



Smallholder agriculture's contribution to better nutrition

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Abbreviations

ACF	Action Contre la Faim
ADB	Asian Development Bank
BCC	Behaviour Change Communication
BDHS	Bangladesh Demographic and Health Survey
BINP	Bangladesh Integrated Nutrition Plan
CFA	Comprehensive Framework for Action
CIDA	Canadian International Development Agency
CIMMYT	International Maize and Wheat Improvement Centre
CPI	Consumer Price Index
DFID	Department for International Development (UK)
DHS	Demographic & Health Surveys
ENHANCE	Expanding Nutrition and Health Achievements through Necessary Commodities and Education (USAID)
FAO (STAT)	Food and Agriculture Organization of the United Nations (Statistical Service)
FPMU	Food Planning and Monitoring Unit (Bangladesh)
GAM	Global Acute Malnutrition – sum of severe acute malnutrition and moderate acute malnutrition
GDP	Gross Domestic Product — the market value of all officially recognized final goods and services produced within a country in a given period of time
GHS	Ghana Health Service
GIEWS	Global Information and Early Warning Systems (FAO)
GPS	Global Positioning System
GSP	Gross State Product
GSS	Ghana Statistical Service
Ha	Hectares
HFP	Homestead Food Production
HKI	Helen Keller International
HLTF	The Secretary-General's High Level Task Force on the Global Food Security

	Crisis (UN)
IFA	Iron and Folic Acid
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
IRDP	Institute of Rural Development Planning (Tanzania)
LBW	Low Birth Weight
LIC	Low Income Country
LMIC	Lower Middle Income Country
M	Million
MCHN	Mother and Child Health and Nutrition
MDG	Millennium Development Goal
MICAH	Micronutrient and Health programme, implemented 1996 to 2005 in Ethiopia, Ghana, Malawi, Senegal and Tanzania by World Vision Canada
NGO	Non-Governmental Organisation
NNSP	National Nutrition Surveillance Project (Bangladesh)
NRA	Nominal Rate of Assistance (to agriculture)
OECD	Organisation for Economic Cooperation and Development
OFSP	Orange-Fleshed Sweet Potato
ORS	Oral Rehydration Salts
PL480	Public Law 480, also known as Food For Peace
QPM	Quality Protein Maize
SHOUHARDO	Nutrition programme implemented by CARE in Bangladesh, it stands for Strengthening Household Ability to Respond to Development Opportunities. Also means 'friendship' or 'amity.'
SIS	Small Indigenous Species
SUN	Scaling Up Nutrition – a global push for action and investment to improve maternal and child nutrition
TGR	Total Goitre Rates
UN SCN	United Nations Standing Committee on Nutrition
UNESCO	United Nations Educational, Scientific, and Cultural Organisation
UNICEF	United Nations Children's Fund
WDI	World Development Indicators (World Bank)
WFSP	White-Fleshed Sweet Potato
WHO	World Health Organisation (United Nations)
WIN	Empowerment of Women in Irrigation and Water Resources Management for Improved Household Food Security Nutrition and Health

Short summary

Food insecurity and under-nutrition remain pressing problems in the developing world. Despite their direct contribution to food production, small-scale farmers and their households are disproportionately vulnerable to hunger. How then can smallholder agriculture that is sustainable contribute to improving food security and reducing under-nutrition?

Potentially, smallholder agriculture can improve food security by making food available through production; reducing the real cost of food by increasing supply; generating incomes for farmers and those working the land as labourers, as well as to others in the rural economy from linkages in production and consumption that create additional activity and jobs. Other considerations include the way that increased rural incomes are spent; impacts on women's incomes, status within the household, and through the demands of farm work, the ability of mothers to allocate income to food and care of young children; the effect of farm work on energy of field workers; and, impacts on health of field workers and those living close to farms.

The record shows:

- ***Worldwide, and especially in the developing world, the production of food has increased ahead of population growth for most of the last fifty years.*** Much of this increase in availability has come from small-scale family farms, particularly in Asia;
- ***Increased food production has led to falling real prices of food, especially for staples,*** with benefits to those vulnerable people who have to buy in most of their food;
- ***Smallholder agricultural development usually leads to higher farm incomes,*** even when output prices may be pushed down by rising production, owing to improved productivity. Increasingly, however, incomes from off the farm — in services, public employment, businesses — tend to rise more. Links from smallholder agricultural development to the rest of the rural economy, especially when farmers spend increased incomes on locally-supplied goods and services, can be strong;
- ***Smallholders who focus on production of crops for sale can also increase their food security and nutrition,*** since commercial production from smallholdings is also often associated with increased food production and higher incomes. Under some conditions, however, nutrition may be impaired by cash crops; as, for example, when the demands of these crops mean that women working in the fields have too little time to feed and care for infants;
- Given appropriate technical knowledge and skill, some of it learned from other farmers, secure tenure and the incentive of markets, ***smallholder agricultural development can support food security and nutrition outcomes while being environmentally sustainable.***

Smallholder agricultural development can be steered to have a greater impact on food security and nutrition through three measures.

- ***Empower women farmers,*** both to allow them more control over income and household spending — which usually leads to more being spent on the feeding and care of young children, as well as to correct for unequal access to labour and inputs that means that women's plots often achieve lower yields than men's;
- ***Promote home gardens and small-scale livestock rearing*** for increased diversity of production and consumption. Children's nutrition often improves: effects that are stronger when these programmes are combined with education on diet, child care and hygiene; and,

- **Complement agricultural programmes with education and communication, health services, water and sanitation.** Smallholder agriculture cannot achieve better nutrition alone.

Four points stand out for policy-makers:

- 1. Smallholder agricultural development can be an excellent way to reduce poverty and tackle hunger** in low income countries. Encourage this by making sure that rural investment climate is conducive to investment and innovation. Provide rural public goods roads and other physical infrastructure, schools, health, clean water, agricultural research and extension. Improve access to inputs, insurance and finance for smallholders and improve their terms of engagement in such markets. Develop and promote innovations for marginal farms. Recognise and protect the rights of small farmers to their land.
- 2. Patterns of agricultural development need steering towards more diversified food production.** Production of staples has increased more than foods with more diverse nutrients. For every person who suffers from undernourishment in the world, more than twice as many suffer from deficiencies in minerals and vitamins. Hence promote home gardens, with small-scale livestock rearing — including fish. Complement this up with communications for nutrition, health and child care. Monitor the adoption of emerging bio-fortified staples of maize, rice and sweet potato by farmers.
- 3. Back up smallholder agricultural programmes with primary health care, clean water and sanitation, other direct interventions for nutrition, and female empowerment.** Empowered and educated mothers are time and again shown to spend incomes on their young children and to protect the nutrition and health of the household. Correct female disadvantages in farming: through recognising and strengthening women's rights to fields and common property resources; directing attention to women's needs in farming and finding ways to support them; and in general, developing innovations both on field and in domestic tasks, such as water supply and fuel collection, that save time and appropriate for women. Make sure that girls living in rural areas are schooled through until the end of secondary.
- 4. Greater political support for improving food security and nutrition is needed.** Political support for nutrition is often lukewarm: perhaps because of ignorance of the problems, or because the remedies can seem dauntingly difficult for problems with multiple causes. Monitor and survey more often the state of food security and nutrition, to highlight the problems and to see where and when progress is being made. Regular national surveys of nutrition and food security should be conducted, at least once every five years, preferably every three years. Sentinel sites could be established for more frequent monitoring of food and nutrition, using text messaging to collect information in real time. Pilot innovations, then evaluate these rigorously, compare them to counter-factuals, and publicise the results.

These policies either have low costs or are not additional to the funding what would be needed for any serious programme of development. FAO in 2011 estimated the **extra annual spending required to eliminate hunger by 2025** as US\$50.2 billion, including US\$7.5 billion for food and cash-based safety nets in keeping with the twin-track approach of dealing with long-term chronic hunger while also addressing short-term needs. Most of the extra investment is for physical infrastructure, and mostly in Sub-Saharan Africa and South Asia.

An extra US\$50 billion a year may sound a lot, but consider the figure for sub-Saharan Africa of US\$13.3 billion more. This is about US\$15.50 for each of the 854M living in the region. The costs are small compared to the numbers who will potentially benefit from better food security and nutrition.

Summary

Objective and approach

Food insecurity and under-nutrition remain pressing problems in the developing world. Some 852M persons in the developing world, 15% of the total, were estimated to be undernourished and so unable to meet their minimum energy requirements in 2010–12, while among children under five years old, 29% were stunted and 18% were underweight. Micro-nutrient deficiencies, especially of vitamin A, iodine, iron and zinc, are even more widespread, with perhaps as many as two billion persons affected owing to insufficient vitamins and minerals in their diet.

Despite their direct contribution to food production, small-scale farmers and their households are disproportionately vulnerable to these forms of hunger. Hence this paper addresses the question of how can smallholder agriculture that is sustainable contribute to improving food security and reducing under-nutrition?

Food security, following FAO definition and concepts, is achieved when individuals have the food they need to live their lives: it depends on sufficient, adequate food being available; people having access to it; food being well utilised; and on reliable availability and access. Adequate nutrition depends partly on access to food, but also on the health environment and child care.

Smallholder agriculture can potentially affect food security and nutrition through the following pathways:

- 1 Making food available through production;
- 2 Reducing the real cost of food by increasing the supply of food. The composition of production also matters, since this affects the availability and prices of different foods with their varying nutrients;
- 3 Generating incomes for farmers and those working the land as labourers, that allow access to food; and through
- 4 Providing incomes to others in the rural economy from linkages in production and consumption that create additional activity and jobs.

In addition, in some circumstances the following may be equally important:

- 1 Whether incomes from agriculture are spent on food, especially higher value foods rich in vitamins and minerals, as well as on health, water and sanitation — all factors that may improve the nutrition of household members and especially infants;
- 2 Impacts of agriculture on women's incomes, status within the household, and through the demands of farm work, the ability of mothers to allocate income to food and care, especially of young children;
- 3 The effect of farm work on energy of field workers: hard labour may create high demands for energy that cannot be met from limited access to food; and,
- 4 Impacts on health, both on field workers who may be exposed to hazards such as accidents, crop chemicals, zoonoses and to others whose environment may be impaired by agriculture — as, for example, when irrigation canals become habitats for disease vectors such as mosquitoes and worms.

This paper examines the contribution of smallholder agricultural development to attaining improved food security and nutrition, how development policy might strengthen its contribution, what complementary actions are needed, and what the political conditions for better policy may be.

The literature has been reviewed, including reports of agricultural programmes explicitly and specifically designed to reduce malnutrition. Since the relations of agriculture to food security, and nutrition especially, are diverse and only explain part of the outcomes, five countries were selected to look in more detail at the interplay of smallholder agricultural development with

other determinants of food security and nutrition. The cases comprise two with relatively rapid agricultural growth, *Ghana* and *Bangladesh*, two with relatively slow agricultural growth, *Tanzania* and *Zambia*, and *Kerala State*, India where agriculture has also grown slowly, but which has seen a concerted effort to improve other basic factors affecting undernutrition.

Smallholder agriculture and food security and nutrition

Food availability and cost. Worldwide, and especially in the developing world, the production of food has increased ahead of population growth for most of the last fifty years. Much of this increase in availability has come from small-scale family farms, particularly in Asia.

From the early 1960s, world food production per person has increased by one third. In the developing world, in Asia the quantity has doubled, in South America increased by more than 80%, and only for Africa has production increased more slowly than the world average — although even in this case, production has increased slightly more than population growth.

This increased food production can lead to falling real prices of food, especially for staples, with benefits to those vulnerable people who have to buy in most of their food. Given the inelastic demand for staple foods, small increases in supply ahead of demand can lead to sizeable falls in prices. Between 1960 and 2000, the prices of maize, rice and wheat in constant terms fell by 69%, 72% and 66% respectively on world markets. Given the strong contribution of smallholder farming to increased production, it has contributed to falling food prices. Since the mid-2000s, prices have spiked and remain above their 2000 levels: but they are still well below prices in 1960.

Incomes of farmers and other rural households. Smallholder agricultural development usually leads to higher farm incomes, even when real output prices may be pushed down by production increases, owing to improved productivity. Increasingly, however, incomes from off the farm — in services, public employment, businesses — tend to rise more. Links from smallholder agricultural development to the rest of the rural economy, especially when farmers spend increased incomes on locally-supplied goods and services, can be strong — with every extra dollar of agricultural incomes generating another 1.4 or more in the rest of the rural economy, and thereby giving others more access to food.

Cash versus food crops. Smallholders who focus on production of crops for sale can also increase their food security and nutrition, since commercial production from smallholdings is also often associated with increased food production and higher incomes. Under some conditions, however, nutrition may be impaired by such a focus on cash crops; as for example, when the demands of these crops mean that women working in the fields have too little time to feed and care for infants.

Environmental sustainability. With the right support, smallholder agricultural development can support food security and nutrition outcomes while being environmentally sustainable. Two cases, Machakos, Kenya and the central plateau of Burkina Faso, show that intensification and agricultural development can go hand in hand with conservation of soil and water and indeed enhancement of the environment. Appropriate technical knowledge and skill, some of it learned from other farmers, secure tenure and the incentive of markets for surplus produce are amongst the reasons for the conservation seen in these cases.

Smallholder agriculture's contribution to food security and nutrition

Smallholder agriculture can clearly do much to improve people's availability and access to food. But how far does this lead to improved food security and nutrition? Cross-country evidence suggests that while low incomes correlate with child stunting (low height for age, an indicator of physical development), only about half the variation in stunting can be explained by income differences. Much of the remainder is attributable to health conditions, water and sanitation and levels of female empowerment.

The five country cases provide insights into the interplay of smallholder agricultural development with other variables. **Ghana** and **Bangladesh** show what strong agricultural growth from smallholdings, where policy has supported farming, can achieve. Poverty has been reduced, food prices pushed down, with clear benefits to food security and nutrition. They also show, however, what may be lacking for nutrition, especially in the case of Ghana where progress on health, sanitation, and women's empowerment has been limited. Increased food production in Bangladesh, moreover, has relied too much on rice, with little commensurate increase in complementary crops to the detriment of dietary diversity.

Tanzania and **Zambia** show what may happen when smallholder agricultural growth is limited, owing at least in part to lack of policy support, and in Zambia when overall economic growth is restricted as well. With food availability per capita just keeping up with population growth in Tanzania, and falling behind in Zambia, while poverty remains high and falling slowly, it is no surprise that gains to nutrition have been limited. The few gains seen look to arise from the improving health of under-fives. In both these cases, lack of agricultural development is compounded by failure to improve water and sanitation and to empower women, the last an acute problem in Zambia.

Despite limited economic and agricultural growth, **Kerala** has high levels of food security and low malnutrition, owing to strong public support for health, water, education, and female empowerment for decades. On the other hand, limited agricultural growth and apparently low food availability may explain why nutrition has not improved more in the last twenty years. Kerala's social progress is an object lesson to the rest of India and indeed the world.

How can smallholder agricultural development have a stronger impact on nutrition?

Recent reviews suggest three ways in which smallholder agricultural development can be steered to have a greater impact on food security and nutrition.

- **Empower women farmers**, both to allow them more control over income and household spending — which usually leads to more being spent on the feeding and care of young children, as well as to correct for unequal access to labour and inputs that means that women's plots often achieve lower yields than men's, when all other factors are held constant;
- **Promote home gardens and small-scale livestock rearing** for increased diversity of production and consumption. Since gardens and small-scale livestock are often carried out by women — being close to the house can make them more compatible with women's time, they tend as well to , as well as to empower women giving them more incomes and status. Evaluations in several countries show that households that have improved home gardens have higher production of micro-nutrient-rich foodstuffs, higher consumption of these, and increased sales in local markets. Children's nutrition often improves: effects that are stronger when these programmes are combined with education on diet, child care and hygiene.

Bio-fortification of staple foods with nutrients such as Vitamin A and iron shows promise, but so far these varieties have only been piloted and have yet to adopted at scale. They may come to be useful complement, but for the time being home gardens are probably a better route to more diversified diets; and

- **Complement agricultural programmes with education and communication, health services, water and sanitation.** Smallholder agriculture cannot achieve food security and nutrition alone. But, combined with complementary rural services, the outcomes are powerful. For example, Shouhardo, a programme that works on all these areas with poor households in some of the poorest areas of Bangladesh, has managed to bring down stunting of under-twos by 16 percentage points between 2006 and 2010, at a time when no progress was seen nationally. It

suggests that it may be easier to make progress in improving the fundamental determinants of nutrition than some believe.

Policies for nutrition-sensitive smallholder development

Policy to encourage smallholder development, as for agriculture as a whole, has come back into the limelight in the new century. A broad consensus exists on policies for development of agriculture, and smallholder agriculture in particular. Governments need to do two things above all else. One is to ensure that there is a rural investment climate that encourages agricultural investment and innovation; the other to supply rural public goods including physical infrastructure of roads, power lines, in some areas irrigation and drainage; investments in education, health care, clean water and sanitation; and knowledge generation through agricultural research, preferably that takes account of indigenous knowledge and extension. Both conditions, and especially the second, matter especially for smallholders, since unlike some large-scale commercial farmers who may have the means to access some of these goods and services privately, they cannot.

While these basic conditions can do much to stimulate agricultural growth, many smallholders face difficulties in accessing markets, and especially those for inputs, insurance, financial services and technical assistance. Remedies for failings in rural markets are debated, however: the answers may lie variously with institutions such as contract farming that give farmers access to inputs on credit; or in farmer co-operation that makes it easier to negotiate credit or inputs in bulk; or else in direct state provision to replace the market where it does not function.

Women farmers face disadvantages, some specific to the roles assigned to their gender, others being more intense manifestations of problems that many male smallholders face. To correct some of the worst disadvantages, women need secure access to land, access to markets, ways to reduce the risks faced possibly by micro-insurance, and extension that attends to women farmers and their needs. Other public goods can complement agricultural interventions: ensuring that girls get at least **secondary education** can contribute in lowering barriers to communication, as well as raising female status. **Clean water supplies** can reduce the time taken to draw household water and reduce child sickness. **Health services** are likely to be of particular benefit to mothers. Shouhardo in Bangladesh shows what can be achieved when deliberate actions are taken, through group work, to empower women.

Leadership and political conditions

Food security and nutrition need political support, preferably at high level. **Presidential or Prime Ministerial support was a feature of success in Brazil, Ethiopia and Peru**. There may be no science to firing the imagination of leaders, but there are indications of factors that can contribute. One of these is the creation of convincing narratives that are widely shared. Good experiences can inspire imitation, so that **piloting innovative approaches to smallholder agricultural development and nutrition can capture the imagination**. Civil society can help make results known; researchers can ensure that reviews are rigorous so that they cannot be readily dismissed by sceptics

Pressure for governments to take food security and nutrition more seriously can come from international efforts, witness the efforts of the Special Rapporteur on the Right to Food. More pressure can come from civil society that can monitor progress towards better food security and nutrition, as well as track commitment of resources to programmes — as has been seen in India.

Holding government and leaders to account depends on having **information and data**. At national level, data on food security and nutrition outcomes, preferably disaggregated by sex, needs to be collected regularly. With advances in information technology, most notably mobile phones, the possibility of much more agile data collection and processing arises. Text messaging coupled with GPS, for example, might allow indicators of food security and nutrition to be collected monthly from sentinel sites across nations and regions, with almost no delay in

feeding the results back to decision-makers and the public, the results being presented in easily appreciated maps.

Co-ordinating field efforts

Marrying smallholder development to other efforts to improve food security and nutrition involve co-ordinating the efforts of several agencies. Central co-ordination units at high level may work, but not always: much depends on the political support they receive. Complementary actions may be better arranged locally.

Funding can contribute to co-ordination, so long as public funds are disbursed from one source, such as finance ministries. The danger here is that external funds channelled directly to operating agencies to avoid delays can give them the liberty to ignore other agencies.

Programmes need to fit with local circumstances and capabilities: these should be overloaded and overwhelmed by over-ambitious programmes. The art here is to simplify the vertical structures of programmes, while allowing them to become more complex at the field level as elements are combined to increase the coverage and attractiveness of the programme.

The MICAH programme, operating in four African countries, did this by a broad package of interventions rather than relying on single 'magic bullets', but then allowed community participation to tune the package to local needs. The technical integrity of the programme was nevertheless ensured by technical support and regular supervision of field staff, plus monitoring of results that allowed programmes to be adjusted when it was clear that they were not making headway.

A balance needs to be struck between the limits of what may be possible locally, against impatiently demanding that programmes include all proven interventions.

Conclusions and recommendations

Four points stand out from this review and form the basis of policy conclusions and recommendations.

1. *Smallholder agricultural development can be an excellent way to reduce poverty and tackle hunger* in low income countries. It can increase food production, raise rural incomes, and push down food prices; all of which should improve the access of poor and vulnerable people to food and thereby contribute considerably to improving their food security. Given that many of those who are food insecure work in agriculture, then its effects can be direct.

The implication is to continue with efforts to develop agriculture and especially that of small-scale family farms. Some of the ways to do this are reasonably well known, hence the first two recommendations:

R1: Countries need to ensure that the rural investment climate is conducive to investment and innovation. This means peace and security, a reasonably stable macro-economy without major economic distortions, and the establishment and recognition of critical institutions, such as property rights. Those who suffer most from investment climates that deter investment are small-scale enterprises, including smallholdings. Large businesses may be able to protect themselves from insecurity, macro-economic chaos and the absence of property rights: smallholders can only do so by retreating to autarkic subsistence economy, usually of low productivity.

This may seem a tall order for low income countries that face multiple challenges; but experience shows that the rural investment climate does not have to be ideal; only that the worst failings are eliminated.

R2: Countries need to invest in rural public goods, including: physical infrastructure — rural roads, electricity, perhaps irrigation and drainage where

applicable; human development — education, water and sanitation, health; and public knowledge through agricultural research and extension. Again, these are particularly valuable for smallholders who cannot substitute private investments for most of these public goods.

Spending on public goods in rural areas pays off, both in returns on investment and in reductions of the numbers of people living in poverty: as can be seen from studies of returns to these investments in Asia when agricultural development was particularly rapid (Fan et al. 2007).

Prime responsibility for these lies with domestic governments, but donors can help with some of the capital costs of public investments.

After these, comes a more challenging matter where the responses to the problem are in debate, but in any case will vary by circumstances.

R3: Improve the access to rural markets, especially for inputs, insurance and finance, for smallholders and improve their terms of engagement in such markets. Currently the majority of small-scale farmers in Africa engage much less with markets than the gains to specialisation and use of external inputs would suggest. Part of the reason for this lies in high costs of information and negotiations between enterprises in the supply chain such as banks and small family farms. Responses will need to be tailored to conditions, but promising ways to improve lie in institutional innovations such as contracting and in producer organisations.

Finding effective solutions requires innovative programmes that may be too risky for governments and donors, and hence may be better managed by NGOs, foundations and private enterprise. More effort, however, needs to be made to learn from these experiences, so that where effective solutions are proved, they can be replicated more widely by public programmes.

While these policies will allow some smallholders to develop their farms, other farms marginal either by their very small size, poor quality of soils and climate, lack of labour, or remoteness from services and markets may need additional measures. In particular, on the more marginal holdings farming is often part-time, one of several livelihoods that household members pursue. Hence labour may be scarce, and working capital may also be lacking.

R4: Develop and promote innovations for marginal farms, focusing on higher yields for staples but using few external inputs and where possible saving labour. These will allow these farms to achieve the self-provisioning in staples that is often a primary objective of the farm, as well as potentially allowing some of the land to be switched to more diverse, nutrient-rich fruit, vegetables and small-scale livestock rearing.

Responsibility for this lies with agricultural research systems, although for some researchers taking up this challenge may require setting aside the search for optimal yields. There is scope here for NGOs to foster exchange of experiences from local innovations and NGO research.

Smallholders and especially the more marginalised, need assurance that their land rights are respected both in recognition of their entitlements and to remove any disincentive there may be to invest, innovate and conserve.

R5: Recognise and protect the rights of small farmers to their land. This may mean some form of registration of rights, but it may mean recognising local authorities that define land rights. Two particular issues are to ensure the recognition of women's rights as farmers, especially those of widows; and of safeguarding against land being taken away in land deals without free, prior and informed consent.

Responsibility here lies with governments, although there are roles for civil society in making sure that laws, rules and practice are respected and in bringing abuses to attention.

Last but not least, smallholder agriculture can be environmentally sustainable and increasingly will have to be in a world where natural resources will be in short supply, further ecological damage will carry too high a price for future generations and where global warming will lead to climate change and increasingly volatile weather.

R6: Give sufficient support to make sure that smallholder agricultural development is environmentally sustainable. This can be encouraged by agricultural research & extension that engages with local needs, knowledge and perceptions of the relation of farming to soil, water, and other parts of the local ecology. When better farming practice confers external benefits, farmers should be rewarded for this.

Given the size of this challenge this will require not only appropriate domestic policies, but also support from international policy-making to promote global public goods — and prevent global bads, with major roles for research both technical and social to find responses to the challenges including those of climate change.

2. Patterns of agricultural development need steering towards more diversified food production. Progress on food security and better nutrition has been greater on food availability than on food access, and on access to energy-rich foods than on those with more diverse nutrients. For every person who suffers from undernourishment in the world, more than twice as many suffer from deficiencies in minerals and vitamins. Part of the answer lies with more diversified food production, that may also reduce risk in production and markets for smallholders. The problem of the focus on energy-dense foodstuffs is likely to become ever more pressing this century, with urbanisation and rising incomes allowing people to adopt diets high in energy, sugar and salt that have already taken their toll in the diseases of affluence seen in most OECD countries. Production of foodstuffs rich in micro-nutrients needs encouragement.

Agricultural policy can contribute, even if wider changes in diet will be necessary in the medium term.

R7: Promote home gardens, with small-scale livestock rearing — including fish, and back this up with communications for nutrition, health and child care. This costs little, while the returns can be disproportionate. A key challenge here is ensuring smallholders have access to good seed.

R8: Monitor progress on bio-fortification of staples, especially their adoption by farmers. Since this technology is not yet proven at scale, this should not be seen as the primary and still less the only way to tackle micro-nutrient deficiencies. Home gardens, for example, can be promoted at the same time. Even if bio-fortified crops do become taken up widely, people will want to consume foods complementary to their staples as well.

Responsibility here lies with domestic governments, with ministries of agriculture in the lead, but working in co-operation with those of health, community development and so on. NGOs have a role to play in piloting and demonstrating effective models, documenting them and bringing them to the attention of governments.

3. Back up smallholder agricultural programmes, with complementary actions in primary health care, clean water and sanitation, other direct interventions for nutrition, and female empowerment. Agriculture can play a key role in reducing hunger, but it needs to be supported by actions in these other spheres. Female empowerment may be the outstanding complement to both agriculture and actions on health, water and so on.

Empowered and educated mothers are time and again shown to spend incomes on their young children and to protect the nutrition and health of the household.

R9: Back up agricultural development with commensurate investments in primary health care, clean water and sanitation, and BCC on diet, child care and hygiene. These measures include the direct nutrition interventions recommended in the SUN initiative, but they should not be the only ones, however valuable as they may be. The concern that progress in shifting the deeper causes of malnutrition would be too slow may exaggerate if the striking results of programmes such as Shouhardo in Bangladesh are considered.

R10: Correct female disadvantages in farming: this will not only raise production and improve the pattern of production, but also help empower rural women and overcome longstanding unfairness. Priorities include recognising and strengthening women's rights to fields and common property resources; directing attention to women's needs in farming and finding ways to support them; and in general, developing innovations both on field and in domestic tasks, such as water supply and fuel collection, that save time and appropriate for women. Making sure that girls living in rural areas are schooled through until the end of secondary will underpin these measures.

Prime responsibility lies with national governments, where the challenge is to co-ordinate the actions of different agencies. At central level this may consist of little more than political leadership and budget co-ordination by finance ministries: the detailed operational co-ordination may be simpler at district level than attempting to decide this centrally. NGOs and donors may support these efforts by funding innovative programmes that can show how these programmes may work in specific countries.

4. Greater political support for improving food security and nutrition is needed. Political support to is often lukewarm: perhaps because of ignorance of the problems, or because the remedies can seem dauntingly difficult for problems that have multiple causes. How to generate political support may not be certain, but at least two things seem promising.

R11: Monitor and survey more often the state of food security and nutrition, to highlight the problems and to see where and when progress is being made. At the moment, statistics in many low income countries with high rates of food insecurity and malnutrition are few, collected infrequently, and some, such as those for undernourishment of individuals, are unreliable. Statistics on micro-nutrient deficiency are particularly rare. Regular national surveys of nutrition and food security should be conducted, at least once every five years, preferably every three years. Sentinel sites could be established for more frequent monitoring of food and nutrition (see Barrett 2010). This could take advantage of text messaging to collect information in real time, so that policy-makers and their advisers have information accurate to the month on the state of food insecurity.

R12: Pilot innovative approaches, then evaluate these rigorously with counter-factuals wherever possible, and publicise the results. Currently much is tried, but much either passes without review or is not sufficiently well evaluated to convince sceptical readers. Not all pilots will succeed of course, but some will: understanding in broad terms what works can inspire action — and political will.

Civil society can play a role in generating information to draw attention to problems and opportunities, then making sure that key messages reach leaders, opinion-makers and the general public.

Final consideration: costs

These recommendations have not been costed item by item, partly because some are policies that have low costs, if they have any monetary cost at all; but mainly because most of what is recommended here is not additional spending over and above what would be needed for any programme of development. Most of the recommendations are for adjusting the use of

resources that are already being funded, or would be funded under a serious development effort.

That said, FAO has recently (Schmidhuber & Bruinsma, 2011) estimated the ***extra annual spending required to eliminate hunger by 2025*** as US\$50.2 billion, including US\$7.5 billion for food and cash-based safety nets¹ in keeping with the twin-track approach of dealing with long-term chronic hunger while also addressing short-term needs. Most of the extra investment is for physical infrastructure, and mostly in Sub-Saharan Africa and South Asia.

An extra US\$50 billion a year may sound a lot, but consider the figure for sub-Saharan Africa of US\$13.3 billion more. This is about US\$15.50 for each of the 854M living in the region. Not to labour the point: the costs are small compared to the numbers who will potentially benefit, and the importance to them of food security and nutrition.

¹ Without the consumption safety nets, the extra spending is equal to around US\$42 billion per year (constant 2009), the figure called for in the IF campaign launched in 2013.

1 Introduction

1.1 Objectives

Food insecurity and under-nutrition remain pressing problems in the developing world. Some 852M persons in the developing world, 15% of the total, were estimated to be undernourished² in 2010–12 (FAO 2012). Amongst children under five years old, 29% are stunted³ and 18% are underweight⁴ (UNICEF 2012). Micro-nutrient deficiencies are even more widespread, with perhaps as many as two billion persons affected, most of them suffering from a lack of vitamin A, iodine, iron or zinc (UN SCN 2004).

For two reasons, this report focuses on small-scale farms ('smallholdings'), operated by households, largely with their own labour. One, these farms are home to about 430M households in the developing world,⁵ perhaps two billion persons in all. Two, despite smallholders farming and producing food, their incomes are usually lower than average for their countries, rates of poverty are above average, and many households are vulnerable to hunger: IFPRI (2005) estimates that most persons in absolute poverty live on small farms; as well as half the undernourished in the world, and for Africa, three-quarters of malnourished children.

How then can smallholder agriculture contribute most to improving food security and reducing under-nutrition? The following sets of questions are addressed:

- 1 What is known about the contribution of smallholder agricultural development to attaining improved food security and nutrition? Under what conditions is sustainable smallholder agricultural development most effective in improving food security and nutrition?
- 2 How can agricultural development policy and programmes be designed, implemented and monitored to have a stronger effect on supporting sustainable smallholder production to achieve food security and nutrition outcomes, both directly through the nutrition of farming households and indirectly through their contribution to the reduction of poverty and food prices — without neglecting other objectives or raising costs disproportionately? What specific sustainable smallholder livelihood programmes have been undertaken to improve nutrition and dietary diversity at the household level? What implications of cost-effectiveness can be drawn?
- 3 What complementary actions on the underlying determinants of nutrition — primary health care, water and sanitation, female education — are needed to ensure that sustainable smallholder agricultural development has a strong impact on attaining food security and nutrition? Are there additional implications for gender equity and governance?
- 4 What are the political conditions under which progress is most likely to be made? What evidence is there of political commitment and cross- governmental approaches to supporting environmentally sustainable smallholder livelihoods to improve and monitor progress in food security and nutrition? Has civil society played a role in this?

² Undernourishment implies individuals not getting enough energy in their diet sufficient to lead a healthy and active life.

³ Defined by height for age: children who are 2 standards deviations or more below the median for their age are considered stunted.

⁴ Defined by weight for age: children who are 2 standards deviations or more below the median for their age are considered underweight.

⁵ Although a precise definition of a smallholding may be elusive, FAO has adopted a two hectare threshold as a broad measure of a small farm. There are roughly 450 million farms in the world smaller than two hectares. Most of these in the developing world (Nagayets 2005).

1.2 Food security and nutrition: concepts

A commonly used framework to explain the causes of **food insecurity** comes from FAO (2008), building on the following definition of food security adopted by the World Food Summit of 1996:

Food security exists when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

From that, it is proposed that people will only be food secure when: sufficient food is available; people have access to it; it is well utilised; and when availability and access are reliable. **Food availability** is influenced by the production of food, modified by storage, transport and trade. Globally, there has been no shortage of food for more than half a century. Given obstacles to transport and delays, locally there can, however, be food shortages temporarily.

Food access is related in large part to incomes including implicit income from farm households' own production, as well as other entitlements such as gifts, loans and transfers from government. Sen (1981) stressed the importance of entitlements in determining who suffers during famines, arguing that almost all famines in the twentieth century were the result of entitlement or access failures, rather than from food being unavailable.

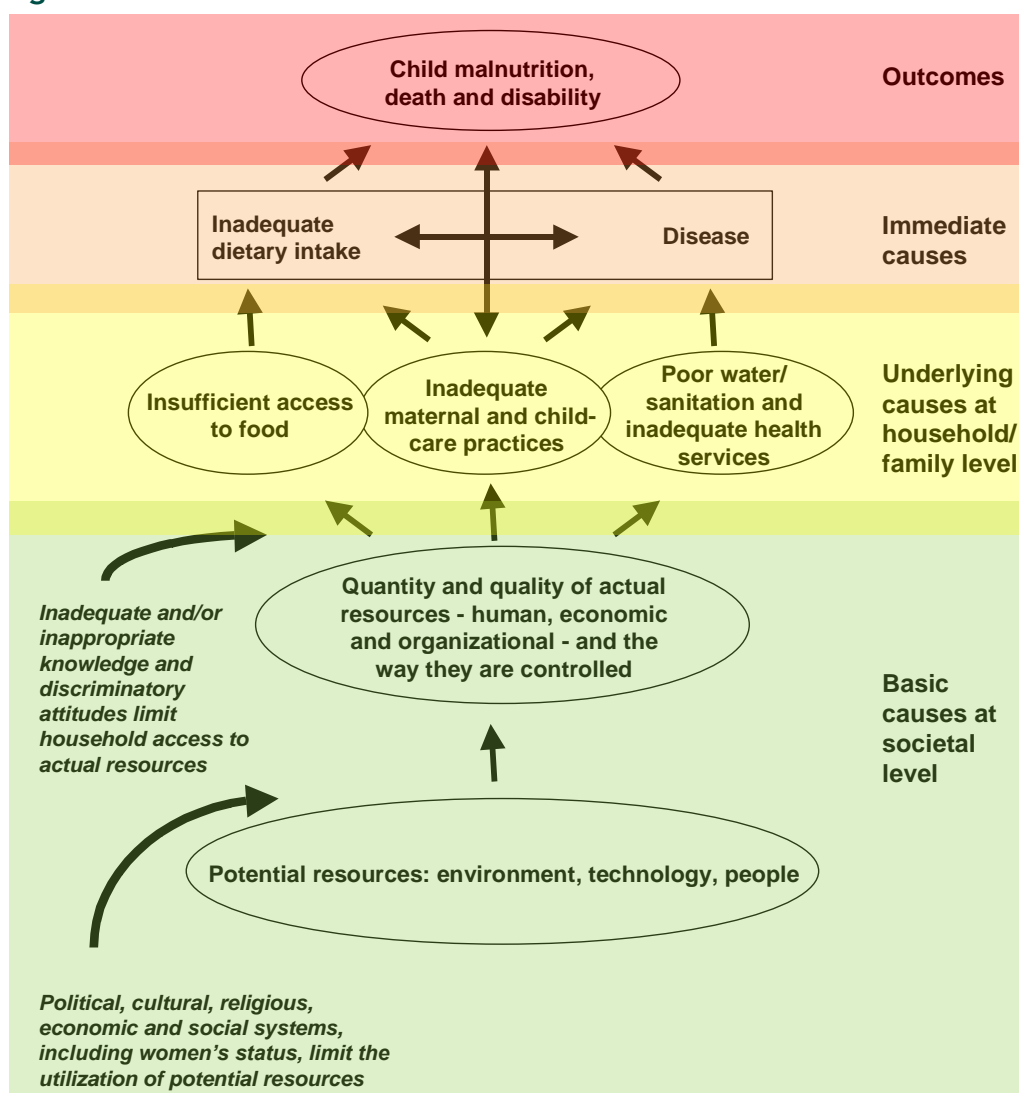
Reliable availability and access: not only should access to available food not vary significantly by season and year, but also people should feel secure of access to food, they should not fear that they will go hungry at some time or other. The unfortunate reality is that many people living in poverty, especially those whose livelihoods depend on farming or other activities influenced by variable weather, do face significant risks of losing access to food.

