Non-staple foods & micro-nutrient status: effects of the 2007/08 food price spike

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Acronyms

FAO	Food and Agriculture Organisation of the United Nations
HRW	Hard Red Winter (Wheat)
IMF	International Monetary Fund
LDCs	Least Developed Countries
LIFDCs	Low Income Food Deficit Counties
MDG	Millennium Development Goal
NEPAD	The New Partnership for Africa's Development
PLW	Pregnant and Lactating Women
UNICEF	United Nations Children's Fund
UNSCN	United Nations Standing Committee on Nutrition
VMDs	Vitamin and Mineral Deficiencies
WDI	World Development Indicators (World Bank)
WFP	World Food Programme of the United Nations
WHO	World Health Organisation of the United Nations

Acknowledgements

Thanks to Anna Taylor for helpful comments on an earlier version. All errors remain with the authors

Summary

Aims

This paper is about the food price spike of 2007/08, non-staple foods, and people's micro-nutrient status — that is their supply and use of vitamins, minerals and trace elements needed in small amounts to allow full physical development and functioning.

It responds to the following questions:

- What happened to non-staple food prices in countries where staple prices rose dramatically in 2008? What were the impacts on micro-nutrient status?
- Are non-staple food prices any more volatile within or between years than staple foods and if so what could be the reasons for this? Are there significant differences between different groups of non-staple foods?
- In countries that have managed to significantly increase agricultural productivity in recent years what has happened to the availability and price of non-staple foods? Is there evidence from the Green Revolution in Asia to suggest investments in rice production reduced people's consumption of non-staples or increased their prices?

A brief survey of data and literature produces the following findings.

Micro-nutrient status and diets in the developing world

Micro-nutrients matter. Currently as many as two billion people suffer from deficiencies. These cause death, illness, and lower capacity to work, learn, and enjoy life.

Diets are changing in the developing world. Since the mid-1970s there has been a major increase in consumption of non-staples, above all of vegetables and fruits. Gains are however quite uneven across developing regions, with areas such as Eastern Asia and Northern Africa pulling up continental averages.

During the last thirty years in developing Asian countries that have seen green revolutions in their cereals production, there have usually been significant increases in both production and consumption of non-staple foods as well. An important exception to this is Bangladesh, where advances in cereals production have not been echoed by other foods.

Consumption of non-staples rises with incomes, but not necessarily that closely. Of non-staple products being consumed, those from animals show the strongest correlation with income. Evidence from East Africa suggests that micro-nutrient intakes rise with incomes, calorie intake, primary education, home gardens, and being close to markets.

Non-staple prices during 2007/08

The prices of several non-staple foods also rose on world markets during the price spike, owing to similar drivers such as rising oil prices, and to knock-on effects of spiking cereals prices such as rising costs to grains for those fattening animals. Much less is known about prices of non-staples on domestic markets. In some cases, the prices of non-staples may have actually fallen as poor consumers cut back on consumption of non-staples to maintain their intake of staples.

Impacts on consumption and nutrition

Reports from the field confirm that generally, poor people eat less fruit and vegetables, meat, and dairy when the cost of staples such as rice, bread and potatoes go up. They thus get fewer vitamins and minerals than they need.

There is however little first-hand evidence to confirm the extent of either increased vitamin and mineral deficiencies, or their outcomes in illness and premature death. It is difficult to measure deficiencies and some of their outcomes; and still more difficult to attribute harm to the effect of higher food prices.

That said, there is plenty of plausible evidence from previous food crises to assume the food price spike of 2007/08 had a strong negative impact on the micro-nutrient status of vulnerable poor people, particularly young children and women.

Implications

Given that it seems very likely that the price spike did increase deficiencies of vitamins and minerals, counter-measures to deal with the effects of price (and other) shocks needs consideration. Three policy areas are indicated:

1. ***Mitigating rises in prices of foods rich in minerals and vitamins.*** Countries with the means might consider subsidising the prices of key foods, such as milk. This, however, would be costly: to reduce costs, subsidised foods might be rationed, and these might be means-tested or otherwise targeted to the poor and vulnerable.

   Measures to dampen volatility of prices include: reducing perishability, for example though increased or improved storage or processing; increasing variety and substitutability of available non-staples, for example by encouraging more varieties in home gardens; and promoting trade in non-staples between regions with complementary harvest schedules.

   Production of foods rich in minerals and vitamins might be stimulated, perhaps by distributing kits for home vegetable gardens. The drawback is that additional foods may only become available late in the day;

2. ***Food fortification and supplementation.*** Rather than trying to restore levels of intake of non-staples during crises, an alternative would be to boost intake of vitamins and minerals through other means. Fortification of staples with vitamins and minerals, in food processing plants may be possible, in countries where significant numbers consume processed staples. Plants would also need to have the capacity and experience to do this. Alternatively, special and temporary programmes could be used to provide supplements to vulnerable mothers and young children, such as vitamin A tablets, or iron supplements. This may only be possible in countries with good coverage of well-functioning public health services: to meet additional needs after a price shock, it will probably be necessary to have existing supplementation programmes already in place.

3. ***Education on vitamins and minerals, feeding strategies, and how best to use limited budgets during economic shocks***.

   In addition, given that making use of vitamins and minerals consumed depends on health, then measures to keep up health are indicated, including temporary suspension or reduction of any charges for health care and water during economic shocks.

Although there is too little information about most aspects of the impacts of price spikes, in the case of micro-nutrient status the deficiency is acute. With so little reliable information, problems do not get the political priority their seriousness would imply; while policy-makers have to make guesses about the measures that might be effective. Priorities for more information include:

- Changes in intakes of foods rich in vitamins and minerals by poor and vulnerable groups. Regular sample surveys of consumption, perhaps using dietary diversity scoring, would help. A proxy is to monitor the prices of key foods rich in minerals and vitamins, as well as key staples, and report on these monthly. A sudden and substantial rise in the price of either groups of foods, staples or non-staples, should ring alarm bells; and,
- Levels of deficiencies in minerals and vitamins amongst vulnerable groups, and especially young children and mothers. Currently, nationally-representative surveys in many low incomes countries take place less than once a decade. At least once every five years national surveys are needed, if levels and trends are to be established

Finally, in the longer run, more concerted action is needed to reduce the current extremely widespread incidence of micro-nutrient deficiency.

1 Introduction

This paper is about the impacts of the food price spike of 2007/08 on micro-nutrient status — that is vitamins, minerals and trace elements needed in small amounts to allow full physical development and functioning.

It responds to the following questions:

- What happened to non-staple food prices in countries when staple prices rose dramatically in 2007/08? What were the impacts on micro-nutrient status?
- Are non-staple food prices any more volatile within or between years than staple foods and if so what could be the reasons for this? Are there significant differences between different groups of non-staple foods?
- In countries that have managed to increase agricultural productivity significantly in recent years, what has happened to the availability and price of non-staple foods?
- How did the Green Revolution in Asia affect the production of non-staples and their prices?
- How might agricultural development enhance the availability of, and access to, non-staple foods?

Since answers to the questions posed are potentially large, this paper concentrates mainly on what is known about the prices of non-staples during the 2007/08 price spike, changes in their consumption during this period, impacts on nutrition, and policies that might be indicated when trying to mitigate harm to micro-nutrient status resulting from price spikes — and indeed other economic shocks. The recommendations presented here are responses to the problems reported, rather than addressing the broader issue of agricultural development strategy.

This paper is based on a brief survey of the literature, plus some simple analysis of existing data. By and large there is not as much readily-available evidence on how the price spike affected, or even may have affected, micro-nutrient status compared to information about the macro-nutrients of calories and protein. Hence some of the conclusions arrived at are tentative.

The paper is set out as follows:

- Chapter 2 sets out the background: the problems caused in the developing from deficiencies in intakes of vitamins and minerals; and the ways in which diets in the developing world have changed since the 1970s;
- The third chapter examines the levels and volatility of prices of non-staple foods that are often rich in micro-nutrients;
- Chapter 4 considers what is known about the consumption of non-staple foods during the 2007/08 price spike, and hence the impacts of the spike on nutrition; and
- In the fifth and final chapter, the main results are discussed and their potential policy implications assessed.

2. Micro-nutrient deficiency and changing diets in the developing world

Micro-nutrients matter

Hunger is widely associated with insufficient intake of macro-nutrients—foods that people need in large quantities, i.e. calories, protein, and fats. When prices of staple foods doubled or more on international markets in late 2007 and early 2008, angry people rioted. Poor micro-nutrient status, meaning not enough vitamins and minerals, is an equally important facet of hunger. It is more likely to be hidden and borne without protest.

Deficiencies of micro-nutrients are far more common than those of macro-nutrients, see Table 2.1. Two billion people are estimated to suffer from lack of iodine, two billion — not necessarily the same group — are reckoned to be anaemic, and 250M children under five years lack sufficient vitamin A. These problems thus affect 30%, 30% and 40% of the relevant groups. Micro-nutrient deficiencies therefore likely affect over twice[1] the estimated number of people suffering from more visible chronic hunger. Estimates by region also exist for Zinc deficiency in children under five—see Figure 2.1. Though similar estimates of deficiency in other nutrients, such Folic Acid, are not available, they are believed to be high, particularly in developing regions[2].

Table 2.1 Global malnutrition statistics

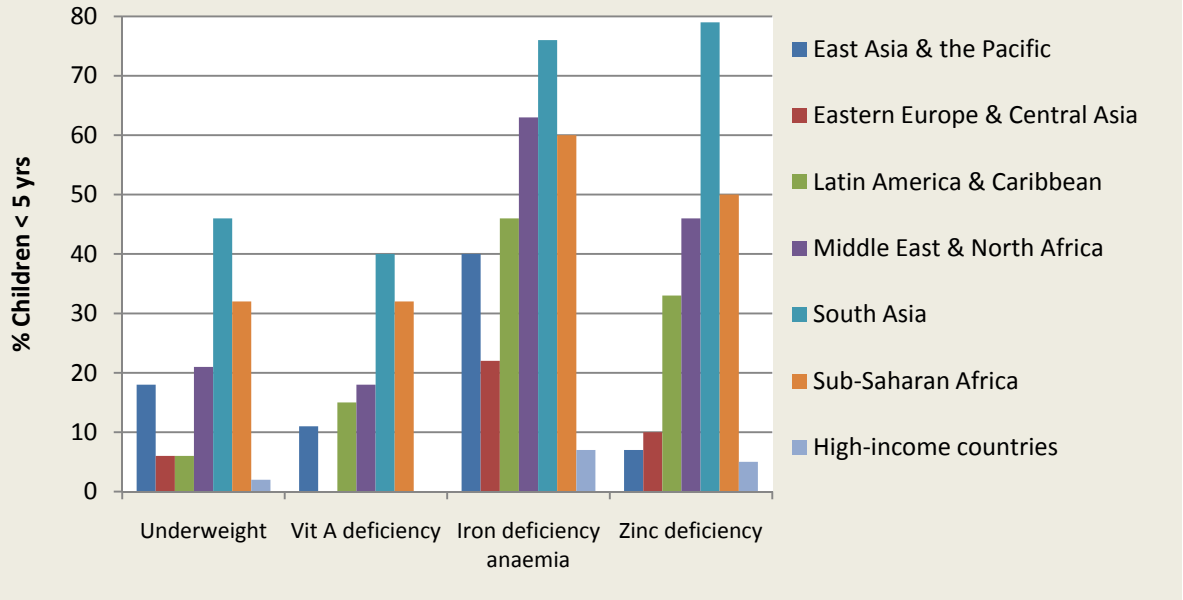
	Millions	*Prevalence*	*Source*
MACRO NUTRITION			
Chronically hungry people [x] [inadequate energy intake]	**925**	13% of all people	FAO
MACRO &MICRO-NUTRITION			
Underweight children under 5 [y] [low weight-for-age]	**148**	24% of under-fives	UNICEF
Stunted children under 5 [low height-for-age]	**214**	35% of under-fives	WHO / WDI
MICRO-NUTRITION			
People with iodine deficiency	**2000**	30% of all people	WHO
Anaemic people [z]	**2000**	30% of all people	WHO
Vitamin A deficient children under 5	**250**	40% of under-fives	WHO

Notes: All estimates from the late 2000s except number of chronically hungry people which is from 2010. [x] Tracked under MDG 1: Target 1.9. [y] Tracked under MDG 1: Target 1.8. [z] Many owing to iron deficiency, frequently exacerbated by infectious diseases. Malaria, HIV/AIDS, hookworm infestation, schistosomiasis, and other infections including tuberculosis are important contributory factors to high anaemia prevalence in some areas.

[1] The exact magnitude is not clear, but it is fairly safe to assume the same 2 billion people with iodine deficiency do not make up the entire cohort suffering other VMDs

[2] In its 10 year strategy for the reduction of vitamin and mineral deficiencies draft action plan 2008-2011, NEPAD cited Iodine, Vitamin A, Anaemia, Zinc, and Folic Acid deficiencies as the five most problematic nutrition deficiencies for Africa as a continent. Other particularly important micronutrients include: Calcium, Vitamins C & E, B-Vitamins (thiamine, niacin, riboflavin), magnesium, copper and selenium, among others.

Figure 2.1: Malnutrition of children under five, by region, early 2000s



Source: Table 28.1 in Caulfield et al. 2004 http://files.dcp2.org/pdf/DCP/DCP28.pdf. **Original sources**: Underweight: Fishman and others 2004; vitamin A: Rice, West, and Black 2004; iron: Stoltzfus, Mullany, and Black 2004; zinc: Caulfield and Black 2004.
Notes: Moderately and severely underweight indicates children with weight for age below -2 standard deviations.

Lack of micro-nutrients in the diets and status of pregnant women can have a significant impact on foetal and baby growth. Studies show that:

- Consumption of more expensive micro-nutrient rich food (milk, green leafy vegetables and fruits) during pregnancy and the level of vitamin B in red blood cells (erythrocyte folate) at 28 weeks of gestation were independently and positively associated with the size of infants at birth in rural India [UNSCN 2009a; Rao et al. 2001]
- Increased intake and/or status of antioxidant nutrients (Vitamin C and E especially) which largely come from more expensive fruit and vegetables, positively influences foetal and infant growth [UNSCN 2009a; Mathews et al. 1999; Hong et al. 2007]
- Multiple micro-nutrient supplementation, plus iron folate supplementation in late pregnancy of thin Indian women (BMI < 18.5), significantly increases birth weight and length (by 98g and 0.80cm respectively)—reducing overall incidence of low birthweight from 43% to 16%. It also reduces early neonatal morbidity by 50% compared to a placebo group [UNSCN 2009a; Gupta et al. 2007]; and
- Iron-folate supplementation versus a true placebo in non-anaemic US women in the latter part of pregnancy increased birthweight by about 100 to 200g [UNSCN 2009a; Cogswell et al. 2003; Siega-Riz et al 2006]

Deficiencies in micro-nutrients also present serious health risks. They are associated with higher neonatal, child and maternal mortality, blindness, birth defects, stunted physical and mental development, poor performance in school, and reduced immunity to illnesses: conditions that are compounded when people suffer from more than one deficiency. These deficiencies have long-

lasting negative impacts on the life-time health, education and income prospects of individuals, their children and whole economies (Horton and Ross 2003; Darnton-Hill et al. 2005; Victora et al. 2008). Estimates of the damage caused by deficient micro-nutrient status include the following:

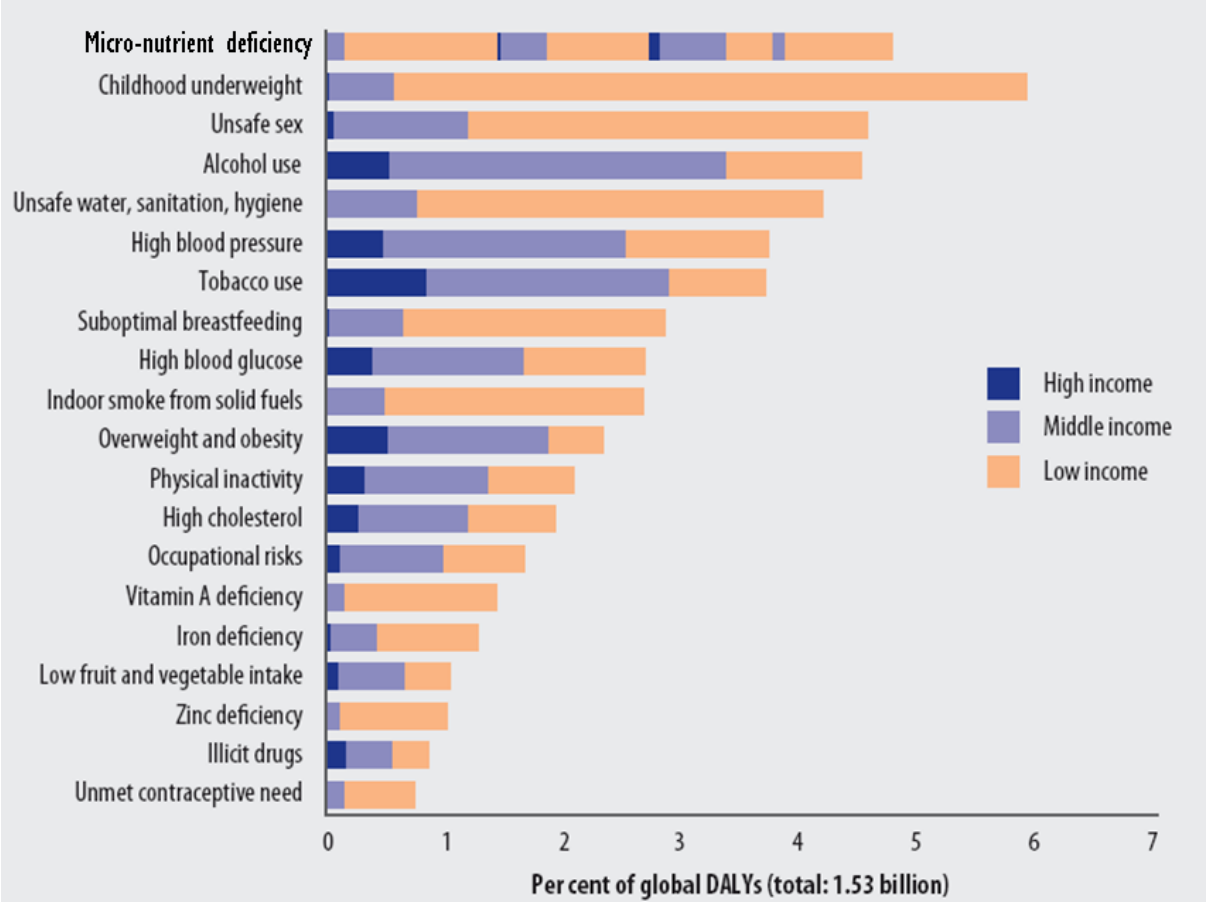
- **Vitamin A deficiency** kills 1 million infants a year [UNICEF 2004], or 1 to 3M [UNSCN 2005], increases the risk of severe illness, and even death, from common childhood infections such as diarrheal diseases and measles [CDCP], and causes some 500,000 children to go blind [United Call to Action, 2009] of whom most, about 70%, die within a year of losing their sight [CDCP]. Black et al, (2008) estimate that in 2004 the deaths of almost 668 thousand children under five (6.5% of under five deaths) could be attributed to Vitamin A deficiency.
- **Iron deficiency** impairs mental development of 40 to 60% of children in developing countries [UNICEF, 2004]. Eradicating it can improve national productivity levels by 20% [WHO Global database on Anaemia]. It is among the top 10 causes of global disease, and contributes to about a quarter of maternal deaths in developing countries [United Call to Action 2009]. Black et al, (2008) estimate that in 2004 the deaths of almost 21 thousand children under five (0.2% of under five deaths) could be attributed to iron deficiency.
- **Iodine deficiency** is the greatest single cause of mental retardation, and causes brain damage in nearly 18 million newborns each year [United Call to Action 2009]. It can easily be prevented by adding iodine to salt [UNSCN, 2005]. Black et al, (2008) estimate that in 2004 the deaths of almost 4 thousand children under five (0.03% of under five deaths) could be attributed to iodine deficiency.
- **Zinc deficiency** caused an estimated 453 thousand under-five deaths in 2004 (Black et al., 2008). Zinc supplementation in young children has been found to reduce mortality by a statistically significant 9% [WHO 2006].
- **Folic acid deficiency** causes severe birth defects in approximately 150,000 newborns each year [United Call to Action 2009]. According to the CDCP, approximately three quarters of the 300,000 annual cases of babies born with severe neural tube defects[3] could have been prevented by women consuming Folic Acid.

