Rural21

No. 3/2012
Volume 46
ISSN 1866-8011
D 20506 F

The International Journal for Rural Development

Photo: FAO/O. Asselin

Organic farming

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Dear Reader,

It has become commonplace for every development policy statement to note that it will be essential to promote sustainable agriculture if hunger and poverty are to be overcome. Agreement on how to do this, however, is not so universal. The debate is no longer so polarised, no longer purely a matter of "large against small", "conventional against organic". The aim now is to combine forms and advantages; yet many issues remain to be solved. Is organic agriculture, which does not seek output maximisation, able to feed a growing world population, or will it always remain a fine but small niche? Can smallholders in the South achieve stable incomes by converting to organic production, or is it possibly even grossly negligent to entice them to join the markets – doubtlessly expanding – for organic food as they may never actually be able to enter them due to the high quality standards and entry costs?

Our authors, too, can not answer unequivocally "yes" or "no" – nor was this to be expected. A part of the uncertainty is due to the strong ideological bias that still often marks debate on the "big" question of whether organic farming can feed the world. Numerous studies, some conducted over periods of many years, are now available on the yield potential of organic and conventional farming practices; but the findings point sometimes in the one direction, sometimes in the other, as our authors show on pages 6–13 and 22–24. The question of the predictive power of the findings of such studies and their transferability to other farms and regions continues to be a source of fierce dispute among the scientists (pages 6–8).

The fact is undisputed that organic yields in intensively farmed regions are 15 to 25 percent lower than conventional yields. It is equally undisputed, on the other hand, that wherever climatic conditions are extreme – very dry, for instance, but also where precipitation is extreme – organic farming produces at least the same yields and often even better ones. Considering the impending threat of climate change, surely this is a clear benefit? Yes, in terms of adaptation to climate change, for organic principles such as creating a good soil structure, promoting crop diversity, utilising local knowledge and diversifying towards combined crop and livestock production increase resilience in both production-related and economic terms. When it comes to climate change mitigation, however, a highly differentiated analysis is needed, as our authors show on pages 14–17. To assess the contribution that organic agriculture can make to cutting greenhouse gas emissions, it is essential to take account of numerous further factors, such as the question of food losses and thus of consumer behaviour. Scientists agree that just too many issues are still unresolved to make a conclusive assessment; the research requirements are as huge as ever (pages 32–34).

What is certain is that organic agriculture is a complex and knowledge-intensive farming system. This means for one thing that many farmers in the South who work without organic fertilisers and other chemical inputs are perhaps already engaging in organic farming as such, but such farming is not automatically sustainable (see pages 6–8). It further means that farmers need intensive advice at all stages of the organic value chain if they are truly to benefit from the advantages it offers (pages 26–31).

Our authors agree that organic agriculture is definitely a development opportunity for smallholder farmers in the South. Our reports on cocoa cultivation in the Democratic Republic of Congo (page 24) and on organic vegetable production in the Philippines (pages 29–31) bear this out. So do further reports which you can find on our website, for instance on the emerging organic farming sector in Serbia or the already established organic shrimp and pangasius sector (www.rural21.com). The prospects would improve if the certified market, which is doubtlessly of prime importance and mainly a matter of the industrialised countries, would open up and organic agriculture would become the production standard, as our author wishes on pages 18–21. A realistic prospect? Or just a pipedream? We would be delighted to learn of your views. Write to us!

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Silvia Richter

Partner institutions of Rural 21:

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Drought in the USA: Impacts on small farmers in developing countries

The USA is in the grip of a drought considered to be the worst for more than 50 years. Over 60 per cent of the country's farms are located in the areas struck by drought, which normally produce some 40 per cent of US-America's wheat and soya and 44 per cent of livestock. Because of the drought, far lower harvests are expected than in previous years. Maize losses of about 20 per cent are anticipated. If the situation becomes more acute it could even rise to 30 per cent, reported the International Food Policy Research Institute (IFPRI) at the beginning of August 2012.

This situation has lead to strong price increases on the world market. According to the World Bank, wheat prices rose by about 50 per cent and maize prices by more than 45 per cent from mid-June to end July 2012. Soybean prices rose by almost 30 per cent from the beginning of June till the end of July 2012, making an increase of almost 60 per cent since the end of last year. Rice prices have remained stable. This is the difference compared to the 2008 food crisis, when the price of all cereals escalated, including rice prices.

In order to resist this food crisis, the IFPRI recommended in August 2012 that, amongst other measures, cereal production in developing countries should be increased for the next season. This would help developing countries reduce the impacts of the high and volatile prices on their national food security. In the long term, IFPRI signals that „boosts to smallholder productivity, including enhanced access to high-quality/stress-tolerant seeds, fertiliser, new and affordable technologies, and rural infrastructure, must be made top priority". In this context, the World Bank also points out that in the long term "sustained investments in agriculture in poor countries" are essential.

The Church Development Service (Evangelischer Entwicklungsdienst – EED) considers that this crisis situation offers a real opportunity for farmers in developing countries. Higher world market prices for cereals would make cereal production profitable for them again. Many of these countries are cereal importers, buying chiefly from the USA and the EU. When world market prices are low, domestic farmers are not competitive. "To make a livelihood from farming, men and women smallholder farmers need higher world market prices" says the EED. The World Bank also sees an opportunity for developing-country farmers – "higher prices can bring desperately needed income to poor farmers, enabling them to invest, increase their production and thereby become part of the global food security solution."


Photo: laif

Due to the drought, maize losses of about 20 per cent are anticipated in the USA.

Despite such opportunities, however, the fact remains that high world market prices are first of all a threat to food security for the world's poorest countries, and consequently a threat to social stability. *(ile)*

WorldRiskReport 2012

The WorldRiskReport 2012 focuses on interaction between environmental degradation and disaster risk. In the Report, published by the German non-governmental organisation (NGO) "Bündnis Entwicklung Hilft", the link between environmental degradation and disaster risk is highlighted by a number of case studies in areas across the world.

The Sahel, where a prolonged lack of rainfall has brought about a serious decline in crop yields, is threatened by a severe food crisis. As less and less crops can be harvested, poor peasants are resorting to increasingly intensive land use. This in turn results in a progressive degradation of the land, ultimately leading to the vicious circle of desertification. The German NGO Welthungerhilfe has been collaborating with local partner organisations and peasants to combat desertification through an appropriate and sustainable use of water and soil.

The WorldRiskReport 2012 gives many other examples of human intervention in nature resulting in a disaster potential. They include the destruction of mangrove forests and coral reefs, which reduces protection against tidal waves, especially in Southeast Asia. In Pakistan and other countries, clear-cutting of mountain forests accelerates erosion and increases the extent of flooding. The WorldRiskReport 2012 also contains the WorldRiskIndex, which calculates the risk of becoming a victim of a disaster following a natural event for 173 countries worldwide. The Index has been compiled by the United Nations University Institute for Environment and Human Security (UNU-EHS) in Bonn, Germany, in collaboration with Bündnis Entwicklung Hilft. It is based on the notion that a society's disaster risk is influenced by its structure, processes and framework conditions, which may in turn be affected by natural events and the effects of climate change.

The WorldRiskReport 2012 is to be presented in Berlin, Germany on the 12th September. *(mg)*

Orange sweet potato verifies: biofortification works

A study on vitamin A-enriched orange sweet potato that was released in Uganda in the mid 2000's not only gave evidence that the new varieties were accepted by the Ugandans, but also showed that vitamin A intake has measurably increased, particularly among the most vulnerable groups, like small children and women.

Vitamin A deficiency is a major public health concern in poorer countries and accounts for more than 600,000 deaths a year among children under five years of age. In Africa, Vitamin A deficiency prevalence is estimated at 42 per cent among children under five. The deficiency can impair immunity and cause eye damage that can lead to blindness and even death (Rural 21 also reported on this in Edition 4/2009).

In many African countries, white or yellow sweet potato varieties are an important staple crop, but these provide little, or no, vitamin A. An orange-coloured variety which not only contains high vitamin A levels but is also high-yielding and drought-tolerant was developed by HarvestPlus via conventional breeding. HarvestPlus is part of the Research Program on Agriculture for Nutrition and Health of the Consultative Group on International Agricultural Research (CGIAR). From 2007–2009, HarvestPlus and its partners disseminated new Orange Sweet Potato (OSP) varieties to more than 10,000 farming households in Uganda. The project provided OSP vines for farmers to grow, as well as extension services and nutritional information so that farmers could incorporate OSP into their cropping systems. Since sweet potato is available for about ten months a year, it can be a rich and steady source of vitamin A.

The project resulted in 61 per cent of households adopting the vitamin A-rich OSP to grow on their farms. According to the study, vitamin A intake increased by two-thirds for older children and nearly doubled for younger children and women by project end. For children of six to 35 months, who are especially vulnerable, OSP contributed more than 50 per cent of their total vitamin A intake. The high prevalence of inadequate vitamin A intake among a subset of children of 12 to 35 months who were no longer breastfeeding fell from nearly 50 per cent to only 12 per cent as a result of the project. At project end, researchers also found that women who got more vitamin A from OSP had a lower likelihood of having marginal Vitamin A deficiency.

Photo: M. Malungu/HarvestPlus

Ugandan children eating orange sweet potato.

This project was undertaken concurrently in Mozambique, where results showed even higher levels of adoption – and consumption – of OSP by vulnerable households. HarvestPlus is now scaling-up OSP to reach another 225,000 households by 2016. The International Potato Center (CIP) plans to scale-up OSP to reach more than 600,000 households in ten countries by 2015, including 120,000 households in Mozambique. HarvestPlus runs similar projects with vitamin A-rich 'yellow' cassava and with iron reach bean varieties in Rwanda. Both projects are promising: In January 2012, the Nigerian Government announced the release of three new vitamin A-rich 'yellow' cassava varieties, and the Rwandan Government released five new iron-rich bean varieties in July 2012. *(HarvestPlus/wi)*

For more information on CGIAR biofortification projects, see **www.rural21.com**

Organic agriculture in developing countries

Status quo and challenges

The principles of organic farming were developed in Northern countries, largely in response to nutrient abuse in young, nutrient-rich soils. Consumers in the North are willing to pay for products with additional value such as environmental benefits. In contrast, farmers in the South struggle with the often low nutrient status of their soils and poor access to markets. The authors argue that avoidance of organic farming being limited to "prime sites" will require a more site-specific definition of organic agriculture; they suggest that organic certification systems be broadened to bring organic agriculture from the "elite" to the public while meeting global needs for food security.