Food utilisation comprises those factors that intervene between having food and this translating into adequate nutrition: it includes the way that food is distributed within households, how it is prepared, care of infants and their feeding, and the health of those eating the food. Since each of these considerations can be quite complicated, this dimension is not always fully appreciated:

... outside the nutrition community dialogues about food security often remain focused on household-level access to sufficient food energy... (Arimond et al. 2011)

Since these dimensions of utilisation are so important for the nutrition of young children, UNICEF created a framework to show the causes of child malnutrition, mortality and disability, see Figure 1.1: a frame that has been widely used and adapted in the twenty or more years that it has been in circulation. This sees two immediate determinants of child malnutrition: inadequate diet and disease. These in turn originate from three factors: insufficient access to food; inadequate care; and poor water, sanitation and health services. Behind these lie the political, economic and social reasons that govern how food and public services are produced and provided, and how they are distributed. Nutrition is thus the outcome of multiple factors interacting in complex systems. The key point here is that food insecurity is only one of the factors leading to undernutrition.

Figure 1.1 Causes of child malnutrition



Source: The State of the World's Children, reproduced in Pelletier 2002

1.3 Pathways from smallholder agricultural development to food security and nutrition

These frameworks help set out the expected pathways from smallholder agricultural development to food security and nutrition,⁶ as follows:

- 1 Agriculture produces food, thereby making it available. To the extent to which food can be produced and stored locally at moderate cost, this can reduce temporary local shortages;
- 2 Increased food supplies will tend to push down the prices of food, thereby improving the entitlement and access to food by people with limited incomes. The pattern of production matters here, since the availability and prices of different foods with their varying nutrients depend on what is produced. Diverse production, including fruit and vegetables as complements to staple crops, makes a diverse diet rich in micro-nutrients more accessible and affordable;

⁶ This draws partly on Gillespie et al. 2012 who set out seven ways that agriculture can affect nutrition in India.

- 3 Agriculture provides incomes to farmers and those working the land as labourers, incomes that may be taken directly as food produced on farm. Incomes allow access to food in markets; and,
- 4 Agriculture generates links to other activities, such as those in the supply chain where increases in farm output generate additional activity, jobs and incomes for those working in the chains. Similarly, as farmers and labourers spend incomes earned from farming, those providing goods and services for rural communities also see additional activity, jobs and incomes. Hence the access to food of others outside of farming may also increase.

In addition, in some circumstances the following may be important as well:

- 1 The extent to which income from agriculture is spent on food, especially higher value foods, rich in vitamins and minerals, as well as on health, water and sanitation — all factors that may affect nutrition of household members and especially infants. This is related to the next pathway;
- 2 Impacts of agriculture on women's incomes, status within the household, and through the demands of farm work, the ability of mothers to allocate income to food and care, especially of young children;
- 3 The effect of farm work on energy of field workers: hard labour may create high demands for energy that cannot be met from limited access to food; and,
- 4 Impact on health, both on field workers who may be exposed to hazards such as accidents, crop chemicals, zoonoses and to others whose environment may be impaired by agriculture — as, for example, when irrigation canals become habitats for disease vectors such as mosquitoes and worms.

While agriculture can thus affect some important determinants of food security and nutrition, it may not often be a major influence on two of the underlying determinants of child malnutrition: care and health.

1.4 Approach taken

To answer the questions, literature has been reviewed on the pathways outlined from smallholder agricultural development to improved food security and nutrition. Reviews of agricultural programmes explicitly and specifically designed to reduce malnutrition were of particular relevance.

Since the relations of agriculture to food security, and nutrition especially, are diverse and only explain part of the outcomes, five countries were selected to look in more detail at the interplay of agricultural development with other determinants of food security and nutrition. These were chosen from developing countries of special interest to DFID⁷, the main object being to look at how countries with differing agricultural growth have seen changes in food and nutrition security. The countries comprise:

- Two with relatively rapid agricultural growth, **Ghana** and **Bangladesh**;
- Two with relatively slow agricultural growth, **Tanzania** and **Zambia**; and
- One state of India with slow agricultural growth, but which has seen a concerted effort to improve other basic factors affecting undernutrition: **Kerala**.

For each of these cases, available data and statistics on agricultural growth, poverty reduction, health, water and food and nutrition security from 1990 to the present, together with relevant analyses and literature, were reviewed. Detail of each of the countries appear in Annexes A to E.

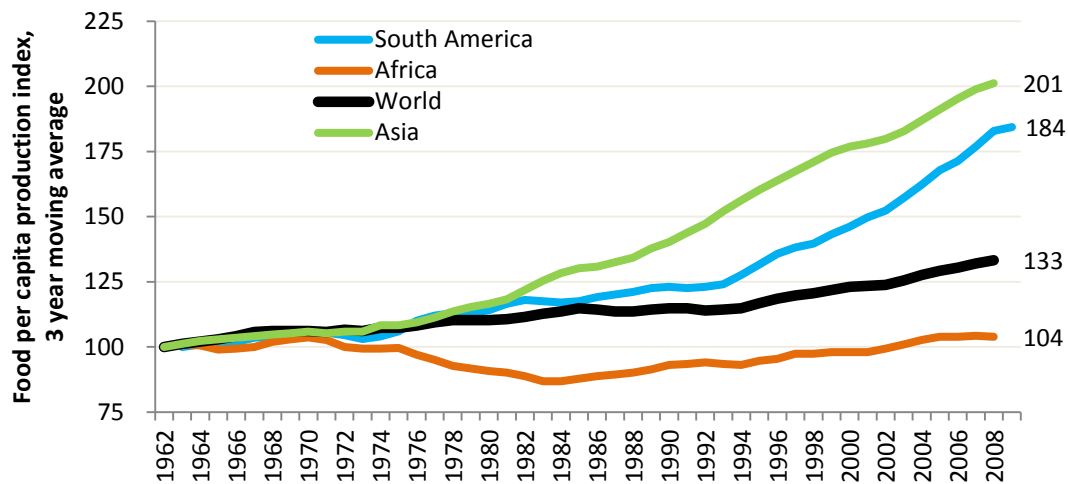
⁷ The selected countries are also all on the list of 36 countries identified in the Lancet (Black et al. 2008) that carry 90% of the stunting burden for which financing needs related to the Scaling up Nutrition (SUN) framework were estimated by Horton et al. 2009.

2 How can smallholder agricultural development improve food security and nutrition? Pathways reviewed

2.1 Producing food: availability and its cost

Worldwide, and especially in the developing world, the production of food has increased ahead of population growth during the last fifty years. From the early 1960s, world food production a person has increased by one third. In the developing world, in Asia the quantity has doubled, in South America increased by more than 80%, and only for Africa has production increased more slowly than the world average — although even in this case, production has increased slightly more than population growth.

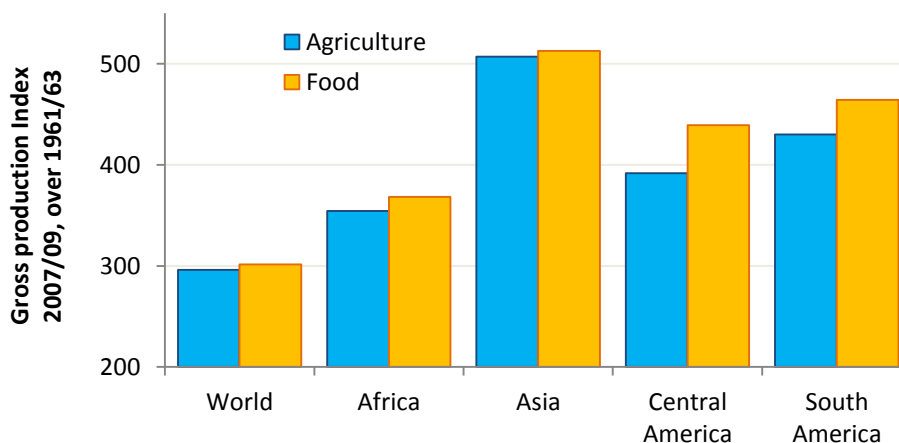
Figure 2.1 Food production a person, 1961/63 to 2007/09, indexed



Source: From FAOSTAT data

Food production has increased more than that for agriculture as a whole, see Figure 2.2.

Figure 2.2 Agriculture and food production, 2007/09 compared to 1961/63



Source: FAOSTAT. Data are gross production indices, taken as three-year moving averages, comparing 2007/09 to 1961/63

That there is more food available today compared to half a century ago, despite this period having seen the world population more than double from 3.1 billion to 6.75 billion, has been largely due to the '*green revolution*' that began in the late 1960s across the developing world (see Hazell 2009, Lipton & Longhurst 1989). This involved the application of higher-yielding varieties of maize, rice and wheat, with much greater use of manufactured fertiliser and crop protection chemicals, usually supported by irrigation.

The green revolution, however, was uneven with greater impact, being effective in areas of irrigation, for the three main grains, and in those countries that were able to roll out the technical improvements with extensive state support to farmers in technical assistance, input supply, seasonal credit and guaranteed prices for additional crops offered for sale. Hence it had its greatest impact in Asia, then Latin America, and only sporadically and weakly in Africa.

It has also entailed some environmental losses, as for example in acidification of soils from continuous use of fertiliser, loss of diversity of crop varieties, salination of poorly-drained irrigated land, and over-drawing of groundwater from tubewells (Hazell, 2002).

How much of this agricultural development came from small farms?

Although production data are rarely reported in the developing world by farm size, we can be reasonably sure that smallholders have made a large contribution to the increases seen. Most of the additional production from the green revolution, at least in Asia, came from family farms of less than ten hectares — many considerably less. The technology based around improved seeds was neutral to scale: applicable on very small fields. Initial adoption of the new seeds may have been by the larger family farmers, but within a decade most smallholders in areas suited to the new varieties had adopted (see Hazell & Ramasamy 1991 for the case of northern Tamil Nadu).

China is perhaps the outstanding example from Asia: after land reforms and collectivisation under Mao, almost no large private holdings were left in China by the time the reforms of 1978 re-instated small-scale family farming from previous collective production. The remarkable acceleration in agricultural growth that took place subsequently should prove, if proof were necessary, that small farms are no barrier to rapid agricultural growth.

Much the same can be said for agricultural development in Africa where the majority of farms are smallholdings. Examples of successful agricultural development in Africa (see, for example, Gabre-Madhin & Haggblade 2001, Wiggins 2000), are almost entirely accounts of increased production from smallholdings.

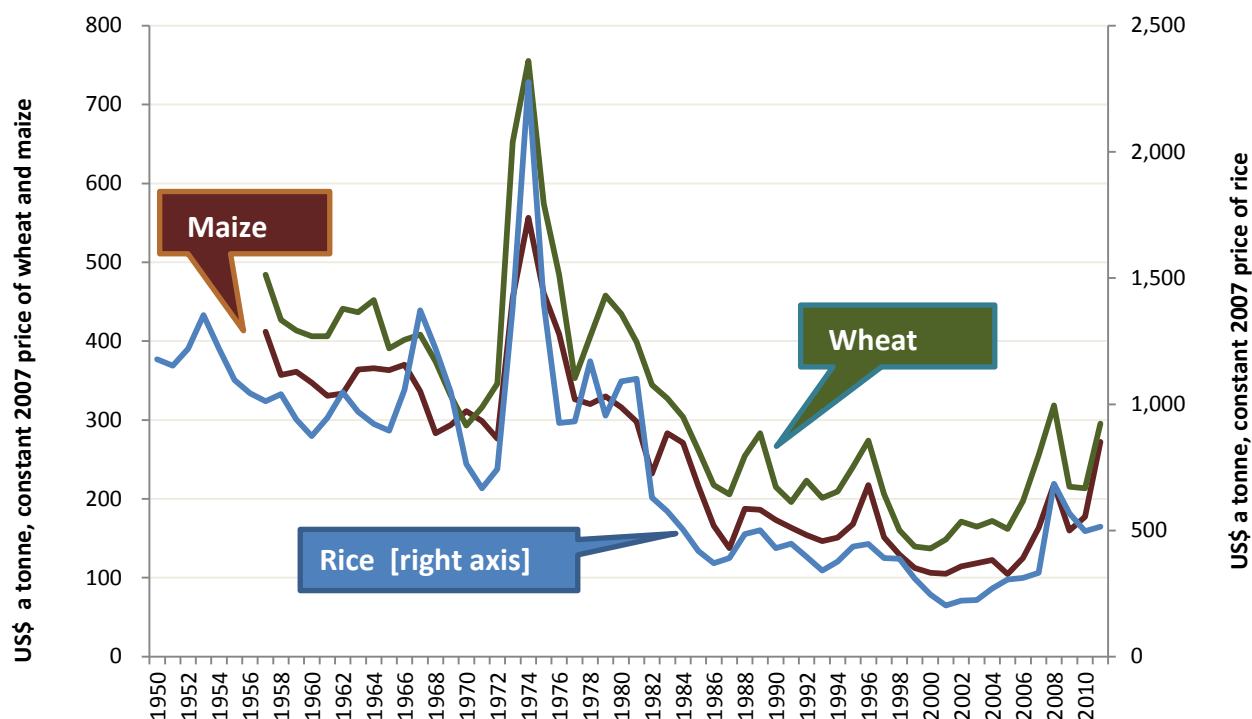
For Latin America, however, the answer would be different: here much of the increase in output have come from medium to large farms. Some therefore see that in this region, the same results would not have been forthcoming from small family farms. The Asian experience suggests otherwise.

Lower food prices as production of food increases

Increased food production can lead to falling real prices of food, especially for staples. Given that the demand for staple foods is inelastic, small increases in supply ahead of demand can lead to sizeable falls in prices.

Worldwide, between 1960 and 2000, the prices of maize, rice and wheat in constant terms fell by 69%, 72% and 66% respectively, see Figure 2.3. Most of the increase in the volume of cereals that made this possible came from developing countries, rather than from the OECD countries. Since the mid-2000s, prices have spiked and remain well above their 2000 levels: but they are still well below prices in 1960.

Figure 2.3 Cereals prices on the world market, constant, since 1950



Source: From Timmer, 2008, supplemented by statistics from IMF commodity price records

At national level, the effect can be equally strong. Between 1980 and 2003, the real⁸ wholesale price of rice on the Dhaka market in Bangladesh fell by more than 40% (Food Planning and Monitoring Unit data and authors' calculation). In this period, Bangladeshi rice production rose from around 150 kg a person a year, to more than 185 kg, owing in large part to the use of higher-yielding varieties of rice and irrigation that allowed more frequent cropping.

Cash versus food crops

A longstanding concern is that production by smallholders for the market, especially of non-staples, might see farmers, especially smallholders, replace their food crops for their own consumption with cash crops for sale and thereby reduce their food security.

An early review of this, Maxwell & Fernando (1989), reported that at national level, countries that produce more cash crops also tend to produce more food crops as well. Does that still apply, almost a quarter century later? If the growth of production of cereals in the developing world is compared to the growth of other agricultural produce from 1990 to 2010, the correlation is high: 0.95 for Africa, 0.97 for South America and 0.91 for Asia. There is little to indicate that staple food production trades off against that of other agriculture.

What happens on individual farms is, however, perhaps more important. At farm level cash crops could reduce household food security and nutrition in three ways:

- Through reduced production of food on farm leading to lower domestic consumption, coupled with ...
- ... failure to spend any incomes from cash crops on food or other items that might contribute to nutrition, such as water and health care; and,

⁸ Prices were deflated using the non-food Dhaka middle-income Cost of Living Index (and the national CPI after June 1998)

- Increased demands on the labour of caregivers leading to less care of infants, in particular too little time to prepare and serve complementary foods.

So then, how widespread and severe are these potential dangers?

Case studies suggest that ***smallholders, at least in the early stages of development, tend not to specialise their production, even as they produce more for the market.*** For example, Leavy (2007) for Zambia and Sharp et al. (2007) for Ethiopia report farm households diversifying their crops and livestock for market, rather than expanding a single enterprise. In Kenya, in areas that have grown coffee for export since the 1950s, it was still the case in the 1980s that as little as 10–20% of the land was under coffee, the rest being devoted to diverse food crops, despite the returns to coffee being far higher than those to staples (Haugerud 1988). In the same country Tiffen (1992) reported the same reluctance to depend on markets for staple foods in Machakos District in the late 1980s and early 1990s.

Two reasons explain this. One, ***farm households dislike the increased risk from relying on a single crop*** for income. Two, they try to produce a large share of staples for home consumption, since ***they do not trust local markets to have staple foods in stock at reasonable prices.*** As Heltberg (2001:3) puts it for Africa, the tendency to add cash crops to existing food production activities can be attributed to the:

'... urge for food self-sufficiency in environments of large transaction costs and high risks found in many sub-Saharan African countries'.

The returns to producing staples for home consumption, moreover, may be underestimated since the value of foods consumed at home is not their value in sale, but rather their cost of acquisition were they not produced at home. In many rural areas there is a major wedge between these two valuations, thanks to high transport costs to markets (Low 1986).

Indeed, the relation between cash and food crops may be the reverse of that feared: growing cash crops may boost staples production at the same time. Cash incomes can allow better seed or fertiliser to be bought for the staple crop, or for more labour to be used in weeding and other operations likely to raise yields. Oyugi et al. (1987) reported that farmers in South Nyanza, Kenya growing tobacco did not cut back on food production; instead they used earnings to invest in food crops. In Gokwe, Zimbabwe a household survey from 1996 showed that cotton farmers had higher yields on their food plots, when controlling for the effects of household assets, education and location (Govereh & Jayne 2003). On contract farming schemes a common observation is that some of the fertiliser and chemicals supplied to grow the cash crop is diverted to staples. For example, in northern Ghana part of the fertiliser supplied by companies was switched to food crops (Dorward et al. 1998). In other cases, fertiliser applied to an annual cash crop planted in rotation with staples may confer some residual benefits to the staple grown the year after. This has been seen for maize and sorghum after cotton is grown in the Sahel (Bassett 1988), as well as for rice sown on plots previously under green beans in Madagascar (Minten et al. 2011).

The complementary relation can apply in the other direction: higher yields from fields of staples has tended to promote cash cropping, sometimes as pre-condition for this to take place. In Kenya, the spread of coffee and other cash crops in densely-settled central parts of the country was boosted by the introduction of hybrid maize that made it possible to feed the household off a smaller maize plot (Tiffen et al 1994).

Studies that allow comparison of volumes of marketed produce with volumes of staples produced across different households, commonly report that the two correlate positively, not negatively. For example, in Zambia in the 1980s, as farm sizes increased, so did area to food crops and the amount of staple food retained for home consumption, see Table 2.1.

Table 2.1 Food production and availability, northern Zambia, mid-1980s

Farmer Category:	'subsistent'	'emergent'	'commercial'
Average family size	6	6	6
Average number of dependents	2	2	2
Farm area (ha.)	1.94	2.72	4.51
Farm area (ha.) devoted to food crops	1.57	1.66	1.80
Average quantities of food retained by households			
Bags of maize	4	7	11
Finger millet (kg)	13	17	18
Beans (kg)	106	279	420

Source: IRDP (Serenje, Mpika, Chinsali), reproduced in Moore & Vaughan 1987

Turning to the second issue, is additional income from agricultural sales spent on food, health, water and sanitation that would probably improve child nutrition? Produce sold by men may then see them spend the money on things other than the basic needs of the household, at worst drinking and gambling away precious funds. The dangers are greatest when incomes from sales come in large lumps, exacerbating the temptation to spend unwisely.

Although not much evidence can be found on the spending patterns of commercialised small farmers, reports from the 1980s on the marginal spending of small farmers in Burkina Faso, Niger, Senegal and Zambia show that more than half of additional income was likely to be spent on food and drink. More detailed breakdowns for Burkina Faso show that most of the food spending, and more than half of all marginal spending, was on cereals (Delgado et al. 1998). While this is reassuring, more evidence would be welcome.

Does commercial production by smallholders raise workloads to the detriment of child care? Producing commercial crops and livestock on small farms nearly always raises the total amount of labour used. That does not necessarily, however, mean that members of the households work longer or harder: hired labour may take the strain, and indeed, the additional income may encourage some households to take some of their gains in less time worked on fields or in stables. But it can mean more effort, as one woman interviewed in Machakos poignantly reported:

'My father could sing and dance, but I have no time.' (Tiffen et al. 1994, : 175)

It is perhaps not the amount of the work that matters, but who gets additional work: if it falls to women, then there are concerns that children may lose out.

This has been a persistent problem in northern Zambia where women are expected to take care of children but also do much of the farming of food gardens — in the past this has been exacerbated by the men migrating to work in the copper mines, so that many households have been headed by females with little male labour to help. In the 1940s it was observed that meals were infrequently prepared, to the detriment of young children who need frequent meals. Maize commercialisation, even with oxen, in the 1970s and 1980s used more female labour. Studies showed increased child malnourishment with commercialisation despite households having more staples of all kinds (see Table 2.2). The most likely explanation was lack of female labour to prepare food and especially weaning foods (Moore & Vaughan 1987).

Table 2.2 Under-five nutritional status by farmer category, northern Zambia, mid 1980s

Farmer category	No. of 90 kg bags of maize sold to Provincial Marketing Union	Proportion of farm households with adequate nutrition of children	Proportion of households where children showed mild malnutrition
'subsistence'	0	70	26
'emergent'	1-30	52	41
'commercial'	30 +	50	44

Source: IRDP (Serenje, Mpika, Chinsali), Reproduced in Moore & Vaughan 1987.

Note: Sample consisted of 205 households containing 166 children aged 6 to 60 months.

Gillespie & Mason (1991) report studies, mainly from the 1980s, where mothers' work did affect the nutrition of infants in the Philippines, Kerala, and south India; but results were qualified by the usually positive impact of additional earnings by mothers. In some cases, it was seasonality that mattered: for example, when demands for planting crops coincided with higher incidence of disease to which infants were particularly vulnerable.

In a more recent and particularly detailed study from rural Nepal, Paolisso et al. (2001) report that preschool children were less likely to get care from mothers working on cash crops when there was only one child: but when there was more than one child, field work did not detract from child care. Reasons for this surprising outcome included the stronger demand on mothers' time from multiple children, plus the likelihood that mothers with several children would have received more education and training. This study confirms that the relation between farm work by mothers and child care is neither straightforward nor direct, and may be mediated by a wide range of factors.

Detailed pathways aside, what have been the **observed impacts of cash cropping by smallholders on nutrition**? In the late 1980s and early 1990s, the International Food Policy Research Institute (IFPRI) carried out surveys designed to investigate the links between commercialisation and nutrition in the Gambia, Guatemala, Kenya, the Philippines and Rwanda. This was complemented by reviews from India, Malawi, Papua New Guinea, Sierra Leone and Zambia. The key findings from these studies (see the synthesis by von Braun 1995) were:

- Generally smaller farms participated less in commercialisation schemes, but when they did their degree of participation was often higher than larger farms;
- In most cases, commercialisation increased staple food crop production either by bringing in new land or by increasing yields;
- Commercialisation usually meant more work in the fields with corresponding increases in the use of hired labour. In some cases it also meant more off-farm work as well. Much of the work on commercial enterprises was carried out by men;
- Income increased in most cases for participants, whilst the demand for hired labour often spread the benefits of increased output. Total household income increased by less than the increase in crop income, given the importance of off-farm earnings for most households; and,
- In almost all cases higher income meant better child nutrition, although the relation was quite weak. There was, however, little evidence, other than for Sierra Leone, of nutrition getting worse under commercialisation.

They concluded that smallholder **commercialisation does not usually impair food security and nutrition**, but that increased incomes only improve nutrition weakly. These findings were

confirmed and qualified by DeWalt's (1993) review of these and similar studies. She concluded that:

First, the income effects of shifts to cash cropping are highly dependent on pricing policy for cash crops. Short term gains seen in some schemes are often highly dependent on the maintenance of high prices for commercial crops.

Second, those schemes in which subsistence production is protected or stabilized are more likely to show positive results with an increase in income generated from cash cropping.

Third, increased income does not translate directly into increased food consumption at either the household or individual (child) level. Shifts in control of income from women to men are important.

Fourth, morbidity, especially from diarrheal disease is an important predictor of child growth. A failure to improve morbidity of children may offset gains in food consumption and in some instances a decrease in the time women have to care for their children as a result of commercialization has resulted in greater morbidity among children.

Hence it is not whether farming is for subsistence or sale that matters, but rather **prices for cash crops and food, access to land, and who has control over produce and income** (DeWalt 1993).

2.2 Smallholder agricultural development and incomes

Smallholder agricultural development should raise the incomes of farmers and thereby improve access to food. While there is much evidence from single period surveys to show that farm incomes are greater for farmers with more agricultural production, data sets that show how farm incomes change through time are less common. Those that do exist, however confirm the expected relation.

For example, from the mid-1950s onwards, agricultural development was relatively rapid in the **highlands of Machakos District, Kenya** as farmers first planted coffee, then later began small-scale dairying and vegetable growing. These were accompanied, and indeed made possible, by the intensification of food crops, such as maize using hybrids, thus sparing the amount of land that had to be planted for home consumption — even as rapid population growth meant the land was divided into ever smaller plots. (Tiffen et al. 1994) When households were surveyed in the early 1990s, it was clear that agricultural development had led to rising farm incomes a head in Machakos. Output on farms per capita, measured in maize equivalents, had risen from 54 in 1930 to 137 in 1987.

In **Ibarapa District, south-west Nigeria**, between the 1960s and 1980s, production of cassava, maize and tomatoes sold to the growing cities of the region increased. Returns to farm work, and hence incomes, over the two decades rose by 25% (Guyer 1992).

For **Bangladesh, Philippines, Tamil Nadu (India) and Thailand**, household surveys in the 1980s were compared to those in the mid-2000s (Otsuka & Yamano 2008) to examine changes in real household incomes, with comparisons possible between areas of high and marginal potential, see Figure 2.4. It is clear that in all cases other than marginal areas of Thailand, farm incomes had risen over the twenty or so years between surveys. Those increases were quite modest, however, often less than a 25% increase. Overall rural household incomes increased by more, since in all cases except high potential Tamil Nadu, non-farm incomes rose by much more — a point that will taken up in the next paragraph.

Figure 2.4 (a) Changes in real household incomes, high potential rural areas, 1980s to 2003/04

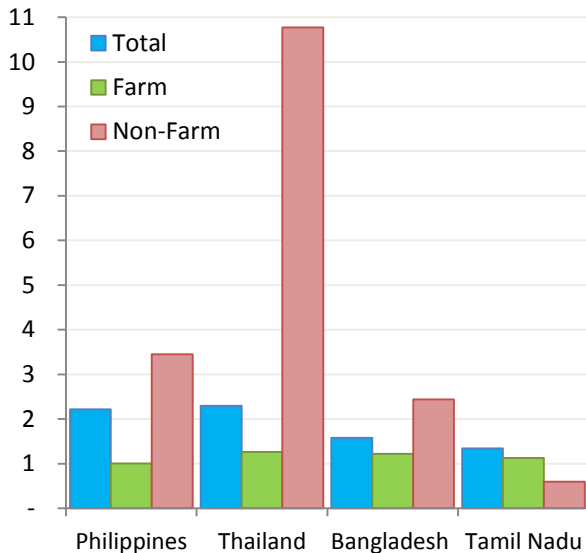
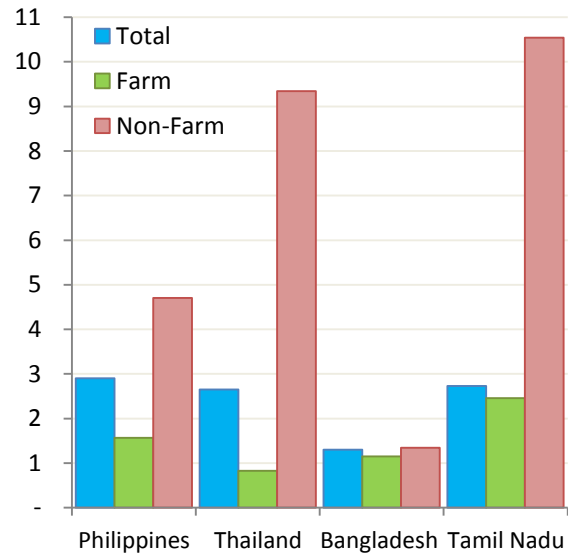


Figure 2.4 (b) Changes in real household incomes, marginal potential rural areas, 1980s to 2003/04



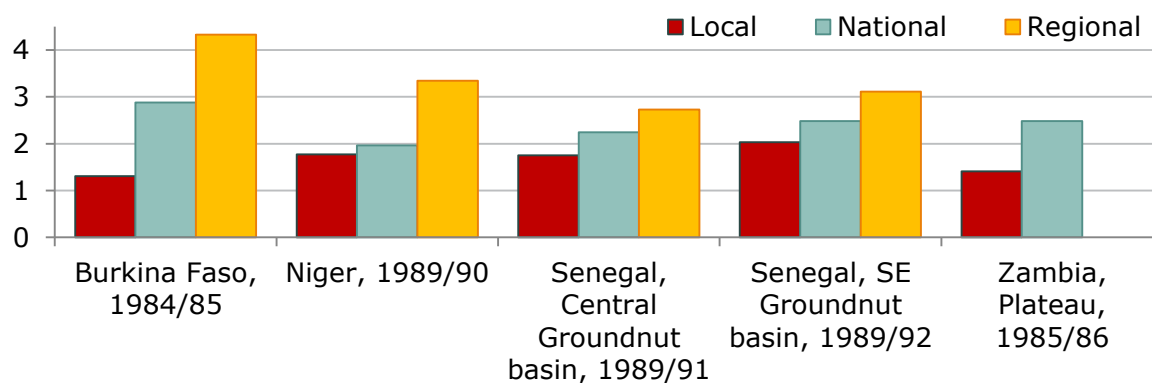
Source: Compiled from data in Otsuka & Yamano 2008.

Note: Incomes were measured in constant terms. More detailed breakdown of these statistics, moreover, show that income gains were more or less equal across social groups defined by access to land: income gains were broadly shared and not concentrated amongst any landholding class.

As important as gains to farm households, are those to others who benefit from smallholder agricultural development. **Increased farm output can create additional jobs, both on and off farms. The most notable link is rising demand for labour on small farms as production rises. Crops grown for sale can have high labour requirements.** In Machakos, Kenya small farms with coffee, fruit and vegetables typically hired in the equivalent of one full-time worker for each hectare cultivated (Tiffen 1992). In the Guinea savannah of northern Nigeria in the 1980s maize production for sale boomed, encouraged by urban demand and the spread of improved varieties. Labour demand on fields rose, raising wages and drawing in migrants to the zone (Goldman & Smith 1995). Some intensively grown vegetables can generate huge demands for labour. For example, exported snow peas from (very) small farms in Guatemala required 600 days of labour per hectare meaning that growers were hiring in more hands to cope (von Braun et al. 1989).

Some of the stronger links arise through consumption, in jobs created when small farmers with additional incomes spend on locally produced goods and services — including furniture, entertainment, food and drink, and house improvements. Some estimates of multipliers in rural Africa can be high (Delgado et al. 1995), see Figure 2.5. Most of the effect comes from consumption rather than production. The high indices reflect the high fractions of additional income likely to be spent locally.

Figure 2.5 Growth multipliers for rural Africa, mid to late 1980s. Impact of extra income from farm tradables

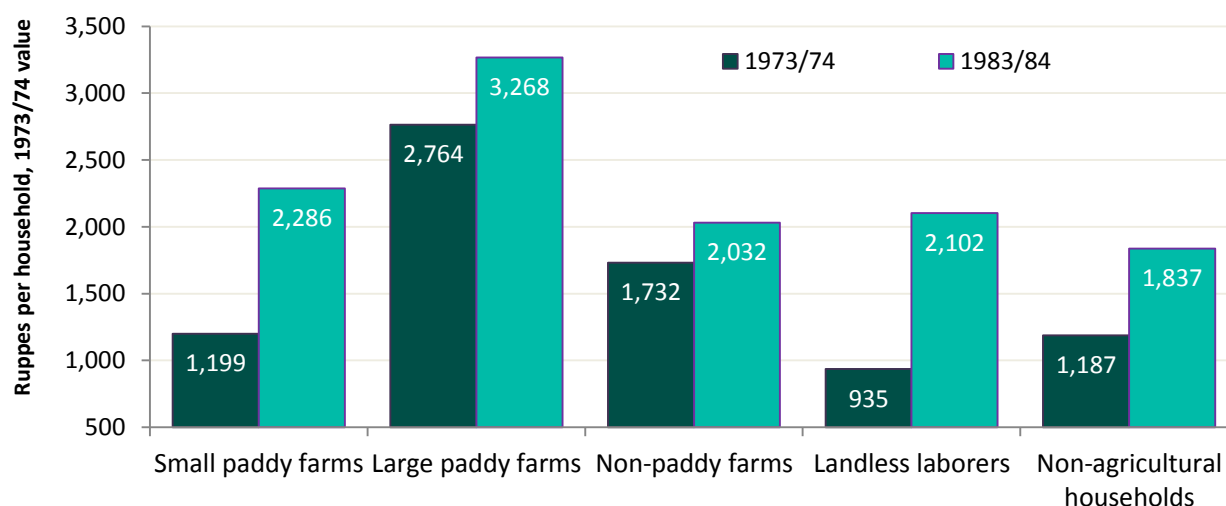


Source: Delgado et al. 1994

Note: Different estimates relate to degree of tradability of marketed farm produce

One of the most remarkable observations of the power of these linkages comes from *North Arcot District, Tamil Nadu* during the 1970s. In this case *modest increases in rice production, at around 1% a year over the decade, from irrigated fields as improved varieties of rice were adopted, led to a doubling of real incomes and welfare of the poorest in the surveyed villages, including landless labourers* (see Figure 2.6).

Figure 2.6 Changes in incomes, resurveyed villages, North Arcot District, Tamil Nadu, 1973/74 and 1983/84



Source: from Table 3.7, Hazell & Ramasamy 1991

Increased production of rice, plus more dairy cattle, led to more demand for workers in input supply, in processing and marketing of produce; as well as in local services and manufacturing to meet the demand of farmers with additional incomes. Small farmers apparently withdrew from the rural labour market as their more productive farms now absorbed household labour, while income rises made working for low pay off the farm unattractive. The combination of reduced supply of labour and increased demand for workers meant more paid days and increased wages for landless labourers (Hazell & Ramasamy 1991).

In sum, evidence suggests that smallholder agricultural development can generate higher incomes that should thereby improve food security through better access to food.

2.3 How much is smallholder agricultural development environmentally sustainable?

Alarming reports of agricultural development harming the environment can be found. Some of these deal with the impacts of large-scale, capitalised farming. But equally smallholders with little capital and employing limited external inputs can harm the environment, especially when they lack support from research and extension. The following problems feature frequently in these accounts, and can be seen in the country cases:

- Repeated cropping of soils that lead to over-extraction of nutrients, leaching of nutrients, and soil erosion — see, for example, Koning & Smaling 2005, Sanchez 2002. In 2006, the International Centre for Soil Fertility (Henao & Baanante 2006) suggested that African soil nutrients were, on average, depleted five times quicker than they were renewed. They see this as resulting from population pressure: *'...high population density in many countries already exceeds the long-term population carrying capacity of the land'*. Concerns over soil erosion are frequent in Tanzania and Zambia, although the degree and extent of the problem are not precisely known;
- Overgrazing of pastures;
- Conversion of valued habitats, above all forest, to arable and grazing land — resulting in loss of biodiversity [UN & ADB 2012, Rosegrant et al 2007]. In Ghana forests declined from 7.4M ha in 1990 to 4.9M ha in 2010, being lost at a rate of about 2% per year (FAOSTAT & WDI), while in Tanzania area under forest reduced from 41M ha in 1990 to 34M ha in 2009, (FAOSTAT). In both cases, clearance for fields was the main driver.
- Land conversion is especially worrying since large amounts of carbon are often released as gas, thereby contributing to global warming and climate change; and,
- Drawing down of aquifers by excessive water abstraction, especially when wells are used to pump out groundwater (UNESCO 2006). Bangladesh and Kerala have both seen water tables falling from heavy use of tubewells for irrigation, as well as for domestic uses in the case of Kerala.

Problems correspond in large part to population density, pressure on land and the way in which agriculture then grows. In Africa where population density is often quite modest, agriculture has been able to expand by clearing new fields from forests: hence the reports on forest loss for Ghana and Tanzania. These rates may fall as population density rises and there is less forest left to clear. Soil erosion from cropping on sloping land is reported for Tanzania and Zambia, but precise statistics are not available — hardly surprising given the difficulty of measuring erosion.

Other issues that apply less often with smallholders than larger farmers include:

loss of land races and farmer varieties as improved varieties displace them;

- pollution from excess use of fertiliser and pesticide — a problem in both Bangladesh and Kerala arising from highly intensive cultivation; and,
- salination from irrigation without adequate drainage.

Two questions thus arise: how general is environmental degradation from smallholder farming? And is this inevitable when smallholders expand production?

