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**Nutrition-sensitive
agriculture**

Photo: J. Boethling

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Dear Reader,

The concept of “nutrition-sensitive agriculture” sets out from the assumption that agriculture has a role in providing food security – which means access for all people at all times to sufficient, safe, and nutritious food. However, judging from the number of close to 800 million people who are classified as chronically hungry and an estimated two billion people suffering from micronutrient malnutrition, it would appear that agriculture is not fulfilling this role, or at least not doing so adequately. How can this be remedied? For one thing, agricultural policies, projects and investments need to be steered towards increasing availability and access to precisely those foods that many people lack for a healthy diet – vegetables, fruits, legumes and some animal source food. Second, the impact of agriculture on nutrition has to be measured more accurately in order to draw conclusions regarding targets and the design of interventions. Here, you can find some key recommendations in our introductory contribution (p. 6).

Seeds form the basis of all agricultural production. Our authors discuss what functioning seed systems must look like to maintain the three pillars of food security – availability, access and utilisation of food. The possibility for farmers to use their own farm-saved seeds, especially for crops of minor economic importance and in emergency situations, is crucial in this context, as is nutrition quality assuming a higher status in breeding programmes (p. 10).

Increasing dietary diversity constitutes an important strategy to improve nutrition and health. However, unlike frequently assumed, raising production diversity on the farm does not automatically result in greater consumption diversity in rural households; in certain circumstances, improved market access and options to generate off-farm income can play a more decisive role (p.12).

Women’s empowerment is often seen as the key to improving nutrition. But even though much is known about the roles which both men and women play in the interaction between agriculture, nutrition and health, many crosslinks are as yet not explained. Which gender-based differences matter most for nutrition- and health-related outcomes, and how exactly do different aspects of empowerment impact on these outcomes? What unintended consequences of agricultural interventions could arise for women’s well-being and empowerment? (p. 15).

More than 40 per cent of the just below 1.3 billion people living in India are vegetarians, and their diets make them particularly dependent on high-quality plant-based proteins. With their considerable nutritional value, pulses offer the best conditions to cover this requirement. However, there is still a huge gap between supply and demand. Our author describes the mea-

sures that the government could take to promote production and consumption of these nutritious crops (p. 20). The United Nations is providing impetus that such steps can benefit from, having declared 2016 the International Year of Pulses (p. 18).

How does the concept of nutrition-sensitive agriculture affect development co-operation? Stefan Schmitz of Germany’s Ministry for Economic Cooperation and Development outlines the programmes of the Special Initiative “One World – No Hunger”. Here, the key components are nutrition education and the integration of nutrition in value chain development (p. 23). The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) demonstrates how these elements can be implemented with the example of its project activities in Kenya, Benin, Ghana, Nigeria and Ethiopia (p. 26).

The use of quality infrastructure services can help improve the quality of food. Not only can potential threats to consumers be fended off, but tangible income benefits can also be attained for farmers. However, a lack of awareness among actors as well as insufficient incentives often present obstacles to using the corresponding services, as our example from Ghana shows (p. 35).

The Sirkhazi Organic Farmers Association in the Indian State of Tamil Nadu has committed itself to the production and marketing of chemical-free food. And what is more, with around 180 traditional rice varieties that they are producing for conservation purposes, these farmers are making an important contribution to conserving agro-biodiversity while also strengthening self-reliance among the communities (p. 38).

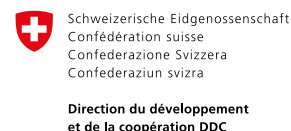
For rural extension workers, access to relevant and up-to-date agricultural information is often time-consuming and costly. The International Livestock Research Institute in Ethiopia has equipped around 100 of them with e-book-readers to test whether and how this tool can facilitate their daily work. Portability, the long battery life and the ease of use the gadgets offer went down well with the extension workers. However, incompatibility with local language scripts and difficulties in tackling technical problems sometimes proved disheartening (p. 41).

We wish you inspired reading.

Silvia Richter



Partner institutions of Rural 21:



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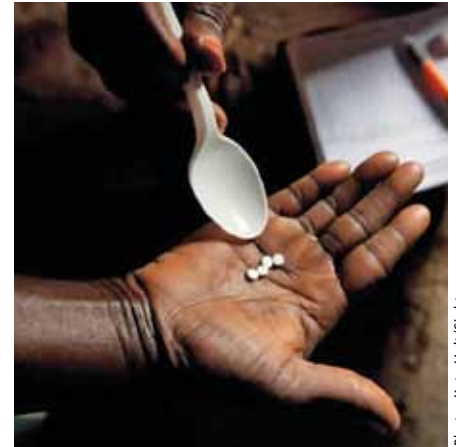


Photo: Kate Holt/Sightsavers



Photo: IFPRI/Milo Mitchell



Photo: Susanne Neirel



Photo: Sharada Balasubramanian

Reaching the last mile

Around 1.5 billion people worldwide are affected by the so-called neglected tropical diseases (NTDs) – illnesses that the poorest of the poor usually suffer from and that could easily be defeated – if there was enough funding and political will to do so. In May this year, the World Health Organization (WHO) will be launching an initiative to focus the national combating strategies addressing individual NTDs pursued by the countries affected. Magda Robalo of the WHO Regional Office for Africa presented the initiative at an event in March held by the German network against neglected tropical diseases in Berlin.

According to the WHO definition of the term, “neglected tropical diseases” refers to a group of 17 communicable diseases that occur in 149 tropical and subtropical countries and “mainly affect populations living in poverty, without adequate sanitation and in close contact with infectious vectors and domestic animals and livestock”. These include well-known diseases such as dengue, sleeping sickness and leprosy – but also less familiar ones like river blindness (onchocerciasis) and lymphatic filariasis. These latter diseases are at the focus of the WHO initiative ESPEN – the Expanded Special Project for the Elimination of Neglected Tropical Diseases. “We want to reach 145 million people in 26 countries by 2016,” said Magda Robalo, Director of the Communicable Diseases Cluster (CDS) at the WHO’s Regional Office for Africa, explaining the ambitious goal of the initiative, which is to run for five years. Instead of single disease initiatives such as the African Programme for the Control of Onchocerciasis (APOC), which expired in December 2015, an integrated, multiple disease approach is to be applied in future that “puts the countries on the driver seat” and gives them space to define their own priorities.

The African Region bears about 40 per cent of the global burden of NTDs. All the 47 countries of the region are endemic for at least two NTDs, and



*Lymphatic filariasis is one of the NTDs the new WHO initiative focuses on.
Photo: Centre for Neglected Tropical Diseases*

ESPEN requires an annual budget of ten million US dollars to support its operations. So far, however, the WHO has only two million US dollars at its disposal for this purpose. Magda Robalo demonstrated how well financial means had been invested in combating NTDs with the example of Guinea worm disease. In 1986, 3.5 million cases had been reported; today, the disease is close to eradication. The trend in the number of people surviving HIV/Aids also clearly reflected how much success could be scored if political will and public attention were there, and, above all, enough money was provided and the right drugs were developed.

However, all these factors are usually still posing problems in combating NTDs – despite a number of good drugs being available, as Professor Achim Hörauf, Director of the Institute of Medical Microbiology, Immunology and Parasitology at Bonn University, pointed out. At the meeting in Berlin, Hörauf referred to the agent Ivermectin, which is used to tackle river blindness and lymphatic filariasis. Furthermore, many drugs are now being provided by pharmaceutical companies free of charge. However, the way the parasites live, and hence the duration and type of

therapy, often thwart the efforts of the medical scientists. For example, Ivermectin only kills off the larvae of the worms (so-called microfilaria) that cause river blindness. But as long as the adult female worms are living under people’s skin, and they do so for up to 17 years, the programmes to combat them have to be consistently continued. “Each year, therapy has to reach people even in the remotest areas”, Hörauf noted.

This is one of the greatest challenges in combating neglected tropical diseases, which “often start where the roads end,” as Professor Martin Kollmann, Senior Advisor for NTDs at Christoffel Blindenmission (CBM), put it. Efforts to permanently master the diseases will not meet with success if the health systems themselves are not strengthened. Here, capacity building in the countries affected, involving the rural communities and especially supporting the peripheral health services, would have to be a priority in order to ultimately achieve the goal of universal health coverage. Magda Robalo rounded off the event with an optimistic forecast: “If Coca Cola can manage to get to even the remotest village, why shouldn’t we be able to do so with healthcare?”

Silvia Richter

Land rights need to be protected

Only one-fifth of the land cultivated by rural and indigenous communities in developing countries is legally protected from land grabbing by governments and companies. Since 2002, nearly one thousand people have been killed as a result of violent land conflicts. This is revealed in the report "Common Ground", published in March 2016 by the International Land Coalition (ILC), Oxfam and the Rights and Resources Initiative (RRI). The report connects with a Call for Action for the Protection of Land Rights, with which more than 300 organisations worldwide have aligned themselves.

The lack of protection of land rights has serious consequences: Since 1990, conflicts over land rights have frequently been at the centre of civil wars. In Darfur, for example, the break-up of the traditional land ownership structure triggered conflicts between pastoralists and farmers. Globally, land conflicts are becoming increasingly acute, particularly in Brazil, Honduras, Peru and the Phil-

ippines. Since 2002, the number of people killed in the struggle for land rights has been increasing. In addition, insecure land rights mean reduced protection from land grabbing by mining or agricultural companies, which appropriate forests, grazing grounds or agricultural land with the help of governments and local elites.

Peace in the affected countries is only possible if land conflicts are settled in a manner that is acceptable for all involved parties. The report provides examples of the positive effect that can come from secured land rights:

Mongolia: After decades of state control, followed by a phase of privatisation, Mongolia is now handing over public pasture land to the responsibility of communities. Old land administration structures are thus being revived. The result: The degradation of soil conditions could be significantly reduced and incomes of the participating communities increase by 50 per cent.

Guatemala: In the Maya Biosphere Reserve, as a measure against the deforestation of the rainforest, communities are permitted small-scale use of the forest. As a result, the deforestation rate in this part of the rainforest remained twenty times lower than in two other parks. Land rights mean that these natural resources are better protected.

Sri Lanka: When the military in Sri Lanka drove out residents from their land on the east coast in 2011 in order to build a tourist site, the women of the Paanama area responded with public campaigns and legal action. They took the case to court, submitted a petition to the national human rights commission and allied themselves with other groups. At the start of 2015, the new government ordered the land to be returned to the community. *(ile)*

For more information, see:

➤ www.rural21.com

Dependency on food imports threatens food security

Worldwide, the potential collapse of food imports threatens the food security of 200 million people, according to study results published by the Mercator Research Institute on Global Commons and Climate Change (MCC) in March 2016.

Many developing countries produce insufficient staple foods, be it wheat, rice or corn, for their own needs and are dependent on importing these from a few exporting countries. The MCC researchers estimated what would happen if major exporters were to reduce or stop their exports, after events such as a heat wave or drought. Their finding: Import-dependent countries with a large poor population would be particularly affected, especially some West African

countries that rely on rice imports. Countries in North Africa and Central America are the most dependent on imports, although the poor there are less affected. By contrast, in sub-Saharan Africa, dependence on imports is lower, but the poor are more affected.

If Thailand, as the world's largest rice supplier, were to stop its exports, this would impact 136 million people from Mauritania to Nigeria who are considered poor according to the definition of the World Bank. The loss of as little as five per cent of rice on the market of a developing country could drive up the price there by 17 per cent. This is a dramatic price hike for people having less than two dollars a day. A halt of corn exports by the United States, market leader of that

staple, would have far-reaching consequences and affect some 21 million people, mostly in Central America and the Caribbean. As for wheat, countries in North Africa and the Middle East would be the most vulnerable to import-related price increases.

These scenarios are plausible, according to the researchers. Indeed, major exporting nations such as Russia, Thailand and Vietnam tend to adopt restrictive export policies when seeking to pull their own domestic markets through difficult times. Moreover, extreme weather events are becoming more frequent, which takes its toll on the harvests and returns. *(ile)*

For more information, see:

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How agriculture can boost nutrition

That agriculture can play a crucial role in the fight against malnutrition is no new insight. But what has to be done for agriculture to adequately fulfil this vital role? Our author reports on the state of debate and presents the multiple entry points and top priorities for nutrition-sensitive agriculture.

The last five years have seen a groundswell of interest in improving nutrition through agriculture, globally and within countries. Countries and donors have committed both rhetorically and financially to nutrition-sensitive agriculture (e.g. the Nutrition for Growth commitments, the commitments of the Second International Conference on Nutrition [ICN2], and the UN Sustainable Development Goals). These commitments reflect recognition that food systems do not satisfy the nutritional needs of all, and that malnutrition cannot be solved by therapeutic interventions alone. Commitments, however, need to be followed through with action. This overview briefly presents the multiple entry points and top priorities for nutrition-sensitive agriculture.

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As the main producer of food, agriculture has a role in providing access for all to safe, nutritious sufficient food to meet dietary needs year round. Since that is the definition of food security (see box), “nutrition-sensitive agriculture” is not so much a new concept as an emphasis on a central rationale for agricultural development. Generally, nutrition-sensitive agriculture refers to agriculture which has a nutrition objective and addresses one or more of the underlying causes of malnutrition, including inadequate food access, care and feeding practices, and health and sanitation environments.

It should be noted that there have been different terms used to communicate this basic concept, such as “nutrition-directed” agriculture and “nutrition-enhancing” agriculture. While different stakeholders may prefer various terms to reflect a similar concept, the majority of discourse uses the term “nutrition-sensitive”.

Inadequate access to nutritious food results in poor diets. Given current food availability, it is theoretically possible for all people to consume enough calories; however, even if food were equally distributed it would be impossible for all people to consume recommended nutritious diets. This is a problem that manifests in all forms of malnutrition, including maternal and child undernutrition, micronutrient deficiencies, overweight and obesity and diet-related non-communicable diseases (NCDs). All countries in the world have a serious burden of malnutrition. Increasingly, low-income countries suffer from the “double burden” of both undernutrition of various forms (child stunting,

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 a healthy and active life.

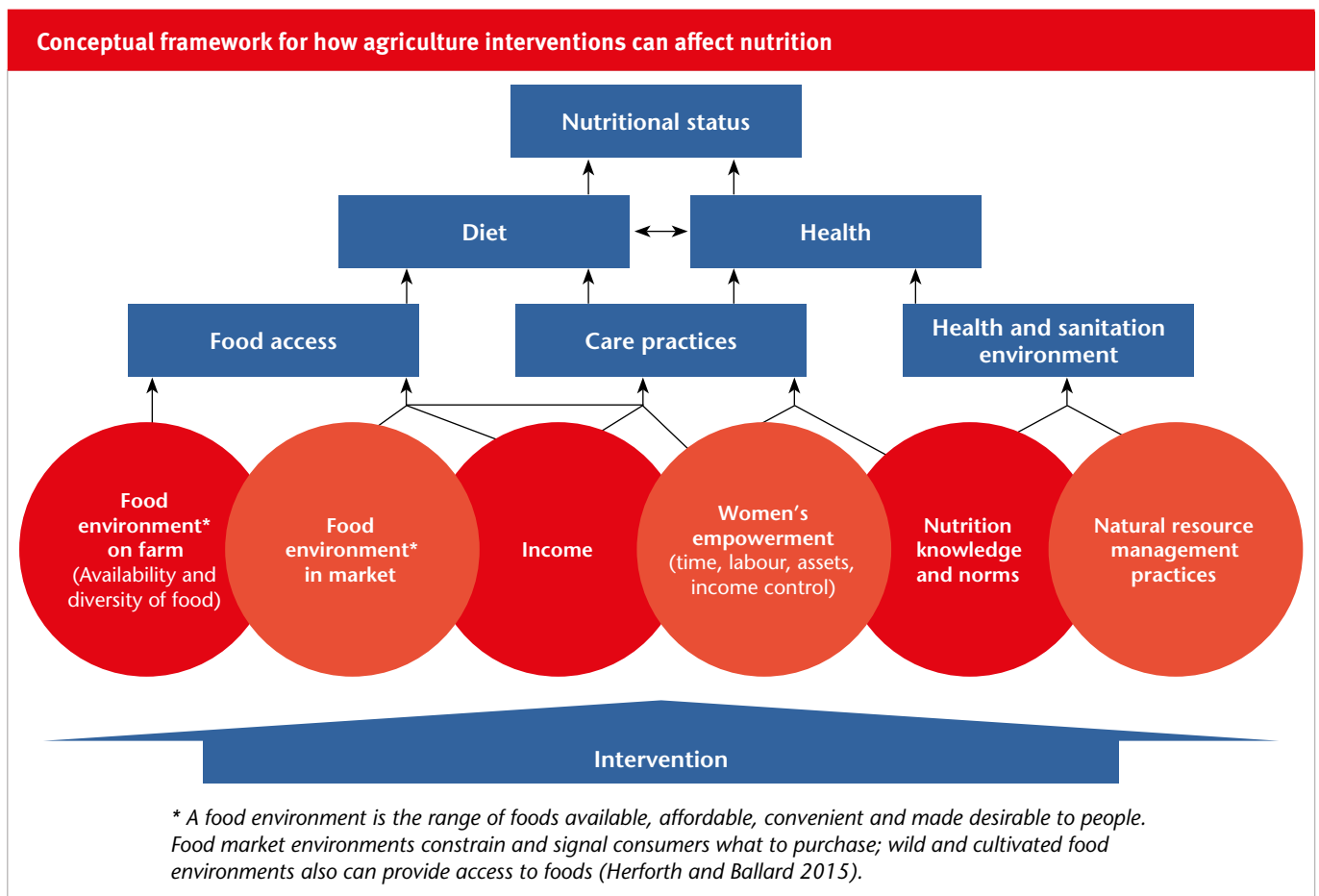
FAO/UN definition 1996

maternal underweight, vitamin and mineral deficiencies) and increasing prevalence of overweight, obesity and diabetes. Sub-Saharan Africa and South Asia – the regions with the highest burden of child undernutrition – are also projected to have the biggest increases in diabetes by 2030. Dietary risks are the number one risk factor for deaths and disability-adjusted life-years (DALYs) lost globally. Among the top contributors to dietary risks are low fruit and vegetables, high sodium, low nuts and seeds, low whole grains, low omega-3 fatty acids, low fibre, and high processed meat. These dietary risks mirror food availability and affordability.

How, then, can agriculture investments, projects and policies be more nutrition-sensitive? One primary way is to increase availability and access to the micronutrient-rich, diverse, and often perishable foods that are missing or inadequate in diets of most people: vegetables, fruits, legumes, and some animal-

source foods. Public, non-profit and private investments have a role in making these foods more available and affordable, as well as less risky and more lucrative for farmers to grow. In many places demand for diverse diets including these foods is increasing, but several factors prevent an efficient supply response; one factor is continued policy and investment emphasis on a small number of staple grains, relative to crop-neutral research and development (R&D) and policies. This calls for a shift in direction from what has been the main focus of R&D and investment since the Green Revolution – growing more calories through staple grains – towards investment in more diverse foods; also described as a shift in focus from a *food shortage* paradigm towards a *nutritious food shortage* paradigm (World Bank 2014). Nutritious diets are less available and affordable than unhealthy diets; if the situation were reversed, market signals would support, rather than thwart, consumption of healthy diets.

A second overarching way that agriculture can become more nutrition-sensitive is by improved measurement of its impact, to enable better targets, feedback and design. Rather than stopping at increased production and income and assuming positive nutrition impact, much more information could be gained by measuring impacts on factors more closely related to nutrition. Indicators of dietary quality and access to nutritious foods are often appropriate to many nutrition-sensitive agriculture interventions. The most appropriate indicators will vary by the scope and nature of the investment, and should match the pathways the investment will affect. These can be selected from numerous existing indicators, including those that have been well-researched and validated to measure specific constructs, such as the Minimum Dietary Diversity for Women (MDD-W) and the Food Insecurity Experience Scale (FIES). Where standard indicators have not been developed, many indicators are being used, and further research



and creativity is needed – particularly to measure the food environment, the health and sanitation environment, and women’s empowerment.