The combined effect of vitamin A deficiency, iron deficiency, low fruit and vegetable intake, and zinc deficiency are second only to children being underweight, in terms of disability-adjusted life years[4], see Figure 2.2.

[3] Spina bifida (malformed vertebra/e) and anencephaly (small or missing brain hemispheres)

[4] The disability-adjusted life year (DALY) is an indicator developed by the WHO to measure the burden of disease as number of years lost to poor health, disability, or premature death.

Figure 2.2: Percentage of disability-adjusted life years (DALYs) attributed to 19 leading risk factors, by country income level, 2004



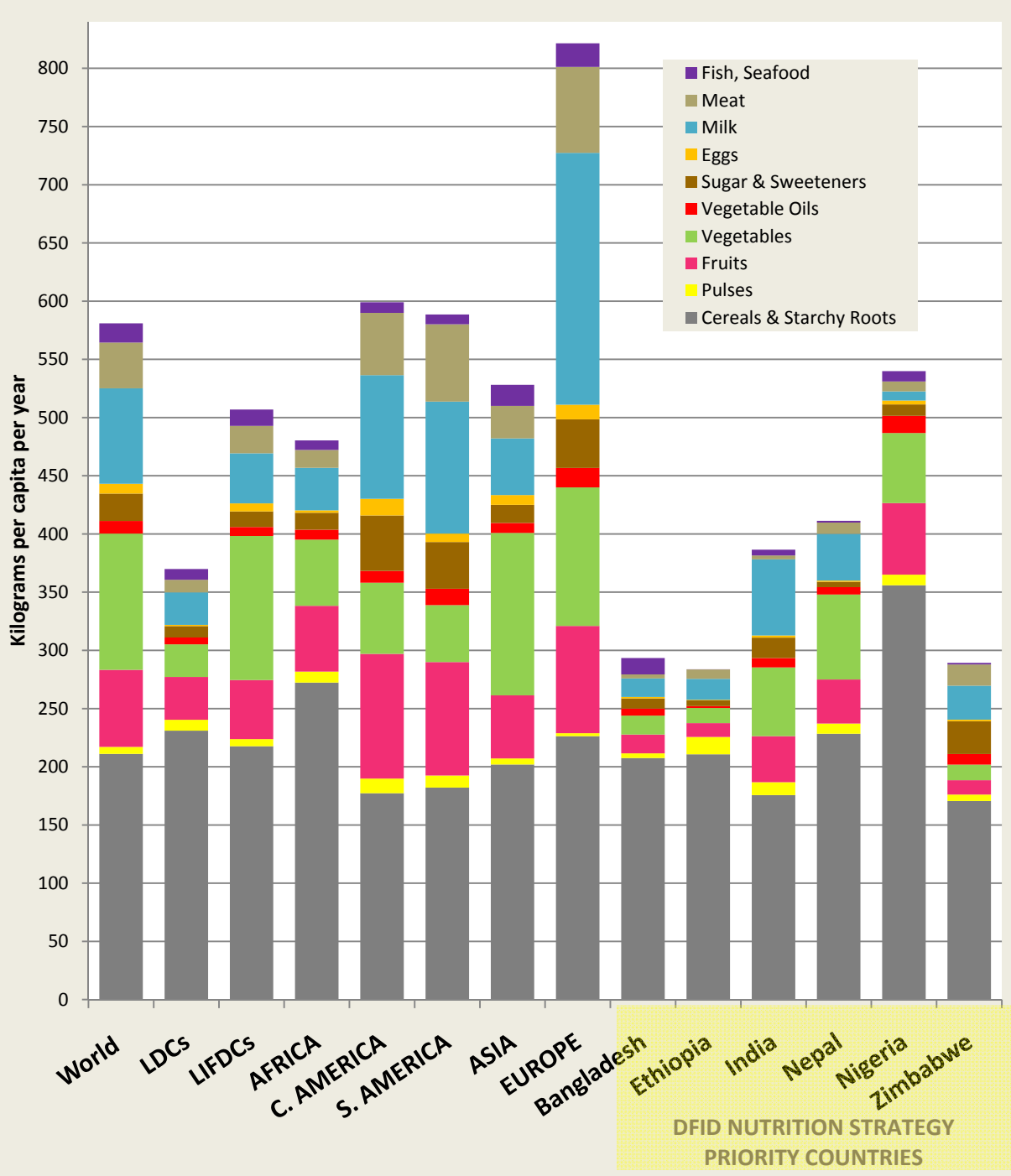
Source: WHO 2009. **Notes**: The top bar entitled 'Micro-nutrient deficiency' was added; constructed as a combination of Vitamin A deficiency, Iron deficiency, Low fruit and vegetable intake, and Zinc deficiency. Low fruit and vegetable intake can impact health through other avenues than micro-nutrient deficiency.

Changing patterns of food consumption in the developing world

How much non-staple food is available in poorer regions of the world? Amounts vary greatly by country and region. Figure 2.3 illustrates kilograms per capita availability[5] of various foodstuffs in the mid 2000s (an average for 2004 to 2006) for the six countries DFID prioritised in its nutrition strategy of 2010 — Bangladesh, Ethiopia, India, Nepal, Nigeria, and Zimbabwe — as well as the world average, the averages across developing country groups thought to be particularly vulnerable to food insecurity — Least Developed Countries [LDC] and Low-Income Food-Deficit Countries [LIFDC] — and for regions — Africa, South America, Central America, Asia, and Europe for comparison[6].

[5] Measured by FAO as a balance of what is available considering production, netting out imports and exports, and deducting for waste and reuse within farming.
[6] More detail appears in Annex A, including figures arranged by commodity type.

Figure 2.3 Amount of different foods supplied in the mid 2000s by region and country



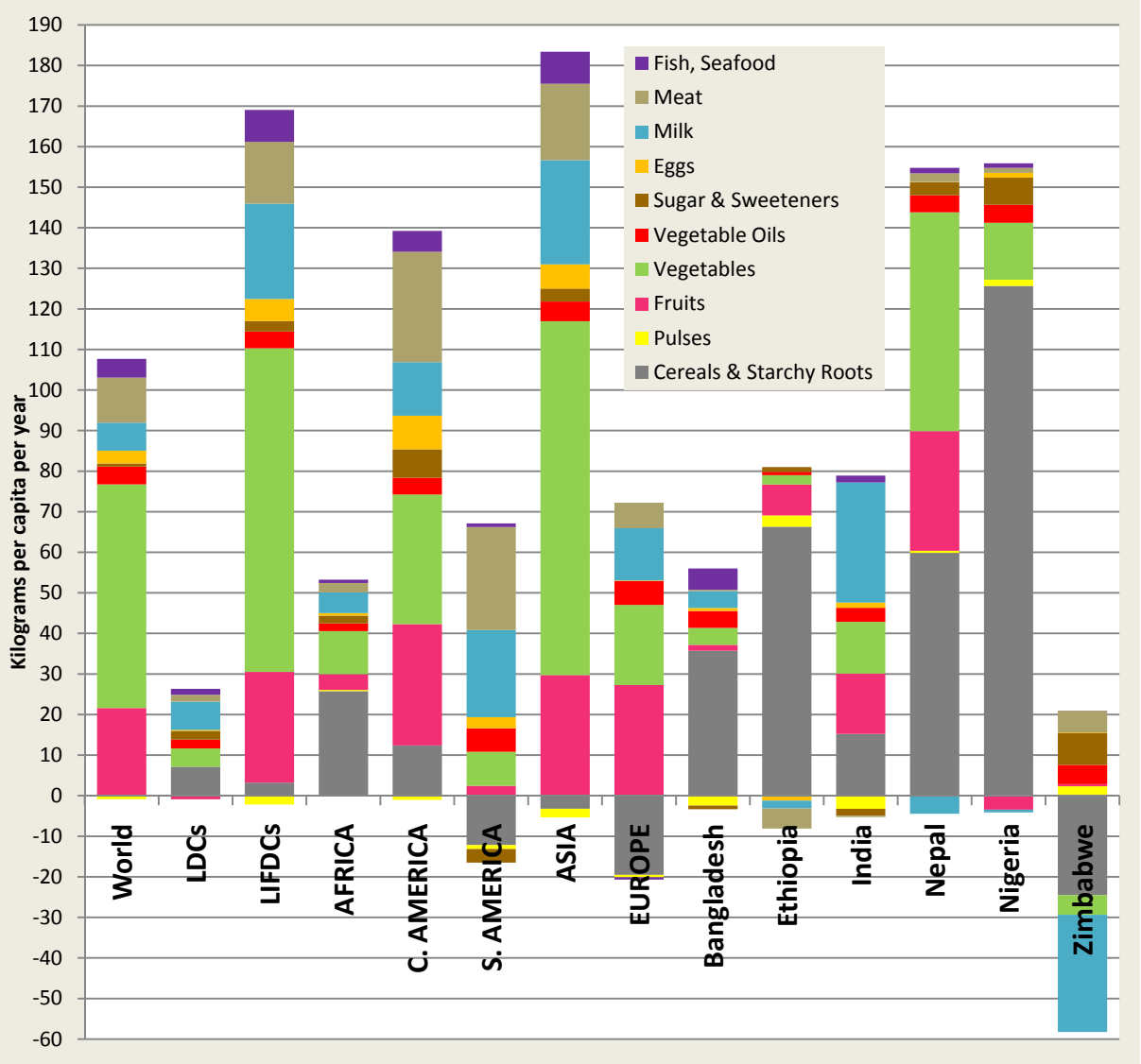
Source: Constructed with data from FAOSTAT. **Notes**: Average amounts supplied in mid 2000s (2004 to 2006). LDCs = Least Developed Countries; LIFDCs = Low Income Food Deficit Countries

- Diets in developing countries are dominated by cereals and pulses, with consumption of these foods above the world average.
- Oils, sugar, meat, milk — are all consumed to a much greater degree in OECD countries than in developing countries.

- Asian diets are notably richer in vegetables than other parts of the developing world.
- Central and South American diets are particularly rich in fruits, milk, and sugar

While it seems that developing world diets are dominated by staples, with relatively low intakes of complementary foods, this is changing — and has been for many years. Since the mid-1970s dependence on cereals and pulses has been falling, while considerably more complementary foods — fruits and vegetables, oils, and animal products are being consumed, above all in Asia. Figure 2.4 plots the percentage change in consumption of food groups per capita from the mid-1970s (average of 1974–76) to the mid 2000s (average of 2004–06). More detail appears in Annex A.

Figure 2.4 Change from the mid 1970s to the mid 2000s in amount of different foods supplied by region and country

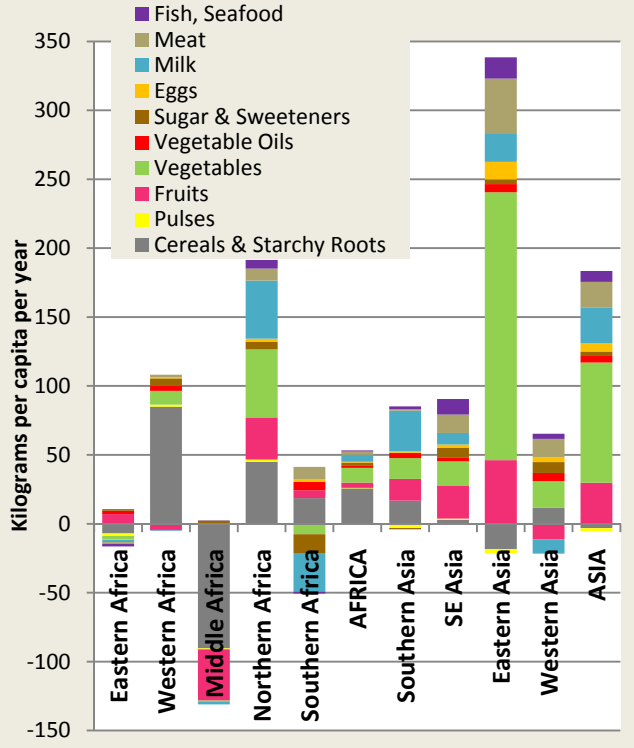


Source: Constructed with data from FAOSTAT

- Since the mid-1970s, for the world, there has been a major increase in consumption of non-staples foods, by 107 kg/person a year; while there has been hardly any change in the

volume of staples consumed. Half the increase in non-staples has been in vegetables, a quarter from meat, milk, eggs and fish one fifth from fruits. Improvements have been particularly strong in Asia and Central America

Figure 2.5 Change from the mid 1970s to the mid 2000s in the amount of food supplied by region in Africa and Asia



Source: Constructed with data from FAOSTAT. **Note**: Central Asia figures are not included as data for that region is not available from the mid 1970s.

- Some countries and country groups are lagging very seriously behind progress in other areas of the world
- Continental aggregates hide considerable variation – See Figure 2.5.
- Improvements in non-staple availability in Africa are largely driven by Northern Africa. Eastern Asia dominates Asian improvements in vegetables, while Southern Asia saw considerable improvement in milk availability.

Relationship between average incomes and non-staple consumption

On a household level, rising average incomes are probably important in explaining the increased consumption of non-staples, since most non-staple foods have a higher income elasticity of demand than staple foods. On an intra-household level, access may also depend on factors such as whether or not infants are prepared special weaning foods, and whether women and children eat meat after men, and therefore less. In this sense, much depends on education and empowerment of mothers, and local food culture and customs

But how close is the relationship to incomes? A simple test is to correlate wealth with consumption of the different categories of foods. This was done for a sample of 88 countries, correlating household consumption expenditure per capita and the amount of food supplied in kilocalories for different categories of non-staple foods, in 1990, 2000 and 2007.[7] Table 2.2 presents the results.

[7] Pulses are included, though they tend to be considered staple foods, they can provide as much or more micronutrients (particularly folate – vitamin B9) as some more 'luxury' commodities. See Table C in Annex C for micro-nutritional content of a selection of pulses, animal products, fruits and vegetables.

Table 2.2 Correlations between expenditure and supply of various non-staple foods in 88 countries

	1990	2000	2007*	*Commentary*
Cereals	-45	-44	**-47**	A moderate, negative relationship with wealth.
Starchy roots	-8	-11	**-15**	Weak, negative relationship with wealth
Pulses	-41	-41	**-43**	A moderate, negative relationship with wealth.
Fruits	10	7	**13**	Little correlation with wealth
Vegetables	35	35	**34**	A weak correlation with wealth
Vegetable oils	52	55	**56**	A moderate connection with wealth
Sugar	56	60	**59**	A moderate connection with wealth
Animal products	79	81	**80**	A very strong correlation with wealth
Eggs	66	61	**58**	Correlation with wealth appears to be weakening**
Fish, Seafood	53	56	**59**	A moderate correlation with wealth
Meat	74	75	**75**	A very strong correlation with wealth

Sources: Calculated with data from World Bank WDI [Household final consumption expenditure per capita (constant 2000 US$)] and FAOSTAT [Food supply (kcal/capita/day)], using a sample of 88 countries for which data was available for all 3 years. **Notes**: *2007 is the latest year for which FAOSTAT supply data is available.**For example, according to FAOSTAT, egg amount supplied (kcal/capita/day) grew by more than 5% a year in 15 countries from 1990 to 2007: Myanmar, Samoa, Angola, Mauritius, Mongolia, Lao PDR, Seychelles, Maldives, Paraguay, Bahamas, Kiribati, Bangladesh, China, Sao Tome and Principe, and Saint Lucia

Key points that emerge are:

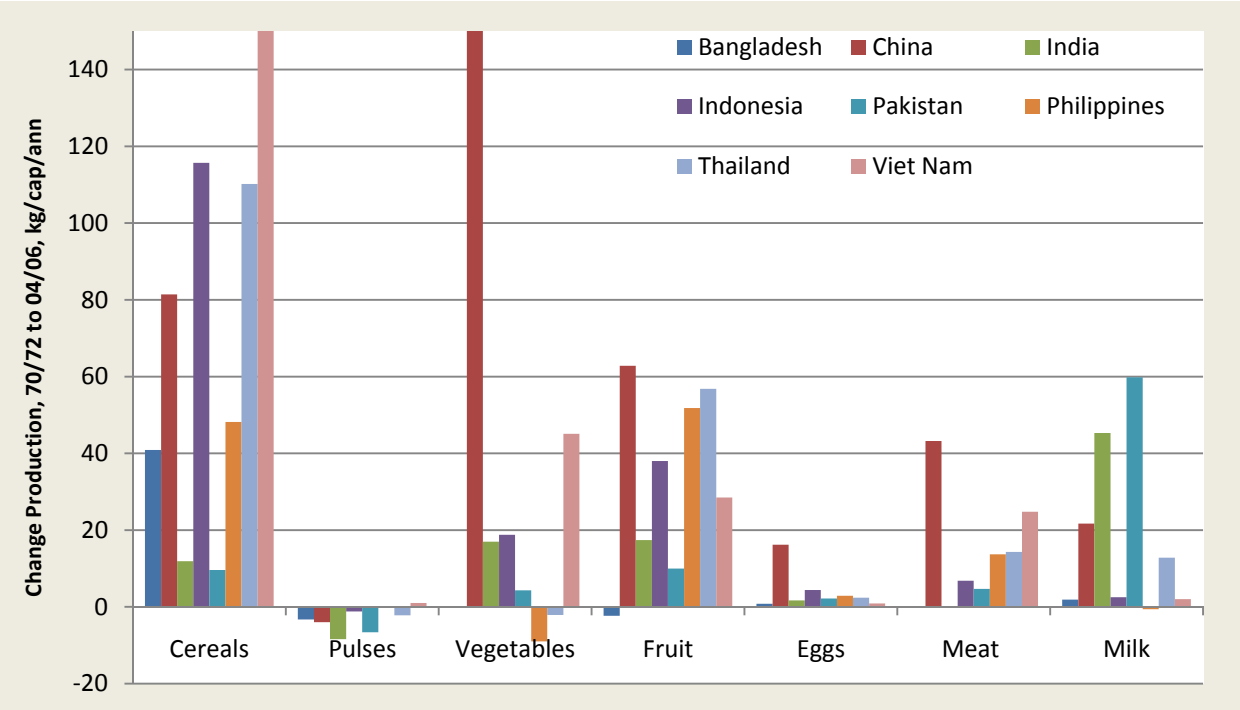
- Consumption of some foods clearly correlates well with wealth, above all for animal products.
- Consumption of others is moderately related to wealth, as applies for eggs, sugar and vegetable oils;
- Fruit and vegetables consumption barely correlates with wealth at all.
- Consumption of staples foods correlates inversely with wealth.

This confirms what is well understood about changing diets: that as people see their incomes rise, they consume less of staples and more of the non-staples. That said, the variations between the categories are considerable. Diets rich in fruit and vegetables do not apparently depend on people raising their incomes.

Agricultural development and consumption of food staples

How much has agricultural development contributed to increasing consumption of non-staples? The Asian green revolution is instructive. Increases in cereal production in a number of large Asian countries over the green revolution are well documented; but what happened to non-staple food production over this period? Comparing the early 1970s with the early 2000s, clearly shows very large increases in cereals production, see Figure 2.6.