The former question provokes some controversy. Although there are some dramatic assertions of large areas suffering land degradation, evidence for this is imperfect (see essays in Leach &

Mearns 1996). It is not clear that some landscapes, seen as damaged by humans, owe their characteristics to human processes. Ideas about 'fragile' semi-arid environments have been contested by those proposing the high resilience of the ecosystems in question (Behnke et al. 1993). Indeed, there are suggestions that narratives of widespread environmental damage represent a projection of the assumptions of outsiders on to local rural realities that lead to exaggerations — see Hoben (1995) for a discussion of this in Ethiopia — and complete mis-readings of local processes — see Fairhead & Leach (1996) for confusions over change in woodlands and its causes in the savannah of Guinea.⁹

Resolving some of these debates is difficult, since getting more accurate and widespread evidence is still beyond the means of current scientific monitoring.

Turning to the second question, is environmental harm the likely outcome of smallholder agricultural development? Evidence from two parts of Africa suggest that no, it is not: indeed ***it is perfectly possible to have increased output and productivity with environmental conservation and enhancement.***

Machakos, Kenya (Tiffen et al. 1994) is one of the best documented accounts. In the 1940s, before commercial crops were planted, the district saw widespread soil erosion and deforestation as increasing populations expanded their fields and cut fallowing times. Yet half a century later, the introduction of coffee, dairying and green beans to upper Machakos had justified widespread terracing, gully stabilisation, tree planting and application of green manures. Areas that in the 1940s were denuded with bare patches and few trees, were by the early 1990s terraced, with green cover of the land and increased density of trees. The explanation for this given by the authors was that once commercial crops and livestock were taken up, it became worth the cost — often in hard labour — of conserving the land.

Some reacted to this publication by claiming that Machakos was an unusual or unique case. Yet this is not the only account of intensification going hand-in-hand with conservation. In the Sahel, and above all on the central plateau of Burkina Faso, the use of planting pits and stone bunds has increased with intensification, as has planting of trees, keeping livestock and applying their manure (Mazzucato & Niemeyer 2001, Reij & Smaling 2008).

Yet in the 1960s the central plateau of Burkina Faso was an area of average rainfall in the range 500–700mm, poor soils, and yields of cereals — mainly millet and sorghum — of just 500 kg/ha. With such meagre resources, many of the able-bodied young men migrated to find better work, often to Côte d'Ivoire and other countries to the south. But since then field surveys reveal the following changes:

- Soil and water have been conserved, most notably by use of stone bunds and improved traditional planting pits ('zai') to retain water and topsoil;
- Trees have been planted, livestock have been kept in semi-intensive systems and the manure gathered and applied to the fields; and,
- Collective institutions to manage wells, natural resources, village cereal banks, and schools have multiplied.

An experienced observer commented:

Thirty years ago a World Bank sector report estimated that land losses in Burkina Faso amounted to something like 2 percent of GDP per year. Today the land supports nearly twice the population than in 1980 ...

The change is visible to the naked eye: On a recent visit crops looked greener and healthier than the visitor had ever seen them before, crop livestock integration had happened in many parts, degraded arid lands were being recuperated via traditional and new techniques, and a number of new crop varieties had been introduced,

⁹ Seeing trees concentrated around settlements, outsiders had assumed these were the remnants of extensive woodlands that had been cleared to leave the savannah grasses. Locals told researchers that no, the reason for the trees was they had been planted by villagers. Inspection of air photos from the past confirmed this: as the number of villages grew with population growth, so did the area under trees.

there were more trees on the land. [Binswanger & McCalla 2008, paragraphing added]

The results can be seen in the national statistics that shows cereals production in Burkina Faso has grown at an annual average of 3.5% a year from the mid-1960s to the mid-2000s, well ahead of population growth, and at a rate that matches that of Vietnam where the Asian green revolution was particularly effective. Local results confirm this. In Bam province, for instance, millet and sorghum yields rose from 406 and 446 kg/ha respectively in 1984/88 to 662 and 669 kg/ha in 1996/00. Water levels in wells have risen in areas that have conserved soil and water. More greenery is evident in aerial surveys.

These examples show that smallholder agricultural development has the potential to contribute to environmental sustainability and to preserve the local environment. Although it is difficult to be completely sure what has made the difference in Machakos and the Mossi Plateau, at least three elements can be seen in the accounts reported.

One, there were **technical skills** that locals had either developed themselves, or learned from others. In Machakos it seems that some farmers got the inspiration for their terraces from observing Indian farms when posted there as soldiers with the King's African Rivals during the Second World War.

Two, farmers in both areas believed in the **security of their tenure**, whether or not — mostly not — they had a formal title to their land.

Three, **conservation took place as the value of the land rose** either given the value of the commercial activities in Machakos, or in Burkina perhaps more owing to the rising value of home produce. There is some confirmation in these accounts of the hypothesis developed by Templeton & Scherr (1999) having examined 70 cases in hill lands: that initial intensification may degrade land, but as population density builds up, then land becomes increasingly valuable leading to its conservation.

The country studies also provide evidence of sustainable practice. Home gardens have long been highly developed in **Kerala**, made necessary by the scarcity of land, and assisted by high rainfall. These combine production on several levels —'multi-storey cropping', usually including perennial crops along with annuals, often agroforestry crops, and in some cases aquaculture and livestock. The gardens mimic a climax ecology, containing diverse species and varieties and allowing the created ecology to recycle moisture and nutrients. (Jose & Shanmugaratnam 1993, Pushkaran 2001) Some gardens may be becoming more specialised, gradually concentrated on a limited number of cash-crops with increased use of external inputs, but others have been able to integrate commercial production with intensive management without relying on external inputs. (Peyre et al. 2006)

On the slopes of **Mount Kilimanjaro in northern Tanzania** the combination of coffee bushes, fodder grasses, bananas and field crops in very small plots produces a landscape of diversity with considerable cover that protects against erosion. Similar to Machakos, this case combines local skills with secure tenure, incentives to conserve — the slopes are thickly populated, and for the furrow irrigation that is a feature of these systems, collective organisation (Grove 1993).

In summary, then, while smallholder development can lead to environmental loss, it can just as well lead to conservation of the land. ***With appropriate technical knowledge and skill, secure tenure and incentives to conserve — above all in the value of land, then conservation may be expected.***

3 How far can smallholder agricultural development contribute to better food security and nutrition?

3.1 Beyond availability and access

Food availability and access may be essential for food security and nutrition, but as the UNICEF framework indicates, smallholder agricultural development needs to be accompanied by other actions in the fields of care, health, water and sanitation to reduce hunger.

The importance of different underlying factors for child malnutrition was studied by Smith & Haddad (2002). They examined the relation between income and child underweight rates from 1970 to 1995 across countries using regression. Almost 60% of reduced prevalence of underweight infants could be attributed to rising incomes. Higher incomes, however, did not affect nutrition directly through access to food and consumption alone. Instead incomes affected malnutrition through interactions with increased food availability, more female schooling, better access to safe water, and through improvements in the ratio of female to male life expectancy (a proxy for female status) — factors that responded in part to higher incomes, but only in part. In order of their contribution to reducing malnutrition, female schooling was the strongest factor followed by food availability, safe water and the life expectancy ratio.

The importance of female schooling is remarkable. Quite why this, defined as enrolment of girls in secondary schools, should be so powerful is open to interpretation; but it very probably indicates the value of women being empowered in their education, job opportunities and status and how this then impacts through income and mothers' control over income, better information and access to health care on child nutrition.

Haddad (et al. 2003) then followed this study up with a similar one that used data from 66 countries, with 12 studied in detail, to ask whether likely rates of future incomes would by themselves lead to reductions in malnutrition sufficient to achieve the first of the Millennium Development Goals of halving hunger. They concluded that, yes, income growth would reduce malnutrition ...

Even with no change in community and household infrastructure, rates of malnutrition (low weight for age) are projected to decline by an average of around 27 percent by 2015 if countries can achieve per capita income growth of 2.5 percent a year. Allowing community and household infrastructure to change over time increases the effect of the growth to a 34 percent reduction in national malnutrition rates. Cross-country regressions imply similar reductions. The cross-country estimates add another dimension, showing that historical patterns of income distribution are consistent with income growth leading to marked improvements in nutrition.

... but in some cases not sufficiently to reach the Goal by 2015.¹⁰

This confirms the UNICEF proposition: improved food security and nutrition requires complements to those things that smallholder agricultural development can achieve in producing more food, pushing down food prices and raising rural incomes.

¹⁰ An early draft of a 2012 review of subsequent studies on the relation of income to nutrition confirms these findings: that if anything the findings from Haddad et al. 2003 may be towards the higher end of income to nutrition effects.

3.2 Insights from country cases

To explore the ways in which smallholder agricultural development may lead to better food security and nutrition, five cases have been studied. For these, key indicators of food security and nutrition have been compiled, together with indicators for factors influencing them: agricultural development, economic growth, health, water and sanitation and female empowerment, for 1990 and 2012, or the closest years to these for which there were statistics available — see Tables 3.1 to 3.4.

Smallholder agriculture dominates farming in all these cases: for example, the fraction of farms of two hectares or less has been reported as 96% for Bangladesh, 85% for Ghana, 82% for India, 75% for Tanzania and 76% for Zambia (farms of less than one hectare in this case) (Nagayets 2005, FAO country profiles at <http://www.fao.org/ag/AGP/AGPC/doc/Counprof>). Only in the case of Zambia are large-scale farms present in any significant number. Hence most of the growth seen nationally comes from small-scale, family farms.

Agricultural growth varies across these cases, with Ghana and Bangladesh showing appreciable increases — 58% and 43% per person rises — over the 20 years; Zambia and India's growth has been less, but still ahead of population; while Tanzanian agricultural output has only just matched population growth. These are reflected in changing food availability per person: Ghana and Bangladesh showing strong increases, to reach levels well above those needed to provide enough energy for an active life; with less change for the other three cases.

Economic growth has raised average incomes in all cases, but with stronger growth for Ghana, Bangladesh and Kerala than for Tanzania and Zambia. This is reflected in poverty rates that have fallen considerably for Ghana, Bangladesh and Kerala between 1990 and 2010 — with Kerala reporting especially low poverty rates by the end of the period. For Tanzania and Zambia, poverty has fallen only a little and remains at very high levels.

Table 3.1 Agricultural and economic growth, food availability and poverty 1990-2012

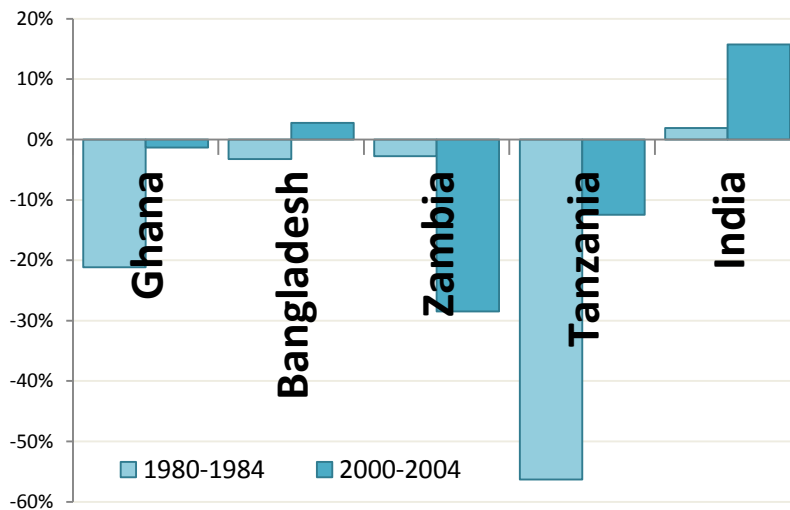
	Ghana	Bangladesh	Tanzania	Zambia	Kerala
Agricultural net production indices per capita; 1990-92 = 100	 1990: 78, 2011: 158	 1990: 100, 2011: 143	 1990: 102, 2011: 114	 1990: 105, 2011: 126	 1990: 100, 2011: 131
Food net production indices per capita; 1990-92 = 100	 1990: 78, 2011: 159	 1990: 100, 2011: 144	 1990: 103, 2011: 115	 1990: 106, 2011: 117	 1990: 100, 2011: 129
Food availability (kcal/cap/day)	 1991: 2,080, 2009: 2,930	 1990: 2,150, 2009: 2,480	 1990: 2,160, 2009: 2,140	 1990: 2,060, 2009: 1,880	 1993/94: 1,970, 2004/05: 2,010
GDP per capita, real 2000 US\$	 1990: 221, 2011: 402	 1990: 280, 2011: 588	 1990: 305, 2011: 473	 1990: 385, 2011: 439	 1990: 743, 2011: 1,209
Poverty (% national poverty line)	 1992: 52, 2006: 29	 1992: 57, 2010: 32	 1992: 39, 2007: 33	 1991: 70, 2006: 59	 1994: 25, 2010: 12
Rural poverty (% rural poverty line)	 1992: 64, 2006: 39	 1992: 59, 2010: 35	 1992: 41, 2007: 37	 1991: 88, 2006: 77	 1994: 26, 2010: 12

Sources: Various, see text. Note: Agricultural net production indices are not available for Kerala, so data displayed is for India. Kerala is among the weaker agricultural states of India.

Policy explains a good part of the variations in agricultural performance. A broad measure of support to agriculture is the net rate of assistance to agriculture which is an estimate of the combined effects of trade policies, taxes and subsidies on the prices that farmers receive in domestic markets, see Figure 3.1. Ghana and Bangladesh, the two best agricultural performers, show improved support to agriculture from the first half of the 1980s to the first half of the 2000s: Ghana going from over 20% taxation to almost no taxation; Bangladesh moving from around 3% tax to 3% subsidy. These cases can be compared to the slow-growing

agricultures of Tanzania and Zambia, where net taxation has been high. Tanzania may have reduced its taxation of agriculture, though levels still remain high at 12%; while Zambia actually taxed its agriculture more over the period, going from about 3% to almost 30% taxation. India, which subsidised agriculture to the tune of about 2% in the first half of the 1980s increased this to some 16% over the first half of the 2000s.

Figure 3.1 Nominal rates of assistance to agriculture, case countries: early 1980s and early 2000s



Source: Data from Anderson & Valenzuela, 2008.

Note: The Nominal rate of assistance (NRA) to farmers is the price of their product in the domestic market (plus any direct output subsidy) less its price at the border, expressed as a percentage of the border price (adjusting for transport costs, quality differences and so forth). Distortions in input prices and exchange rates are also captured.

How well do these changes in agricultural production, economic growth and poverty, reflecting primary determinants of food availability and access, match the observations of changes in food security and nutrition, see Table 3.2? The main measure used to compare food security across counties is the FAO estimate of the percentage of the under-nourished population unable to access enough energy for their daily needs. Since this is closely related to food availability, it is no surprise to see that undernourishment has fallen considerably for Ghana and Bangladesh. For Tanzania and Zambia, however, the incidence of undernourishment has risen. Lack of agricultural growth has its costs in these cases. [For Kerala the earlier data point is missing so change cannot be seen: estimated undernourishment is higher than in Ghana and Bangladesh.]

These changes do not necessarily match those in child malnutrition. In all cases other than Kerala, the fraction of under-fives underweight has fallen — most strongly in Ghana and Bangladesh, but also in Zambia and Tanzania. In Kerala no change can be seen. When underweight is split into its components of stunting — a measure of longer-term nutrition — and wasting — usually a measure of short-term distress, the patterns diverge. Bangladesh and Kerala have seen stunting fall considerably; Ghana and Tanzania have seen smaller falls; while stunting remains unchanged for Zambia. Wasting rates have fallen most for Ghana, a little for Bangladesh and Tanzania, no change for Zambia, and have apparently actually increased for Kerala.

Table 3.2 Food security and nutrition 1990-2012

	Ghana	Bangladesh	Tanzania	Zambia	Kerala
Under-nourishment (% of population)	<p>41 1990 2012</p>	<p>35 1990 2012</p>	<p>29 39 1990 2012</p>	<p>34 44 1990 2012</p>	<p>no data 29 1990 2008</p>
Underweight (% under-fives)	<p>25 14 1994 2008</p>	<p>62 36 1990 2011</p>	<p>25 16 1992 2010</p>	<p>21 15 1992 2007</p>	<p>24 24 1993 2006</p>
Stunting (% under-fives)	<p>34 29 1994 2008</p>	<p>63 41 1990 2011</p>	<p>50 43 1992 2010</p>	<p>46 46 1992 2007</p>	<p>36 25 1993 2006</p>
Wasting (% under-fives)	<p>15 9 1994 2008</p>	<p>18 16 1990 2011</p>	<p>8 5 1992 2010</p>	<p>6 6 1992 2007</p>	<p>13 16 1993 2006</p>

Sources: Various, see text

Changes in food availability and access explain some of the changes in nutrition, but not all. So what can be seen of changes in indicators for other underlying determinants of nutrition? Comparative statistics for health, water, and sanitation over the period are shown in Table 3.3. The under-five mortality rate is taken as a proxy for the health of young children, those most susceptible to malnutrition.

Impressive reductions in under-five mortality can be seen in all cases, with remarkable progress being made in Bangladesh, Tanzania and Zambia. Previously these countries had very high rates of mortality, but have more than halved these over the two decades. For Tanzania and Zambia which show little or no improvement on food production and poverty, **improvements in the health of young children may well explain their achievements in reduced child malnutrition.** For the other two cases, sizeable reductions have also taken place: Kerala has halved its under-five mortality, from already low levels, while Ghana has cut child deaths by more than a third.

Access to clean water has improved for all cases other than Tanzania, with notable increases for Ghana and Kerala. Use of improved sanitation has improved for all cases other than Zambia, but with major differences in levels: Ghana and Tanzania still have very low scores on this indicator.

Table 3.3 Health, water, sanitation, 1990-2012

	Ghana	Bangladesh	Tanzania	Zambia	Kerala
Under-5 Mortality rate (deaths/1000 live births)	<p>1990: 121, 2011: 78</p>	<p>1990: 139, 2011: 46</p>	<p>1990: 158, 2011: 68</p>	<p>1990: 193, 2011: 83</p>	<p>1992/93: 32, 2005/06: 16</p>
Potable Water (%)	<p>1990: 53, 2010: 86</p>	<p>1990: 77, 2010: 81</p>	<p>1990: 55, 2010: 53</p>	<p>1990: 49, 2010: 61</p>	<p>1992/93: 21, 2004/05: 69</p>
Sanitation (%)	<p>1990: 7, 2010: 14</p>	<p>1990: 39, 2010: 56</p>	<p>1990: 7, 2010: 10</p>	<p>1990: 46, 2010: 48</p>	<p>1992/93: 71, 2004/05: 96</p>

Sources: Various, see text

Cross-country studies show the importance of female empowerment for nutrition. Proxies for female empowerment include adolescent fertility, female literacy and education, see Table 3.4. Kerala's impressive indicators, good for the last 20 years — and longer — stand out. Ghana and Bangladesh have seen improvements, while progress on these indicators in Tanzania and Zambia has been slight.

Table 3.4 Female empowerment, 1990-2012

	Ghana	Bangladesh	Tanzania	Zambia	Kerala
Adolescent fertility rate (births/1000 females 15 – 19)	<p>90 (1997), 66 (2010)</p>	<p>130 (1997), 73 (2010)</p>	<p>133 (1997), 129 (2010)</p>	<p>143 (1997), 142 (2010)</p>	<p>no data (1997), 18 (2008)</p>
Youth female literacy (% 15 – 24)	<p>65 (2000), 79 (2009)</p>	<p>38 (1994), 77 (2010)</p>	<p>78 (1988), 76 (2010)</p>	<p>66 (1990), 67 (2010)</p>	<p>90 (1991), 94 (2011)</p>
Female completion of primary school*	<p>58 (1991), 69 (2008)</p>	<p>no data (1997), 71 (2009)</p>	<p>59 (1992), 87 (2009)</p>	<p>56 (1998), 52 (2008)</p>	<p>93 (2001), 90 (2006)</p>

Source: Various, see text. **Note:** *Except in Kerala, where comparable data is not available and the first data point refers to enrollment of all children 6 to 10 years, the second to enrolment of children 6-17 years. Data for enrollment of 5-14 year old children in 2005 show slightly higher proportion of girls than boys enrolled (UNICEF, May 2011)

While changes in food security and nutrition in these five cases cannot be fully explained by these statistics, they yield some useful insights that can best be summarised by country.

Ghana and **Bangladesh** show what strong agricultural growth can achieve, in countries dominated by smallholder farming. With good growth in the agriculture sector and such large fractions of society engaged in smallholder agriculture, agricultural and economic growth has reduced poverty and destitution, with clear benefits to food security and nutrition. They also show, however, what may be lacking for nutrition, especially in the case of Ghana where progress on health, sanitation, and women's empowerment has been limited (Tables 3.3 and 3.4). Increased food production in Bangladesh, moreover, has relied too much on rice, to the detriment of other crops, reducing dietary diversity.

Tanzania and **Zambia** show the costs of limited agricultural growth, made worse in Zambia by limited economic growth. With food availability per capita just keeping up with population growth in Tanzania, and falling behind in Zambia, while poverty remains high and falling slowly, it is no surprise that gains to nutrition have been limited. The few gains seen look to arise from the improving health of under-fives. In both these cases, lack of agricultural development is compounded by failure to improve water and sanitation and to empower women, the last an acute problem in Zambia.

Kerala shows what can be achieved despite limited economic and agricultural growth, when health, water, education, and female empowerment are taken seriously — and have been for decades. On the other hand, limited agricultural growth and apparently low food availability may explain why nutrition has barely improved in the last couple of decades. Kerala's social progress is an object lesson to the rest of India and indeed the world.

4 How can smallholder agricultural development have a stronger impact on nutrition?

Are there ways to adjust the pattern of smallholder agricultural development to maximise the benefits for nutrition? Two recent reviews (World Bank 2007, Arimond et al. 2011) address this question.¹¹ Three main lessons emerge from these. One is a general point of considerable importance for development overall, but which has a specific nutritional benefit: female empowerment in agriculture improves child nutrition. A second concerns a specific intervention, but one can be powerful in reducing micro-nutrient deficiency: home gardening and small-scale livestock raising can provide micro-nutrients. The third point concerns the wider relation of smallholder development to nutrition: that agricultural programmes should be complemented by education and communication, health services, water and sanitation.

4.1 Empowering women farmers

Empowering women farmers can improve food security and nutrition both through increased food production as well through better use of food and income. On the former, large disparities often exist between men and women farmers in access to land, security of tenure, education, credit, extension and other services. This makes it harder for women farmers to achieve the same yields and levels of production as men can, since they cannot get the inputs or technical knowledge needed to match their labour. A particular concern is that women often have less control over household resources, such as labour and manure, than men do. In Burkina Faso, for example, it was estimated that if household labour and manure were distributed across male and female plots more equitably and efficiently, production would rise by 10–20% (Udry et al. 1995). Overall, FAO has estimated that closing the gender gap in agriculture could reduce the number of hungry people in the world by 12 to 17%, or by 100 to 150M people. (FAO 2011, also summarised in Tripathi et al. 2012)

Women are more likely to use household incomes and food supplies to care for children and feed them, 'since they are the prime givers of care, stewards of health and preparers of food.' (World Bank 2007) 'Women have consistently been shown to be more likely than men to invest in their children's health, nutrition, and education.' (ibid.) This effect probably contributes to the strong relation seen between female secondary schooling and child nutrition, as described in Section 3.1.

Potential ways to close the gender gaps encompasses a broad range of activities from legislation on rights, education, awareness raising including generating statistics that keep the issues in view, ensuring respect for women's rights to land and water, reducing the drudgery of household maintenance such as water collection, and making sure that agricultural development programmes reach women farmers (FAO 2011). In the next section an effective example of directly working to raise women's self-esteem and status will be described.

4.2 Addressing the micro-nutrition challenge: home gardens

Home gardens producing fruit, vegetables, herbs, medicinal plants and serving as a space to rear livestock on a small scale, can address the frequent observation of micro-nutrient deficits amongst rural populations in the developing world. Inadequate intake of Vitamin A, iron, iodine and zinc can impair the mental and physical development of infants, as well as more widely causing illness, disability and premature death.

¹¹ For the rest of this section, these are the sources, unless otherwise indicated.

Since home gardens are often controlled by mothers, they can increase their access to food, and incomes from sales of surplus. Since gardens occupy small areas, households with little land can participate.

Reviews suggest these potential benefits can be realised through programmes to encourage development of gardens — and where they are absent, their establishment, through provision of seeds, tools, and information and training. For example, in the late 1980s *Helen Keller International* (HKI) piloted home gardens for Vitamin A in north-west Bangladesh, with a programme of promotion, village nurseries and nutrition education. That eventually led to a national programme in the late 1990s that engaged 0.9M households at an annual cost of just US\$8 a household. This was then replicated in Cambodia, Nepal, Philippines and adapted for Niger. HKI later realised the importance of animals for bio-available Vitamin A, so added this component.

Monitoring and evaluation showed that households were indeed taking up gardening:

Between 1997 and 1998, the proportion of households without a homestead garden decreased from 25% at baseline to less than 2%. After 1 year of participation, the proportion that practised year-round (developed) gardening increased from 3% to 33%. (Arimond et al. 2011)

Fruit and vegetable production increased, by three times the volume seen in traditional gardens, more varieties were cultivated.

... households participating in the intervention produced a median of 135 kg of vegetables and 24 kg of fruit in the preceding 3 months, compared with 46 kg of vegetables and 14 kg of fruits during the same period for control households. (ibid.)

Consumption also rose, with reduced deficiency of Vitamin A for children:

... children in households with developed gardens consumed 1.6 times more vegetables. The risk of night blindness was lower for at-risk children when their house had a homestead garden. (ibid.)

Incomes also increased from sales, and some of this allowed them to buy in complementary foods they did not produce:

Participating households earned, on average, the equivalent of US\$8 on a bimonthly basis selling fruits and vegetables. The main uses of this income were food purchases and investments in seeds, seedlings, saplings, poultry, or other income-generating activities. Nearly 10% of households saved income generated from the garden.

Households with improved or developed homestead gardens consumed micronutrient-rich, non-cereal foods more frequently than other households. These foods, such as lentils and animal products, were not produced in the gardens, but were purchased using income generated from sales of garden produce. (ibid.)

Furthermore, most (73%) of gardens were operated by women and they had control over production and use of income from sales.

Results were also sustained:

Three years after withdrawal of programme support, formerly participating households maintained higher production of vegetables (120 kg) and fruits (24 kg), relative to controls. Similarly, income from gardening remained more than twice as high in formerly participating households, compared with controls. (ibid.)

Other experiences show that home gardens can succeed. In Chipinge District, Zimbabwe, Action Against Hunger (Action Contre la Faim, ACF) promoted low input vegetable gardens for

the benefit of people living with HIV/AIDS, with 1,200 households benefiting by 2009. An evaluation showed that beneficiaries were eating more diverse diets from participating, although it is not known to what degree. The gardens allowed people to sell vegetables and buy in other complementary foods. Interviewees reported that belonging to groups increased their social contacts, esteem, made them feel empowered. In this case, however, it was not clear that the participants were more food secure or in better state of nutrition than control groups. (Roberfroid et al. 2011, Tonderayi 2012)

In Kita, southern Mali, ACF runs a programme that combines promotion of vegetable gardens with education and behaviour change communication (BCC) on diet, hygiene and child care. Although Kita lies in some of the best land in Mali, there are high rates of vulnerability, poverty and GAM. The programme reached 1,400 households.

Participants had more production from gardens; more income; were eating a more diverse diet; and child malnutrition had fallen in participating villages — according to a 2010 evaluation comparing the beneficiaries to others in the same communities and others living in control villages. There were concerns, however, about the time that women have to participate in gardening. Evaluators recommended the programme ensure that vulnerable households are targeted and included, and that communications on hygiene and nutrition be improved and complemented with participatory hygiene and sanitation activities. (ACF 2010, 2012)

The World Bank (2007) review also commended home gardens, concluding that these:

... carry considerable potential to effectively address micronutrient deficiencies. The review identified a significant body of evidence documenting the success of homestead gardens in raising production, income, household consumption, and the intake of targeted fruit and vegetables by vulnerable population groups.

Nutrition impacts are enhanced when livestock raising, or fish culture, are included to make animal foods more available ...:

Programs and interventions involving animal source foods have even greater potential to tackle micronutrient deficiencies, especially vitamin A, iron, and zinc deficiencies. These micronutrients are more readily bioavailable in animal source foods than in plant foods.

... and especially when there is communication to influence behaviour and when women are empowered.

Several programs also showed significant impacts on dietary and biochemical indicators of micronutrient deficiencies, and especially so when they included components designed to change behavior through education and to empower women.

... Several interventions showed gains in production, income, and household food security, and significantly greater nutrition impacts when combined with interventions involving women's empowerment, education, and behavior change. (World Bank 2007)

A review of 30 agricultural programmes that recorded nutritional impact, including home gardening, livestock, mixed garden and livestock, cash cropping, and irrigation, confirms these findings (Berti et al. 2004). While the interventions improved food production, they did not always improve nutrition or health. Home gardens, however, were very likely— seen in 11 out of 13 cases — to improve nutrition. Programmes that improved nutrition were typically those where there had been a wider range of action than agriculture alone, especially where there was nutrition education and attention to gender.

In sum, home gardens, it seems, can diversify and improve household diets, raise income, and empower women. But for greatest nutritional impact, complementary measures to address

health, water and sanitation, female empowerment, and care practices are needed; a point to which discussion will return in section 4.3.

Before that an alternative way to remedy micro-nutrient deficiency needs mention: bio-fortification.

Bio-fortification: another way to remedy micro-nutrient deficits

Fortification of processed foods with additional nutrients has long been used to address nutrition deficiencies: for example, iodine added to salt and iron to bread. Benefits can be very high compared to the costs. A more recent development is the possibility of breeding varieties of staples to include higher content of minerals and vitamins for people who consume them, but who are chronically short of these micro-nutrients.

Rice with enhanced Vitamin A, 'golden rice', is an example. One of the most prominent, and well advanced of these initiatives is the *orange-fleshed sweet potato* (OFSP), which has been bred for its content of beta-carotene that is a pre-cursor of Vitamin A. OFSP has the additional advantages of being easy to plant, requires little labour, tolerates drought, and can be harvested over the season. Tubers can either be sold or consumed at home. (Arimond et al. 2011)

Mozambique has seen a pioneer action research. Implemented in drought-prone areas of Zambezia Province, where most households produce sweet potato but where nutrition is poor and Vitamin A intake is low, the programme promoted OFSP, complemented by BCC messages and marketing. Around 1000 farmers, 70% of them women, in 53 groups were reached. Villages were divided into intervention and control, then households within them were surveyed for:

.. socio-economic and demographic characteristics of households, agricultural production, child morbidity, adult and child anthropometry, parental nutrition knowledge, food frequency, dietary intakes and biochemical indicators. In addition, sweet potato plots were measured annually and market prices were monitored monthly. (ibid.)

Children showed improved Vitamin levels:

There was a marked decrease in the prevalence of low serum retinol (an indicator of vitamin A deficiency) among children in intervention households (60 to 38%); prevalence remained unchanged in control communities.

Moreover, the intervention saw progress along the expected path from growing OFSP to more Vitamin A in children:

There were large differences in production of OFSP (90% of intervention households compared with 11% of controls) and increases in sales (30% of households compared with 13% at baseline, among producers). Mean sweet potato plot size increased more than tenfold in intervention households and agronomic performance was acceptable, with yields similar to [white-fleshed sweet potato] WFSP. Both women and men showed positive changes in nutrition knowledge, relative to baseline and relative to controls. Intervention children were ten times more likely to eat OFSP frequently. Vitamin A intakes among intervention children were eight times higher than in controls; energy intakes and intakes of several other micronutrients were also higher. Finally, by the end of the study, OFSP was the cheapest source of vitamin A (per retinol unit) in local markets. (ibid.)

There remains the question of sustainability, both in distribution of free vines and in the intensity of extension.

The country cases include some initial experiences with bio-fortified crops. In **Ghana**, OFSP has been introduced and programmes to promote the variety have started, although it is too early to know the effects. Ghana is a target country for dissemination of HarvestPlus maize bio-fortified with Vitamin A (Pixley & McClafferty 2006). People may be willing to pay for bio-fortified maize in Ghana, and willing to change preferences given clear information (De Groote et al. 2010). Potential new maize sources for high iron and zinc were identified by CIMMYT in 2005 (Pixley & McClafferty, 2006) though varieties are not available yet in Ghana. High quality protein maize is another bio-fortified variety that has been transferred to Ghana, where the varieties are drought tolerant as well as resistant to Striga, a parasitic weed (Atser, 2010). The combination of physical hardiness and nutritional benefits could make this attractive.

Bio-fortification is in early stages in **Bangladesh**. Several species appear to have potential, including OFSP, golden rice which is currently being investigated for efficacy by HKI (HKI 2012), and high-zinc rice that may become available in Bangladesh within the next five years (IRIN 2011).

Tanzania has also seen promotion of OFSP which has been added to breeding work. Sweet potatoes are already part of the diet, and the orange-fleshed sweet potato has been accepted and enjoyed, particularly by children, in trials (RAC, 2012). Quality Protein Maize (QPM) was promoted under CIDA's QPM Development project, which ran 2003 to 2010. (CIDA, 2012). Seed availability may limit adoption.

Zambia is also a target country for dissemination of HarvestPlus high Vitamin A maize. Recent studies show this to be acceptable to consumers in Zambia, with potential to compete with white maize even without nutrition campaigns — and may fetch a premium over white maize where nutrition information is provided (Meenakshi et al., 2012).

All these experiences are recent, being trials and pilots. So far adoption has not been widespread. It remains to be seen how acceptable these bio-fortified varieties may be and whether they are a more effective way to improve the quality of diets, rather than through consumption of more diverse foodstuffs. Until pilots are completed and seed of bio-fortified varieties becomes widely available at reasonable cost, home gardens will remain the proven response to micro-nutrient deficiency: one that can have additional benefits in female empowerment.

4.3 Complementing farming

Reviews of home gardens and other agricultural interventions where the primary intention is to improve nutrition commonly report that complementary activities through education and behaviour, health services, water and sanitation are necessary to get the full benefit of interventions. Two recent examples provide stimulating evidence of what may be achieved by working both on smallholder farming as well as other sectors.

ShouharDO, Bangladesh: combatting malnutrition amongst very poor people

A remarkable programme in Bangladesh gives insight into the relation between smallholder livelihoods, direct nutrition interventions and attention to the underlying determinants of nutrition, according to a recent review (Smith et al. 2011).

Between 2006 and 2010¹² CARE ran the SHOUHARDO¹³ programme funded by US PL480 food aid funds. This focussed attention on poor and vulnerable households who were living in four of the most marginal areas of Bangladesh: on the seasonally-flooded Haor lands, the Charlands (sand and silt islands) of the big rivers, and the coast — all areas highly vulnerable to river flooding, cyclones or both. Some 400,000 households were enrolled in the programme, around three-quarters of the communities in the target areas.

¹² A second phase is now running

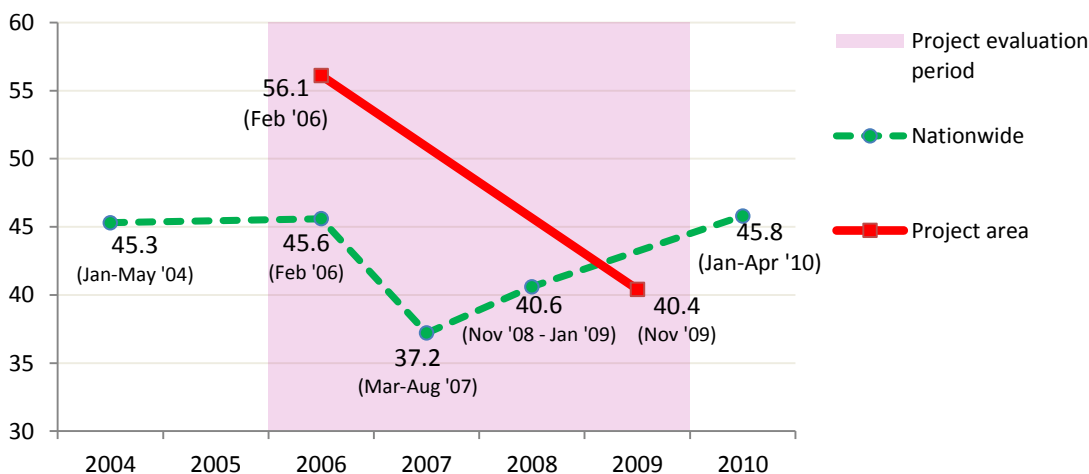
¹³ The SHOUHARDO acronym stands for 'Strengthening Household Ability to Respond to Development Opportunities' and also means "friendship" or "amity"

Shouhardo provided direct nutrition interventions such as mother and child health and nutrition (MCHN) care consisting of food rations, supplements, education and behavioural change communication (BCC). The programme went further, however, by attending to deeper causes of malnutrition, including rights, with the following activities:

- Support for livelihoods, including crops, fishing, livestock and home gardens;
- Sanitation through tubewells for water free from arsenic and use of latrines;
- Groups formed for female empowerment;
- Savings groups;
- Food and cash for work to provide employment for those without, and to build physical infrastructure;
- Disaster risk reduction with preparation and building to offset threats from floods and cyclones; and,
- Village development committees formed to administer resources and to defend rights of the poor.

This concerted and co-ordinated assault on malnutrition has produced little short of exceptional results. In four years the programme **reduced stunting amongst children aged 6–24 months by 16 percentage points**. The largest reductions in stunting, moreover, came amongst the children of extremely poor households. At the same time across Bangladesh as a whole there was hardly any improvement at all. Indeed, stunting amongst the targeted households from being well above the national average, fell below it: see Figure 4.1.