There are several other entry points for nutrition-sensitive agriculture including, and beyond, food. The Figure on page 7 shows many of the ways agriculture can affect nutrition – which is useful for both planning interventions and measuring their impact. Investments may affect:

- The foods available and affordable in markets, as well as the diversity of foods available on farm. Access to adequate nutritious food occurs when *both* food environments and individual factors (such as income) allow people to obtain sufficient, safe, nutritious food to meet dietary needs.
- Women’s time, labour, income, and other aspects of empowerment. These affect not only women’s own nutrition, but that of their whole families including young children, given women’s role as nutritional gatekeepers.
- Natural resource management practices can affect health risks, such as through water availability or contamination, disease vectors, and hygiene regarding proximity with animals.
- Nutrition knowledge and norms, which can modify care practices and health risks. Well-targeted nutrition education and promotion could be delivered through the agriculture sector itself or in partnership with other sectors such as health and education.

These multiple entry points are encapsulated in the “Key Recommendations for Improving Nutrition through Agriculture and Food Systems” (see Box). These were formulated by the Ag2Nut Community of Practice and adopted by the UN Food and Agriculture Organization (FAO), following an extensive review of available guidance on agriculture programming for nutrition and through consultation with a

broad range of partners (CSOs, NGOs, government staff, donors, UN agencies). These recommendations reflect the remarkable consistency within the development community on the main principles for what can be done to improve nutrition through agriculture, and are adopted and used by many

organisations. Given their brevity, FAO has also recently released a checklist and guidance for programme formulation, which contains more detailed guidance on how these principles can be incorporated into projects.

For references, see: > www.rural21.com

Key Recommendations for Improving Nutrition through Agriculture and Food Systems

Agricultural programmes and investments can strengthen their impact on nutrition if they ...

- 1) **Incorporate explicit nutrition objectives and indicators into their design**, and track and mitigate potential harms, while seeking synergies with economic, social and environmental objectives.
- 2) **Assess the context at the local level, to design appropriate activities to address the types and causes of malnutrition**, including chronic or acute undernutrition, vitamin and mineral deficiencies, and obesity and chronic disease. Context assessment can include potential food resources, agro-ecology, seasonality of production and income, access to productive resources such as land, market opportunities and infrastructure, gender dynamics and roles, opportunities for collaboration with other sectors or programmes, and local priorities.
- 3) **Target the vulnerable and improve equity** through participation, access to resources and decent employment. Vulnerable groups include smallholders, women, youth, the landless, urban dwellers and the unemployed.
- 4) **Collaborate and coordinate with other sectors** (health, environment, social protection, labour, water and sanitation, education, energy) and programmes, through joint strategies with common goals, to address concurrently the multiple underlying causes of malnutrition.
- 5) **Maintain or improve the natural resource base** (water, soil, air, climate, biodiversity) critical to the livelihoods and resilience of vulnerable farmers and to sustainable food and nutrition security for all. Manage water resources, in particular to reduce vector-borne illness and to ensure sustainable, safe household water sources.
- 6) **Empower women** by ensuring access to productive resources, income opportunities, extension services and information, credit, labour and time-saving technologies (including energy and water services) and supporting their voice in household and farming decisions. Equitable opportunities to earn and learn should be compatible with safe pregnancy and young child feeding.
- 7) **Facilitate production diversification, and increase production of nutrient-dense crops and small-scale livestock** (for example, horticultural products, legumes, livestock and fish at a small scale, underutilised crops, and biofortified crops). Diversified production systems are important to vulnerable producers to enable resilience to climate and price shocks, more diverse food consumption, reduction of seasonal food and income fluctuations, and greater and more gender-equitable income generation.
- 8) **Improve processing, storage and preservation** to retain nutritional value, shelf-life, and food safety, to reduce seasonality of food insecurity and post-harvest losses, and to make healthy foods convenient to prepare.
- 9) **Expand markets and market access for vulnerable groups, particularly for marketing nutritious foods** or products vulnerable groups have a comparative advantage in producing. This can include innovative promotion (such as marketing based on nutrient content), value additions, access to price information, and farmer associations.
- 10) **Incorporate nutrition promotion and education** around food and sustainable food systems that builds on existing local knowledge, attitudes and practices. Nutrition knowledge can enhance the impact of production and income in rural households, especially important for women and young children, and can increase demand for nutritious foods in the general population.

Source: FAO 2015

A Little Nutrition Glossary

A4NH

The *Research Program on Agriculture for Nutrition and Health* (A4NH) is one of 16 research programmes of the Consultative Group on International Agricultural Research (CGIAR). It has four components: value chains for enhanced nutrition; bio-fortification; prevention and control of agriculture-associated diseases; and integrated agriculture, nutrition, and health programmes and policies.

Ag2Nut Community of Practice

The *Agriculture-Nutrition Community of Practice* (Ag2Nut CoP) is a global network of roughly 650 professionals from 49 countries. The group arose in June 2010 to facilitate the work of multiple organisations all concurrently developing guidance on how to link agriculture and nutrition. The Ag2Nut CoP is hosted by the United Nations Standing Committee on Nutrition (UNSCN).

Biofortification/Fortification

Fortification is the practice of deliberately increasing the content of an essential micronutrient, i.e. vitamins and minerals (including trace elements) in a food, so as to improve the nutritional quality of the food supply. *Biofortification* is the process by which the nutritional quality of food crops is improved through agronomic practices – either by conventional (selective) plant breeding or by genetic engineering. So biofortification aims to increase nutrient levels in crops during plant growth rather than through manual means during processing of the crops. It may therefore present a way to reach populations where supplementation and conventional fortification activities are difficult to implement and/or are limited.

DALY – Disability-Adjusted Life Year

The *disability-adjusted life year* (DALY) is a measure of overall disease burden. It is expressed as the number of years lost due to ill-health, disability or early death. The DALY was developed in the 1990s as a way of comparing the overall health and life expectancy of different countries.

FIES – Food Insecurity Experience Scale

The *Food Insecurity Experience Scale* (FIES), developed by the UN Food and Agriculture Organization's 'Voices of the Hungry' project, is an experience-based metric of severity of food insecurity that relies on people's direct responses. People are asked eight questions regarding their access to adequate food. The FIES is to supplement traditional ways that indirectly assess food insecurity, such as FAO's 'prevalence of undernourishment', determinants such as 'food availability' or 'income', and outcome measures such as 'nutritional status'.

HDDS – Household Dietary Diversity Score

The *Household Dietary Diversity Score* (HDDS) counts the food of groups that a household has consumed over the preceding 24 hours (FAO score). It is meant to reflect the economic ability of households to access a variety of foods, and sets out from the assumption that an increase in dietary diversity is associated with socio-economic status and household food security. Furthermore, various dietary diversity scores have been validated for several age/sex groups as measures to reflect macro and/or micronutrient adequacy of the diet. This is why different food groups are entered in the respective scores.

Hidden hunger

Hidden hunger or micronutrient deficiency is a form of → *undernutrition* that occurs when intake or absorption of vitamins and minerals is too low to sustain good health and development in children and normal physical and mental function in adults. Causes include poor diet, disease, or increased micronutrient needs not met during pregnancy and lactation.

Hunger

Hunger refers to the distress associated with lack of food. The UN Food and Agriculture Organization (FAO) defines food deprivation, or → *undernourishment*, as the consumption of fewer than about 1,800 kilocalories a day – the minimum that most people require to live a healthy and productive life.

ICN/ICN2

The *Second International Conference on Nutrition* (ICN2) was a high-level intergovernmental meeting at the FAO Headquarters in Rome in November 2014; the first conference (ICN) took place in 1992. The outcome documents of the ICN2 include the 'Rome Declaration on Nutrition' and the 'Framework for Action'; endorsed by the participating parliaments, they are intended to commit world leaders to establishing national policies aimed at eradicating malnutrition and transforming food systems to make nutritious diets available to all.

Malnutrition

Malnutrition refers to an abnormal physiological condition, typically due to eating the wrong amount and/or kinds of foods; it encompasses both undernutrition (problems of deficiencies) and overnutrition (problems of unbalanced diets, such as consuming too many calories in relation to requirements with or without low intake of micronutrient-rich foods).

MDD-W – Minimum Dietary Diversity for Women

see → *WDDS*

The Nutrition for Growth (N4G) commitments

The Nutrition for Growth (N4G) commitments were established at the Nutrition for Growth Summit in London/UK in June 2013. The Compact states the goal of preventing at least 20 million children from being stunted and saving at least 1.7 million lives by 2020. To meet these goals, donor governments, businesses, foundations and civil society organisations have secured new commitments of 4.15 billion US dollars to scale up nutrition specific actions by 2020.

SUN Movement

The *Scaling Up Nutrition* (SUN) *Movement* launched in 2010 is a global network of representatives from governments, civil society, the United Nations and the private sector. The aim is to address malnutrition through country-led approaches. Fifty-six countries are now represented in the network.

Undernourishment

Undernourishment describes a chronic calorie deficiency with consumption of less than 1,800 kilocalories a day, the minimum most people need to live a healthy, productive life (see also → *hunger*).

Undernutrition

Undernutrition signifies deficiencies in any or all of the following: energy, protein, or essential vitamins and minerals. Undernutrition is the result of inadequate intake of food – in terms of either quantity or quality –, poor utilisation of nutrients due to infections or other illnesses, or a combination of these factors.

WDDS – Women's Dietary Diversity Score

The *Women's Dietary Diversity Score* (WDDS) reflects the probability of micronutrient adequacy of a woman's diet. In 2014, a new indicator, *Minimum Dietary Diversity – Women* (MDD-W) was added. It reflects the consumption of at least five of ten food groups: starchy staple foods, beans and peas, nuts and seeds, dairy, flesh foods, eggs, vitamin A-rich dark green leafy vegetables, other vitamin A-rich vegetables and fruits, other vegetables, and other fruits. (sri)

(Sources: CGIAR, FAO, IFPRI, WHO)

What should seed systems look like?

The concept of nutrition-sensitive agriculture addresses the relationships between agricultural production, human nutrition and health by focusing on the nutritional outcomes of farming and food systems. This article discusses ways in which seed issues are related to the concept, and suggestions are made for addressing such relations when designing seed-related policies.

Nutrition-sensitive agriculture (NSA) strongly relates to the definition of food and nutrition security, which is based on the three pillars of availability, access to and utilisation of food, with stability being an inherent feature of all three. Hence, when looking at how the issue of seed is linked to NSA, it could be a first step to explore how it is linked to these pillars (see Figure on page 11).

■ Seeds and the availability of food

Seeds are the basis of all agricultural production. Unlike other agricultural 'inputs', such as fertilisers or pesticides, they are indispensable. So in order to produce food, farmers need seed at the time of sowing. Therefore, a functioning seed system which makes seeds available in sufficient quantity and quality and at the time needed is an important prerequisite for ensuring food availability in a country. This task

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alone is not trivial to perform: in many developing countries, it is a challenge to ensure that seeds from the formal breeding and seed sector reach distribution points in rural areas when they are needed. Farmers are keen to retain seeds from their own harvest because, apart from avoiding costs, this makes them independent from external supply. Decentralised seed production and distribution systems can thus be important elements of food and nutrition security, particularly where extreme weather conditions such as floods or landslides occur frequently and make it difficult to supply farmers in remote areas with seeds produced elsewhere.

Not all varieties realise their full yield potential under less favourable growing conditions. Adaptation of varieties to soil and climate is therefore an important factor in helping to ensure availability of adequate quantities of food. Such inherent traits may be found in seeds of certain varieties, either as a result of farmers' own selection, or of science-based plant breeding. In areas where climate and soil conditions are highly variable, farmers tend to adjust the land area allocated to certain crops and varieties every year, based on their latest observations and past experiences. Hence, seeds of a range of varieties have to be at their disposal at the time of sowing in order to mitigate effects of variable production and climate conditions, and to make farming and food systems more resilient.



*Dried maize cobs saved from the general harvest.
Photo: massonforstock/www.fotosearch.com*

■ Seeds and access to food

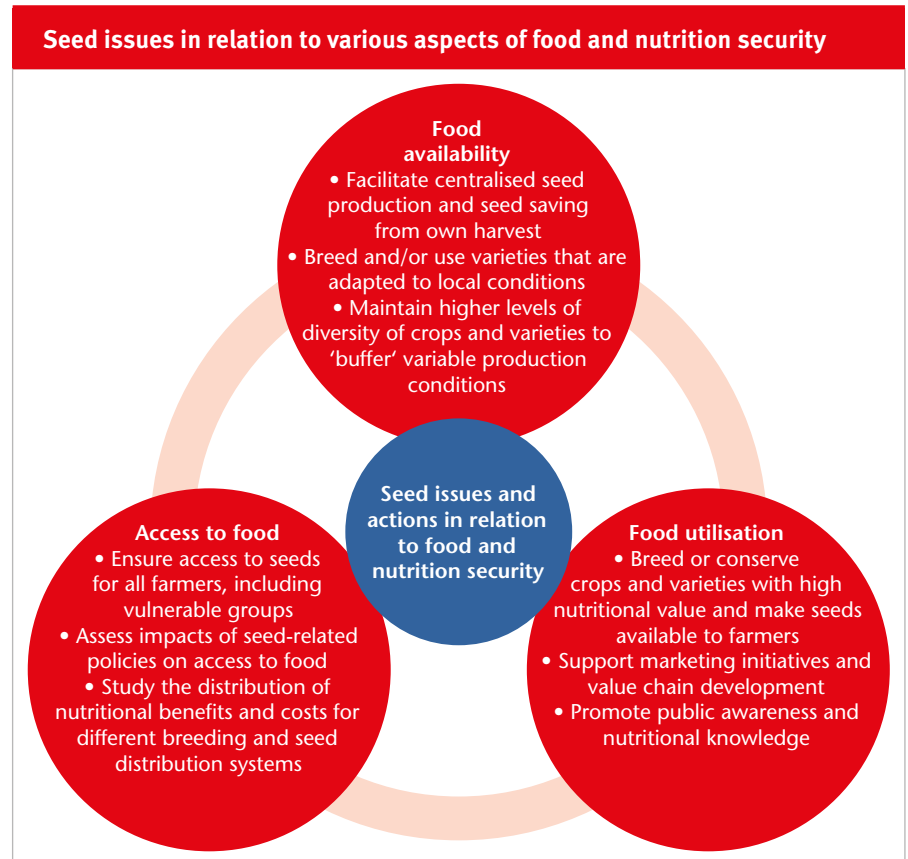
Not only the physical availability of seeds but also the individual's entitlements to access them are important for food and nutrition security. The price of farmer-produced seeds is usually much lower compared to certified seeds from the formal sector. Farm-saved seeds are of outstanding importance in developing countries; for many crops of 'minor' economic importance, they are even the sole source of seed. Hence, the possibility for farmers to use their own seeds or to locally borrow, exchange or purchase them from family members or neighbours ensures their access to seeds, also in emergency situations.

Variety protection and seed laws can affect farmer-managed seed systems, with different impacts on various groups of people, depending e.g. on gender, ethnic affiliation or wealth group. Such laws have a potentially large impact on food and nutrition security, since not only rural families, but also urban populations depend on the farmers' ability to access seed of a range of crops in a variety of situations. Whether the increase in production costs that is associated with the use of 'modern varieties' and 'improved seed' is outweighed by potential nutritional benefits, e.g. improved quantity and quality of food consumed, should be carefully assessed for the specific conditions found in each country and for different groups of farmers and consumers.

■ Seeds and food utilisation

The utilisation aspect of food and nutrition security entails issues such as quality losses during storage and processing, and nutritional quality of the food items used, as well as the preparation and composition of meals according to dietary needs of individuals. Post-harvest quality and nutrient content are determined by genetic traits of crop varieties used, besides other factors. These traits can be enhanced or maintained through breeding and targeted selection. Many traditional crops and varieties contain high levels of micronutrients, and screening of germplasm collections for nutritionally relevant traits shows that there is considerable genetic variability in important food crops. Nutritional quality has, however, not played an important role in most breeding programmes in the past, so that the potential of plant breeding to contribute to nutritional improvements has remained largely untapped. Some plant breeding programmes, such as the AgroSalud and Biofort programmes in Latin America, or breeding initiatives under the A4NH of CGIAR and HarvestPlus (see page 9), have focused especially on increasing the micronutrient contents of crops such as sweet potatoes, cassava, maize, rice, wheat, pearl millet and beans, to address widespread deficiencies ('hidden hunger'). Whether farmers can use such nutritionally valuable crops, either new or traditional ones, depends on whether they can access seeds of these varieties, and whether their cultivation is rewarded by their market partners. Hence, supportive measures may be required in order to raise public awareness and create marketing opportunities. Where traditional seed production and distribution networks become weak, alternative pathways may gain importance, e.g. seed fairs, seed producer networks or community seed banks.

Furthermore, dietary needs of individuals differ, e.g. depending on sex, age and health status. Preparing food according to individual dietary needs requires nutritional knowledge, diversity of foods to choose from, and



possibilities of access. Hence, to support the utilisation dimension of food and nutrition security, farmers need seeds of a range of nutritionally valuable crops to provide their own families and communities as well as urban consumers with nutritious foods the whole year round, from which individuals can make the 'right' choices.

■ Outlook and conclusions

In many developing countries, farming, food and seed systems are presently undergoing a process of transformation. In the course of this process, seed and variety protection laws are being introduced or revised. In order to direct the transformation process towards improved nutritional outcomes, particularly for vulnerable groups, the human right to food needs strong consideration by governments and donors. Different actors in seed systems have at the same time shared and diverging interests. For example, farmers and consumers are interested in having a range of diverse crops and varieties at their disposal, whereas private seed companies strive for increas-

ing the market share of the relatively few crops and varieties they focus on. Hybrid varieties can increase agricultural production but may impede access to seed for vulnerable groups who cannot afford to purchase new seeds year after year. 'Better-off' farmers, however, may be interested in using these varieties. It is a responsibility of governments to balance such diverging interests. Policies and incentives have to be targeted and evaluated more clearly towards nutritional outcomes; various actors' contributions and approaches may be needed to establish seed systems that are supportive to NSA. Lastly, the concept of NSA entails more than improving the various aspects of food and nutrition security. Feedback loops between farming, environmental and human health are often insufficiently addressed by agricultural and food policies. Therefore, research and institutions are needed that address such interrelated policy fields and develop adequate programmes and activities. In this regard, the recently launched SDGs and relevant human rights could provide guidance for governments, civil society and the private sector alike.



Agricultural production systems in Africa are often highly diversified.
Photo: M. Qaim

Market access and farm household dietary diversity

Diversifying the range of crop and livestock species produced by smallholder farmers is often seen as a good strategy to improve their dietary diversity and nutrition. Based on data from different countries, we show that this link between production and consumption diversity is less strong than typically assumed. Market access plays a much more important role for dietary quality in farm households.

Hunger and malnutrition are complex global problems. In spite of improvements in food and nutrition security over the last decades, the prevalence of undernutrition remains high, especially in Africa and Asia. Close to 800 million people are still classified as chronically hungry, meaning that they do not have sufficient access to calories. An estimated two billion people suffer from micronutrient malnutrition, mostly due to low intakes of vitamins and minerals such as iron and zinc. Nutritional deficiencies

are responsible for a large health burden in terms of lost productivity, impaired physical and mental human development, susceptibility to various diseases and premature deaths. Nutritional deficiencies are not only the result of low food quantities consumed, but also of poor dietary quality and diversity. In fact, indicators of dietary diversity are often used as proxies for people's broader nutritional status because diverse diets facilitate balanced intakes of all essential nutrients.

Increasing dietary diversity is therefore an important strategy to improve nutrition and health. This implies that agricultural production also needs to be diversified, so that a wide range of different types of foods are available and accessible to poor population segments as well. Over the last 50 years, agricultural modernisation

has contributed to narrowing global production patterns with a focus on a limited number of major crop plants.