Figure 2.6 Change in production of main foods, 1970/72 to 2004/06, developing Asia



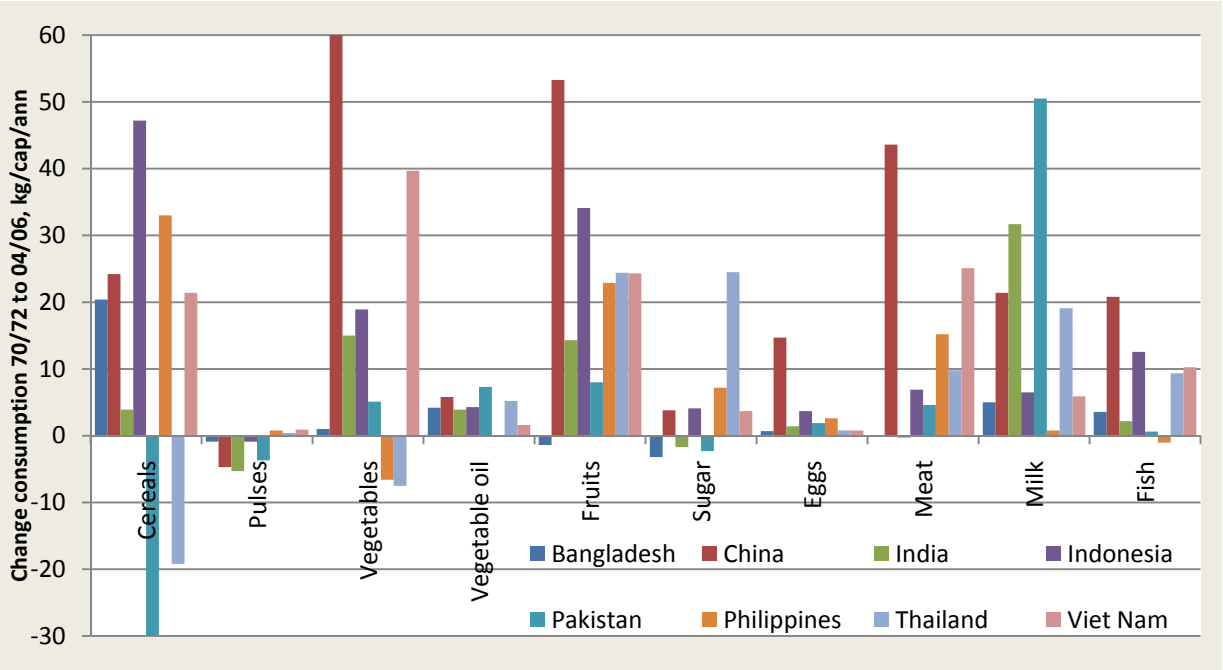
Source: FAOSTAT production data. **Note**: For cereals production in Vietnam the increase was 228 kg/cap/ann; for vegetables in China, it was 270 kg/cap/ann

Increases in cereals production were accompanied by increases in production per capita of vegetables— except in Pakistan, Philippines, Thailand; of fruit — except for Bangladesh; of meat — except for Bangladesh and India; and of milk in China, India, Pakistan and Thailand. There were small increases in eggs production in all cases. Only one group of food shows declines in production per capita over the thirty years: pulses in all cases except for Philippines and Vietnam.

Hence while the Green Revolution was first and foremost about raising production of cereals, for most foods and countries, there were significant increases in production of other foods, over and above population growth. The main exception here is Bangladesh, where advances in cereals production were not matched by production of any other food groups, other than small increases in eggs and milk. But this case is clearly unusual for Asia.

What about changes in consumption over this same period? The changes, see Figure 2.7, look similar to those in production, as would be expected in countries where the fraction of the domestic production that is traded is small. The main difference is that two countries that produced more cereals a head over the thirty years, Pakistan and Thailand, saw reduced consumption of cereals per person. Since production was rising, the change was presumably one of consumers switching from staples to more preferred foods. The increased production was in part exported — both countries are major exporters of rice, while Pakistan also exports wheat. These statistics also show changes in fish consumption: this has been rising in all cases except Thailand.

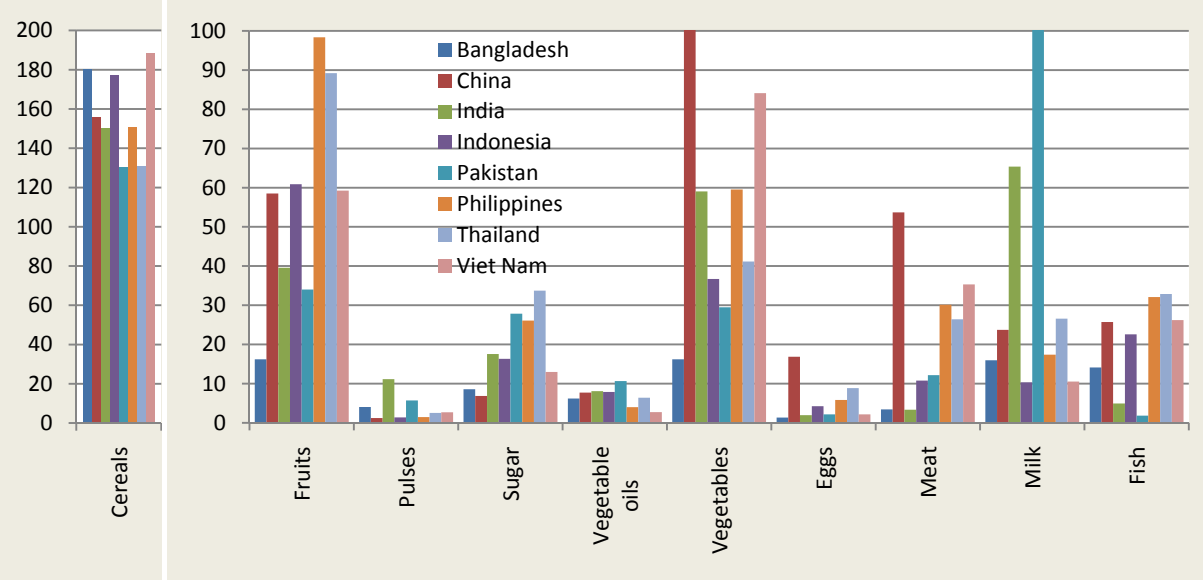
Figure 2.7 Change in consumption per capita of main food groups, 1970/72 to 2004/06, developing Asia



Source: Constructed with data from FAOSTAT. Consumption is proxied by FAO per capita Food Supply data, which is calculated as the balance of national production, trade, stocks, and waste, per the estimated population. **Notes**: China's vegetable consumption increased by 225 kg/cap/ann. Figures illustrating average per capita production and consumption of cereals and some non-staple groups are available in Annex A Figures A.3 to A.11

These statistics show changes in consumption: these can be deceptive since they do not show the levels. For example, during the 30 years, consumption of fish fell per capita in the Philippines. But this still left consumption at one of the highest levels in Asia, see Figure 2.8.

Figure 2.8 Consumption of main food groups, 2004/06, developing Asia



Source: Constructed with data from FAOSTAT. Consumption is proxied by FAO per capita Food Supply data, which is calculated as the balance of national production, trade, stocks, and waste, per the estimated population. **Notes**: China's vegetable consumption was 271 kg/cap/ann. Pakistan's milk consumption was 153kg/cap/ann.

In summary, during the last thirty years in developing Asian countries that have seen green revolutions in their cereals production, there have usually been significant increases in both production and consumption of other foods as well. The single exception to this is Bangladesh where advances in cereals production have not been matched by other foods.

3 Price movements and volatility

What happened to the prices of non-staple foods during the shock of 2007/08? During the food and fuel price crisis of 2007/08, attention was concentrated on price hikes in staple food markets—predominantly cereals. Transmission of high cereals prices from international to domestic markets, though muted in most places, had a serious impact on vulnerable people in many countries in the developing world (Compton et al. 2010). The somewhat more complicated question of what happened to non-staple food prices over this period remains.

Price movements on international markets

The prices of cereals, pulses, edible oils, fruit, sugar, and animal products on international markets were inspected for the period January 2005 to July 2010[8]. Spikes were identified, with the date of their take-off and peak, and the size of the increase from take-off to peak, recorded — see Table 3.1.

The increases in cereals prices are well-known: ranging from 95% to 206%. Those for pulses and edible oils were similar, from 101% to 171%. For all other foods inspected, all non-staples, there were rises over the period of cereals price spike, but all by less than 60%. Milk is the exception, where there was strong spike that took place before that for cereals.

[8] See Figures B.1 to B.4 in Annex B.

Table 3.1 Nominal price movements around the time of the food price crisis 2007/08

Commodity	*Take-off*	*Peak*	*Duration (months)*	*Percent change*	*Price spike around 2007/08?*
Oil (non-food)	*Jan 2007*	*July 2008*	*18*	*148%*	*Yes – strong*
Cereal staples					
Maize	July 2007	Jun 2008	11	95%	Yes – strong
Rice	Aug 2007	Apr 2008	8	206%	Yes – strong
Wheat	Mar 2007	Mar 2008	12	121%	Yes – strong
Pulses					
Groundnut	Feb 2006	Jan 2008	23	136%	Yes – strong
Soybean	Aug 2006	Jun 2008	22	171%	Yes – strong
Edible oils					
Soybean oil	Sep 2006	Jun 2008	21	165%	Yes – strong
Coconut Oil	Feb 2007	July 2008	17	101%	Yes – strong
Palm Oil	Sep 2006	Jun 2008	21	163%	Yes – strong
Fruits & Sugar					
Bananas	Nov 2007	Mar 2008	4	57%	Yes - moderate
Oranges	Dec 2007	July 2008	7	55%	Yes – moderate
Sugar	Dec 2007	July 2008	7	15%	No – only a small rise
Animal products					
Beef	Apr 2008	Aug 2008	4	31%	Yes – weak to moderate
Milk	Jun 2006	Oct 2007	16	140%	Yes – spike but not coincident
Lamb	Jan 2008	Mar 2008	2	11%	No – only a small rise
Chicken	Dec 2007	July 2008	7	15%	No – only a small rise
Pork	Mar 2008	Aug 2008	5	59%	Yes – moderate with lag
Shrimps	Aug 2008	Jan 2009	5	45%	Yes – moderate with long lag

Source: Calculated from data on monthly price series from IMF and FAO. **Notes**: Maize is US#2 HRW; Rice is 5 percent broken, fob Bangkok; Wheat is U.S. # 1 HRW, fob Gulf of Mexico; Soybean is U.S., cif Rotterdam; Soybean oil is Dutch, fob ex-mill; Groundnut is US runners, cif European; Coconut Oil is Philippine/Indonesia, cif Rotterdam; Palm oil is Malaysia and Indonesian, cif NW Europe; Bananas are avg of Chiquita, Del Monte, Dole, US Gulf delivery; Oranges are Brazilian, CIF France; Sugar is US, import price contract number 14 cif; Beef is Australia/New Zealand frozen, U.S. import price; Milk is Whole Milk Powder Oceania, indicative export prices, f.o.b.; Lamb is New Zealand, PL frozen, London price; Chicken is Ready-to-cook, whole, iced, FOB Georgia Docks; Pork is Hogs, 51-52% lean, 170-191 lbs; IL, IN, OH, MI, KY; and Shrimps are U.S., frozen 26/30 count, wholesale NY.

Why did non-staple foods also see price spikes and rises in 2007/08? The following factors were probably[9] involved:

- Prices of those non-staples that can be used as feedstock for biofuel, such as soybean and palm oil, see Table 3.1, were pushed up because higher oil prices made biofuels economically attractive;
- Higher prices for cereals led to land being switched from some non-staples, such as soybean in the USA, to cereals; thereby reducing supply of soybean to the market;
- Costs of feed rose for those animal products, such as chicken, that are largely produced using grain; and,
- The increased oil price which pushed up costs of inputs (fertiliser, irrigation) and transport will have pushed up costs of production of non-staples as it did for cereals.

[9] Probably: a detailed review of the markets for each of the products inspected was beyond the means for this paper.

Prices of non-staples on domestic markets

Much of the monthly consumer food price data collected by national statistical agencies is not readily accessible, so it was not possible for this paper to analyse patterns systematically across countries. Indeed, Cambodia was one of the few countries for which prices of non-staples over the medium run could be obtained.

Looking at these figures, it seems that prices of non-staples on domestic markets behaved in one of three ways:

- Non-staple prices rose since they were caused by the same factors that pushed up cereals prices, as set out above. Examples here include edible oils and pulses, and grain-fed animal products such as pork and chicken;
- Prices of non-staples fell as demand shrank from poor consumers who having paid for their staples have little to spend on complements,[10] as applies for prawns, tomatoes in Cambodia. Prices of non-staples may have also fallen over the time of the international cereals price spike for independent reasons, such as, a fruit crop being in season; and,
- Non-staple prices were unaffected by the price spike, since they are perishables, little traded, and their prices depend on local harvests — as applies with fish in the case of Cambodia.

As may be imagined, in any given case, considerable variations can be seen, as applies for the case of fruit prices in Cambodia, see Box A.

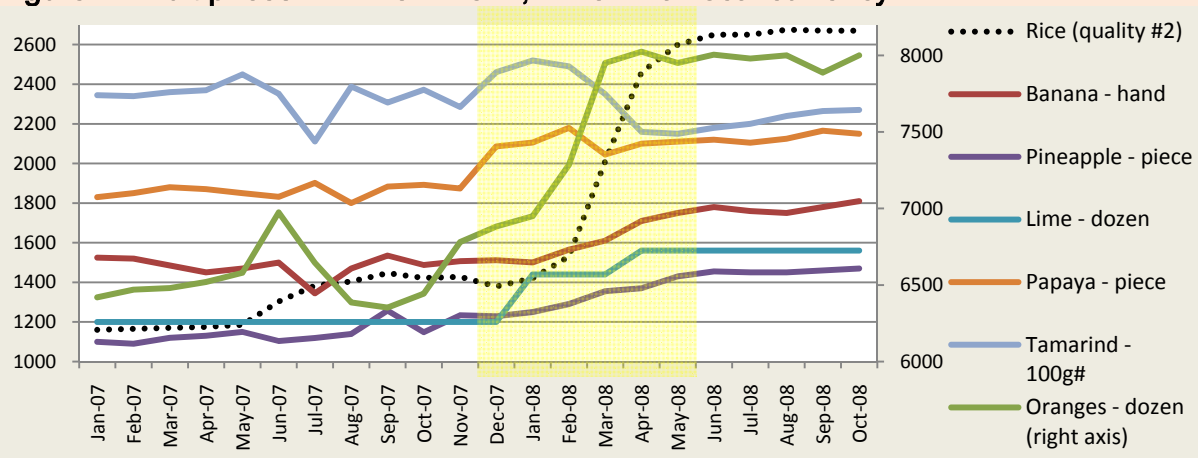
[10] Staples are often Giffen goods for poor people. This means that as the price increases, if it is the most inferior, cheapest good, people will spend more of their money on it, cutting down on complements.

Box A: Price behaviour in fruit markets in Phnom Penh

Even across commodity groups within a particular market, patterns may not be obvious. Take *fruits* in Phnom Penh for example, as shown in Figure A.

While the price of rice, shown by the black dotted line, was rising, what was happening to fruit prices? Over the period highlighted in yellow, December 2007 to May 2008, the rice price went up 89%. The price of limes increased 30%. Bananas, oranges, and pineapples all went up 16%. The price of papaya was moving up and down, so the net effect was a 1% increase, and tamarind prices fell 13%. So, in the fruit market of Phnom Penh, most fruit prices increased over the international price crisis, but none to an extent approaching the scale of increase seen in rice, and there were exceptions such that two of the six series were largely unaffected.

Figure A. Fruit prices in Phnom Penh, in nominal local currency



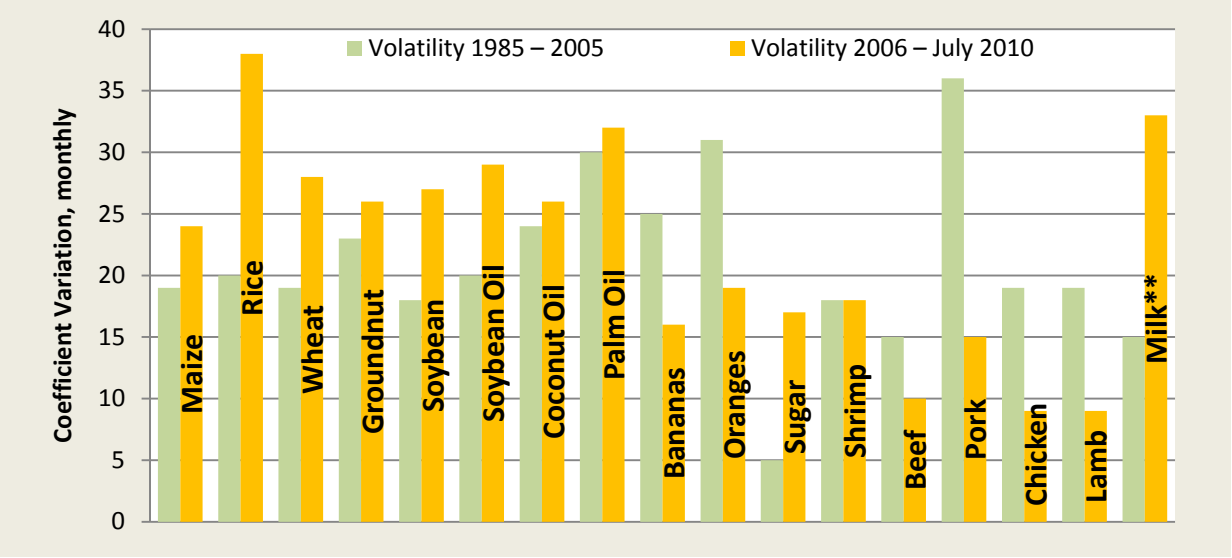
Source: Constructed with data from WFP

Price volatility in staples & non-staples

What can be said about differences in monthly price volatility between staples and non-staples? This was tested by computing the coefficient of variation, for international monthly price series for the twenty years before the spike, and since 2006. This is calculated using the standard deviation for prices over any given period, divided by the mean of those prices, so that comparisons can be made across commodities which are sold at different price levels[11].

[11] Because the standard deviation is calculated as the by-product of a regression which fits a trendline to the data, this type of calculation is sensitive to the way a trend is fitted and consequently to breaks from trend in the series.

Figure 3.1 Volatility in international monthly price series over two periods



Source: Calculated from data in IMF and FAO (for dairy prices) **Notes**: For details about the commodity price series see note to Table 3.1 which describes the same price series. **Milk powder data earlier than 1995 was not available, hence the period for milk is reckoned for 1995 – 2005.

The results, see Figure 3.1,[12] indicate the following:

- Over the twenty years before the spike, monthly international prices of most foods ranged between 15% and 30%. There are no apparent systematic differences in volatility between cereals and pulses and the non-staples;
- On international markets, volatility did rise between the two periods for most cereals, pulses and edible oils; while prices of most animal products, with milk a marked exception, and fruits became less volatile;
- In most cases any increases in volatility have been small, and may not even be statistically significant; and,
- Only for a few products do prices seem to have become notably more volatile — milk powder, rice and sugar.

That said, the numbers should be interpreted with care since they are sensitive to the time periods chosen[13]

Assessing domestic market level volatilities is beyond the scope of this paper; it is to be expected that domestic market prices will be more volatile than international ones, although in some countries — usually not the low income countries —price stabilisation measures may be effective and local prices may be less variable.

