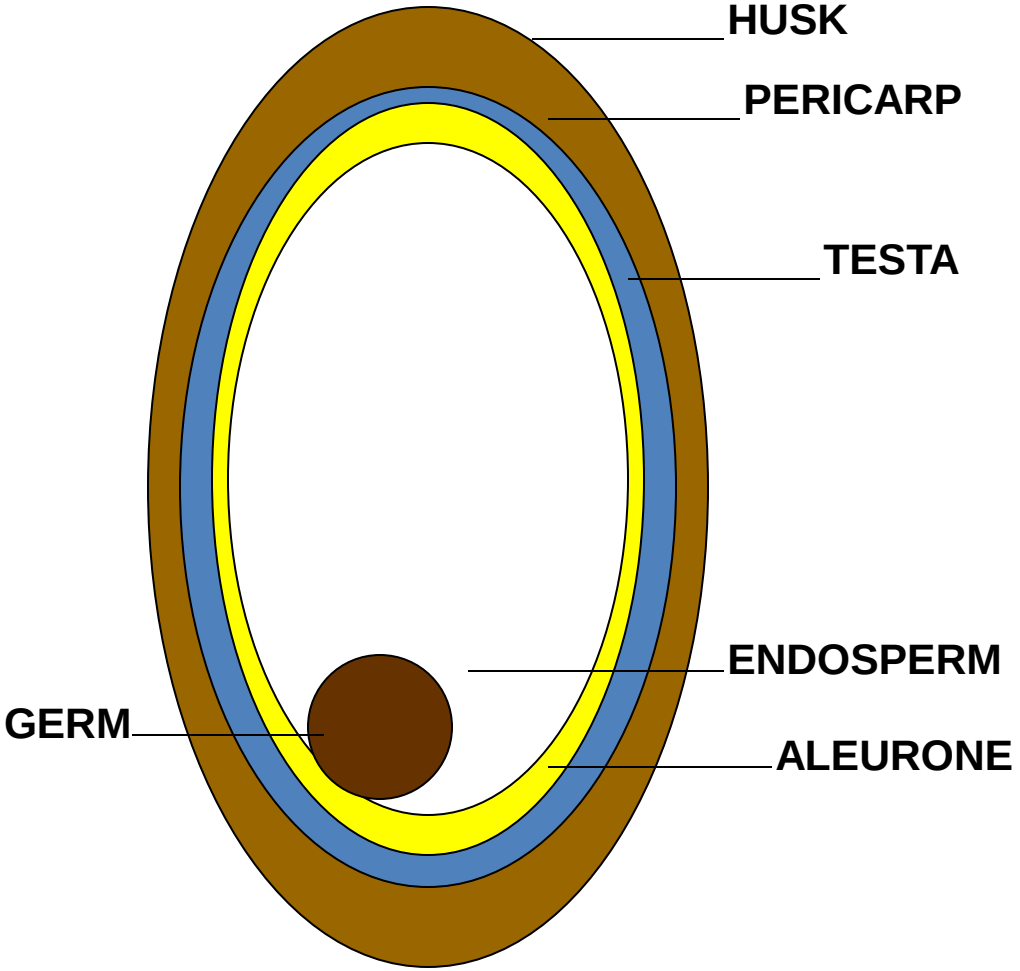
- Form the basis of most diets
- Edible seeds of domesticated grasses: maize, sorghum, millets, wheat, rice, oats, teff, barley, quinoa
- Provide up to 70% of energy intake
- Wheat, rice and maize > ½ the world's food energy
- High in carbs; some have moderate amounts of protein and B vitamins; low in vitamins A, C

Cereal Composition

Most Cereal Grains have similar structure and nutritive value

100g of whole grain:

- 350 kcal
- 8 to 12 g protein
- Ca, iron and B vitamins
- Lack Vit C and A



Husk – no nutritive value
Pericarp – fibrous; few nutrients
Aleurone – rich in protein, V and M
Endosperm – mainly starch
Germ – nutrient rich