In Africa and Asia, the majority of the undernourished people live in rural areas. Many of them are smallholder farmers. Against this background, further diversifying production on these smallholder farms is often perceived as a useful approach to improve dietary diversity and nutrition. Several recent development initiatives have promoted smallholder diversification through introducing additional crop and livestock species with the intention to improve household nutrition. As farm diversity can help to increase agrobiodiversity too, this approach is also welcome from an environmental angle. But is there really such a clear link between production diversity on the farm and consumption diversity in

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the farm household? And what other factors influence this relationship and dietary diversity in smallholder households more generally?

■ Conceptual frame

A positive relationship between farm production diversity and dietary diversity is plausible, as much of what smallholders produce is consumed at home. However, assuming that all smallholders are pure subsistence farmers without selling and buying any food is too simplistic. Taking into account market transactions, the relationship becomes more complex. Instead of producing everything at home, households can buy food diversity in the market when they generate sufficient income. Farm diversification may contribute to income growth and income stability up to a certain point, but beyond that point, further diversification may also reduce household income, because benefits from specialisation cannot be realised. As lower household incomes tend to be associated with lower dietary quality, the relationship between production and consumption diversity may even turn negative in some situations.

Beyond farming, most smallholder households in developing countries have off-farm sources of income as well, further adding to complexity. When relying on markets, nutrition effects in farm households will also depend on how well the markets function and who within the household controls the income from commercial farm sales and off-farm employment. It is known that gender aspects can play important roles in determining household food and nutrition security. Hence, the direction and strength of the production-consumption diversity link will be situation-specific.

■ Empirical evidence

In a recent study, we have analysed the role of production diversity and market access for farm household dietary diversity with data from various developing countries. In particu-

Selected farm and household characteristics in four countries

	Ethiopia	Malawi	Kenya	Indonesia	Four countries combined
	Mean values (standard deviations)				
Farm size (ha)	1.63 (1.91)	0.74 (0.60)	0.71 (0.94)	4.50 (7.42)	1.26 (2.60)
Market distance (km)	63.53 (47.50)	8.17 (5.71)	3.09 (3.58)	6.55 (7.41)	21.27 (33.37)
Production diversity (number of crop/livestock species produced per farm)	10.19 (5.81)	4.80 (3.08)	7.82 (2.58)	1.74 (0.91)	6.13 (4.75)
Dietary diversity score (number of food groups consumed by farm households)	5.42 (1.70)	8.48 (2.02)	11.40 (0.97)	10.02 (1.29)	7.99 (2.48)
Number of observations	2,045	5,114	397	674	8,230

lar, we used more than 8,000 household-level observations from Ethiopia, Kenya, Malawi, and Indonesia (K.T. Sibhatu, V.V. Krishna, M. Qaim, 2015. Proc Natl Acad Sci USA 112: 10657-10662). We measured production diversity in terms of the number of crop and livestock species produced on a farm. Dietary diversity was measured in terms of the number of different food groups consumed by the farm household (see Table).

■ Role of production diversity

Country comparisons reveal that dietary diversity is higher in situations with more commercialised agriculture than in subsistence-oriented settings. For instance, dietary diversity is highest in Indonesia, where most of the farm households in the sample have specialised in the production of non-food cash crops such as rubber and oil palm. This suggests that specialisation and low on-farm production diversity are not necessarily associated with lower dietary diversity, when diverse types of foods can be purchased from the market.

Regression models were used to analyse this relationship further and control for possible confounding factors, such as differences in education, gender, and household wealth. The results show that production diversity

has a positive effect on dietary diversity. However, this effect is relatively small. On average, producing one additional crop or livestock species on the farm only leads to a one per cent increase in the number of food groups consumed by the farm household. The effect is smaller still in situations where the level of production diversity is already high, as is the case in many subsistence-oriented settings in Africa. In Ethiopia, for instance, the average farm produces ten different crop and livestock species (see Table).

■ Role of market access

We also analysed the role of market access by including additional explanatory variables into the regression models. Market proximity has positive effects on dietary diversity, and these effects are stronger than those of farm production diversity. Moreover, the effect of production diversity on household diets tends to decline with higher levels of market integration.

Selling farm produce significantly improves dietary quality, as the cash income generated allows households to purchase diverse foods from the market throughout the year. The average effect of commercial sales on household dietary diversity is five times stronger than that of producing one additional crop or livestock spe-

cies on the farm. Hence, facilitating the commercialisation of smallholder farms is a better strategy to improve nutrition than promoting more diversified subsistence production.

We also found that households operating highly diversified farms tend to buy less diverse foods in the market. This is perhaps not surprising: if the farm produces diverse foods itself, diversity from the market may not be needed to the same extent. However, diversified own production cannot fully substitute for diversity from the market. Even subsistence farms often depend on market purchases for many food items, at least seasonally. In Ethiopia and Malawi, where the average degree of commercialisation is relatively low, farm households acquire 50 to 60 per cent of the foods consumed from the market. In Kenya and Indonesia, the share of market purchases is still higher than this.

Another indicator of market access is the availability of off-farm income sources. Many smallholders complement their farm income with off-farm income when employment opportunities in other sectors arise. Our analysis shows that off-farm income is clearly associated with higher dietary diversity. Cash earnings from off-farm activities increase the households' ability to buy diverse foods from the market. At the same time, the availability of off-farm income reduces the role of farm production diversity for household nutritional quality.

Wider implications

Increasing people's dietary diversity is an important strategy to improve nutrition and health. At aggregate level, this also requires diversification of agricultural systems. A research and policy focus on only a few cereal crops, as was sometimes observed during past decades, may have been useful to address issues of calorie undersupply, but seems less suitable to deal with problems of various nutritional deficiencies. While sustainably increasing the productivity of cereal crops remains a continuous challenge,

agricultural research and policy efforts need to be broadened and also include the promotion of plant and animal species that were rather neglected in the past. Improved technologies and market potentials for a broader set of agricultural species would increase farmers' incentives to adopt alternatives best suited to their conditions. The optimal mix will vary from one location to another. More diverse agricultural systems are also good for biodiversity and the environment.

Yet, this plea for more diverse agriculture should not be misunderstood in a way that every individual farm should increase the level of production diversity. Especially in smallholder systems of Africa, the number of different species produced is often quite high anyway. Resource-poor farmers diversify their sources of food and income as a risk-coping strategy. Our analysis with data from different African and Asian countries showed that farm production diversity is positively associated with dietary diversity in some situations, but not in all. When production diversity is already high, the dietary diversity relationship is not significant, or it even turns negative, because of foregone income resulting from farm diversification beyond economically optimal levels.

Our results also demonstrated that smallholder access to agricultural markets and off-farm employment has positive effects on household dietary diversity. In most cases, these market effects are stronger than those of increased production diversity. Comparisons show that more commercialised farms that produce cash crops for the market have more diverse diets than subsistence farms on average. Households with higher cash incomes tend to buy more diverse foods from the market. This food diversity from the market cannot be fully substituted

through diverse subsistence production.

While improved market access often provides incentives for farmers to specialise, actual outcomes depend on many factors. Where properly functioning markets for various commodities exist, commercial orientation of farms and high levels of production diversity are not necessarily a contradiction. Markets and their functioning need to be strengthened to provide economic incentives to produce diverse foods. Without proper market incentives, a strategy to increase production diversity will rather foster subsistence, act against comparative advantage, and thus be associated with income losses for farm households.

Conclusion

The common assumption that higher farm production diversity is always conducive to household nutrition needs adjustment. The most suitable policy mix to improve nutrition in smallholder farm households will vary from case to case. In many situations, facilitating market access through improved infrastructure and other policies to reduce transaction costs and price distortions seems to be more promising than promoting further production diversification as such.



Dietary quality in farm households is often relatively low, especially in remote settings with poor market access.

Photo: M. Qaim



Women watering crops in Ethiopia. Irrigation has shown great potential to improve nutrition and livelihoods. Photo: IFPRI/F.G. Mariam

Gendered pathways to better nutrition

Food and nutrition security cannot be achieved without paying attention to gender. Much is already known about the close links between agriculture, nutrition and health and the roles that women and men play respectively in this context. But there are still many open questions.

Ensuring that poor people have access to nutritious and high-quality diets is a daunting challenge. Typically, poor households subsist on monotonous staple-based diets, lacking in nutritious foods, such as fruits, vegetables, animal source foods like fish, meat, eggs and dairy products, or wild foods of high nutrient content. Lack of diversity in the diet is strongly associated with inadequate intake and risks of deficiencies of essential micronutrients. The resulting deficiencies have far-reaching health and nutrition consequences, both in the short and the long term. Economic constraints, lack of knowledge and information and related lack of demand for nutritious foods are critical factors that limit poor populations' access to such foods.

■ Understanding agriculture, nutrition, and gender linkages

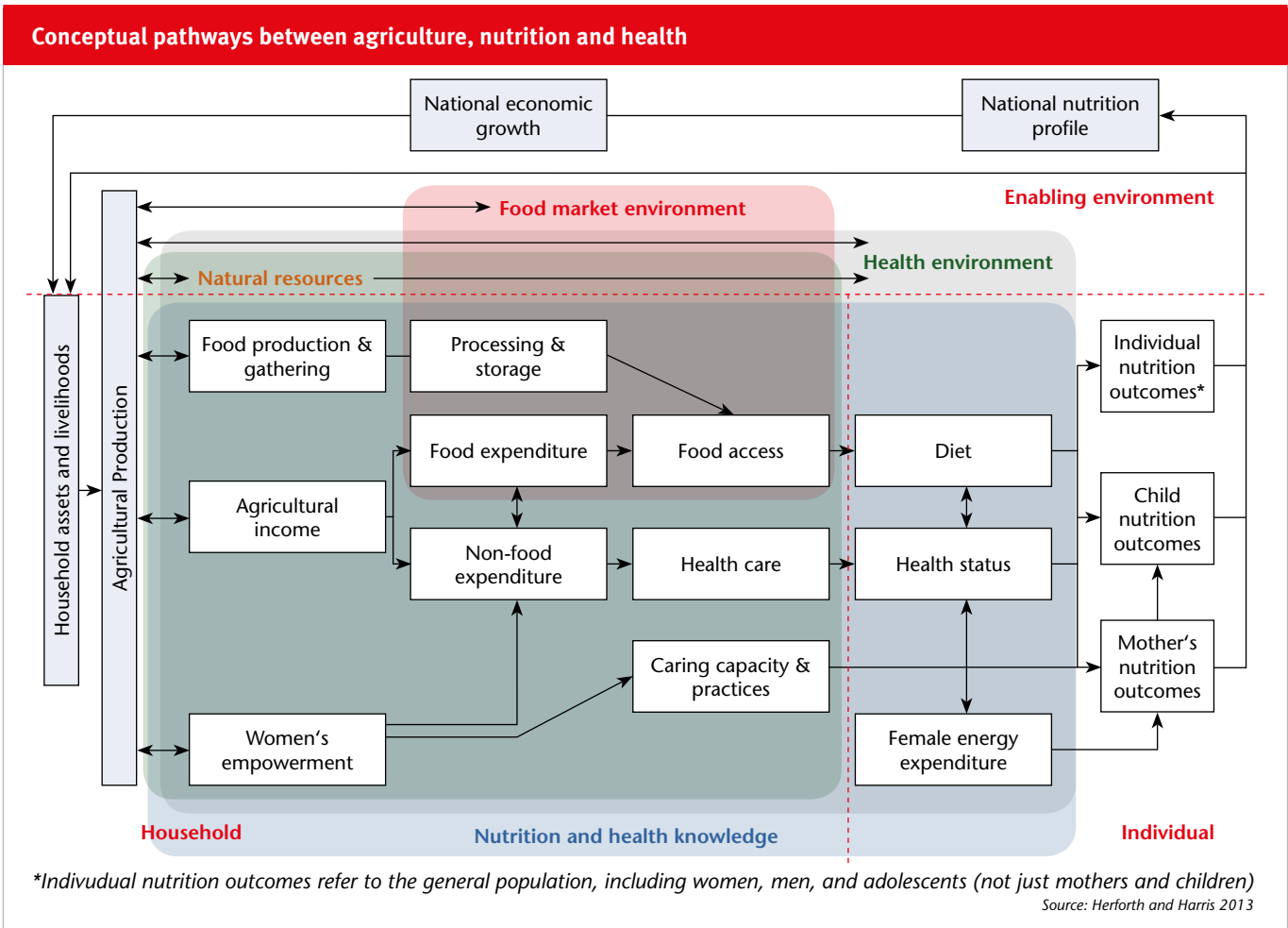
Both men and women have important roles in achieving good health and nutrition. They work together on

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family farms and in the labour market to earn income to buy food and other goods and services for their families. However, accumulating evidence shows that gender-based constraints may further impose limitations on poor populations' ability to achieve better nutrition. In addition to their roles as agricultural producers and income earners, women are more likely to be caregivers and food providers within their families throughout much of the world, and thus are considered the guardians of household food security and nutrition. At the same time, economic and cultural factors including gender roles – the socially-determined relationships between women and men – limit women and girls from actively participating in economic activities that may improve their status and the household's well-being, and in decision-making related to food purchases and allocation that may improve their nutritional status. Biological factors increase women and girls' risk of experiencing micronutrient malnutrition and poor health, especially during their reproductive years. Adolescent girls in particular may be vulnerable owing to their youth and low social status in many societies, placing them at risk for early marriage or risky sexual behaviour during a critical period for investment in their own human capital. Men face their

own unique set of social and biological risks to attaining good health and nutrition. It is not enough to focus on women as key to food and nutrition security; they must also be viewed in the context of their relationships with men, being influenced by, and also influencing, men.

The increased attention given to gender as a factor to consider in improving nutrition results from the large body of evidence showing that households do not behave "as one" when allocating food and nonfood resources. A wealth of empirical information from both developed and developing countries shows that males and females within households do not necessarily pool resources, and often have different preferences on how to use limited household resources to achieve multiple objectives. Women tend to spend their additional income on food, healthcare and children's education, while men spend more of their income on personal items. In Bangladesh, a higher share of women's assets is associated with better health outcomes for girls. In addition, simulations using Demographic and Health Survey data from 36 developing countries suggest that equalising women's status (by increasing women's decision-making relative to their husbands and improving societal gender equal-



ity) could lower child malnutrition in South Asia by 13 per cent (13.4 million children) and in sub-Saharan Africa by 3 per cent (1.7 million children). Moreover, gender roles often dictate what men and women grow and how resources are allocated to men's and women's plots. For example, in Burkina Faso, one reason why women's maize yields were lower than men's, within the same household, was that fertiliser and labour tend to be allocated to men's plots.

Moreover, men and women have different roles in agriculture value chains, from production to marketing. These roles vary across contexts. In many developing countries, both men and women produce crops and raise livestock on the farm, but marketing is often dominated by men, who have greater mobility to go to markets. In other contexts, such as Southeast Asia and parts of West Africa, women are very active traders in the market. Despite this, there is evi-

dence from Kenya and Tanzania that training on best practices is often still targeted mainly on men. Women and men did not have equal access to markets; women were more involved in the sale of livestock products, yet they had a lower number of market options available to them than men did. The different roles men and women play in agricultural systems indicate that men and women bear differential exposure to agriculture-associated health risks. For example, women from a Tibetan nomadic pastoralist community had a significantly higher risk of *E. multilocularis* (a small tapeworm) infection than men. This may be because the traditional responsibilities of women put them in contact with dogs and dog faeces more frequently than men, a risk factor for *E. multilocularis* infection.

Finally, the reproductive role of women has significant implications not only for agricultural production during their lifetime, but also for the inter-generational impact of their nu-

trition and health status. Frequent pregnancy and lactation may deplete a mother's nutrient reserves, which in turn can reduce the child's access to nutrients during gestation and through breastmilk. This increases the risks that children will be born small, will continue to experience growth faltering during early childhood, will have impaired cognitive development and lower schooling performance and will become smaller, less healthy and less economically productive adults. In the many areas of the developing world where societal norms discriminate against girls, these effects will disproportionately affect girls and women, and perpetuate the transmission of poverty, poor health and undernutrition into the next generation. For example, early marriage and child-bearing in many developing countries imply that many adolescent girls become mothers even if they have not yet attained full physical maturity, with negative implications on their own health and the health of their children.

■ Mapping gendered agriculture-nutrition-health pathways

The roles that both men and women play along agriculture-nutrition-health pathways are highlighted in the figure and can be differentiated as follows:

- 1) Agriculture as a source of food: Farmers produce for their own consumption, but gender roles influence what is grown by women and men.
- 2) Agriculture as a source of income for food and non-food expenditures: As a major source of rural income, agriculture influences diets and other nutrition- and health-relevant expenditures.
- 3) Agricultural policy and food prices: Agricultural conditions can change the relative prices and affordability of specific foods and foods in general. If men and women grow different crops, price policies may affect the differential return to those crops. If food prices increase, men (who are often viewed as primary breadwinners) may be favoured in intrahousehold food allocation, at the expense of women and children.
- 4) Women's roles in agriculture and intrahousehold decision-making and resource allocation may be influenced by agricultural activities and gendered control of assets, which in turn influences intrahousehold allocations of food, health, and care.
- 5) Maternal employment in agriculture and child care and feeding: A mother's ability to care for her child may be influenced by her engagement in agriculture. Women fulfil multiple household responsibilities, as the children's primary caregivers and as wage-earners. Factors such as poverty, an inflexible or time-intensive job, the type of alternative caregiver and control over income earned can have a negative effect on child growth.
- 6) Women in agriculture and maternal nutrition and health status: Maternal health and nutritional status may be compromised by the often arduous and hazardous conditions of agricultural labour, which may in turn influence child nutrition outcomes.

These pathways acknowledge the unique multi-functional role of agriculture. Unlike other productive sectors, agriculture provides rural households with food as well as income, it frequently employs multiple household members, it directly affects household members' energy expenditure, and it is shaped by household decisions. Ultimately, whether an individual is healthy and well-nourished depends on whether he or she obtains the right food, both in terms of quality and quantity, and the right inputs of health, care, and time. Gender matters for all of the six pathways because: 1) existing gender differences in roles, preferences and power mediate nutrition and health outcomes; 2) the agriculture-nutrition-health pathways can bring differential benefits and risks to different genders and social groups, given that men and women have specific health needs and sources of resilience that vary across contexts and the life cycle, and 3) the pathways also present opportunities to shift gender relations, en-

hancing women's empowerment and their own well-being.

These pathways show that we cannot hope to achieve food and nutrition security without paying attention to gender. Although the conceptual linkages between agriculture, nutrition and health may make sense intuitively, reality is much more complicated. Many questions remain unanswered. For example, which gender-based differences matter the most for nutrition and health outcomes in a given context? Should we be worried about the unintended consequences and tradeoffs between outcomes of agricultural interventions? These are precisely the evidence gaps that the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH) is hoping to address (see Box). Agricultural research is therefore crucial in understanding exactly how gender influences agriculture's impacts on nutrition and health along these pathways and in identifying opportunities to enhance gender equity.

Where should research on gender, agriculture, and nutrition go?

The CGIAR Research Program on Agriculture for Nutrition and Health (A4NH) has identified three strands of research that deserve greater attention:

Impact of gender-based differences on nutrition- and health-related outcomes (pathways 1, 2 and 3): Which gender-based differences matter for nutrition and health outcomes? Through which mechanisms do they influence nutrition and health (for example, men and women's preferences on production and consumption decisions, allocation of productive and reproductive work, and access to assets, credit, information, social capital, and so on). These questions are particularly critical for research related to agricultural development interventions or delivery, since investigating and addressing gender-based differences is important in the design and ultimately for the success of such projects.

Improving nutrition through women's empowerment (pathway 4): How do different aspects of women's empowerment affect various nutritional and health outcomes? Ongoing research investigating the impact of decision-making power, access to and control of assets, autonomy in production and hours worked, and women's time use on nutrition and health outcomes has begun to indicate that different aspects of women's empowerment influence different health and nutritional indicators (e.g. diets, child feeding practices, maternal and child anthropometric measures). More research is needed to understand the patterns of impact in different contexts, as well as the mechanisms driving impact. Gender dynamics – relationships between women and men – are likely to play an important role, but one that varies across contexts and cultures.