Millions of farmers in developing countries, particularly in agro-ecologically or infrastructurally marginalised areas, practise no-external-input agriculture and are thus fulfilling the legal requirements of certified organic agriculture (avoidance of easily-soluble mineral fertilisers, chemical-synthetic plant protection and genetically modified organisms (GMOs)) without being recognised or compensated for. Despite their heavy reliance on nutrient recycling and often highly diverse germplasm (such as in agro-silvo-pastoral, homegarden or multiple cropping systems), these frequently ancient land-use modes may not be sustainable, however, as often indicated by field abandonment, soil erosion or rural exodus.

Andreas Buerkert
Organic Plant Production and Agroecosystems Research
Eva Schlecht
Animal Husbandry in the Tropics and Subtropics

University of Kassel and University of Göttingen
Witzenhausen, Germany
buerkert@uni-kassel.de
schlecht@uni-kassel.de

In the higher latitudes, the yield-enhancing principles of organic agriculture were elaborated many decades ago by writers and philosophers such as Jerome Irving Rodale (USA), and for the bio-dynamic movement, Rudolf Steiner (Switzerland), rather than by agricultural scientists such as Rolf and Maria Müller and Hans Peter Rusch (Switzerland). These principles largely reflect negative ecological experiences of nutrient abuse in temperate agro-ecosystems where young soils predominate. Such soils are typically rich in plant-available nutrients and organic matter that can be easily exploited by appropriate cropping systems. In addition, today's farmers in these regions benefit from easy access to consumers willing to pay for products whose labels promise additional value such as environmental benefits, animal welfare, social fashion, or personal health. The socio-ecological reality of lower latitude (subtropical and tropical) countries is, however, often fundamentally different: many low- or no-external input farmers in Africa, Asia and Latin America are exposed to high rainfall variability and suffer from poor access to produce markets. In addition, their primary production is often limited by extremely low levels of available nutrients such as phosphorus and potassium in highly weathered soils, which cannot be easily replenished by nutrient cycling or mobilisation from the subsoil regardless of land-use or cropping systems. Moreover, only in temperate regions can soil organic matter be maintained or even enhanced through lay- or legume-based rotation systems with a winter-related break of mineralisation.

Aimed at avoiding certified organic farming from remaining limited to 'prime sites' a debate is going on about modifications to the different certification systems that regulate the worldwide, often excessively energy-intensive trade with organic produce. At present, the different organic certification schemes seem to focus too much on DON'Ts rather than DOs (absence of sustainability criteria and social standards, but permission of indiscriminate fossil water use for food or forage production). This debate has the potential to open the avenue for a more site-specific definition of rules under which organic production may occur and its produce be marketed locally and worldwide. Purists criticise such efforts to reconcile existing restrictions of the better-off in the temperate zones with the agro-ecological realities of the poor in the lower latitudes. They argue that this may be one step towards a 'conventionalisation of organic agriculture'. However, given the global needs of food security and food sovereignty, the concepts of organic certification need to be broadened and mutually beneficial linkages between conventional and organic agriculture merit to be explored.

What can organic agriculture achieve, and where are its limits?

During the last decade, an often emotional, unnecessarily provocative discussion has been initiated over the question of whether organic agriculture (under its current set of regulations) can 'feed the world'. Five years ago, based on a rather large dataset from field experiments, the 'Michigan Study' (Badgley et al., 2007) seemed to provide evidence of a large, unexploited yield potential of organic agricultural practices compared to conventional crop management, particularly in developing (tropical and subtropical) countries. Similar claims of yield superiority by the use of organic approaches were made recently by proponents of the 'System of Rice Intensification' (SRI). These reports were taken up by broad vision statements of international agricultural organisations adjuring the potential of organic agriculture for a better future of the developing world's poor (El-Hage Scialabba, 2007). While a widely cited UNEP report (2008) concluded 'that organic agriculture can build up natural resources, strengthen communities and improve human capacity, thus improving food security by addressing many different causal factors simultaneously', this statement seems largely based on poorly defined circumstantial evidence, lacking sufficient solid data.

An analysis of the Michigan Study's database (Connor, 2007) unravelled that in addition to basic calculating errors in the analysis, the experimental results for organic yields were based on often enormous quantities of organic amendments brought in from outside (mulch, compost, manure) and a poor choice of conventional reference yields. Therefore, the study's overly optimistic description of yield levels in organic systems can hardly be extrapolated from the plot to the field or regional level. Nevertheless, even at 20–50 per cent lower yields, agricultural households may strongly benefit from organic production whenever its output can be adequately supplied to national or international premium markets. If organic produce is derived from rare germplasm (landraces of plants and animals, wild collections), its sustainable utilisation and organic marketing may even guarantee its survival (in situ conservation) under structural change. Organic agriculture can thus very well contribute to strengthening rural livelihoods and offer opportunities for decent work, value addition and genetic diversity to producers in developing countries. Organic agriculture should, however, not accept to be held hostage by the undeniable need for mass production of low-cost food and agrarian raw materials that the majority of the global population demand, industry requires, and politicians promise to procure.

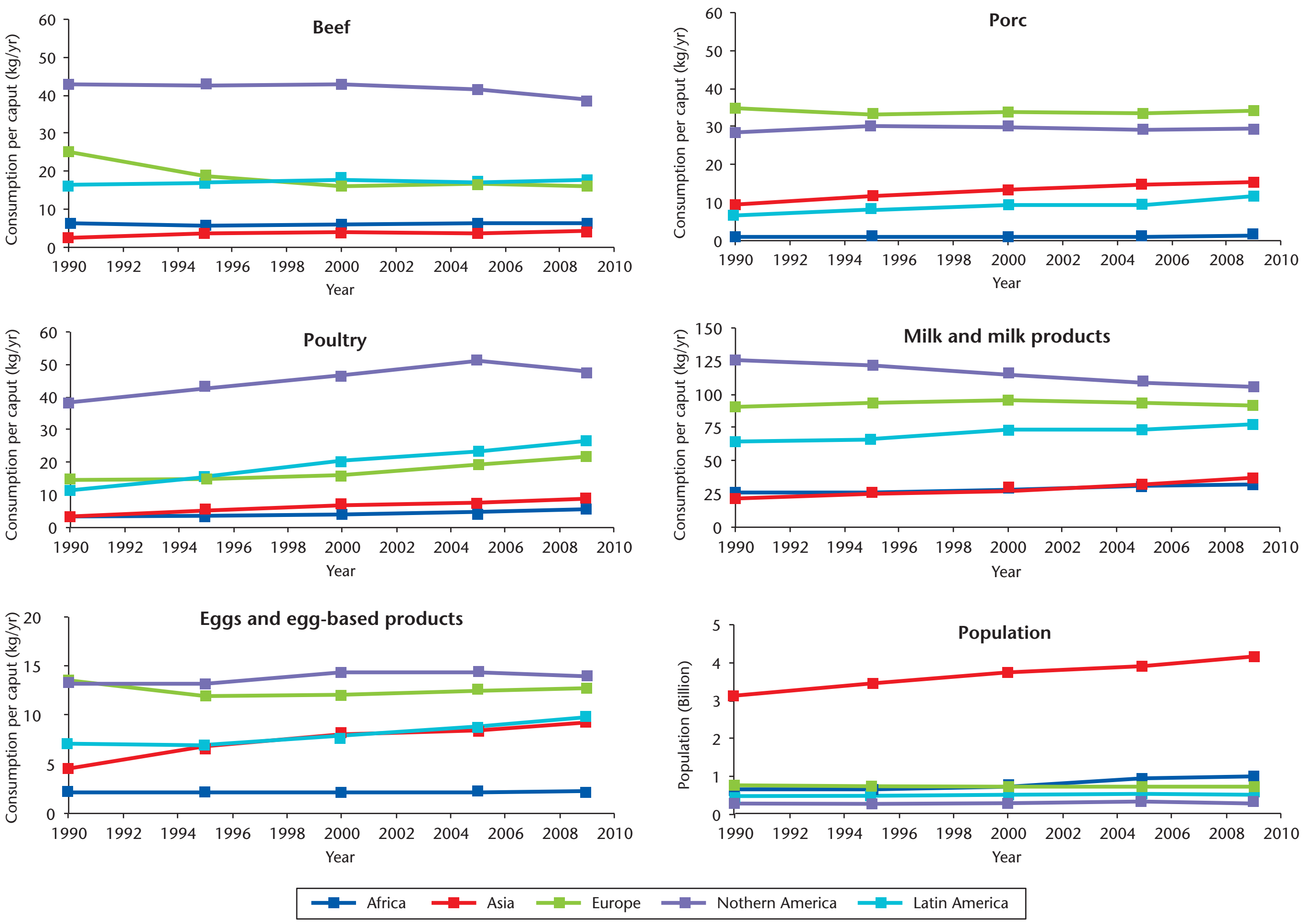
Current trends in global agriculture ...

Over the last ten years, new trends in global agricultural production have emerged. These were triggered by (i) a large absolute growth in non-agricultural consumers due to demography and urbanisation, (ii) a major increase in middle-class consumers, mainly in Asia, who only spend a fraction of their income on their caloric needs and shift their diet to a larger share of animal products (meat, milk and eggs; see Figure on page 8, whereby consumption per caput has to be multiplied by population numbers to obtain total demand data), and (iii) the expansion of industrial agriculture geared towards the provision of feed concentrates (corn, cassava, soybean) and as raw material for the renewable energy sector beyond sugarcane (mainly oil palm and maize for diesel and ethanol production; Buerkert and Schlecht, 2009). This has led not only to a large increase in total production of the crops concerned

Photo: J. Boethling

What prospect does organic farming hold for farmers in the South?