Figure 4.1 Change in stunting prevalence among children 6-24 months: Shouhardo project area versus nationwide rural Bangladesh

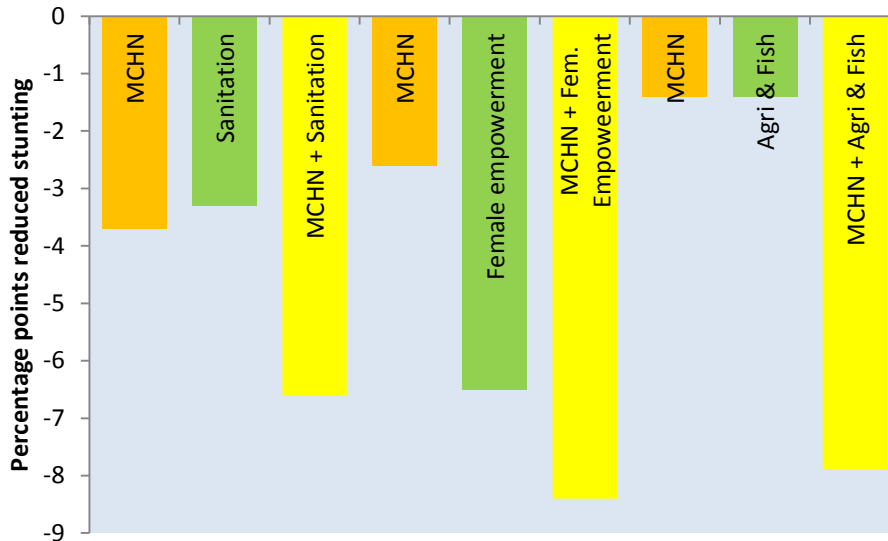


Source: Figure 2 in Smith et al., 2011. Project prevalences: From the baseline and November 2009 endline surveys. Nationwide prevalences: The five data points on which the trends are based are, in temporal order, from analysis of the data in the following surveys: Bangladesh Demographic and Health Survey (BDHS) 2004, National Nutrition Surveillance Project February 2006 survey conducted by Helen Keller International (NNSP-HKI), BDHS 2007, the Bangladesh Household Food Security and Nutrition Assessment conducted by the World Food Programme, UNICEF and the Institute of Public Health Nutrition (2008/09), and the NNSP-HKI survey conducted in January-April 2010.

A series of tests were carried out to see how much this could be attributed to the programme: Shouhardo passed the tests— it seems that only the programme can explain these changes. The study team then looked at how much the changes might be caused by direct nutrition measures, as compared to the other measures. Using propensity score matching to make sure that they compared households similar in all respects except for their different level of

participation in the various interventions, they derived the following picture of the effectiveness of the different parts of the programme (Figure 4.2).

Figure 4.2 Reductions in stunting among 6-24 month olds. Synergies between direct nutrition activities and other actions



Source: Figure 5 in Smith et al., 2011, Authors' calculations

As can be seen, all interventions worked, with female empowerment being the strongest single determinant — echoing the Smith & Haddad reports from cross-country regression. The synergies, however, were most impressive. The combinations of mother and child health care with sanitation, female empowerment, and agriculture and fisheries significantly strengthened the effects.

Although this is only one programme, albeit one so large and affecting people so disadvantaged that it deserves attention, the implications are potentially very important for nutrition policy. The influential Scaling Up Nutrition (SUN) (2010) framework — see Box B in section 5 — can be read to suggest that trying to move the fundamental factors behind malnutrition — poverty, access to food, health and sanitation — may take so long that the overwhelming priority should be direct interventions such as MCHN, micro-nutrient supplementation, and therapeutic feeding. Shouhardo, in contrast, suggests that significant progress can be made on underlying factors at the same time as direct intervention, and to very good effect: a remarkable finding.

Micro-nutrient and health (MICAH) programme, Africa

An unusually wide-ranging evaluation has been carried out of a **comprehensive micronutrient and health (MICAH) programme** funded by World Vision Canada since 1995 in five countries — Ethiopia, Ghana, Malawi, Senegal and Tanzania — to promote better micro-nutrition and health care (Berti et al. 2010). In each country, interventions were designed for poor rural areas — areas with worse nutritional indicators compared to data from (DHS) national surveys carried out at that period — corresponding to their understood problems. The programmes typically included dietary diversification through fruit and vegetable cultivation and raising livestock on small-scale, supplementation, fortification, infant and young child feeding practices, water and sanitation, and disease control.

Most of the programmes succeeded in reducing micro-nutrient deficiencies and their consequences; health was improved; and, with the exception of Ethiopia, child malnutrition was reduced. In each case, it seems that programme participants enjoyed greater improvements than national averages suggested would have been so for those outside the programme.

Of particular interest, in this case it seemed that the results of multiple interventions produced larger effects than might have been expected from trials of isolated interventions. Of the country programmes, the one where most resources were brought to bear on the problems, Malawi, saw the largest impact. Integrating efforts across sectors — in this case food production, care, water and sanitation, and health — paid off.

5 What are political and administrative conditions for progress?

5.1 Policies for smallholder agricultural development

Policy to encourage smallholder development, as for agriculture as a whole, has come back into the limelight in the new century. The 1980s and 1990s saw a decline in support for agriculture from the main donors, and from governments as well in some parts of the developing world, most notably in Africa (Binswanger-Mkhize & McCalla 2008). Since 2000, however, there has been a growing sense that agriculture has been unduly neglected. In part this came from the Millennium Development Goals that set reduced poverty and hunger as the first objectives, thereby drawing attention to the concentration of poverty in rural areas. Frustration over slow agricultural growth in Africa led ministers of agriculture meeting in Maputo in 1993 to pledge to increase spending on agricultural development to raise growth rates of agriculture to 6% a year. The refocusing of attention on agriculture was further stimulated when cereals prices spiked on world markets in 2007–08 to a degree not seen since 1973–74.

A broad consensus exists on policies for development of agriculture, and smallholder agriculture in particular, perhaps best expressed in the World Development Report for 2008 (World Bank 2007). Governments need to do two things above all else. One is to ensure that there is a rural investment climate that encourages agricultural investment and innovation. These enabling conditions include peace, law and order in rural areas; macro-economic stability in the shape of a competitive exchange rate, relatively low inflation and interest rates; and support for key institutions such as property rights, weights and measures, contract law, financial supervision and regulation, and business regulations that protect public interests but do not deter investors. This is understood largely by default: when the investment climate is grossly deficient, agricultural growth slows to a crawl — see, for example, the studies of effective rates of protection in the 1970s that showed how damaging heavy taxation, most of it implicit, of agriculture was in the developing world (Krueger, Schiff & Valdés 1991).

The other is to supply rural public goods: those goods that private investors will not otherwise supply. These include physical infrastructure of roads, power lines, in some areas irrigation and drainage; investments in education, health care, clean water and sanitation; and knowledge generation through agricultural research, preferably that takes account of indigenous knowledge and extension. Returns to rural public goods have often been found to be high: see evidence for Asia in Fan et al. 2000, 2003, 2007.

Public goods matter especially for smallholders, since unlike some large-scale commercial farmers who may have the means to access some of these goods and services privately, they cannot. Roads that allow trucks to reach small farms without undue unit cost are particularly important. Public agricultural research needs to focus on smallholder needs, with technical innovations that are sparing in their use of capital, but which emphasise labour and the skilful

application to local circumstances: reflecting the relative endowments of smallholders. For very small, part-time farms there is often a call for intermediate technologies that raise yields of food crops without heavy demands for labour or external inputs.

It is probably not necessary that public performance needs to be exemplary in either of these tasks. China, for example, saw extraordinary growth of its agriculture from 1978 onwards, simply because a poor rural investment climate had been reformed into being a tolerably deficient one — it was subsequently improved with further reforms, but most of the impact was achieved through removing the worst faults (Rodrik 2003). Ghana whose agriculture was in dire straits in the early 1980s saw it become one of the fastest-growing in the world after the reforms that began in 1983 (Leturque & Wiggins 2011). For a quarter century since, the average rate of growth has been between 4% and 5% a year, well ahead of population growth. Ghana's reforms were far from comprehensive or perfect: but they removed the main blockages faced by farmers, and provided some rural public goods that were not there before.

While these basic conditions can do much to stimulate agricultural growth, many smallholders face difficulties in markets, and especially those for inputs, insurance, financial services and technical assistance. Inability to obtain seeds, fertiliser, advice and credit on reasonable terms explains in part why in many parts of Africa yields are so far below what fields trials suggest is possible with technical improvements. Remedies for failings in rural markets are debated, however: the answers may lie variously with institutions such as contract farming that give farmers access to inputs on credit; or in farmer co-operation that makes it easier to negotiate credit or inputs in bulk; or else in direct state provision to replace the market where it does not function.

Tackling female disadvantage in agriculture

Women farmers face disadvantages, some specific to the roles assigned to their gender, others being more intense manifestations of problems that many male smallholders face.

Access to land for women needs to be made secure, especially for widows who often lose access to land when their husbands die. Making sure national laws recognise women's rights to land they have long cultivated is one response; but equally work at local level with traditional authorities to raise awareness of potential injustice may be effective. The Tripathi et al (2012) review gives an example of this work in southern Africa. It is not just rights to crop land: women may rely as well on collective rights to grazing, firewood and water — rights that can be vulnerable to private appropriation. Such collective rights need to form part of official recognition and local defence.

The difficulties male smallholders face in markets are magnified for many women farmers — owing to entrenched inequality in which women often have less education, less facility in national languages, and less time and more difficulty in engaging with (largely male) actors outside of the village. Hence actions to improve the functioning of rural markets are likely to be of disproportionate benefit to women farmers. For credit, **rotating savings groups** may be one way forward (Tripathi et al., 2012).

Risks in agriculture of harvest failures and deaths of livestock may be greater for women who have fewer resources: these may deter them from innovation and investment. **Micro-insurance** may be one response. Disaster resilience and risk reduction at greater scales of village, district and province need to be gender-sensitive.

Of the public goods for rural areas, several are particularly important for women farmers. **Extension services** too often do not recognise women farmers' circumstances and often do not have women extensionists; the technologies they seek to disseminate are rarely designed with women in mind — above all taking into account a critical factor for women farmers: time. Labour-saving technologies such as drip irrigation can be particularly useful for women with irrigated gardens. Forms of communication matter as well: community radios, literacy programmes for rural women, farmer field schools and farmer-to-farmer exchanges, mentoring

support for women producers to improve organisational and technical skills, and establishing plant clinics in local markets — may be appropriate (Tripathi et al., 2012).

Other public goods can complement agricultural interventions: ensuring that girls get at least **secondary education** can contribute in lowering barriers to communication, as well as raising female status. **Clean water supplies** can reduce the time taken to draw household water and reduce child sickness. **Health services** are likely to be of particular benefit to mothers.

Ultimately underlying gender inequities need to be challenged:

'Therefore, women's economic empowerment must be accompanied by measures to address broader gender issues including power imbalances, gender stereotypes and discrimination against women. Among and between both men and women, activities that promote discussion and mutual understanding of issues such as gender roles, unequal workload, rights and responsibilities are important for raising awareness, informing programmes and policies and ultimately addressing gender inequality.' (Tripathi et al., 2012)

Shouhardo in Bangladesh, see section 3.3, is an example of a nutrition programme that included explicit and direct action on female empowerment, to good effect. Central to this was the formation of ...

'... Empowerment, Knowledge and Transformative Action (EKATA) groups, which established a recognised and accepted forum for women to meet and express themselves in a public role. The groups, comprised of twenty women and ten adolescent girls, provided a platform for empowering women and girls through education, solidarity, group planning, and rights advocacy.

[Together with pre-school groups and parent-teacher associations that included women ...]

... the three interventions had a broad range of goals: increasing women's decision making power at household and community levels, reducing gender-based violence, raising awareness of educational entitlements for women and girls, building women's leadership, advocacy, and literacy skills, and consciousness-building around important social issues, including dowry, early marriage, divorce, and violence against women. (Smith et al. 2011)

Ensuring smallholder development be environmentally sustainable

In the cases of Machakos and Burkina Faso where smallholders had conserved their land while developing it, three factors stand out. One is that farmers had the appropriate technical knowledge and skill, much of it the product of farmer-to-farmer learning. A second element was that farmers were secure in their tenure of their land, albeit under longstanding collective tenure rather than formal registration. A third factor was they had incentives to conserve: in both cases there was little chance to raise production by expanding the area, and the fields had to be conserved if productivity was to rise.

Not all of these factors can be promoted by policy alone, but there are pointers for policies and programmes. Farmer-to-farmer learning, especially of agro-ecological approaches with considerable local specificity, can be facilitated and promoted by innovative extension services; research on conservation of soil and water need to recognise how and where local innovations function. Security of tenure may be enhanced by formal recognition of collective tenure and local control over access to land.

To these considerations may be added measures to deal with externalities where they arise — for example, in drawing down of groundwater reserves. Governments need then either to regulate or set incentives in the form of taxes and subsidies to make sure that private and public calculations are aligned for sustainable use of natural resources.

A major challenge is that since the environment and its functioning is so specific to particular ecosystems and localities, public policy ideally needs to be adjusted to circumstances — an ideal that does not match with the administrative possibilities that require a certain uniformity of public action if it is to be feasible.

These issues become all the more important given the context in which environmental concerns such as scarcity of water and the need to conserve biodiversity are becoming more pressing, not to mention the looming imperative of adapting to and mitigating climate change. Although this exceeds the scope of this paper, responses probably lie in further progress with agro-ecological technology — innovation such as *faidherbia* trees planted amongst food crops and other agro-forestry initiatives, minimal tillage, micro-dosing of nutrients, integrated pest management, soil and water conservation, etc. Policies that seek to develop these techniques and disseminate them, backed by incentives to encourage their use will be needed.

Specific agricultural interventions for nutrition

Patterns of agricultural production need in many countries, Bangladesh being a prominent example, to be shifted to more diverse crops and livestock so as to make foodstuffs rich in vitamins and minerals more available, and probably in the process, less costly. At very least, research and extension systems need to be directed to give as much attention to complementary foodstuffs as to staples. There may be scope beyond this for looking to see what bottlenecks arise for farmers seeking to diversify their crops and livestock, then designing appropriate policy responses.

More specifically, home gardens with small-scale livestock keeping are proven ways to diversify diet and often to empower women farmers. Promotion of home gardens may require little more than information, encouraging local groups to share ideas, some technical assistance and providing access to seeds — that might, for example, be produced in village or district nurseries. For best effect, however, home garden programmes need to be coupled with education and behaviour change communication about diet, care and hygiene.

Fortifying staples with added minerals and vitamins through plant-breeding may have promise as well: although it remains to be seen how much the varieties being developed are acceptable to farmers and consumers.

5.2 Leadership and political conditions

Convincing narratives

It is one thing to specify the kinds of policies needed to make smallholder agricultural development more effective for food security and nutrition, another to find the political will to implement them. So what makes the difference in leadership?

Very little is known about how to create leadership for hunger reduction ...
[Foresight 2011]

Clearly there needs to be support, and preferably at the highest level, for better food security and nutrition. ***Presidential or Prime Ministerial support was a feature of success in Brazil, Ethiopia and Peru*** (Mejía A. & Fanzo 2012). Clearly there is no science to firing the imagination of leaders, but there are indications of factors that can contribute.

One of these is the creation of convincing narratives that are widely shared. In Bangladesh, for example, the price of rice has become a point of reference for food security debates (Mejía A. & Fanzo 2012). Although these authors do not consider the rice price central to nutrition in Bangladesh, it is not hard to see why the rice price has come to have such importance. In the famines of 1943 and 1974 rice prices rapidly doubled (1974) or even quadrupled (1943), so

that many of the poor simply had no access to sufficient food, leading to widespread suffering and many dying, largely from diseases.

For nutrition there is opportunity and threat with narratives: on the one hand, the simple statistics of child malnutrition can create a dramatic sense of the problem; on the other, the multiple causes of malnutrition impede the building of a simple, clear story of causes and hence solutions. But this line of thought should not end in pessimism: good experiences build narratives and inspire imitation. *Piloting innovative approaches to smallholder agricultural development and nutrition can capture the imagination*. Programmes such as MICAH or Shouhardo are good examples of eye-catching experiences where the first round of evaluation suggests there are important lessons that can and should be taken on board by government for potential replication. There is a role here for civil society in making these results known, and for researchers in making sure that reviews are sufficiently rigorous that they cannot be readily dismissed by sceptics.

Setting nutrition as a central aim of development can help, although that begs the question of the processes by which nutrition can compete with other goals — such as economic growth. Box A records the frameworks of policy aims and approaches proposed and agreed internationally by the UN and other prominent agencies. These cover most priorities. The question here is how to make sure that they become part of funded action plans.

Just drafting national strategies with nutrition as a goal does not mean that this will capture the political imagination. Civil society initiatives, such as that for child nutrition in Peru, can work.

In Peru, civil society movements and other stakeholders organised around the Children's Nutrition Initiative played a critical role to encourage the government to include nutrition goals as part of Peru's poverty reduction strategy. (Mejía A. & Fanzo 2012)

Box A Policy frameworks for food security and nutrition

Reducing hunger forms part of the UN **Millennium Development Goals** [see <http://www.un.org/millenniumgoals/bkgd.shtml>] set in 2000 to be reached by 2015, together with specific targets and indicators to measure progress towards them. Under the first goal of eradicating extreme poverty and hunger, the target (1.c) is to halve, between 1990 and 2015, the proportion of people who suffer from hunger. Two indicators to track progress have been selected: halving the proportion of children under five years of age who are underweight; and halving the proportion of people under-nourished, that is, those below a minimum level of dietary energy consumption (UN 2008, Statistical Annex). In the baseline years of 1990–1992, in developing regions 31% of children under five were underweight and there were 817M people suffering from undernourishment.

In 2004 **Voluntary Guidelines to support the progressive realization of the right to adequate food in the context of national food security** were adopted by the FAO Council, as a first attempt to interpret food security as an economic, social and cultural right. The guidelines include the identification of the food insecure and the causes of their hunger; assessing the effectiveness of policies, laws and programmes influencing food insecurity; formulating national strategies to address the issues with budgets, roles of public agencies and responsibilities; integrating the right to food in national legislation; monitoring nutrition outcomes; and holding responsible agencies to account.

Following the unexpected spike in cereals prices on world markets in late 2007 and early 2008, the UN Secretary General appointed a **High Level Task Force (HLTF) on the Global Food Security Crisis** in April 2008, intended to help co-ordinate and galvanise international responses to the spike and its consequences. Later that year the Task Force produced the first draft of the **Comprehensive Framework for Action (CFA)** in 2008 that has subsequently been revised and updated, the latest version being from September 2010. This sets out twin objectives of short-term measures to 'improve access to food and nutrition and to take immediate steps to increase food availability', combined with longer term steps to 'Strengthen food and nutrition security in the longer-term by addressing the

underlying factors driving the food crisis'.

Leading donors have also set out their visions. The **European Commission** (2010), for example has set out a food security framework. This recommends for the Commission and member states measures that address the availability of food, access to it, nutrition, and responses to food crises. This emphasises agricultural production by small-scale farmers, since this will give growth with poverty production. It highlights environmental sustainability, recommending:

... intensification approaches that are sustainable and ecologically efficient, respecting the diverse functions of agriculture. This means inter alia optimising agri-inputs, integrated pest management, improved soil and water management and stress resistant crop varieties.

Agricultural research thus needs to respect farmer needs, to incorporate traditional knowledge, and to provide access to intellectual property. It highlights gender dimensions, recommending specific investment in women. Land rights of longstanding users need to be respected.

To these frameworks can be added the **Rome Principles for Sustainable Global Food Security** adopted in 2009 by the World Summit on Food Security in Rome: country-owned plans; co-ordinate at national, regional and world level; take the twin-track to food security; improve effectiveness of multilateral agencies; and, commit to invest in agriculture, food security and nutrition. These build on the wider aid effectiveness principles set out in the **Paris Declaration**: developing countries to own their development strategies; donors to align with those strategies and use local systems; donors to harmonise their procedures to avoid duplication; focus on results in development and measure outcomes; and donors and governments mutually accountable for results.

All the above have been incorporated into the **Global Strategic Framework for Food Security and Nutrition**, second draft, May 2012, of the Committee of Food Security (CFS). This confirms the simultaneous approach of 'Direct action to immediately tackle hunger and malnutrition for the most vulnerable'; plus 'medium to long-term actions to build resilience and address the root causes of hunger.' The latter includes:

- Improve agricultural productivity and enhance livelihoods and food security in poor rural communities; promote productive activities and employment;
- Develop and conserve natural resources; ensure access to productive resources;
- Expand rural infrastructure, including capacity for food safety, plant and animal health; and broaden market access;
- Strengthen capacity for knowledge generation and dissemination (research, extension, education and communication'

For agriculture, this Framework recommends paying attention to the needs and potential of small-scale farmers; addressing gender issues including women farmers' access to land, technology and inputs; promoting agriculture that is sustainable environmentally, socially, and economically; and protecting rights to land and water. It also recommends direct action to improve nutrition.

Some frameworks look at agriculture as a way to reduce poverty and hunger. A full list of those produced by the main international and bilateral development partners would be long, but three can be picked out to illustrate some of the main lines of thought.

The World Bank (2007) in its **World Development Report 2008** focused on agriculture and how agricultural development could reduce poverty. It states the case for agricultural development in low income countries as a major route out of poverty. Smallholder agriculture is seen as usually efficient, although the Report worries that larger-scale operations may become more appropriate as supply chains and technology change. It also recognises differences in context, especially between countries seen as being either agricultural, in transition or urbanised: as countries move along this spectrum, increasingly rural poverty will also be relieved by growth of the rural non-farm economy and by out-migration from rural areas.

The 2008 **International Assessment of Agricultural Science and Technology for Development** (IAASTD) addresses a wide range of issues in agriculture, moving beyond the usual concerns of growth, poverty and hunger to emphasise environmental

sustainability and indeed, cultural dimensions as well. It argues for revising technology policies to reflect these multiple concerns and to respect the diversity, natural and cultural, found in rural areas across the world.

IFAD's (2010) **Rural Poverty Report 2011** focuses on smallholder agriculture and poverty reduction, with an emphasis on the risks that poor farmers face and which deter them from investing and innovating. It stresses the need for sustainable intensification in farming worldwide, and a need to re-direct policies towards intensification that is environmentally sustainable.

Finally, and specifically for nutrition, the 2010 **Scaling up Nutrition initiative** has been signed by 95 UN and other international agencies, bilateral donors, NGOs and research organisations, plus seven private enterprises. This aims to accelerate investments to reduce malnutrition, within a framework 'of key considerations, principles and priorities for action'. The immediate priorities are to scale up 13 direct interventions — covering good nutrition practices, increasing intake of vitamins and minerals, and therapeutic feeding of malnourished children (listed in Annex H) — to address malnutrition that are known to be both effective and which offer high returns to investments. Action should take place across sectors, including agriculture, health, social protection, education, water and sanitation. That said, the framework focuses on the thirteen interventions, especially for the 36 countries where 90% of the world's under-nourished children live.

At local level it may be possible to link nutrition programmes to electoral support, as occurred in parts of Brazil:

In Brazil, the success of national poverty reduction schemes (such as Bolsa Familia) encouraged local mayors from the government and opposition parties to further support and sponsor these programmes in their own districts and benefit from the electoral rewards. (Mejía A. & Fanzo 2012)

But there is a word of warning here: it is rarely the case that nutrition programmes alone draw forth community interest according to Mason (2002). They thus need to be combined with health and other programmes, in some cases agriculture, that may gain more support. Aligning nutrition interventions with locally strongly felt priorities is an obvious point, but one that can be overlooked.

Holding government to account

Pressure for governments to take food security and nutrition more seriously can come from international and local sources. Internationally, the right to food — see Box A — can be very useful since it allows UN agencies and staff to be more critical of national inaction than they might otherwise be: the reports on national progress by the Special Rapporteur on the Right to Food have been scathing about the situation in some countries.

Nationally, **civil society can play a role in monitoring progress** towards better food security and nutrition, as well as commitment as seen in resources committed to nutrition programmes. In some countries, the right to food, especially when part of national law, can allow strong complaints over government inaction. For example, India has seen formal legal complaint over the failure to ensure the right to food, in a country with very large public reserves of grains.

In May 2001, the People's Union for Civil Liberties (registered in Rajasthan by a small group of social activists) submitted a petition in the Supreme Court, demanding that the country's gigantic food stocks should be used without delay to prevent hunger and starvation. This Supreme Court hearing, which is likely to last several years, has led to a larger "right to food campaign".' (Piron 2003, 11)

It may be possible for local civil society groups to monitor the disbursement of funds intended for agriculture and nutrition programmes at district level — if such data are publicly available.

Holding government and leaders to account depends on having information and data. Hence having ready indices of commitment could be useful — at least internationally when comparing across governments (Foresight 2011). At national level, data on food security and nutrition outcomes, preferably disaggregated by sex, needs to be collected regularly. Not only does this help focus political attention on food security and nutrition, but also helps monitor progress and adjust programmes. (Mejía A. & Fanzo 2012) Civil society has a role to play here: at very least in publishing, but in some cases also in generating statistics. Since national surveys of food security and nutrition and its determinants are relatively costly for non-governmental organisations, there is scope here for alliances of civil society to combine and underwrite costs.

With advances in information technology, most notably mobile phones, the possibility of much more agile data collection and processing arises. (Foresight 2011) Text messaging coupled with GPS, for example, might allow indicators of food security and nutrition to be collected monthly from sentinel sites across nations and regions, with almost no delay in feeding the results back to decision-makers and the public, the results being presented in easily appreciated maps.

5.3 Delivering in the field: co-ordinating activity

Compared to technical issues, less has been written about the political and administrative conditions for better food security and nutrition. Since these respond to multiple factors, it is widely agreed that efforts need to proceed through several programmes and agencies, and hence that this needs co-ordinating. But what kind of co-ordination works, and where in the administration should this take place?

Central co-ordination units at high level may work, but not always:

Bodies set up to coordinate nutrition actions can play a critical role to facilitate cooperation across government ministries, facilitate effective funding allocations, monitor progress and include other stakeholders in the decision-making process. But they can just as easily be ineffective fig-leaves, meeting infrequently and without much power to demand change. (Mejía A. & Fanzo 2012)

Others also report that high-level food security and nutrition co-ordination units have sometimes not achieved much (World Bank 2007). Complementary actions may be better arranged locally:

More limited, lower-level opportunities for collaboration to address specific and local issues contributing to malnutrition appear to offer greater promise for effective action. This local collaboration offers the prospect of incrementally improving higher-level coordination of multi-sectoral action to address food insecurity and malnutrition effectively on a national basis. (World Bank 2007)

Funding mechanisms can contribute to co-ordination, so long as public funds are disbursed from one source, such as finance ministries. The danger here is that external funds channelled directly to operating agencies to avoid delays in disbursement, can then give them the liberty to ignore other agencies. (Mejía A. & Fanzo 2012)

Programmes need to fit with local circumstances and capabilities. Typical lessons are those of not overloading and overwhelming local structures and capacities. The art here is to simplify the vertical structures of programmes, while allowing them to become more complex at the field level as elements other than nutrition are combined to increase the coverage and attractiveness of the programme. (Mason 2002) The MICAH programme, operating in four African countries, found a way to do this. It planned for a broad package of interventions rather than relying on single 'magic bullets', but then allowed community participation to tune the package to local needs:

... community participation in programme design, implementation and monitoring and evaluation, such that some interventions could be tailored to suit community preferences, especially regarding animal husbandry where existing practices differed from community to community (Berti et al 2010)

The technical integrity of the programme was nevertheless ensured by technical support and regular supervision of field staff, plus monitoring of results that allowed programmes to be adjusted when it was clear that they were not making headway. (Berti et al. 2010)

A tension thus arises between accepting to do what may be possible, against impatiently demanding that programmes are designed to allow proven interventions to be implemented. Getting the balance right is a matter of fine judgment, rather than precise science.

6 Conclusions and recommendations

Four points stand out from this review and form the basis of policy conclusions and recommendations.

1. Smallholder agricultural development can be an excellent way to reduce poverty and tackle hunger in low income countries. It can increase food production, raise rural incomes, and push down food prices; all of which should improve the access of poor and vulnerable people to food and thereby contribute considerably to improving their food security. Given that many of those who are food insecure work in agriculture, then its effects can be direct.

The implication is to continue with efforts to develop agriculture and especially that of small-scale family farms. Some of the ways to do this are reasonably well known, hence the first two recommendations:

R1: Countries need to ensure that the rural investment climate is conducive to investment and innovation. This means peace and security, a reasonably stable macro-economy without major economic distortions, and the establishment and recognition of critical institutions, such as property rights. Those who suffer most from investment climates that deter investment are small-scale enterprises, including smallholdings. Large businesses may be able to protect themselves from insecurity, macro-economic chaos and the absence of property rights: smallholders can only do so by retreating to autarkic subsistence economy, usually of low productivity.

This may seem a tall order for low income countries that face multiple challenges; but experience shows that the rural investment climate does not have to be ideal; only that the worst failings are eliminated.

R2: Countries need to invest in rural public goods, including: physical infrastructure — rural roads, electricity, perhaps irrigation and drainage where applicable; human development — education, water and sanitation, health; and public knowledge through agricultural research and extension. Again, these are particularly valuable for smallholders who cannot substitute private investments for most of these public goods.

Spending on public goods in rural areas pays off, both in returns on investment and in reductions of the numbers of people living in poverty: as can be seen from studies of returns to these investments in Asia when agricultural development was particularly rapid (Fan et al. 2007).

Prime responsibility for these lies with domestic governments, but donors can help with some of the capital costs of public investments.

After these, comes a more challenging matter where the responses to the problem are in debate, but in any case will vary by circumstances.

R3: Improve the access to rural markets, especially for inputs, insurance and finance, for smallholders and improve their terms of engagement in such markets. Currently the majority of small-scale farmers in Africa engage much less with markets than the gains to specialisation and use of external inputs would suggest. Part of the reason for this lies in high costs of information and negotiations between enterprises in the supply chain such as banks and small family farms. Responses will need to be tailored to conditions, but promising ways to improve lie in institutional innovations such as contracting and in producer organisations.

Finding effective solutions requires innovative programmes that may be too risky for governments and donors, and hence may be better managed by NGOs, foundations and private enterprise. More effort, however, needs to be made to learn from these experiences, so that where effective solutions are proved, they can be replicated more widely by public programmes.

While these policies will allow some smallholders to develop their farms, other farms marginal either by their very small size, poor quality of soils and climate, lack of labour, or remoteness from services and markets may need additional measures. In particular, on the more marginal holdings farming is often part-time, one of several livelihoods that household members pursue. Hence labour may be scarce, and working capital may also be lacking.

R4: Develop and promote innovations for marginal farms, focusing on higher yields for staples but using few external inputs and where possible saving labour. These will allow these farms to achieve the self-provisioning in staples that is often a primary objective of the farm, as well as potentially allowing some of the land to be switched to more diverse, nutrient-rich fruit, vegetables and small-scale livestock rearing.

Responsibility for this lies with agricultural research systems, although for some researchers taking up this challenge may require setting aside the search for optimal yields. There is scope here for NGOs to foster exchange of experiences from local innovations and NGO research.

Smallholders and especially the more marginalised, need assurance that their land rights are respected both in recognition of their entitlements and to remove any disincentive there may be to invest, innovate and conserve.

R5: Recognise and protect the rights of small farmers to their land. This may mean some form of registration of rights, but it may mean recognising local authorities that define land rights. Two particular issues are to ensure the recognition of women's rights as farmers, especially those of widows; and of safeguarding against land being taken away in land deals without free, prior and informed consent.

Responsibility here lies with governments, although there are roles for civil society in making sure that laws, rules and practice are respected and in bringing abuses to attention.

Last but not least, smallholder agriculture can be environmentally sustainable and increasingly will have to be in a world where natural resources will be in short supply, further ecological damage will carry too high a price for future generations and where global warming will lead to climate change and increasingly volatile weather.

R6: Give sufficient support to make sure that smallholder agricultural development is environmentally sustainable. This can be encouraged by agricultural research & extension that engages with local needs, knowledge and perceptions of the relation of farming to soil, water, and other parts of the local ecology. When better farming practice confers external benefits, farmers should be rewarded for this.

Given the size of this challenge this will require not only appropriate domestic policies, but also support from international policy-making to promote global public goods — and prevent global

bad, with major roles for research both technical and social to find responses to the challenges including those of climate change.

2. Patterns of agricultural development need steering towards more diversified food production. Progress on food security and better nutrition has been greater on food availability than on food access, and on access to energy-rich foods than on those with more diverse nutrients. For every person who suffers from undernourishment in the world, more than twice as many suffer from deficiencies in minerals and vitamins. Part of the answer lies with more diversified food production, that may also reduce risk in production and markets for smallholders. The problem of the focus on energy-dense foodstuffs is likely to become ever more pressing this century, with urbanisation and rising incomes allowing people to adopt diets high in energy, sugar and salt that have already taken their toll in the diseases of affluence seen in most OECD countries. Production of foodstuffs rich in micro-nutrients needs encouragement.

Agricultural policy can contribute, even if wider changes in diet will be necessary in the medium term.

R7: Promote home gardens, with small-scale livestock rearing – including fish, and back this up with communications for nutrition, health and child care. This costs little, while the returns can be disproportionate. A key challenge here is ensuring smallholders have access to good seed.

R8: Monitor progress on bio-fortification of staples, especially their adoption by farmers. Since this technology is not yet proven at scale, this should not be seen as the primary and still less the only way to tackle micro-nutrient deficiencies. Home gardens, for example, can be promoted at the same time. Even if bio-fortified crops do become taken up widely, people will want to consume foods complementary to their staples as well.

Responsibility here lies with domestic governments, with ministries of agriculture in the lead, but working in co-operation with those of health, community development and so on. NGOs have a role to play in piloting and demonstrating effective models, documenting them and bringing them to the attention of governments.

3. Back up smallholder agricultural programmes, with complementary actions in primary health care, clean water and sanitation, other direct interventions for nutrition, and female empowerment. Agriculture can play a key role in reducing hunger, but it needs to be supported by actions in these other spheres. Female empowerment may be the outstanding complement to both agriculture and actions on health, water and so on. Empowered and educated mothers are time and again shown to spend incomes on their young children and to protect the nutrition and health of the household.

R9: Back up agricultural development with commensurate investments in primary health care, clean water and sanitation, and BCC on diet, child care and hygiene. These measures include the direct nutrition interventions recommended in the SUN initiative, but they should not be the only ones, however valuable as they may be. The concern that progress in shifting the deeper causes of malnutrition would be too slow may exaggerate if the striking results of programmes such as Shouhardo in Bangladesh are considered.

R10: Correct female disadvantages in farming: this will not only raise production and improve the pattern of production, but also help empower rural women and overcome longstanding unfairness. Priorities include recognising and strengthening women's rights to fields and common property resources; directing attention to women's needs in farming and finding ways to support them; and in general, developing innovations both on field and in domestic tasks, such as water supply and fuel collection, that save time and appropriate for women. Making sure that girls living

in rural areas are schooled through until the end of secondary will underpin these measures.

Prime responsibility lies with national governments, where the challenge is to co-ordinate the actions of different agencies. At central level this may consist of little more than political leadership and budget co-ordination by finance ministries: the detailed operational co-ordination may be simpler at district level than attempting to decide this centrally. NGOs and donors may support these efforts by funding innovative programmes that can show how these programmes may work in specific countries.

4. Greater political support for improving food security and nutrition is needed.

Political support to is often lukewarm: perhaps because of ignorance of the problems, or because the remedies can seem dauntingly difficult for problems that have multiple causes. How to generate political support may not be certain, but at least two things seem promising.

R11: Monitor and survey more often the state of food security and nutrition, to highlight the problems and to see where and when progress is being made. At the moment, statistics in many low income countries with high rates of food insecurity and malnutrition are few, collected infrequently, and some, such as those for undernourishment of individuals, are unreliable. Statistics on micro-nutrient deficiency are particularly rare. Regular national surveys of nutrition and food security should be conducted, at least once every five years, preferably every three years. Sentinel sites could be established for more frequent monitoring of food and nutrition (see Barrett 2010). This could take advantage of text messaging to collect information in real time, so that policy-makers and their advisers have information accurate to the month on the state of food insecurity.

R12: Pilot innovative approaches, then evaluate these rigorously with counter-factuals wherever possible, and publicise the results. Currently much is tried, but much either passes without review or is not sufficiently well evaluated to convince sceptical readers. Not all pilots will succeed of course, but some will: understanding in broad terms what works can inspire action — and political will.

Civil society can play a role in generating information to draw attention to problems and opportunities, then making sure that key messages reach leaders, opinion-makers and the general public.

Final reflection: what will this cost?

These recommendations have not been costed item by item, partly because some are policies that have low costs, if they have any monetary cost at all; but mainly because most of what is recommended here is not additional spending over and above what would be needed for any programme of development.

To single out the costliest item mentioned for public investment, rural roads: passable rural roads that allow vehicles to reach rural communities at moderate cost are not needed for nutrition-sensitive agriculture alone, nor for agriculture alone; but for almost any kind of rural development one could imagine. The same applies to all the costly elements in rural public goods (R2) and complementary public investments (R8): clean water, education — these are not just for food security and nutrition.

Most of the recommendations are for adjusting the use of resources that are already being funded, or would be funded under a serious development effort.