Avoiding unintended consequences to women's well-being and empowerment (pathways 4, 5 and 6): Do agricultural interventions have unintended consequences for women's well-being and empowerment? Are there tradeoffs between outcomes of agricultural interventions? Gender-based differences can increase women's exposure to risk and potentially harm women and children's health and nutrition through impact on women's energy expenditure, time burden, and access to and control over assets. Anticipating these consequences and tradeoffs at the design stage, or being able to make mid-term corrections during implementation, will be important for interventions to achieve their desired objectives, while improving gender equality and women's empowerment.



Maria Helena Semedo joined the UN Food and Agriculture Organization in 2003. In July 2009, she was appointed FAO Assistant Director-General/Regional Representative for Africa. Since 2013, she has been FAO Deputy Director-General, Coordinator for Natural Resources.

Photo: FAO/Giuseppe Carotenuto

Rural 21: Ms Semedo, the slogan of the International Year of Pulses is “Nutritious seeds for a sustainable future”. Why are pulses so important both in nutrition and with a view to sustainability?

Maria Helena Semedo: From a health point of view, pulses have a high nutritional value – they are packed with nutrients and are good sources of protein. Pulses are made up of about 20–25 per cent of protein by weight, which is double the protein content of wheat and triple that of rice. When eaten together with cereals, the protein quality in the diet is significantly improved, and a complete protein is formed.

Pulses have a low fat content and contain zero cholesterol. The Glycaemic Index – an indicator of the effect on blood sugar – is also low in pulses, and they are a significant source of dietary fibre. Since they do not contain gluten, they are an ideal food for coeliac patients. Additionally, pulses are rich in minerals – iron, magnesium, potassium, phosphorus, zinc – and B-vitamins – thiamine, riboflavin, niacin, B6, and folate –, all of which play a vital role in health.

Pulses are a vital source of plant-based proteins for people around the globe and should be eaten as part of a healthy diet to address obesity, as well as to prevent and help manage chronic diseases such as diabetes, coronary conditions and cancer; they are also an important source of plant-based protein for animals.

In terms of sustainability, pulses are leguminous plants that have nitrogen-fixing properties which can contribute to increasing soil fertility and have a positive impact on the environment. It has been estimated that legumes can fix between 72 and 350 kg of nitrogen per hectare per year. Additionally, some species of pulses are able to free soil-

“We must highlight the pluses of pulses”

The United Nations declared 2016 International Year of Pulses. Ms Maria Helena Semedo, Deputy Director-General, Natural Resources, of the UN Food and Agriculture Organization (FAO), explains why these crops are so valuable for a nutritious diet and the livelihoods of farmers.

bound phosphorous, which also plays an important role in the nutrition of plants. These two features are particularly important for low-input agricultural production systems and agro-ecological principles because they allow a drastic reduction in the use of fertilisers. At the same time, with rotations including leguminous crops, future production can be continued on the same plot of land. Pulses in intercropping systems not only allow a higher underground utilisation efficiency due to their root structures but can also reduce pesticide utilisation, and deep rooting pulses like pigeon peas can supply groundwater to intercropped companion species. The use of indigenous pulses such as bambara beans might contribute to improve food security because they are adapted to local production and consumption systems. Finally, it is important to note that pulses are highly versatile and can be used in different agricultural production systems like rotations, intercropping, ley-farming and, of course, as a cover crop.

Pulses have been grown for centuries, and for many people, they are part of the daily diet. How can it be that their value has sunk into oblivion over the past years?

It’s true that world-wide, pulse crops such as lentils, beans, peas and chickpeas are a critical part of the general food basket. The production of beans, chickpeas and lentils dates back to 7000–8000BC! From Italy to India, we can find pulses as part of traditional menus. Indeed, FAO has always recognised the importance pulses play for both custom and well-being, and you’ll find that we’ve long encouraged the use of pulses in our nutritional guidelines. I wouldn’t say that pulses have sunken into oblivion over the past years – they are still widely used as part of daily and staple diets. Nonetheless, the production and consumption of pulses, in per capita terms, has seen a slow but steady decline in both developed and developing countries. According to FAO, this reflects not just changing dietary patterns and consumer preferences but also the failure of domestic production to keep pace with population growth in many countries. We need to revitalise the virtues and advantages of pulses in the larger public eye – and for this, the International Year of Pulses is a really great opportunity!

What is the role of pulses today for the nutrition and livelihoods of smallholders?

Pulses can contribute both to the nutrition and livelihoods of smallholders. Firstly, as mentioned above, pulses have a high protein and mineral content – eating them regularly can help improve overall health and nutrition. Secondly, pulses can enhance livelihoods by optimising and sustaining production in pulse-cereal crop rotations. In such rotations, subsequent cereal yield and crude protein concentration can be increased due to the residual nitrogen provided by the previous pulse crop. As already noted, including pulses in intercropping farming systems and/or cultivating them as cover crops enhance soil fertility and reduce dependency on chemical fertilisers by fixing nitrogen and freeing phosphorous, thus contributing to a more sustainable production system. In addition to offering a shelf-stable supply of food, pulses crops can provide additional income to producers by being sold and traded. Pulses are high-value crops, usually getting two to three times higher prices than cereals. Local processing of pulses can also offer further employment opportunities in rural areas. As well, some variety of pulses can cope with climate change impacts, which is of particular interest to disaster-prone areas.

At the moment, we don't have sufficient data and information on the real contribution of pulses to household food security and nutrition – we hope that this important issue will be better documented and explored during the International Year of Pulses.

On the one hand, we are facing a combination of hunger and malnutrition, and on the other, nutrition-conditioned illnesses caused by food that is too rich or simply by the wrong food. This phenomenon is set to grow as urbanisation progresses and eating habits change among the burgeoning middle classes in countries such as China and India. Where do you think pulses could still play a role?

Indeed, this is really the two sides of the same problem – what we call the double burden of malnutrition – that we've seen evolving these last years. By promoting the dietary virtues of pulses, we hope to boost their popularity and use in cooking habits and trends. Pulses are an important part of a healthy diet because they are high in protein, fibre and other essential nutrients. Their high iron and zinc content is especially beneficial for women and children at risk of anaemia. Pulses also contain bioactive compounds that show some evidence of helping to combat cancer, diabetes and heart disease, and some research indicates that eating pulses regularly can help control and combat obesity as well.

Many small family farms lack awareness of the value that pulses bear both in terms of nutrition and health and regarding the conservation of soil fertility and the adaptation of agriculture to climate change. Often, the target group for nutrition counselling is women, while men are frequently the target group for agricultural extension. Wouldn't it make sense to link agricultural extension more strongly with nutrition counselling?

A woman selling pulses in a small Mozambican market. The International Year of Pulses is to heighten public awareness of the nutritional benefits of these crops.

Photo: FAO/Paballo Thekiso

Absolutely – and in fact, this multipronged, multi-stakeholder approach is something FAO has been doing for years. We need to tackle and target these issues in a holistic way. When we work with countries, colleagues and communities on the ground, we try to make sure to include a full range of stakeholders across all levels in order to be able to discuss and promote nutritional guidelines, good practices and knowledge exchange, responsible policies, smart partnerships, etc.

Which stakeholders have to become active in particular to achieve the goal of the International Year of Pulses – raising awareness and boosting production and trade?

The International Year of Pulses 2016 is designed to heighten public awareness of the nutritional benefits of pulses as part of sustainable food production aimed towards food security and nutrition. In this way, we are hoping to create a unique opportunity to encourage connections throughout the food chain that would make better use of pulse-based proteins, further global production of pulses, better utilise crop rotations and address the challenges in the trade of pulses. Overall, international trade in pulses has grown rapidly, much faster than output. And the value of pulse exports has grown even more rapidly, especially in recent years – rising from 2.5 billion US dollars in 1990 to about 9.5 billion US dollars in 2012. For the future, international trade in pulses is likely to continue growing. So we need to reach producers – especially smallholders – and encourage further growth. But we must also reach a wide audience – from farmers to nutritionists to chefs to consumers, from the young to the old – to reverse consumption and production patterns and really show the pluses of pulses.

The interview was conducted by Silvia Richter.

Seizing the opportunity

Despite India being the largest producer and consumer of pulses, the country has been importing an annual 3.44 million tons of pulses at a huge outgo of foreign exchange. Briefly reviewing the research and development efforts since the early 1950s, our author suggests that the momentum given by the International Year of Pulses be taken advantage of to set the right incentives to promote production and consumption of these nutritious crops.

India is the largest producer and consumer of pulses in the world. It accounts for 33 per cent of the global area under pulses and 22 per cent of production of pulses, with a share of 90 per cent, 65 per cent and 37 per cent of pigeon pea, chickpea and lentil respectively. Despite several Government initiatives to implement nationwide programmes to step up productivity, production and profitability, the country has to import pulses on an average of 3.44 million tons annually, amounting to more than 80 billion rupees (1.19 billion US dollars). And yet India has currently witnessed an unprecedented price-rise of pulses which could be controlled by capitalising opportunities – the country ought to make use of the momentum created by the International Year of Pulses to raise the output and better manage the stock and distribution system.

■ Healthy diets, healthy soils, healthy climate

Pulses contain roughly 23 per cent of protein, almost twice the amount of protein available in wheat and thrice that of rice. They are the major source of proteins for vegetarians, who account for more than 40 per cent of the Indian population, and supplement the staple cereals in the diets with health-sustaining ingredients such as essential amino acids, vitamins and minerals. They are nu-

tritious and are known to reduce the impact of several non-communicable diseases, including colon cancer and cardiovascular diseases, and avoid calorie-catastrophe through balancing intake of carbohydrates and protein. Therefore the consumption of pulses should be increased as an integral part of nutritional food security.

Pulses also offer a considerable range of advantages for crops. They can be grown on a wide variety of soils, under many climatic conditions and in different farming systems, such as crop rotation and mixed and intercropping. As legumes, they help fixing atmospheric nitrogen into soil and release soil-bound phosphorus. They add organic matter into the soil in the form of leaf mould; some pulses are suitable as green-manure crops. They can thus improve soil fertility and counter soil erosion.

Most pulse crops are of short duration, which facilitates growing a second crop on the same land in a year; they can serve as industrial crops and deliver material to industries, such as the pulse industry, roasted grain industry, etc., and they serve as a rich source of nutritious fodder for cattle.

More importantly, pulses have low carbon emissions. The production of one kilogram (kg) of legumes emits 0.5 kg carbon equivalent as compared to 9.5 kg carbon equivalent for the production of one kg of meat. To produce one kilogram of pulses, 359 litres of water is needed, against more than 1,000 litres each for soybeans and groundnut, which makes them ideally suitable for India's farming system.

As per recent estimates, water needs for the production of one kilogram of meat are five times higher than those of pulses.

■ The result of years of neglect

There is a significant yield gap between farmers' yield in India (750 kg/ha) and other developed countries (2,000 kg/hectare in Canada and Australia) and also between farmers' yield and research stations' yield (1,800 kg/hectare) in India. What are the causes of this low productivity? Around 84 per cent of the area under pulses is rain-fed with soils of relatively low fertility. Whereas between 1966/67 and 2012/13, pulses under irrigation increased from 9 per cent to 16 per cent, the share of irrigated land grew from 38 per cent to 59 per cent for rice and 48 per cent to 93 per cent for wheat. Drought and heat stress regularly lead to a 50 per cent reduction in pulses' seed yields, particularly in arid and semi-arid regions of the country. Moreover, pulses are often grown in soils with a high level of salinity and alkalinity in the semi-arid tropics and the Indo-Gangetic plains. In the states of Uttar Pradesh, Bihar, West Bengal, Chhattisgarh, Madhya Pradesh and Jharkhand, poor drainage leads to water logging during the rainy season, causing substantial yield losses in pigeon pea in particular.

The Green Revolution in the 1970s and 1980s pushed pulses cultivation to marginal and sub-marginal lands, resulting in declining productivity. While small and marginal farmers more often prefer growing staple

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cereals for home consumption, other farmers go for growing cash crops on a larger area rather than pulses. Small, marginal and tenant farmers have little access to institutional credit, which discourages them from purchasing and using seeds of high-yielding varieties and phosphatic fertilisers and adopting improved technologies. About 70 per cent of farm subsidies provided for irrigation, fertilisers and pesticides are given to just three crops, paddy, wheat and sugarcane, leaving an insignificant share for pulses. Moreover, pulse-growers did not benefit from crop insurance schemes.

About 70 per cent of Indian farm subsidies provided for irrigation, fertilisers and pesticides are given to just three crops, paddy, wheat and sugarcane.

Photo: J. Boethling



■ Promising cropping systems

According to the Indian Institute for Pulse Research, by 2030 and 2050, demand for pulses will be around 32 million tons and 50 million tons respectively. This would require an additional 3 to 5 million hectares of land, and productivity per hectare will have to rise from the present 750 kg/ha to 1,361 kg and 1,500 kg respectively. In fact, India would need to produce 40 million tons of pulses annually in order to meet the per capita requirement of 80 grams/day of pulses recommended by the World Health Organization (WHO) as against present consumption of 27.2 grams/day/capita for 1.282 billion people. This can be achieved by extending promising cropping systems which researchers have evolved and which have successfully demonstrated their economic benefits to farmers:

Chickpea in rice fallows. Rice fields in the prosperous agricultural Indo-Gangetic Plains remain fallow during the winter season. Large-scale on-farm trials from agriculture universities in five States have shown that short-duration varieties of chickpea

and lentil can be successfully grown after rice harvest and can yield from 1,000 kg to 2,500 kg per hectare. Short-duration indigenous and *kabuli* chickpea varieties were found to be suitable. More recently, a heat tolerant chickpea variety named JG 14 has proved highly adaptable to late-sown conditions in the rice fallow area.

Pigeon pea in rice-wheat cropping systems. Rice-wheat cropping systems are managed on 10 million ha in the Indo-Gangetic Plains of India. However, the practice of continuous rice-wheat rotation over several years has impacted adversely on soil fertility and water availability and increased incidence of pests and diseases, posing a serious threat to the sustainability of the system. The inclusion of legumes promises to restore soil fertility and reduce other associated problems. Experiments on research stations and field trials on farmers' fields using extra-short duration pigeon pea varieties (e.g. ICPL 88039) in two States confirmed that pigeon pea can be grown profitably instead of rice during the monsoon season (sown in late May and harvested in late October or early November), allowing timely sowing of wheat crop. Pigeon pea yields per hectare were 1,500 kg to 3,000 kg. As pigeon pea adds nitrogen through a biological nitrogen fixation process accompanied by leaf fall (contributing about 40–50 kg N to the system), the succeeding wheat crop needs less nitrogenous fertilisers. The net eco-

nomical returns under the pigeon pea-wheat system were higher compared to those of the rice-wheat system.

Pigeon pea at high altitudes. Extra-short duration pigeon pea can be successfully cultivated up to the elevation of 2,000 metres above sea level in Uttarakhand state in Northern India. A pilot study along with several on-farm trials across different elevations in Uttarakhand during

2007/08 by the Agricultural Research Institute, Almora, and the department of agriculture, Uttarakhand, showed that the pigeon pea variety ICPL 88039 can be grown successfully in low and medium hill regions. This variety proved to be highly adaptable in regions with high elevations and has yielded 1,800 kg/ha of grains. As the long duration of cold and frost can severely damage the foliage and flowers of pigeon pea, its cultivation should be confined only to regions with low and mid hill regions. Farmers' willingness to extensively cultivate this extra-short duration pigeon pea cultivar in Uttarakhand can be profitably capitalised.

■ The State of Andhra Pradesh shows the way

Andhra Pradesh, once considered unsuited for chickpea cultivation due to its warm and short-season environment, has now ushered in a chickpea revolution. Farmers in this south-eastern state of India started growing short-duration and wilt-resistant chickpea varieties in rain-fed rice-fallow lands. From 2000 to 2009, the state increased the area under chickpea five times from 102,000 hectares to 602,000 hectares and raised yields 2.4 times, from 583 kg/ha to 1,407 kg/ha, the synergic effect of which was a nine-fold increase in output from 95,000 tons to 884,000 tons. Such a phenomenal rise in output can be attributed to various factors:

- the development and on-time availability of high-yielding, short-duration, fusarium wilt-resistant varieties suited to short-season and warmer environments of southern India;
- the motivation and willingness of a large number of farmers to adopt improved varieties in combination with easy access to production technologies;
- successful commercial cultivation by mechanising field operations and efficient management to minimise the incidence of pod-borer infestation;
- the availability of grain storage facilities to farmers at local level at affordable cost.

With an average yield of 1,400 kg/ha Andhra Pradesh now has the highest chickpea yields in the country. More than 80 per cent of the chickpea area is under improved short-duration cultivars.

■ Expand cultivation, improve market potential

An additional area of 2.5 million hectares could be brought under pulses – for example through the integration of crops like Bengal gram (chickpea) or green gram (mung bean) as catch crops in the summer season under cereal-based cropping systems or inter-cropping with short-duration pulses like green gram, Bengal gram and cowpea in sugarcane, millets, cotton etc. In the northern region of the country, new cropping systems such as pigeon pea-wheat bear a considerable potential; in the eastern region, rice-lentil and, in the southern peninsula, Bengal gram-rice are suitable.

Of course, in addition to expanding cultivation, the market potential of cultures needs to be improved. Here, a value chain approach right from the production at farm level (and encompassing post-harvest, processing, packaging, transportation) to marketing is essential for small and marginal farmers to reduce losses/wastages and increase income. Furthermore, price discovery and transparency has

to be improved. This could be accomplished e.g. via electronic trading of pulses, and corresponding facilities have been created in a few Agricultural Produce Market Committees in Karnataka, Andhra Pradesh and Telangana. The recently envisioned National Common Market also offers a potential (see box).

■ Supporting the International Year of Pulses with the right policies

The United Nations' General Assembly has declared 2016 the International Year of Pulses. India ought to take advantage of this and adopt measures to promote the growing and consumption of nutritious crops in the country. Significantly improving the country's technical capabilities to forecast nearer to correct season-wise estimates of the area under pulses and output of pulses through investing in and better use of state-of-the-art technology and refining methods of estimation could be an initial step, for this is still an area with considerable deficits. Furthermore, a result-oriented campaign should be launched to transfer already proven and demonstrated technologies in farmers' fields accompanied by efficient systems of

linking institutional credit with on-time availability of quality seeds and marketing services that can guarantee expected yield. To prevent wastage, a need-based buffer stock with accountability for proper management is necessary. A close watch would be desirable on crop growth in the 30 pulse-exporting countries to India through effective co-ordination with the FAO and India's embassies that could help India negotiate favourable terms for timely import as and when imminent. And last but not least, an efficient system to make pulses easily available in the open market throughout the year should be put in place – through rigorous enforcement of the Essential Commodities Act. Entering into force in 1955, the Act empowers the Union and state governments concurrently to control production, supply and distribution of certain commodities in view of rising prices. Its provisions include entitlement to licensing, distribution and imposing stock limits; furthermore, the governments have the power to fix price limits, and selling the particular commodities above the limit will attract penalties. Warranted distribution through the Public Distribution System or direct benefit transfer schemes would also be suitable measures to boost the consumption of pulses.

More market transparency envisaged

Markets for agricultural products in India are highly regulated under the *Agricultural Produce Market Committee (APMC) Act* by the respective state governments. The first sale in these commodities can be conducted only under the aegis of APMC through the licensed commission agents. Various taxes, fees/charges and cess are levied on the trades conducted in each of the 586 APMC markets. The APMCs charge multiple fees of substantial magnitude that are non-transparent. In 2003, the Union Government has developed a Model APMC Act to make farmers free to sell their produce directly to the contract-sponsors or in the market. But the Model Act is only being partly implemented by the state governments, which have also amended some of its contents.