Changes in per caput consumption of livestock products and in population across different continents during the past 20 years



(from 2000–2010 global production increased by 104 % in palm oil, 43 % in corn, 30 % in roots and tubers, 38 % in soybean, and only 12 % and 6 % in the poor's staples paddy rice and millet), but also to an unprecedented expansion in cultivated area. The consequences were the ongoing rainforest destruction (conversion into palm oil plantations and cassava stands) in Southeast Asia and a partial replacement of areas dedicated to food crops by energy plant cultivations in the USA and South America, often involving genetically modified varieties with herbicide or insect resistance (Roundup-ready soybean, Bt-maize). As these changes occurred, global investors have discovered the food market with its dwindling reserves to be a profitable area of speculation, thereby increasing price volatility and subsequent vulnerability of undernourished people. Despite numerous efforts to enhance access to affordable food, their numbers have remained relatively constant, at 880 million people in 1969 (33 % of the world's total) and 925 million in 2010 (16 % of total) of whom today, 62 per cent live in Asia and the Pacific region and 26 per cent in sub-Saharan Africa (FAO, 2010). Their short-term increase to 1,030 million people in 2008 reflected the then dramatic rise in food prices, which peaked at 950 US dollars per ton of wheat as a consequence of the above described three trends.

... and upcoming challenges for organic food production

Global agricultural development efforts and policies therefore urgently need a double focus: on the one hand, they should continue to support the production of affordable staples rather than energy plants to enhance the food security of non-agricultural poor consumers with little willingness / ability to pay for a socio-environmentally beneficial food histoiry (resource-efficient, yield- and consumer-oriented conventional agriculture). On the other hand, (certified) organic agriculture needs to be fostered to fulfill its roles in enhancing food sovereignty for largely subsistence-oriented farmers while providing an additional opportunity for the marketing of premium value plant and animal surpluses. This will allow many small-scale agricultural producers to secure their livelihoods and strengthen land-use systems which emphasise *in situ* conservation of genetic resources and (agri-) cultural identity. This will also strengthen the dialogue between promotors of organic and conventional agriculture towards making the latter more ecologically sound and products of the former more accessible to consumers worldwide.

Organic agriculture and food security –not a contradiction

Organic farming is not going to succeed in feeding the world's growing population, its critics say. This is wrong, our author maintains, for there are numerous studies that refute the notion that conventional agriculture turns out higher yields in all circumstances. Moreover, increases in production levels achieved over the last few years have not been able to solve the problem of hunger either.

Ever since economist Thomas Malthus wrote 'An Essay on the Principle of Population' in 1798 and first raised the spectre of overpopulation, various experts have been predicting the end of human civilisation because of mass starvation. Malthus predicted that human society would starve in the 1800s.

Andre Leu
President
International Federation of Organic Agriculture Movements (IFOAM)
Bonn, Germany
a.leu@ifoam.org

The theme was again popularised by Stanford University Professor Paul Ehrlich in his 1968 book, 'The Population Bomb'. According to his logic, we should all be starving now that the 21st century has arrived. *'The battle to feed all of humanity is over. In the 1970s the world will undergo famines; hundreds of millions of people are going to starve to death in spite of any crash programs embarked upon now.'*

The only famines that occurred since 1968 have been in countries saddled with corrupt governments, political turmoil, civil wars and periodic droughts. The world had enough food for the affected people. It was political and logistical events that prevented them from producing adequate food or stopped aid from reaching them.

Although the world produces more than double the amount of food to feed everyone, around one billion people suffer from hunger.

Photo: J. Boethling


Photo: Courtesy of the Rodale Institute

Organic (left) vs. conventional: Better water infiltration, retention and delivery to plants help to sustain yield during drought.

Hundreds of millions of people did not starve to death.

The spectre of mass starvation is again being pushed, based on highly questionable and contestable assumptions, as the motive for justifying genetically modified organisms (GMOs) and the unsustainable use of toxic chemicals to push for higher yields.

Enough food for everyone

According to the UN Food and Agriculture Organization (FAO) and other figures, the world produces more than double the amount of food to feed everyone. Despite this, around one billion people suffer from hunger and another billion are malnourished, lacking the essential micronutrients they need to lead healthy lives. Clearly, our current market-based distribution systems are failing the poorest as they cannot afford to buy this food. The market-based systems concentrate the food in the areas where people have the money to pay for it. Consequently one billion adults are overweight and almost half of them are obese.

Food losses also are staggering. About one-third of the food produced for human consumption is lost or wasted every year, amounting to about 1.3 billion tons annually (FAO, 2011). Reducing food losses and food waste, and improving food access, is highly relevant to efforts to combat hunger, raise income and improve food security in the world's poorest countries. Simple affordable measures such as village grain silos and better transport would prevent most of these losses. The problem of hunger is mostly due to poor distribution systems and inadequate production in the poorest communities. It has very little to do with the total amount of food produced in the world.

Where Organic has higher yields: Conditions of climate extremes ...

Research has shown two significant areas where organic systems have higher yields than the conventional system. These are under conditions of climate extremes and in traditional smallholder systems. Both of these areas are critical to achieving global food security.

According to research by NASA and others the world is seeing increases in the frequency of extreme weather events such as droughts and heavy rainfall. Even if the world stopped polluting the planet with greenhouse gases tomorrow, it would take many decades to reverse climate change. This means that farmers have to adapt to the increasing intensity and frequency of adverse and extreme weather events such as droughts and heavy, damaging rainfall.

Published studies show that organic farming systems are more resilient to the predicted weather extremes and can produce higher yields than conventional farming systems in such conditions (Drinkwater, Wagoner and Sarrantonio, 1998; Welsh, 1999; Pimentel, 2005). For instance, the Wisconsin Integrated Cropping Systems Trials found that organic yields were higher in drought years and the same as conventional yields in normal weather years (Posner et al., 2008).

Similarly, Farming Systems Trials (FST) of the US-based Rodale Institute showed that the organic systems produced more maize than the conventional system in drought years (see photo). The average maize yields during the drought years were from 28 per cent to 34 per cent higher in the two organic systems. The yields were 6,938 and 7,235 kg per hectare in the organic animal and the organic legume systems respectively, compared with 5,333 kg per hectare in the conventional system (Pimentel, 2005). The researchers attributed the higher yields in the dry years to the ability of the soils on organic farms to better absorb rainfall. This is due to the higher levels of organic carbon in these soils, which makes them more friable and better able to store and capture rainwater which can then be used for crops (La Salle and Hepperly, 2008).

Improved efficiency of water use. Research also shows that organic systems use water more efficiently due to better soil structure and higher levels of humus and other organic matter compounds (Lotter, Seidel and Liebhart, 2003; Pimentel, 2005). Lotter and colleagues collected data over ten years during the Rodale Farming System Trials. Their research showed that the organic manure system and organic legume system (LEG) treatments improve the soil's water-holding capacity, infiltration rate and water capture efficiency. The LEG maize soils averaged a 13 per cent higher water content than conventional system (CNV) soils at the same crop stage, and 7 per cent higher than CNV soils in soybean plots (Lotter, Seidel and Liebhart, 2003).

The more porous structure of organically treated soil allows rainwater to quickly penetrate the soil, resulting in less water loss from run-off and higher levels of water capture. This was particularly evident during the two days of torrential downpours from Hurricane Floyd, which hit the eastern United States and the Bahamas in September 1999, when the organic systems captured around double the water than the conventional systems captured (Lotter, Seidel and Liebhart, 2003).

This is very significant information as the majority of the world farming systems are rainfed. The world does not have the resources to irrigate all of the agricultural lands. Nor should such a project be started as damming the world's watercourses, pumping from all the underground aquifers and building millions of kilometres of channels would be an unprecedented environmental disaster.

Improving the efficiency of rainfed agricultural systems through organic practices is the most efficient, cost effective, environmentally sustainable and practical solution to ensure reliable food production in the increasing weather extremes being caused by climate change.

... and smallholder farmer systems

The other critical area where research is showing higher yields for good practice organic systems is in traditional smallholder systems. This is very important information as over 95 per cent of the world's farmers fall into this category. A report by the United Nations Conference on Trade and Development (UNCTAD) and the United Nations Environment Programme (UNEP) found that organic agriculture increases yields in Africa. *'... the average crop yield was ... 116 per cent increase for all African projects and 128 per cent increase for the projects in East Africa.'*

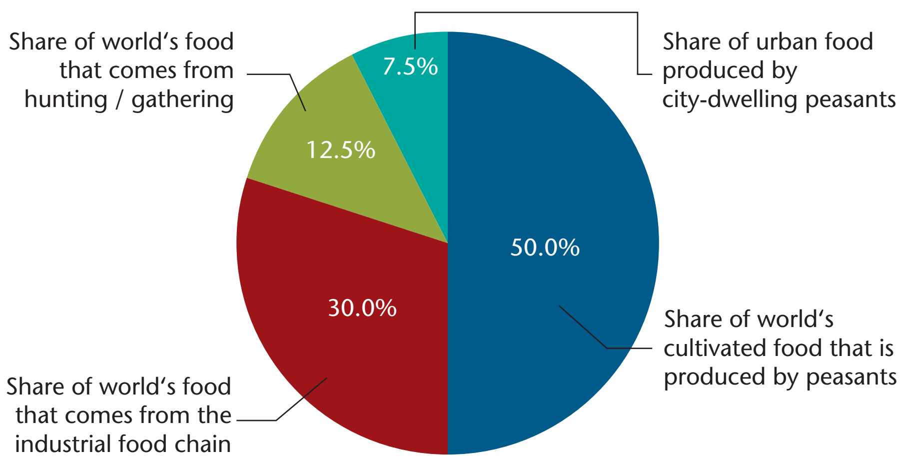
The report notes that despite the introduction of conventional agriculture in Africa, food production per person is 10 per cent lower now, than in the 1960s. *'The evidence presented in this study supports the argument that organic agriculture can be more conducive to food security in Africa than most conventional production systems, and that it is more likely to be sustainable in the long term'*, Supachai Panitchpakdi, Secretary General of UNCTAD and Executive Director of UNEP Achim Steiner stated.

