



Sustainable nutrition security

*Restoring the bridge
between agriculture
and health*



Cover photo: Mothers and children participating at a Junior Farmer Field and Life School in Samba, Central African Republic, May 2012. The schools are part of an FAO project that is helping 22 500 households to increase and diversify food production.

© FAO/Riccardo Gangale

Sustainable nutrition security

*Restoring the bridge between
agriculture and health*

by Modibo Traoré, Brian Thompson
and Graeme Thomas

Contents

Introduction	1
Executive summary	2
The challenge	5
Agriculture, nutrition and gender	10
The way forward	20
The role of FAO's nutrition team	27
References	30

FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS
Rome, September 2012

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views of FAO.

All rights reserved. Reproduction and dissemination of material in this information product for educational or other non-commercial purposes are authorized without any prior written permission from the copyright holders provided the source is fully acknowledged. Reproduction of material in this information product for resale or other commercial purposes is prohibited without written permission of the copyright holders. Applications for such permission should be addressed to: Chief, Electronic Publishing Policy and Support Branch, Communication Division, FAO, Viale delle Terme di Caracalla, 00153 Rome, Italy; or by e-mail to: copyright@fao.org

Introduction

Good health depends on good nutrition. Good nutrition, in turn, depends on agriculture to provide the foods – cereals, pulses, vegetables, fruit, meat, fish, milk and dairy products – for a balanced diet that meets our needs for energy, protein, vitamins and minerals.

The founders of FAO were acutely aware that nutrition is the bridge between agriculture and health. In the preamble to the Organization’s constitution, “raising levels of nutrition” is the first purpose of its Member Nations. FAO’s first Director-General was awarded the Nobel Peace Prize for his pioneering work on nutrition. Nutrition is embedded in FAO’s definition of food security: that all people, at all times, have sufficient, safe and nutritious food for an active and healthy life. In its strategic framework 2010-2019, FAO’s first goal is reducing the number of hungry and ensuring adequate nutrition for all.

Yet, malnutrition remains the world’s most serious health problem and the single biggest contributor to child deaths. Although agriculture currently produces enough food for everyone, the number of people who go to bed hungry is estimated at close to one billion; one third of the developing world’s population suffers micronutrient deficiencies that can lead to blindness, mental retardation and early death; and, worldwide, an estimated 1.5 billion adults are overweight or obese and at greater risk of non-communicable diseases.

It is time to restore the bridge between agriculture and health. FAO’s Member Countries and its development partners are calling for a more incisive analysis of the causes of persistent hunger and malnutrition, a better understanding of how they can be addressed, and practical action to ensure the nutrition, health and well-being of present and future generations. This paper is intended as a contribution to that discussion.

Executive summary

The challenge

Although agriculture currently produces enough food for all, close to 1 billion people are unable to meet their minimum food energy requirements, and 2 billion suffer from “hidden hunger” caused by micronutrient deficiencies. The main victims are the poor, especially young children, pregnant and lactating women, the sick and the elderly.

Because women’s own nutritional status has a direct impact on child nutrition and health, agricultural development aimed specifically at improving the diets of women of reproductive age is crucial to ending the intergenerational cycle of hunger and malnutrition.

Agriculture, nutrition and gender

Sustainable improvements in the nutritional status of women and their children will only be possible when their diets provide all the macro- and micronutrients they need. Narrowing the nutrition gap requires “nutrition-sensitive” food and agriculture systems that explicitly incorporate nutrition objectives.

A proven means of promoting nutrition improvements is the “food-based” approach, which aims at increasing the availability and consumption of the diverse range of foods necessary for a healthy diet. Food-based interventions promote diversification of household food production, recognize the contribution of forest foods to healthy diets, and include the fortification and biofortification of staple foods.

Well designed food-based interventions sustainably improve the diets of vulnerable populations in a relatively short period of time. Factors contributing to successful interventions are: a focus on low-income, resource-poor rural

households and on food production for both household consumption and sale; a good understanding of local nutritional status and livelihoods; behaviour-change communication; and recognition of the crucial role of women in promoting nutritional improvements.

There is a strong positive association between rural women's empowerment and good child nutrition. Women with higher status have better nutritional status themselves, are better cared for, and provide higher quality care to their children. Where inequalities between women and men are greatest, women's health and child nutritional status are poorest. If women and men had equal status in South Asia, the prevalence of underweight children would decline by almost 30 percent. If female farmers had equal access to inputs, they could boost food production enough to reduce the number of undernourished people in the world by up to 150 million.

The way forward

1. Diversify agricultural production. FAO programmes for crops, aquaculture and livestock should promote increased production of nutrient-rich foods for *direct consumption* as well as income generation. Options include homestead production of small livestock, fish and horticultural crops, which improves dietary quality and can generate incomes that women control.

Nutrition-sensitive diversification requires crop varieties and animal stock with enhanced nutritional quality, and post-harvest technologies that reduce food losses and conserve nutrients. They will need to be adapted to a wide range of farming systems, agro-ecological zones and diet typologies.

2. Empower rural women. Rural women are the strongest link between agriculture and good child nutrition. An FAO nutrition-sensitive food and agricultural systems approach must aim, therefore, at supporting rural women of

reproductive age in their multiple roles. At national level, improved diets and higher levels of nutrition among vulnerable women and children should be an explicit goal and expected outcome of food and agricultural development policies. At field level, both nutrition and gender inequities need to be addressed in the design of agricultural development programmes and projects.

3. *Strengthen links between the agriculture, nutrition and health sectors.* Interventions aimed at improving diets and raising levels of nutrition should combine public health, nutrition education and dietary strategies. Agriculturalists need to work with nutritionists to identify deficits in local diets and micronutrient intakes. Food-based interventions will be more effective when accompanied by community health programmes.

4. *Provide nutrition education.* Interventions should include a strong programme of nutrition education and behaviour change, targeted principally towards women, in order to ensure that increases in food supply and income lead to improved household nutrition.

The role of FAO's nutrition team

FAO's nutrition team should play a central role in guiding and supporting an FAO nutrition-sensitive food and agriculture systems approach through:

- *first*, its normative work on nutrition-related indicators, methodologies, tools and guidelines, the design of policies and programmes, and monitoring and evaluation;
- *second*, informed coordination of stakeholders at global level and support to country programmes, including those of FAO, SUN, REACH and NGOs.

The challenge

Fifty years ago, more than half of the developing world's population suffered from chronic undernutrition, with a daily calorie intake insufficient for an active and healthy life (FAO, 1996). Since then, agricultural development has dramatically increased global food production and contributed to economic growth in most developing regions. With the advent of the Green Revolution, world cereal production rose from 876 million tonnes in 1961 to more than 2.4 billion tonnes in 2010, an increase far in excess of population growth (FAO, 2012a). Between 1975 and 2000, cereal yields in South Asia increased by more than 50 percent, while the poverty rate declined by 30 percent (World Bank, 2007b).