The *National Agriculture Common Market (NACM)* slated to be launched on 14th April 2016 is envisaged as a pan-India electronic trading portal which seeks to network the existing 586 APMCs and other market yards to create a unified national market for agricultural commodities. It would increase farmers' access to markets through warehouse-based sales and thus obviate the need to transport his produce to the APMC. For the local trader, the NACM offers the opportunity to access a larger national market for secondary trading. Bulk buyers, processors, exporters, etc. shall benefit from being able to participate directly in trading at the local market level through the NACM platform, thereby reducing their intermediation costs. The gradual integration of all the major markets in the States into NACM is to ensure common procedures for issue of licences, levy of fee and movement of produce. In a period of 5–7 years the Government expects significant benefits through higher returns to farmers, lower transaction costs to buyers and stable prices and availability to consumers.

“All measures must bring tangible benefits for smallholder farmers”

How is German development cooperation implementing the concept of nutrition-sensitive agriculture? Stefan Schmitz, Deputy Director-General at the German Federal Ministry for Economic Cooperation and Development and Commissioner for the One World – No Hunger initiative on awareness raising, food taboos and the challenge of cross-sectoral cooperation.



Photo: BMZ

Rural 21: Mr Schmitz, what role does nutrition play in the One World – No Hunger initiative?

Stefan Schmitz: The importance of nutrition as a topic on the international agenda has increased considerably in recent years. Nowadays, food security and nutrition are often mentioned in the same breath and there is a growing awareness, throughout the world, not only of the negative impacts of malnutrition but also of the development potential afforded by a well-nourished population and a balanced diet. The new Sustainable Development Goals set forth in Agenda 2030 include ending not only extreme undernourishment and chronic hunger but poor nutrition as well.

With its Special Initiative, the BMZ aims to make a substantial contribution to combating hunger worldwide and has therefore begun to focus more strongly on the issue of nutrition. We are working on this topic both at the international level, for example through the Scaling Up Nutrition (SUN) initiative, and at country level, where we are integrating nutrition-specific or nutrition-sensitive elements into our programmes and projects.

The “One World – No Hunger” Special Initiative

The One World – No Hunger Special Initiative was launched in 2014 with the aim of ending hunger and malnutrition. It works to establish the conditions necessary to ensure that sufficient food is available for future generations. The Special Initiative is implemented through official and non-governmental development cooperation and involves multilateral partners. It centres on three flagship programmes: **Food and Nutrition Security, Enhanced Resilience** (overall term: 2014–2021; budget (German contribution): 146 million euros; priority regions: sub-Saharan Africa and Asia); **Green Innovation Centres for the Agriculture and Food Sector** (overall term: 2015–2019; budget: 138 million euros; 12 centres in Africa, one in India) and **Soil Protection and Rehabilitation for Food Security** (overall term: 2015–2017; budget: 70 million euros; countries: Benin, Burkina Faso, Ethiopia, Kenya, India; objective: rehabilitation of more than 140,000 hectares of land).

Let’s take the “Global Programme on Food and Nutrition Security, Enhanced Resilience”. It says that poor households should have access to safe, nutritious and sufficient food at all times. Which measures are being deployed to achieve this goal?

The programme implements measures to improve the nutritional status of women and children in eleven countries of the world. There are many causes of hunger and malnutrition, so we are pursuing an integrated multi-sectoral approach across key fields of action, including health, education, water, sanitation and hygiene (WASH) and agriculture. Providing advice on agricultural diversification, increasing awareness of a balanced diet and hygiene, improving health services and mainstreaming best practices in national strategies and policies are just some of our activities. Our goal is to improve the nutritional status of around two million people and boost their resilience to future hunger crises.

How is the success of these actions measured?

We have selected a set of indicators, in line with internationally recognised standards, to measure the diversity and frequency of food intake. They include the Women’s Dietary Diversity Score, which specifically assesses the quality of women’s diets. The indicators were standardised during comprehensive baseline data-gathering in all eleven countries and provide us with reliable information about target group outcomes during and after programme implementation.

What role does nutrition education play in the programme?

Nutrition education plays a key role in the programme. When combating hunger and malnutrition, it is important not only to supply food in sufficient quantities but also to

raise public awareness of the best methods of growing, storing, processing and consuming food. This information is rarely available to people in the partner countries, and there are also few opportunities to put this knowledge into practice. This applies particularly to the specific dietary needs of pregnant women, breastfeeding mothers and infants. Our training sessions, workshops and advice services equip people with knowledge and build their skills, with a strong focus on practical relevance based on local conditions and options.

How is nutritional diversity being addressed?

Nutritional diversity is a key element of the programme. Diversification has many potential entry points: for example, it can start with farming by introducing new varieties, identifying suitable crop rotations, and establishing home and school gardens. Changing consumer behaviour, with a focus on food choices, is also important. Ultimately, this is about changing longstanding dietary habits and sometimes even tackling taboos.

What kind of taboos do you mean?

In many instances, food taboos do have the functional aspect of conserving scarce resources or preventing disease. They are often an element of religious practices. However, many taboos also go hand in hand with the social exclusion of women and girls, thus exacerbating their malnutrition. In some West African countries, for instance, women and girls are not allowed to consume certain products such as milk or eggs.

The "Global Programme on Green Innovation Centres" aims to boost the incomes of smallholders, create more employment opportunities and increase regional food supplies in the project's rural target areas. How do nutrition and nutritional diversity feature in this programme?

One of the aims of the Green Innovation Centres is to achieve sustainable improvements in rural communities' food security by promoting appropriate innovations. This does not just mean increasing the quantity of food available – it means achieving a high-quality food supply which meets people's dietary needs. So we are promoting designated value chains that support nutritional diversity in our partner countries. One example is the support for smallholders in Ethiopia, which enables them to introduce innovative production processes for wheat and broad beans. A similar approach is being adopted for orange-fleshed sweet potato growing in Kenya.



Part of training in nutrition education in Ethiopia: Raising awareness on the best ways to prepare and consume food.
Photo: SEWOH/BMZ

In Ethiopia, the programme also aims to provide smallholders with better-quality seed. Does 'better' in this instance mean higher yields, or are better-quality nutrients also important?

Our project in Ethiopia pursues both goals simultaneously. On the one hand, it provides high-quality seed for households with very limited or no financial resources. The increased yields produce crop surpluses which can be sold, enabling farmers to reinvest the revenue in diversifying their diets and improving their families' health. On the other hand, we ensure that the seed itself contains high-grade nutrients so that its consumption has a direct and positive effect on families' nutritional status.

One aim of the Green Innovation Centres is to build knowledge networks. To what extent is local indigenous knowledge being integrated in this context?

Knowledge of local conditions and social relations is an important starting point for our work. Mainstreaming this knowledge is a key success factor, not least because it encourages the active involvement of local communities. So we provide targeted support for local NGOs which gather traditional agricultural knowledge and feed it into knowledge networks. This approach enables us to successfully integrate locally developed and adapted innovations into farming systems.

How important is agrobiodiversity in the Global Programmes?

In our Global Programme on Soil Protection and Rehabilitation for Food Security, integrated soil fertility management

is a priority. We field-test and disseminate innovative best practices for improving agrobiodiversity and climate resilience. We have also embedded the topic of biodiversity more generally in capacity building and extension services.

Agricultural research – especially plant breeding research – has a key role to play in improving food and nutrition security, particularly in the context of climate change. Do the Global Programmes promote plant breeding research in the partner countries themselves?

No, that's not a feature of the Global Programmes. However, the Special Initiative provides funding for international agricultural institutes engaged in relevant research in the partner countries. One example is the AVRDC – the World Vegetable Center in India, where we are supporting an integrated pest control project focusing on begomovirus-resistant tomatoes, peppers and mung bean varieties.

How are research and practice linked together?

In general, international agricultural research adheres to the 'research for development' principle. This means that it has strong practical relevance, with an emphasis on the future application of the findings. This is made possible, for example, through cooperation between BMZ-funded agricultural and nutrition research projects and the Special Initiative's bilateral or non-governmental partners. In Ethiopia, for instance, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) is currently trialling user-friendly software, developed by the University of Hohenheim, to collect data on the nutritional status of target groups in rural regions.

How do the Global Programmes reach out to women, who after all play an important role in food and nutrition security?

Women bear the main responsibility for childcare as well as for food preparation in rural households, so they have a key role to play. It's important to emphasise that under no circumstances should their own human right to nutritious and sufficient food be ignored in this context. We focus especially on women of childbearing age, pregnant women and breastfeeding mothers, as this lays the foundations for healthy foetal development. We involve women in various training schemes, ensuring at the same time that this does not create additional burdens for the women in their daily routines. We are increasingly involving men in awareness-raising projects as well, as they are usually the decision-makers in rural households. Some of these approaches have already proved successful, but we recognise the need to give greater weight to the gender perspective. Joined-up thinking on food and nutrition security and gender equality is essential.

How much awareness of the importance of nutrition-sensitive agriculture exists in the partner countries? Do you see any obstacles?

We see a steadily growing awareness of this topic among partner governments. Many governments have come to recognise the costs and impacts of a failure to invest in nutrition. That's why many national food security strategies nowadays expressly aim to improve nutritional status. In-

deed, in some cases, national nutrition programmes are being set up. Very often, however, the lead department for nutrition within the partner governments is the Ministry of Health, which makes it more difficult to exert influence on other sectors, such as agriculture.

Other challenges include the lack of experience in coordinating multi-sectoral processes, poor stakeholder consultation, and the absence of structures for effective knowledge management and hence for the sharing of lessons learned and best practice.

Non-governmental organisations are highly critical of the SEWOH projects in some cases. One point of criticism is that the projects promote market-oriented cultures and neglect or fail to take adequate account of people's nutritional situation. Do you see any conflict between encouraging people to market their goods for livelihood security, on the one hand, and improving the nutritional status of farming families, on the other?

From the BMZ's perspective, the main challenge is to see the concept of nutrition-sensitive agriculture as an opportunity to increase food and nutrition security and promote development. It should not be seen as a rival approach that simply aims to boost production in local agriculture or reinforce its export orientation. The two dimensions should complement each other – and achieving that requires political commitment and openness to new approaches, especially in the partner countries.

A further point of criticism is the programmes' close cooperation with the private sector, particularly multinationals. And in relation to the Green Innovation Centres, you are accused of failing to put farmers at the heart of the projects. Is this criticism justified?

We can only master the challenge of feeding a growing world population if we involve all stakeholders – and that must include the private sector. Sustainable, future-proof agriculture needs massive investment – far more than can be mobilised from public funds alone. That's why the BMZ is also using its resources to leverage private investment. The precondition in every case is that the measures contribute to the development policy goal of ending hunger and bring tangible benefits for smallholder farmers.

Stefan Schmitz was interviewed by Silvia Richter.



*Training in nutrition education by a local Ethiopian NGO.
Photo: SEWOH/BMZ*

Walking the talk in nutrition-sensitive agriculture

How can the concept of nutrition-sensitive agriculture be translated into concrete projects in the context of development cooperation? Four examples from the activities of GIZ.

Over the past years, aspects of nutrition have gained more importance in German development cooperation. This is also reflected in the Strategy Paper "Promoting Sustainable Agriculture" of Germany's Federal Ministry for Economic Cooperation and Development (BMZ), which calls for a stronger contribution of agricultural programmes to food and nutrition security. Therefore, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) as implementing agency has focused its agricultural approaches more strongly on addressing aspects of food and nutrition security. To do so, GIZ had to develop an operational understanding of nutrition-sensitive agriculture which, while fitting in with the approaches pursued in the existing agricultural programmes (e.g. the value chain approach), also encompasses the required additional nutrition aspects.

According to the concept of nutrition-sensitive agriculture (see also article on pages 6–8), various pathways can lead to improved nutrition. The most suitable ones for the current GIZ agricultural portfolio seem to be:

1) to increase investments in value chains of nutritious food crops or livestock products (e.g. milk or pulses) in order to achieve higher availability and diversity of nutritious food at country level and

2) to translate food diversity into dietary diversity by nutrition-sensitive accompanying measures alongside agricultural programmes (e.g. nutrition education or consumer awareness) in order to achieve better nutrition.

Both pathways require a closer look at the food and nutrition security situation in the respective country or region that an agricultural programme engages in. While the first one has already been practised in many value chain programmes world-wide, the second one requires more adjustment and conceptual discussion – also with

our partners. Developing effective nutrition-sensitive activities and measuring the contribution of agricultural projects to food and nutrition security is not always easy, but GIZ is learning here and gaining experiences from the first good practices.

However, the ultimate goal of nutrition sensitive-agriculture remains a challenge: individual behaviour change in nutrition – which takes time and is therefore hard to achieve in ever shorter programme planning cycles. Yet GIZ has taken on the challenge, as the following four project examples illustrate.

Promoting biofortified sweet potatoes in Western Kenya

Kenya's west is one of its poorest regions. About 700,000 smallholder households in the project intervention area cultivate, on average, less than one hectare of often degraded land. A fifth of the population are malnourished.

Sweet potato is a versatile and nutritious crop that copes with difficult climatic conditions and can even be grown in poor soils. Cultivation patterns are largely aligned to the bimodal rainfall pattern. It is this adaptive potential and the fact that the sweet potato is traditionally cultivated by women that have made it an important pillar of household food security in Western Kenya.

During the past decade, the orange-fleshed sweet potato (OFSP) varieties have had the attention of international research organisations such as the Consultative Group on International Agricultural Research (CGIAR). OFSP varieties have been improved through selective breeding for their vitamin A content. Available varieties range in their content of β -carotene between 4–15 mg/100 g, compared to the widely used traditional varieties (0–1 mg for white-fleshed and 1–2 mg for yellow-fleshed sweet potato).

They show a much higher yield potential (4 t/ha) than conventional sweet potatoes (0.6–1 t/ha) and a higher resistance to weevils. The high vitamin A content makes the crop an important health factor for household nutrition, especially for children. Additionally, the nutritious benefit of the crop has attracted commercial interest: various community-based processing procedures allow OFSPs to be used by local self-help bakery groups at regional and national level. Flower millers fortify maize flour with them, and the food industry uses OFSP puree to enhance the nutritious value of various food products. OFSPs offer substantial income opportunities to local communities, especially to women, through value addition.

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The three-year project “**Food security through improved agricultural productivity in Western Kenya**” started in 2014. The aim is to promote sweet potato production, thereby stabilising food and nutrition security at household level and improving farmers’ income through different options for value addition. Here, GIZ and partners apply a value chain approach with activities like

- cooperation with agricultural research for the establishment of commercial OFSP seed vine propagation and dissemination systems for high quality planting material reaching up to 10,000 farmers;
- cooperation with local NGOs to conduct training courses on local value addition and processing, especially for rural women groups;
- support to the development of local processing technologies (flour, puree) for the development of different product ranges;
- cooperation with the private sector to develop the expansion of the fresh produce markets and processing capacities, e.g. for puree.

The project region is the counties of Siaya, Kakamega and Bungoma in West Kenya, totalling 7,737 km² with a population of 3,878 million people (2009 census). OFSP propagation is one of the value chains supported under the Green Innovation Programme.

The absence of a commercial market outlet for OFSP tubers and products in past years has been a disincentive for the upscaling of seed supply systems. The vastly growing commercial interest of the food industry, mainly large-scale supermarket bakeries, has provided a massive impetus for broad-scaled production of OFSP tubers.

The immediate challenge is to upscale the vegetative seed vine multiplication capacities at all levels to sustain broad-based OFSP production. Depending on natural production conditions and planting techniques, seed plots can supply planting material for an area 8–15 times larger; for instance, wheat has a ratio of 60–80 times the size of the seed plot. With the expansion of seed vine propagation by the next rainy season, approx. 2.000 tuber producers will have access to improved planting material. This number is expected to more than double by the end of 2016.

With people having learnt that the OFSP is more nutritious and more resistant to disease than the traditional varieties and has

value addition potential for income-generation, it is now in high demand. In parallel, the project aims to expand the supply to the regional and national markets. The programme thus supports private and public extension services and raises awareness of the nutritious benefits as well as the commercial potential that OFSP varieties offer.

A health-conscious middle class in Kenya are demanding nutritious food – therefore, the programme will continue to support the improved OFSP value chain and invest in up-scaling of piloted technologies to utilise the full commercial and nutrition potential of the crop to raise the incomes of the rural population in Western Kenya.

Dr. Andrea Bahm, Karina Brenneis, Heike Weber, Josef Grimm



Advertising campaign of Tuskie's supermarkets for sweet potato bread.

Photo: Ruth Niedermüller

Supporting female cotton growers in soybean processing in Benin

According to the Comprehensive Food Security and Vulnerability Analysis of the World Food Programme in 2013, eleven per cent of the households in Benin are facing severe or moderate food insecurity, and 34 per cent of the households are classified as marginally food secure. The average rate of food insecurity is higher in rural areas (15 %).

The overall objective of the **Competitive African Cotton Initiative (COMPACI)** that runs from 2009 to 2016 in eleven sub-Saharan countries is to improve sustainable cotton production and thus the living conditions of smallholder cotton farming households

while strengthening women’s empowerment, food security and nutrition. Within the COMPACI project area in Benin, Atacora and Donga are among the most food insecure departments. Despite the diversity of cultivated food products in these areas, these products are not properly used to cover the food and nutritional needs of the population. Against this background, COMPACI decided to support soybean production and processing in addition to its promoting the cotton value chain. This additional work stream provides an appropriate way to contribute to the project’s overall food security and nutrition objective, because over the past few years, soybean has returned to the eating habits of many people in

Benin. Soy cheese can validly replace meat and fish in many households as a source of protein.

COMPACI in Benin has a strong focus on women's groups. Already organised women's groups are supported in strengthening their organisational capacity and are supplied with the necessary equipment. The main nutrition activity of the programme has been to engage women in cotton producing households in trainings for improved techniques of processing soy cheese. This small-scale pilot built the capacity of female cotton producers on technical methods of soybean production and on agricultural entrepreneurship for better produce and marketing. Female processors were sensitised to create their own associations or cooperatives.



Women's groups are trained in soy cheese production.

Photo: Team COMPACI/giz

In the process of women empowerment and enhanced professionalism of the activities, today, COMPACI supports the establishment and operation of centres for the promotion of female entrepreneurship (*centres de promotion de l'entrepreneuriat féminin, CePEF*). These centres mobilise soybean and rice processing women and help them to work out their organisational structures. At the same time, business partnerships between these women groups and other stakeholders along the value chain are created. The initial impacts are that women groups get access to credit and to better markets. In the future, these centres could become places of peer-learning and coaching for other women who also want to make progress in their entrepreneurial agricultural activities.

More than 3,000 women were trained on technical topics of production, entrepreneurship, hygiene, and marketing of the produce, while 264 women received credit and nine women's groups now have their own well-functioning centres for promotion of female entrepreneurship (CePEF). In view of these positive impacts, COMPACI will continue these nutrition-sensitive activities and scale up the number of women reached.

Rodrigue D.Y. Sogan, Colette Bounde

Providing family nutrition training in Ghana and Nigeria

The **Competitive African Rice Initiative – CARI** – is a value chain initiative aimed to increase the income of poor households in rice producing regions of Ghana, Nigeria, Burkina Faso and Tanzania. CARI improves farm productivity, provides technical and financial services and connects producers, processors and consumers by using a value chain approach. In addition to these activities, the initiative pursues various nutrition-sensitive interventions.

The typical diet consumed in rice-producing households is characterised by a high intake of cereals and a lack of essential micronutrients such as vitamin A and iron. Child undernutrition remains a challenge, and subnational data indicate vast regional disparities and identify regions with a very high burden of undernutrition.

In Ghana and Nigeria, for example, only every tenth child aged 6–23 months receives an adequate diet by international standards. Since women are most likely to invest in family nutrition, CARI supports female household members in increasing their earnings from the parboiling and trading of rice through training in technical and business skills. CARI also helps rice-producing households diversify their agricultural production towards vitamin-rich and protein-rich crops. Thus the programme increases the availability of a diverse basket of food at household level. Finally, CARI includes a nutrition education component to stimulate behaviour change for improved nutrition.