This is crucial information as FAO data shows that 80 per cent of the food in the developing world comes from smallholder farmers such as those in Africa. The developing world is also the region where most of the one billion undernourished people live, the majority of which are smallholder farmers. With a more than 100 per cent increase in food production in these traditional farming systems, organic agriculture provides the ideal solution to end hunger and ensure global food security.

The key to food security

Information published by the ETC group, an international organisation dedicated to "the conservation and sustainable advancement of cultural and ecological diversity and human rights", shows that 70 per cent of the world's food is produced by smallholders and only 30 per cent by the agribusiness sector (ETC group, 2009; see Figure below). Increasing the yields in the 30 per cent that comes from the agribusiness sector will show little benefit for two reasons. Firstly, this sector is already high-yielding, and it has very little scope for large increases in yields such as the more than 100 per cent that can be achieved by organic methods in traditional smallholder systems. Secondly, this sector is largely focused on the commodity supply chain. The

Where the world's food comes from

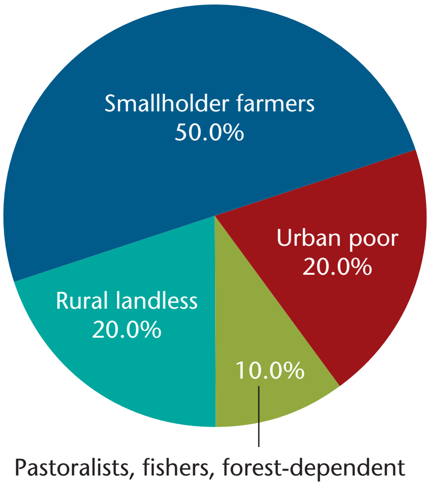


Source: ETC group

large food surpluses produced in the sector have not lowered the number of people who are hungry. According to FAO figures, this number has been steadily increasing since 1985.

Fifty per cent of the world's hungry are smallholder farmers and 20 per cent are the landless poor who rely on smallholders for their employment (see Figure). Logically, increasing the yields in this sector is the key to ending hunger and achieving food security. Organic methods are the most suitable as the necessary methods and inputs that are needed to do this can be sourced locally at no or very little cost to the farmers. Conventional systems have largely failed to provide consistent higher yields to the poorest farmers as the expensive synthetic chemical inputs have to be purchased. Most of these farmers do not have the income to do this. It is an inappropriate economic model for the world's most vulnerable farmers whereas organic agriculture is an appropriate one. A good example is a project managed by the Institute of Sustainable Development in Tigray, Ethiopia (see Box).

Who the hungry are



Source: ETC group

What about yields and farm income?

The assumption that greater inputs of synthetic chemical fertilisers and pesticides are needed to increase food yields is not always accurate. In a study published in *The Living Land*, Professor Jules Pretty of Essex University looked at projects in seven industrialised countries of Europe and North America. *'Farmers are finding that they can cut their inputs of costly pesticides and fertilisers substantially, varying from 20 to 80 per cent, and be financially better off. Yields do fall to begin with (by 10 to 15 % typically), but there is compelling evidence that they soon rise and go on increasing. In the USA, for example, the top quarter sustainable agriculture farmers now have higher yields than conventional farmers, as well as a much lower negative impact on the environment'* (Pretty, 1998a). Numerous studies into organic systems confirm this insight – the following refers to only a few of them:

US Agricultural Research Service (ARS) Pecan Trial. The ARS organically managed pecans out-yielded the conventionally managed, chemically fertilised Gebert orchard in each of the past five years. Yields on ARS' organic test site surpassed the Gebert commercial orchard by 18 pounds of pecan nuts per tree in 2005 and by 12 pounds per tree in 2007 (Bradford J.M., 2008).

Rodale Organic Low/No Till. The Rodale Institute (Pennsylvania, USA) has been trialling a range of organic low tillage and no tillage systems. The 2006 trials resulted in organic yields of 160 bushels an acre (bu/ac) compared to the County average of 130 bu/ac.

Iowa Trials. The results from the Long Term Agroecological Research (LTAR), a 12 year collaborative effort between producers and researchers led by Dr Kathleen Delate of Iowa State University (Iowa, USA) showed that while the organic systems had lower yields in the beginning, by year four they started to exceed the conventional crops. Across all rotations, organic corn harvests averaged 130 bushels per acre while conventional corn yield was 112 bushels per acre. Similarly, organic soybean yield was 45 bu/ac compared to the conventional yield of 40 bu/ac in the fourth year. Cost-wise, on average, the organic crops' revenue was twice that of conventional crops due to the savings from non-utilisation of chemical fertilisers and pesticides (Delate, 2010).

Developing countries. Nicolas Parrott of Cardiff University, UK, authored a report, 'The Real Green Revolution'. He gives case studies that confirm the success of organic and agroecological farming techniques in the developing world (Parrott, 2002):

- In Madhya Pradesh, India, average cotton yields on farms participating in the Maikaal Bio-Cotton Project are 20 per cent higher than on neighbouring conventional farms.
- In Madagascar, SRI (System of Rice Intensification) has increased yields from the usual 2 – 3 tons per hectare to yields of 6, 8 or 10 tons per hectare.
- In the highlands of Bolivia, the use of bonemeal and phosphate rock and intercropping with nitrogen-fixing Lupin species have significantly contributed to increases in potato yields.

Studies comparing the income of organic farms with conventional farms have found that the net incomes are similar, with best practice organic systems having higher net incomes (Cacek, 1986 and Wynen, 2006). A study by Dr Rick Welsh of the Wallace Institute, USA, has also shown that organic farms can be more profitable. The premium paid for organic produce is not always a factor in this extra profitability. While many organic farmers have higher incomes due to the premium they receive, others have higher net incomes due to their lower input costs rather than from the premium.

The United Nations report already cited notes: *'A transition to integrated* *organic agriculture, delivering greater benefits at the scale occurring in these projects, has been shown to increase access to food in a variety of ways: by increasing yields, increasing total on-farm productivity, enabling farmers to use their higher earnings from export to buy food, and, as a result of higher on-farm yields, enabling the wider community to buy organic food at local markets.'*

Conclusion

There is very good research that clearly shows organic agriculture can get the yields that are needed to feed the poor and the hungry. This is especially the case in smallholder agriculture – the majority of the world's farmers.

'All case studies which focused on food production in this research where data have been reported have shown increases in per hectare productivity of food crops, which challenges the popular myth that organic agriculture cannot increase agricultural productivity', the UN report stated.

Organic agriculture is a low-cost and effective way to help many of the world's poorest people to have good levels of nutrition and a better quality of life. We need to see more research and extension in this area to ensure that all farmers can improve their yields and resilience by adopting the appropriate best-practice organic systems (see article on pages 32–34).

Most importantly, the world urgently needs to increase the training in good organic practices to ensure that the poorest smallholder farmers can have the increases in yield that are needed to achieve food security.

A full list of references and literature cited can be accessed from the website: **www.rural21.com**

Simple methods, big success: Sustainable development in Tigray, Ethiopia

The Tigray Project started in 1996 in four local communities in the central, eastern and southern parts of the Tigray Regional State of Ethiopia. It was initiated by an Ethiopian NGO, the Institute of Sustainable Development (ISD). The ISD worked in cooperation with the farmers to revegetate their landscape to restore the local ecology and hydrology. The biomass from this revegetation was then sustainably harvested to make compost and to feed biogas digesters. This was applied to the crop fields. The result after a few years was more than 100 per cent increases in yields, better water use efficiency and greater pest and disease resistance in the crops.

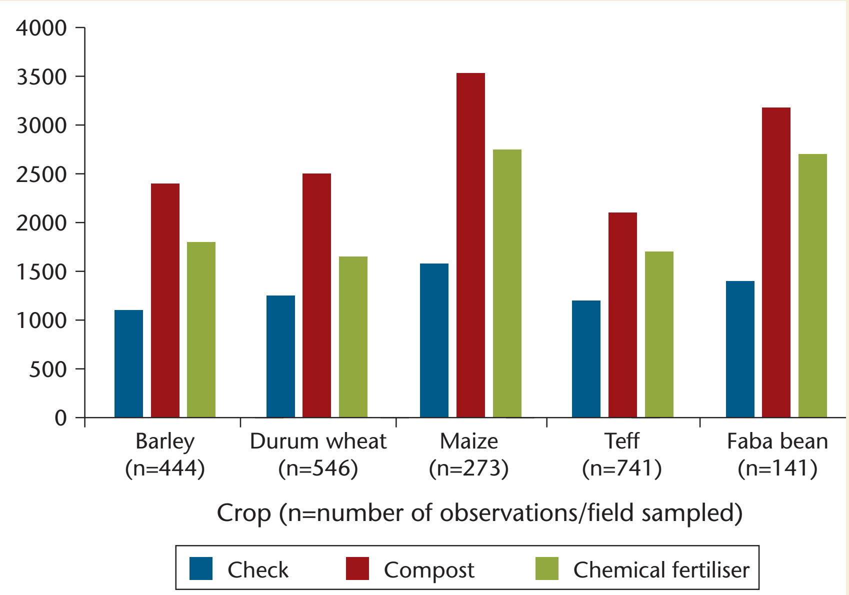
The farmers used the seeds of their own landraces which had been developed over millennia to be locally adapted to the climate, soils and the major pests and diseases. These farmerbred varieties proved to be very responsive to producing high yields under organic conditions, whereas under conventional input practices they were susceptible to diseases such as rust.

The major advantage of this system was that the seeds and the compost were sourced locally at no or little cost to the farmers whereas the seeds and synthetic chemical inputs in the conventional systems had to be purchased. The organic system had both higher yields and a much better net return to the farmers.

This project using simple appropriate organic methods took a region that was previously regularly affected by severe famines that killed people through to a food surplus and relative prosperity. The people could now afford to eat well, buy clothes, send their children to school, pay for medical treatment, afford transport into town and build adequate houses.