Milling and Fortification

- Pestle and mortar – outer coat is removed but germ remains – leaving some nutrients
- Heavy milling – undesirable from nutritional view
- Unprocessed grains are often considered “poor man’s food” or not the taste preference
- Due to milling, many nations have added fortificants to refined flours

Maize

- Provides mainly carbohydrate calories
- Average annual per capita human consumption is 20 kg in developing countries
- 1/3 of mean caloric intake

Rice

- Primarily carbohydrate source
- Major staple consumed by 3.3 billion people in Asia
- Milling removes roughly 80% of the thiamine from brown rice

Wheat

- Major source of energy
- Higher in protein content than almost all other cereals
- Thiamine, riboflavin, niacin, and small amounts of vitamin A are also present

Content of certain nutrients in 100 g of selected cereals

Food	Energy (kcal)	Protein (g)	Fat (g)	Ca (mg)	Fe (mg)	Thiamin (mg)	Ribo (mg)	Niacin (mg)
Maize flour, whole	353	**9.3**	3.8	10	2.5	0.30	0.10	1.8
Maize flour, refined	368	**9.4**	1.0	3	1.3	0.26	0.08	1.0
Rice, polished	361	**6.5**	1.0	4	0.5	0.08	0.02	1.5
Rice, parboiled	364	**6.7**	1.0	7	1.2	0.20	0.08	2.6
Wheat, whole	323	**12.6**	1.8	36	4.0	0.30	0.07	5.0
Wheat flour, white	341	**9.4**	1.3	15	**1.5**	0.10	0.03	0.7
Millet	341	**10.4**	4.0	22	**3.0**	0.30	0.22	1.7
Sorghum	345	**10.7**	3.2	26	**4.5**	0.34	0.15	3.3

Root crops

- Cassava, potato, cocoa yam
- Easier to culitivate
- High yields/hectar
- High in starch
- Low in protein (1-2%) and vitamins and minerals
- Inferior to cereals nutritionally

Cassava (*Manihot esculenta*)

- High starch
- Major source of calories
- Leaves of cassava are rich in protein, vitamins A and B

Potato

- a source of energy
- high vitamin C

Sweet Potato (*Ipomoea batata*)

- High in carbohydrates
- High in vitamin C
- Yellow-orange fleshed varieties also provide b-carotene

Yam (Dioscorea alata)

- Yam's flesh may be white, yellow, purple or pink
- A source of protein and some minerals such as phosphorus and potassium

Malanga

Arrowroot

Staple Crop Nutrition

Food (100 g)	*Energy (cal)*	*Protein (g)*	*Fat (g)*	*Iron (mg)*	*Calcium (mg)*	*B-caro (ug)*	*Vit C (mg)*
Maize flour (whole)	353	**9.3**	3.8	2.5	10	0	0
Maize flour (refined)	368	8.0	1	1.3	3	0	0
Rice (polished)	361	6.5	1	0.5	4	0	0
Rice (parboiled)	364	6.7	1	1.2	7	0	0
Cassava (bitter, raw)	140	1.2	0.2	1.9	**68**	15	31
Cassava (meal)	320	1.6	0.5	3.6	**66**	0	4
Potato (raw)	75	1.7	0.1	1.1	13	12	21
Sweet Potato (pale)	110	1.6	0.2	2	33	35	37
Sweet Potato (yellow)	110	1.6	0.2	2	33	**1800**	37