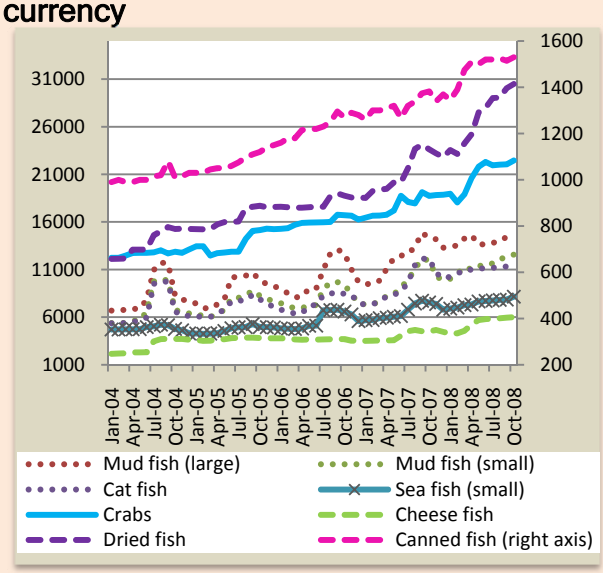
[12] Annex B provides a table showing the numbers depicted in Figure 6 as well as graphs of each of these monthly prices.
[13] They are quite sensitive to the mean and thus the time period over which they are analysed. For example, taking the period 1995 – 2000 instead of 1985 to 2005 shows considerable differences in some cases. For example, over the shorter period (1995 to 2000) compared to the longer period containing it (1985 – 2005), chicken is 11% less volatile, beef 9% less volatile, shrimp 8% less volatile, groundnuts 15% less volatile, oranges 13% less volatile, maize and wheat both 7% more volatile. The other products change by 5 or less percent, but significant differences depending on time period chosen remain.

Crops which are little traded, usually since they are perishable, such as fruits, would be expected to have more volatile prices, often associated with seasonal harvests. Box B illustrates how seasonality, perishability and substitutability affect volatility in prices in the fish and seafood market in Phnom Penh. Volatility of non-staple food prices can strongly affect people's access to these foods.

Box B: Price behaviour in fish and seafood markets in Phnom Penh

The figure below shows prices for eight aquatic foods in Cambodia, some of which are seasonal and highly perishable (river mudfish and catfish—dotted lines), some seasonal and preserved (dried fish, canned fish—dashed lines), and some less seasonal (sea fish and crabs—solid lines).

Figure B. Aquatic animal product food prices in Phnom Penh, nominal local currency



Source: Constructed with data from WFP. All prices in Riel per unit (some per kg, some per can, piece or other unit)

Mudfish and catfish follow clear seasonal patterns. This is because they are river fish and tend to be caught more in the dry season. Sea fish (shown with crosses) would have less seasonal harvests, but price fluctuations in the river fish appear to influence the sea fish prices; this effect is particularly clear in 2006 and 2007.

Dried, canned, and cheese fish (a kind of fish paste) are preserved and thus show little or less of the seasonal variation in prices. Crab prices, the solid line, show little intra-year fluctuation as they are captured in the sea and consequently not such a seasonal product as the river fish. They are also less substitutable and experience less price pass-through from the river fish market than do the sea fish.

4 Impacts of the food price spike of 2007/08

Micro-nutrient deficiencies generally arise through ***three channels***:

1. Not eating enough vitamins and minerals in the diet;
2. Inhibitors in the diet preventing absorption once eaten. Bioavailability is influenced by presence of other compounds which act as inhibitors, facilitators, and competitors. For example, tannins found in tea and coffee inhibit iron absorption, vitamin C facilitates it, and zinc competes with it[14]; and
3. Losing or only partially absorbing nutrients because of illness. For example diarrhoea can prevent nutrient absorption. Poor micro-nutrient status may also exacerbate a person's susceptibility to illnesses like diarrhoea. Existing levels of nutrient deficiency may also influence ability to absorb nutrients.

[14] See http://sickle.bwh.harvard.edu/iron_absorption.html

Since this report tried to relate the effects of the food price rise on micro-nutrient status, the likeliest channel of impact is the first, since higher prices of foods could lead to falls in micro-nutrient intakes. Even if the price of non-staple foods that are rich in vitamins and minerals did not rise, the rise in staple food prices seen in 2007/08 meant less consumption of non-staples as households cut back on complementary foods to maintain their intakes of staples[15]. Therefore, a food price crisis represents a significant threat to micro-nutrient status.

It is possible that the price spike also affected inhibitors and illness. But since it would be difficult to test if this were so, this paper makes the simplifying assumption that any such effects were small, and that the main effect of the food price spike would be through changed prices and consumption of foods rich in vitamins and minerals.

Consumption of non-staples over the food crisis 2007/08

Vulnerable people decreased consumption of non-staple foods. Not surprisingly, when prices of staples eat into budgets, people tend to cut back proportionally more on the more expensive complementary foods (which have a higher elasticity of demand)[16]. Compton et al. (2010) provide examples of this from the recent crisis for different food groups, as set out in Table 4.1. Even before the crisis, affordability of a balanced diet was not assured for many poor people. See Box C.

Table 4.1 Changes in consumption of food rich in micro-nutrients during the 2007/08 price spike

Vegetables & fruit	In previous crises, high food prices have frequently led to reduced fruit and vegetable consumption. Evidence in this crisis was mixed. While some surveys (e. g. Cambodia, Sierra Leone) reported declining consumption, especially among children, others (rural Bangladesh, Gansu in China) reported steady or increased vegetable consumption. In the case of Gansu this was due to cabbage and other vegetable prices remaining low in comparison to cereal prices, while in Bangladesh many poor families collected wild green leaves to supplement their diet. (WFP/FAO 2008b; S de Pee et al. 1998)
Oils	Some studies (e.g. Bangladesh and Hunan, China) reported reduced household oil consumption in 2008, and studies from previous crises, e.g. Block et al. (2004), have also documented significant drops in consumption.
Animal products	These expensive and nutrition-rich foods were cut back in nearly every case examined, being substituted by increased consumption of lower-cost vegetables or pulses. Sometimes cheaper varieties of fish were substituted for other animal products (see also West and Mehra 2010). Whether this makes a major difference to the nutrition of the most vulnerable family members, however, depends on the nutritional value of the chosen substitutes, plus the distribution of food within the household (Campbell et al. 2008). In some earlier studies (e.g. Frongillo and Begin 1993, Bouis and Novenario-Reese 1997), men and older boys, not the nutritionally most-vulnerable, were found to consume the lion's share of animal-origin foods.
Starchy staples	Normally the last part of the diet to be cut back. However in some parts of the world, cheaper local staples such as millet or cassava were substituted for imported rice following price rises (e.g. Akindès 1999). The nutritional impact of such substitution varies: while local grains may have a higher nutritional value than white rice, cassava normally has less protein than cereals, and can pose a risk to the nutrition of small children if it is used as a substitute for grain (Okigbo 1980).

Source: Adapted from Compton et al. (2010), Box 4: Unbalancing the diet

[15] While non-staple foods are also a source of macro-nutrients, particularly fat and protein, the focus of this paper is on their use as a source of micro-nutrients. A wider discussion of nutrition in general is beyond the scope of this paper.

[16] To some extent, seasonality can mask this kind of cut-back, if complementary foods happen to be in season coinciding with a price spike, but since this is something that would have happened regardless of any spike in international staples prices, it is a marginal point

Box C: Can the poor afford nutritious diets?

Even before the global food crisis pushed up prices of staples, many poor people were already finding it difficult to afford balanced diets containing essential micro-nutrients. Darnton-Hill et al (2005) wrote: "In developing countries, intakes of expensive animal-derived foods are often not accessible to the poor and this substantially reduces intake of vitamins and minerals"

Ecker et al. (2010) looked at nutrition in three cases from East Africa, with samples from rural areas in Rwanda, Uganda, and Tanzania. They wrote:

> The mean number of different food items consumed over the day surveyed amounts to only 6.7 in Rwanda, 5.9 in Uganda and 8.7 in Tanzania. Thus, the diets comprise a relatively narrow range of foods, which limits the provision of micronutrients to few sources and makes sufficient intakes difficult. Savy et al. (2005) report a similarly low FVS of 8.3 for rural Burkina Faso, applying 24-hour recall data to women's food consumption. 58% of the households in Rwanda, 30% in Uganda and 27% in Tanzania consume fewer than three meals (of solid foods) a day. Often the same dish, or in only slightly modified form, is eaten for both lunch and dinner. If breakfast is taken at all, it mostly consists of porridge purely based on staple foods.

This lack in dietary diversity means that most households in the samples were not taking in adequate daily requirements of micro-nutrients. See Table C for a summary.

Table C: Prevalence of nutrient deficient households in samples from rural areas in three East African countries

	Prevalence of deficient households (%)		
	Rwanda	**Uganda**	**Tanzania**
Calories (kcal)	68	69	27
Vitamin A	81	77	85
Iron	87	80	56
Zinc	54	50	26

Source: Adapted from Table 2 in Ecker et al. 2010. **Notes**: These figures are based on people's diets at particular times depending on when the surveys were conducted. For Uganda and Rwanda, this was before the harvest of short-season crops, whereas in Tanzania the harvest was already underway at the time of the survey. Vitamin A sufficiency is measured against the USDA recommended requirement, which is twice as stringent as proposed by FAO and WHO.

Chastre et al. (2007) used linear programming to estimate the lowest feasible cost of a daily diet that would satisfy energy, fat, protein, mineral and vitamin needs for a household of two adults, three children including one under 24 months for rural areas of Bangladesh, Burma, Ethiopia and Tanzania. They found that the daily cost ranged from US$0.72 in Tanzania to US$1.27 in Ethiopia. When they compared these costs to the incomes of households in these areas, they found that many could not afford the healthy diet —79% of households in Bangladesh, all households in Ethiopia, and the very poor in Burma and Tanzania. The going rate for a day's unskilled work would just cover the cost in Bangladesh and Tanzania, but not in Ethiopia where it was worth only 69% of the cost, and even less in Burma where it covered only 50% of the cost.

This thus confirms the suspicion that for the rural poor, their incomes are often too low to allow them to buy a sufficiently nutritious diet.

Ecker et al. (2010) estimated determinants of calorie and iron, zinc, and vitamin A intakes, and their findings support the importance of reducing poverty. In addition, their results indicate:

- Strong correlations between calorie intakes and micro-nutrient intakes, minerals in particular, emphasising the importance of increasing as well as diversifying diets.
- Completing primary education contributes to dietary diversity and quality
- Household gardens, particularly if combined with nutritional education, improve vitamin A intakes.
- Calorie, iron, and zinc intakes in particular are strongly influenced by location-specific factors including infrastructural endowments

As well as entire households switching to poorer quality diets, micro-nutrient consumption was impacted by cutting back on weaning foods for infants and other special foods for young children.

> "Young children were fed from the family pot instead of being given special nourishing foods such as milk, meat, eggs and fruit. Many households in urban areas stopped purchasing high-energy and fortified commercially-purchased complementary foods and switched to home-prepared foods. This is likely to have a serious effect on micronutrients as well as the energy density of the diet, which is critical for infants (Bhutta et al. 2008; Dewey and Adu-Afarwuah 2008)[17]. '...Complementary feeding is the most effective intervention that can significantly reduce stunting during the first two years of life' (UNICEF 2009). *Compton et al. 2010*

Absorption of micro-nutrients was also potentially hurt as people cut expenses in both time and money on health and sanitation — see Box D.

Box D: Hygiene, health and caring: impacts on micro-nutrient status over the food crisis

Two studies have noted increased diarrhoeal episodes among young children; these can be both a cause and consequence of malnutrition (UNICEF 1998, Black et al 2008).

Several studies reported savings made by cutting purchases of soap and detergent, and increased workloads for mothers and older children, leading to less caring time for small children. A study in Kenya also raised concerns about cut-backs in water use by the urban poor, many of whom purchase water (Kenya Food Security Steering Group 2008). Worsening care and hygiene potentially has a serious impact on malnutrition (UNICEF 1998, Humphrey 2009).

A decrease in access to healthcare may also increase malnutrition (UNICEF 1998), although the very low quality of healthcare often available to the poor in practice means that this is far from certain.

Source: Compton et al. 2010

Data on movements and trends in levels of actual vitamin and mineral deficiencies (VMDs)[18] however are scant; there are few benchmarks against which to measure VMD levels[19], even if data for the period of the crisis existed. Compton et al. (2010) wrote:

> Evidence from previous crises is that a rise in micronutrient deficiencies can be widespread, with the long-term effects often going undetected. Following the earlier Indonesian economic crisis, for example, mean child haemoglobin declined by 7%, and anaemia rose from 52% to 70% over 1.5 years. 'The largest declines were for cohorts born or conceived during the crisis' (Block et al. 2002, Block et al. 2004b).
> It is very likely that micronutrient deficiencies also increased in this crisis, as predicted. However, we were not able to locate robust measurements on changes in micronutrient levels following price rises in 2007/8, despite calls for such evidence to be collected (Klotz et al. 2008).

Some additional confirmation that fewer micro-nutrients may have been consumed by the vulnerable as a consequence of the food price spike comes from falling dietary diversity scores:

[17] However, the nutritional impact of family sharing depends on the family and the context. For example a study in Nepal showed that 'plate-sharing' can lead to young children getting a more diverse and high-nutrition diet or a more deficient diet, depending on whether they share with adult females or males (Shankar et al. 1998)

[18] For instance Anaemia, Vitamin A deficiency, Iodine deficiency, Zinc deficiency, and Folic Acid deficiency.

[19] A brief scan of FAO national nutrition profiles for example shows that for countries two or three nationally representative surveys of macro-nutrition since 1990 have been reported, there may be only one survey of micronutrient deficiencies.

There is some indirect evidence of increased micronutrient malnutrition from the declines in Dietary Diversity Scores recorded following food price rises (e.g. Sanogo 2009; Holleman and Moloney 2009, WFP/UNICEF/IPHN 2009). Dietary diversity measures count (and sometimes weigh) different foods or food categories to give a measure of the diversity of the diet[20]. Positive correlation has been recorded between individual Dietary Diversity Scores and micronutrient intake in both young children (Kennedy et al. 2007; Moursi et al. 2008) and women (Mirmiran, Azadbakht, and Azizi 2006) although more work to refine scores is needed (Ruel 2003).

Impacts on nutrition of vulnerable people

There are plenty of plausible reasons to suppose that the incidence of vitamin and mineral deficiency (VMD) increased in response to the international cereals prices spike (UNSCN, 2009b; Bouis, 2008), as follows:

- "Harvest Plus estimates that a 50% increase in all food prices across the board (holding income constant) will result in a 30% decline in iron intakes. This, in turn, will result in an increase in the prevalence rate of iron deficiency among women and children of 25 percentage points (e.g. if currently the diets of women result in 60% consuming below the mean average iron requirement, then 85% will consume below the mean average iron requirement after the 50% price rise)." (Bouis, 2008)
- Bhutta et al. (2009) predicted for East Asia and the Pacific that "if unaddressed the recent crisis could increase rates of maternal anaemia by 10–20% and prevalence of low birth weight by 5–10%.In addition rates of childhood stunting could increase by 3–7% and wasting by 8–16%... overall under 5 child mortality in severely affected countries… could increase by 3–11%." (from Compton et al. 2010)
- Klotz et al. (2008) focused mainly on the risk of micro-nutrient deficiencies resulting from households trying to protect their staple food intake at the cost of comparatively expensive micronutrient-rich foods. In poor populations, they predict the following sequence:
  - » Depletion of body micro-nutrient stores and lowered immunity;
  - » Appearance of clinical symptoms of micro-nutrient deficiencies, such as night blindness, anaemia and increased morbidity;
  - » Weight loss and wasting in mothers and young children; and
  - » Increase in early child mortality.

  Previous research had shown that clinical symptoms of micro-nutrient malnutrition such as anaemia, vitamin A deficiency and increased levels of illness can appear within 2–3 months, before symptoms such as wasting are evident (Kiess et al. 2000; Block et al. 2004; Klotz et al. 2008)(from Compton et al. 2010).

Evidence from other crises shows that nutritional impacts of high food prices on women and children can be significant. The UNSCN (2009) cited examples from three crises outlined below:

- When food prices rose during the Indonesian financial crisis in 1997-98…
  - » Wasting in Javanese women increased—though without commensurate increases in child undernutrition, suggesting women buffered children's food intake.

[20]Dietary Diversity Scores (DDS) have been defined and used in different ways. (Swindale and Bilinsky 2006) provide a guide to the use of Household DDS as a measure of access to food, while (Ruel 2003) discusses the evidence to date and challenges for both individual and household DDS.

    - » Anaemia prevalence in mothers and children increased, associated with reduced consumption of high quality foods.
    - » Combined effects of the above two points were severe on children conceived and weaned during the crisis[21]
- When the Congo currency devalued in 1994 and imported foods became more expensive…
    - » Mothers' wasting increased, more babies were born with low weights and children's stunting and wasting increased[22].
- When maize prices increased in Zambia during the drought of 2001-2002…
    - » Pregnant mothers had reduced Vitamin E and vitamin A status and stunting of infants increased.[23]

Data on some outcomes of VMDs — birth defects, maternal and child deaths, blindness, and anaemia — exist to some extent. However attribution to VMDs is not necessarily clear. Other expected consequences of vitamin and mineral deficiency such as increased vulnerability to infections, poor academic performance and work productivity cannot be easily measured, and attribution to malnutrition would be difficult if not impossible.

5 Discussion and implications

Key findings

To summarise, the key findings from this review are:

- Deficient intake of vitamins and minerals is highly prevalent across the developing world, affecting two billion or more persons —more than are affected by under-nourishment or other forms of malnutrition. The costs are high in terms of limiting the physical and mental development of children, illness and premature death.
- Diets have been changing in the developing world over the last 30 or so years, as consumption of cereals and pulses has been reduced in favour of complementary, non-staple foods. By volume, the largest increases have been in fruit and vegetables. All other things being equal, this should have improved consumption of vitamins and minerals in diets;
- During the last thirty years in developing Asian countries that have seen green revolutions in their cereals production, there have usually been significant increases in both production and consumption of non-staple foods as well. An important exception to this is Bangladesh, where advances in cereals production have not been echoed by other foods.
- When the spike in cereals prices took place in 2007/08, prices on international markets of pulses and edible oils rose by 100% or more, similar increases to those seen for cereals. For other non-staples, there were price increases at the same time, but generally by 60% or less.

[21] UNSCN 2009a; original source Block SA, Kiess L, Webb P, Kosen S, Moench-Pfanner R, Bloem MW, Timmer CP (2004) Macro shocks and micro outcomes: child nutrition during Indonesia's crisis. Econ Hum Biol 2(1):21-44

[22] UNSCN 2009a; original source: Martin-Prevel Y, Delpeuch F, Traissac P, Massamba JP, Adou-Oyila G, Coudert K, Treche S (2000) Deterioration in the nutritional status of young children and their mothers in Brazzaville, Congo following the 1994 devaluation of the CFA franc. Bull World Health Organ 2000 78:108-18

[23] UNSCN 2009a; original source: Gitau R, Makasa M, Kasonka L, Sinkala M, Chintu C, Tomkins A, Filteau S (2005) Maternal micronutrient status and decreased growth of Zambian infants born during and after the maize price increases resulting from the southern African drought of 2001-2002. Public Health Nutr 8(7):837-43

Prices of non-staples rose in response to higher oil prices driving up costs of production and making biofuels more attractive, for some animal products from rising costs of grains for feed, and from land being switched out of non-staples to staples;

- It is difficult to establish how much domestic prices of non-staples rose during the spike. Some may even have fallen as households spending more on staples reduced demand for these;
- Prices of many foods have become more volatile on international markets since 2005 compared to the previous 20 years, but not by that much, and there are exceptions: prices of several animal products have become less variable;
- Although systematic and comprehensive evidence is lacking, there are plenty of accounts that show during 2007/08, poor and vulnerable households cut down on consumption of non-staple foods so as to maintain their consumption of staples. Hence it is very likely that intake of vitamins and minerals declined. Particularly worrying are reports that weaning foods may have been sacrificed so that weaning children were fed from the family pot;
- Reports also indicate that reduction in spending on health care, water and soap may have worsened the health environment for nutrition;
- Direct measurements of reduced micro-nutrient status are very few, so that arguments about impaired micro-nutrition rest on plausible argument and inference from evidence from previous economic crises; and,
- It is as yet difficult to establish the overall impact on the health of the vulnerable, especially young children and mothers, although the same plausible arguments suggest that it would have worsened.