The Third World Network provided the initial funding for the project. Today ISD is working with the Ethiopian Bureau of Agriculture and Rural Development (BoARD), district (woreda) experts and development agents to continue implementing the Tigray Project. The funding from several donor agencies is assisting the scaling up so that more regions in Ethiopia can adopt the practices (Edwards S., Egziabher T., Araya H., 2011).

Average mean grain yields in kg/ha for four cereals and one pulse crop from Tigray, northern Ethiopia, 2000 – 2006 inclusive



Changing agriculture in a changing climate

Changes in weather patterns are going to affect agriculture with impacts differing according to region. The developing countries can reckon with the first effects. The authors look at the role that organic agriculture can play in adaptation. They assess the potential that organic agriculture could have but also look at the contribution that agriculture itself is making to climate change and examine how organic agriculture fares in this respect.

"Year after year the monsoon starts later and the drought period prolongs, putting a heavy charge on crop production. Then, rains start and the degraded soils cannot absorb enough of the water. The gift becomes a punishment and crops and humans suffer again. Climate changes and our cropping practices have to change as well to assure our survival." Such statements can increasingly be heard from farmers in Southern India, for example.

Climate change is real. Mitigation measures have to be taken, but even with strong action, climate change will increasingly affect societies and the environment. For agriculture, the most pressing question is how to assure food production in a changing climate, or, framed differently, how to adapt to climate change. The more mitigation action is taken, the easier this task will be. Thus, the other important question is how agriculture may contribute to climate change mitigation.

Adrian Muller
Andreas Gattinger
Urs Niggli
Research Institute of Organic Agriculture (FiBL)
Frick, Switzerland
adrian.mueller@fibl.org

The effects of climate change on agriculture

Climate change affects agriculture in various ways. CO_2 levels, temperatures and climate variability and the frequency of extreme events such as heavy rain, floods and droughts will increase. Increasing CO_2 levels and moderately higher temperatures lead to higher production, but beyond temperature increases of 1.5 °C – and global forecasts go well beyond that – production generally decreases. Precipitation, crop growing seasons and weed, pest and disease pressure will change, but the direction of these changes will vary between regions. The general pattern is that low-latitude dry zones will shift to higher latitudes and precipitation will increase around the equator and in high latitudes. These changes will also affect current monsoon and El Niño patterns and effects on water availability and irrigation water requirements can be huge. Generally, these impacts will be larger and increasingly negative in the second half of our century and the negative impacts will be earlier and stronger in lower latitudes. Most affected by food insecurity and livelihood decline are thus developing countries, including the poorest.

Adaptation in organic agriculture

Key topics for adaptation in agriculture can be derived from the future climate change impacts. First, assuring water availability and optimised water management will be crucial. Agricultural production has to better cope with water scarcity and drought,

The late onset of monsoon rains is forcing more and more farmers to change their cropping practices.

but also with waterlogging and flooding. Second, as impacts vary strongly between regions, locally adapted strategies are needed. Third, increased weed, pest and disease pressure will put stress on agricultural production and necessitate a focus on sustaining strong and healthy plants. Fourth, agricultural production faces increasing variability and risks in production conditions.

Organic agriculture is a promising strategy to face these challenges. Many of its core concepts and practices focus on sustaining healthy and fertile soils with high organic carbon levels, a well-aerated structure and a rich diversity of the soil biota. Such soils are able to absorb large amounts of water from heavy precipitation without water logging or erosion. They also store the available water better, thus hedging against water scarcity and droughts and reducing irrigation needs. Practices that support such healthy soils are the use of organic fertilisers such as compost, manure or mulch layers from crop residues, reduced tillage and avoidance of ploughing, and the incorporation of deep rooting forage legumes in crop rotations. Organic agriculture also exhibits a high level of diversity among crops, crop rotations and production practices.

Photo: J.-M. Caimi/laif

Soil carbon sequestration

Plants build organic matter from atmoshperic CO_2 via photosynthesis. Decaying plant matter such as roots after harvesting or crop residues and organic fertilisers such as compost or manure are transformed by biological, chemical and physical soil processes and deposit this organic carbon in soil organic matter, viz. humus. Humus contains fractions of different stability and parts of it remain stored in the soil for a long time, while other parts are decomposed fastly and emitted as CO_2 over time.

Organic agriculture uses local knowledge which is highly adaptive to local variations, and combines it with modern agro-ecological methods. Moreover, the high diversity on organic farms improves economic and ecological stability and increases resilience against adverse impacts of climate change. A higher diversity of income sources hedges against the risk of crop losses. Optimised and diverse crop rotations can break life-cycles of pests. Landscape elements such as fallow land, buffer or flower strips provide resorts for beneficial animals.

Diversification towards combined crop and livestock production also increases resilience. Grasslands can be used for animal feed production, also in situations where no crops can be grown, in particular on marginal and degraded lands. This adds to food security, as it helps utilising land for human nutrition that cannot be used for this directly via crops. Economic risk is also reduced as organic agriculture is a low external input farming system. Absence of costly farm inputs reduce potential financial losses from crop failure, while net profits can still be higher than for conventional farms, in particular if organic price premiums can be realised on the markets. The risk of indebtedness is thus reduced, which is particularly important for smallholders and poor farmers as it helps to avoid the poverty trap.

Agriculture's contribution to climate change

While agriculture is strongly affected by climate change, it is also contributing significantly to it. Direct emissions from agriculture account for 10–12 per cent of total global greenhouse gas emissions. Including emissions from land use change, such as from deforestation to gain cropland, this share rises to 20–30 per cent. The most important direct agricultural emissions are N_2O emissions from fertilised soils and methane emissions from the digestive processes in ruminants, each accounting for 30–35 per cent of total global direct agricultural emissions. Overall, most important are indirect CO_2 emissions from land use change such as deforestation to gain new cropland, reaching about the same level as total direct agricultural emissions. Methane and N_2O from biomass and crop residues burning accounts are next important, together with methane from rice fields (each between 10–15 % of total direct agricultural emissions). Methane and N_2O emissions from manure management and storage, CO_2 and N_2O emissions from fertiliser production and CO_2 emissions from fossil fuel consumption for irrigation and farm machinery are each between 5–10 per cent of total direct agricultural emissions.

Mitigation in organic agriculture

The mitigation potential of agriculture is about the same size as its direct emissions, mainly through soil carbon sequestration (see Box above). Thus, synergies occur between mitigation and adaptation as organic practices increase soil fertility and soil carbon stocks and improve water management of soils. Organic agriculture might also reduce N_2O emissions. While much is still unclear regarding the dynamics of N_2O emissions depending on soil management, fertiliser type and soil characteristics, the correlation between inputs and stocks of plant-available nitrogen in the soil and N_2O emissions is robust and significant.

Nitrogen is a scarce resource in organic agriculture. Therefore, over-fertilisation is less a topic and nitrogen input levels tend to be lower than in conventional agriculture. This translates in generally lower N_2O emissions per hectare and per tonne except for cases where organic yields are exceptionally low. However, nitrogen-use efficiency is often higher in organic systems, which works again towards lower emissions. How these competing factors sum to net emissions per kilogram produce depends on the concrete situation.

Taking a narrow view, organic agriculture does not perform well regarding the other big emission category, namely methane from ruminants. Concentrate-fed ruminants emit less methane than roughage-fed animals. In addition, higher milk yields per cow further reduce emissions per litre milk for conventional production. Yet this picture changes totally when accounting for the production emissions of the concentrate feed. While adequately managed grasslands and pastures can sequester carbon, intensive soy or maize production for concentrate feed emits large amounts of greenhouse gases. Those stem from fertiliser production and use and from soil carbon losses, in particular if these crops are grown on areas gained from recent land use change, e.g. from deforestation or from conversion of pastures to croplands, as it is common in the big soy producing countries in South America. Furthermore, maximising milk yields increases diseases and reduces animal longevity. This increases emissions per kg produce, as the unproductive rearing phase of a larger amount of replacement animals has to be accounted for. To conclude, methane emissions from ruminants show-case the necessity to adopt wide system boundaries.

Organic livestock production is pasture based with adequate, rather low stocking densities. It supports animal health and longevity. Such systems can be carbon neutral as the sequestration in pastures can compensate the methane emissions from animals and manure management. Clearly, less meat and milk is produced in such systems. Sustainable livestock production also shows the necessity to address other aspects than climate change mitigation in agricultural production only. Consumer aspects are relevant as well. Mitigation in the livestock sector is only possible if less meat and milk is consumed. This does not only mitigate climate change but it contributes to resource efficiency in general, as intensive, concentrate-based meat and milk production is very inefficient in providing calories for human nutrition regarding soil, water, nutrient and energy use.

Livestock production illustrates the need for wide system boundaries in other contexts, too. Conventional stockless arable farms depend on synthetic fertilisers while manure and slurry from conventional livestock farms is often disposed rather than efficiently used, leading to greenhouse gas emissions and other environmental problems such as water pollution. This problem is mitigated in organic production systems, where farmyard manure is used efficiently as a fertiliser in crop production, be it on-farm on mixed crop-livestock farms or be it on a regional level between different farms.

Organic agriculture also performs favourably regarding other greenhouse gas emission categories. As open burning of biomass is prohibited in organic systems, the corresponding emissions are avoided. The use of the biomass waste and residues, legume leys and manure as organic fertilisers reduces emissions from fossil fuel use, as energy intensive synthetic fertiliser production is avoided. Organic agriculture usually uses 20 to 50 per cent less fossil energy per hectare and per unit produce than conventional agriculture. This advantage is less marked in cases where weed control is a challenge to organic production and necessitates additional machinery and fuel use.

A particular challenge is rice production. Methane emissions from flooded rice fields can be higher in organic systems, due to the use of organic fertilisers. Switching to different water management such as partial flooding, as promoted in the system of rice intensification SRI, for example, reduces methane emissions but leads to increased N_2O emissions. Further research is needed to determine the net effect of such a change in practices.