Diversifying Beyond Staple based diets

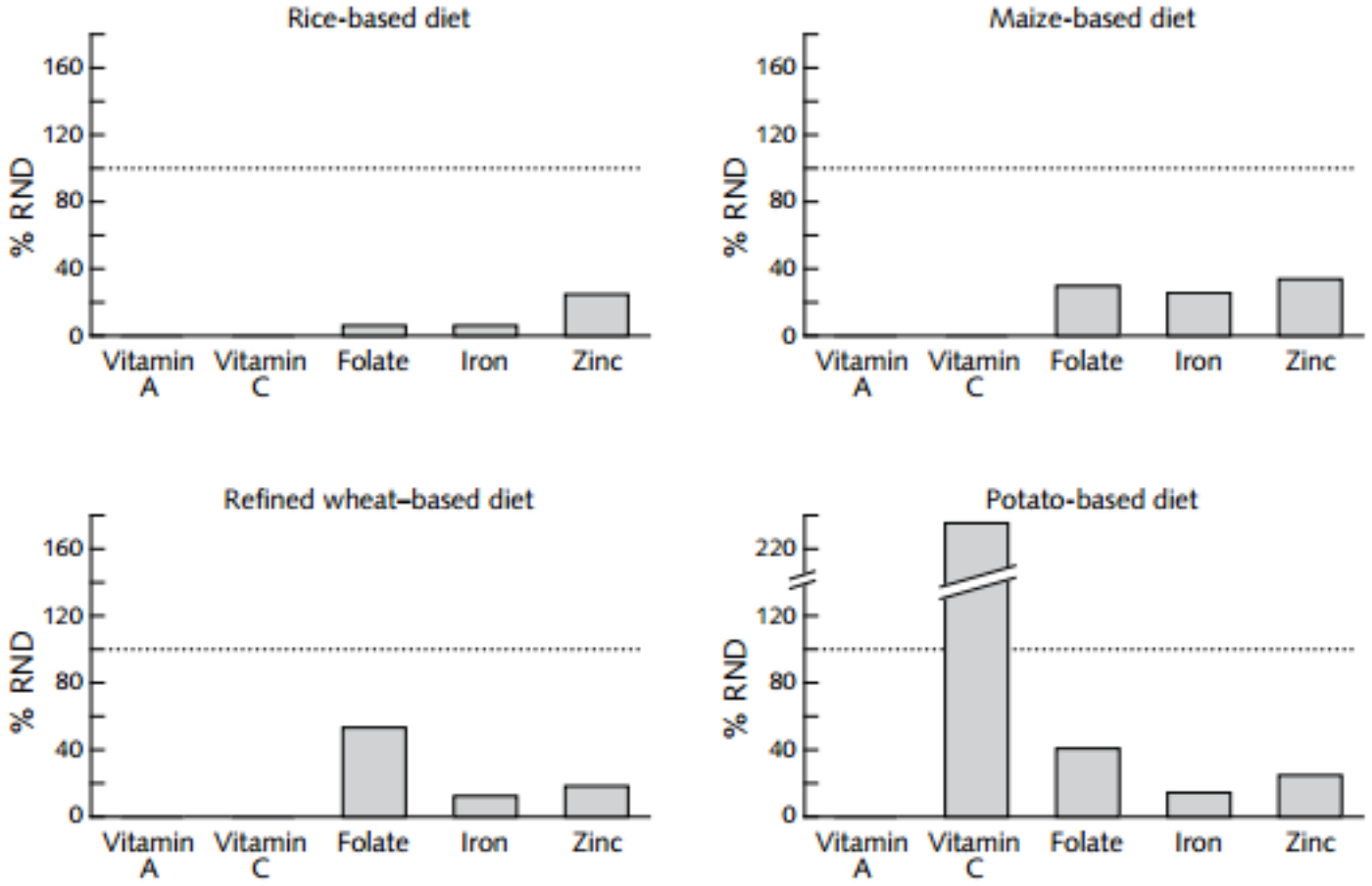


FIG. 4. The insufficiency of common staple foods to meet critical micronutrient needs, expressed as percentages of required nutrient density (RND). Adapted from Uauy-Dagach and Hertrampf [18]

Pulses (legumes)

- e.g. – beans, peas, lentils, chick peas, groundnuts (peanuts)
- edible seeds
- ~ 22% protein + fat
  - peanuts 45% protein
  - soybeans 35% protein

Common bean (*Phaseolus vulgaris*)