Policy implications

Given that it seems very likely that the price spike did increase deficiencies of vitamins and minerals, counter-measures to deal with the effects of price (and other) shocks needs consideration. Three policy areas are indicated:

1. ***Mitigating rises in prices of foods rich in minerals and vitamins.*** Countries with the means might consider subsidising the prices of key foods, such as milk. This, however, would be costly: to reduce costs, subsidised foods might be rationed, and these might be means-tested or otherwise targeted to the poor and vulnerable.

   Measures to dampen volatility of prices include:, reducing perishability, for example though increased or improved storage or processing; increasing variety and substitutability of available non-staples, for example by encouraging more varieties in home gardens; and promoting trade in non-staples between regions with complementary harvest schedules.

   Production of foods rich in minerals and vitamins might be stimulated, perhaps by distributing kits for home vegetable gardens. The drawback is that additional foods may only become available late in the day;

2. ***Food fortification and supplementation.*** Rather than trying to restore levels of intake of non-staples during crises, an alternative would be to boost intake of vitamins and minerals through other means. Fortification of staples with vitamins and minerals, in food processing plants may be possible, in countries where significant numbers consume processed staples.

Plants would also need to have the capacity and experience to do this. Alternatively, special and temporary programmes could be used to provide supplements to vulnerable mothers and young children, such as vitamin A tablets, or iron supplements. This may only be possible in countries with good coverage of well-functioning public health services: to meet additional needs after a price shock, it will probably be necessary to have existing supplementation programmes already in place.

3. ***Education on vitamins and minerals, feeding strategies, and how best to use limited budgets during economic shocks*** — see Box E. This however needs to be done with some sensitivity, lest the messages are rejected by people who resent being patronised when facing hardships not shared by those imparting the messages.

Box E: Effectiveness of nutritional education as an additional policy response

Poor infant and young child feeding practices can lead to malnutrition. Hence nutrition education, especially for infant and child feeding practices, 'deserves priority attention' within the context of the food price spike, according to WFP/UNICEF/IPHN [2009]. The Lancet nutrition review (Bhutta et al. 2008) found that nutritional education about complementary feeding was effective when combined with help to acquire food where needed. Foods of similar cost may vary greatly in their nutritive value (Maillot et al. 2008).

Households that allocate a higher proportion of their food budget to more nutritious (non-grain) foods have a lower prevalence of underweight children and under-5 mortality (Torlesse, LynndaKiess, and Martin W. Bloem 2003; Campbell et al. 2008; Mayang Sari et al. 2010). During the Indonesian economic crisis, Block et al (2002) noted that 'a subset of mothers seemed aware of the importance of micro-nutrient-rich foods, and their children were better protected from the crisis than others'. In follow-up studies of the same crisis, Block (2004, 2007) also found that mothers' knowledge of nutrition issues was important in dietary diversification and nutrition: mainly accounted for by exposure to nutrition education at schools and clinics.

The demand for more nutritious food, however, is often limited by the time and effort needed to acquire and prepare it. Consumers, moreover, may not feel any benefits from improved micro-nutrient status owing to the great variety of other factors affecting individual health [Hoffman 2009]. Education is one way to overcome these barriers to better diets.

Source: Compton et al. 2010

In addition, given that making use of vitamins and minerals consumed depends on health, then measures to keep up health are indicated, including temporary suspension or reduction of any charges for health care and water during economic shocks.

Although there is too little information about most aspects of the impacts of price spikes, in the case of micro-nutrient status the deficiency is acute. With so little reliable information, problems do not get the political priority their seriousness would imply; while policy-makers have to make guesses about the measures that might be effective. Priorities for more information include:

- Changes in intakes of foods rich in vitamins and minerals by poor and vulnerable groups. Regular sample surveys of consumption, perhaps using dietary diversity scoring, would help. A proxy is to monitor the prices of key foods rich in minerals and vitamins, as well as key

staples, and report on these monthly. A sudden and substantial rise in the price of either groups of foods, staples or non-staples, should ring alarm bells; and,

- Levels of deficiencies in minerals and vitamins amongst vulnerable groups, and especially young children and mothers. Currently, nationally-representative surveys in many low incomes countries take place less than once a decade. At least once every five years national surveys are needed, if levels and trends are to be established

Finally, in the longer run, more concerted action is needed to reduce the current extremely widespread incidence of micro-nutrient deficiency.

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Annex A: Average amount of foods supplied per capita per year (kg)

By countries identified as a priority for DFID nutrition strategy and certain country aggregates

A note on data and statistics:

- Production = measured by FAO as quantity produced nationally in any given year
- Consumption = Called *food supply* by FAO, this is measured as a balance of what is available considering production, netting out imports and exports, and deducting for waste and reuse within farming.

Table A.1 Average consumption (kg/capita/year) of food stuffs through time: selected regional groups and countries

	Mid-	Cereal	Starchy Roots	Pulses	Fruits	Vegetables	Vegetable Oils	Sugar	Eggs	Milk	Meat	Fish etc
WORLD	70s	137	74	7	45	62	6	23	5	75	28	12
	80s	150	61	6	49	74	8	24	6	78	31	13
	90s	151	61	6	56	88	10	24	7	76	35	15
	2000s	**147**	**64**	**6**	**66**	**117**	**11**	**24**	**8**	**82**	**39**	**16**
Least Developed Countries	70s	126	98	9	38	24	4	8	1	21	9	8
	80s	128	96	9	36	25	4	8	1	25	9	8
	90s	130	90	8	34	25	5	7	1	23	9	7
	2000s	**136**	**95**	**9**	**37**	**28**	**6**	**10**	**1**	**28**	**11**	**9**
Low Income Food Deficit Countries	70s	137	77	8	23	44	4	11	2	19	8	6
	80s	159	59	8	28	59	5	14	3	26	12	7
	90s	159	61	6	39	84	7	14	6	32	19	12
	2000s	**151**	**66**	**6**	**51**	**124**	**8**	**13**	**7**	**43**	**24**	**14**
Net Food Importing Developing Countries	70s	136	74	9	44	35	5	15	1	40	11	7
	80s	139	72	9	44	37	6	17	2	45	12	8
	90s	142	69	8	45	39	7	16	2	46	13	7
	2000s	**143**	**75**	**9**	**47**	**47**	**7**	**17**	**2**	**53**	**15**	**9**
Small Island Developing States	70s	105	66	10	94	37	6	39	4	84	25	14
	80s	112	61	10	102	40	9	43	5	88	29	15
	90s	98	58	10	96	37	9	38	3	67	28	13
	2000s	**111**	**66**	**12**	**109**	**72**	**10**	**38**	**4**	**58**	**35**	**14**
Bangladesh	70s	155	17	6	15	12	2	9	1	12	3	9
	80s	161	15	5	12	11	3	8	1	13	2	7
	90s	161	12	4	10	11	4	7	1	13	3	8
	2000s	**180**	**27**	**4**	**16**	**16**	**6**	**9**	**1**	**16**	**3**	**14**
Ethiopia	70s	109	35	12	4	11	1	4	2	20	13	0
	80s	112	49	12	4	11	1	4	1	24	12	0
	90s	119	61	10	4	12	1	3	0	18	8	0
	2000s	**141**	**69**	**15**	**12**	**13**	**2**	**5**	**0**	**18**	**8**	**0**
India	70s	141	19	14	25	46	5	19	1	36	4	3
	80s	152	19	14	29	51	6	22	1	50	4	3
	90s	155	20	13	34	54	7	23	1	57	4	4
	2000s	**150**	**26**	**11**	**40**	**59**	**8**	**18**	**2**	**65**	**3**	**5**
Nepal	70s	146	22	8	8	19	2	1	1	45	8	0
	80s	156	24	6	19	40	3	3	1	41	10	0
	90s	173	34	8	40	53	5	3	1	36	9	1
	2000s	**173**	**56**	**9**	**38**	**73**	**6**	**5**	**1**	**40**	**10**	**2**
Nigeria	70s	99	131	8	65	46	10	3	2	9	7	8
	80s	114	98	4	61	41	10	6	3	7	10	7
	90s	136	235	8	64	51	13	6	3	7	8	6

	Mid-	Cereal	Starchy Roots	Pulses	Fruits	Vegetables	Vegetable Oils	Sugar	Eggs	Milk	Meat	Fish etc
	2000s	**141**	**215**	**9**	**62**	**60**	**15**	**10**	**3**	**8**	**9**	**9**
	70s	184	11	3	12	18	4	20	1	58	13	1
	80s	166	12	5	12	14	6	23	1	43	11	2
	90s	151	15	3	11	11	7	22	1	22	10	3
Zimbabwe	**2000s**	**153**	**17**	**5**	**12**	**13**	**9**	**28**	**1**	**29**	**18**	**1**

Source: Constructed with data from FAOSTAT. **Note**: Figures have been rounded to zero decimal places. The values for mid-decade consumption refer to the three year averages 1974 to 1976, 1984 to 1986, 1994 to 1996, and 2004 to 2006.

Availability by Commodity in the mid 2000s (Focus on Bangladesh, Ethiopia, India, Nepal, Nigeria, and Zimbabwe)

Vegetable products

- **Pulses:** This is one commodity that relatively poorer countries tend to have more of per capita than wealthier countries, since they are cheap alternative to animal-source protein as a source of essential amino acids. Ethiopia, India, Nepal and Nigeria all had over the world average in the mid 2000s, and Zimbabwe and Bangladesh were not too far off.
- **Fruits**: Bangladesh, Ethiopia, and Zimbabwe fare particularly poorly in this category, with less than 1/3 of the world average, while India and Nepal are a little better (about two thirds the world average), and Nigeria is approaching the world average. Africa and Asia averages are very close to the world average, and SIDS are well above it.
- **Vegetables**: Bangladesh, Ethiopia, and Zimbabwe are again poor in this category, with less than 1/6th the world availability. India and Nigeria have about one half of the average world levels, similar to the Africa average, and Nepal has slightly more than this, but only about half the level of Asia on average. Interestingly, LIFDCs as a whole have higher vegetable availability than the world average.
- **Vegetable oils**: Ethiopia has less than a fifth of global average availability, while Bangladesh and Nepal have close to 60%, and India almost three quarters. Nigeria is the exception with a third again as much as the global average.
- **Sugar & Sweeteners**: Nepal and Ethiopia are the lowest in this category, with about a fifth of the world average and about a third of Asian and African averages. Bangladesh and Nigeria have close to 40% of the world average. India has the closest to the world level—three quarters—and above Asian average levels.

Animal products

- **Eggs:** All six countries in the sample have poor egg availability compared to the world average, and all except Nigeria have less than the amount that is average for their continent. Ethiopia has only 5% of the world average, while Nepal has less than an eighth, Bangladesh and Zimbabwe about a sixth, India less than a quarter, and Nigeria close to 40%.
- **Milk**: Like eggs, this is fairly low in all of the sample countries, though best in India (80% of world average and above the average for Asia in general) and Nepal (half of world average). Zimbabwe has slightly more than a third and Ethiopia and Bangladesh have about a fifth of the world average.
- **Fish / Seafood**: Bangladesh and Nigeria do fairly well in this category, with Bangladesh having close to 90% of the world average, and Nigeria more than half. India has slightly less than a third, Nepal and Zimbabwe less than 10%, and Ethiopia, not surprisingly, only one percent.
- **Meat**: Zimbabwe is best in this category, with close to half of the world average, and above the average for Africa as a whole. Nepal has about a quarter, Ethiopia and Nigeria closer to a fifth, and India and Bangladesh both have less than 10% of the world average.

Growth by focus country from the mid 1970s to the mid 2000s

Africa

- **AFRICA as a whole**: **Increased egg availability by more than 40%, vegetable oils by 30%, vegetables by 23%, meat and milk by 18 and 16% respectively, sugar by 15%, fish by 11%, fruits by 7% and pulses by 4%.**
- **Ethiopia:** Increased availability of fruits by close to 180%, doubled availability of vegetable oils, increased sugars by over a quarter, pulses and seafood by over 20% (though this latter coming from a very low base), and vegetables by over 10%. In milk, meat, and eggs it did not perform so well, with eggs availability decreasing almost 80%, meat by about a third, and milk by about 10%.
- **Nigeria:** More than tripled sugar availability, increased eggs by close to 60%, vegetable oils by close to 50%, vegetables by almost a third, pulses by 20%, and meat and fish by more than 15%. Fruit and milk availability did not keep pace with population growth, but did not fall too much, decreasing by 5% and 8% respectively
- **Zimbabwe**: Doubled vegetable oil availability, increased pulses by about three quarters, and sugar and meat by about 40%. Eggs went up by 8%, while fish and fruits increased by close to 5%. Milk availability per capita halved however, and vegetable availability fell by close to a third.

Asia

- **ASIA as a whole**: **Increased egg availability by more than three and a third, tripled meat availability, increased vegetables by two and two thirds, vegetable oils by two and one third, and fruits by almost two and a quarter. Milk more than doubled, and fish increased almost 80%. Pulses fell by close to 30%.**
- **Bangladesh:** Tripled vegetable oil availability, and more than doubled availability of eggs. Fish increased almost 60%, milk and vegetables each by more than one third, and meat by more than 10%. Pulses availability dropped almost 40% however, and sugar fell by close to 10%.
- **India**: Tripled egg availability, increased milk by over 80%, vegetable oils by close to 80%, fruits by 60%, and fish by more than half. Pulses availability decreased 22% however. Sugar and meat also decreased, by 9% and 8% respectively.
- **Nepal**: Saw a six-fold increase in fish availability, albeit from an extremely low base. Fruit availability more than quadrupled, vegetables increased over 280%, sugar climbed over 220%, and vegetable oil tripled. Meat availability increased by close to 30%, eggs by 7%, and pulses by 6%. Milk availability per capita fell by 10%.

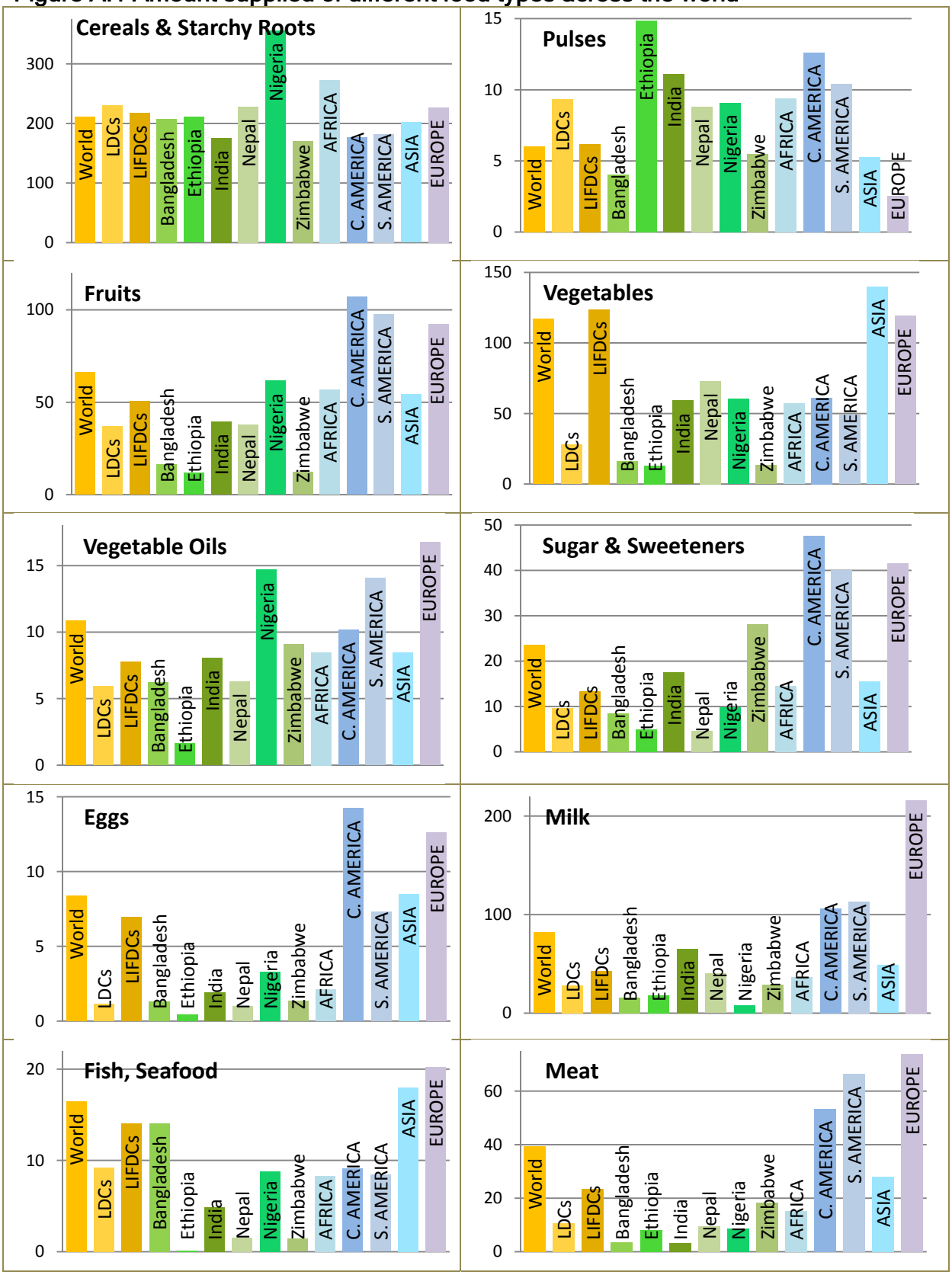
Table A.2 Average consumption (kg/capita/year) of food stuffs through time by UN region

	Mid-	Cereal	Roots	Pulses	Fruits	Vegetables	Vegetable Oils	Sugar	Eggs	Milk	Meat	Fish etc
WORLD	70s	137	74	7	45	62	6	23	5	75	28	12
	80s	150	61	6	49	74	8	24	6	78	31	13
	90s	151	61	6	56	88	10	24	7	76	35	15
	2000s	**147**	**64**	**6**	**66**	**117**	**11**	**24**	**8**	**82**	**39**	**16**
Eastern Africa	70s	114	133	16	49	24	2	9	1	28	12	6
	80s	111	133	14	51	22	3	9	1	31	12	6
	90s	109	118	13	49	23	4	9	1	26	10	5
	2000s	**115**	**125**	**14**	**56**	**21**	**5**	**10**	**1**	**27**	**11**	**4**
Western Africa	70s	109	136	7	62	40	9	4	1	16	9	12
	80s	122	113	5	56	36	9	7	2	16	11	9
	90s	137	194	7	58	44	11	8	2	13	10	9
	2000s	**142**	**187**	**8**	**58**	**50**	**12**	**10**	**2**	**15**	**11**	**11**
Middle Africa	70s	61	322	7	76	23	6	5	0	11	11	9
	80s	55	292	5	78	21	7	5	0	15	11	13
	90s	55	265	6	60	20	6	5	0	9	10	8
	2000s	**67**	**225**	**6**	**39**	**23**	**6**	**7**	**0**	**9**	**11**	**9**
Northern	70s	182	16	6	41	93	9	22	2	48	13	3
	80s	201	23	7	46	105	10	29	3	64	17	5