However, growth in staple crop production and levels of income has not triggered matching reductions in the incidence of chronic hunger and malnutrition. The number of chronically undernourished – people unable to meet their minimum food energy requirements – rose steadily from 1995 and reached more than 1 billion in 2009 (FAO, 2009d). The proportion of undernourished in the developing world's population has “stabilized” at around 16 percent, only slightly less than average levels of the past 15 years (FAO, 2010).

While nearly 20 percent of the undernourished are found in 22 countries “in protracted crisis” – where recurrent natural disasters or conflicts limit food production and availability – it has been estimated that more than 40 percent live in China and India, which have recorded strong economic growth over the past decade (FAO, 2010). The state of Punjab, which is considered India's breadbasket, has had historically higher levels of malnutrition than other less well endowed areas of the country (World Bank, 2005). That same paradox is found in Sikasso, one of Mali's most fertile and productive agricultural regions, where the incidence of acute child

undernutrition was reported at 16 percent, as high as the national average (UNOCHA, 2009).

Undernutrition – the result of not having enough to eat – frequently overlaps with malnutrition caused by deficiencies in the quality of diets, such as lack of protein and of micronutrients, including iron, iodine, zinc and vitamin A. Micronutrient malnutrition (or “hidden hunger”) afflicts as many as two billion people and can lead to poor physical growth and development, lowered mental capacity, reduced productivity, impaired immune systems and other health problems (FAO, 2010).

The prevalence of vitamin A and iodine deficiencies, which are largely linked to deficiencies in diets, ranges from 30 to 40 percent in Africa and Asia and from 10 to 20 percent in Latin America and the Caribbean. The prevalence of iron deficiencies in non-pregnant women is as high as 40 percent in Africa and Asia and 30 percent in Latin America. Disturbingly, those numbers *have changed very little* since the 1990s, despite widespread initiatives that have promoted the use of supplements, fortificants and ready-to-use therapeutic foods (Meerman, Carisma and Thompson, 2012).

Meanwhile, rapid urbanization in developing countries is accompanied by a “double burden” of malnutrition. On the one hand, more than half of children in Nairobi’s slums are chronically undernourished (UNICEF, 2012). On the other hand, the prevalence of overweight and obesity, and associated chronic diseases such as diabetes, is increasing among those slum dwellers who over-consume low-cost, high-energy and nutrient-poor foods (FAO, 2006b). In 2010, almost 170 million preschool children in developing countries were stunted, while 35 million were overweight or obese (WHO, 2012b).

The causes of persistent hunger and malnutrition are complex. They result from a combination of inadequacies in food access and availability, income, dietary knowledge,

health, sanitation and care. Overwhelmingly, however, the victims have one thing in common: poverty. People in low-income, food-insecure, resource-poor, socially excluded and economically marginalized households, in both rural and urban areas, are malnourished because they do not have enough resources to produce, or enough income to buy, sufficient amounts of all the foods they need. Their precarious nutritional status is undermined further by poor feeding practices, high levels of illness and disease, unsanitary living conditions, and a lack of access to safe drinking water and preventive health services.

Nutrition in poor households is highly vulnerable to shocks. In rural areas, crop failures caused by drought or pest attacks reduce farming households' food supply and income, which in turn reduces both the quantity of food, in terms of dietary energy intakes, and the quality of food, in terms of variety, diversity, nutrient content and safety. Similarly, food price increases force the urban poor to reduce food consumption. When international food prices doubled between 2006 and 2008, about 100 million poor rural and urban people were forced into the ranks of the world's hungry (IFAD, 2010).

Among the poor, the most vulnerable are those whose nutritional needs are higher and social status is lowest: young children, pregnant and lactating women, the sick and the elderly (UNSCN, 2010a). An estimated 60 per cent of the world's undernourished people are women (ECOSOC, 2007). Rural women are particularly vulnerable because they receive less health care and are subject to greater risks, owing to repeated pregnancies and delivery of children (FAO, 2011b).

Hunger and malnutrition place an intolerable burden not only on individuals but on the entire cultural, social and economic fabric of nations. Estimates of GDP lost to malnutrition range from 2 percent to as high as 11 percent in some countries of Central America (FAO, 2010). The annual cost of malnutrition to national economic development has

been calculated at \$360 billion, through the loss of productivity and education and higher health costs (UNSCN, 2010a).

The United Nations' report of 2011 on progress towards the Millennium Development Goals (UN, 2011) says nutrition must be given higher priority in national development if MDG-1, to eradicate extreme hunger and poverty, and the other health-related MDGs are to be achieved. It calls for urgent, accelerated and concerted action aimed at delivering and scaling up nutrition interventions at key stages of the life cycle, particularly from conception to two years after birth ("the first 1000 days").

FAO has welcomed the international consensus on the need to make adequate nutrition the goal of national policies and programmes for agriculture, food supply, social protection, health and education (UN, 2010). Along with greater awareness of the nutrition and health needs of vulnerable households, there is now a sharper focus on the specific needs of mothers, infants and young children living within those households.

Improved nutritional status of mothers is associated with better child health and survival. Good nutrition in the early months of pregnancy has the greatest positive impact on birth outcomes. For the foetus and infant entirely dependent on its mother for nutrients, the consequences of undernutrition are most serious, and more likely to be irreversible, during the first half of those 1000 days. Inadequately nourished mothers perpetuate an intergenerational cycle of deprivation that begins with low birth weight and higher risk of illness and death, and leads to poor classroom performance and low work productivity (Mora and Nestel, 2000; Shrimpton *et al.*, 2001; UNSCN, 2010b).

Because women's own nutritional status has a direct impact on child health and development, agriculture has a unique role to play in efforts to scale up nutrition to benefit

mothers and their children. Adequate nutrition of mothers, either during or preferably before the first six months of pregnancy, and of adolescent girls, offers important opportunities to improve the health and well-being of both mother and child. Improving *the quantity and quality* of the mother's diet leads to better growth in children and, later, to healthier adults (UNSCN, 2010b).

Agricultural development aimed specifically at improving the diets of women of reproductive age is crucial, therefore, to ending the intergenerational cycle of hunger and malnutrition, and restoring the bridge between agriculture and health.