- High source of iron, fiber and carbohydrate
- Good high quality protein source
- 1 cup provides half of folic acid RDA, 30% of daily iron intake, 15% zinc and potassium

Cowpea (*Vigna unguiculata*)

- Provides protein
- High in B vitamins

Peanut (Groundnut)

- High quality oil (50%)
- Digestible protein (25%)
- Valuable source of E, K and thiamin (B1)
- Rich in niacin

Soybeans

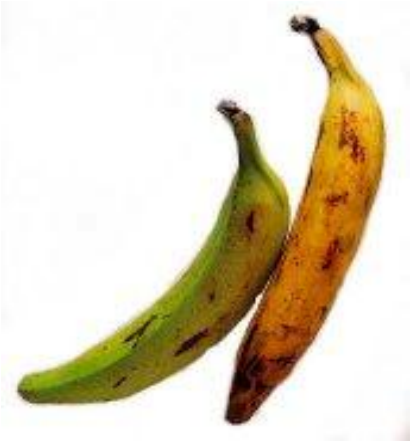
- 38% high quality protein (highest of all food crops)
- 18% oil
- High in B vitamins

Fruits

- Outside carbs their main value is vitamins (e.g. C and A)
- Avocados – high in fat
- Guava – highest vitamin C content
- If consumed with fat, vitamin A is absorbed better

Bananas and plantains

- Rich in carbohydrates
- High phosphorus, calcium and potassium
- Rich in vitamin C

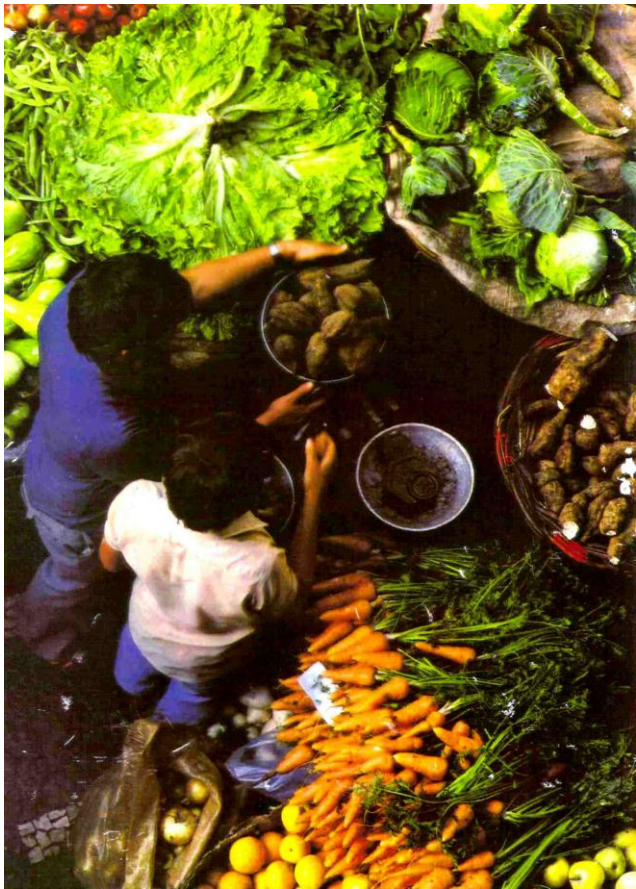


Durian

- A 1-cup serving of durian fruit contains 357 calories.
- It also contains quite a bit of fat -- 13 g per serving
- Significant amount of fiber
- 80 percent of the vitamin C you need each day; high in thiamin

Vegetables

- Depends on the type but dark leafy greens are rich in iron, folate, calcium



Vegetables are important for micronutrient consumption:

Nutrient composition of Green Leafy Vegetables found in Timor-Leste

Per 100 g	Kailan	Kangkung	mustard leaf	bok choy	chinese cabbage	silverbeet	RDA for adult women
Protein	2.3 g	2.7 g	3.7 g	1.5 g	1.2 g	3.27 g	58 g
Calcium	173 mg	60 mg	57.7 mg	105 mg	77 mg	51 mg	400 mg
Iron	1.4 mg	2.5 mg	0.8 mg	0.8 mg	0.31 mg	1.8 mg	19 mg
Vitamin A	10,000 IU	9665 IU	5881 IU	4468 IU	318 IU	6116 IU	2500 IU
Vitamin C	140 mg	45 mg	39.2 mg	45 mg	27 mg	30 mg	30 mg
Other names	*chinese broccoli*	*water spinach*		*chinese cabbage*	*napa cabbage*	*chard*	

Nutrients in Different Types of Foods

Food	Rich source of	Moderate source of
Cereals	Starch, fibre	Protein, B vitamins, many minerals
Starchy roots and fruits	Starch, fibre	Some minerals, vitamin C if fresh, vitamin A it yellow or orange
Beans and peas	Protein, starch, some minerals, fibre	B vitamins
Oilseeds	Fat, protein, fibre	B vitamins, some minerals
Fats and oils	Fat	Vitamin A if orange or red
Dark- to medium-green leaves	Vitamins A and C, folate	Protein, minerals
Orange vegetables	Vitamins A and C	Fibre
Orange fruits	Vitamins A and C	Fibre
Citrus fruits	Vitamin C	Fibre
Milk	Fat, protein, calcium, vitamins	
Eggs	Protein, vitamins	Fat, minerals (not iron)
Meat	Protein, lat. iron	
Fish	Protein, iron	
Liver	Protein, iron, vitamins	

Source: King and Burgess, 1993.

The 9 essential amino acids

- Indispensible to the body to function properly
- Must be obtained from the diet. Our bodies cannot synthesize.

Protein quality of a food

- Ability of a food protein to support growth and maintain body tissues
- ***Complete protein*** – all 9 essential amino acids
- ***Incomplete protein*** – missing or low in at least 1 essential amino acid
- ***Limiting amino acid*** – essential amino acid in the lowest concentration

Animal foods contain all 9 e.a.a.

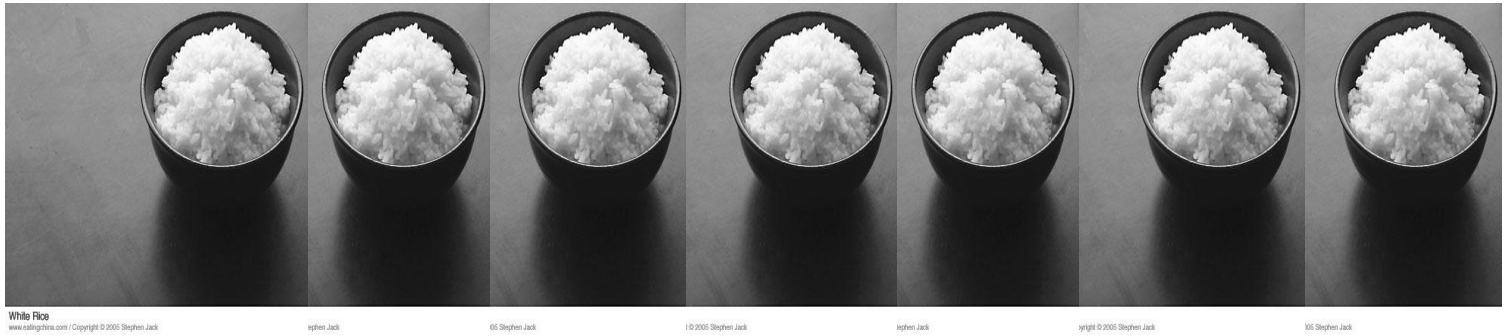
Complementary proteins

- 2 food protein sources whose amino acid content complement each other in such a way that the limiting amino acid content in one is supplied by the other
- Different plant groups have different limiting amino acids
- Cultures have developed dietary patterns over thousands of years that provide a full complement of essential amino acids

In general, legumes provide plenty of the amino acids isoleucine (Ile) and lysine (Lys), but fall short in methionine (Met) and tryptophan (Trp). Grains have the opposite strengths and weaknesses, making them a perfect match for legumes.