	Mid-	Cereal	Roots	Pulses	Fruits	Vegetables	Vegetable Oils	Sugar	Eggs	Milk	Meat	Fish etc
Africa	90s	218	24	7	58	108	10	26	3	70	19	7
	2000s	**211**	**32**	**8**	**72**	**142**	**8**	**28**	**4**	**91**	**22**	**10**
Southern Africa	70s	174	26	4	31	46	7	43	4	84	35	10
	80s	177	29	4	31	46	9	38	4	60	35	8
	90s	177	31	4	34	42	10	33	4	54	36	7
	2000s	**182**	**36**	**4**	**36**	**38**	**13**	**30**	**6**	**56**	**44**	**8**
Southern Asia	70s	144	18	13	26	42	4	19	1	40	5	4
	80s	153	19	12	31	49	6	21	1	51	5	4
	90s	157	20	11	37	51	7	22	2	59	6	5
	2000s	**153**	**26**	**10**	**42**	**57**	**8**	**18**	**2**	**69**	**6**	**6**
South-Eastern Asia	70s	148	51	2	42	35	4	13	2	7	9	16
	80s	158	44	4	51	35	6	15	3	9	12	18
	90s	166	37	3	55	45	6	18	4	13	18	22
	2000s	**167**	**34**	**3**	**66**	**52**	**6**	**20**	**5**	**16**	**23**	**27**
Eastern Asia	70s	142	98	5	13	59	3	6	4	8	12	14
	80s	176	65	4	16	91	5	10	6	12	21	15
	90s	168	61	2	35	150	7	10	13	15	38	26
	2000s	**152**	**69**	**1**	**59**	**254**	**9**	**10**	**17**	**28**	**52**	**29**
Central Asia	70s	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	80s	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	90s	210	42	0	22	88	10	15	3	142	35	1
	2000s	**186**	**61**	**1**	**36**	**139**	**10**	**16**	**4**	**165**	**34**	**1**
Western Asia	70s	182	32	9	102	142	10	23	4	119	18	4
	80s	195	39	8	106	167	13	30	6	128	27	7
	90s	192	39	8	96	158	14	28	7	107	26	7
	2000s	**187**	**38**	**8**	**92**	**161**	**16**	**31**	**7**	**108**	**32**	**8**
Eastern Europe	70s	178	119	3	41	93	8	44	12	195	62	23
	80s	166	105	3	48	109	10	46	15	182	67	24
	90s	154	117	2	41	90	9	37	12	163	55	12
	2000s	**152**	**123**	**2**	**57**	**116**	**13**	**44**	**13**	**172**	**56**	**14**
Western Europe	70s	95	91	1	91	82	12	42	14	218	86	15
	80s	103	85	2	97	90	14	40	16	263	95	17
	90s	101	77	2	105	91	17	42	14	255	90	20
	2000s	**113**	**70**	**1**	**103**	**97**	**18**	**48**	**13**	**260**	**86**	**22**
Southern Europe	70s	152	70	5	101	169	19	32	12	173	58	22
	80s	140	70	5	104	175	22	28	12	216	73	26
	90s	135	63	6	110	167	22	30	11	203	84	26
	2000s	**132**	**58**	**5**	**129**	**170**	**24**	**32**	**11**	**221**	**88**	**28**
Northern Europe	70s	94	91	2	63	63	11	45	13	253	66	20
	80s	95	99	3	69	75	14	42	12	258	70	21
	90s	102	101	4	77	76	15	40	10	244	72	23
	2000s	**115**	**103**	**3**	**120**	**91**	**16**	**39**	**11**	**260**	**83**	**24**
Northern America	70s	85	59	3	99	103	18	56	15	236	105	15
	80s	93	60	3	116	111	22	57	14	250	109	19
	90s	116	65	4	114	124	24	65	13	251	115	22
	2000s	**110**	**63**	**5**	**112**	**121**	**28**	**68**	**14**	**248**	**121**	**24**
Caribbean	70s	103	64	11	105	40	6	42	5	93	25	13
	80s	107	57	11	115	44	9	47	5	98	30	13
	90s	91	54	11	106	37	9	42	3	71	27	10
	2000s	**107**	**62**	**13**	**121**	**79**	**10**	**42**	**5**	**60**	**36**	**11**
Central America	70s	154	11	14	77	29	6	41	6	93	26	4
	80s	168	12	14	92	42	10	45	9	95	35	8
	90s	165	14	13	97	41	10	47	11	90	39	9
	2000s	**160**	**18**	**13**	**107**	**61**	**10**	**48**	**14**	**106**	**53**	**9**
South	70s	106	88	11	95	41	8	43	5	92	41	8
	80s	111	73	10	82	40	11	44	6	94	43	8

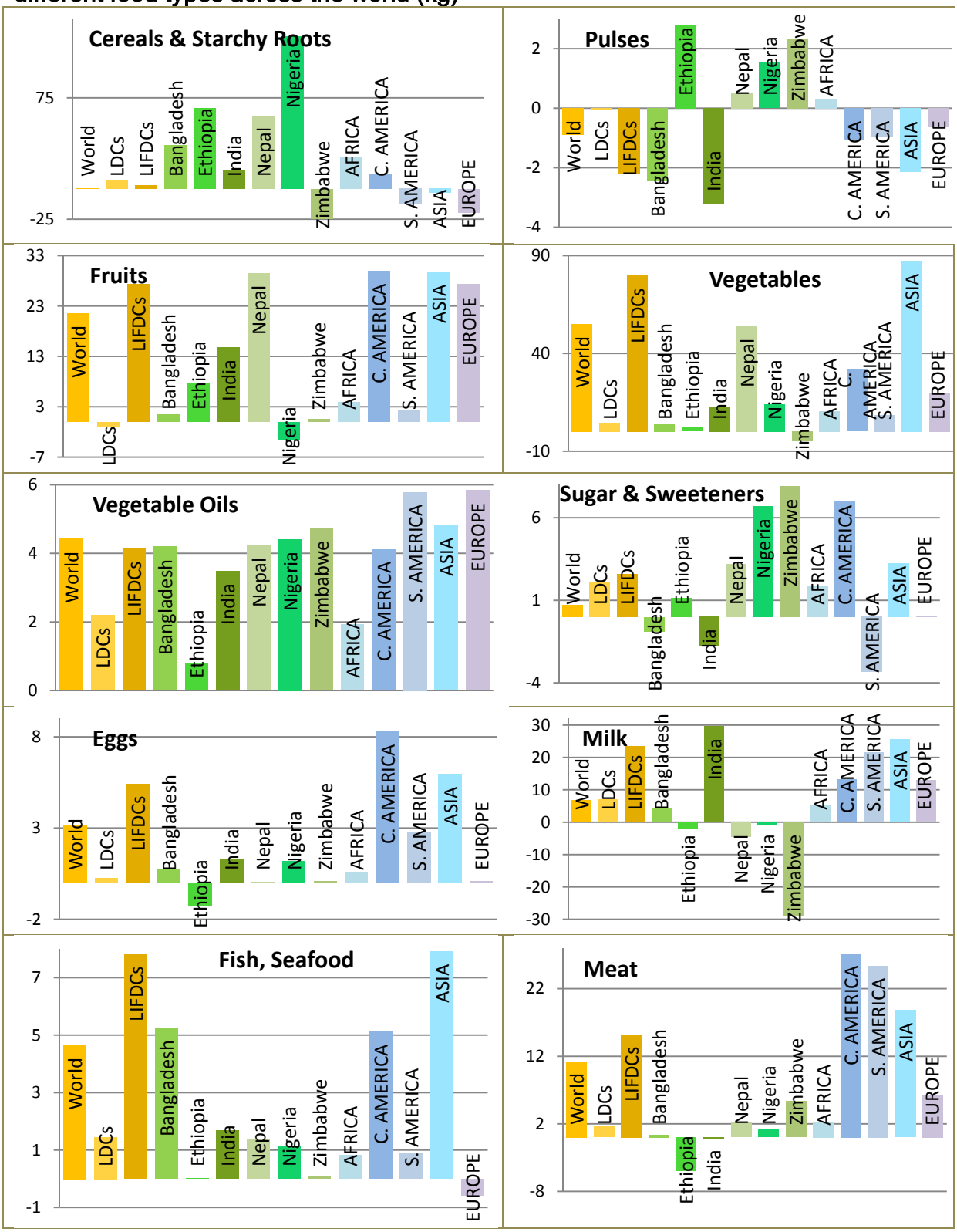
	Mid-	Cereal	Roots	Pulses	Fruits	Vegetables	Vegetable Oils	Sugar	Eggs	Milk	Meat	Fish etc
America	90s	110	67	11	96	44	12	44	7	115	59	9
	2000s	**118**	**64**	**10**	**97**	**49**	**14**	**40**	**7**	**113**	**66**	**8**
Australia and New Zealand	70s	94	47	2	83	70	7	55	13	258	119	15
	80s	89	57	5	91	80	11	51	11	245	109	17
	90s	91	62	2	91	107	15	47	7	230	106	20
	2000s	**85**	**58**	**2**	**105**	**106**	**20**	**49**	**6**	**202**	**110**	**25**
Oceania	70s	94	54	2	82	67	7	53	12	243	113	16
	80s	90	65	5	88	76	11	49	10	229	103	19
	90s	93	67	2	88	101	15	44	7	216	101	21
	2000s	**88**	**66**	**2**	**102**	**100**	**19**	**47**	**6**	**188**	**105**	**26**

Figure A.1 Amount supplied of different food types across the world



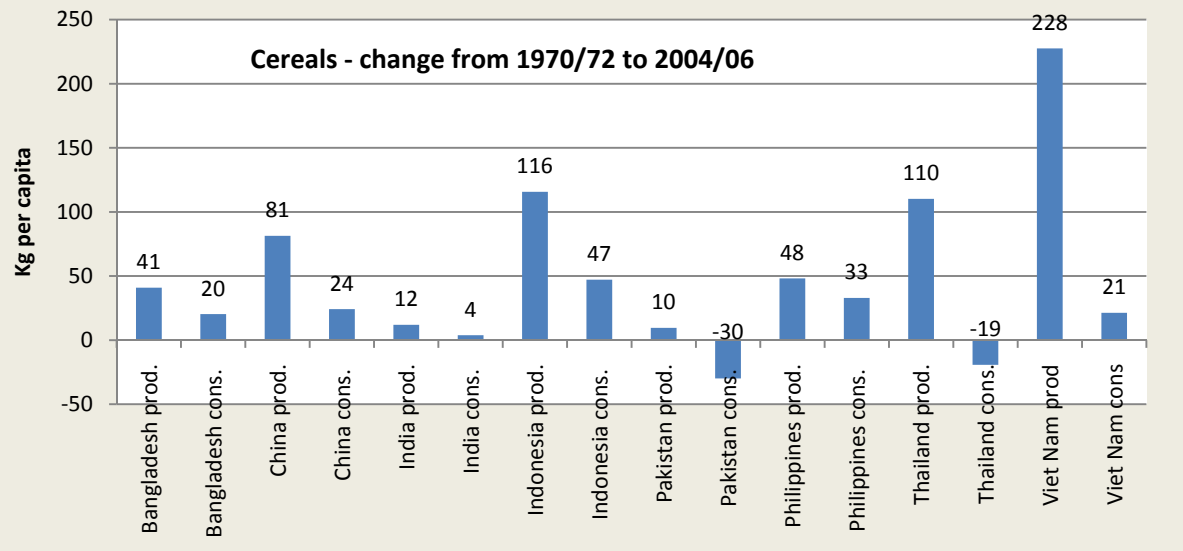
Source: Constructed with data from FAOSTAT. **Notes**: All measured in kilograms per capita per year. Average amounts supplied in mid 2000s (2004 to 2006). LDCs = Least Developed Countries; LIFDCs = Low Income Food Deficit Countries

Figure A.2 Change from mid 1970s to mid 2000s in amount supplied per capita of different food types across the world (kg)



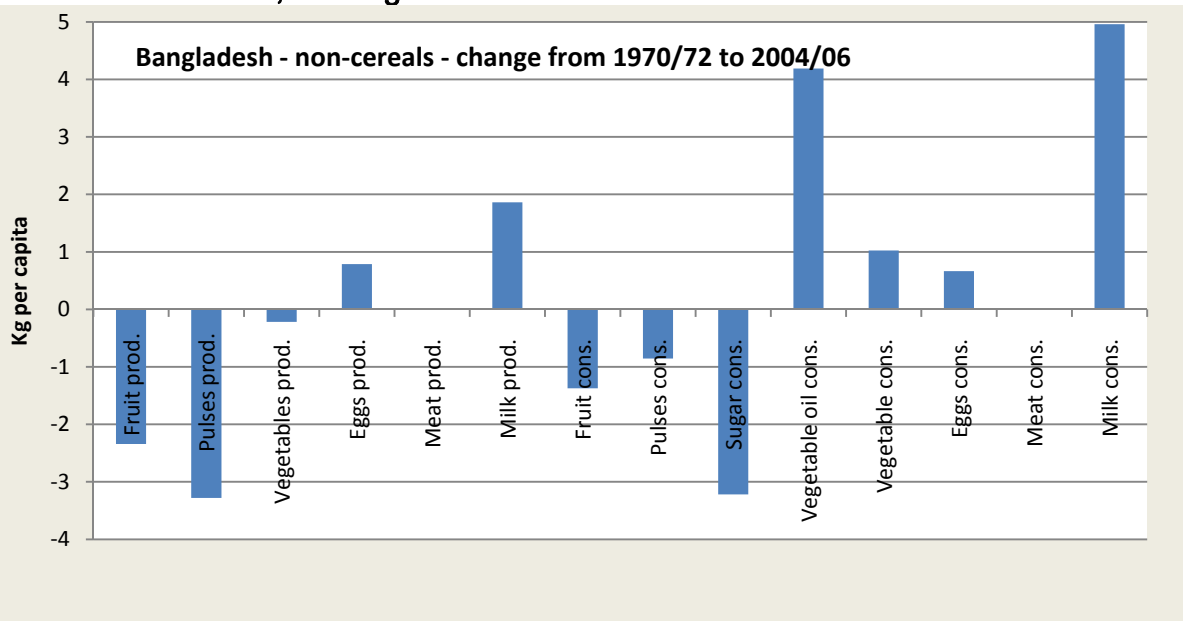
Source: Constructed with data from FAOSTAT. **Note**: Amount supplied is measured as kg/capita/year. For definitions of regional acronyms, see note to Figure A.1.

Figure A.3 Change in cereals production and consumption a head a year, 1970/72 to 2004/05 in eight Asian countries



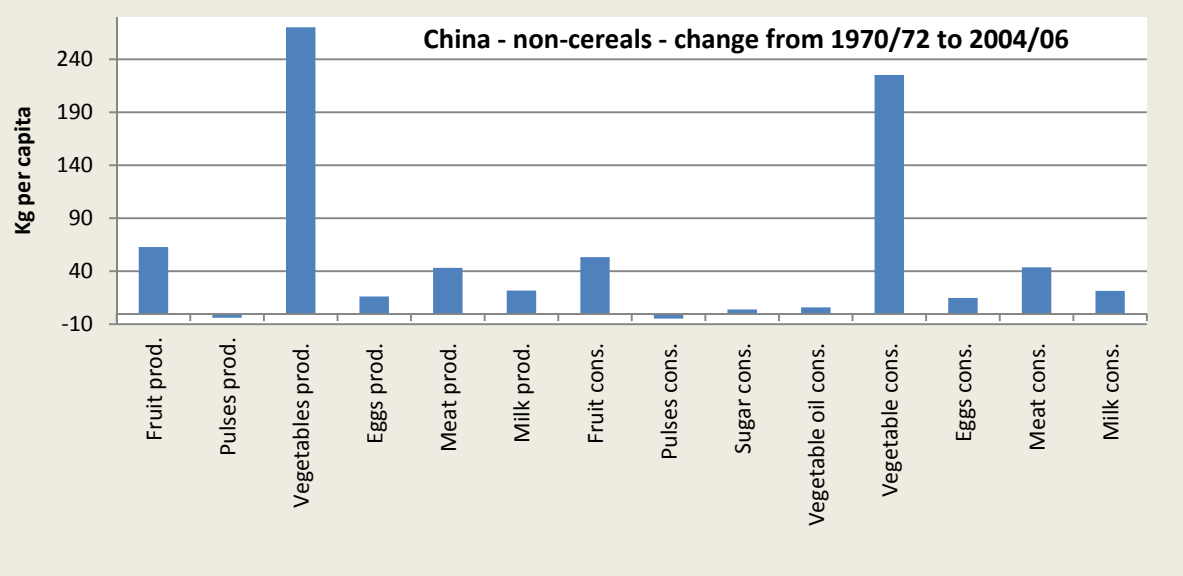
Source: Constructed with data from FAOSTAT. **Notes**: Prod. = production. Cons. = consumption. Per capita production estimated from total national production divided by annual population statistics. Per capita consumption is from FAOSTAT quantity supplied per capita data.

Figure A.4 Change in non-cereals production and consumption a head a year, 1970/72 to 2004/05, in Bangladesh



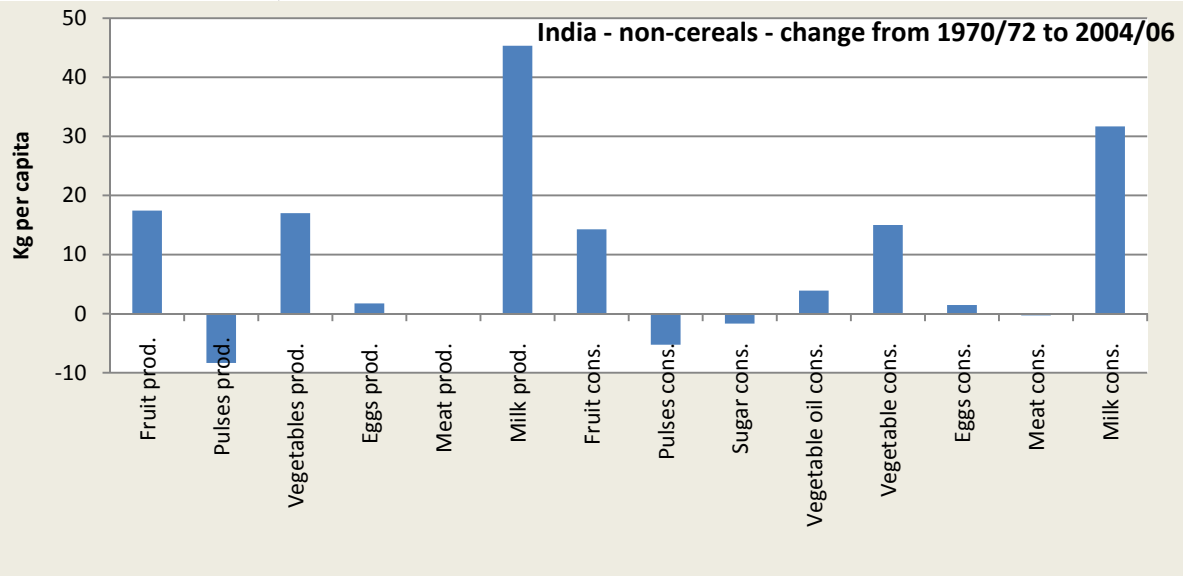
Source: Constructed with data from FAOSTAT. **Note**: See note to Figure A.3

Figure A.5 Change in non-cereals production and consumption a head a year, 1970/72 to 2004/05, in China



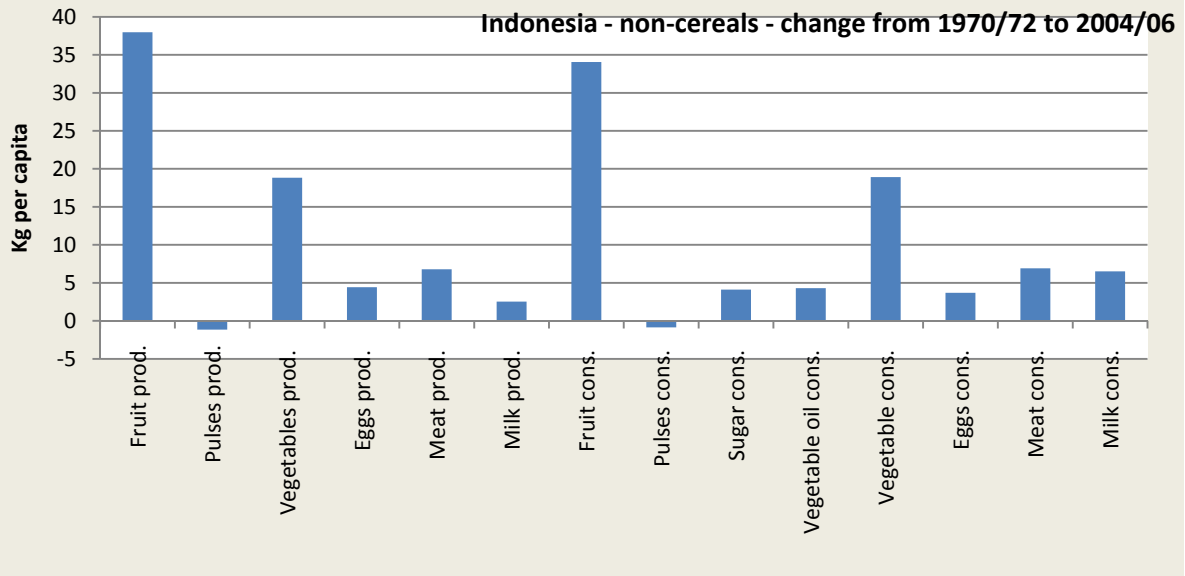
Source: Constructed with data from FAOSTAT. **Note**: See note to Figure A.3