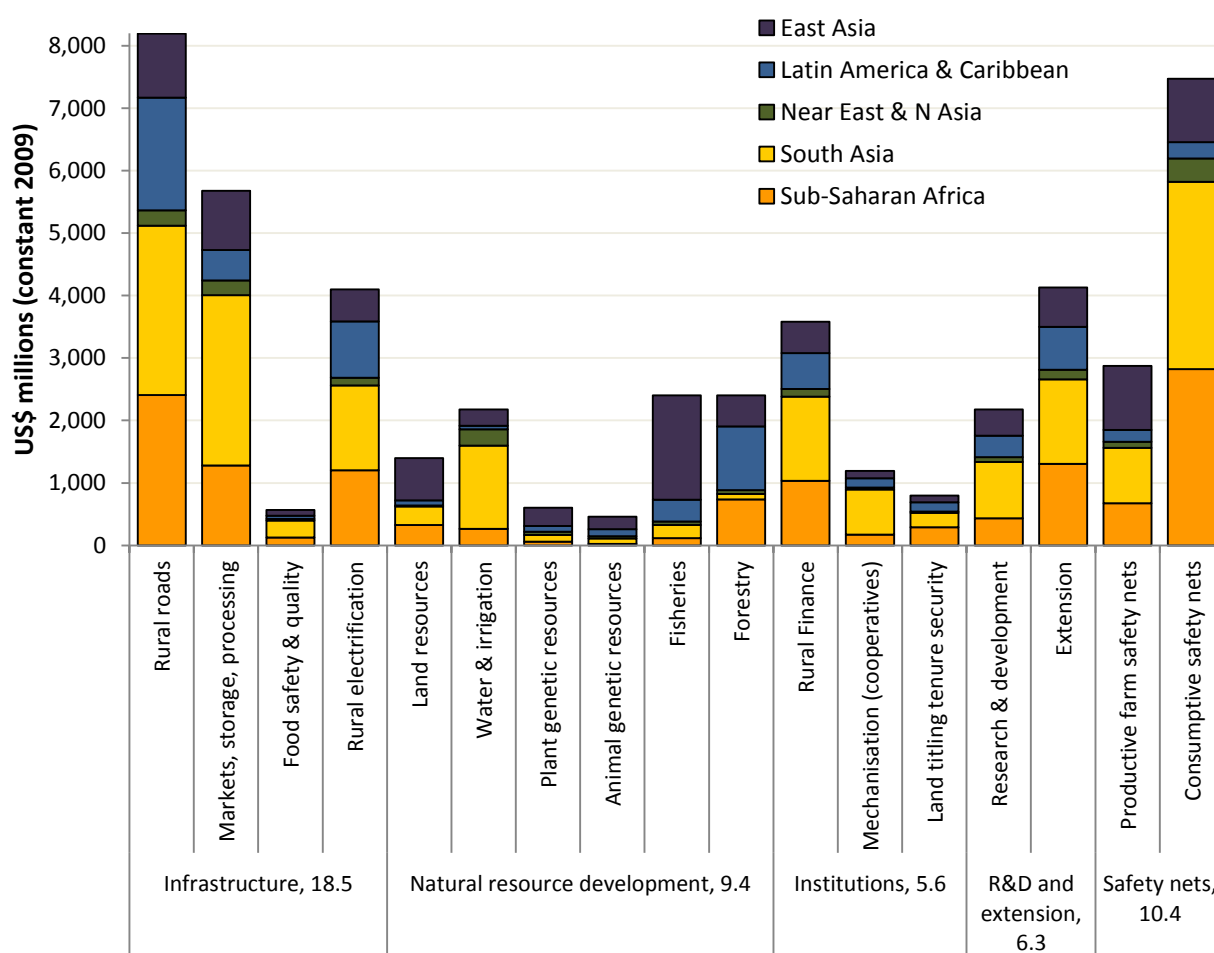
That said, two sets of costings have been made that are relevant what is proposed here.

The **thirteen direct nutritional interventions recommended by the SUN initiative** have been estimated to cost US\$11.8 billion a year for the 36 countries where 90% of the world's under-nourished children live (see Annex H). Expressed per person, for the 2,845M persons in those countries, that is about US\$4.15 for every person each year: the return for which would

not only be a decent start in life, a fundamental birth-right for children, but also great benefits in the greater capacity of future workforces.

Most comprehensively, FAO (Schmidhuber & Bruinsma, 2011) has estimated the **extra annual spending required to eliminate hunger by 2025** as US\$50.2 billion, including US\$7.5 billion for food and cash-based safety nets¹⁴ in keeping with the twin-track approach of dealing with long-term chronic hunger while also addressing short-term needs. Figure 6.1 shows the break-down of this spending by sector and region. Most of the extra investment is for physical infrastructure, and mostly in Sub-Saharan Africa and South Asia.

Figure 6.1 Extra annual spending needed to end hunger by 2025, by sector and region



Source: Data from Schmidhuber & Bruinsma, 2011.

Notes. Numbers on the horizontal axis are sub-totals in US\$ billions for spending groups.

Regional sub-totals: sub-Saharan Africa, US\$13.2 billion; South Asia, US\$17.6 billion; Near East and North Africa, US\$2 billion; Latin America, US\$7.3 billion; and East Asia, US\$10 billion.

An extra US\$50 billion a year may sound a lot, but consider the figure for sub-Saharan Africa of US\$13.3 billion more. This is about US\$15.50 for each of the 854M living in the region. Not to labour the point: the costs are small compared to the numbers who will potentially benefit, and the importance to them of food security and nutrition.

¹⁴ Without the consumption safety nets, the extra spending is equal to around US\$42 billion per year (constant 2009), the figure called for in the IF campaign launched in 2013.

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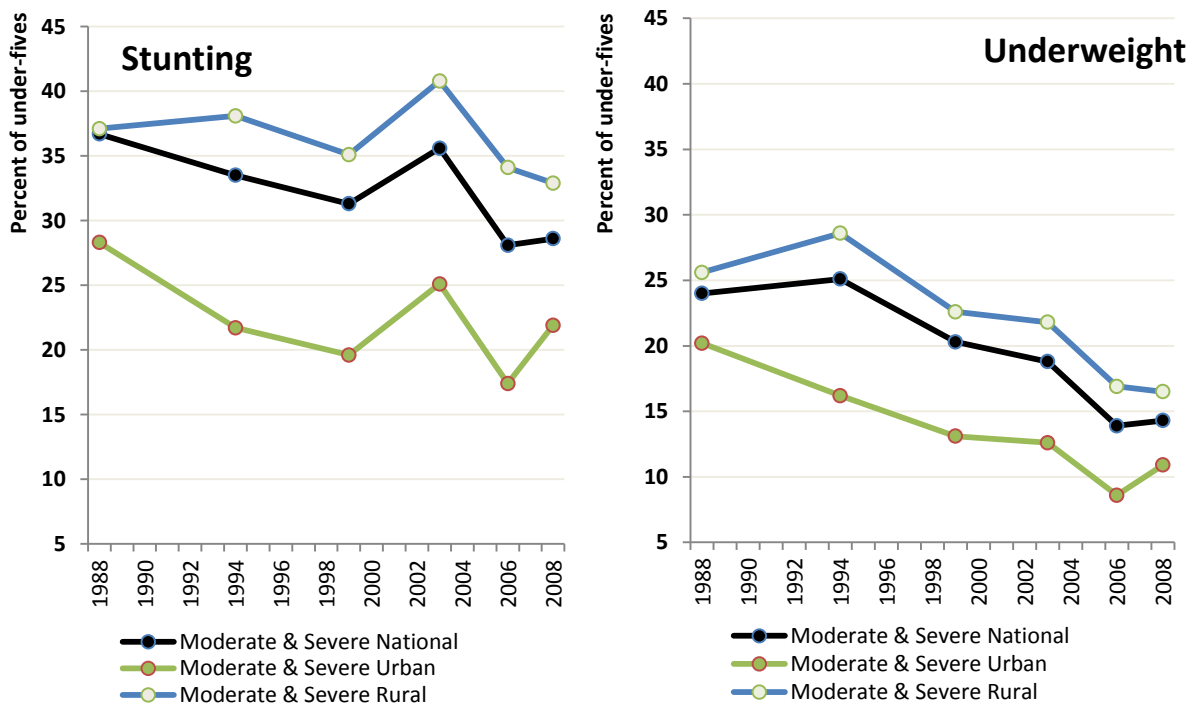
Annex A. Ghana: Star agricultural performance, on track to meeting MDG1 - but disappointing progress in stunting of pre-school age children

Observed changes in nutrition

Underweight and Stunting

The prevalence of underweight children under-five fell from 25% in 1994 to 14% in 2008, while stunting fell from 33.5% in 1994 to 29% in 2008, see Figure A.1. In both cases, Ghana has moved from *high* to *medium* severity, by the WHO classification. Undernutrition is worse among rural than urban children.

Figure A.1 Stunting and underweight in pre-school age children in Ghana, 1988-2008



Source: With data from WHO Global Database on Child Growth and Malnutrition. **Note:** Sub-national figures from 1988 and all figures from 1994 are for under-3s only

Micronutrient deficiencies

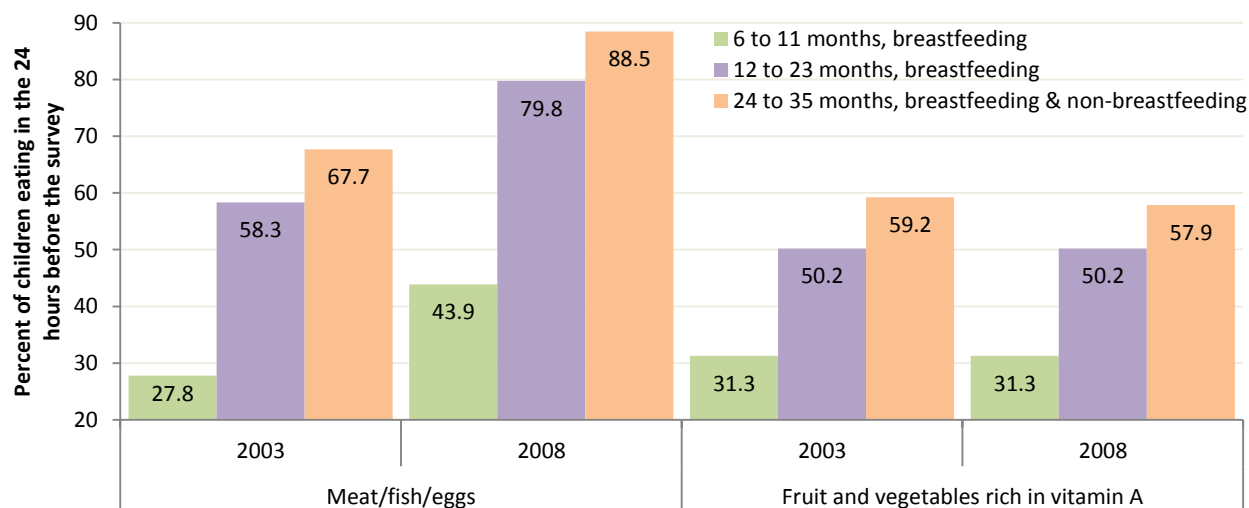
Micronutrition problems also prevail, though survey data available on micronutrition are sparse. In 2003, 70% of under-fives, and about 65% of pregnant women were at least moderately anaemic¹⁵. While levels of dietary iron technically available in Ghana nationally as reported by FAO appear good compared to other countries, and have been improving, the problem of iron-deficiency anaemia remains severe in vulnerable populations. Analysts attribute high levels of anaemia in Ghana to poor bio-availability of iron in diets owing to low consumption of iron-absorption enhancing foods such as meat and vitamin-C rich foods, as well as malaria¹⁶ and parasitic diseases such as hookworm (Agle, 2009).

¹⁵ This is from a 2003 survey. Moderate anaemia means having haemoglobin levels in blood below 110g/L. WHO classifies anaemia prevalence of 40% and over an issue of severe public health significance (WHO, 2008).

¹⁶ Malaria is hyper-endemic in Ghana, a leading cause of morbidity and mortality, especially among pregnant women and preschoolers [Estimates suggest malaria accounts for 22% of under-five mortality and 9% of maternal deaths (GSS & GHS 2009)]

Vitamin-A deficiency is also a public health issue in Ghana, where diets provide inadequate levels of vitamin A-rich foods. While statistics on vitamin A deficiency for preschoolers in Ghana are inadequate, evidence suggests young children do not eat enough vitamin A rich foods: See Figure A.2

Figure A.2 Complementary feeding of under-threes in Ghana, comparing 2003 and 2008: focus on vitamin A and selected animal products



Source: Constructed with data in Table 15 of Agble et al., 2009 & Table 11.5 in GSS & GHS 2009. **Note:** Meat, fish, and eggs, includes poultry. Vitamin-A rich foods includes fruits and vegetables such as pumpkin, red or yellow yams or squash, carrots, red sweet potatoes, dark green leafy vegetables, mangoes, papayas, and other locally grown fruits and vegetables rich in vitamin A.

Iodine deficiency is a problem in Ghana, where people's iodine levels are reportedly influenced by poor iodine availability in the soil, by some compounds in certain cassava varieties that aggravate iodine deficiency, and the fact that seafood rich in iodine, while in relatively good supply in coastal Ghana, is less available further inland (The Ghanaian Journal, 2009).

Data, as for other micronutrients, are poor: only available for some sub-national populations of school age children and women for the mid-1990s. While there is evidence that micro-nutrient deficiencies have eased,¹⁷ in some districts from a severe to a mild public health issue¹⁸, surveys are needed to determine extent and guide intervention.

Growth of economy

Economic growth has been good in Ghana since 1990. Real (2000) GDP per capita grew from around US\$221 in 1990 to US\$402 in 2011, an 82% rise: enough for Ghana to move from low income (LIC) to lower middle income country (LMIC) status.

Agriculture

Agricultural growth

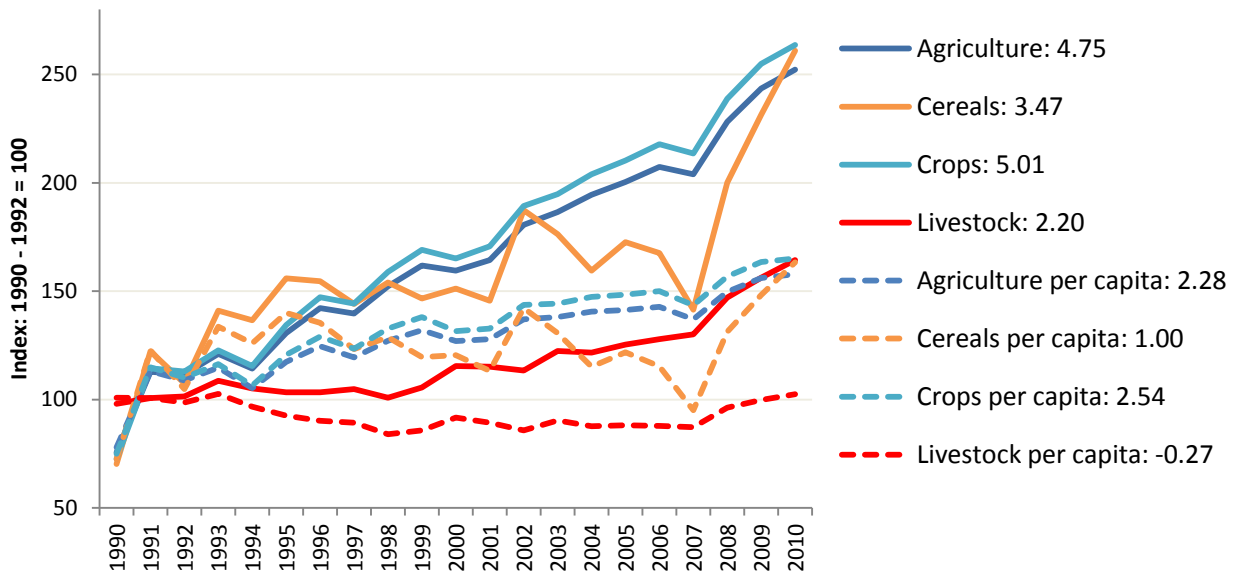
Net production indices for Ghanaian cereals, crops and livestock show consistent growth from 1990 to 2010, overall at almost 5% a year. On a per-capita basis too they have been growing, at an equivalent of 2.3% a year; except for livestock which fell slightly from 1990 to about

¹⁷ For instance, a recent study of two districts which had extremely severe rates of goitre in the 1994 survey shows there has been considerable improvement. One district in the Upper West Region saw total goitre rates (TGR) fall from 56% to 11%, and in another district in the Upper East Region rates fell from 57% to 18% between 1994 and 2007 (The Ghanaian Journal, 2009)

¹⁸ WHO classifies TGR as public health problems as follows: <5 = no public health problem; 5-19.9 = mild; 20 - 29.9 = moderate; >30% = severe

2007 before it started to pick up again. Cereals growth also stuttered from around 2002 to 2007, before shooting up rapidly over the next 3 years. See Figure A.3

Figure A.3 Agricultural net production indices and growth rates for Ghana, 1990-2010



Source: with data from FAOSTAT. Note: Numbers in the legend are the average annual growth rates of the series depicted from 1990 – 2010.

Food availability – and its price

Overall calorie supply grew from around 2000 kilocalories per person a day to close to 3000 kilocalories per person a day from 1990 to 2009 (FAOSTAT data). Undernourishment has been reduced dramatically, estimated by FAO at under 5% of the population by 2009, compared to 25 to 40%¹⁹ in the early 1990s.

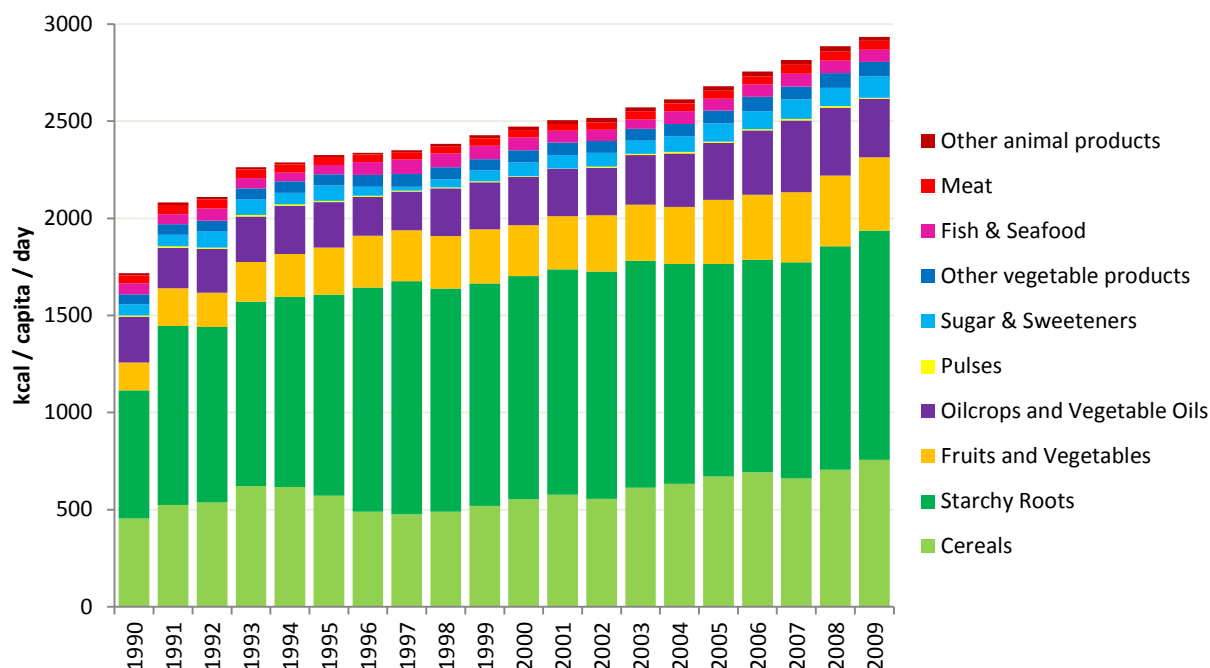
Both staple²⁰ and non-staple²¹ supply has grown, with the share of available food from fruits and vegetables, oils and animal products rising from one quarter to one third. On average therefore, diversity of diets ought to be improving as supply of all foodstuffs has grown faster than population, see Figure A.4.

¹⁹ Recent revisions of FAO data put 1990 figures at 40% undernourishment, reportedly largely owing to larger estimates for food waste. By 1991 their estimates dropped to 30% and by 1992 to 25%.

²⁰ While in the early 1990s about 1500 available average daily kilocalories came from cereals and starchy roots, by 2009, almost 2000 kcal/person/day was supplied from these sources.

²¹ Non-staples, which supplied only a little over 500 kcal/capita/day in the early 1990s were supplying double the amount by 2009.

Figure A.4 Stacked supply of different foodstuffs in kilocalories per person per day in Ghana, 1990-2009



Source: With data from FAOSTAT. Note: On average, people's energy requirement is around 1800kcal/day. The jump from 1990 to 1991 looks implausible, and could arise from some adjustment of how the data is calculated.

Though trends in real *consumer prices* for staple cereals have been relatively flat over the period in question (they fell over a longer period – see for instance Wiggins & Leturque, 2011), even increasing slightly in recent years. Prices for staple root crops like cassava have fallen slightly. In addition, the food portion of the Consumer Price Index has fallen in real terms.

At the same time, there has been good news for farmers reportedly achieving higher prices for many crops from cash crops like cocoa, to staples like maize and cassava, as well as complementary vegetables like tomatoes and eggplants which women farmers often grow and sell (FAOSTAT data).

Poverty

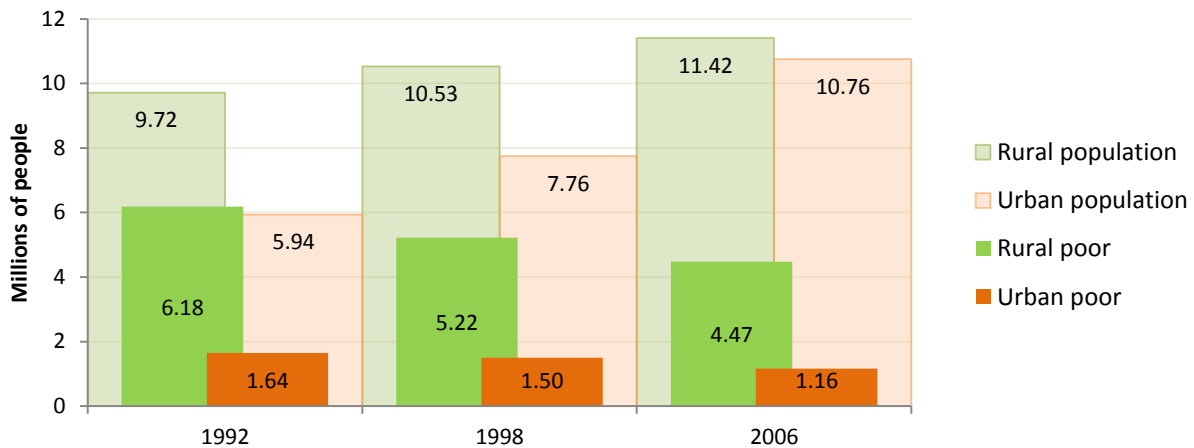
Overall poverty

Poverty rates at the national poverty line fell from 52% of the population in 1992 to 29% of the population in 2006 (World Bank WDI).

Rural poverty

Rural poverty prevalence fell from 64% in 1992 to 39% in 2006 (World Bank WDI). Absolute numbers of poor fell in rural areas by 1.7million, while absolute numbers of urban poor fell by almost half a million, despite a boom in urban population of almost 80%, see Figure A.5.

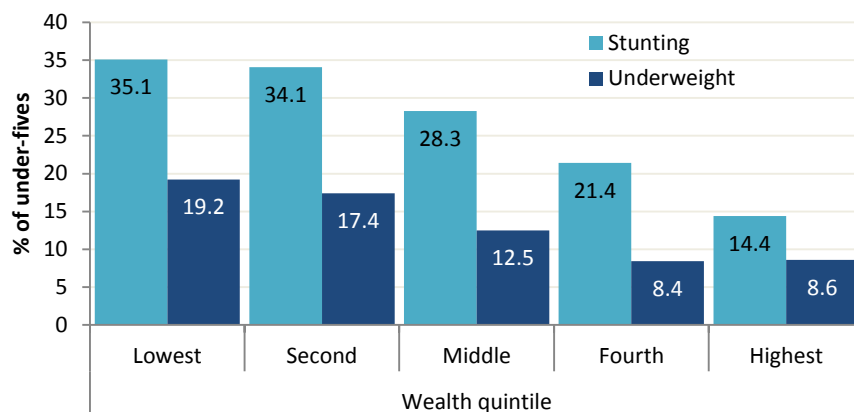
Figure A.5 Absolute numbers of poor in Ghana compared to population, rural and urban: 1992-2006



Source: With data from World Bank WDI for poverty and FAOSTAT for population figures

Figure A.6 Stunting and underweight of preschoolers in Ghana in 2008 by wealth quintile

Wealth is strongly linked to malnutrition of children, with the richest quintile seeing far lower levels of both stunting and underweight in their preschoolers than the poorest quintile: See Figure A.6



Source: With data from Table 11.1 in GSS & GHS 2009.

Health

Under-fives mortality rate

The mortality rate of under-fives fell from 121 deaths per 1,000 live births in 1990 to 78 deaths per 1,000 live births in 2011. While this level is below the low-income country average, it is about 30 more than the world average.

Water & sanitation

Just over half the population had access to an improved water source in 1990, but by 2010 the proportion had risen to 86%²². The biggest improvements were seen in rural areas, where in 1990 only 36% of the population had access to an improved water source. This had risen to 80% by 2010 (World Bank WDI).

²² This is close to the levels of access in lower middle income countries, and much higher than levels in low income countries.

In contrast, progress in increasing access to improved sanitation has been discouraging. World Bank estimates 7% of the population had access to improved sanitation in 1990 and only 14% had access to improved sanitation by 2010—under half the levels of access seen in low income countries on average.

Female empowerment

Female schooling

Literacy rates for young (15 to 24 years) females went from 65% in 2000 to 80% in 2009 (World Bank WDI data).

The female net enrolment in primary school for 2007-2010 was 77%. Secondary school female net enrolment over the same period was 44% (UNICEF, 2012).

Schooling matters for the nutrition of future generations. In Ghana about 30% of under-fives of mothers with no or only primary education are stunted, compared with about 18% of those whose mothers have a complete secondary education or more. Underweight rates varied similarly with education of mothers – from 17% of children of uneducated mothers underweight, to only 7% of children with mothers with at least secondary education being underweight (Data from GSS & GHS 2009).

Teenage pregnancy rate

Adolescent fertility fell from 90 births per 1000 girls aged 15 to 19 in 1997, to 66 births per 1000 girls aged 15 to 19 in 2010. Ghana's trend on this indicator has followed a similar trajectory as that of lower middle income countries; well below the average level for low income countries.

Specific nutrition interventions

National nutrition interventions such as programmes for salt iodisation or vitamin A supplementation have helped improve micronutrient availability, but in general coverage is still not high (Agle, 2009). Furthermore, degree of implementation of various national nutrition programmes—for instance deworming of school age children or programmes to improve infant and young child feeding—are not well documented.

Agricultural interventions for nutrition

Agricultural interventions for nutrition can fall into three broad categories: Firstly, nutrition-sensitive gender empowerment; secondly, home gardens, small livestock, and aquaculture; and thirdly, bio-fortification of staple crops. Often the boundaries between the first two categories overlap on a programme level. Furthermore, agricultural interventions are frequently combined with non-agricultural initiatives, or included as part of larger programmes. Some examples from Ghana of these types of programmes for which evidence on nutrition-related outcomes can be found are set out below.

World Vision's CIDA-funded programmes *Micronutrient and Health (MICAH)* and *Expanding Nutrition and Health Achievements through Necessary Commodities and Education (ENHANCE)*, both of which have been active in Ghana, involve a package of interventions of which agriculture is only a part.

MICAH began in 1996, and was predominantly a health and nutrition programme, involving supplementation, fortification, promoting best practices in breastfeeding and infant feeding, immunization campaigns, malaria control, treatment of worms and parasites, and improving water and sanitation.

On the agriculture side it also involved promoting small animal rearing, vegetable gardens and fruit trees, as well as providing education, information, and local capacity building. Though evaluation of various components is not available, in Ghana, MICAH is credited with helping to

spread acceptance of exclusive breastfeeding for six months, improving immunization coverage, and is also reported to have contributed to significant reduction in anaemia among children, women of reproductive age, and pregnant women (World Vision, 2009)

It was followed by ENHANCE, also health-focussed²³, but involving some training on home gardens. This programme was shown to have resulted in Ghanaian children aged 12 to 23 months in target communities seeing a 10% increase in animal-source food consumption, and a 33% increase in vitamin A intake (World Vision, Sep 2011).

Bio-fortification

Varieties of orange-fleshed sweet potato (OFSP), a good source of beta-carotene, were introduced to Ghana in 2005. The extent to which they are grown and consumed nationally is unknown, though white sweet potatoes have a relatively long history of cultivation in Ghana. OFSP are a good candidate for promotion through home garden schemes.

Initial studies found positive responses in terms of people's consumption, and are currently being followed with programmes such as a USAID / HortCRSP project looking at how to incorporate sweet potatoes into more diverse food preparations – to improve economic welfare for farmers, processors, and others in the supply chain, as well as so boost OFSP consumption (HortCRSP 2010, 2012). Evaluations are not yet available.

Maize is another contender for bio-fortification in Ghana. Ghana is one of the initial target countries for dissemination of HarvestPlus maize²⁴ biofortified with Vitamin A (Pixley & McClafferty, 2006). Studies have shown that while people's preferences for maize are highly varied within regions, people are willing to pay for bio-fortified maize in Ghana, and willing to change preferences given clear information (De Groote et al., 2010). The need for public campaigns through channels such as rural radio have been discussed (ibid).

In 2005, potential new maize sources for high iron and zinc were identified by CIMMYT (Pixley & McClafferty, 2006) though varieties are not available yet in Ghana.

High quality protein maize is another type of bio-fortified food that has been developed and transferred to Ghana, where the varieties are drought tolerant as well as resistant to Striga, a parasitic weed (Atser, 2010). It is possible that this combination of physical hardiness and nutritional character could aid adoption.

While opportunities for bio-fortification in Ghana appear strong, not enough is known about the extent to which biofortified crops are being taken up by farmers; the suspicion is that as yet none of these varieties are widespread.

Interpretation

It seems that good agricultural and economic growth has improved food access and diversity, while reduced poverty means wasting has been reduced considerably since destitution is so much less common. But the high and only slowly declining stunting may reflect a combination of (a) Low birth weights from previously undernourished mothers, (b) inadequate care, too little breastfeeding, low quality weaning foods, dirty water, (c) infant diseases, (d) micro-nutrient effects whereby deficiencies cause disease and otherwise prevent normal growth. Agble et al (2009) cite feeding practices and low access to health services as among the main causes of chronic malnutrition in preschoolers.

Ghana emerges as a clear case in which agriculture can play its role in reducing malnutrition — up to a point. From here on, it looks as though priorities lie with health, water, sanitation, education, and so forth.

What could agriculture do for better nutrition in this case? At the margin:

²³ ENHANCE focused on full & timely immunisation, treated bednets, vitamin A supplements, hygiene practices, ORS to treat diarrhoea, antibiotics to treat pneumonia, health worker training and health education for caregivers.

²⁴ A CIMMYT initiative. Other initial target countries are Brazil, Ethiopia, Guatemala, and Zambia.

- Bio-fortification of staple foods — clear potential exists
- Home gardens, as a way to combat micro-nutrient deficiency, in particular to encourage consumption of vitamin-A and vitamin C-rich foods.
- On top of home gardens, growth in a more diverse range of agricultural products ought to improve availability of complementary foods high in nutrients – as for instance a thriving green bean export sector in Kenya has contributed to higher availability of green beans domestically²⁵. Better availability ought to help bring down prices and help people to choose healthier diets²⁶

To realize the full potential of strategies like these, they need to be accompanied with good education about nutrition and child feeding and care practices.

²⁵ Bean production took off in Kenya driven mainly as an export crop, but production increases have helped to boost domestic supply; from about 3kg per capita a year in 1990 to close to 10kg per capita a year in 2009. It is likely that this is partly supply-driven, though growing demand particularly from increasingly affluent urban markets has undoubtedly played a key role.

²⁶ While more educated people report knowing more about benefits of diverse diets rich in fruits and vegetables, this doesn't necessarily translate to higher consumption in these groups (See Nti et al., 2011), indicating other factors including potentially cost may be contributing

Annex B. Bangladesh: Good progress on undernutrition over the last 20 years but more needed to maintain momentum

Observed changes in nutrition

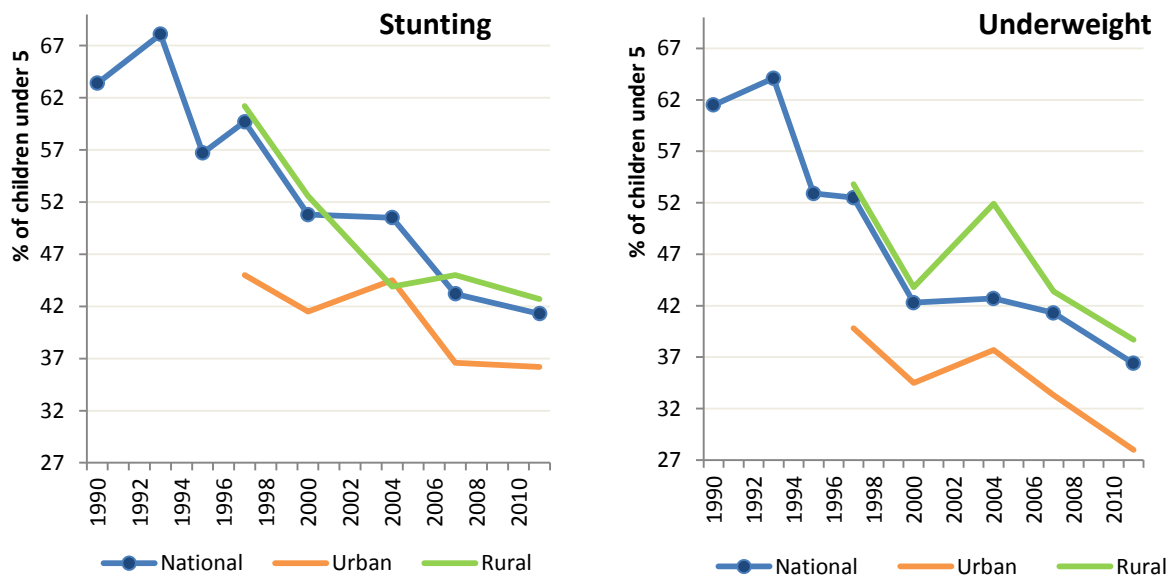
Underweight and Stunting

National surveys show a decline from staggering levels of stunting around 60% and 70% in the early 1990s to 41% in 2011, see Figure B.1. While these drops in the rate of stunting are impressive — 20 to 30 percentage point reductions over 16 or 17 years — they are reductions from severe levels.

Progress on underweight has been similar. Some 62% of children under five were underweight in 1990 in Bangladesh, falling to 36% in 2011. This is another impressive reduction but undernutrition remains a major public health and economic problem in Bangladesh (Muiruri et al., 2012).

As with stunting prevalence, underweight is worse among rural than urban children.

Figure B.1 Stunting and underweight of children under five, moderate and severe 1990-2011, Bangladesh



Source: With data from WHO Global Database on Child Growth and Malnutrition and BDHS 2011 for 2011 data. **Note:** National figures before 1997 are converted estimates.

Micronutrient deficiencies

Micronutrient deficiencies, particularly iron deficiency anaemia and iodine deficiency are widespread in Bangladesh, and multiple deficiencies are common (Muiruri et al., 2012). While up to date nationally representative information is not common for micronutrient status, some trends over the last two decades have been observed.

The problem of *iron-deficiency anaemia* remains severe in the under-five population, where in 2004, almost 70% of rural under-fives were at least moderately anaemic²⁷. This is an increase from 47% recorded in this population in both 1997 and 2001. Rural pregnant

²⁷ Having haemoglobin levels below 110g/L

women's rate of anaemia improved: from 49% in 1997 to 39% in 2004 (WHO Global Database on Anaemia)²⁸.

Probably the most progress has been made combatting **vitamin A deficiency**. Night blindness is often caused by diets with insufficient vitamin A. In Bangladesh this deficiency is not as prevalent as others and is now likely below WHO's threshold of 1% (Muiruri et al., 2012).

Some progress has also been made in combatting **iodine deficiency** in Bangladesh — with prevalence of low iodine levels in urine falling nationally from close to 70% in 1993 to about 43% in 1999 (Who Global Database on Iodine deficiency). Though later comparable statistics do not appear in the WHO database, a 2004 survey revealed 39% of women and girls of reproductive age (15–44) were iodine deficient, while in pregnant women the prevalence was 56% (Muiruri et al., 2012). Prevalence in rural areas was higher than in urban areas.

Rickets, caused by calcium and or vitamin D deficiency²⁹ has emerged as a public health problem over the last two decades, with up to 8% of children clinically affected in some areas (Cravari et al., 2008). Muiruri et al. (2012) contend over half a million children in Bangladesh are currently affected by rickets.