	Ile	Lys	Met	Trp
Legumes	■	■		
Grains			■	■
Together	■	■	■	■

Complete protein – grains + legumes



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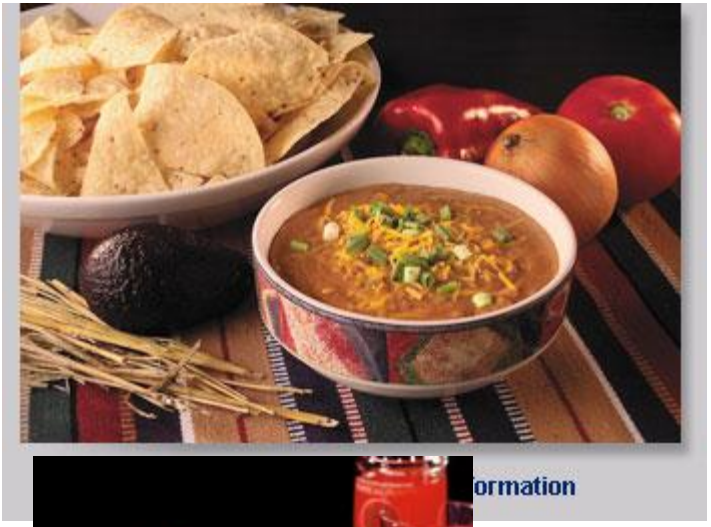
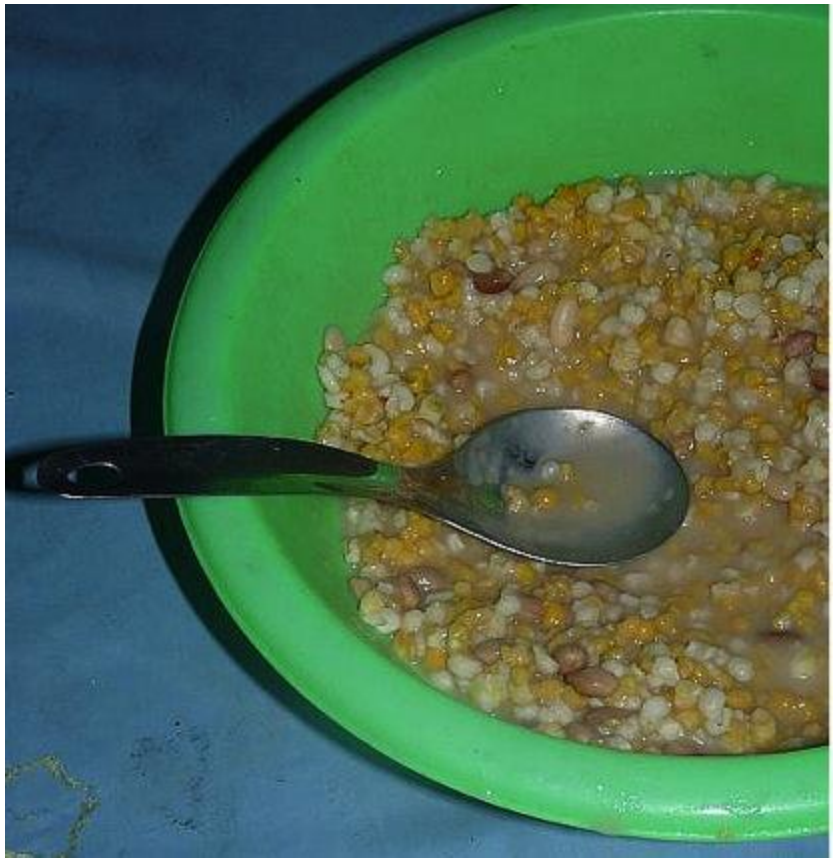
Corn tortillas or rice and beans