Figure A.6 Change in non-cereals production and consumption a head a year, 1970/72 to 2004/05, in India



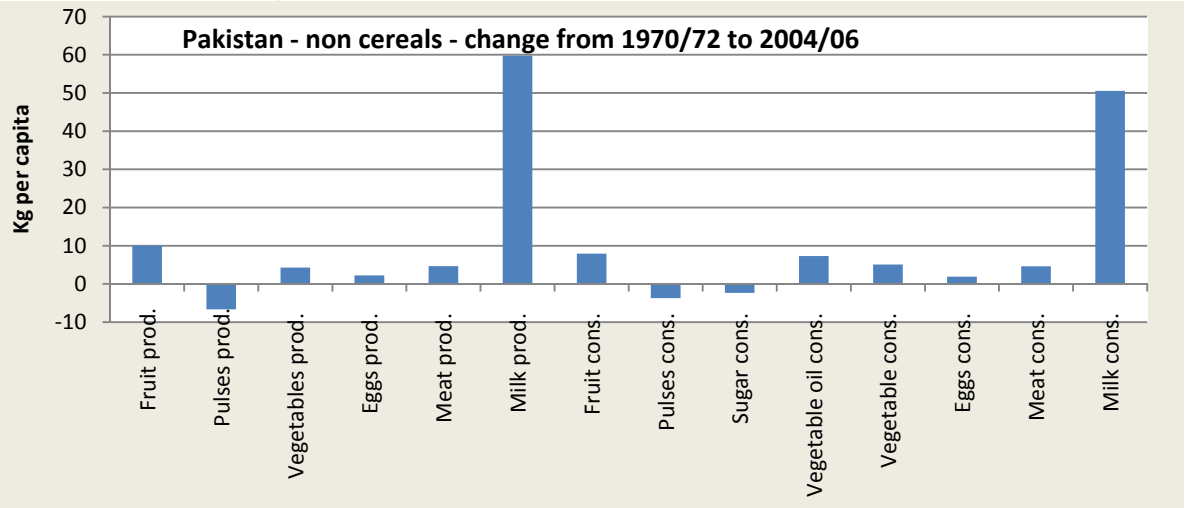
Source: Constructed with data from FAOSTAT. **Note**: See note to Figure A.3

Figure A.7 Change in non-cereals production and consumption a head a year, 1970/72 to 2004/05, in Indonesia



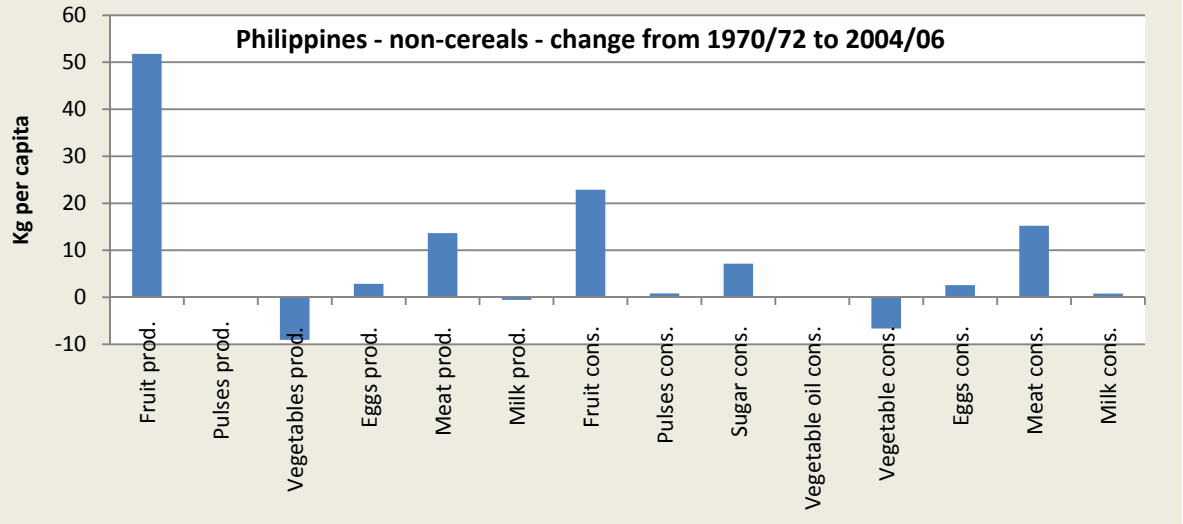
Source: Constructed with data from FAOSTAT. **Note**: See note to Figure A.3

Figure A.8 Change in non-cereals production and consumption a head a year, 1970/72 to 2004/05, in Pakistan



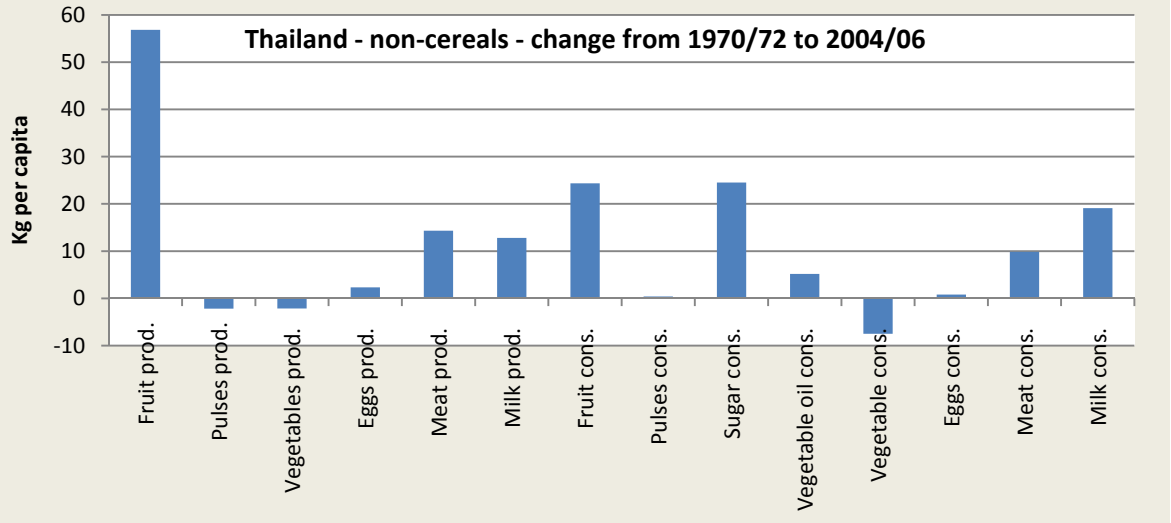
Source: Constructed with data from FAOSTAT. **Note**: See note to Figure A.3

Figure A.9 Change in non-cereals production and consumption a head a year, 1970/72 to 2004/05, in the Philippines



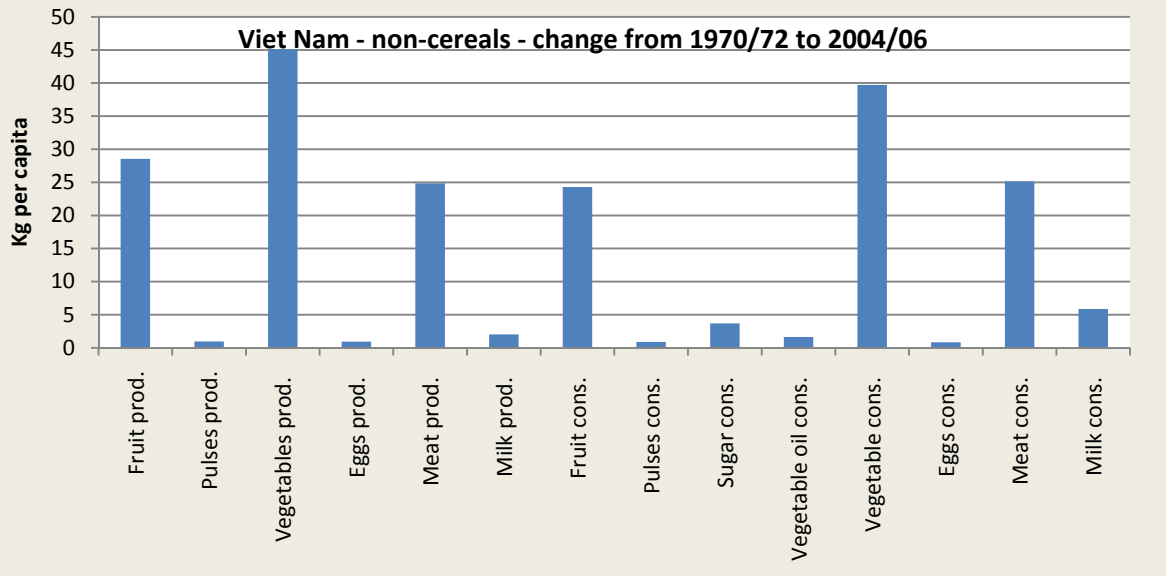
Source: Constructed with data from FAOSTAT. **Note**: See note to Figure A.3

Figure A.10 Change in non-cereals production and consumption a head a year, 1970/72 to 2004/05, in Thailand



Source: Constructed with data from FAOSTAT. **Note**: See note to Figure A.3

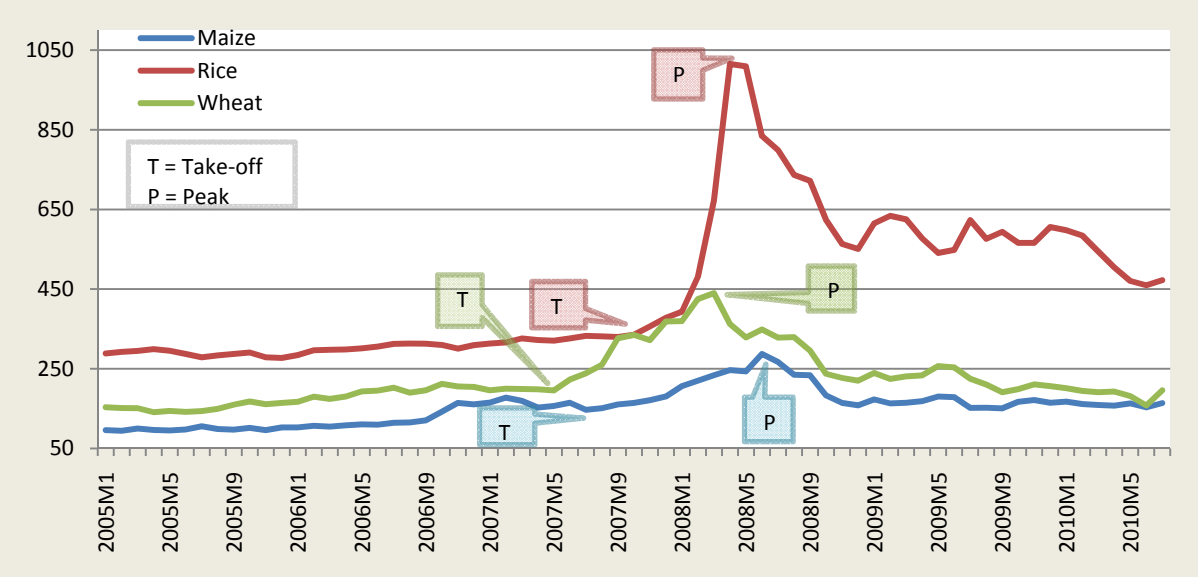
Figure A.11 Change in non-cereals production and consumption a head a year, 1970/72 to 2004/05, in Viet Nam



Source: Constructed with data from FAOSTAT. **Note**: See note to Figure A.3

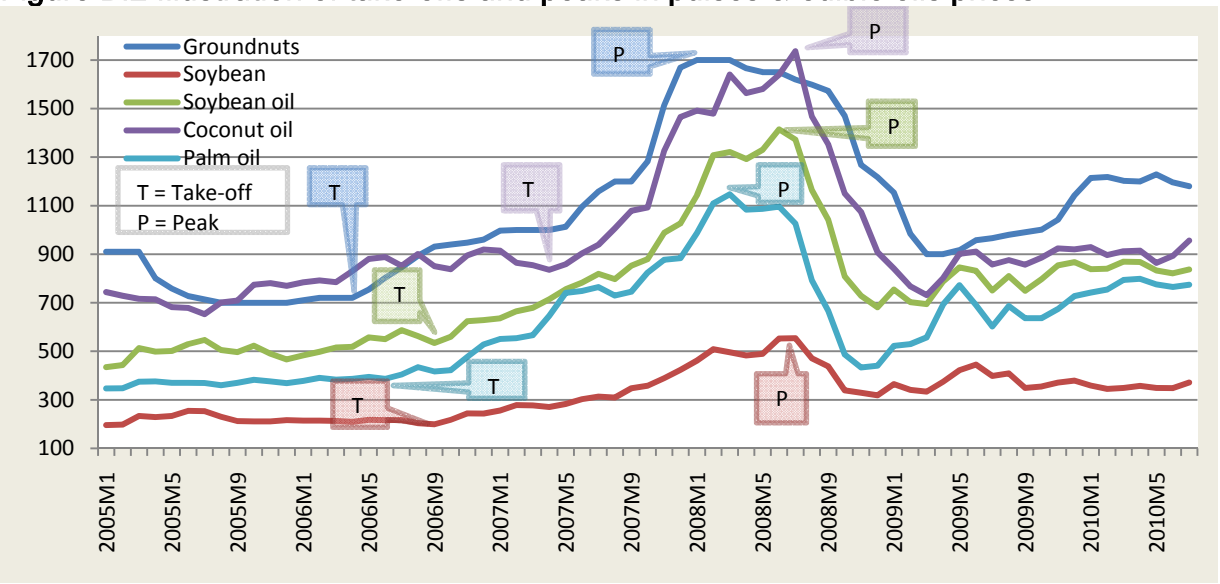
Annex B: International monthly price series

Figure B.1 Illustration of take-offs and peaks in cereal prices



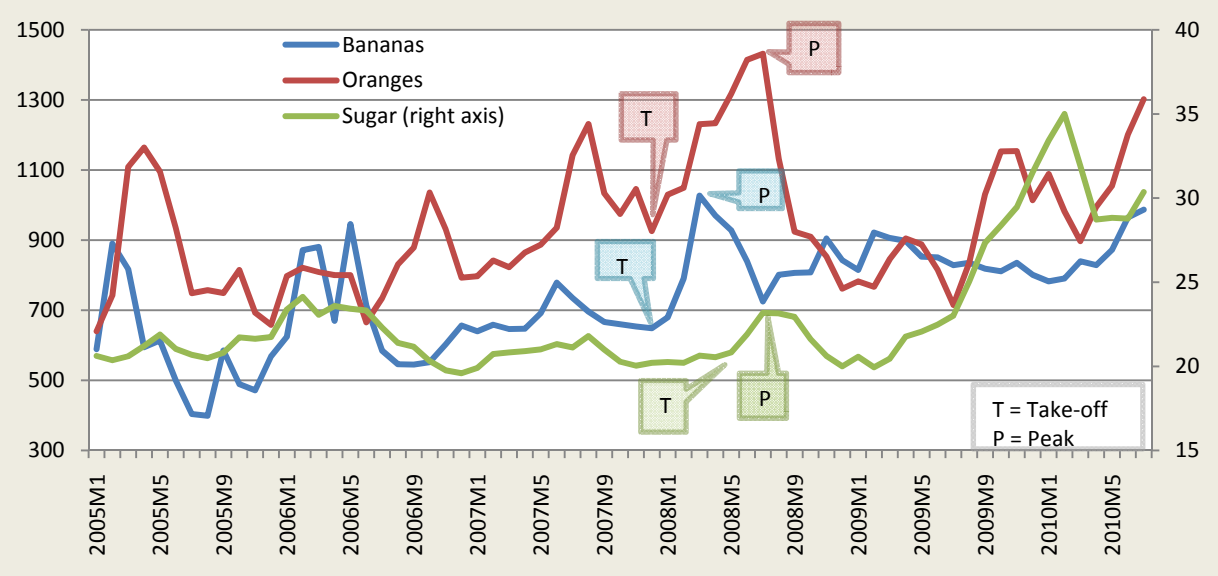
Source: Price data from IMF. **Note**: For details on varieties see the notes accompanying Table 4.

Figure B.2 Illustration of take-offs and peaks in pulses & edible oils prices



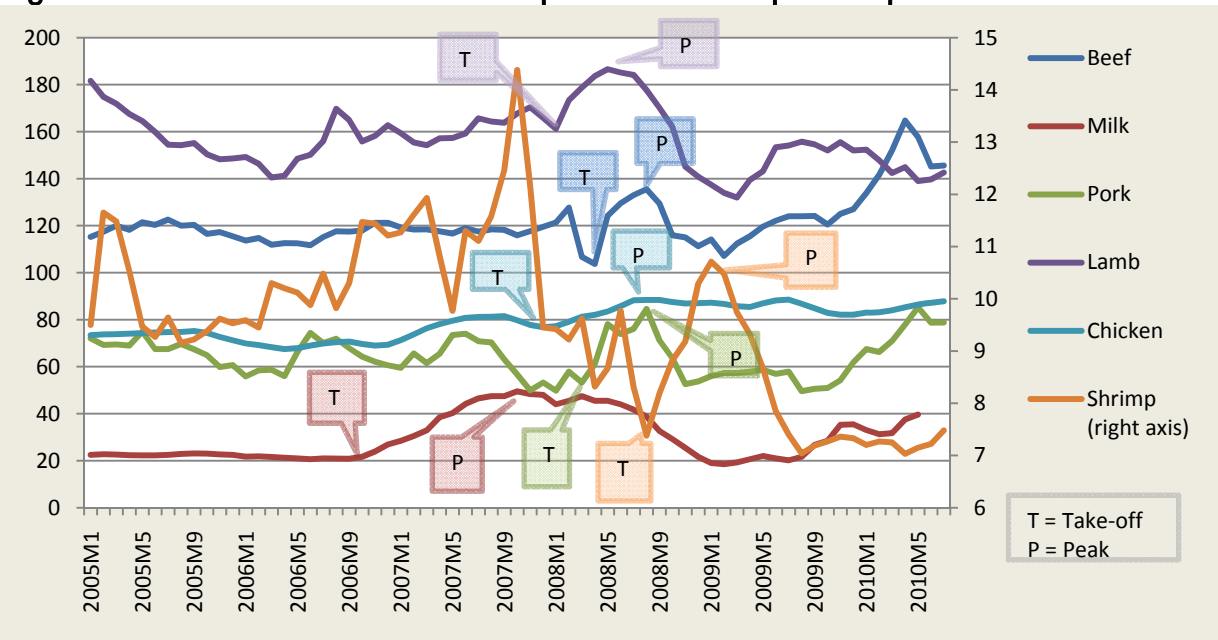
Source: Price data from IMF. **Note**: For details on varieties see the notes accompanying Table 4.