Agriculture, nutrition and gender

About 75 percent of the world's poor and hungry live in rural areas and depend on agriculture as their primary source of food, employment and income (FAO, 2009b). That is why progress in agriculture is essential for long-term, sustainable improvements in nutrition. Agricultural development stimulates national economic growth, and reduces inequality and poverty. Diversification into higher-value crops or more capital-intensive forms of agriculture generates higher cash income. Agriculture provides often the only opportunity to increase rural people's physical and economic access to more and better-quality food.

However, the scale and persistence of inadequate nutrition indicates that it cannot be overcome simply by increasing production of staple food crops. Increasing the supply of foods high in carbohydrates, such as rice, wheat, maize, tubers and cassava, which has been the main focus of agricultural development for the past 50 years, may satisfy dietary energy needs, but does not by itself guarantee commensurate improvements in nutrition.

Similarly, increases in income have not generally led to proportional reductions in malnutrition. Numerous studies have shown that while cash-crop schemes generally led to increased smallholder incomes, overall, commercialization did not have a significant impact – negative or positive – on young child nutritional status (Arimond *et al.*, 2011).

Much more attention needs to be given, not only to the quantity, but also to the *quality* of foods available and consumed, especially among low-income rural households, where monotonous diets high in starchy staples and low in micronutrients are the norm, and where adequate amounts of micronutrient-rich foods, such as meat, dairy products, legumes, vegetables and fruit, are generally unavailable.

In many countries of rural Asia, as much as 80 percent of household diets is made up of cereals, roots and tubers. In rural Bangladesh the proportion of protein- and micronutrient-rich foods in diets is small and even declining (FAO, 2007a). In West Africa, low consumption of foods rich in vitamin A and beta-carotene is the main determinant of chronic vitamin A deficiency, which affects mainly women and children and contributes to high rates of child mortality (FAO, 2003).

Sustainable improvements in the nutritional status of vulnerable households and, particularly, of mothers and young children within those households, will only be possible, therefore, when their diets provide all the macro- and micronutrients they need.

Options available for ensuring the poor's access to a well-balanced diet of good quality include complementing home-grown staple foods with sufficient quantities of protein-, vitamin- and micronutrient-rich foods that can be purchased locally. In practice, however, this approach depends upon sustainably raising disposable incomes and/or lowering the price of those foods.

A more sustainable approach for subsistence farming households is diversification of their food production through the introduction of horticultural crops, fish and livestock that are suited to local agro-ecological conditions and can fill macro- or micronutrient deficiencies in the local diet.

The “food-based” nutrition concept

Narrowing the “nutrition gap” – between what foods are grown and available and what foods are needed for good nutrition – requires “nutrition-sensitive” food and agriculture systems that explicitly incorporate nutrition objectives, concerns and considerations, with the aim of protecting and promoting food and nutrition security. One key strategy in nutrition-sensitive agricultural development is the “food-based” approach, which is aimed at increasing the availability

and consumption of the diverse range of foods necessary for a healthy diet.

The “food-based” approach uses food – whether fresh or processed – as the primary tool for improving the quality of people’s diets, overcoming and preventing malnutrition, and correcting nutritional deficits. (With perhaps the exception of iron, all the nutritional needs of pregnant and lactating women can be met by food alone [FAO, 1981].)

The nutritional quality of the diet improves as a greater diversity of food items and food groups is consumed. Therefore, food-based interventions promote *dietary diversification* by increasing the availability of, access to and consumption of foods with a high content and bioavailability of nutrients throughout the year. Those foods include nutrient-rich animal-source foods, such as red meat, dairy products, poultry and fish, which address multiple nutrient deficiencies, as well as pulses, vegetables and fruit.

Food-based approaches recognize the important contribution that *forest foods*, of plant and animal origin, already make to the diets of low-income households living in and around forest areas. Forest foods include fruit, seeds, tubers, insects, fish and bush-meat, and provide a wide variety of nutrients. For example, some 900 species of edible insects are found in tropical forests, and many enrich local diets with protein, fats and vitamins (FAO, 2005).

When part of a comprehensive strategy, industrial *fortification* of commonly consumed food vehicles – such as iodized salt and fortified flour – and home fortification of meals using micronutrient powders and lipid-based spreads, can all play an important role in food-based nutrition interventions.

A more sustainable approach, however, is *biofortification*, i.e. increasing the vitamin A, iron and zinc content of staple food crops through plant breeding and improved agronomic practices. For example, improved varieties of orange-fleshed

sweet potato and “golden rice” are very rich in beta-carotene; fertilizer can be applied to foliage to enhance its iron content and to the soil to improve the zinc, selenium and iodine content of staple food crops.

Food-based strategies for improving nutrition have often been overlooked as governments, researchers, donors and the health sector sought solutions with rapid start-up times and quick, measurable results. However, experiences in a number of developing countries have shown that well-designed food-based interventions – combined, where appropriate, with the use of supplements and supported by health and nutrition education – can improve the diets of vulnerable populations in a relatively short period of time and that those improvements are sustainable (FAO, 2011a). For example:

Homestead gardening in Bangladesh. A major NGO programme is building household “nutritional self-sufficiency” through the establishment of homestead gardens and poultry units managed mainly by women. The programme reaches 900 000 households and benefits an estimated 4.5 million people. Significantly higher intake of eggs, meat, milk and dark green leafy vegetables – double that of control households – has led to a decline in the prevalence of anaemia in women and in children aged from six months to five years (Arimond *et al.*, 2011).

Orange-fleshed sweet potato in rural Mozambique.

A sustainable nutrition improvement project introduced cultivation of biofortified orange-fleshed sweet potato in an area with high levels of child malnutrition and vitamin A deficiency. By integrating agricultural extension with nutrition education, the project achieved adoption rates of 90 percent among 1 000 farmers, most of them women. Evaluations found reductions of up to 60 per cent in the prevalence of vitamin A deficiency among children, and

sweet potato was the cheapest source of vitamin A available in local markets (Arimond *et al.*, 2011).

Multi-sectoral approach to improving nutrition in Kenya.

An integrated food- and livelihoods-based project in Nyanza Province targeted subsistence farming communities in which almost one child in 10 dies before the age of five. It helped boost food security by supplying subsidized hybrid maize seed and fertilizer, encouraged crop diversification and small-animal production, and started a “home-grown” school meals programme for 20 000 children. By year three, increased consumption of legumes, vegetables and animal-source foods had led to a reduction of 85 percent in the prevalence of underweight among children aged less than two years.

Increased dietary carotenoid intake was associated with a 52 percent drop in the rate of vitamin A deficiency among under-five year olds (Fanzo *et al.*, 2011).