Growth of economy

The World Bank classifies Bangladesh as a low income country (LIC). GDP per capita measured in constant 2000 USD grew from around US\$280 in 1990 to US\$588 in 2011, a rise of 110%.

Agriculture

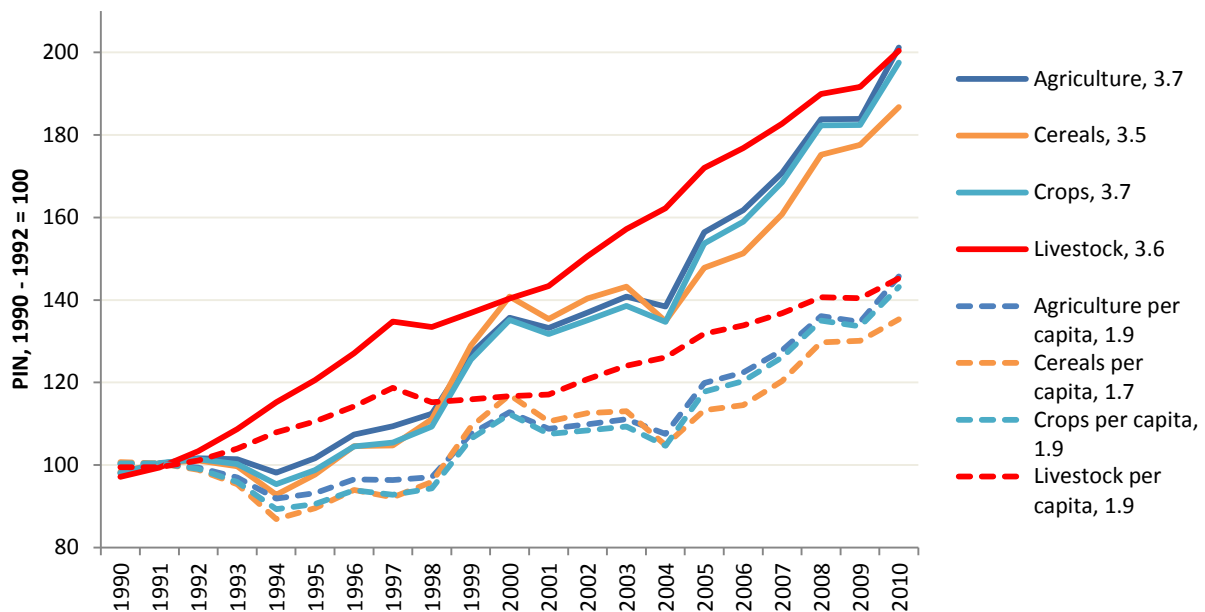
Agricultural growth

Net production indices for Bangladeshi cereals, crops and livestock show overall growth from 1990 to 2010 at an annual equivalent of 3.7%. On a per-capita basis too they have been growing, at an average of 1.9% a year, though mostly since the late 1990s. Growth in the livestock indices has been the most consistent, while growth for cereals (agriculture and crops are largely driven by the cereals index) was slow over the first half of the 2000s, see Figure B.2.

²⁸ WHO considers anaemia prevalence of 40% and over an issue of severe public health significance (WHO, 2008)

²⁹ Cravari et al. (2008) say insufficiency of dietary calcium is thought to be the underlying cause, while treatment with calcium (350–1,000 mg elemental calcium daily) is curative.

Figure B.2 Agricultural net production indices and growth rates for Bangladesh, 1990-2010



Source: With data from FAOSTAT

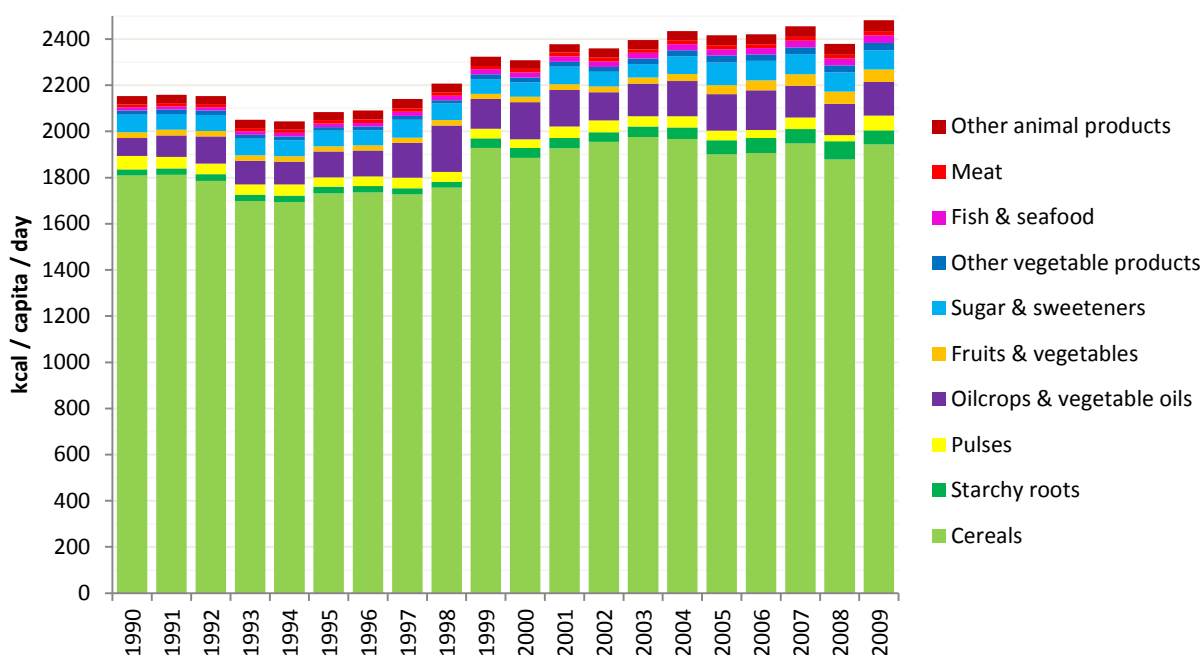
Food availability – and its price

Increased supply of cereals in particular has contributed to reduced calorie undernourishment by FAO's estimates, though the rate of reduction has plateaued in recent years. While the estimates show a sharp improvement from the mid-1990s to the early 2000s (from 38% in 1994 to 18% in 2000), for most of the 2000s progress appears to have stagnated, leaving around 17% of the population estimated undernourished in 2011³⁰.

This growth in cereal production has unfortunately not contributed much to dietary diversity. Bangladesh has the dubious distinction of being the country with the second highest staple (cereals plus starchy roots) contribution to total calories in the world, at 81% in 2009, after only Eritrea (82%). Diets in Bangladesh depend heavily on rice, with insufficient diversity to guarantee good micro-nutrition. Other Asian countries with similar poverty prevalence which had in 1990 similarly restricted sources of food supply (Cambodia and Lao PDR for example) have made more progress than Bangladesh on diversifying diets.

³⁰ This figure is still closer to that of LMIC economies rather than LICs as a whole (of which Bangladesh is one) that have an average undernourishment rate in 2011 of 30%

Figure B.3 Stacked supply of different foodstuffs in kilocalories per person per day, 1990-2009, Bangladesh



Source: With data from FAOSTAT. Note: On average, people's energy requirement is around 2000kcal/day.

The price of rice has remained relatively the same in real terms since the late 1990s (FAO GIEWS coarse rice price data); except for two periods of crisis in 2007/08 and 2010/11.

Bangladesh is vulnerable to food crises, though its vulnerability appears to have decreased from 1990 to 2011. Food aid deliveries which might indicate vulnerability have tended to decline over the last few decades³¹. This in spite of the fact that relative food prices in general³² rose about 10% from their 2000 levels by mid-2011.

On average, household expenditure on cereals was 38% of food expenses in 2000, and 36% in 2010. Expenditure on a more diverse variety of food was stronger in urban areas, where 28% of food expenses went on cereals in 2010, compared to about 40% in rural areas in 2010.

Poverty

Overall poverty

Poverty prevalence at the national poverty line has decreased from 57% in 1992 to 32% in 2010 (World Bank WDI). Of the 32% poor, about 50 million people, 18% (about 27 million) are below the lower poverty line, which means they cannot afford a basic diet (Muiruri et al., 2012).

Bangladesh's latest Demographic and Health Survey identifies very clear connections between income and stunting and underweight of preschoolers, see Figure B.4

³¹ Food aid (grain equivalent) which was around 10kg/capita in 1990 was only around 2kg per capita for the mid-2000s onward. To put it another way, while per capita annual food aid exceeded 4kg in 9 out of 10 years from 1990-1999, from 2000 - 2011 it exceeded 4kg/capita in only 1 year, and 2kg per capita in only 3 years.

³² As measured by the food CPI deflated by the CPI in general

Figure B.4 Stunting and underweight rates in Bangladeshi preschoolers by wealth quintile, 2011



Source: with data from and BDHS 2011, Table 23

Rural poverty

Rural poverty declined from 59% of the rural population in 1992 to 35% in 2010 (World Bank WDI data). Absolute numbers of rural poor fell by close to 14 million from 1992 to 2010³³.

Health

Under-five mortality rate

The mortality rate of under-fives fell impressively from 139 deaths per 1,000 live births in 1990 to 46 deaths per 1,000 live births in 2011. While these rates have always been better than the LIC average, by 1999 they were better than LMIC average rates, and by 2006 fell below world average rates. Improvements in infant vaccination will have helped: for infants (12–23 months) they rose from about 60% in 1993/94 to 86% in 2011, well above the norm seen in LICs.

Water & Sanitation

Rates of access to improved water sources went from 77% in 1990 to 81% in 2010 nationally — well above the LIC average (World Bank WDI data).

Progress in access to improved sanitation was also encouraging, going from 39% in 1990 to 56% in 2010 (World Bank WDI data).

Female empowerment

Child stunting is significantly affected by several female empowerment indicators in Bangladesh, including attitudes towards domestic violence, mothers' education, height, and age at first marriage (Bhagowalia et al., 2012). Food access at household level may be unfair to women and young children owing to unequal distribution and cultural norms that require for example men eating first or boys receiving larger portions of high-nutrient foods than girls (Muiruri et al., 2012; CARE, 2012).

³³ Absolute numbers also fell in urban areas despite relatively fast population growth in urban areas, by about 800,000 people over the same period.

Female schooling

Women's status in Bangladesh is playing catch-up³⁴, though laudable improvements have been seen in indicators such as literacy of young women that rose from 38% in 1991 to 79% in 2000.

Net enrolment ratio for girls in primary school was 93% over 2007 to 2010. The same ratio for secondary school female participation over the same period was 43% (UNICEF, 2012).

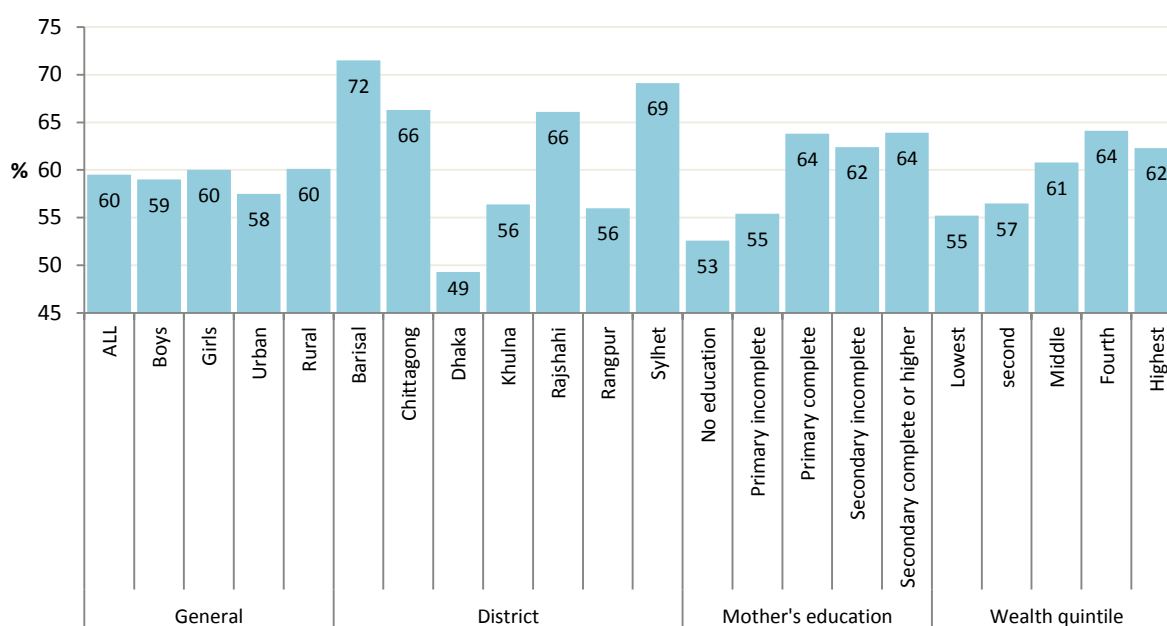
Teenage pregnancy rate

The adolescent fertility rate dropped from about 130 births per 1000 women aged 15-19 to about 73 births per 1000 women aged 15-19 from 1997 to 2010. This is important for child nutritional status as early pregnancy exacerbates risks of perpetuating the intergenerational cycle of undernutrition (Muiruri et al., 2012). In Bangladesh, more than two thirds of girls are married before they turn 18, with early pregnancy contributing to the negative cycle of small mothers, stunted by chronic undernutrition, giving birth to low birth-weight (LBW) babies³⁵.

Specific nutrition interventions

Specific national nutrition interventions such as vitamin A supplementation and salt iodisation have seen success in improving features like vitamin A status or iodine deficiency. About 60% of under-fives in 2011 had received a vitamin A capsule in the 6 months prior to the survey (BDHS, 2011); though rates varied considerably across regions, as well as according to mothers' levels of education and wealth (see Figure B.5.). Vitamin A deficiency has been reduced significantly, but even here coverage is lacking.

Figure B.5 Children aged 6 to 59 months in receipt of a vitamin A capsule in the last 6 months, by characteristic



Source: With data from BDHS 2011

Bangladesh's first large-scale nutrition intervention, formed in the 1980s and active from 1995 to 2002, the **Bangladesh Integrated Nutrition Plan (BINP)** spent only 6% of its budget

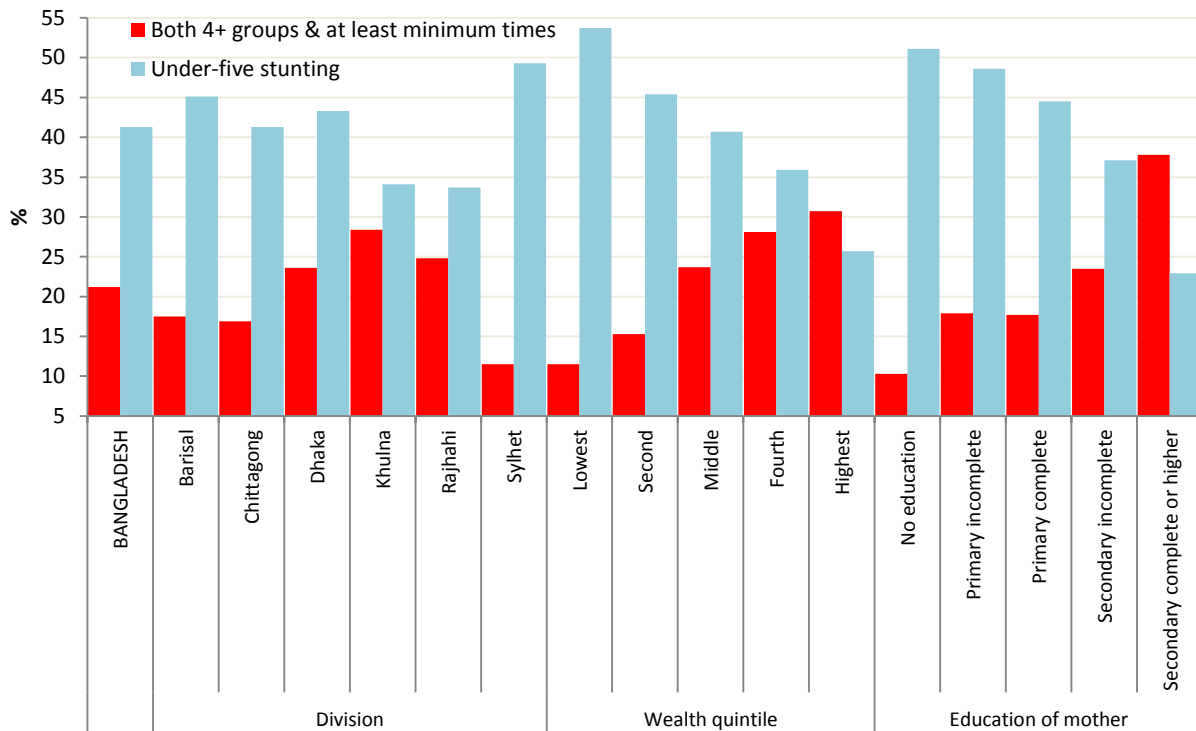
³⁴ Of the case study countries, Bangladesh is the only one to have a ratio of female to male life expectancy of less than 1 at any point in the last 20 years; although this improved to 1.02 by 2010, the low income country average was 1.04.

³⁵ LBW babies are more likely to fail to grow properly, which, combined with inadequate food intake and caring practices, leads to stunting and childhood and youth underweight. To break this cycle, it is important not only to improve nutritional status of women, adolescent girls and children, but also to delay marriage and first pregnancy, while improving education and livelihood opportunities for women (Muiruri et al., 2012)

during the 1990s. Evaluation of its aim (to reduce severe underweight by 40% and moderate underweight by 25%) was hampered by lack of necessary monitoring and evaluation guidelines³⁶ (Taylor, 2012).

Its successor, the *National Nutrition Programme (NNP)*, ran from 2002 to 2011. This programme reportedly provided some 20% of the population (and 30% in 2009), with information, advice and counselling by Community Nutrition Promoters (Taylor, 2012). Behaviour Change Counselling has a large role to play in improved nutrition, particularly where wealth and education are no guarantee of ensuring best practices. Consider for example Figure B.6 which shows a clear relationship between better child feeding practices and better child nutrition outcomes with increasing wealth and education of mothers. Even among the most wealthy and well-educated, less than two-fifths adhere to the recommended child diets.

Figure B.6 Percent of infants fed adequately diverse diets frequently compared to stunting rates in Bangladesh by area, wealth quintile, and mothers' education, 2011



Source: With data from BDHS 2011, Table 25. **Note:** Among children 6 – 23 months, 97% are breastfed. Red columns refer to children getting fed four or more food groups at at least the minimum recommended frequency.

Achievements of the NNP beyond Behavior Change Counselling were lacking, notably in therapeutic malnutrition treatment. In 2008 only 20% of Bangladesh's severely malnourished children could be managed in health facilities (Taylor, 2012). Plans were similarly unambitious in terms of coverage 37.

Some large-scale specific nutrition interventions have seen impressive results in Bangladesh. In collaboration with USAID and the GoB, CARE's Strengthening Household Ability to Respond to Development Opportunities (SHOUHARDO) project is an excellent example; described as the

³⁶ Severe underweight rates in Bangladesh fell from 26% in 1991 to 12% in 2002, while moderate underweight rates fell from 62% to 43%, but attribution of these falls to the BINP is not possible.

³⁷ For example, Bangladesh's National Nutrition Programme (see for instance World Bank, 2006) only aimed to cover 105 of Bangladesh's 464 *upazilas* (less than 25% coverage).

first large-scale project using a rights-based livelihoods approach to addressing malnutrition³⁸ (Smith et al., 2011). An evaluation found extraordinary impact on stunting among children 6–24 months old: around 4.5 percentage points per year rate of reduction from early 2006 to late 2009. Over the same period for the same age group in Bangladesh, stunting declined only 0.1 percentage points per year. Targeting the poor helped to accelerate these reductions (ibid). More detail on SHOUHARDO is provided in the next section as an example of nutrition sensitive gender empowerment.

Agricultural interventions for nutrition in Bangladesh

Nutrition sensitive gender empowerment

SHOUHARDO is an outstanding example of a direct intervention putting women's empowerment at its centre (Feed the Future, 2012). Agricultural interventions were only one part of a package of interventions carried out at community level in rural areas, targeting the most vulnerable, including (numbers are % of participating households) (Smith et al., 2011):

- Mother and Child Health and Nutrition (MCHN) - 33%
- Sanitation - 19%
- Women's empowerment – 25%
- Field crop production / fisheries - 36%
- Homestead gardening & livestock rearing - 46%
- Income generating activities - 37%
- Food/cash for work - 11%
- Savings groups - 32%

An evaluation of SHOUHARDO discovered the single-most effective intervention was women's empowerment (Smith et al., 2011). Another key finding was the presence of strong synergies between different types of intervention. Regarding agricultural interventions, extremely strong synergies were observed between agricultural production/fisheries interventions and MCHN interventions, implying a very large reduction in stunting could be achieved by combining these interventions compared to small reductions they might achieve alone (Smith et al., 2011).

Significant synergies were also demonstrated between sanitation and MCHN; women's empowerment and MCHN; women's empowerment and participation in savings groups; and field crop production / fisheries promotion and participation in sanitation.

Home gardens and small livestock

Helen Keller International (HKI) began a homestead food production (HFP) programme in the early 1990s which has since expanded dramatically. In 20 years, HFP reached nearly 4% of Bangladesh's population, covering just over half the country's subdistricts (Ianotti et al., 2009).

HFP promotes home gardens, small livestock production, and nutrition education with the aim of increasing consumption of micronutrient-rich foods and improving health and nutritional status of women and children. Establishing HFP systems crucially involved agricultural and non-agricultural aspects (Ianotti et al., 2009):

- Establishing village model farms;
- Forming mother's groups
- Providing gardening and livestock inputs
- Behaviour Change Communication
- Community mobilization

³⁸ Consistency with this approach requires relying on both direct nutrition interventions and those that address underlying structural causes including poor sanitation, poverty, and deeply-entrenched inequalities in power between women and men (Smith et al., 2011).

- Making links with health and other sectors

The programme, implemented by NGO partners and government has improved food security for nearly five million vulnerable Bangladeshis across the country via: increased production and consumption of micronutrient-rich foods; increased income from gardens and expenses on micronutrient-rich foods; women's empowerment; enhanced partner capacity; and community development (Ianotti et al., 2009).

HFP also had more diverse impacts on people's welfare owing to the extra income generated. One study showed that extra income from sale of HFP garden products was spent on food (36%), education (35%), clothes (26%), productive assets (18%), health care (15%), housing (5%), and social activities (3%) (Ianotti et al., 2009). Another found that income from sale of poultry products went for savings (40%), followed by productive assets (37%), education (33%), food (30%), and clothes (14%) (ibid).

Home gardens for nutritious food appear sustainable beyond interventions by implementers. One study comparing household production and consumption of vegetables compared levels of those active in HKI programmes, those who had completed programmes, and a control group. Households involved in the programmes grew about 10 varieties of vegetable in their gardens, compared to 6 in those who had completed the programme, and only 3 in the control group. Production in the active group for the 3 months of the study was 130kg, compared to 120kg in the completed group, and only 40kg in the control. Household consumption was better in both the active and completed groups, at 85 and 70kg respectively over the 3 months, compared to 38kg for the control group (Helen Keller Worldwide, 2003).

While evidence on increased consumption and food diversity is clear, more evidence is needed to demonstrate HFP programme impact on improving maternal and child micronutrient status (Ianotti et al., 2009). Some studies have nonetheless found clear benefits of HKI home gardens for intake and nutrition outcomes in Bangladesh, for instance a case where HKI sponsored home gardens in Northern Bangladesh led to increased intakes of vegetables by children and infants, improved stunting and underweight rates, and reduced their incidence of anaemia and night blindness (Berti et al., 2004).

Some studies of home gardens in Bangladesh show less clear nutrition outcomes. For example, another case in Berti et al., 2004³⁹ where although home gardens led to increased intake of vitamin A rich foods by some 10 to 20%, this did not lead to any change in incidence of night blindness.

This highlights the importance of combining home gardens with BCC and other nutrition-enhancing strategies such as women's empowerment, as well as in designing monitoring and evaluation to capture anthropometric or micronutrient status impacts.

Aquaculture

For Bangladesh's rural poor, fish provides an important source of protein. Small indigenous fish species (SIS) dominate, but supply is under pressure and a growing share of available fish is supplied by rural carp culture of both indigenous and exotic species. SIS have higher vitamin A than the cultured species, and are also a better source of calcium as most of their bones are eaten (Ahmed et al., 2012).

While studies show households with aquaculture ponds (there were some 1.3M of these in Bangladesh around 2000) do not consume more fish than those without ponds, there is potential for high vitamin A species of fish to be grown in ponds with good potential to improve levels of vitamin A available in average diets (Roos et al., 2000).

Mola for instance is a fish high in vitamin-A commonly eaten in Bangladesh. Researchers found that of the mola harvested in ponds, around 47% were eaten by pond-owning households,

³⁹ Worldview International Foundation's *Nutritional Blindness Prevention Programme*

which contributed around 21% of vitamin A required over the period examined (Roos et al., 2000).

An evaluation of two Danida aquaculture extension project/components⁴⁰ running from 1989 to 2006, one in Mymensingh and the other in Greater Noakhali, found participants in the programmes had increased fish consumption, improved diets, nutrition, and health. Rising incomes were also used to buy more nutritional food and to access health care services. Non-participating households however showed similar improvements in diet, nutrition, health, and access to health services, making attribution to the aquaculture programmes difficult (Danida, 2009).

What is clear is that aquaculture has increased availability of fish nationally. In 1990, Bangladesh aquacultured fish production was around 200,000 tonnes, around 20% of fish production nationally. By 2005, this had risen to nearly 900,000 tonnes; contributing around 40% of total fish produced in Bangladesh (Danida, 2009).

Bio-fortification

Bio-fortification is in early stages in Bangladesh, with little evidence of programmes for bio-fortification or impacts. A number of species appear to have potential, including orange-fleshed sweet potato (OFSP), golden rice currently being investigated for efficacy by HKI (HKI, 2012), and high-zinc rice, which is currently under development in the hope it may become available in Bangladesh within the next five years (IRIN 2011).

Interpretation

Progress on nutrition indicators has been encouraging in Bangladesh, but several come from extreme positions. Empowerment of women for instance may produce impressive results in Bangladesh owing to low starting levels of women's empowerment⁴¹. From 1990 to 2011, Bangladesh reduced stunting by 1 percentage point a year: an impressive rate, close to that achieved by China over a similar period. The trick for Bangladesh will be to maintain—or even accelerate this rate over the next decade.

Agriculture certainly has a role to play in reducing undernutrition in Bangladesh; as it already has. Agricultural growth has been good at improving staple access but diets depend too heavily on rice⁴². This is not good news for people's micro-nutrition. It may not be good for macro nutrition either, as high dependency on one staple does not spread risk⁴³. Furthermore, improvements in fundamentals such as public health and education need to continue – as also do campaigns to change unhelpful behaviours in feeding and care of infants, and the cycle of stunted mothers bearing stunted babies⁴⁴.

Political accountability for nutrition is a grey area in Bangladesh, owing to involvement of many government agencies, as well as strong involvement of large NGOs such as BRAC or HKI which step in to implement programmes the government might not otherwise implement. Particular problems arise when states are weak; NGOs take over public functions, thus leaving the state perhaps even weaker (Mason, 2002). NGOs might be less accountable to local people, though not necessarily. Furthermore, local accountability may not always be appropriate. For instance,

⁴⁰ Since 2000 the interventions which were originally projects became official components of Bangladesh's Agriculture Sector Programme Support

⁴¹ The Global Gender Gap Index (a composite measure of women's economic participation and opportunity; educational attainment; health and survival; and political empowerment) for Bangladesh ranked 86th in 2012, compared to Tanzania's rank of 46th and Ghana's of 71st. It was however still above India's rank of 105th, and Zambia, which had the worst rank at 114th (135 countries were measured, ranked from 1: Iceland, to 135: Yemen) (Hausmann et al., 2012)

⁴² Agricultural policy in Bangladesh centres heavily on rice; perhaps not surprising as the famine of 1974 continues to influence politicians and citizens.

⁴³ Rice production in Bangladesh remains vulnerable to natural disasters which are relatively frequent.

⁴⁴ More than one in five (22%) of newborns have low birth weight and as many as 18% of mothers are acutely undernourished (Muiruri et al., 2012).

the much-admired Grameen Bank makes a point of not adapting its programmes to local circumstances to avoid bias and corruption.

Nonetheless the political profile of Bangladesh's fight against hunger has been cited as a key factor underpinning its success to date (Sanchez-Montero et al., 2010.) Gender focussed non-farm employment opportunities and development of microcredit especially for women also contributed to Bangladesh's success to date (ibid).

What could agriculture do for better nutrition in this case? At the margin:

- Given the strong pressures on land in Bangladesh, the dangers of mono-cultivation, and the widespread micro-nutrient deficiencies, there is a strong case for Bangladesh to reduce rice production in favour of a more diversified production of crops and animals that are both more diverse ecologically as well as nutritionally. With extra earnings from this, the country can import rice, for example from Burma or Thailand⁴⁵.
- Home gardens, aquaculture, and small livestock are a part of this, particularly as they are a practice well established in Bangladesh with proven impacts on people's nutrition.
- Bio-fortification of staples – this appears to have potential, though largely unexplored.
- Diversify production to encourage better consumption of micronutrient rich food and diverse weaning diets. Home gardens are a good way to do this⁴⁶, with agricultural interventions particularly effective when combined with Mother & Child Health and Nutrition interventions.

⁴⁵ Though high and volatile international prices for imported rice may complicate this strategy. In addition, while rice is the main calorie source in Bangladesh, staple supply is not high in absolute terms. Compared to Ghana for example, in 2009, when FAO estimates for Ghana's undernourishment reached <5%, it had about 260kg/capita more staple (staples for Ghana include cereals, starchy roots & plantain) supply than Bangladesh (some 13% more), while total calorie availability was some 15% higher.

⁴⁶ HKI reported studies have shown that children in households with developed gardens consume 1.6 times more vegetables and have a lower risk of night blindness than children in homes without homestead gardens.

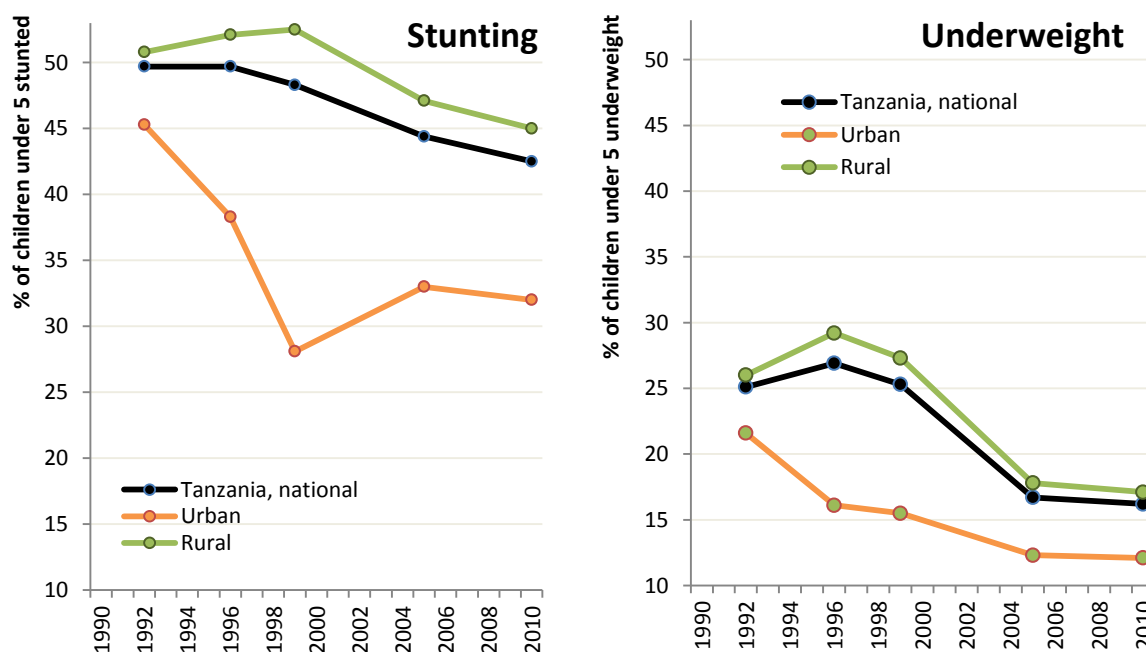
Annex C. Tanzania: Disappointing agricultural growth and not enough focus on health or education of girls means poor progress on child malnutrition

Observed changes in nutrition

Underweight and Stunting

- Tanzania has achieved good progress on underweight. It is possible the country could even achieve this indicator of MDG1, though not if the slow rate of improvement over the second half of the 2000s persists. A quarter of children under five were underweight in 1992. By 2010, underweight prevalence had fallen to 16.2%, a drop from high to medium severity by WHO's classification.
- It is worse among rural than urban children – though the gap has lessened since the mid-1990s.
- Progress on stunting rates has been discouraging. Nationally, 50% of under-fives were stunted in 1992. By 2010, the rate had fallen to only 43%. This is almost 20 years of 'very high' severity with disappointingly slow improvement. Though rates fell rapidly in urban areas from the early to late 1990s, this was not the case for rural preschoolers, and the decrease in urban areas reversed over the first half of the 2000s.
- As with underweight prevalence, stunting of children in rural areas is far worse than urban areas. In 2010 the margin was 13 percentage points: See Figure C.1.

Figure C.1 Stunting and underweight of children under five in Tanzania, moderate and severe, 1992-2010



Source: With data from WHO Global Database on Child Growth and Malnutrition.

Micronutrient deficiencies

Data on micronutrient status are not encouraging. The problem of iron-deficiency anaemia is severe in vulnerable populations. In 2004/05, 71.8% of pre-school age children had at least moderate anaemia (Haemoglobin below 110g/L) (WHO Global Database on Anaemia). At the

same time, 58.2% of lactating women were at least moderately anaemic⁴⁷. By 2010, anaemia prevalence in under-fives had declined to 58.6% (NBS & ORC Macro 2011) — still a major public health problem, if 10 percentage points lower than the previous survey. Kinabo et al., (2008) wrote:

Iron deficiency due to the low level of consumption of foods of animal origin is the main cause, but incidence of malaria and other parasitic diseases are contributing causes.

...

'One of the factors contributing to the high prevalence of anaemia in the Southern zone is low consumption of fruit and animal foods, and low awareness about the relationship between food consumption and nutritional status.'

Vitamin A deficiency is thought to be widespread, mainly owing to low intake of animal products⁴⁸ high in absorbable retinol and not enough fruit and veg rich in vitamin A in diets. There are not however any surveys of national level vitamin A deficiency in children.

Growth of economy

Economic growth, while sluggish for most of the 1990s, with constant 2000 GDP per capita actually falling from 1990 to 1994, began to grow more rapidly after 2000, and by 2011 was about 55% higher than in 1990 (World Bank WDI).

Agriculture

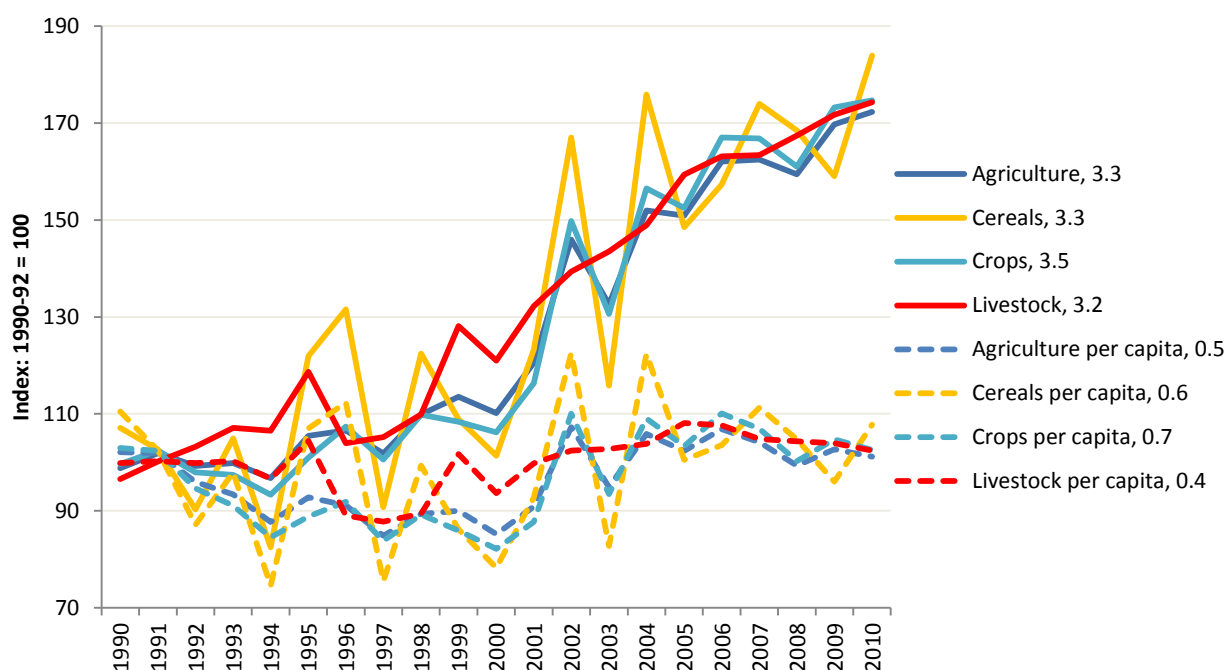
Agricultural growth

Tanzania's economy is heavily dependent on agriculture, which accounted for about 45% of GDP and 2/3 of the country's export earnings in 2005. Furthermore, the agriculture sector is the main source of employment and livelihood for 76% of the population (Kinabo et al., 2008). Agricultural growth, however, has fallen short of its potential over the last 20 years, with per capita rates of growth discouragingly slow. While the net production index for agriculture has grown at a rate of 3.3% per year from 1990 to 2010, per capita it grew only half a percent per year over the same period, see Figure C.2.