Training of trainers for nutrition education.

Photo: CARI Nigeria

This "Family Nutrition Training" concept is based on a training module developed by the **Sustainable Smallholder Agri-Business Programme (SSAB)** of GIZ as part of the Farmer Business Schools (FBS) approach. It includes messages on the importance of a diversified diet, post-harvest food handling, and storage and adequate preparation of balanced and healthy meals. Counsel-

ling on breastfeeding and complementary feeding for infants and young children as well as basic Water, Sanitation and Hygiene (so-called WASH) aspects also form integral part of the training. The CARI programme works hard to ensure that this training is not a stand-alone activity but that it is integrated into interventions that enhance rice yields and crop diversification. In Ghana, CARI teams up with governmental agricultural extension services, the Women in Agriculture Development Unit (WIAD) of the Ministry of Food and Agriculture. WIAD, in turn, coordinates with private extension agents to reach the same households for maximum effectiveness of the agricultural and the nutrition intervention. In this context, CARI provides demand-oriented, high-quality, up-to-date training materials and contributes to capacity building through the training of WIAD staff.

By 2017, CARI and its partners will have targeted 8,000 male and female farmers in Ghana and 11,000 in Nigeria with family nutrition trainings. In addition, with the support of SSAB, the national Cocoa Board Ghana is integrating this nutrition training into the national cocoa extension curriculum, thus reaching out to an additional group of 35,000 smallholders in Ghana in 2016. And there is further good nutrition news. Via the Ghanaian Cocoa Board, this training has already been introduced by SSAB to other partners in the region such as Côte d'Ivoire and Cameroon.

Stefan Kachelriess-Matthess, Tanja Cohrs, Anna Stancher

Diversification of agricultural production and household diet in Ethiopia

The Global Programme “**Food and Nutrition Security, Enhanced Resilience**” is funded by the One World – No Hunger Initiative of the German Federal Ministry for Economic Cooperation and Development (BMZ) (see also pages 23 to 25). Worldwide, the programme addresses the improvement of the nutritional status of women of child-bearing age and children below five years of age. The Programme is active in eleven countries, one of which is Ethiopia. The activities of this country project focus on the Tigray region in the North of Ethiopia, where the nutrition situation is particularly critical. Just four per cent of the infants aged between six months and two years receive a minimum acceptable diet in terms of frequency of meals and nutritional diversity. Therefore, diet-related growth retardations and stunting are widespread.



Complementary feeding practices with mothers.

Photo: Susanne Neiro

In Ethiopia, the global programme cooperates closely with ongoing projects of bilateral German development cooperation such as the “**Sustainable Land Management Programme**” (SLM). The SLM aims at counteracting the progressing land degradation through sustainable management of resources and increase of the agricultural production. Yet the improvement of the nutritional situation cannot be achieved by an increase in production or sustainable resource management alone. Therefore, the Global Programme “Food and Nutrition Security, Enhanced Resilience” works in a multi-sectoral approach to address the various different reasons for undernourishment and malnutrition. Here, the diversification of agricultural production with nutritious crops is an important aspect: crops containing vitamin A, iron and zinc among others are important to combat so-called hidden hunger, the wide-spread lack of essential micronutrients. Additionally, the cultivation of protein-rich legumes and vegetable varieties as well as vitamin-A rich sweet potato and oilseed varieties is promoted.

This diversification of the agricultural production is coupled with activities supporting the diversification of the household diet for all family members: behavioural changes in the rural households are necessary to improve the nutritional situation. Here, the programme promotes cooking demonstrations that show women how to preserve valuable nutrients while preparing more nutritious and more diverse meals. Moreover, mothers are taught how to prepare healthy and age-based complementary food for infants. The application of good hygiene practices is closely linked to these areas. All these activities also directly address men as decision-makers in rural households as well as religious leaders. The programme is implemented mainly by governmental agricultural extension staff as well as farmer and women’s groups, who are trained in teaching methods and coached by the programme staff. The first impact assessment is to take place by mid-2016.

Claudia Lormann-Nsengiyumva

Combining efforts to end hunger and malnutrition

The SUN Movement

Individual, isolated measures are not enough to eradicate hunger world-wide. Rather, a collective approach is required; an approach that is driven and owned by countries and combines efforts across different sectors and at all levels. This is precisely the approach that the SUN Movement is pursuing.

The Scaling Up Nutrition (SUN) Movement was founded in 2010 and has been joined by stakeholders from government, civil society, the United Nations, business and research. It is based on the principle that all people have the right to food and good nutrition. The initiative sets out from the notion that the role to scale up country-specific nutrition interventions lies primarily with the respective governments and stakeholders, including the adoption of effective laws and policies, and this through strengthened national multi-stakeholder platforms. It combines efforts across different sectors and at all levels, from national to sub-national. The core focus is on empowering women and on infant development, for intervening in the first thousand days of a child's life is found to be of significance to tackling malnutrition and to ensure the child's development to its full potential as a child, adult and citizen.

■ How SUN works

Each country involved has a national SUN Government Focal Point Person who collaborates with relevant ministries, civil society, business, donors, academics and UN agencies.

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The combined efforts of all countries and stakeholders make up the core of the initiative and enable results that no country could achieve on its own. Therefore, SUN is led by a coordinator under the stewardship of its 27-member lead group appointed by the UN Secretary General (see Figure).

Four global networks shift resources and align actions to support the efforts of the respective country network. The **Donor Network** seeks to ensure that nutrition remains a key development priority in international forums and agendas. Donors' investments in nutrition have proven to be of great value, for every dollar invested by a country in nutrition returns 16 dollars. The Network aims to improve co-ordination of funding and provide technical support e.g. in developing national nutrition plans and their implementation, budgeting, costing and monitoring and evaluation. In line with this, most donors have revised their nutrition strategy, developed action plans and introduced special initiatives including Germany's establishment of a special initiative to combat hunger and advance nutrition (One World – No Hunger), the Bill and Melinda Gates Foundation Nutrition Strategy and the European Commission's launch of the European Food and Nutrition Action Plan 2015–2020.

The **Business Network** mobilises business efforts in support of the SUN movement by engaging business in backing national nutrition strategies applying a country-led approach. For example, the Nigerien company *Société de Transformation Alimentaire* (STA) intends to treat 400,000 children in Niger as well as the sub-Saha-

ran region with their locally produced therapeutic foods.

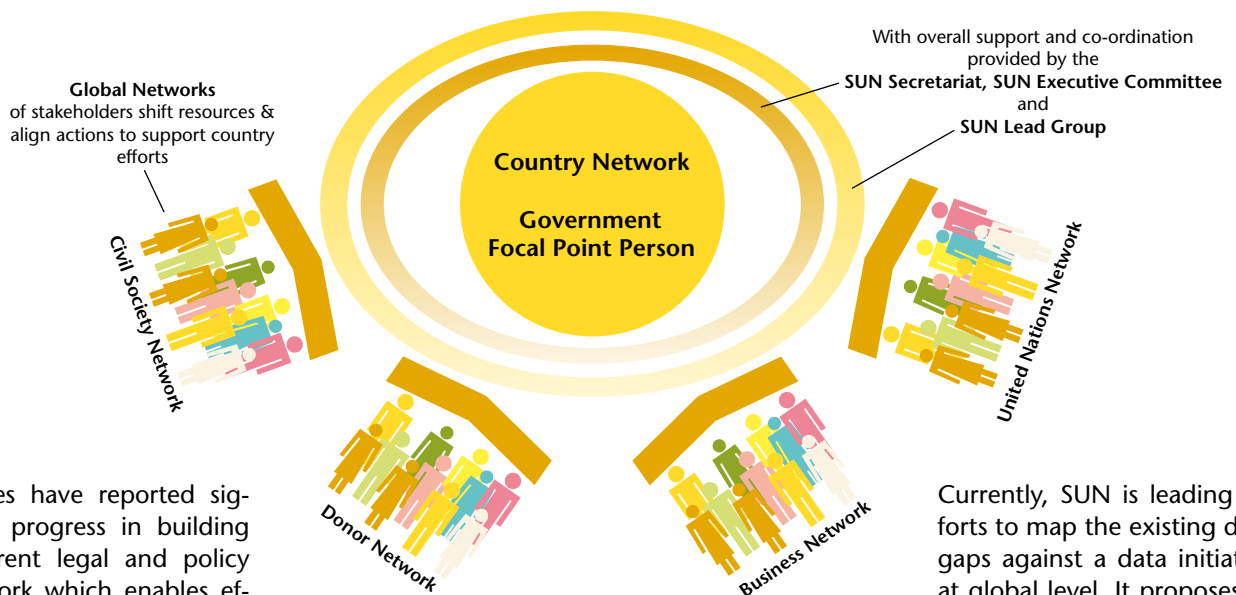
The **UN Network** aims to bring together all relevant UN agencies to help countries accelerate their efforts to improve nutrition through co-ordinated, harmonised and aligned action from the global to the country level. The **Civil Society Network** plays a key role by bringing the voices of those directly affected by malnutrition to the table and ensuring active citizen engagement and community participation in promoting good nutrition.

Donors of the SUN movement annually track and publicly report their financial disbursement on nutrition-specific and nutrition-sensitive programmes, applying a joint methodology to track external development assistance resources aimed at addressing undernutrition. Civil society network members are improving the transparent reporting of their contributions to the movement's efforts.

■ What has been achieved?

Within just a short time, the number of countries within SUN has risen to 56 and is growing, with nutrition sitting at highest level of government. Presidents, prime ministers, first ladies and senior ministers spearheaded high-level nutrition events in 34 SUN countries throughout 2014–15. These engagements provided opportunities to launch national nutrition plans, encourage commitments, increase investments on direct nutrition and nutrition-sensitive interventions, create mass awareness through the media and unite stakeholders. Beyond this,

The SUN approach



countries have reported significant progress in building a coherent legal and policy framework which enables effective governance to scale up nutrition interventions.

A number of SUN countries demonstrate reductions in stunting. For example, Zambia reduced the stunting rate among children from 45 per cent in 2007 to 40 per cent in 2013/14, while Tanzania reported a reduction by 8 per cent in four years and Peru reduced stunting rates by 50 per cent in seven years thanks to public investment and disbursement for health investment in sectors with health goals and the work with government and society.

Civil Society is crucial to advancing multi-stakeholder and multi-sectorial nutrition efforts in countries, and it is increasingly taking part in multi-stakeholder efforts (84 % of established Civil Society Alliances at country level were engaging in multi-stakeholder platforms in 2014). However, this needs to be improved, moving forward through active participation of civil society-organised inclusive and democratic processes, with all stakeholders acknowledging that such

processes are grounded on the SUN Movement Principles of Engagement.

■ Looking forward

Mirroring the ambition of the 2030 Agenda, the strategy of the SUN movement for 2016 to 2020 (see Box) calls for greater emphasis on implementation and accountability. The SUN vision remains a world where all children can realise their right to good nutrition, with a focus on improving nutrition in the first thousand days, from the start of pregnancy to a child's second birthday, and on addressing the nutritional needs of women – especially adolescent girls. While the focus of the movement remains centred on eradicating undernutrition, everyone is encouraged to address the multiple burden of malnutrition. Collectively, the ambition must not leave anyone behind – equity and rights will be at the heart of the SUN efforts, and countries in states of protracted crises must be supported, given their challenging contexts.

Currently, SUN is leading efforts to map the existing data gaps against a data initiative at global level. It proposes to create capacity at national levels to have better-quality disaggregated open data and use this data to empower all concerned to improve co-ordinated practices on the ground.

Nutrition needs to be kept high on the agenda through ongoing advocacy reinforcing global commitments such as the World Health Assembly (WHA) targets, Nutrition for Growth and the International Conference on Nutrition 2, with global entities like the Committee on World Food Security making nutrition central to their efforts and, finally, with key moments to ensure that nutrition remains embedded in our sustainability agenda with the Sustainable Development Goals.

All stakeholders – civil society organisations, the UN, business and donors – will continue supporting the high political commitment of SUN stakeholders through key political events at global and national levels in the coming years. There will be more focus on strengthening capacities, roles and responsibilities at country level, including in particular on increased national budgets. The SUN movement has the potential to reach 82.5 million stunted children in the 56 countries participating – just over 50 per cent of the 162 million children suffering from stunting worldwide.

Main objectives of the renewed SUN strategy for 2016 to 2020

- Expand and sustain an enabling political environment
- Prioritise effective actions that contribute to good nutrition
- Implement actions aligned with national CommonResults Frameworks
- Effectively use, and significantly increase, financial resources for nutrition

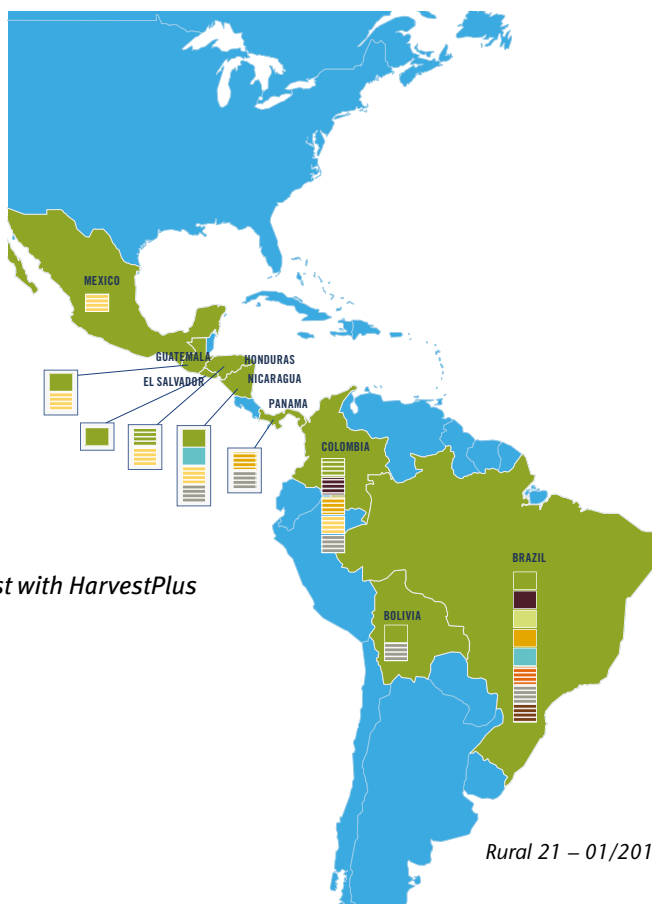
Completing the revolution through biofortification

Interventions to fight hidden hunger particularly eclipse poor people living in remote rural areas – and hence many who are involved in agriculture. Biofortified crops can help bridge this gap, our author maintains.

In a perfect world, we would all enjoy a diverse diet, one that provides all the nutrients our bodies need to be healthy and to function properly. We would have regular access to fruits, vegetables, and meat – a balanced diet that includes macronutrients (proteins, carbohydrates, fats) and micronutrients (vitamins and minerals). But our world, of course, is nowhere near perfect. Nutritional deficiencies are widespread. Micronutrient deficiencies, or hidden hunger, affect one-third of the world's population – some two billion people.

Hidden hunger's most vulnerable victims are the poor in developing countries, whose daily diets usually consist of a few staple food crops such as rice, maize, and cassava. These crops provide lots of energy to their consumers, but practically nothing else of nutritional worth. The deficiency in critical vitamins and minerals means populations reliant on such diets face increased susceptibility to infections and disease, and impaired mental and physical development among children. The burden is not just on individuals; economies suffer, too, as a result of lost productivity and economic growth. India, for example, loses over twelve billion US dollars in GDP annually due to vitamin and mineral deficiencies.

In such a nutritionally imperfect world, what hope is there that a major global problem like hidden hunger can be solved? Nutrition interventions have typically encompassed supplementation and fortification to provide at-risk populations with missing micronutrients. The perfect scenario, then, would be for supplements and fortified foods to penetrate to every corner of society, leaving no one behind. Sadly, due to affordability and accessibility constraints, significant numbers of people – particularly those in rural, hard-to-reach areas – fall through the cracks of these interventions.



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Thankfully, a new and complementary approach is now available that aims to plug that gap. Biofortification might be a recent addition to the nutrition-intervention pool, but it is the perfect fit for populations engaged in or dependent on agriculture, such as those often missed by the other interventions. Through conventional breeding, biofortification improves the nutritional content of the staple foods that these populations consume day in, day out. Farmers and their families grow and consume these crops over and over, and in the process improve their nutritional status for free. From iron-rich pearl millet in India's Maharashtra state to vitamin A-enhanced cassava in Nigeria, biofortified crops are bringing hope to millions of people who often are at the periphery of major nutrition interventions.

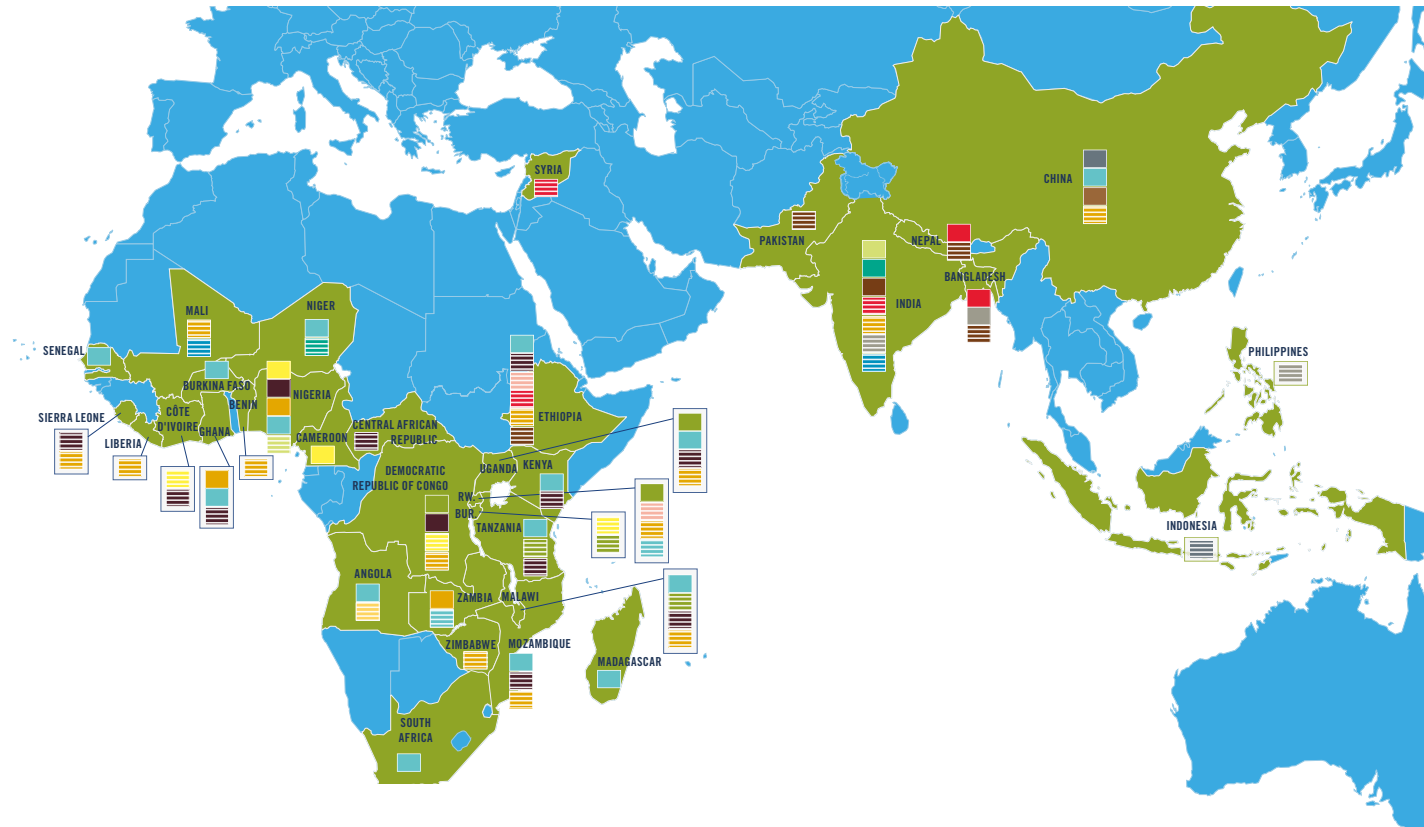
That hope is crystallised by the results of recent studies that demonstrate the nutritional and health impact of biofortified crops. Iron-rich pearl millet was found to have reversed iron deficiency among Indian school children within six months. In Africa, vitamin A-rich orange sweet potato reduced both the prevalence and duration of diarrhoea among young children studied in Mozambique. HarvestPlus, a programme promoting biofortified crops globally, continues to study and produce evidence on their impact as it scales up delivery efforts in Africa, Asia, Latin America, and the Caribbean. It expects at least 15 million farming households – some one hundred million people – growing and consuming these nutritious crops by 2020.