Small animal production in Malawi. Predominantly maize-based diets inhibit iron absorption, resulting in high rates of anaemia among mothers and children. A community-managed revolving fund provided 40 000 goats, rabbits and chickens to rural households, along with training in animal care, intensive nutrition education, iron supplementation and malaria control. A marked increase in the consumption of animal foods – a highly bioavailable source of iron and other micronutrients – was a key factor in a significant reduction in anaemia in children and pregnant women (MacDonald *et al.*, 2011).

Snack food supplements for women of child-bearing age in India. A maternal nutrition project in Mumbai, India, has developed a snack food consisting of fresh green leafy vegetables, milk powder and dried fruit. Among low-income women of child-bearing age, one serving of the snack more than doubles the median intake of fruit, vegetables and milk, and provides micronutrients amounting to 12 to 43 percent of average daily requirements. Trials in rural India found that

mothers with adequate intakes of similar formulations at 28 weeks' gestation delivered fewer low birth-weight babies (Shivashankaran *et al.*, 2011).

Homestead food production in Viet Nam. In 1995, half of pregnant women in Viet Nam suffered from anaemia. The nationwide VAC programme, launched in 1990 with FAO support, promoted vegetable gardening along with aquaculture and animal production in order to provide the diversity of foods that meet community nutritional needs. Surveys have shown that the population's dietary intake improved in both quality and quantity, with much higher meat, fish and fruit intake. By 2002, the prevalence of child malnutrition had fallen and the rate of anaemia in pregnant women had been reduced from 50 percent to one third (Shetty, 2011; Hop, 2003).

Increased fish consumption in Zambia. High levels of malnutrition among children in Luapula province, Zambia, were addressed through an FAO-supported project to improve access to a variety of nutritious foods, generate income for poor and vulnerable groups, and enhance local knowledge of nutrition and health issues. Achievements included more diversified diets, notably the addition of a small pelagic fish to children's porridge. A household survey found a significantly lower prevalence of stunting among children whose diets regularly included fish (Thompson and Subasinghe, 2011; FAO, 2006a).

The examples above illustrate key features of food-based approaches. First, the primary beneficiaries were *low-income rural households*, the main victims of malnutrition. The interventions encouraged food production for *the households' own consumption* – the most direct pathway to improving household members' nutritional status – and also *production for sale* in markets, which provides income that can be used to obtain the variety of food people need. Increased income also

contributes to better health and nutrition when used to purchase other essential goods (e.g. fuel for heating and cooking) and services (e.g. education, health and transport). While promoting agricultural diversification as a means of increasing dietary variety, many of the interventions – for example in Kenya – also supported staple crop production as a source of income and food security.

The more successful interventions were grounded in a *good understanding of the nutritional status and livelihoods of local communities*. They invested in different types of capital: human, physical, social, environmental and financial. Interventions that invested more broadly in various types of capital, such as the homestead programmes in Bangladesh and Viet Nam, cited above, tended to have a greater impact on nutrition than those focused on production only.

Another key finding was that *behaviour-change communication* through multiple channels was a highly effective means of informing beneficiaries about the nutritional qualities of the foods they produced and consumed, which ensured that improved access to food and higher incomes translated into better diets and improved nutrition.

Significantly, in all interventions associated with marked improvement in diets and nutritional status, *women played a crucial role*. As well as being among the main beneficiaries of nutritional improvements, women acquired economic power and knowledge that they shared within their households, particularly for the benefit of young children.

Gender dimensions of nutrition security

Food-based interventions have produced sustainable improvements in the nutrition of mothers and children. In addition, they have confirmed what has been amply reported by numerous studies over the past 20 years: that there is a strong positive association between rural women's

empowerment – through higher incomes and increased control of resources – and child nutrition.

In fact, studies in different developing regions and social contexts have concluded that female empowerment has positive spill-over effects for all household members, especially children (FAO, 2011b).

An IFPRI research report, which analysed data from 36 countries of South Asia, sub-Saharan Africa and Latin America and the Caribbean, found that higher women's status – defined as women's power relative to men's – had a significant, positive effect on children's nutritional status in all three regions. Further, it affirmed that women's empowerment benefits child nutrition because women with higher status have *better nutritional status themselves*, are better cared for, and provide higher quality care to their children (Smith *et al.*, 2003). A later World Bank/IFPRI study of linkages between agricultural development and nutrition also identified “a specific focus on women's empowerment” as one of the key contributors to positive nutrition impact (World Bank, 2007a).

Those findings have found further support in research recently reviewed by FAO (FAO, 2011d). In Brazil, additional income in the hands of women was associated with increased spending on food and increased household consumption of both calories and protein. Maternal income had a significantly larger effect than paternal income in reducing the prevalence of wasting and stunting among children (Thomas, 1997). In extended family households in rural Mexico, higher earnings by *any* female household member were found to have “substantial positive impacts” on child nutrition, while this was not the case with higher male incomes (Djebbari, 2005).

In Malawi, rural women's access to microcredit boosted household spending on food and improved the nutrition of girls aged 0 to 6 years; males' access to microcredit had no

positive nutritional outcomes for either girls or boys (Hazarikha and Guha-Khasnabis, 2008). In Côte d'Ivoire, the nutrition and health improvements seen in children as the result of an increase in women's income would require a *tenfold* increase in male income (Hoddinott and Haddad, 1995).

If rural women's empowerment leads to improvements in household nutrition, then the opposite is also true. As well as highlighting the links between women's control of economic resources and positive nutrition outcomes, the IFPRI study found that where inequalities between women and men are greatest, both women's health and child nutritional status are poorest. In South Asia, especially, the extremely low status of women relative to men is thought to compromise women's own health and the subsequent birth weight of their children (Smith *et al.*, 2003).

Three decades of FAO studies – most recently, the *State of food and agriculture 2010-11* – have documented in great detail the extent, and impact, of discrimination against rural women, its heavy cost to the nutrition and health of women and their children, and the broader economic consequences: wasted human capital and low productivity that stifle rural development and progress in agriculture, and ultimately undermine food and nutrition security.

Discrimination against females pervades rural households, farm production and the wider economy. In India, unpaid work in agriculture accounts for 34 percent of women's informal employment (UNIFEM, 2005); the "gender gap" between rural men's and women's wages in both farm and non-farm employment stands at 50 percent in Costa Rica and Pakistan, and 70 percent in Afghanistan (FAO, IFAD and ILO, 2010). Women are also the victims of "food taboos": in parts of Nigeria, for example, pregnant women are denied eggs, rabbit and antelope meat (Onuorah and Ayo, 2003).

Gender inequity goes a long way to explaining the continuing high rates of malnutrition found among children in

countries with satisfactory aggregate food availability and rapid economic growth. The persistence in India, over decades, of child undernutrition has been linked to the ongoing “feminization” of agriculture, which has increased women’s work burdens, leading to chronic energy deficiency, but with no matching increases in socio-economic status (Gillespie and Kadiyala, 2011); the high rates of hunger among children in Mali’s most productive farming region were put down to a lack of nutritional knowledge and women’s full-time engagement in the production of cash crops for export (UNOCHA, 2009).