⁴⁷ The WHO considers anaemia prevalence of 40% and over an issue of severe public health significance (WHO, 2008).

⁴⁸ Poverty limits consumption of animal products. Plant sources of vitamin A are more affordable, but bio-availability of animal sources is higher (Kinabo et al., 2008).

Figure C.2 Agricultural net production indices and growth rates for Tanzania, 1990-2010



Source: with data from FAOSTAT. Note: Numbers in the legend are the average annual growth rates of the series depicted from 1990 – 2010.

Tanzania's agriculture is furthermore vulnerable to environmental shocks as the majority of production is rainfed and variable. Lean periods can last three or four months (FAO GIEWS), and in regions with one rainy season shortages are common. Inadequate storage also contributes (Kinabo et al., 2008).

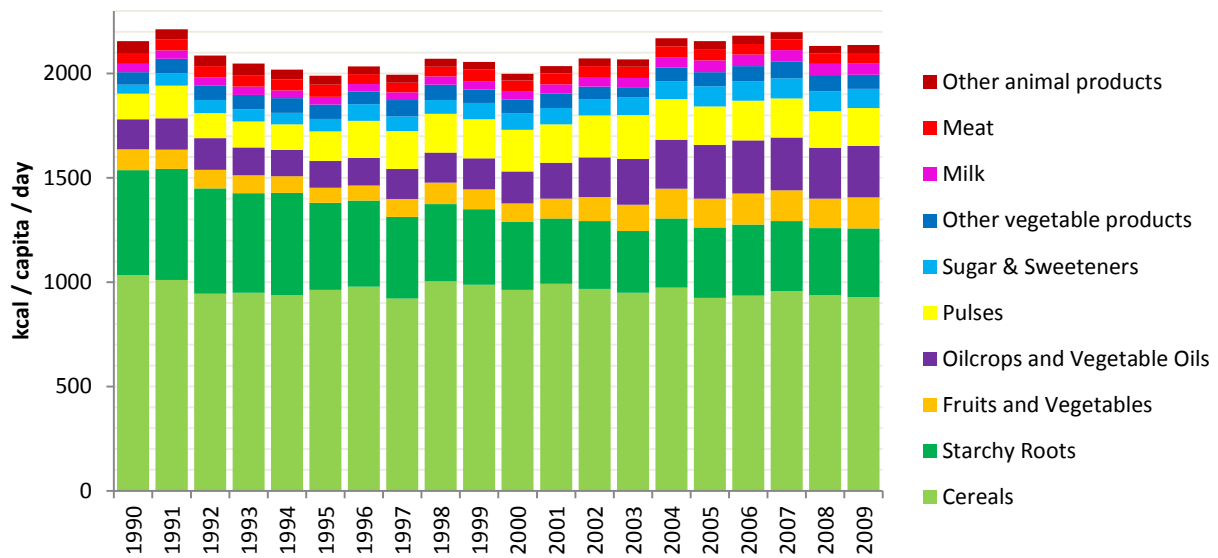
Food availability – and its price

Overall calorie supply saw next to no change in per capita values over the 20 years from 1990 to 2009: see Figure C.3. The share coming from staples has fallen in favour of complementary foods.

Calories supplied from cereals per capita decreased at a rate of 0.3% a year from 1990 to 2009, while calories from starchy roots available per capita decreased at a rate of 2.9% per year over the same period. Other vegetable products supply grew at a rate of 2.9% per year and animal products⁴⁹ at 0.1%.

⁴⁹ A recent survey in 2008 found very infrequent meat consumption, particularly in rural areas

Figure C.3 Stacked supply of different foodstuffs in kilocalories per person per day, 1990-2009, Tanzania



Source: With data from FAOSTAT. **Note:** On average, people's energy requirement is around 1800kcal/day.

While diversity of average diets appears to have increased, diversity of children's weaning diets is still not good enough, with complementary foods comprising mainly cereal-based porridges with few or no vegetables and often lacking animal proteins (Muhimbula & Issa-Zacharia, 2010).

Staple food prices increased in real terms from 2006 to current levels. While longer term trends in staple food prices are difficult to track, wholesale maize prices in Dar es Salaam increased by over 50% in real terms from their average levels in 2006 to their average levels in 2011. They are also relatively volatile, which contributes to food insecurity (FAO GIEWS).

If food aid deliveries are an indication of trends in food security, they appear to have been getting worse. While it is difficult to pick out a trend in food aid deliveries, per capita deliveries from 1990 to 1999 were on average less than from 2000 to 2010, by more than half a kg per capita. Also, in 7 years of the most recent decade, food aid per capita was above 2 kg per capita, compared to being over 2 kg per capita in only 3 years of the earlier decade (WFP FAIS).

Poverty

Overall poverty

The proportion of poor people in Tanzania has reduced very slightly since the early 1990s. Poverty prevalence as measured at the national poverty line fell from 39% of the population in 1992 to 33% in 2007 (World Bank WDI).

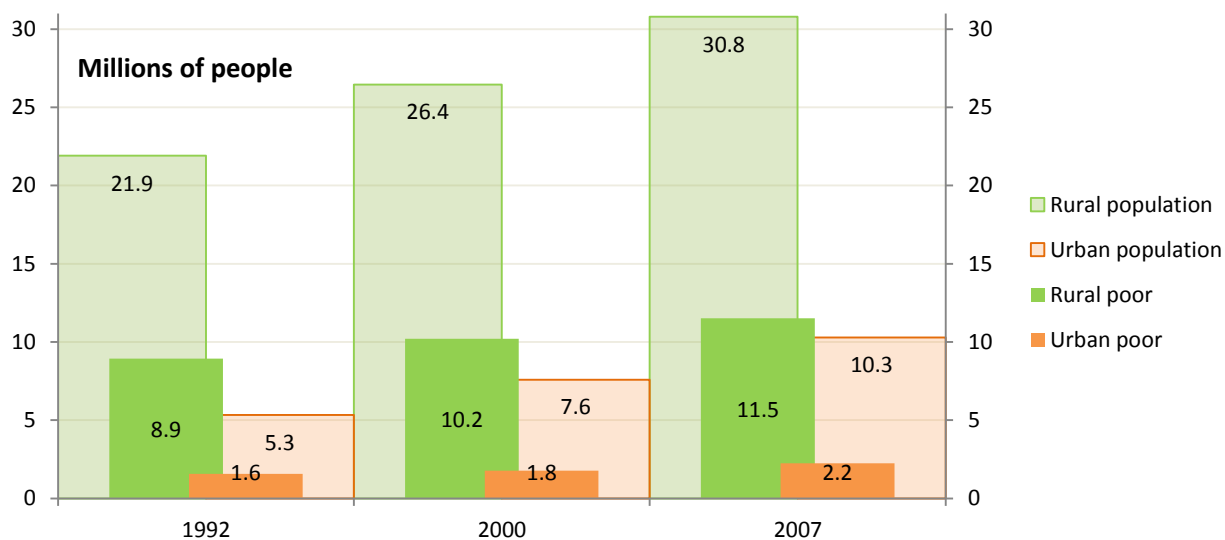
Rural poverty

Rural poverty rates fell a little from 41% in 1992 to 37% in 2007 (World Bank WDI). The gap between urban and rural poverty rates is pronounced: 15 percentage points in 2007. Moreover, the absolute number of poor people has been rising, as reductions in poverty prevalence are not enough to lead to absolute reductions in the face of a relatively rapidly growing population⁵⁰.

⁵⁰ Tanzania's population has been the fastest growing of all the case studies, at a rate of 2.8% per year from 1990 – 2012 (Data from FAOSTAT)

In 2007 there were 2.6M more poor people in rural areas than in 1992, while the number of urban poor grew by 460,000 from 1992 to 2007: See Figure C.4

Figure C.4 Poverty numbers in absolute terms, compared to urban and rural populations, Tanzania, 1992-2007



Source: With data from World Bank WDI and FAOSTAT for population.

Health

Under-fives mortality rate

The mortality rate of under-fives has been declining in Tanzania at a dramatic rate since the mid-to late 1990s, especially when compared to the average rates of decline in LICs and LMICs. It fell from levels of about 157 per 1000 in 1990 to about 68 per 1000 in 2011. This is less than LICs as an aggregate and approaching the average for LMICs (World Bank WDI). A significant number of children continue to suffer malaria, acute respiratory infections, fever and diarrhoea and other diseases, the underlying causes of which are described (Kinabo et al., 2009) as: poor sanitation and care practices; low levels of education and awareness; and, low access to clean and safe drinking water and to adequate health services.

Water & Sanitation

Tanzania has seen a modest deterioration in prevalence of access to improved water sources over the last 20 years, with improvements failing to keep up with population growth, particularly in urban areas. While 55% of the total population had access to an improved water source in 1990, by 2010 the proportion had fallen to 53% (urban access levels dropped dramatically from 93% to 79%). Levels of access in general were above the LIC average until 1996, when they dropped below (World Bank WDI).

Progress with increasing access to improved sanitation has been a bit more encouraging, though absolute levels of access remain well below the LIC average. Nationally, percent of people with access to improved sanitation grew from 7% in 1990 to 10% in 2010. Access levels for urban Tanzania saw the most growth, while levels for rural Tanzanians have not grown since 1995 (World Bank WDI).

Female empowerment

Female empowerment has significant consequences for the nutrition of children. Infant feeding practices improved slightly from 1992 to 2005, for example with more exclusive breastfeeding of children up to three months old, although there are large numbers of children still receiving complementary foods too early – and a smaller number too late.

"Poor breastfeeding and child feeding practices augmented by very early introduction of nutritionally inadequate and contaminated complementary foods are major factors contributing to persistent child malnutrition in Tanzania." (Muhimbula & Issa-Zacharia, 2010)

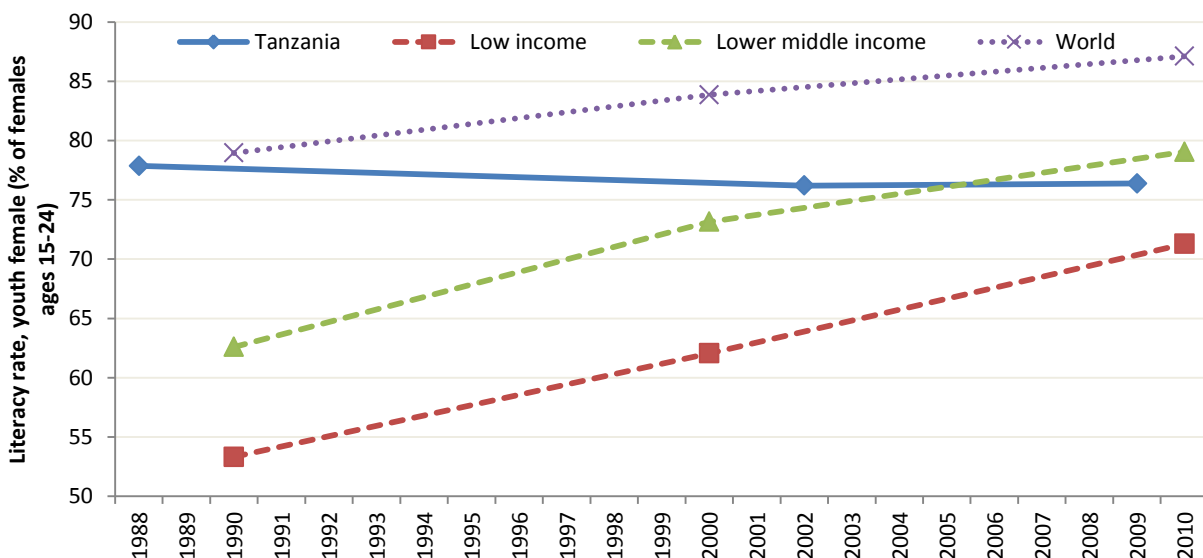
Female schooling

While there have been increases in the proportion of girls achieving some primary education, this suffered recently. Only a very small percent of girls have some secondary education, and even fewer complete or go beyond secondary level. Only in the highest wealth quintile is there any completion of secondary school and the figures are very low. Ten percent of females in the highest wealth quintile in 2007/08 had no education, compared to 45% in the lowest wealth quintile.

Net enrolment ratio for girls in primary school was 97% in recent data (2007-2010), while the net attendance ratio over the same period was 82%. Net attendance ratio for female secondary school participation was 24% for 2005 to 2010.

Women's literacy levels have actually declined slightly from their levels in the late 1980s. They were above the LMIC country average until about 2005, after which they fell below. They remain above the LIC average, but may not longer if current trends continue; see Figure C.5.

Figure C.5 Literacy levels of young women in Tanzania, compared to selected regions, 1991-2011



Source: With data from World Bank WDI Teenage pregnancy rate

The adolescent fertility rate for Tanzania fell only very slightly from 1997 to 2007, from 133 to 129 per 1000 teens 15–19. These rates are well above those for the LIC group, and the 11th highest in the world⁵¹.

⁵¹ Tanzania's population is quite young (43% below 15 years old), and the dependency ratio is high (85%), placing a heavy economic burden on the productive age groups (Kinabo et al., 2008).

Specific nutrition interventions

National nutrition interventions have been undertaken, though success and coverage has been mixed, or undocumented. For instance, in 1995, a Salt Act was approved to ensure salt for human consumption was iodized. In 2005 as a result of this initiative, 84% of households used iodized salt (Kinabo et al., 2008, citing Tanzania Food and Nutrition Centre). Another survey found that about 74% of households used iodized salt, but that only 43% were using adequately iodized levels (>15ppm) (NBS and ORC Macro, 2005).

Some sub-national interventions show clearer improvements. World Vision's Micronutrient and Health (MICAH) programme in Tanzania's Eastern zone for example resulted in a significant increase in rate of exclusive breastfeeding for the first six months (World Vision 2006), improved indicators for children's vitamin A and Iodine intake, as well as for their stunting and underweight (Berti et al., 2010). This programme involved vitamin A and iron supplementation, maize fortification; agricultural interventions such as home gardens, supply of fruit trees and small animals; water and sanitation; deworming and other health interventions, training of staff and volunteers, and education and media dissemination (World Vision, 2006).

While there is considerable overlap between specific agricultural nutrition interventions and other elements of nutrition programming, some examples are provided below.

Gender empowerment in food processing

Home gardens in Tanzania have a strong gender focus as women tend to be most heavily involved in this kind of agriculture. In Tanzania, women are usually responsible for food processing activities as well.

The Tanzania Food and Nutrition Centre (TFNC) implemented a project from 1995 to 1998 in a region where TFNC in collaboration with the Ministry of Agriculture had initiated a horticulture project to encourage vegetable gardens and fruit trees in 1992. The project aimed to encourage women who processed fruit and vegetables to use improved solar dryers which enhanced nutritional quality of the dried products as well as increasing women's income through dried food products. The intervention included education about nutrition and business training (Mulokozi et al., 2000). Results showed that while there was demand and good adoption of the improved solar drying technology, leading to more year-round availability of vitamin-A rich foods, most of the positive results on children's intake of such foods came from the nutrition education part of the intervention; highlighting the importance of nutrition education (ibid).

Home gardens and small livestock

Studies have associated home gardens in Tanzania with households eating statistically significant higher levels of vitamin A rich foods (Ecker et al., 2010).

One evaluation of a home gardening project in rural Tanzania in 1992–93 found five years later it had resulted in more gardens growing guava and pawpaw (Kidala et al., 2000). People were also eating more vitamin A rich food; 50% more than the control group. Though biochemical indicators were unchanged, behaviours related to vitamin A intake had changed, as helminth infections were lower than in the control areas, with 79% being infection free compared to 49% in control areas (Berti et al., 2004)

Small livestock systems have also been associated with better diets. For example, introduction of dairy goats from Norway in 1988 has led to improved diets and food security among smallholder farmers in the Mgeta area of Tanzania. The new technology is adapted and rapidly spreading to other parts of the country (Eik et al., 2008).

Bio-fortification

Projects promoting orange-fleshed sweet potato have been undertaken in Tanzania. For example, the Tanzanian National Sweetpotato Research Program has incorporated OFSP into its conventional breeding efforts (RAC, 2012). Though it is difficult to find evidence of impacts as yet, it appears to have considerable potential, as sweet potatoes are already part of the

diet, and the orange-fleshed sweet potato has been accepted and enjoyed, particularly by children, in trials (RAC, 2012).

Quality Protein Maize (QPM) has also made some inroads in Tanzania. For instance it was promoted under CIDA's QPM Development project, which ran 2003 to 2010 in Ethiopia, Kenya, Tanzania, and Uganda, with 15% of funds for Tanzania. Results for Tanzania specifically are unavailable, but reportedly the project increased QPM production by an average of 31%. It increased consumption of QPM, especially by children and female members of farm families by 90% on average (CIDA, 2012). The extent to which it is cultivated in Tanzania and its impacts are not known, though its uptake is thought to be small scale to date. A key issue for adoption is availability of seed.

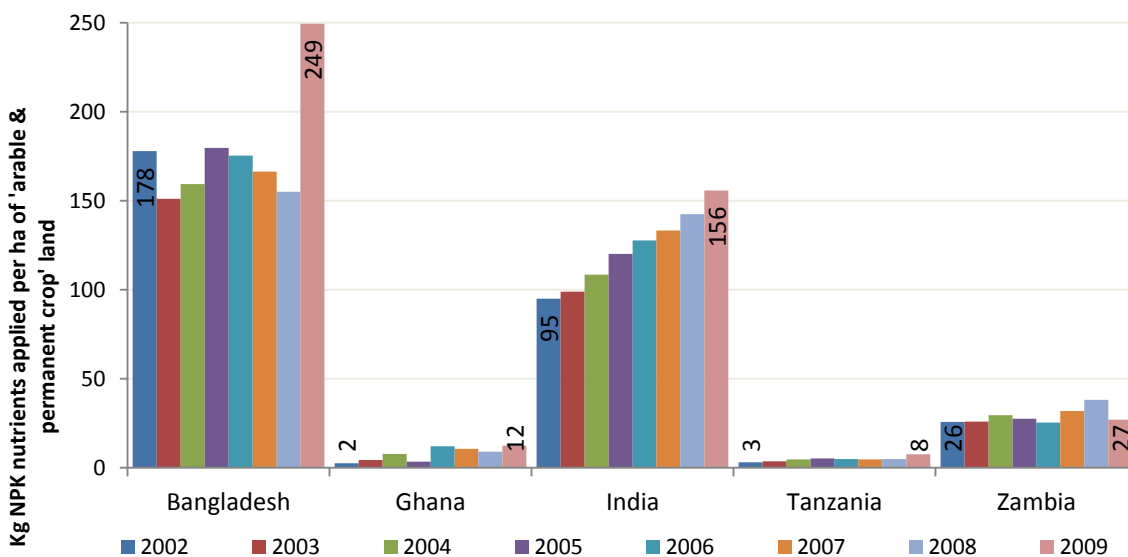
Interpretation

Restricted agricultural growth in Tanzania has likely contributed to disappointing improvements in child undernutrition though pathways including failure to reduce poverty. Poor care practices, low feeding frequency, low diversity of diet, and poor access to health care services also contribute. Neglect of attention to women's empowerment also stands out in the Tanzanian case.

What could agriculture do for better nutrition in this case?

- Improve production, particularly yield, of staple foods, particularly maize, where there is much scope to raise yields by, for example, raising fertilizer use from the very low levels seen in Tanzania, Figure C.6. Removing barriers to trade, particularly with neighbouring countries, would raise incentives to domestic producers.
- Focus on women farmers
- Bio-fortification of the staple, maize, particularly with vitamins like A and minerals like Iron could help.
- Diversify to encourage better consumption of micronutrient rich food and diverse weaning diets (combined with better education). Home gardens are a good way to do this, and if women in particular are involved, could help empower women.

Figure C.6 Fertilizer use per unit of arable and permanent cropland in case study countries



Source: With data from FAOSTAT

Annex D. Zambia: Faltering agriculture, slow progress on fundamentals, and high inequality means high levels of chronic child malnutrition

Observed changes in nutrition

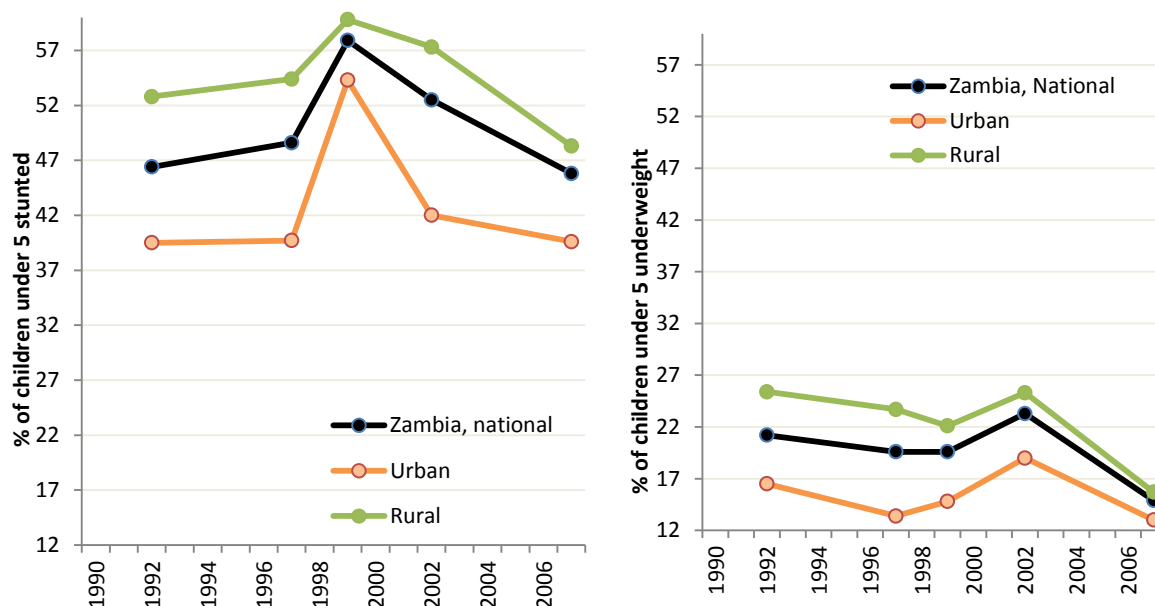
Underweight and Stunting

In almost 20 years there has been almost no improvement in stunting of under-fives: it was 46% nationally in 1992 and still 46% in 2007. There has, however, been some progress in reducing underweight prevalence, reduced from 21% of under-fives in 1992 to 15% in 2007—a drop from the WHO classification of *high* to *medium* severity.

Stunting of children in rural areas is far worse than urban areas. In 2010 the margin was about 8 percentage points; an improvement on the gap in 1992 which was more than 12, see Figure D.1.

As with stunting prevalence, underweight is worse among rural than urban children – though the gap has lessened since the early-1990s.

Figure D.1 Stunting and underweight of children under five, moderate and severe 1992-2010, Zambia



Source: With data from WHO Global Database on Child Growth and Malnutrition.

Micronutrient deficiencies

Micronutrient status is not good, though on some indicators it has improved owing to interventions. In the early 1990s, iodine deficiency was a severe public health problem, but since the enforcement of salt iodization in 1996, recent surveys of urinary iodine levels indicate sufficient iodine intake. Vitamin A deficiency has also decreased among women owing to supplementation. However, only about half of mothers receive these supplements during the post-partum period, and among children, vitamin A deficiency remains very high, in spite of supplementation covering almost two thirds of children.

Iron deficiency anaemia is found in more than half of pre-school age children, and almost one third of non-pregnant women. High malaria incidence and incidence of other parasitic infections contributes to high anaemia prevalence.

Growth of economy

Economic growth in Zambia has been patchy and poor. GDP per capita measured in constant 2000 USD fell from 1990 to 1999, following a decline nearly two decades long (Siamusantu, 2009), after which it began rising again. Overall, the change from 1990 to 2011 is an increase of only 14% in real GDP per capita terms (World Bank WDI).

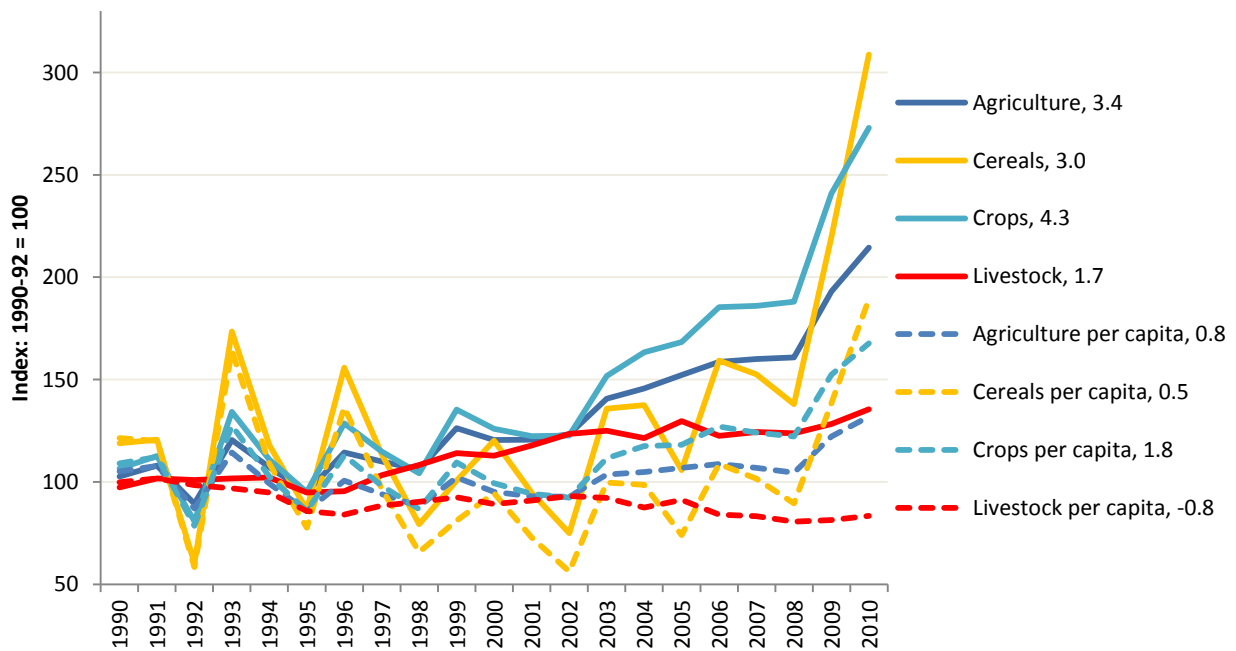
Agriculture

Agricultural growth

Net production indices for Zambian crops, agriculture in general, and livestock seem to have grown from about the mid-1990s. Cereals, which looked to be falling from 1990 to 2002 — though volatile — took off after that point, particularly after 2008, which meant overall they have a positive annual average growth rate of 3% in absolute terms, and 0.5% per capita, see Figure D.2. Livestock production declined in per capita terms.

Despite this weak growth, Zambia is the only country of the case study locations where agricultural contribution to GDP and employment in the agriculture sector have been *rising* since 1990: farming accounted for 50% of all employment in 1990, but 72% in 2005 — reflecting the low growth of other sectors in the economy.

Figure D.2 Agricultural net production indices and growth rates for Zambia, 1990-2010



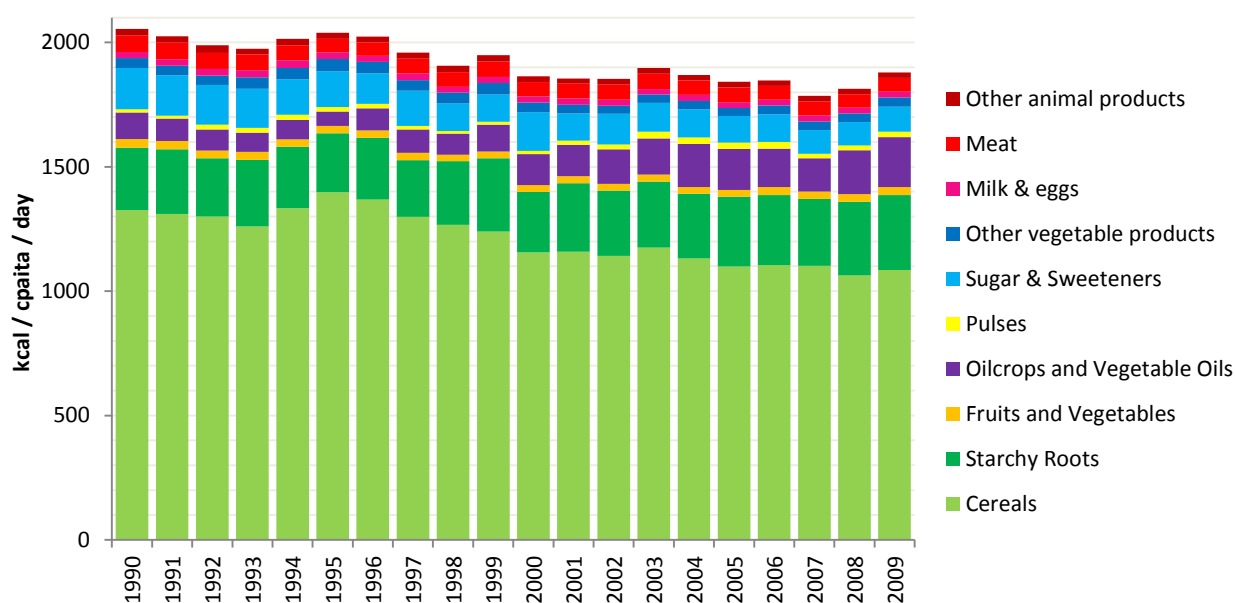
Source: with data from FAOSTAT. **Note:** Numbers in the legend are the average annual growth rates of the series depicted from 1990-2010.

Food availability – and its price

Diets in Zambia are mainly composed of cereals, predominantly maize, starchy roots and, to a lesser extent, fruit and vegetables. The heavy dependency on a single staple, maize, makes it especially vulnerable to droughts and floods, particularly for rural residents as urban farmers diversify staples increasingly towards other crops like rice and sweet potatoes (Siamusantu et al., 2009).

Per capita food supply, (production, including net trade and changes in stocks) in Zambia has declined from 1990 to 2009 overall, though there have been some increases in sub-groups. Most of the decline came from cereals, followed by sugar and sweeteners. Cereals and starchy roots, which made up over 70% of staples in 1990 fell to just under 60% in 2009. Proportion of calories supplied by oilcrops, pulses, fruits and vegetables, and sugar all increased slightly: See Figure D.3.

Figure D.3 Stacked supply of different foodstuffs in kilocalories per person per day, 1990-2009, Zambia



Source: With data from FAOSTAT. **Note:** On average, people's energy requirement is around 1800kcal/day.

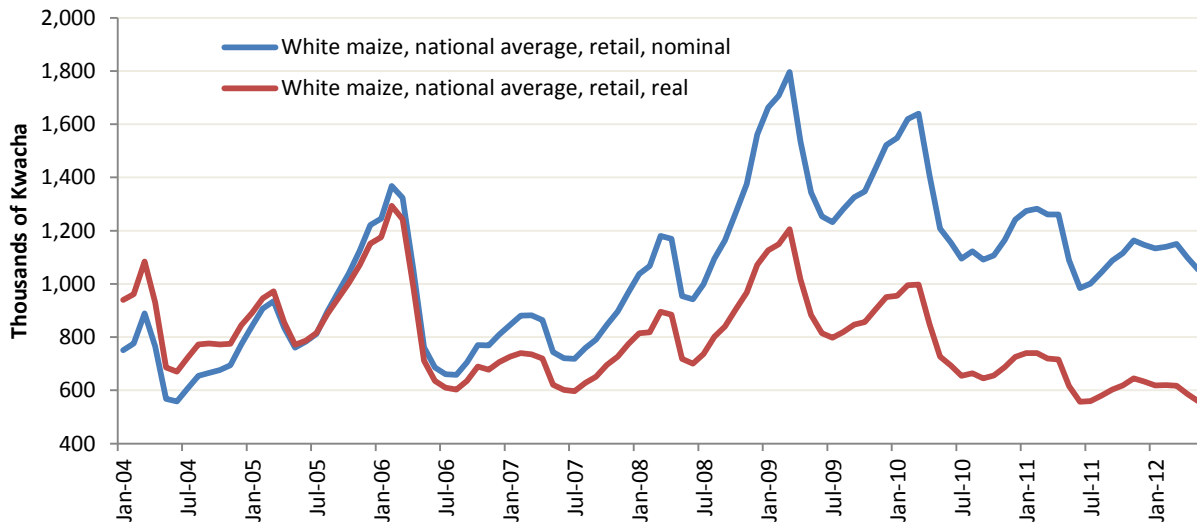
There is little evidence of either improved supply of food in terms of quantity, or even in terms of relative quantity changes that might indicate diets becoming more diverse: discouraging statistics.

Maize production's decline, particularly in per capita terms, contributes to food insecurity in Zambia (Siamusantu et al., 2009). Owing, however, to rising wages, staple foods in Zambia (and Kenya) have become more affordable over time:

Mason et al. (2009) show that average formal sector wages (in various public and private sector categories) in urban Kenya and Zambia rose at a faster rate than retail maize meal and bread prices between the mid-1990s and 2007. Although the recent food price crisis partially reversed this trend, the quantities of maize grain, and maize and wheat flour affordable per daily wage in urban Kenya and Zambia during 2008–09 marketing season were still roughly double their levels of the mid-1990s. (Tschirley & Jayne 2009)

Seasonal price volatility does continue to be significant, however, particularly in years with smaller harvests. This volatility in prices contributes to food insecurity: See Figure D.4

Figure D.4 White maize prices in Zambia, 2004-2012



Source: With data from FAO GIEWS

Poverty

Overall poverty

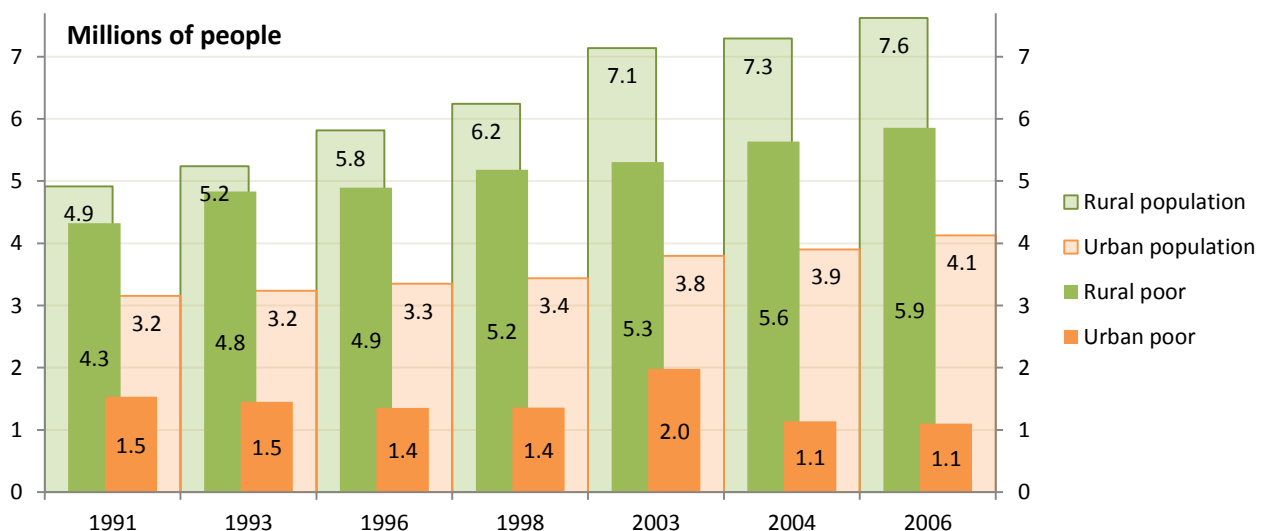
Poverty rates in Zambia have shown slow improvement since the early 1990s. Poverty prevalence as measured at the national poverty line fell from about 70% of the population in 1991 to just under 60% in 2010 (World Bank WDI).

Rural poverty

Rural poverty, over 90% in 1993, fell to 77% in 2006, but the largest reductions were in urban poverty: already much lower than in rural areas, this fell from close to half of urbanites in 1991 to 27% in 2006 (World Bank WDI).

In absolute numbers, urban poor have shrunk slightly – from 1.5 to 1.1 million, but rural poor have increased, from 4.3 to 5.9M people: See Figure D.5. In addition, income inequality is very high in Zambia, among the highest in Africa.