© BLE, Photo: T. Stephan

Livestock systems with low stock densities can be carbon neutral. However, lower milk and meat production are the inevitable consequence.

Less soil capping after heavy rains: Soils under organic management have better drainage and water-holding capacity, as the DOK long-term system comparison in Switzerland shows. Left: Field with mineral fertiliser. Right: organic field.

© FiBL, Photos: A. Fliessbach

Resource use and organic agriculture

Organic agriculture generates other benefits besides its favourable performance regarding climate change mitigation and adaptation. Its focus on soil fertility directly conserves the resources "healthy and fertile soils" and "water". Reduced and efficient use of nitrogen improves water quality, as runoff and eutrophication can be reduced. The absence of synthetic pesticides also conserves soil and water resources from pollution. Furthermore, the use of organic fertilisers contributes to conserve fertile soils as well, as there are strong indications that the use of synthetic fertilisers can cause losses of soil organic matter. The use and recycling of organic matter helps to conserve phosphorous resources and fossil fuels are conserved due to the reduced energy needs. Finally, local and regional air quality is improved in regions where biomass burning is still common practice, as this is avoided in organic agriculture.

Most of these resource conservation effects are synergies of both the mitigation and adaptation measures resulting from practices that increase soil organic carbon levels. The holistic approach of organic agriculture is in contrast to some mitigation measures promoted in conventional agriculture, such as feed additives to reduce methane emissions from ruminants. Such additives improve feed energy uptake in animals but lead to adverse health effects without any benefits for adaptation. On the other hand, increasing soil organic carbon levels and the corresponding organic core practices such as organic fertilisers or legume leys in crop rotations are increasingly being promoted for climate change mitigation and adaptation in conventional contexts as well.

A systemic, holistic approach is needed

Best agricultural mitigation and adaptation practices complement each other and ideally have further benefits. In particular, mitigation in agriculture needs to look beyond farm production and has to address consumer behaviour and diets. Consumer behaviour is also key when it comes to food waste. In the North, 30–40 per cent of food produce is wasted due to quality and freshment requirements and the demand for continuous availability. In the South, a similar amount is lost due to poor storage. Halving these losses would already reduce agricultural emissions by 15–20 per cent.

Challenges

First, organic yields are 15 to 25 per cent lower than conventional yields under best geo-climatic conditions in intensively farmed regions. If food waste cannot be reduced, organic agriculture thus needs more land than conventional production. However, in less intensive contexts and under water scarcity, organic yields are on a par or even higher than conventional yields (see article on pages 9–13). **Second,** organic agriculture is a complex and knowledge-intensive farming system. Due information and extension services need to be established to assure success of its implementation. **Third,** it is unknown, among other knowledge gaps, how different qualities of synthetic and organic fertilisers compare on a life-cycle basis.

Finally, the strategy of eco-functional intensification as promoted by organic agriculture needs to be scientifically further developed and integrated into dissemination work. It focuses on farm-ecosystem management and on the improved and sustainable usage of ecosystem services like fertile soils, high-diversity habitats, pollination and the soil-food webs. Climate change mitigation, the adaptive capacity to adverse effects of climate change and, finally, the food security of billions will depend on this.

A full list of references can be obtained from the authors and at: **www.rural21.com**

Standards and certification: means, not ends

Organic is not just about standards and certification. Organic is a holistic concept for sustainable development. To be properly understood, organic standards and certification should be viewed in the broader context of the objectives of the organic movement.

When most people think about organic products in the marketplace, they think in terms of certified products, and with good reason: Worldwide, there are over 70 countries with governmental organic regulations (plus over two dozen that are drafting regulations), plus dozens of privately-owned certification standards. More than 500 organic certification bodies (CBs) are active in the world, each serving one or more of these government regulations and/or private standards. With so many different programmes, you might think there is a lot of difference among them. Some are stricter than others, but overall the bulk of the content of these standards is quite similar. The minor differences, though, have made complications for those who want to trade their products across countries and markets. Is my standard "better" than yours? How do we know you really checked your producers against your standard? How can we trust that you are "really" organic?

Standards vs. certification

Unpacking these issues a bit further, we see there are two main aspects to consider: standards and certification. While many people think the two are either synonymous or that they must necessarily go together, this is not true. Organic standards are about practices; most of these practices relate to environmental facets of farming, or to materials that can or cannot be used when a product is called (or labelled) "organic" in the marketplace. Standards can exist without ever being linked to certification.

Certification is a formalised way to confirm that the requirements described by the standard were adequately done. Certification is valuable and needed in certain circumstances – mainly when there is a lack of familiarity or trust between producer and consumer. The more the consumer knows about the producer and the way the product was made, the less need for some external confirmation. Certification is thus a substitute for confidence that comes from first-hand knowledge.

It thus becomes easy to see why governments have come to rely on certification for organic products: Goods are being traded all around the world, bought by people who want to believe they are getting what they think they are paying for. Meeting such expectations in a consistent way from one product to another serves the public interest, and also helps to protect the integrity of the organic label. Assuring that the certification is credible is a major concern of governments as well as the private sector.

When governments or any private organic standard owner thinks about whether or not an organic product should be accepted in their market, they are looking at how good the standard stacks up against their own organic standard, and how good the verification of the product against the standard is. One without the other is not enough; no matter good a standard might read, if you can't trust that the producer of the product actually followed it, what good is it really? On the other hand, if you think the checking is very good, but the standard is too weak or not meaningful, then what's the point?

Solutions going forward

Standards: equivalence, not compliance. For many years, requiring absolute *compliance* of one standard to another, to be *the same* in all the many detailed requirements, was the norm. Basing trade negotiations around these minor differences created barriers to trade. As the market has matured, the understanding that standards are a *norm of practices*, a *baseline* of expectations from operators, is becoming the new approach. This newer approach is based on the concept of *equivalence*, which acknowledges that different organic standards are written by people living in different regions under different cultural and agronomic conditions. This diversity logically gives rise to a certain tolerance for "regional variation" among different standards, which can be tolerated as long as the

David Gould
Value Chain Facilitator
International Federation of Organic Agriculture Movements (IFOAM)
IFOAM USA Office
Portland, Oregon, USA
d.gould@ifoam.org

standard as a whole agrees with the Principles of Organic Agriculture (see www.ifoam.org/about_ifoam/principles/index.html) and contain certain critical elements deemed necessary for a standard to be adequately robust.

Granting of equivalence by one country to another facilitates trade. Recognising another standard can be unilateral (one programme recognises one or more others), bilateral (two programmes agree they are equivalent to each other), or multilateral (many recognise many). And while all of these types of agreements may be seen as positive, there remains a question of efficiency: for example, do the math for how many bilateral agreements would be necessary for all of the different organic standards in the world today to recognise each other one at a time – that is a LOT of bilateral agreements – and a LOT of redundant work!

IFOAM (International Federation of Organic Agriculture Movements), in partnership with UNCTAD (United Nations Conference on Trade and Development) and FAO (Food and Agriculture Organization of the United Nations), developed a solution: Have a common reference point for all standards to compare themselves to. The COROS – Common Objectives and Requirements of Organic Standards – is an organic standard developed through a multi-stakeholder consultation, which reflects the core content and objectives of all organic standards. The COROS is organised two ways: (i) the way requirements are typically laid out in organic standards documents; and (ii) in terms of the manifest objectives of organic standards intended by these requirements. Standards owners (governmental or private) can each compare their standard to the COROS, and the results of this comparison then be shared with all (see www.ifoam.org/about_ifoam/standards/norms.html). Standards deemed equivalent to the COROS – meaning that they substantially meet the objectives – can be included in the IFOAM Family of Standards (see Figure on page 21), a visualisation of a goal of organic certification – to draw a line between what is organic and what is not.

Certification: Confidence via accreditation. Who decides if a certification body (CB) is credible? The main answer is through the process of accreditation – essentially the certification of CBs. In order for an accreditation body to be able to make such a determination, they have to evaluate the CB's ability to apply the standards in a way that is consistent, impartial, and transparent, for all operators. In short, the accreditor checks the CB for being procedurally competent and technically knowledgeable. That means the accreditors themselves have to also have these same competencies. Governments rely heavily on accreditation as a measure of CB credibility; the organic sector is no exception.

Most accreditation bodies are national bodies that accredit all kinds of certification activities in their native country. If a CB is active in more than one country, this means that they must, therefore, either attain multiple accreditations for the same scope (i.e. organic), or benefit from some kind of recognition of their activities by the government and/or national accreditation body of another country. Sometimes this works smoothly, and sometimes it doesn't; when it doesn't, the usual result is that trade barriers, bureaucracy, and costs rise.

In contrast to national accreditation, international accreditation can be a better model for organic certification. International accreditation bodies operate internationally in a particular sector, rather than nationally in a wide variety of sectors. This creates certain advantages including the ability to build greater expertise in evaluating the specific sector – organic in this case. Additionally, international accreditation bodies accredit certifiers worldwide, thus establishing a basis for equivalence and recognition of certificates issued by different CBs around the world. Currently there is only one international organic accreditation body, the IOAS – the International Organic Accreditation Service (see www.ioas.org/).

In the European Union, legislation is afoot to only permit national accreditation bodies to accredit CBs' activities in the EU. The law does not yet strictly apply to the organic sector, but revi-

IFOAM Africa Office Coordinator Hervé Bougnimbeck exchanges experiences with Andean farmers during an IFOAM training.

Photo: IFOAM

Limitations of the certification paradigm

Certification is the main way to gain entry to the organic market, but limiting market access to *only* certified products may not be the best long term strategy.

- **It can be costly.** Producers in developing countries – where there is generally lower certified organic market activity – sometimes pay even more for certification than in developed countries. Travel costs of inspectors and distances between farmers make for less efficient work. For countries where there is no active locally based certification body (CB), the costs for foreign inspectors and for the administrative services by CBs based in countries with higher costs of living can make certification financially unfeasible – more costly than the actual benefits.