IFPRI estimated in 2003 that if women and men had equal status in South Asia, the percentage of children underweight would decline from 46 to 33 percent. The study concluded that, in the interest of sustainably improving child nutrition, women’s status should be improved in all regions. Empowering women, said IFPRI, is a powerful force for improving the health, longevity, capacity and productivity of the next generation of young adults (Smith *et al.*, 2003).

More recently, FAO has calculated the extent to which “levelling the playing field” in agriculture would result in higher income for rural women and generate significant nutrition improvements. Closing the input gap – estimated at 20 to 30 percent – on agricultural land held by women could boost food production enough to reduce the number of undernourished in the world by up to 150 million people. For countries where hunger is more prevalent, particularly those where women play a major role in the agricultural sector, the gains would be even greater.

“Closing the gender gap in agriculture,” FAO concluded, “would put more resources in the hands of women and strengthen their voice within the household – a proven strategy for enhancing the food security, nutrition, education and health of children. Better fed, healthier children learn better and become more productive citizens” (FAO, 2011d).

The way forward

To help restore the bridge between agriculture and health, FAO must play a role commensurate with its global mandate and the vast scale of hunger and malnutrition, which remains the single greatest threat to human development. An FAO Inter-divisional Task Team is charged with formulating a corporate vision and strategy for a nutrition-sensitive food and agriculture systems approach, to be mainstreamed into all of FAO's work from 2014. The process will include a clear commitment to the international development agenda on nutrition, including FAO's active engagement with the Scaling Up Nutrition (SUN) movement and the United Nations Standing Committee on Nutrition (UNSCN).

The following is an outline, for discussion, of key points for the proposed vision and strategy. These points are intended to provide the basis for an FAO programme of food-based nutrition interventions with a priority focus on school-age children and women of reproductive age.

1. Diversify agricultural production

Diversification of smallholder production is a crucial step in agricultural development. Broadening production to include horticulture, small livestock and aquaculture allows smallholders to diversify sources of food in their diets and enter domestic markets for higher-value products. It also increases their resilience to economic and climate risks. Diversified production, therefore, can help improve nutrition, strengthen livelihoods, create opportunities for local agro-processing, generate employment along the value chain, and stimulate rural economic development.

As part of a nutrition-sensitive food and agriculture systems approach, FAO programmes for crop diversification, aquaculture and livestock should include among their goals

explicit improvements in the food consumption and nutrition status of vulnerable households, through increased production of nutrient-rich foods for *direct consumption* as well as for income generation.

Among vulnerable households with limited productive resources, an effective strategy for improving nutrition is homestead food production. By employing household labour intensively in production of crops and animals with high nutritional and monetary value, homestead farming improves the quality of family nutrient intake, while allowing women to fulfil their domestic and child care roles. With extension support, facilitated access to land, credit and markets, and economies of scale achieved through the organization of women in groups, homestead programmes can also generate incomes that women control, leading to better child nutrition and health (Meinzen-Dick *et al.*, 2011).

School feeding programmes that make use of homestead-produced foods not only improve the nutrition of children, but create real opportunities for diversifying and strengthening local small-scale farming systems.

Aquaculture and small animal husbandry provide a valuable source of high quality protein and micronutrients, especially for vulnerable households. Those ventures may need to be supported by female extension workers, by improvements in the nutrient content of soil in which forage is grown, and by the introduction of technologies to prevent food spoilage and losses (Neumann *et al.*, 2011).

Interventions should also encourage the utilization of indigenous foods, including forest foods, which may have considerable potential to address micronutrient deficiencies.

To improve the supply and consumption of vegetables in rapidly growing urban areas, efforts should focus on sustainable intensification of market gardening on city peripheries. Horticulture is a significant activity in cities in many developing countries, but the sector is still largely

informal and sometimes illegal. By integrating horticulture into urban planning, developing countries could reap considerable benefits, including nutrition security, employment creation and recycling of organic wastes (FAO, 2012b). In densely populated slum areas, household micro-gardens allow low-income residents to grow vegetables for consumption and sale (Patterson and Álvarez, 2010).

Nutrition-sensitive diversification is knowledge-intensive, and requires significant support to farmers in testing new practices and adapting technologies. Development support services will need to offer farmers improved and adapted seed and small animal stock, fish species high in nutrients and suitable for small-scale aquaculture, and training in their management.

Research and development programmes can support nutrition-sensitive agriculture by investing in the breeding of crops with enhanced nutritional quality, and developing post-harvest handling, storage, preservation, preparation and processing technologies that reduce post-harvest losses and conserve nutrients. Subsidy programmes can help increase the availability of fertilizers supplemented with micronutrients for the biofortification of food crops.

Interventions will need to be tailored to a wide range of farming systems, agro-ecological zones and diet typologies (Thompson and Meerman, 2010). In the warm, arid and semi-arid tropics, extension services should promote the consumption of local or indigenous plants and animals as well as staple foods, and introduce drought-tolerant cultivars with high micronutrient content. By intercropping cereals with drought-resistant legumes, such as cowpea, farmers can improve soil health and increase yields, thus increasing the local supply of both vegetable protein and dietary energy.

In the warm sub-humid tropics, fertilizers enriched with trace elements are needed to improve the nutritional value of crops. In some countries of the warm humid tropics, dietary

energy supply is adequate but the share of protein and lipids in people's diets is low. Food-based solutions include small livestock production, cereal-legume cropping and horticulture.

FAO technical units will need to collaborate closely in nutrition-sensitive agricultural development. For example, in much of the developing world, irrigated food production may boost yields and nutrition security, but can increase the risk of malaria, which causes anaemia especially in children and pregnant women. Water and crop specialists can help design preventive measures, such as improved drainage, rotations with "dry crops" and integrated pest management. Land tenure and wastewater treatment specialists can assist in development of urban and peri-urban horticulture.

2. Empower rural women

Efforts to restore the bridge between agriculture and health are more likely to succeed when they recognize that *rural women are the strongest link between agriculture and nutrition*. FAO's nutrition-sensitive food and agricultural systems approach must aim, therefore, at supporting rural adolescent girls and women of reproductive age in their multiple roles as food producers, food processors, managers of household resources, care-givers and educators.