Figure D.5 Poverty rates in absolute numbers, compared to urban and rural populations: Zambia, 1991-2006



Source: With data from World Bank WDI and population statistics from FAOSTAT

Health

Under-fives mortality rate

On under five mortality, Zambia has the worst rates of all the case studies. Nonetheless, it has been declining rapidly, faster than the rates of decline in LICs and LMICs on average: in 1990 the rate was 193 deaths per 1000 live births; by 2011 this had become 83 deaths per 1000.

While malnutrition and micronutrient deficiencies are important contributing factors to overall morbidity and mortality among young children, major causes of under-five deaths were reportedly: neonatal (23% of deaths in 2000-2003), pneumonia (22%) malaria (19%), diarrhoeal diseases (17%) and HIV/AIDS (16%) (Siamusantu et al., 2009; citing WHO data).

Water & Sanitation

Zambia has seen only modest and disappointing progress in access to improved water and sanitation. While about half the population had access to improved water sources in 1990, by 2010 this had risen to only 61%; below the average for low income countries in general (WDI data). Access of the urban population in Zambia is reportedly good (according to World Bank WDI), and it is the rural population where the most progress needs to be made. Rate of improved access in rural Zambia appears to have stagnated from 2008.

Another source, Siamusantu et al., (2009), reported declining levels of access to good water supplies from the early 1990s, as reportedly commercialization of water begun in the early 1990s has made it unaffordable for 40 to 60% of urban dwellers in Lusaka and the Copperbelt, where most of Zambia's urban population lives. They cited estimates of access to safe water declining from 72% nationally in 1992 to 57% in 2002.

Progress with increasing access to improved sanitation has been less encouraging. Nationally, percent of people with access to improved sanitation changed little; from 46% in 1990 to only 48% in 2010.

Female empowerment

Female schooling

Zambia's progress on women's empowerment has been disappointing. Young female literacy levels increased only very slightly from 66% in 1990 to 67% in 2010. This rate dropped and remained below the LIC average levels from 2005.

In 2002, the government has declared free education for all for grades 1-7 (primary education) (CSO et al., 2003). This measure, coupled with expansion of school facilities, curriculum development, provision of education materials, provision of bursaries for vulnerable children and orphans (from primary up to tertiary level), and improvement of equity and gender balance, had a positive impact on school enrolment (OECD, 2006). The net primary enrolment ratio has increased for both male and female pupils from 68% in 1999 to 94% in 2007, but disparities remain between male and female rates of progression and completion of education (UNESCO, 2008). In 2005, 89% of boys but only 66% of girls completed a full course of primary education (UNESCO, UIS Statistics in brief, Zambia). (Siamusantu et al. 2009)

Net enrolment ratio for primary school girls (2007-2010) was 94%, and net attendance ratio 82%. For secondary school girls, net attendance ratio (2005-2010) was only 36%.

Teenage pregnancy rate

The adolescent fertility rate rose from 1997 to 2002, after which it fell, but only slightly, and from extremely high levels, well above those for the LIC group. At 142 per 1000 in 2010, they were the 7th highest in the world.⁵²

Specific nutrition interventions

Zambia has had some success with iodine fortification. Serious shortfalls remain in iron and vitamin A status. Sugar fortification with vitamin A was reportedly begun in Zambia, in 1998, with only some success in urban areas. While fortification of sugar has worked successfully in Latin America, in Africa where sugar consumption is not as high, it is not very successful (World Bank, 2006).

Some success has also been seen in infant and young child feeding practices. Exclusive breastfeeding for instance has increased sharply since the early 2000s (Siamusantu et al., 2009).

Agricultural interventions for nutrition

Nutrition sensitive gender empowerment, home gardens, aquaculture and small livestock

There is plenty of potential for improving women's status in Zambian agriculture. A recent gender assessment for Zambia (Rozel Farnworth et al., 2011) reported that women typically lack command over household assets which in turn inhibits their ability to take risks in production:

Programmes aiming to integrate women into value chains generally pre-suppose a certain level of resources and capabilities that enable them to take on the risks inherent with engaging with value chains and entrepreneurship. Zambia's gender profile indicates that whilst women and men both face challenges to entrepreneurship due to poverty, men are much more able to engage in risk taking and grow their businesses due to their ability to build and command capital. This ability is critically linked to the superior position of men in relation to the ownership and deployment of household assets, and expenditure decisions. By way of contrast, women within male-headed households generally depend on their ability to maintain relations with male kin to secure access to productive assets. Their decision-making capacity over the use of those assets is demonstrably low in many cases. Female-headed households may well be able to take autonomous decisions, but they frequently lack sufficient assets for truly viable livelihoods. To engage women in value chain development will take several years of carefully staged engagement and withdrawal.

Women's disempowerment in Zambia is likely contributing to poor nutrition outcomes for under-fives.

There is evidence however that agricultural interventions including home gardening, for which women are often predominantly responsible, have positive outcomes for nutrition in Zambia. For instance, the ***Empowerment of Women in Irrigation and Water Resources Management for Improved Household Food Security Nutrition and Health*** (WIN) programme in Zambia, which involved vegetable gardens and aquaculture had positive results. Diversified vegetable production led to improved household incomes, better nutrition, and provided new links to local markets which enabled some participating households to move beyond subsistence level agricultural production. Fish production under the WIN programme increased available protein at a household level as well as providing participants with a high-value product for sale at local markets. The programme also involved food preservation and post-harvest value added processing, which contributed to improved nutrition (Eckman 2005)

⁵² After Niger, DR Congo, Mali, Angola, Chad & Guinea.

A positive example of small livestock interventions for nutrition can be found in Heifer International's final report for its *Miyoba Women's Draft Cattle Project* which ran from 2001 to 2007. They found significant evidence of improved nutrition and income for participants, better employment, and more resilience in the face of natural disasters among other benefits (Heifer International, Accessed 2012). An evaluation was able to document substantial improvements in nutrition, income and assets, knowledge on basic care and management of animals, children's access to education, and gender equity (Thomaz, 2011).

Bio-fortification

Like Ghana, Zambia is one of the initial target countries for dissemination of HarvestPlus high vitamin-A maize.

Recent studies show orange maize is acceptable to consumers in Zambia, with potential to compete with white maize even without nutrition campaigns — and could fetch a premium over white maize where nutrition information is provided (Meenakshi et al., 2012).

As in other case studies, while potential for bio-fortified crops including OFSP and special types of maize appears high, there is little documentation of uptake: it is suspected that these types of intervention remain small scale.

Interpretation

Zambia is a case where not only agricultural but also overall economic growth has been poor. On indicators of women's empowerment it stands out as particularly disappointing.

Child care, health, schooling, all contribute as do highly risky and variable agricultural systems.

What could agriculture do for better nutrition in this case?

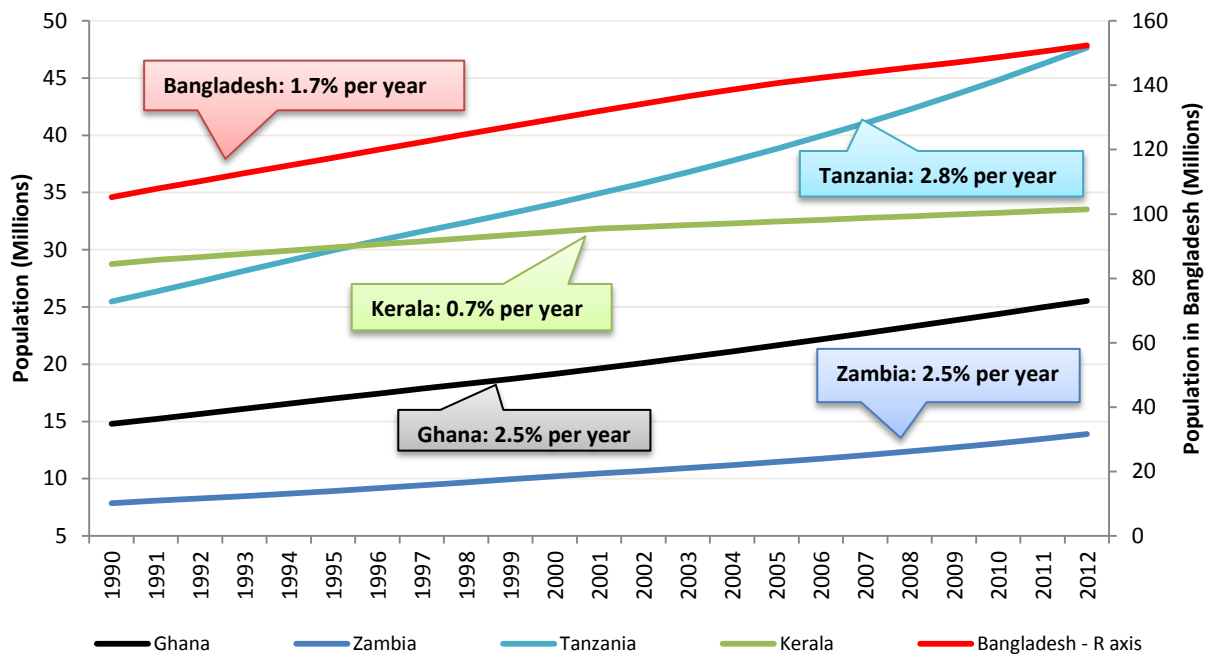
- Similar to the Tanzania case, Zambian producers and consumers would benefit from improved production, particularly yield, of staple foods, particularly (but not only maize). This will help contribute to a dietary energy supply that is currently insufficient to meet the population's energy requirements (Siamusantu et al., 2009).
- Diversifying more into other staples, such as cassava, ought to help overcome some of the risk associated with a single rainfed staple with poor drought tolerance in a country where droughts have such a high return period.
- Bio-fortification of staples, particularly maize could help.
- Quality and diversity of available food is not good enough, contributing to micronutrient deficiency (Siamusantu et al., 2009). As in the case of Bangladesh, diversify to encourage better consumption of micronutrient rich food and diverse weaning diets (combined with better education). Home gardens are a good way to do this, and if women in particular are involved, could help empower women.

Working on agricultural development at the same time as improving the general health environment, educating girls, and improving basic infrastructure, ought to pay dividends in nutrition rates of Zambian children.

Annex E. Kerala: Focus on the fundamentals of health and education means Kerala is a leading Indian state for child nutrition

A case study of India would be a task beyond the resources available. Although Kerala is only one state of India, with around 33M inhabitants, it is larger than Ghana and Zambia. Populations and growth rates for the cases are shown in the figure below.

Figure E.1 Population and average annual growth rates (in boxes) of case study locations, 1990-2012



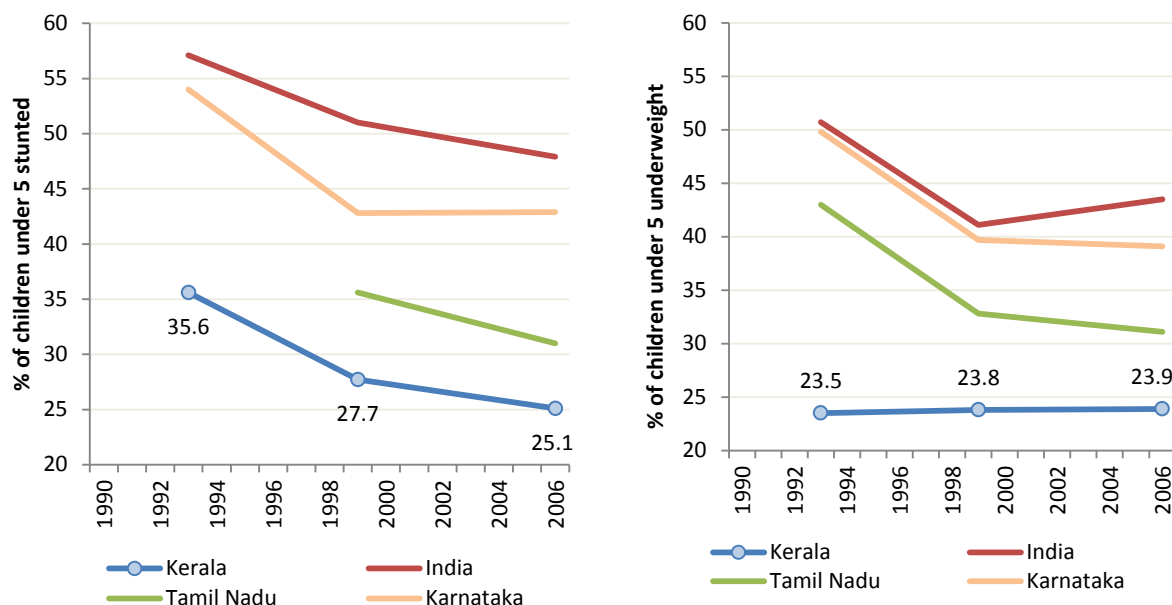
Source: With data from FAOSTAT and Indian Census data. **Note:** Kerala data was imputed using census data from 1981, 1991, 2001 and 2011

Observed changes in nutrition

Underweight and Stunting

Stunting rates fell from 36% in 1993 to 25% in 2005. Surprisingly, then, rates of underweight have seen no progress in Kerala from 1990 to 2010, remaining at just under one in four. It appears the gains in reduced stunting are being offset by rising rates of wasting, from 13% to 16%. Relative to the national rate and rates in its neighbouring states however, figures for Kerala are better: indeed, Kerala has the lowest rate of stunting in all Indian states, and the fourth lowest rates for underweight amongst Indian states.

Figure E.2 Stunting and underweight rates in Kerala, compared to neighbouring states and the national average 1993-2006



Source: With data from WHO Child Growth Database. **Note:** 1999 figures are from IIPS & ORC Macro (2000), converted using the Yang & de Onis (2008) algorithm. No data is available for 1993 stunting in Tamil Nadu.

Micronutrient deficiencies

Anaemia rates in women in Kerala increased from 1998/99 to 2005/06, going from 23% in 1998/99 to 33% in 2005/06, although only 0.5% of women in either year had severe anaemia.

Children's anaemia prevalence in Kerala barely moved from 1998/99 to 2005/06, and is high at about 45%. Very few cases are severe in Kerala. Rates in Kerala are also better than the rest of India.

While there are few data assessing iodine deficiency in Kerala, in one district of Kerala in 1999 school children were considered to be in a transitional phase from iodine deficit to sufficiency, revealed by a total goiter rate in the children of 7.05 and a median urinary iodine level of 17.5 µg/dL (Kapil et al., 2002). In 2005/06, surveys revealed some 70% of children under five were living in households with adequate salt iodization levels, while 74% of households were estimated to have adequate salt iodization in 2005/06 (IIPS, 2007).

Vitamin A deficiency levels in Kerala are not a public health problem for young children. A 2001–2003 survey of children 1 to 5 years old indicated no night blindness.

Although there are no up-to-date figures for women's vitamin A deficiency in the WHO database, in a 1998/99 survey, women aged 15 to 50 in urban Kerala had rates of 1.20% (slightly above the 1% WHO threshold), and women in rural Kerala had rates of 2.3%, indicating a public health problem.

Growth of economy

Economic growth in Kerala has been disappointing over the last 20 years, lagging compared to the rest of India and heavily dependent on remittances and tourism (Biswas, 2010). One feature of Kerala that makes its economy unusual is the high dependence on emigrants working overseas, particularly in the Middle East region, who send home remittances that annually contribute as much as a fifth of gross state product (GSP) (Kannan & Hari, 2002).

Agriculture

Agricultural growth

In 2004/05, agriculture contributed 17% of Kerala's Gross State Product (GSP), but by 2010/11 this is estimated to have fallen to 10.6% (Government of Kerala). Nonetheless, nearly half of Kerala's population is dependent on agriculture alone for income (Government of Kerala data from around the mid-2000s.). Over 70% of Kerala's agricultural land is reportedly used by small or marginal farmers.

Dev (2012) estimated the average annual growth rate of agricultural production in Kerala from 1999/2000 to 2008/09 at only 0.55%, India's second-worst performing state on this measure.

Kerala's key agricultural staple is rice. However rice production has been shrinking since the 1970s when it began to be more cost-effective to produce rice in other parts of India. Profitability of growing crops in general in Kerala is decreasing owing to a shortage of farm labour, high land prices, and small size of holdings (PCI, 2008). Agricultural production has consequently shifted towards perennial tree crops and home gardens which make up a significant proportion of Kerala's agricultural production (Mohan, 2004).

Food availability – and its price

Average calorie consumption in Kerala is lower than in India nationally, and appears barely changed from 1965 kcal per rural person a day in 1993/94 to 2014 kcal per rural person a day in 2004/05 (a 2.5% increase) and from 1966 kcal per urban person a day to 1996 kcal per urban person a day (1.5% increase) over the same period. These statistics describe consumption, and may not be comparable to the statistics in the other cases which show supply. This might explain why the Kerala levels seem low; quite close to being insufficient.

Average protein consumption in Kerala is close to national levels for urban areas, and just below national levels for rural areas. It has increased considerably from 1993/94 to 2005/06 in both rural and urban areas, by 9.1% and 8.2% respectively.

Average fat consumption in Kerala is above the national average for rural areas, and only slightly below the national average for urban areas. This has increased most strongly over the period in question, by 25% in rural areas and by 21% in urban areas.

Compared to neighbouring states of Karnataka and Tamil Nadu, consumption in Kerala was higher for average calories, protein, and fat. There was also less difference between urban and rural areas as well.

Diets in Kerala are about half cereal-based, with the fraction slightly higher in rural than urban areas. The contribution of cereals to the diet is lower in Kerala than in India nationally, and also than the neighbouring states. Of the non-cereal products, pulses, nuts, and oilseeds make up the next-largest share of calories. Fruits and vegetables share is low, though still above national proportions. Meat, eggs and fish make up a considerably larger share in Kerala than in the other regions to which it is compared, indicating potentially better consumption of micronutrient-rich livestock foods.

Kerala saw moderate improvements in average women's diversity of consumption from the late 1990s to the mid-2000s. While on average, more women in Kerala consume chicken meat or fish, eggs, and fruits in any given week than the national average, they lag behind the national average on prevalence of consumption of green leafy vegetables and pulses.

Real rice prices in Kerala were relatively stable from the early 2000s to early 2008, after which they became higher and more volatile. They have also tended to be a bit higher than in the neighbouring state of Tamil Nadu. Real wheat prices in Kerala rose from the early 2000s to the mid-2000s, and remained relatively flat across 2005 to early 2011, after which they dipped and rose (Retail price information system, GoI).

Poverty

Overall poverty

Kerala leads India on the Human Development Index. Poverty rates in Kerala have also declined dramatically over the last few decades, from 25% in 1994 to 12% in 2010.

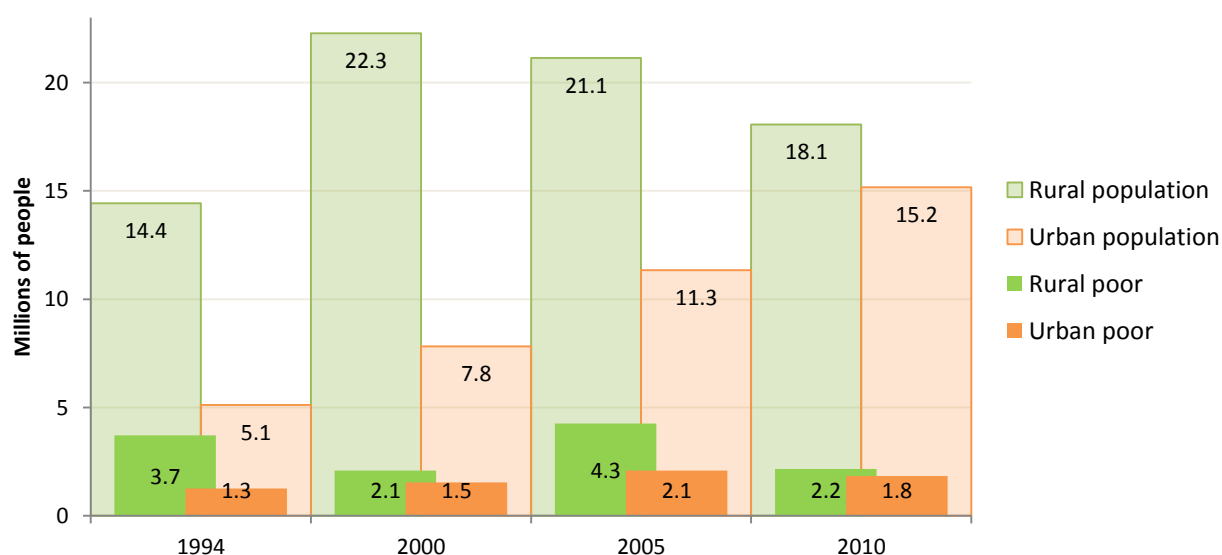
Rural poverty

Poverty prevalence in urban and rural areas appear to have converged. Rural poverty fell from 26% of the rural population in 1994 to 12% of the rural population in 2010.

Poverty in absolute numbers has fallen overall from 1994 to 2010, however it has risen slightly in the fast growing urban population, see Figure E.3. While there were around 3.4 million rural poor and 1.3M urban poor in 1994, there were an estimated 2.2M rural poor and 1.8M urban poor in 2010.

Rural-urban gaps in Kerala are far less pronounced than in the other cases, where commonly urban poverty prevalence is 10 percentage points below rural ones.

Figure E.3 Numbers of poor in Kerala compared to population, rural and urban: 1994-2010 estimate



Source: With data from India's Planning Commission, GoK 2006, Ghoshal 2012, and Indian Census data

Health

Under-fives mortality rate

The under-five mortality rate is one of Kerala's most impressive achievements. At 16.3 per 1000 live births in 2006, it was well below the rate for India, LMICs, and MICs on average.

Childhood vaccinations levels in Kerala slipped slightly for all basic vaccinations from 1998/99 to 2005/06. They remain however at relatively high levels, with three quarters of children in Kerala receiving all basic vaccinations, well above the average of less than half for Indian children in general. The administration surrounding immunization also appears stronger in Kerala, with a much higher percent using vaccination cards than do nationally and in neighbouring states; even Tamil Nadu where rates of vaccination are slightly higher.

On infant feeding and care practices, Kerala's statistics are also among the leading values for India. For example, initiation of breastfeeding within a day of birth is very high (96% in 2004/05).

Infant care during diarrhoea is significantly better in Kerala than other Indian states.

Water & Sanitation

Improvement in drinking water availability has increased dramatically in Kerala from the early 1990s to the mid-2000s. In 1992/93, 21% of households had access to improved sources of drinking water, but in 2004/05 this had risen to 69% of households (IIPS 1995, IIPS & ORC Macro 2000, & IIPS 2007).

Improvements in sanitation facilities have also been significant, despite coming from a relatively high base compared to the rest of India. In 1992/93, 71% of households had access to toilet or latrine facilities. By 2004/05 this figure had risen to 96%. For India, the comparable statistics were 30% rising to 31% (ibid).

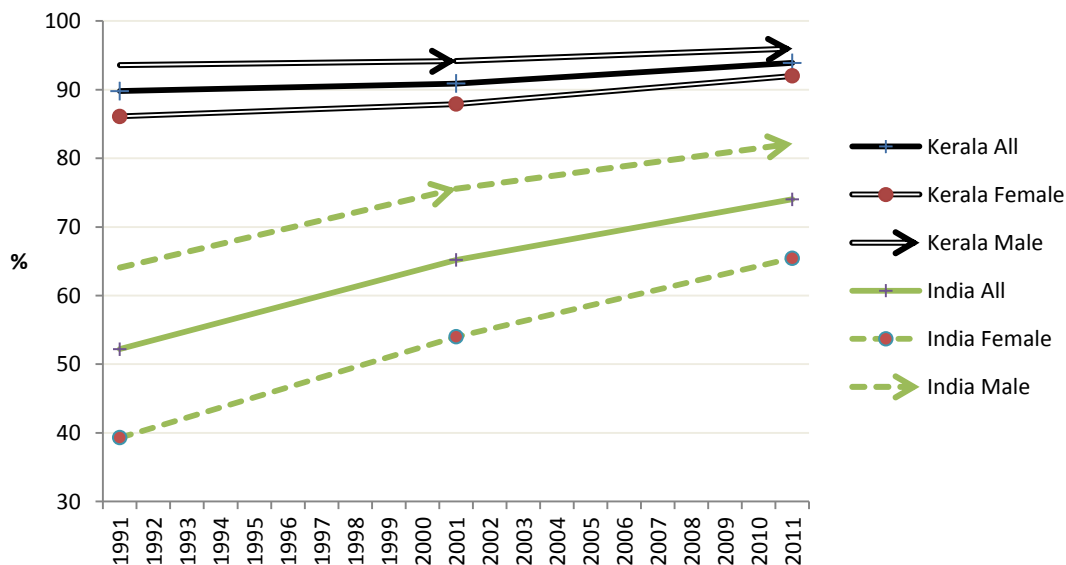
Female empowerment

The ratio of female to male life expectancy at birth was used by Smith & Haddad (2000) as a measure of women's relative status. In Kerala, relative status by this measure is well above that of India and has improved from 2000 to 2009; in contrast the situation in India has deteriorated slightly over the period in question. For India in general, ratios are much lower with neglect of female health contributing to these low ratios (Sen, 1990).

Female schooling

Literacy rates in Kerala are high and improving, for both men and women, see Figure E.4. While in 2011 the gap between male and female literacy rates in India nationally was about 17 percentage points, it was only 4 percentage points for Kerala. The gap has also narrowed in Kerala since the early 1990s, when it was close to 8 percentage points.

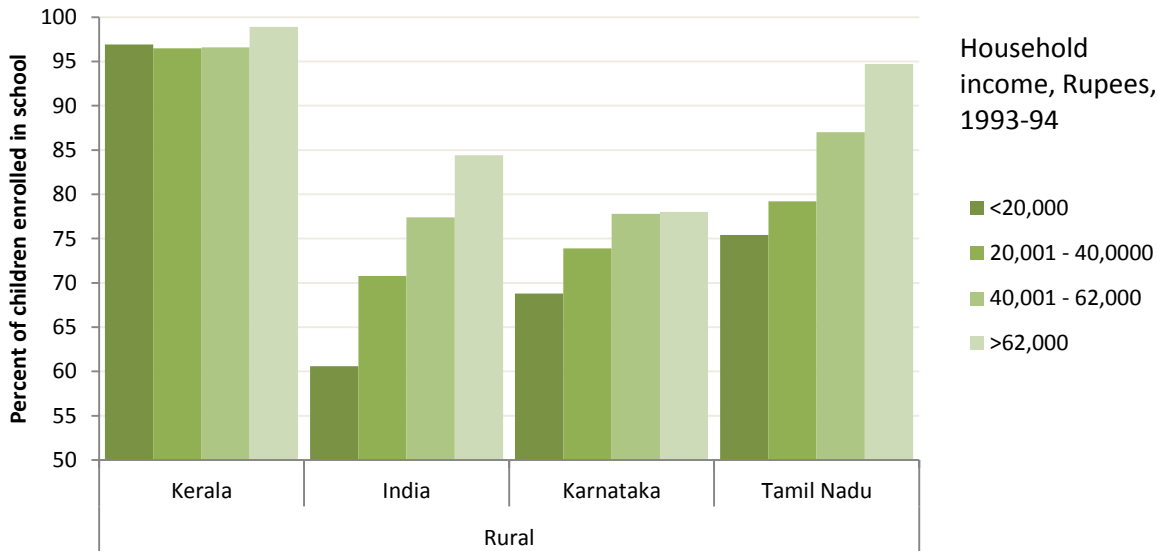
Figure E.4 Female, male, and average literacy rates in Kerala compared to India nationally, 1991-2011



Source: With data from GoK 2006 and Indian Census 2011

Enrolment in education in Kerala is high, at more than 95% and much more equitable across income groups compared to neighbours and the rest of India, see Figure E.5. These data, almost two decades old, show education in Kerala has been equitable for some time.

Figure E.5 School enrolment of children in different income groups in rural Kerala, compared to India nationally and neighbouring states, 1993-94



Source: GoK 2005

Kerala is set apart from other states by its high literacy rate – much higher than in India, and also substantially higher than in China, especially for women (Sen, 1990).

Kerala's experience was one of state-funded expansion of basic education that began two centuries ago by the rulers of the kingdoms of what was then Travancore and Cochin⁵³ -- and consolidated by a left-wing state government from about 1957 (Sen, 1990, Sen, 1991).

'The causal chain of Kerala's exceptional record goes back in history and includes among other things such steps as the public policy of "enlightenment" and "diffusion of education," clearly articulated by the reigning queen ... as early as 1817. The high level of education also contributed to the development and utilization of Kerala's extensive public health services, by making the population more informed, more articulate, more keen on demanding health services, and more able to make use of what is offered...

Literacy and basic education have also contributed, it can be argued, to Kerala's radicalism, by making it easier to depart from the traditional mold of Indian conservative politics.' Sen (1991)

Teenage pregnancy

The adolescent fertility rate is low in Kerala: in 2008 it was only 18.3 per 1000 women aged 15 to 19.

⁵³ These were two native states not part of British India that joined with a small part of the old Madras presidency to form the new state of Kerala post-independence (Sen, 1990). In 1817, the queen of Travancore gave instructions for public support of education as follows: "The state should defray the entire cost of education of its people in order that there might be no backwardness in the spread of enlightenment among them, that by diffusion of education they might be better subjects and public servants and that the reputation of the State might be advanced thereby." (Sen, 1990)

Specific nutrition interventions

Kerala has made great progress with salt iodization from the late 1990s to the mid-2000s. While in 1998/99, some 48% of households did not have iodized salt (worse than the national average of 28% of households), by 2005/06, 74% of Kerala's households had adequately iodized salt, and only 17% had no iodization of salt. In contrast, the national average levels of iodization barely moved over his period.

Iron and folic acid supplementation for pregnant and post-partum women is also high in Kerala, and has risen from already high levels in 1992/93 to 2005/06. The percent of women using (given or bought) IFA tablets or syrup who had given birth in years just before the survey went from 91% in 1992/93 to 96% in 2005/06, compared to national rates that rose from about 51% to 65% in the same period.

Agricultural interventions for nutrition

Home gardens and small livestock

Home gardens are the main form of agriculture in Kerala, where the average size of holdings is very small — in 1990/91, 84% of Kerala's land holdings were less than half a hectare (Mahesh, 2000) — and tending to reduce with further subdivision. Home gardens have emerged as a result of these small farm sizes in lowland areas and from growing lack of competitiveness for staple crops such as rice; the production of which has been shrinking in Kerala since the 1970s, as the state imports from other regions of India where rice is more economically viable.

Kerala's home gardens contain diverse species, tree crops as well as annual crops, pulses, vegetables, and in many cases animals — most commonly cattle and poultry. They are thought to be sustainable and efficient systems (Mohan, 2004; Salam et al, 1995). In the smaller gardens, households consume more than 50% of the produce, compared to about 20% for medium, large and commercial sized farms (Mohan, 2004), so home gardens clearly have an influence on food consumption in Kerala, with likely positive impacts for nutritional outcomes, particularly where food types cultivated are of high nutritional value. The role of home gardens in nutrition for Keralites however is not well documented and deserves more attention.

Bio-fortification

While sweet potato is produced widely in Kerala, how much is orange-fleshed is not clear. While there is clear potential for production and consumption of bio-fortified crops to have a positive impact on nutrition, as yet there is little evidence of programmes involving bio-fortification in Kerala.

Interpretation

Modern Kerala does deserve credit for consolidating and building on past achievements. But the background to these developments has to be traced, to a considerable extent, back to Kerala's remarkable past, and we have to take note, among other things, of its old policy of educational expansion. These issues are important since the role of education, and in particular of female education, may well be central to many problems of the contemporary world. Sen (1991)

Kerala has an unusual and enviable record on some of the basic determinants of nutrition, such as education, female status and health care: particularly when compared to the rest of India. Kerala shows how much can be done to improve child nutrition even where food availability and agricultural progress disappoint. There are connections between education, public activism, and the development and use of health facilities that are by no means unique to Kerala (Drèze & Sen, 1989).

What could agriculture do for better nutrition in this case?

- Smallholder farm development to improve incomes for Kerala's smallholder farmers would help as far as poverty alleviation is concerned, though there is no imperative to improve food production for the sake of availability in Kerala, where sufficiency can be met with supplies from other Indian states.

- Bio-fortification of staples and sweet potatoes
- Diversify to encourage better consumption of micronutrient rich food and diverse weaning diets. Home gardens and small livestock, already reportedly widespread in Kerala, are a good way to do this, perhaps through promotion of more nutritious products.

Annex G. WHO classifications of stunting, underweight, and wasting indicators

Uses WHO Child Growth Standards adopted in 2006		Severity of malnutrition prevalence (%)			
		Low	Medium	High	Very high
Prevalence of low height-for-age (stunting) in preschool children	Children's skeletal (linear) growth compromised due to constraints to one or more of nutrition, health, or mother-infant interactions. This is an indicator of chronic nutritional deprivation .	<20	20 – 29	30 39	– >=40
Prevalence of low weight-for-age (underweight) in preschool children	This is a composite measure of child nutritional status, reflecting both chronic and transitory nutritional deprivation . This is a Millennium Development Goal indicator.	<10	10 – 19	20 29	– >=30
Prevalence of low weight-for-height (wasting) in preschool children	Children suffer thinness resulting from energy deficit and/or disease-induced poor appetite, malabsorption, or loss of nutrients. This is an indicator of transitory nutritional deprivation .	<5	5 – 9	10 14	– >=15

Source: Adapted from Table 7.1 in Alderman, Harold; Jere R. Behrman, and John Hoddinott. 2005. Nutrition, Malnutrition, and Economic Growth, in eds López-Casasnovas, Guillem; Berta Rivera & Luis Currais. Health and Economic Growth: Findings and Policy Implications. MIT & WHO website: <http://www.who.int/nutgrowthdb/about/introduction/en/index5.html>

Annex H. Scaling Up Nutrition: the thirteen recommended direct interventions

Evidence Based Direct Interventions to Prevent and Treat Undernutrition

Promoting good nutritional practices (\$2.9 billion):

- breastfeeding
- complementary feeding for infants after the age of six months
- improved hygiene practices including hand-washing

Increasing intake of vitamins and minerals (\$1.5 billion)

Provision of micronutrients for young children and their mothers:

- periodic Vitamin A supplements
- therapeutic zinc supplements for diarrhoea management
- multiple micronutrient powders
- de-worming drugs for children (to reduce losses of nutrients)
- iron-folic acid supplements for pregnant women to prevent and treat anaemia
- iodized oil capsules where iodized salt is unavailable

Provision of micronutrients through food fortification for all:

- salt iodization
- iron fortification of staple food

Therapeutic feeding for malnourished children with special foods (\$6.2 billion):

- prevention or treatment for moderate undernutrition
- treatment of severe undernutrition ("severe acute malnutrition") with ready-to-use therapeutic foods (RUTF).

Source: SUN 2010, with costs taken from Scaling Up Nutrition: What Will it Cost? Horton, et.al. 2009

Note: Figures in brackets are the estimated costs of these for the 36 countries where 90% of malnourished children live.

The **Hunger Alliance** is a joint DFID-NGO consortium which addresses food insecurity and undernutrition and promotes predictable long term responses to food insecurity. We bridge institutional differences between development and humanitarian responses to hunger (food insecurity and undernutrition) in contexts that have a particular vulnerability to crisis. We share information and generate learning around multi-faceted interventions to address food insecurity, including livelihood support to vulnerable groups (such as women, smallholder farmers, pastoralists and agro-pastoralists); safety nets and social protection and nutrition interventions. The Alliance provides a forum for formalising agreement on specific aspects of policy, enabling parties to join forces on policy influence and programming.

The following organisations within the Hunger Alliance supported this project:

Action Against Hunger UK	Action Against Hunger is committed to ending child hunger. We work to save the lives of malnourished children while providing communities with sustainable access to safe water and long-term solutions to hunger.
ActionAid	Founded as a British charity in 1972, ActionAid is an international NGO working in 45 countries worldwide, and our positions and recommendations reflect the experiences of our staff and partners in Africa, Asia, the Americas and Europe. Our vision is a world without poverty and injustice in which every person enjoys the right to a life with dignity. We work with poor and excluded people to eradicate poverty and injustice.
British Red Cross	The British Red Cross helps people in crisis, whoever and wherever they are. We are part of a global voluntary network, responding to conflicts, natural disasters and individual emergencies.
CARE International	CARE International is a leading humanitarian organisation which fights global poverty and provides lifesaving assistance in emergencies. We place special focus on working with poor girls and women because, equipped with the proper resources, they have the power to help lift families and communities out of poverty. Last year, we worked in 84 countries assisting more than 122 million people
Christian Aid	Christian Aid works in more than 40 countries across the world, in partnership with local organisations, the private sector, churches, and governments, to tackle the effects of poverty, as well as its root causes.
Concern Worldwide	Concern Worldwide helps the poorest people in the poorest countries to transform their lives. We seek out those who most urgently need our support, and work with them through thick and thin to tackle poverty, hunger and disaster.
Oxfam	Oxfam GB delivers emergency assistance to people affected by disasters or conflict, and helps to build vulnerable people's resilience to future crises. We also work with others on long-term programmes to eradicate poverty and combat injustice.
Save the Children	Save the Children is the world's independent children's rights organisation. We're outraged that millions of children are still denied proper healthcare, food, education and protection and we're determined to change that.
Tearfund	Tearfund is a Christian relief and development agency working with a global network of churches to help eradicate poverty. Tearfund supports local partners in more than 50 developing countries and has operational programmes in response to disasters.
World Vision UK	World Vision is a Christian relief and development organisation working with children, their families and communities to overcome poverty and injustice in 100 countries around the world.