  Furthermore, setting up a local or national CB in a developing country (or anywhere else) is a major undertaking. Aside from the actual legal establishment, recruitment and training of staff, and gaining enough clients to have a viable business, there are hurdles of achieving recognition by importing markets such as the EU, US, Japanese, or other active markets. This involves costly accreditation and lengthy review procedures, which can take years to complete. If there is no local market or other sooner benefit to getting certified by these CBs, there is low incentive to use their services.
- **It suffers from increasing bureaucracy.** Certified producers everywhere complain about ever-increasing amounts of paperwork, which drains time and energy from "real" work in the field. (Some farmers in developing countries do not read or write, making paperwork something of low value to them and a barrier to certification.)
- **THE RESULT:** Costs and trouble can outweigh the benefits of certification, chasing farmers out of the certified market and making them look for other outlets.

sions in the near future may make it so. In contrast, EU organic regulations now are moving toward greater use of equivalence as a strategy to expand the sector. A recent landmark bilateral equivalence agreement with the US National Organic Program has removed decades-old trade barriers. In terms of certification, individual CBs have been able to apply for acceptance of their certificates by the EU import authorities, making another way in which products can enter the EU market with less bureaucracy. In these cases, an evaluation of each CB's standard and competence was done by the EU; in many cases, the IOAS wrote the report on which these decisions were based, with a disproportionately high success rate among those applying certification bodies who used the IOAS for this purpose.

Where we came from

As the title of this article states, standards and certification are a means, not an end in themselves. While the organic movement sees itself as a key piece in solving the puzzle of global sustainability, it also knows that organic standards still have a ways to go to fully encompass what sustainability means. In addition to the environmental aspects covered by organic standards, the organic concept of sustainability is concerned with right livelihoods for farmers and farming communities, and to a clearer public understanding of the interconnectedness of agriculture, health, economic wellbeing, and social justice. So how does the organic movement get from where it is now to these broader goals?

The floor and the ceiling. Organic standards describe practices that serve as a core around which truly sustainable development can occur. It might be more ideal, though, if existing organic standards encompassed a fuller spectrum of sustainability, e.g. socio-economic criteria. In fact, organic standards are always improving over time, as knowledge and experience grows. While the commonality among organic standards – such as exists in the COROS – reflects a "middle ground," there are also certain organic standards that describe additional practices and requirements in a more leading edge way. These leading standards are of inestimable value to the organic community and its vision, seeking to broaden and deepen the impact of certified organic production. But adding too many extra requirements into all standards all at once could be too much burden on organic farmers, and could be either an unrealistic expectation and/or backfire by chasing producers out of the *certified* market – which, as we have said, is still the *main* market. Standards and certification will remain an important market for organic goods for the foreseeable future. Standards that reach for the "ceiling," that try to raise the bar of performance, have an influential role to play.

Where we are going

We need to keep innovating ways organic production and products can be made accessible to more farmers and consumers. One way this currently happens in developing countries is through group certification, whereby cooperatives of similar farmers market their pooled crops through common channels. They are certified – and sometimes de-certified – as one entity. While it should be seen as no small effort for a certification body (CB) to certify hundreds or even thousands of farmers at once, it is possible to do this credibly as long as there is strong internal management of the group, to show that only produce compliant with the standard reaches the market. It can be a highly efficient and cost-effective way for farmers to enter certified organic markets. Usually these are export market streams, but not always.

But in order to really bring the organic sector to the mainstream, the development of local demand and markets for organic products needs to happen in every country. Raising awareness of the benefits of organic practices for both farmers and consumers through research and gathering of tangible evidence is justification and promotion for more to occur. The learning gained from these experiences can further improve standards.

Shorter supply chains from farmer to consumer allow for innovations in how customers believe claims about the "organic-ness" of products. One avenue with great potential is through **Participatory Guarantee Systems (PGS)**, whereby groups of farmers and consumers agree to a common set of requirements (such as could be included in the IFOAM Family of Standards), and they do the checking of the producers instead of a certification body. This close familiarity saves money, affords learning, and can be just as credible if not more so than certain kinds of more distant certification scenarios. In Brazil and India, PGS have gained governmental endorsement as a form of assurance that is equivalent to more typical third-party certification, enabling thousands of smallholders to enter the organic market locally and nationally. Similar efforts are underway in other countries. While PGS markets tend to focus on markets closer to home, it is not illogical to imagine a next step whereby such recognition also extends to international trade. PGS are active in at least 20 different countries, on all continents (see: www.ifoam.org/about_ifoam/standards/pgs_projects/pgs_projects/index.php).

Someday, when the longer-term vision of the organic movement is realised and the majority of farmers and agricultural products on the market are organic, maybe certification won't be as crucial – it will just be the way people do it because it has been widely accepted as the best way. But the standards still will be just as important – the guide for what people should do.

IFOAM Family of Standards

The Familiy of Standards contains all standards officially endorsed as organic by the Organic Movement, based on their equivalence with the Common Objectives and Requirements of Organic Standards. Both private standards and government regulations are admissible.

GLOBAL

- IFOAM Standard
- International Standard for Forest Garden Products (FGP)

AFRICA

- *Tunisia Organic Regulation*
- *East African Organic Products Standard*
- EnCert Organic Standards, Kenya
- Basic Norms of Organic Agriculture in Senegal, Senegal
- Afrisco Standards for Organic Production, South Africa
- Green Growers Association Standard, South Africa
- Kumnandi Standard, South Africa
- Organic Standards for Tancert, Tanzania
- Uganda Organic Standard, Uganda

ASIA

- Saudi Arabia Organic Regulation
- *China Organic Regulation*
- *India Organic Regulation*
- *Israel Organic Regulation*
- *Japan Organic Regulation*
- OFDC Organic Certification Standard, China
- Hong Kong Organic Resource Center Standard, Hong Kong
- IBOAA Organic Agriculture Standard, Israel
- Japan Organic & Natural Foods Association Organic Standard, Japan
- MASIPAG Organic Standards, The Philippines
- CONU Organic Standard, South Korea
- DCOK, IIC International Standards, South Korea
- GOAA International Standards, South Korea
- ACT Basic Standard, Thailand
- Vietnam PGS Standards, Vietnam

OCEANIA

- *National Standard for Organic and Bio-Dynamic Produce, Australia*
- *New Zealand Organic Export Regulation*
- *Pacific Organic Standard, Pacific Community*
- Australian Certified Organic Standard, Australia
- NASAA Organic Standard, Australia
- AsureQuality Organic Standard, New Zealand
- BioGro Organic Standards, New Zealand

EUROPE

- *EU Organic Regulation*
- *Switzerland Organic Regulation*
- *Turkey Organic Regulation*
- Bio Suisse Standards, Switzerland
- Organska Kontrola Standards for production and processing, Bosnia and Herzegovina
- Biocyclic Standards, Cyprus
- Nature & Progrès Standards, France
- BioPark Guidelines for Organic Production and Processing, Germany
- Ecoland Standards for Organic Agriculture and Food Production, Germany
- Gäa Private Standards, Germany
- Naturland Standards, Germany
- CCPB Global Standard, Italy
- Italian Organic Standard, Italy
- Krav Standard, Sweden

SOUTH AMERICA

- *Argentina Organic Regulation*
- *Costa Rica Organic Regulation*
- Argencert Organic Standard, Argentina
- LETIS IFOAM Standard, Argentina
- OIA Organic Standards, Argentina
- Bolicert Organic Standard for Production and Handling, Bolivia
- Guidelines for the IBD Quality Organic Standard, Brazil

NORTH AMERICA

- *Canada Organic Regulation*
- *USA Organic Regulation*
- DOAM Organic Standards, Dominica
- Red Mexicana de Tianguis y Mercados
- Orgánicos' Standard, Mexico
- CCOF Global Market Access Standard, USA
- Farm Verified Organic Requirements Manual, USA
- NOFA Standards for Organic Land Care, USA
- QCS Int. Program Standard Manual, USA

Note: Applicant standards are marked in grey.

A viable alternative?

The question of whether a comprehensive conversion to organic farming is possible and appropriate on a global scale is the subject of lively international debate. While a shift on such a scale may be purely hypothetical at present, the conversion to organic methods is already opening up substantial opportunities for many small-scale farmers in the developing world. This article considers the pros and cons of organic farming as the solution for a worldwide system of sustainable agriculture, and in particular the present opportunities that it offers small-scale farmers in developing countries.

Everyone concerned with the issue of food security is aware that the world's rapidly rising population presents a major challenge. How much additional land remains available is still a matter of debate, but no-one disputes that the amount of land suitable for farming is limited. Many other resources essential to farmers are in similarly short supply. Experts therefore agree that the only viable type of farming is one that, rather than consuming these resources, uses them in ways that are sustainable as well as profitable. In 2050 such a system will have the task of feeding some nine billion people: what form will it need to take?

For IFOAM, the International Federation of Organic Agriculture Movements, it is clear that it can and must be an organic farming system. IFOAM's vision is a global conversion from conventional to organic farming – with certification accompanied by marketing at higher prices, but probably for the most part without certification. In the Federation's view, the conversion to organic farming not only makes sense but can also be profitable even without marketing at higher prices – especially if conventional farming internalises the external environmental costs that it incurs by assigning them directly to the conventionally produced agricultural products (see article on pages 18–21).

Dr Stephan Krall
Stefanie Kirse
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Eschborn, Germany
Stephan.Krall@giz.de

Organic agriculture without certification

If farmers were to convert to organic methods without selling their products at higher prices, this form of farming would have to achieve similarly high yields on the same area of land as other forms of sustainable agriculture without requiring significantly more extensive or expensive inputs. Otherwise many farmers would refuse to make this change.

The level of yields is a subject of heated scientific debate. It would appear that some crops achieve yields similar to those obtained in conventional agriculture, but others do not. In organic farming yields are closely related to the agro-climatic site conditions and the nutrient availability in the soil. Studies conclude that, depending on location and product, yields in organic systems are between 5 and 34 per cent lower (Seufert et al. 2012; de Ponti et al. 2012). If enough land was available, this could be offset by using more land – although this could encourage climate change unless animal production was reduced at the same time. As far as inputs are concerned, the labour factor in organic agriculture is particularly critical, since more labour is required for many crops – for example for weeding. A sufficient supply of inexpensive labour needs to be available; even in developing countries migration to the cities means that this is not necessarily the case.