FAO's strategy for gender equity in agricultural and rural development has been formulated in response to evidence that gender inequality exacerbates food insecurity and malnutrition (FAO, 2009 a,c). Achieving gender equity requires actions at global, national and local levels that have been amply described in development literature and embodied in declarations, plans of action, policies, programmes and projects for agriculture and rural development (FAO, 2011c; 2007b; Meinzen-Dick *et al.*, 2011; World Bank, 2011).

The challenge now is to see wide implementation of those measures, which are needed to underpin an FAO strategy for nutrition-sensitive agricultural development. At national level,

improved diets and raised levels of nutrition in vulnerable households, and particularly among women and children, need to become explicit goals and expected outcomes of food and agriculture policies and programmes. At field level, both nutrition and gender inequities need to be addressed in the design of agricultural development programmes and projects.

Since smallholder female farmers provide the most direct route to improving household nutrition security, FAO, governments and other development partners need to prioritize support to them in programming. For example, interventions should facilitate the introduction of labour-saving and productivity-enhancing technologies – including fuel-efficient stoves, clean water sources in villages and “gender-aware” farm tools that reduce time spent in the field – in order to allow more time for other activities.

Credit schemes can strengthen women’s position by requiring the registration of assets in women’s names, or targeting loans at rural businesses that employ women. Extension services must learn to adapt their schedules to women’s multiple roles, seasonal workloads and time constraints, and use innovative approaches such as farmer field schools, a proven way of empowering and transferring knowledge to female farmers (FAO, 2011d).

3. Strengthen links between the agriculture, nutrition and health sectors

Interventions aimed at improving diets and raising levels of nutrition cannot rely on agriculture alone. The best approach is one that combines public health, nutrition education and dietary strategies, and involves a team of specialists in nutrition, epidemiology, agriculture, rural extension, adult education, development communication and community health (FAO, 2011a).

Agricultural development programmes rarely consider the health and nutritional status and nutrient requirements of those they are meant to assist, or the adequacy of the nutrient content of the local diet. Agricultural planners usually give primary importance to the agronomic characteristics of the crops they introduce or promote, such as drought tolerance or disease resistance, and how they will fit into existing cropping patterns and fill seasonal food gaps.

Agriculturalists need to work with nutritionists to identify deficits in local diets and micronutrient intakes, and understand the motivations and constraints that determine household consumption decisions (Arimond *et al.*, 2011). A general knowledge of the macro- and micronutrient content of foods and the bioavailability of nutrients provided by meals can guide the selection of the most appropriate diversification strategy and help to identify the most appropriate crops, fish and small animals.

The impact of food-based interventions on nutrition status will be greater if they are accompanied by community health programmes that encourage exclusive breastfeeding of infants for the first six months, home-based fortification and hygienic food storage; improve sanitation; and treat parasitic and helminth infestations, which are important contributors to micronutrient deficiencies.

4. Provide nutrition education

Teach a man and you have taught a man; teach a woman and you teach a family. That popular wisdom from West Africa recognizes women as the guardians and communicators of household knowledge, including that related to nutrition, foods, food preparation, childcare and feeding practices. For that reason, interventions need to include a strong programme of nutrition education and behaviour change, targeted principally towards women, in order to ensure that an increase

in food supply and income translates into better diets and improved household nutrition (FAO, 2011a).

Nutrition education is designed to facilitate the adoption of eating and other nutrition-related behaviours conducive to health. It builds on local knowledge of foods that are available, either in the market or locally produced, in order to define better ways – including better storage, processing and preparation techniques – to improve family diets. Effective entry points for nutrition education in low-income rural communities include agricultural extension, school feeding and school garden programmes, and community-based health care that provides prenatal advice, vaccinations and growth monitoring of infants.

In Bangladesh, nutrition education persuaded women to increase the quantity of vegetables in family meals. In Malawi, it was instrumental in orienting small animal production towards household consumption, rather than for sale. Nutrition education also helps communities gain a sense of empowerment through a better understanding of what makes their children healthy.

FAO expertise in nutrition education and behavioural change will make a key contribution to a nutrition-sensitive food and agriculture systems approach through, for example: nutrition awareness training which helps farmers decide what crops to produce; training of smallholders in food preparation, cooking and food preservation; development of food-based dietary guidelines and nutrition classes for primary schools; training teachers to teach nutrition and work with children in setting up and managing school gardens; and helping communities overcome taboos that deny children and women nutrient-rich foods, such as eggs, meat, pulses and vegetables.

Nutrition education can also help counterbalance the “nutrition diseducation” of advertising campaigns which promote consumption of branded processed foods that are often lower in nutrients than traditional foods.

Operationalizing the approach: the role of FAO’s nutrition team

The nutrition-sensitive food and agriculture systems approach outlined above aims at diversifying food production in order to achieve significant improvements in the nutritional status of all members of vulnerable households, and especially of women and children. The approach cuts across sectors – nutrition, agriculture, health, social protection and education – and involves joint contributions from technical specialists in crop, livestock, fisheries and forestry development.

Consequently, mainstreaming nutrition into agriculture and food security interventions requires a unity of vision among FAO technical units, and innovations in the way they design, implement and evaluate programmes and projects.

FAO’s nutrition specialists need to play a more central role in guiding and supporting the implementation of a nutrition-sensitive food and agriculture systems programme. They can do that by providing improved tools for assessing the nutrition situation in a given area and identifying the major causes of nutrition problems and specific nutrient deficiencies; by designing policies and programmes to overcome the challenges identified; and by monitoring their progress and evaluating their effectiveness.

The nutrition team should be responsible for conducting assessments that define the nature, extent and causes of inadequate nutrition in a population or community, and set benchmarks to monitor progress. The benchmarks may include indicators of food consumption (portion size, frequency and intakes of foods and food groups) and of the prevalence, by age and gender, of micronutrient deficiencies, such as iron deficiency anaemia.

Baseline data will help identify at-risk groups and specific deficiencies – not only of energy, protein and fat, but also of important micronutrients – that could be overcome through, for example, small livestock or fish production, cultivation of biofortified crops or better exploitation and use of underutilized forest foods and communal property resources. The nutrition team should also direct formative research over seasons to gain a full understanding of the interests, behaviours and needs of selected populations, and to shape behaviour-change communication objectives and strategies.

Together, baseline surveys and formative research will guide the setting of objectives and the formulation by technical units, in consultation with target populations, of interventions using approaches that are most likely to be successful and sustainable. The nutrition team will use benchmark indicators and the results of repeat surveys to prepare periodic impact assessments and end-of-project evaluations. Regular monitoring and evaluation will serve programme managers' needs for timely information for trouble-shooting, programme improvement and fine-tuning, and assist in the development of guidelines to facilitate the replication of cost-effective nutrition interventions.