Figure B.3 Illustration of take-offs and peaks in fruits and sugar prices



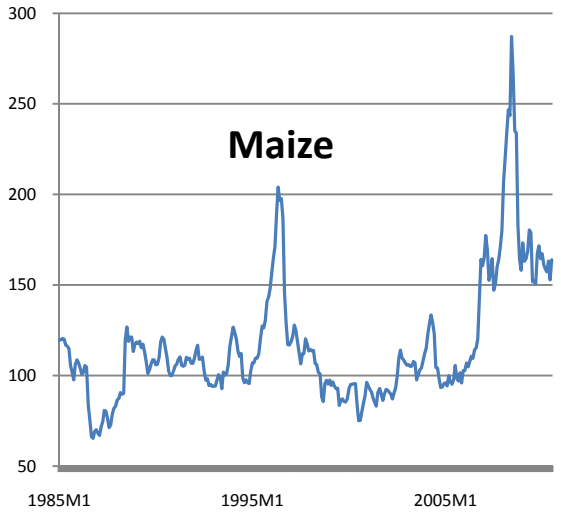
Source: Price data from IMF. **Note**: For details on varieties see the notes accompanying Table 4.

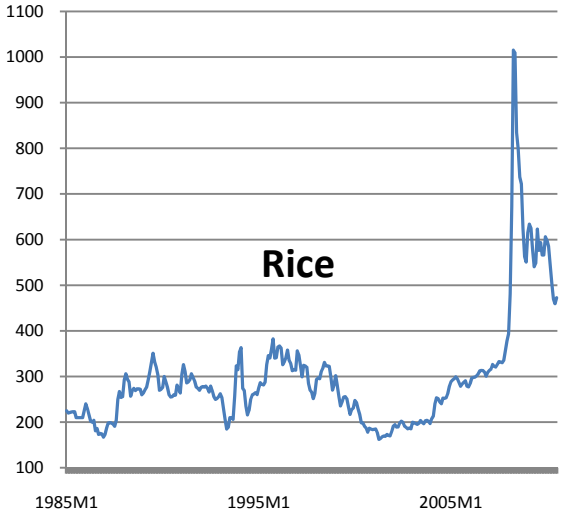
Figure B.4 Illustration of take-offs and peaks in animal product prices

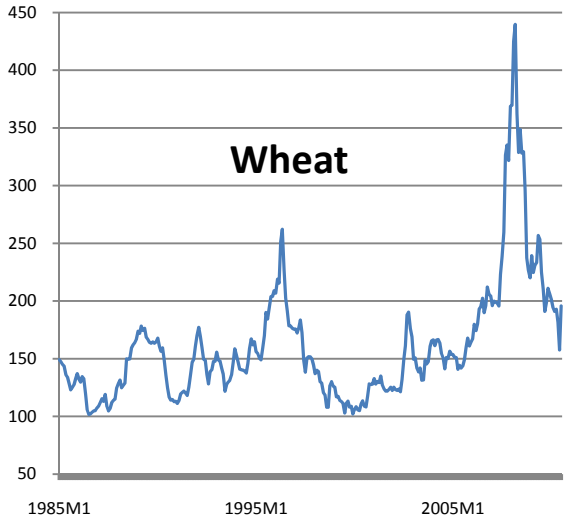


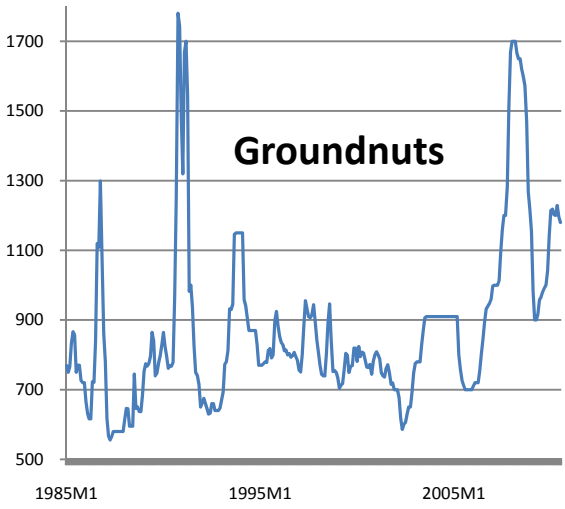
Source: Price data from IMF. **Note**: For details on varieties see the notes accompanying Table 4.

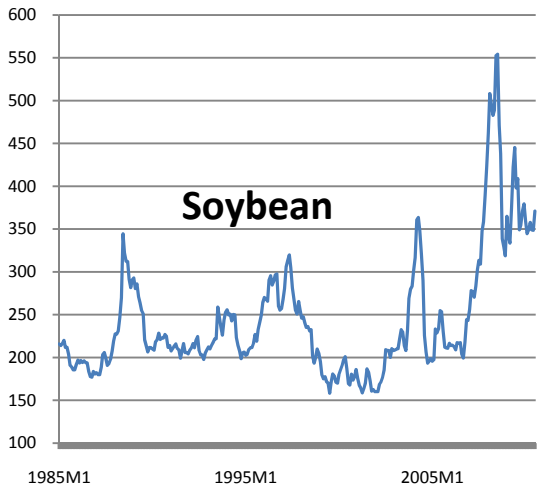
Figure B.5 International monthly price series from 1985 – 2010

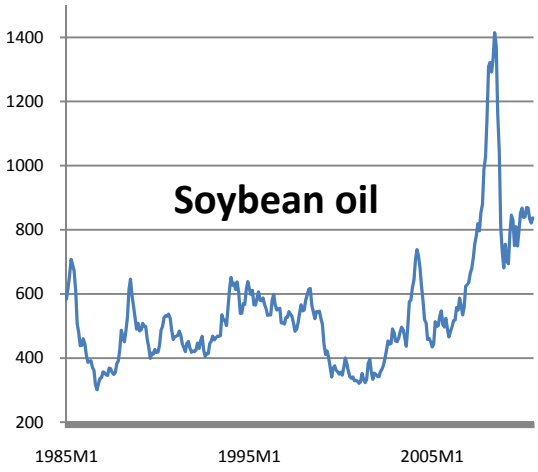


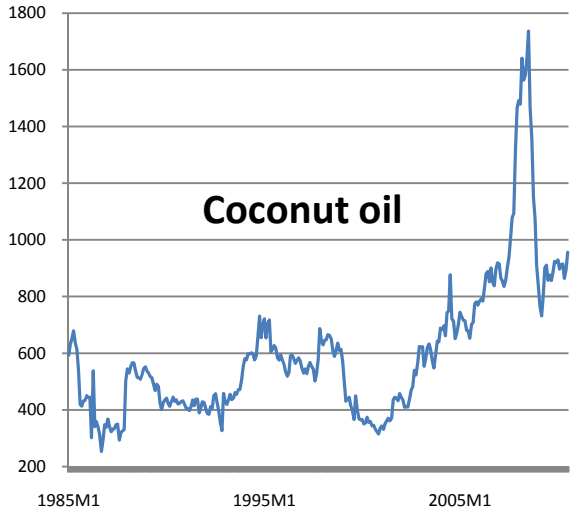


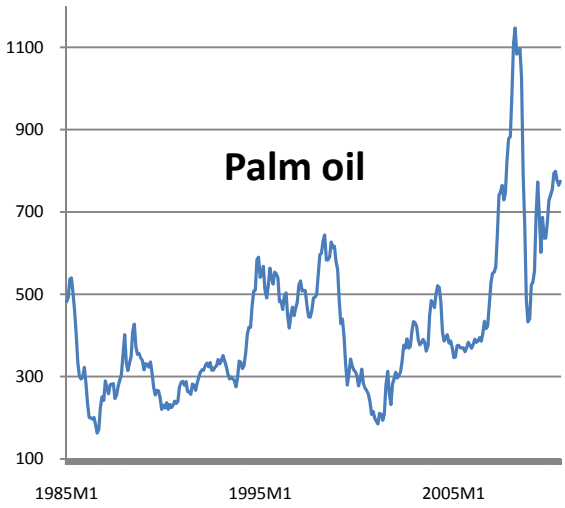


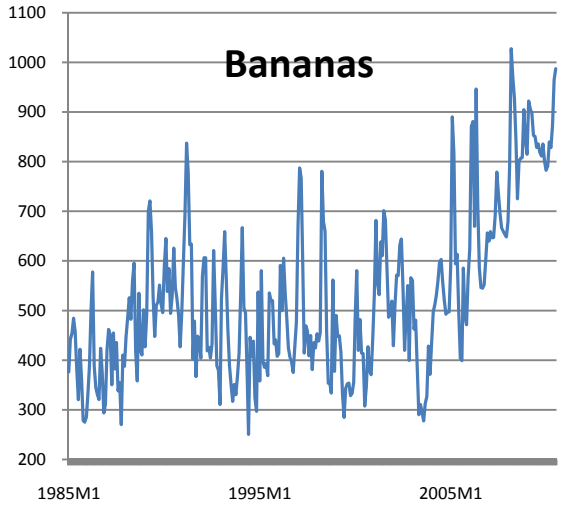


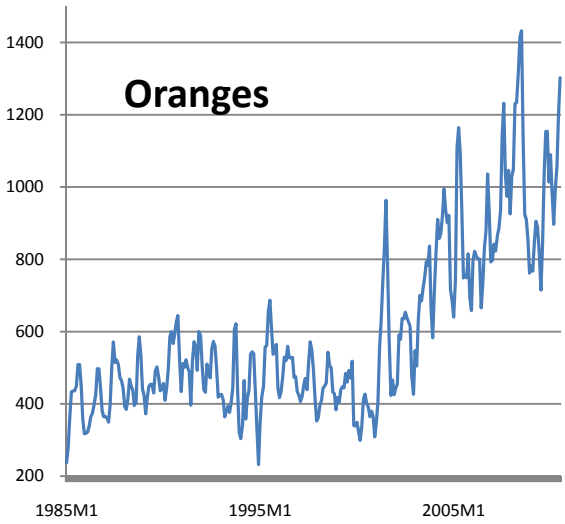


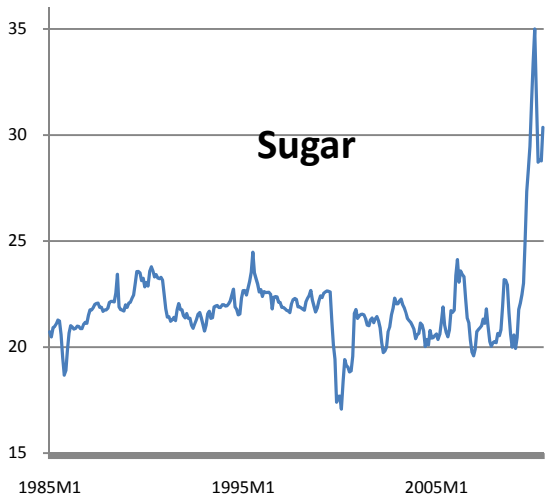


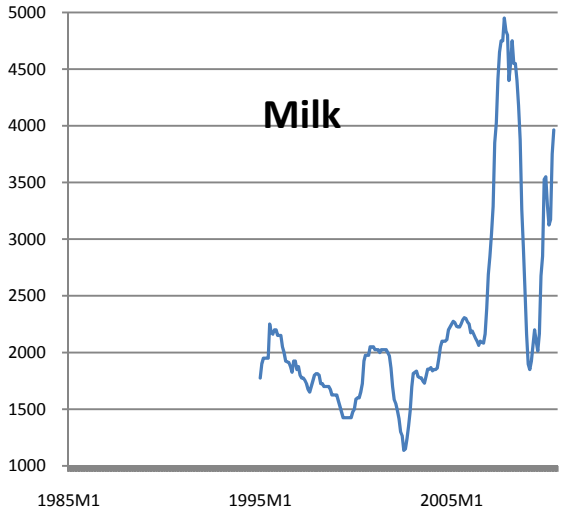

Coconut oil
1800
1600
1400
1200
1000
800
600
400
200
1985M1
1995M1
2005M1

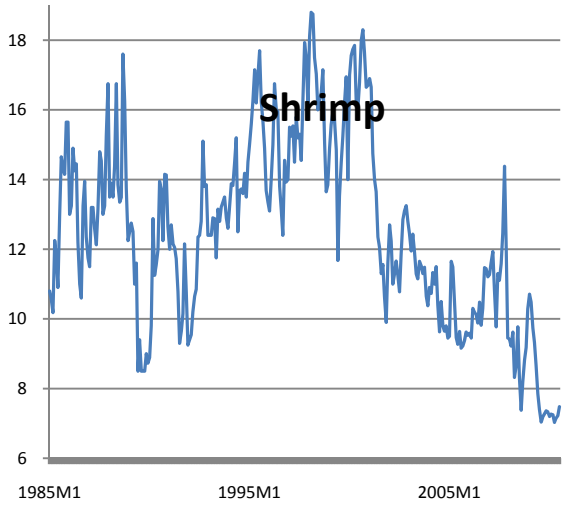

Palm oil
1100
900
700
500
300
100
1985M1
1995M1
2005M1

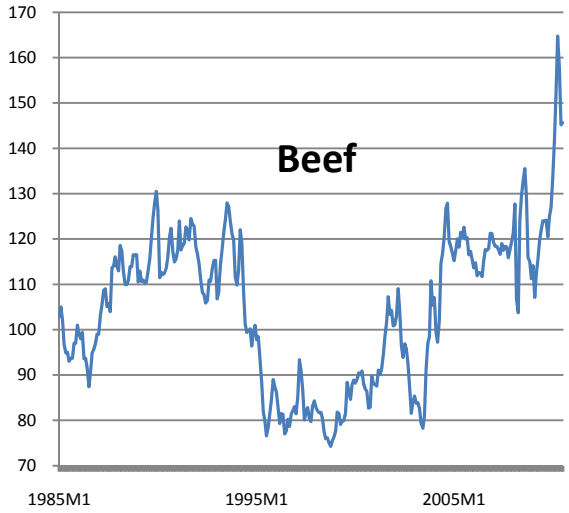

Bananas
1100
1000
900
800
700
600
500
400
300
200
1985M1
1995M1
2005M1

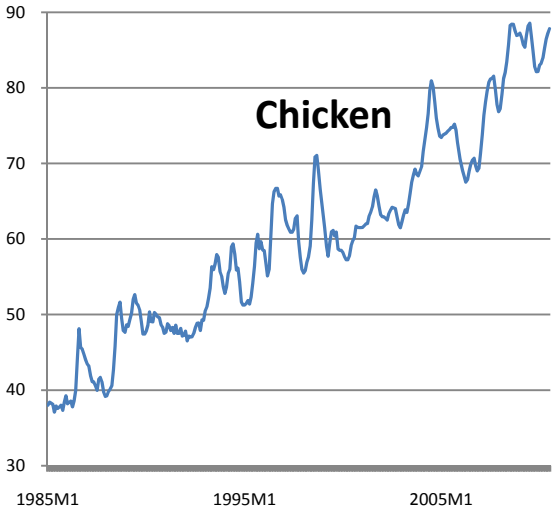

Oranges
1400
1200
1000
800
600
400
200
1985M1
1995M1
2005M1

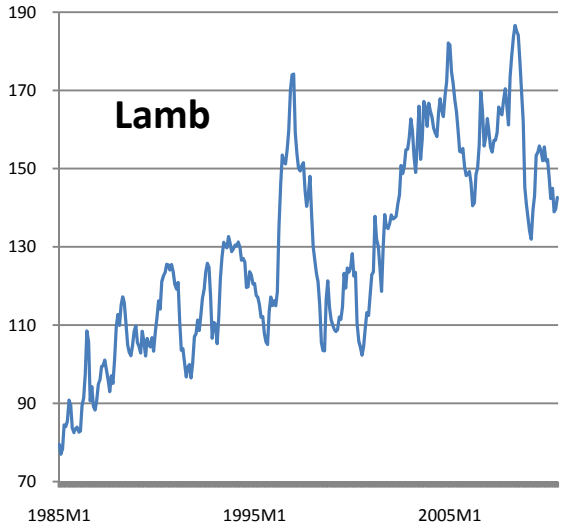

Sugar
35
30
25
20
15
1985M1
1995M1
2005M1

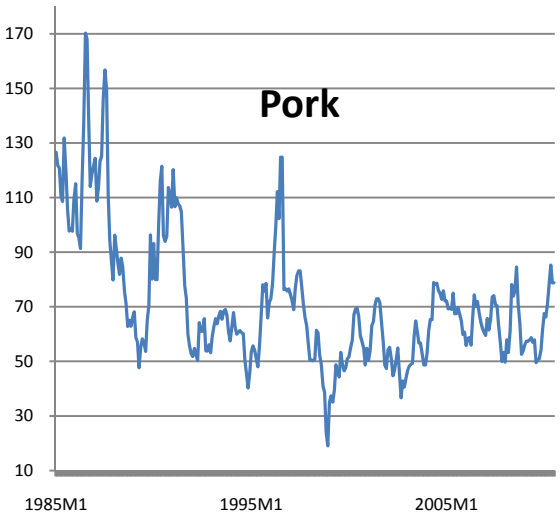












Source: IMF data except the milk series which is from FAO

Table B.1 Volatility in international monthly price series

	Commodity*	Volatility (%) (1985 – 2005)	Volatility (%) (2006 – July 2010)	Difference between the two periods***
Cereals	Maize	19	24	5
	Rice	20	38	17
	Wheat	19	28	9
Pulses & Edible Oils	Groundnut	23	26	3
	Soybean	18	27	9
	Soybean Oil	20	29	9
	Coconut Oil	24	26	2
	Palm Oil	30	32	1
Fruits & Sugar	Bananas	25	16	-9
	Oranges	31	19	-12
	Sugar	5	17	12
Animal Products	Shrimp	18	18	0
	Beef	15	10	-5
	Pork	36	15	-21
	Chicken	19	9	-10
	Lamb	19	9	-11
	Milk**	15	33	5

Source: Calculated from data in IMF and FAO (for dairy prices) **Notes**: *For details about the commodity price series see note to Table 3.1 which describes the same price series. **Milk powder data earlier than 1995 was not available, hence the period for milk is reckoned for 1995 – 2005. ***Difference calculated on unrounded numbers.

Annex C: Vitamins and minerals in foods

Table C.1: Vitamin & mineral daily requirements met by 100g of various foods (%)

Vitamins & Minerals	Sources: Percentage of US recommended daily consumption for adults met by 100g of:																	
	Pulses & Legumes					Animal products			Fruits				Vegetables				Other	
	Chick peas: Mature seeds, cooked	Kidney beans, raw	Lentils, raw	Tofu, raw	Peanut, Valencia, raw	Chicken egg, whole, hardboiled	Pork, fresh, loin, broiled	Chicken, broiler, stewed	Lychee, raw	Orange, raw, Florida	Papaya, raw	Passion fruit, raw	Avocado, raw	Spin-ach, raw	Carrot, raw	Raw sweet potato	Almond nut, raw	Sun-flower seed kernels, dried
Vit A						16		5			6	7		52	93	79		
Vit B1	9		67		46	5				8	3	9	5		3	8	18	176
Vit B2	4				20	33				3	3	10	9		3	7	53	17
Vit B3	4				86					3	2		12		8	4	27	30
Vit B5	6	16			36	28		13		5			28			16	6	135
Vit B6	11				23		36			4	8		20		8	15	10	59
B9 Folate	43	99	120		62	11				4		4	20	49	5	3	7	57
VitB12							29											
Vit C	2						1		120	75	103	50	17	47	12	4		2
Vit E	2													13			175	230
Vit K	4													460				
Calcium	5	14		35	6	5	2		1	4	2	1	1	10	3	3	25	112
Iron	23	64	60	43	16	10	7	9		1	1	13	4	22	5	5	32	54
Magnesium	13	38		8	50	3	8		3	3		8	8		5	7	74	96
Phosphorus	24				48	25	35		4	2		10	7		5	7	65	101
Potassium	6				7	3	9			4	5	7	10		5	7	15	15
Zinc	15	30			33	10	24			1		1	6			3	30	51

Source: Compiled from USDA data; USDA Nutrient database and US recommendations for adult consumption of various nutrients, as reproduced in Wikipedia. **Note**: Vitamin A = Vitamin A equivalent, from Beta-carotene, lutein and zeaxanthin. Vitamin B1 = Thiamine, B2 = Riboflavin, B3 = Niacin, B5 = Pantothenic acid. B9 = Folate

0-4		14-19		45-64	
5-9		20-29		65-94	
9-14		30-49		>94	