Beyond their nutritional and health purpose, biofortified crops are also deliberately bred to have superior or desired agronomic qualities compared with non-biofortified varieties. In addition to resistance to threats such as pests, diseases, heat, and drought, all biofortified crops provide farmers

with high yields. In that sense, biofortification brings the Green Revolution full circle by matching the increased productivity of staple crops with increased nutritional quality. As HarvestPlus founder Howarth Bouis notes, biofortification returns agriculture to its fundamental purpose to nourish people.

For more information, see: www.harvestplus.org

BIOFORTIFIED STAPLE FOOD CROPS: WHO IS GROWING WHAT?	
RELEASED AND/OR AVAILABLE TO FARMERS through formal or informal channels	TESTING BEING EVALUATED OR TESTED in a target or expansion country
BANANA/PLANTAIN (Vit A)	BANANA/PLANTAIN (Vit A)
BEANS (Iron)	BEANS (Iron)
CASSAVA (Vit A)	CASSAVA (Vit A)
COWPEA (Iron, Zinc)	COWPEA (Iron, Zinc)
IRISH POTATO (Iron)	IRISH POTATO (Iron)
LENTIL (Iron, Zinc)	LENTIL (Iron, Zinc)
MAIZE (Vit A)	MAIZE (Vit A)
MAIZE (Zinc)	MAIZE (Zinc)
PEARL MILLET (Iron)	PEARL MILLET (Iron)
PUMPKIN (Vit A)	PUMPKIN (Vit A)
RICE (Zinc)	RICE (Zinc)
RICE (Iron)	RICE (Iron)
SORGHUM (Iron, Zinc)	SORGHUM (Iron, Zinc)
SWEET POTATO (Vit A)	SWEET POTATO (Vit A)
WHEAT (Zinc)	WHEAT (Zinc)



Scientists fear severe shift in human diet through climate change

Changes in temperature and precipitation are expected to reduce global crop productivity and drive people to eat less red meat and less water-intensive fruit and vegetables, says a study by British scientists. This would counteract ongoing efforts to improve nutrition among the world's poorest people. For their study, the scientists linked a detailed agricultural modelling framework, the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT), to a comparative risk assessment of changes in fruit and vegetable consumption, red meat consumption, and bodyweight for deaths from coronary heart disease, stroke, cancer, and an aggregate of other causes. They calculated the change in the number of deaths attributable to climate-related changes in weight and diets for the combination of four emissions pathways (a high emissions pathway, two medium emissions pathways, and a low emissions pathway) and three socioeconomic pathways (sustainable development, middle of the road and more fragmented development), which each included six scenarios with variable climatic inputs. In contrast with previous models, this study looks at the quality – not

just the quantity – of food available on a warmer planet to estimate how it will impact health. The authors of the study note that even quite modest reductions in per-person food availability could lead to changes in the energy content and composition of diets that are associated with substantial negative health implications. Most climate-related deaths in this model are projected to happen in South-East Asia and the Western Pacific region, in particular in China and India. "If you take India for example, they will be likely to substitute vegetables and fruit with potatoes and rice that have less health benefits than leafy vegetables," says lead author Marco Springmann, who is a policy researcher with the Oxford Martin Programme on the Future of Food in the United Kingdom.

The authors of the study conclude that the health effects of climate change from changes in dietary and weight-related risk factors could be substantial, and exceed other climate-related health impacts that have been estimated. Climate change mitigation could prevent many climate-related deaths, they say. Strengthening of public health programmes aimed at preventing and treating diet and

weight-related risk factors could be a suitable climate change adaptation strategy.

A 2014 report by the UN's World Health Organization (WHO) found that climate change would cause 85,000 deaths of under-fives due to malnutrition in 2050, but this did not take changes in diets into account. Commenting the study, Diarmid Campbell-Lendrum, one of the editors of the 2014 report and WHO team leader on climate change and health, notes that the strongest factor determining death rates in the new study is the estimated reduction of fruit and vegetable consumption. "This is plausible as we know that low levels of consumption of these types of foods are now a major killer," he adds. And he continues: "There has been much less research on the effect of climate change on the production, and then the availability of fruits and vegetables than there has been on staple crops." Campbell-Lendrum praises the new study for "broadening the range of evidence beyond simply calories" and for increasing understanding that climate change is a great threat to public health, and food and nutrition security. *(SciDev.net/Lancet/wi)*

Fortified rice may raise risk of hookworm infections

Fortification of staple foods is considered an effective and safe strategy to combat micronutrient deficiencies, thereby improving health. While enhancing micronutrient status might be expected to have positive effects on immunity, some studies have reported increases in infections or inflammation after iron supplementation. Against this background, an international team of scientists conducted a research project aimed to quantify the impact of multi-micronutrient fortified rice, which was distributed through the UN World Food Programme (WFP) school meal programme as a single meal per day. The study focused on micronutrient status, health and cognition of schoolchildren in Cambodia. As uncertainty exists on the most optimal

combination of micronutrients to be added to rice, three different types of fortified rice, with different micronutrient composition, were studied. The study was meant to find out which effects the introduction of fortified rice has on hookworm infection and local intestinal inflammation in Cambodia.

The researchers analysed faecal samples from about 2,000 children at 16 primary schools that are participating in the WFP initiative. The schools were randomly split into four groups: children in one group ate plain, 'placebo' rice, while the other groups received three different types of rice fortified with micronutrients including iron, zinc, folate and different vitamins. After three and seven months, the re-

searchers measured levels of intestinal parasite infections. They conclude from the outcome of the study that consumption of rice fortified with micronutrients can increase hookworm prevalence, especially in environments with high infection pressure. When considering fortification of staple foods, a careful risk-benefit analysis is warranted, taking into account severity of micronutrient deficiencies and local prevalence of parasitic infections, they say. "There is absolutely an important role to play for fortified rice, but it should be tailor-made to the local situation," says Frank Wieringa, a co-author of the study working at the French Research Institute for Development and based in Phnom Penh, the Cambodian capital. *(SciDev.net/wi)*



A female maize trader at the Techiman Market, Ghana.
Photo: T. Pfeiffer

Measuring gaps, weighing benefits

The earlier quality is measured in the agricultural value chain, the more efficiently and sustainably farmers can reach higher quality of their products. However, there is still a lot to catch up on in providing such services for smallholders in particular. This article focuses on maize and pineapple value chains in Ghana to demonstrate what perceptions of quality there are and how the adoption of quality infrastructure services could be promoted.

Twenty-two per cent of Ghana's GDP is produced in the agricultural sector, which currently employs 45 per cent of the country's total labour force. The sector is characterised by a smallholder production base and low productivity. Agriculture plays an essential role – not only for peasants, but also for the growing middle class in Ghana's cities who demand agricultural products from rural areas. In this exchange from rural to urban areas,

trade is being stretched over much greater distances, requiring, in theory, transparent and universal communication on quality. The earlier quality is measured in the "farm-to-fork" sequence, the more efficiently and sustainably farmers reach higher quality. At the smallholder level, services to analyse product quality therefore need to be applied at the beginning of value chains. A team of the Centre for Rural Development (SLE) at Humboldt University of Berlin has examined the use of such services, focusing on maize and pineapple value chains in Ghana. They looked at smallholders who cultivate approximately 2 to 8 acres (0.8 to 3.2 hectares) of land and who sell their produce on local markets, national markets or even for export. The research focused on:

- which Quality Infrastructure (QI) Services are available at local level and who the providers are;
- to what extent and how smallholders take advantage of these services and where potential obstacles are;
- which perceptions of quality there are among smallholders, traders and consumers;
- costs and benefits arising in the use of QI.

Since the capital of Accra hosts most quality infrastructure service providers and laboratories, the distance to the production sites and smallholders was considered in choosing the area to conduct the study in. For maize, the Brong-Ahafo region was selected as a highly commercialised production area, hosting the

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most important supranational maize market in Techiman. For pineapple, an interesting border area was chosen: the Volta region. It is located only half the distance from Accra as compared to Brong-Ahafo.

■ Aflatoxin in the maize value chain: a lack of quality awareness

Ghana produces 1.9 million tons of maize annually. The staple crop is utilised as whole grain for human consumption, in processed maize products (such as cornflakes or Banku flour), and as feed. Brong-Ahafo is the leading maize production region of the country, part of the maize is directly consumed by the poultry industry.

Aflatoxins play a major role in this context. Aflatoxins are toxic carcinogenic by-products of the moulds *Aspergillus flavus* and *Aspergillus parasiticus*. Mould is caused by insufficient drying and storage, in combination with humid, warm conditions. The Accra-based laboratories of the Ghana Standards Authority (GSA) and the Food and Research Institute (FRI) are active in the detection of the highly poisonous mycotoxin. The maize standard GS 211 sets the national threshold value at 15 parts per billion. However, more than half of the maize samples tested in the laboratories of the GSA are above this limit. No farmer was found to perform aflatoxin tests in the observed regions. But if aflatoxin remains undetected at the farm level, the poison trickles further down the value chain with detrimental results.

Aflatoxin can be prevented by drying maize timely to the moisture level of 13 per cent, which is prescribed in the national maize standard. In order to safely determine the moisture level of maize, handheld moisture meters can be used outside laboratories. However, smallholders were found to be unaware of the link between aflatoxin and the moisture content. None of the smallholders interviewed actually used a moisture meter. Experiments that the research team carried out with 44 farmers indicate that traditional meth-

ods used to determine the moisture content, e.g. biting on maize grains, report the maize being, on average, over three per cent dryer than it actually is. This misjudgement raises the threat of infestation with moulds.

Quality does not seem to play a major role in the view of maize farmers and traders. This can partly be explained with the absence of the consumers' quality exigencies. Therefore, there are no incentives for smallholders to invest in aflatoxin tests or moisture meters. Further obstacles include cash constraints of smallholders, as well as insufficient drying and storage facilities that restrict their ability to respond to test results. In contrast to smallholders, poultry farmers and processors check for moisture levels before storing maize and perform aflatoxin tests since they would otherwise be afflicted by high economic losses.

The bulk-good maize is traded in bags of various sizes. Instead of weighing the mass, the maize bags are arbitrarily filled and traded with different prices according to perceived moisture. Up to now, authorities have not used their power to rule trading maize only in kilograms as neighbouring Francophone countries do. At the same time, the Ghana Standards Authority has only been partially successful in convincing Ghanaians to trade by weight.



A female pineapple farmer in the Volta region.

Photo: T. Pfeiffer

■ Pineapple value chain: only export markets and processors scrutinise quality

In the pineapple value chain, a low level of QI use was observed at the smallholder level. Only in the context of export is quality infrastructure utilised, mostly because of certifications that require QI. Large-scale pineapple farmers who certify their pineapple for the lucrative export business invest a lot of time and money in the related processes of obtaining the certification. For smallholders, it is practically impossible to obtain certificates for export without financial support. Only outgrower schemes allow smallholders to take part in group certification. GLOBALG.A.P.-certified farmers (GlobalG.A.P. is a retailer-based certification system for Good Agricultural Practice) are required to utilise all the QI services, such as soil analysis or the testing of pesticide residuals or sugar levels of the fruits. Interestingly, many exporters test in recipient countries and not in Ghana. One reason might be that the Ghanaian labs of the GSA can only test 36 out of 452 residuals for which the European Union prescribes maximum residue levels.

A considerable portion of the 40 to 50 per cent of harvested pineapples gets sorted out – mainly for optical reasons – before export, so that quality demands of the international customers are fulfilled. The second-grade pineapples are traded on the domestic market. Here the quality demands of consumers of fresh pineapples are limited to shape, taste and juiciness of fruits. This lack of pineapple value does not encourage smallholders to use QI services. Fruit processors have higher quality demands for the domestic market than consumers of fresh pineapples and give high attention to the sugar content and colour of fruits. Here, the Food and Drugs Authority (FDA) prescribes the full range of tests on the juice products before allowing juice production. For example, refractometers – handheld devices that determine the sugar content in pineapples – are commonly used by exporters, large producers and most processors since the sugar

level directly affects the quality of the products. In contrast to juice makers, refractometer utilisation among smallholders is absent.

■ Benefit of soil testing too little known

Not only the quality of agricultural products, but also the quality of the soil is an important parameter for smallholder production. The use of soil testing was studied where pineapple production takes place. Interviews revealed that smallholders are largely unaware of benefits from soil testing. Even if the potential is known, farmers do not know how to understand the test results, and there are only few developing agencies to help interpret the findings. Besides high costs for soil tests, another obstacle for smallholders is the lack of available specific fertiliser needed for a given soil fertility. Soil testing is regularly performed by larger producers, particularly when required for certification. While soil analysis laboratories are concentrated in Kumasi and Accra, eight agricultural colleges and farm institutes across the country have been found with the ability to offer commercial soil testing. These institutions also provide vocational training for extension officers.

The study found that pineapples on the local market are traded by piece. In contrast, the more transparent trade by weight is practised by large producers and processors, and when exporting pineapple. A few smallholders use scales, and a growing trend was observed. Smallholders using scales find weighing to be beneficial for them because there is no need for the time and labour intensive sorting and grading of pineapples.

In three cost-benefit analysis this study found concrete potential cases where economic benefits would occur if QI services were actually used. The observed case of a maize processing company testing and measuring its products contributed to a reduction of input losses and costs due to over-drying. The costs of purchasing a moisture meter were recovered be-

cause the savings are five times higher. This study further confirmed the losses that farmers incur due to the limited use of QI services. For example, it was found that pineapple farmers measuring fertilisers with matchboxes instead of scales overdose the fertilisers by 77 per cent, thus wasting money and potentially harming the environment.

■ How to promote the use of QI services?

In the course of the research, four general aspects emerged that determine the use of QI services. The **demand for QI** seems to be increased by smart management of both, voluntary and obligatory measures. In particular, consumers have not used their power to improve quality through consumer protection mechanisms. **Centrality of quality infrastructure services** seems to be a hindering factor for smallholders that the Ghanaian quality infrastructure, which has its laboratories in Accra and Kumasi, has yet to overcome. The observed inconsistent and unorganised maize and pineapple value chains do not contribute to the desired QI utilisation. Instead, this report finds that **higher organisational levels of value chains and trust** among their actors are conducive to an increase in quality. Looking at pineapple and maize products as well as the export business, **the value of agricultural production** proves to be the determining parameter for the use of QI in rural areas.

Development co-operation can render quality infrastructure attractive for smallholders. Co-operation programmes should therefore continue refining their approaches towards

higher quality of agricultural products and quality infrastructure use. Small-scale farmers and small-scale entrepreneurs should be familiarised with the use of quality infrastructure.

Quality infrastructure needs to be seen in the context of agricultural practices and processing. Given the large number of districts and the vast number of locations where QI is required for rural areas in Ghana, it is important to have a very focused use of resources. For example, since Techiman district harbours the largest market for maize, this district or the capital of the Brong-Ahafo region, Sunyani, would be good locations for QI service providers to set up their laboratory capacity. Similarly, each commodity has its main hubs where QI should be offered. Such "rural QI hubs" could also serve to influence good agricultural practices of smallholders. Concretely, the Ghanaian Ministry of Food and Agriculture and the districts' agriculture departments could learn from a specifically built up quality infrastructure expertise and capacity in the regions and help to share the expertise accordingly.

In addition, producer and legally driven approaches should be combined with consumer-driven approaches. Governmental pressure for improved food safety needs to be complemented by more private initiatives to gain sufficient momentum for consumer protection. This should lead to higher quality demands of customers and subsequent QI use, thus ensuring a higher quality of agricultural products.

For more information and references, see: ► www.rural21.com

Background of the study

The study was conducted at the Centre for Rural Development (SLE) at Humboldt University of Berlin on behalf of the National Metrology Institute of Germany (PTB). The PTB has been operating in Ghana since 2007. In the context of technical co-operation with developing and emerging countries, the PTB is working on an improvement of National Quality Infrastructure – the institutional framework that establishes and implements the practice of standardisation, including conformity assessment services, testing, metrology, certification, and accreditation, thus guaranteeing quality assurance and consumer protection.



MS Balasubramanian doesn't believe in conventional farming: "It is said that farming cannot be done without chemicals as we need to increase food production. When there is no food, there will be starvation, but is it right to feed poison to people?"

The seed savers from Tamil Nadu

In Nagapattinam district in the Indian state of Tamil Nadu, a group of organic farmers have set up a producer company on their own effort. These farmers have conserved 180 varieties of traditional rice eleven of which are produced today. They are seed savers, procure funds on credit loans, produce chemical-free food, and market it without any government support.

A narrow, winding lane dotted by solar-powered street light leads to MS Balasubramanian's house. Balasubramanian, who left Tamil Nadu's capital Chennai in the 1990s to practice agriculture on a four-acre plot in Pagasalai village near Sirkazhi, was among the farmers protesting against the Green Revolution. "Farmers dumped huge quantities of urea on their land, only to find later that this had neither solved the pest problem nor increased production," he says. "On the contrary, the soil hardened, reducing its capacity to retain water."

Having decided to go organic, Balasubramanian worked on encouraging the microbes giving life to the soil.

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Keen to learn more about seed saving, and natural pest control measures, he got to know the Centre for Indian Knowledge Systems (CIKS), an NGO, which has been working on traditional knowledge systems and organic farming for over 20 years in Sirkazhi town, in the Nagapattinam district of Tamil Nadu. Since 2001, the organisation has been working on a research project funded by the Department of Science and Technology (DST) to understand the principles of biopesticides, nutrient management, soil fertility and how these different components need to be packaged for organic farming. Subhashini Sridhar, Programme Director at CIKS, explains: "We tested these practices on farmers' land. As a part of research dissemination, we offered farmers training programmes on organic farming." By 2004, CIKS had demonstration farms with 40 farmers in 13 villages. The experiences gained there motivated farmers to pursue organic farming.

■ How the farmers' association evolved

Many farmers were enthusiastic about switching to organic methods and turned to CIKS for support, who suggested that likeminded farmers could get together and form a group, and in 2005, the Sirkazhi Organic Farmers Association (SOFA) was registered. The organisation not only provides technical support for the farmer members on organic farming and organic certification, but also credit support through revolving funds (given by CIKS under various projects) and marketing support for organic produce. The National Bank for Agriculture and Rural Development (NABARD) backed the scheme. "NABARD funded us for three years to gain technical knowledge. We travelled and learned organic practices and applied them in our villages," says Balasubramanian. From 2011 to 2014, the bank supported organic farming initiatives

by working capital loan, crop loans, and milch animal loan totalling 5.5 million rupees. This encouraged the farmers to bring more agricultural land under organic farming.

They covered marketing aspects like procurement, processing, value addition and sale of their organic produce. But they soon realised that for successful marketing, a certificate of guarantee from an accredited certification agency was necessary. In 2007, the group which had 170 members by then, registered for formal third-party organic certification from IMO Control Private Ltd, an accredited agency, under which the products were marked with the "Truthfully Tested Label" (TFL). In a unique approach, SOFA produced and marketed labelled 'Organic Seeds' of Paddy under the brand name of "Akshaya Seeds". The produce was taken from farmers by the procurement team of SOFA for 10 to 15 per cent more than the prevailing market rates. This enhanced the livelihoods of the farmers. The products are sold within 30 km radius of Sirkazhi, and to organic shops in the cities of Tamil Nadu. To ensure the quality of the produce, a few farmers were selected and trained to become internal inspectors.