The comparative advantage of the FAO nutrition team will not be put to best use in direct implementation of “nutrition projects” at country level. Rather, the substance of FAO's contribution to programme and project development and implementation should be, first, its normative work on nutrition-related indicators and tools, on methodologies and guidelines for nutrition and dietary assessment, on the analysis of this data and its use in the design of more effective food and agricultural policies and programmes, and on the monitoring and evaluation of their impact.

Second, the FAO nutrition team should provide informed coordination among stakeholders. At global level, that coordination will be conducted through the Committee on

World Food Security, the UNSCN and the SUN movement. At field level, FAO nutrition teams, based regionally, should support country programmes, beginning with those that already have a nutrition focus and including those of FAO, SUN, REACH and NGOs. Support would include conducting *ex-ante* and *ex-post* programme evaluation, and providing operational teams with advice on programme design, including nutrition education and training-of-trainers.

Finally, FAO's key role in restoring the bridge between agriculture and health needs to be duly recognized by other UN agencies and adequately supported by its Member Countries and the donor community.

References

- Arimond, M., Hawkes, C., Ruel, M.T., Sifri, Z., Berti, P.R., Leroy, J.L., Low, J.W., Brown, L.R. & Frongillo, E.A. 2011. Agricultural interventions and nutrition: Lessons from the past and new evidence. In B. Thompson & L. Amoroso, eds. *Combating micronutrient deficiencies: Food-based approaches*, pp. 41-75. Rome, FAO and Wallingford, UK, CABI.
- Djebbari, H. 2005. *The impact on nutrition of the intrahousehold distribution of power*. Institute for the Study of Labor (IZA) Discussion Paper, No. 1701. Bonn, Germany, IZA.
- ECOSOC (United Nations Economic and Social Council). 2007. *Strengthening efforts to eradicate poverty and hunger, including through the global partnership for development*. Report of the Secretary-General. New York.
- Fanzo, J., Remans, R., Pronyk, P.M., Negin, J., Wariero, J., Mutuo, P., Masira, J., Diru, W., Lelera, E., Kim, D., Nemser, B., Muñoz, M., Palm, C., Sanchez, P., Ehrlich Sachs, S. & Sachs, J.D. 2011. A 3-year cohort study to assess the impact of an integrated food- and livelihood-based model on undernutrition in rural Western Kenya. In B. Thompson & L. Amoroso, eds. *Combating micronutrient deficiencies: Food-based approaches*, pp. 76-91. Rome, FAO and Wallingford, UK, CABI.
- FAO (Food and Agriculture Organization of the United Nations). 1981. *Diet and the pregnant and lactating woman*, by R.G. Whitehead & A.A. Paul. Joint FAO/WHO/UNU Expert Consultation on Energy and Protein Requirements, Rome, 5 to 17 October 1981. Rome.
- FAO. 1996. *World Food Summit. Food for all*. Rome, 13-17 November 1996. Rome.
- FAO. 2003. *Food security and nutrition trends in West Africa – Challenges and the way forward*, by C. Lopriore & E. Muehlhoff. Paper prepared for the 2nd international workshop on food-based approaches for a healthy nutrition. Ouagadougou.
- FAO. 2005. *Non-wood forest products and nutrition*. Appendix 4.1.2 of the report of the international expert consultation on non-wood forest products, Yogyakarta, 17-27 January 1995. Rome.
- FAO. 2006a. *Luapula food security, nutrition action and communication project, Zambia GCP/ZAM/059/BEL*. Final report of a Tripartite Evaluation Mission. Rome.
- FAO. 2006b. *The double burden of malnutrition: Case studies from six developing countries*. FAO food and nutrition paper, No. 84. Rome.

- FAO. 2007a. *Food-based nutrition strategies in Bangladesh. Experience of integrated horticulture and nutrition development*, by L. Bhattacharjee, S. Kumar & B.K. Nandi. Bangkok, FAO Regional Office for Asia and the Pacific.
- FAO. 2007b. *Gender and Development Plan of Action (2008-2013)*. Document prepared for the FAO Conference, Thirty-fourth Session, Rome, 17-24 November 2007. Rome.
- FAO. 2009a. *Bridging the gap. FAO's programme for gender equality in agriculture and rural development*. Rome.
- FAO. 2009b. *How to feed the world in 2050*. Rome.
- FAO. 2009c. *Strategic framework 2010-2019*. Document prepared for the FAO Conference, Thirty-fifth session, Rome, 18-23 November 2009. Rome.
- FAO. 2009d. *The state of food insecurity in the world 2009: Economic crises – impacts and lessons learned*. Rome.
- FAO. 2010. *The state of food insecurity in the world 2010: Addressing food insecurity in protracted crises*. Rome.
- FAO. 2011a. *Combating micronutrient deficiencies: Food-based approaches*, by B. Thompson & L. Amoroso, eds. Rome, FAO and Wallingford, UK, CABI.
- FAO. 2011b. *Intra-household bargaining, gender roles in agriculture and how to promote welfare enhancing changes*, by H. Seebens. ESA Working Paper No. 11-10, March 2011. Rome.
- FAO. 2011c. *Policy roundtable – Gender, food security and nutrition*. Document prepared for the Committee on World Food Security, Thirty-seventh session, Rome, 17-22 October 2011. Rome.
- FAO. 2011d. *The state of food and agriculture 2010-11. Women in agriculture: Closing the gender gap for development*. Rome.
- FAO. 2012a. FAOSTAT statistical database ([http:// faostat.fao.org/](http://faostat.fao.org/)).
- FAO. 2012b. *Growing greener cities in Africa. First status report on urban and peri-urban horticulture in Africa*. Rome.
- FAO, IFAD (International Fund for Agricultural Development) & ILO (International Labour Organization). 2010. *Gender dimensions of rural and agricultural employment: Differentiated pathways out of poverty. A global perspective*, by M. Fontana & C. Paciello. Paper presented at the FAO-IFAD-ILO Workshop on gaps, trends and current research in gender dimension of agricultural and rural employment, Rome, 31 March – 2 April 2009. Rome.
- Gillespie, S. & Kadiyala, S. 2011. *Exploring the agriculture–nutrition disconnect in India*. IFPRI Conference brief, 20. Washington, DC, IFPRI (International Food Policy Research Institute).