Back to Tradition: Batar Dan



100g corn (skins and embryos removed)
10 g red beans
10 g peanuts
20 g boiled pumpkin
15 g green leafy

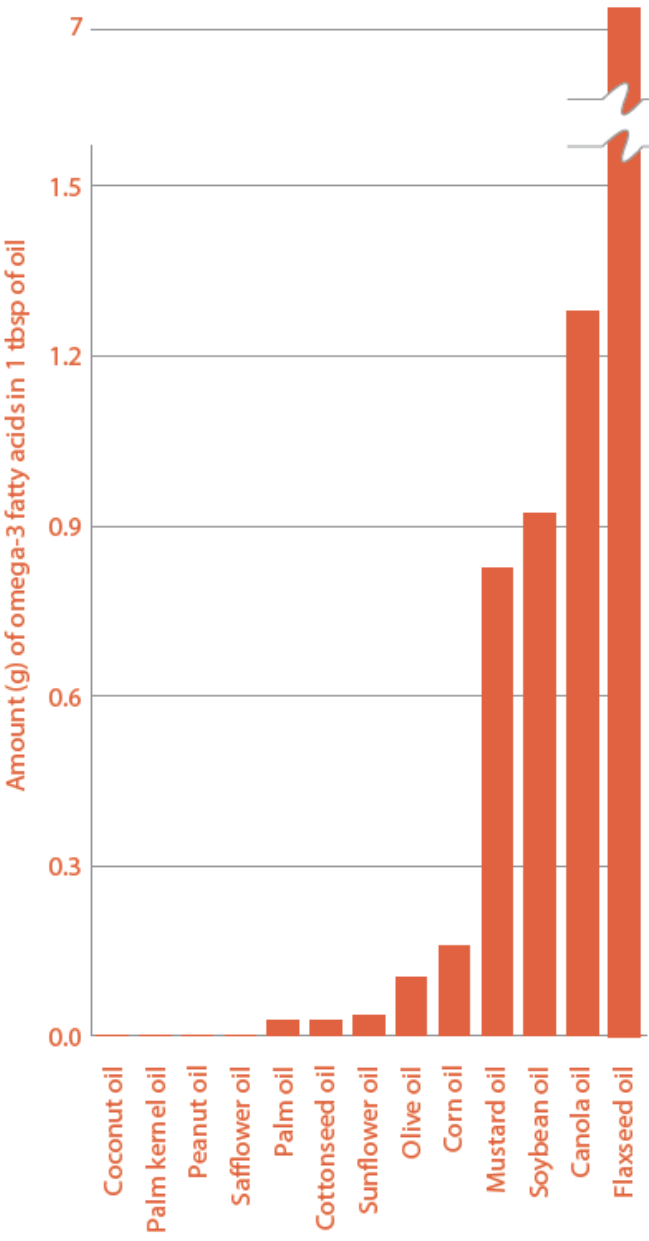
Incomplete protein

- Cassava flour and water
- Cassava + beans ≠ complete protein
- Plantains (or green bananas) + beans ≠ complete protein

Essential Fatty Acids are important in growth

Essential fatty acids are those that humans are unable to synthesize and must therefore obtain through their diet. They include alpha-linolenic acid (ALA), the building block for the longer-chain omega-3 fatty acids, and linoleic acid (LA), the building block for the longer-chain omega-6 fatty acids.

	INFANTS AND YOUNG CHILDREN (6–24 MONTHS)	PREGNANCY AND LACTATION*
Total fat	Gradual reduction to 35% of total energy intake, depending on physical activity	20–35 % of total energy intake
Omega-6 PUFA	3.0–4.5% of total energy intake (linoleic acid only)	2–3% of total energy intake (linoleic acid only)
Omega-3 PUFA	0.4–0.6% of total energy intake (alpha-linolenic acid only)	0.5–2% of total energy intake (ALA + other omega-3 PUFA)



Thank you!