A farmer who wanted to become a member of SOFA could register with Rs 200, and avail technical support, seeds, etc. Farmers were trained and guided by master trainers in the village until their land was certified organic. Witnessing the success of the organisation, Vedaranyam, a neighbouring coastal agricultural village, joined them. In 2013 they started their own group called Tirumaraikadu Organic Farming Association (TOFA).

■ A new source of income for community-based women groups

Farming inputs can quickly become a limiting factor in organic farming. SOFA members strongly advocate that farmers must produce their own manure. But when new members want to shift to organic and lack re-

sources, they can also request support from women community enterprises that have developed in the course of the organic movement.

Kanchana Muralidharan, who won the district's best progressive woman farmer award last year, started a community-based vermicompost unit with twelve other women in 2008 and underwent training for the purpose. "It was important to have our own cow to start this. NABARD gave us a cow loan for 15,000 rupees. Today, each member has a cow and sells milk for an additional income," she explains. "When new members enrol, they take orders from us for providing vermicompost and earthworms to them through SOFA to start organic farming. We also supply these to the neighbouring villages on orders." The women work for one to two hours a day for 15 days a month, earning Rs 250–300. Every member in the group could earn Rs 750–900 a month net, excluding labour costs. This has changed their lives, and now they support their families. From 2009 to 2014, this group has sold 42 tonnes of vermicompost and 225 tonnes of earthworms.

Like the vermicompost unit, there is a self-help group that produces biopesticides. Azhagu Nila, along with four women, makes neem oil soaps, and earns Rs 500 to Rs 750 net per month (excluding labour charges). There are other women self-help groups which make value-added products from traditional rice, such as rice flour, rice flakes, etc., creating more livelihood opportunities. Also, these women entrepreneurs display their products at a women's festival every year.

■ Economically sound, socially inclusive

Rats are a huge problem for farmers in this region. Instead of promoting rodenticides, the Centre for Indian Knowledge Systems roped in the Irula tribe, who are traditional rat catchers. This tribal community, who are nomads, migrated near Sirkazhi. Sixty six Irula families were registered with

the SOFA for rat catching. They not only received a community certificate (proof of one's belonging to a particular caste), but also found a way to earn income.

CIKS also successfully experimented with the barn owl box, another traditional rat control measure. "Within three months, an owl had occupied the box in our farm. Almost 80 per cent of the rat problem is solved," says Chellappa Sivalingam, a farmer who installed the barn owl box in his organic farm.

CIKS brought in traditional practices for pest management for environmentally sound and effective solutions and discussed them with SOFA members. "We need to target one pest and solve the issue, instead of using pesticides and killing good pests," Subhashini explains. To prevent crop contamination from chemical farms, the farmers grow barrier crops such as castor and sunhemp, which grow tall.

■ More of an effort, but many benefits

The farmers know that, largely, organic farming requires a greater effort than conventional farming. "Only when you are at the field and watch your farm can organic farming happen. This is not about a farmer walking in, throwing urea, and going away," says Balasubramanian. And he adds: "Chemical pesticides will not get spoiled with time, but biopesticides like panchagavyam, made from five cow products, have to be prepared on a constant basis for crop growth."

But farmers also realise the advantages of organic farming, especially when it comes to improving soil properties and handling increasing aridity. For example, using panchagavyam and earthworms ensures that there is moisture in the soil. Moreover, the traditional rice varieties grown by the farmers do not need much manure, and some of them are drought-resistant and contain medicinal properties. For instance, mappillai samba, a traditional rice variety, grew with only

6 cm of rainfall, when drought occurred at Vedaranyam in 2009/10.

Further, in 2014, the farmers started the Valanadu Sustainable Agricultural Producer Company Limited (VSAPCL), and SOFA and TOFA are now a part of this. The company has 2,620 shareholders in the Nagapattinam district. Women account for 41 per cent of the shareholders and 81 per cent are small and marginal farmers. A farmer can buy up to four shares at Rs 250 each. Since the farmers have credit loans to pay, the profit was decided to be shared after three years.

In the Nagapattinam district alone, where 1,230 women are entrepreneurs, there are 87 women self-help groups under CIKS. The total cultivable land here is 153,964 hectares, of which 1,600 hectares is the total productive area of the farmers. Within this, 391 hectares of land fall under organic, certified organic and non-pesticidal management (NPM).

■ What government could do...

The farmers have grown with the support of numerous international and national organisations and institutions including the Department for International Development (DFID), UK; Hivos International, Netherlands; the UNDP Global Environment Facility; Ford Foundation; Rabo Bank; NABARD; the Department of Science and Technology (DST), India; Friends of Women World Banking (FWWB); Ananya Finance; and Vrutti, a centre for sustainable livelihoods.

The farmers, though, pay a high rate of interest and there are no subsidies for organic pesticides. Balasubramanian explains: "We avail loans of Rs 10,000–20,000 to prepare biopesticides, and pay interest for the same. The government gives subsidies to farmers for urea at Rs 5.70 instead of Rs 40 per kilo. Such subsidies should not be encouraged." Subhashini Sridhar adds: "For an acre of land, pesticides will cost Rs 2,400. For organic farming, in say, 100 acres of land, farmers would need 20,000 kilos of

vermicompost, for which they have to take loans. If the government were to support the farmers, their cost of cultivation could be reduced by 30 to 40 per cent. The local Panchayats (village councils) do not support us either. We need changes in government policy, only then will the Panchayat support us."

The government is not buying the produce of the organic farmers because these are traditional varieties and are over 200 years old. The rule for buying produce by the government is that the parentage of the plant needs to be known and documented. "We do not know the parental details of traditional rice varieties," says Subhashini Sridhar. "However, at CIKS, we document the height of the plant, straw yield and other details. The government can do the same and procure rice from us. If there is support, production and supply of organic food will increase, and the price of organic rice can be on par with the regular rice in the next two or three years."

■ Protecting local varieties through the bio community protocol

About 180 varieties of traditional rice are produced by the farmers for conservation purpose, eleven of which are produced to be sold in the market. For protecting the local traditional varieties grown in this region, in 2010, the association started to develop a bio community protocol (BCP) through which it declares its rights over 21 traditional rice varieties con-



Azhagu Nila (l.) and Meera Chellappa display the neem flakes prepared at the women's self help group centre.

Photos: S. Balasubramanian

served by the community. Through the BCP, the community aims to address farmland conservation and affirm its rights to traditional farmland. "The patent for the community will give them a sense of security. Also, no one can come and take away these seeds from this land in future," says Subhashini.

The idea of making every village sustainable, from seeds to marketing, has been the focus of the group. This will ensure that local resources stay in the village. The 'Seed to Market' initiative of the Sirkazhi Organic Farmers Association, with CIKS's support, is an example of empowering communities to create their own development. This farmer-managed enterprise has promoted self-reliance among the community through regular and active discussions and making decisions through a transparent, democratic process. This effort shows how communities can be supported in developing technologies and processes that are environmentally sound, socially inclusive and economically profitable, a step towards a greener economy.

E-book readers: Handy tools for agricultural extension workers in Ethiopia?

Especially in remote rural areas, using information and communication tools in agricultural extension makes sense. The International Livestock Research Institute in Ethiopia has tested e-book readers with regard to their practicality.

Agricultural extension workers in Ethiopia have only limited access to relevant and timely information to give better advisory services to small-holder producers/farmers. Accessing information may require long travels and communication with many colleagues and friends. Mengistu, a livestock expert in Arbogona district office of agriculture in Southern Ethiopia, says he had to travel to a bigger city like Awassa or wait for weeks or months to get a copy of a manual on dairy production or other information materials. Thus staying up-to-date with required information and knowledge can result in high transaction costs for Mengistu and his colleagues.

One way to build knowledge and capacity of extension workers is

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through providing relevant and timely information that is easily accessible from their work locations via Information and Communication Technologies (ICTs).

The Livestock and Irrigation Value Chains for Ethiopian Smallholders (LIVES) Project, which is being implemented by the International Livestock Research Institute (ILRI) in Ethiopia, piloted the use of e-book readers by extension workers in its intervention sites. The project works on the development of market-oriented agriculture through value chain development. As part of the project objective, e-book readers were piloted to test for their suitability to improve access of extension workers to relevant and timely agricultural information supporting their agricultural advisory service delivery in rural Ethiopia.

In light of the merits of the e-book readers, a total of 102 Amazon kindle e-book readers were distributed to selected agricultural extension workers in four regions of Ethiopia in late 2013. Prior to the distribution of the e-book readers, the LIVES project team, together with experts from the Ministry of Agriculture, collected, sorted and uploaded relevant publications on the



80 per cent of the extension workers tried to use the devices to support their extension service delivery to varying degrees.

Photo: ILRI/ Z. Sewunet

e-book reader from the Ethiopian Agriculture portal, a gateway to agricultural resources in the country, as well as other materials from national and international organisations. The team compiled manuals, best practices and guidelines as well as research outputs in crop and livestock commodities that the extension workers use at the initial stage while they start using the e-book readers. The information materials were in English and also in local languages. The LIVES team carried out information material upload on the e-book reader only at the initial stage, and afterwards, extension workers were free to upload contents that were relevant for their work when they visited the district or regional offices of agriculture where there is better access to internet or digitalised information materials.

As the e-book readers were new to all the targeted extension workers, project staff conducted training programmes on how to use the devices and how to transfer files from computer to e-book reader. Extension workers were encouraged to upload as many information materials as they wanted as well as to remove the materials uploaded by the LIVES team if they found it irrelevant. After one year of distribution, the project assessed and evaluated the use of the devices by the recipients.

■ A high rate of approval ...

The assessment showed that 80 per cent of the extension workers tried to use the devices to support their extension service delivery to varying degrees. Most of them reported that they used manuals and guidelines on crop and livestock commodities that were already uploaded on the e-book reader. Few read working papers and research papers on value chains and gender mainstreaming. The extension workers welcomed the long battery life of the e-book readers, their portability and their ease of use at any time and place to get information. These features are compatible with the con-

text in which extension workers do their job, involving frequent travels to rural areas as well as locations with little or no electric power supply. They mentioned additional features making the use of e-book readers attractive such as the built-in dictionary, zooming and text to speech.

Twenty-five per cent of the users managed to put additional information materials on the devices. The sources of the additional materials were personal networks and resources from the internet and from organisations such as research institutes in their vicinity. The majority did not upload information materials because they did not know how to do it, feared viruses or had no additional material to add. The extension workers reported that their reading frequency and time spent on reading had increased significantly because of e-book readers.

■ ... but difficulties, too

Three major technical limitations of the e-book reader were reported by users. The first one is incompatibility with Geez scripts (Geez is a script used as an abugida [syllable alphabet] for several Ethiopian and Eritrean

languages). Many relevant extension information materials for extension workers are written in Amharic, which uses the Geez scripts, while the kindle e-book reader only supports Latin scripts for good readability. Information materials written with Geez scripts were uploaded in a PDF format instead of the kindle format, which decreased ease of reading as it displayed texts too small and complicated going from page to page.

The second challenge was incompatibility with illustrations. E-book readers are made for reading novels and biographies which are full of texts, while many extension guidelines and information materials contain illustrations such as graphs, tables and figures. When these materials are converted to the kindle format, they are displayed in a scattered and fragmented manner. This disturbed the text flow and made it difficult for extension workers to follow and grasp the content easily, reducing the motivation to use the e-book reader for such materials.

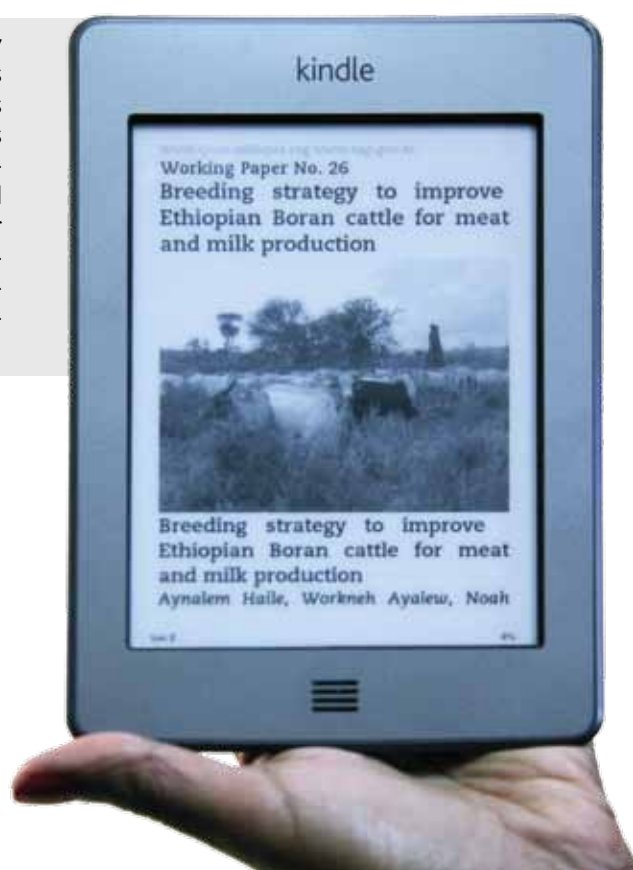
The third challenge concerned computer viruses. From the total number of extension workers who were using the e-book readers, 15 per

An e-book reader is a mobile electronic device that is designed primarily for the purpose of reading digital e-books and other publications. The advantage of an e-book reader is that it can hold the digital equivalent of many printed books without added mass or bulk. What distinguishes the e-book reader from other digital devices such as smartphones, tablets and laptops is that it

provides better readability in bright sunlight and has longer battery life that lasts for weeks or even months with a single charge. Compared to ordinary printed books, the e-book reader has additional features including annotation, a built-in dictionary and book-marking.

“When I provide training to farmers
or when I go for a field visit
I always have the e-book reader with me
so that I refer to some materials easily.”

Amsalu, extension worker in
Dembia district office of agriculture,
Amhara region



cent lost their information materials while trying to add more from their office computers or laptops. Most of the extension organisations did not have the capacity to solve the virus problem, leaving the extension workers frustrated and disinclined to obtain additional information materials.

■ What should one look out for?

The above three issues provided an overview of the technical and contextual factors that need to be in place while considering the use of ICT tools such as e-book readers to improve access of extension workers to information. The following has to be considered while proposing such technologies:

■ **Technical compatibility:** Not all technologies fit in all contexts. The agricultural extension workers in Ethiopia require relevant resources in local languages as well as in English. The kindle touch e-book readers do not support the local language scripts well and create challenges for users. Furthermore these devices, or versions of the kindle, are not compatible with illustrations that are quite common in information materials on agricultural extension. Hence it is important to identify an e-book reader brand or version or another technology that is compatible with Geez script and illustrations while keeping the features that extension workers find attractive in e-book readers.

■ **Access to the additional and relevant information materials:** Without a continuous flow of new information materials, the usability of e-book readers decreases. In the Ethiopian extension service, access to up-to-date and relevant information material for extension workers in rural settings is still a challenge, and thus mechanisms allowing continuous flows of information materials need to be in place. Here, the district office of agriculture could collect relevant resources and facilitate uploading content through wireless internet into the extension worker's e-book reader. Therefore, it is important to invest in an information

management system in the district office of agriculture to facilitate the use of intended information materials in e-book readers.

■ **Personal and organisational capacity to use the devices:** New technologies call for personal and organisational capacity to use them and support mechanisms to cope with new challenges. In the present case, the extension workers were unable to get support from peers/colleagues in time of need. Technical support such as virus-free computers or relevant information materials is also important to make use of information materials on e-book readers. Therefore, capacity building is needed for the users providing repeated trainings and follow up, and the organisation must have the capacity to support the facilities required or other alternative means of acquiring the facilities.

The growth in use of ICTs such as e-book readers in agricultural extension service offers a new opportunity to improve service delivery. These tools facilitate provision of timely and relevant information and knowledge as well as service delivery efficiency and effectiveness. However, issues of relevancy, compatibility as well as sustainability and cost effectiveness are critical factors to consider. Therefore, these aspects need to be studied thoroughly prior to scaling up. We recommend further and rigorous research on feasibility, use and impact of e-book readers in extension service delivery to provide guidance for wider application of the technology in agricultural extension.

The results of the current study showed the challenges that need to be solved and opportunities to consider. Accordingly, the LIVES project together with the regional and district offices of agriculture plans to work further on the utilisation of these tools by extension workers and document their impact in contributing to efficient extension service delivery. Technical support and further training on the use of e-book readers are main elements and are planned to be considered on the next phase.

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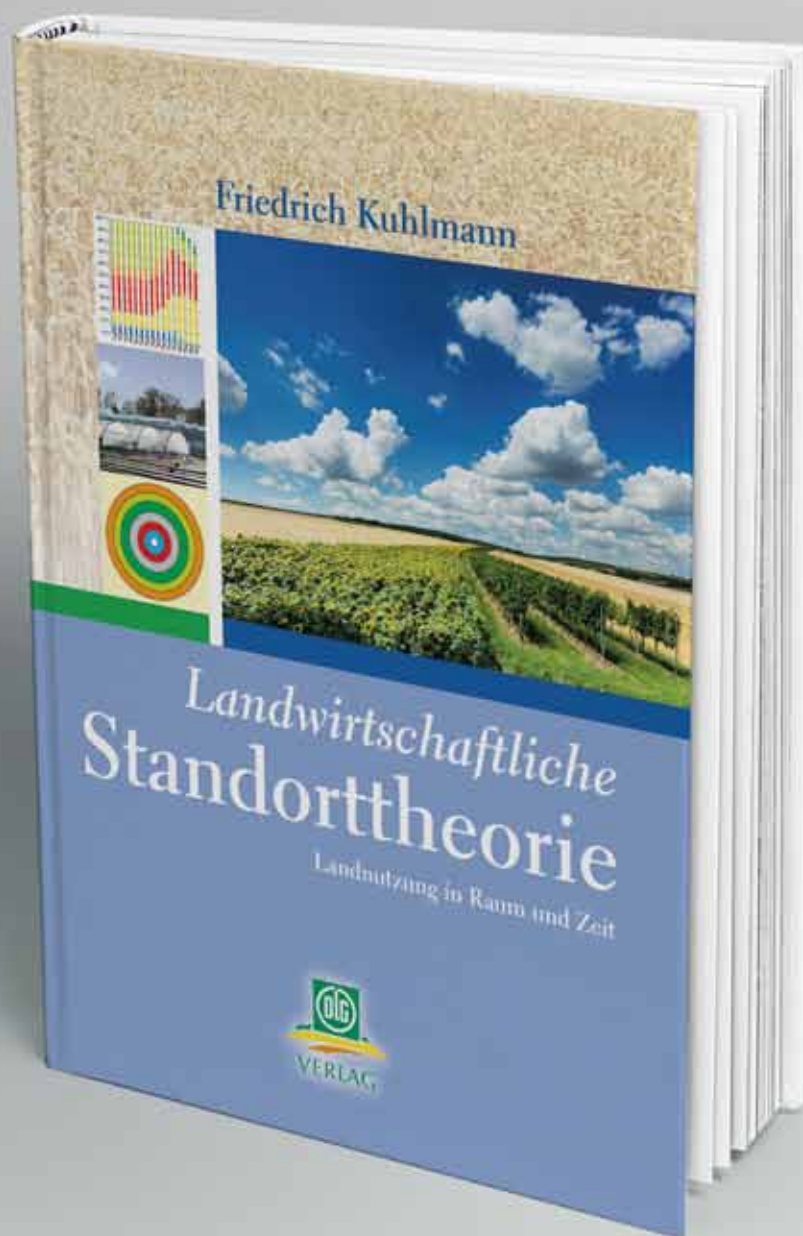
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