- Hazarika, G. & Guha-Khasnobis, B. 2008. *Household access to microcredit and children's food security in rural Malawi: A gender perspective*. Institute for the Study of Labor (IZA) Discussion Paper, No. 3793. Bonn, Germany, IZA.
- Hoddinott, J. & Haddad, L. 1995. Does female income share influence household expenditures? Evidence from Côte D'Ivoire. *Oxford Bulletin of Economic and Statistics*, 57(1): 77–96.
- Hop, L.T. 2003. Programs to improve production and consumption of animal source foods and malnutrition in Vietnam. *J. Nutr.*, 133(11): 4006S-4009S.
- IFAD. 2010. *Rural poverty report 2011*. Rome.
- MacDonald, A.C., Main, B.J., Namarika, R.H., Yiannakis, M.E. & Mildon, A.M. 2011. Small animal revolving funds: An innovative programming model to increase access to and consumption of animal-source foods by rural households in Malawi. In B. Thompson & L. Amoroso, eds. *Combating micronutrient deficiencies: Food-based approaches*, pp. 137-149. Rome, FAO and Wallingford, UK, CABI.
- Meerman, J., Carisma, B. & Thompson, B. 2012. *Global, Regional, and Subregional Trends in Undernourishment and Malnutrition*. Draft paper. Rome, FAO. (mimeo)
- Meinzen-Dick, R., Behrman, J., Menon, P. & Quisumbing, A. 2011. *Gender: A key dimension linking agricultural programs to improved nutrition and health*. IFPRI Conference brief, 9. Washington, DC, IFPRI.
- Mora, J.O. & Nestel, P.S. 2000. Improving prenatal nutrition in developing countries: Strategies, prospects, and challenges. *Am. J. Clin. Nutr.*, 71(5 Suppl): 1353S–1363S.
- Neumann, C.G., Bwibo, N.O., Gewa, C.A. & Drorbaugh, N. 2011. Animal-source foods as a food-based approach to address nutrient deficiencies and functional outcomes: A study among Kenyan schoolchildren. In B. Thompson & L. Amoroso, eds. *Combating micronutrient deficiencies: Food-based approaches*, pp. 117-136. Rome, FAO and Wallingford, UK, CABI.
- Onuorah, C.E. & Ayo, J.A. 2003. Food taboos and their nutritional implications on developing nations like Nigeria – A review. *Nutrition & Food Science*, 33(5): 235-240.
- Patterson, W. & Álvarez, M. 2010. The growing connection project – Mexico case study. In FAO. *Proceedings of the international symposium on food and nutrition security: Food-based approaches for improving diets and raising levels of nutrition, FAO, Rome, December 2010*. Rome, FAO and Wallingford, UK, CABI. (in press)

- Shetty, P. 2011. Addressing micronutrient malnutrition to achieve nutrition security. In B. Thompson & L. Amoroso, eds. *Combating micronutrient deficiencies: Food-based approaches*, pp. 28-40. Rome, FAO and Wallingford, UK, CABI.
- Shivashankaran, D., Gurumurthy, S., Kehoe, S.H., Chheda, P.S., Margetts, B.M., Muley-Lotankar, P., Agarwal, A., Brown, N., Sahariah, S.A., Taskar, V., Fall, C.H.D. & Potdar, R.D. 2011. Developing micronutrient-rich snacks for pre-conception and antenatal health: the Mumbai maternal nutrition project (MMNP). In B. Thompson & L. Amoroso, eds. *Combating micronutrient deficiencies: Food-based approaches*, pp. 214-223. Rome, FAO and Wallingford, UK, CABI.
- Smith, L.C., Ramakrishnan, U., Ndiaye, A., Haddad, L.J. & Martorell, R. 2003. *The importance of women's status for child nutrition in developing countries*. IFPRI Research Report No. 131. Washington, DC, IFPRI.
- Shrimpton, R., Victora, C.G., de Onis, M., Costa Lima, R., Blossner, M. & Clugston, G. 2001. Worldwide timing of growth faltering: Implications for nutritional interventions. *Pediatrics* 107(5): 1-7.
- Thomas, D. 1997. Incomes, expenditures and health outcomes: Evidence on intrahousehold resource allocation. In L. Haddad, J. Hoddinott, & H. Alderman, eds. *Intrahousehold resource allocation in developing countries: Models, methods and policy*, pp. 142-164. Washington, DC, IFPRI and Baltimore, USA, Johns Hopkins University Press.
- Thompson, B. & Meerman, J. 2010. Towards long-term nutrition security: The role of agriculture in dietary diversity. In FAO. *Proceedings of the international symposium on food and nutrition security: Food-based approaches for improving diets and raising levels of nutrition, FAO, Rome, December 2010*. Rome, FAO and Wallingford, UK, CABI. (in press)
- Thompson, B. & Subasinghe, R. 2011. Aquaculture's role in improving food and nutrition security. In B. Thompson & L. Amoroso, eds. *Combating micronutrient deficiencies: Food-based approaches*, pp. 150-162. Rome, FAO and Wallingford, UK, CABI.
- UN (United Nations). 2010. *A road map for scaling up nutrition (SUN)*. New York, USA.
- UN. 2011. *Millennium Development Goals Report 2011*. New York, USA.
- UNICEF (United Nations Children's Fund). 2012. *State of the world's children 2012: Children in an urban world*. New York, USA.
- UNIFEM (United Nations Entity for Gender Equality and the Empowerment of Women). 2005. *Progress of the world's women 2005: Women, work and poverty*, by M. Chen, J. Vanek, F. Lund, J. Heintz, R. Jhabvala & C. Bonner. New York, USA.

- UNOCHA (UN Office for the Coordination of Humanitarian Affairs). 2009. *Mali. The paradox of plenty*. Nairobi.
- UNSCN (United Nations Standing Committee on Nutrition). 2010a. *Nutrition and the MDGs: Accelerating progress towards 2015*. New York, USA.
- UNSCN. 2010b. *Sixth report on the world nutrition situation*. New York, USA.
- World Bank. 2005. *India's undernourished children: A call for reform and action*, by M. Gragnolati, M. Shekar, M. Das Gupta, C. Bredekamp & Y.K. Lee. HNP discussion paper. Washington, DC, International Bank for Reconstruction and Development and World Bank.
- World Bank. 2006. *Repositioning nutrition as central to development – A strategy for large-scale action*. Washington, DC.
- World Bank. 2007a. *From agriculture to nutrition: Pathways, synergies and outcomes*. Report No. 40196-GLB. Washington, DC.
- World Bank. 2007b. *World development report 2008*. Washington, DC.
- World Bank. 2011. *World development report 2012: Gender equality and development*. Washington, DC.
- WHO (World Health Organization). 2011. *Global status report on noncommunicable diseases 2010*. Geneva, Switzerland.
- WHO. 2012a. Global database on body mass index (<http://apps.who.int/bmi/index.jsp>).
- WHO. 2012b. Global database on child growth and malnutrition (<http://www.who.int/nutgrowthdb/estimates/en/index.html>).
- WHO. 2012c. Micronutrients database (<http://www.who.int/vmnis/database/en/>).