The issue of nutrient supply must also be addressed. If synthetic fertilisers are banned in organic agriculture and only certain mineral ones can be used, regional nutrient cycles have to be established to produce enough organic fertiliser or compost to supply the same nutrients in sufficient quantity.

The question of prices is difficult to answer. In industrialised countries food has become a mass product that is often sold at rather low prices, even though consumers could easily afford to spend a significantly higher proportion of their household income on food. This trend has a highly detrimental impact on the sustainability of agriculture, since it creates pressure for food to be produced ever more cheaply. For many poor consumers in developing countries, by contrast, food prices are already so high as to be scarcely affordable. Many of these consumers would be unable to pay more for organic products than for ones produced conventionally or by other sustainable means.

There are various sustainable alternatives to resource-intensive agriculture. An integrated system of plant and animal production that is appropriate to the specific site conditions and uses integrated plant protection measures may also meet all the criteria of sustainability, but because it uses modest quantities of fertilisers and pesticides it cannot be classed as organic. An integrated crop production system can produce yields higher than those of an organic system and is therefore in direct competition with the organic method.

Opportunities for small-scale farmers

What does this mean for the production opportunities of small-scale farmers? As long as other forms of sustainable agriculture, as well as conventional farming, can produce more and do so even more cheaply, it is likely to be difficult for organic farming to prevail as the dominant or even the only form of agriculture in the short term. As a result, if certification and marketing according to organic standards are not possible, the opportunities for small-scale farmers must also be considered in the light of the alternatives.

The situation is different for certified organic farming, the products of which are marketed mainly for export to developed countries. This is where the great opportunity for organic farming lies. With an appropriate product and the right marketing opportunities it can be very profitable for farmers to operate organically. Moreover this opportunity not always needs to involve exporting to developed countries. In emerging and even developing countries there is increasingly a market – albeit a very small one at present – for organic products.

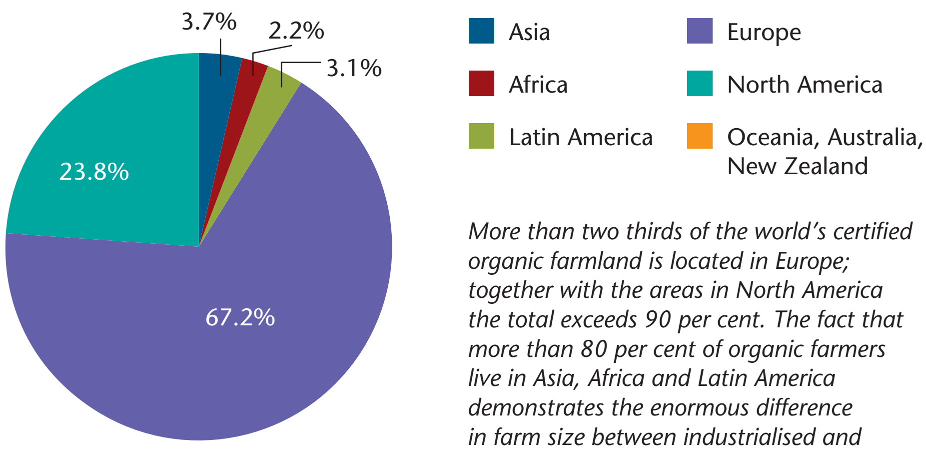
Rising demand for organic products

As the global demand for many food and other agricultural products rises, prices are increasing, too. This is creating opportunities for small-scale farmers to market their products beyond the local market. However, small farms in developing countries face a number of structural disadvantages. Because plots are small and productivity is low, only small quantities are produced; lack of knowledge of growing and processing techniques results in products of lower quality; poor organisation and limited access to market information make marketing of the products more difficult; lack of finance restricts investments.

Sales of organic products are rising steadily all over the world. Global trade in organic products has more than trebled since 1999: in 2010, according to FiBL (Reseaerch Institute of Organic Agriculture, www.fibl.org), sales of organic products were worth 44.5 billion euros (Willer, Kilcher 2012). Except in 2009, annual growth rates have consistently been in the two-digit range (Willer, Kilcher 2011). However, when viewed as a proportion of the total food market, it is clear that the organic market is still a niche one: in 2011 the organic share of the total food market in Germany was 3.7 per cent (BÖLW 2012), while the EU average in 2007 was 2 per cent (European Commission 2010).

Most of the market for organic products is in the northern hemisphere: more than 90 per cent of sales take place in the industrialised countries, especially Europe and North America. However, as a result of the changing consumption patterns of a growing middle class, organically produced products are becoming increasingly popular in emerging and developing countries. It is therefore likely that demand for organically certified products will con-

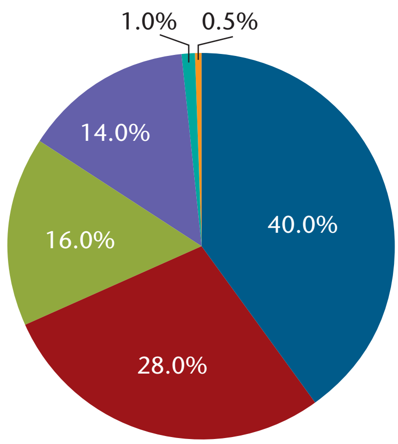
Distribution of organic farming areas worldwide according to continent 2009 (total 5.5 million hectare)



Source: Willer, Kilcher 2011

More than two thirds of the world's certified organic farmland is located in Europe; together with the areas in North America the total exceeds 90 per cent. The fact that more than 80 per cent of organic farmers live in Asia, Africa and Latin America demonstrates the enormous difference in farm size between industrialised and developing countries.

Organic farmers according to continent 2009 (total 1.8 million)



Source: Willer, Kilcher 2011

tinue to grow – small-scale farmers can and should utilise these market trends. Through group certification schemes certified organic farming not only helps such farmers gain a foothold in the market; it can also help them become competitive suppliers and thus improve their position within the value chain.

For example, by forming producer groups or farming for exporters on a contract basis, they can gain access to (international) markets for high-quality agricultural products. Often, too, group schemes make it easier for small-scale farmers to access farm inputs – for example, through prefinancing – and financial services, such as loans and saving schemes. Extension services to small-scale farmers enable them to meet organic farming standards by improving their growing, harvesting, storage and processing methods. The resulting higher quality enables them to access a niche market in which their products usually command higher prices. Contract farming frequently offers small-scale farmers a guaranteed outlet for their products. Farmers in producer groups benefit from the joint marketing of their products. In addition, the reduction in the use of external inputs (i.e. fertilisers and pesticides) also reduces the costs, which makes organic agriculture a farming system well adapted to the economic situation of smallholder farmers.

Organic cocoa production in the DR Congo

Kivu Province is one of the regions most hit by the war that raged for more than ten years in the Democratic Republic of Congo. The war has largely destroyed local people's livelihoods. To thousands of small-scale farmers in the crisis region growing certified organic cocoa offers a source of income and contributes to re-building the economy in the province.

In 2007 the company Esco Kivu launched a development partnership together with the Dutch DOEN Foundation and GIZ – on behalf of BMZ – with the aim of developing sustainable and economically viable organic cocoa production in Kivu. Esco Kivu supplied seedlings to the farmers and employed 50 field staff to train them in organic cocoa cultivation techniques. A quality monitoring system – a so-called Internal Control System – was established as the basis for a farmer group certifcation. Esco Kivu finances the certification and purchases the coffee and markets it. While the company cannot give a purchase guarantee to the farmers, it pays a fixed price premium for organic cocoa. Moreover, Esco Kivu offers farmers a savings scheme allowing them to deposit their income like in a bank and access it whenever they wish.

In the meantime more than 9,000 smallholder farmers have been certified according to EU and US-American organic farming standards.


Photo: S. Kirse / giz

Challenges

However, there are also difficulties associated with the conversion to certified organic production. For example, there is no guarantee of higher prices, since there are no fixed price premiums like those associated with FairTrade certification and similar schemes. And the foregoing of sales options that results from being tied to *one* buyer or exporter can prove to be a disadvantage. The depth of knowledge required in organic farming also harbours risk: agricultural extension services must be consulted. Furthermore, the switch to organic farming imposes financial burdens in addition to the costs of certification itself – especially if, as is usually the case, higher prices cannot be obtained for the agricultural products during the two- to three-year conversion period. The greater labour intensity of organic farming can also result in additional costs.

Depending on the site conditions, the yields of organic farmers may be lower than those of conventional ones. However, because the productivity level of small-scale farmers in developing countries is often very low, intensification of any type and appropriate advice – including a conversion to organic farming – can produce an initial increase in yields.

In order to reduce market and production risks, it is important that farmers diversify their products to minimise their vulnerability to market volatility. Additionally growing varieties that are adapted to local conditions can increase yield stability and provide resilience to weather fluctuations. Also, striking a balance between market-oriented and subsistence farming contributes to food security.

Even if organic farming does not immediately prove suitable as a global agricultural model, certified organic agriculture nevertheless provides small-scale farmers in developing countries with a viable alternative to conventional farming. It requires an enabling setting, including good agro-climatic conditions, adequate training and agricultural extension services and access to markets for high-quality products.

As organic agriculture in developing countries can contribute to food security and economic growth, GIZ supports capacity building not only of farmers (see Box above) but also of public and private agricultural extension services as well as local certification bodies.

Organic Farming – where to find what

FAO: Country profiles, glossary and opportunities for developing countries

On its Website, the Organic Agriculture Programme of the UN Food and Agriculture Organization FAO provides a database on institutions that undertake research relevant to organic agriculture as well as a list of publications on organic farming, country profiles and an overview of relevant events. In addition, it has a Glossary on organic agriculture in English/French and Spanish, English/Arabic, English/Chinese and English/Russian. The Glossary contains some 400 concepts with synonyms, variants, definitions, remarks and context fields – from "abiotic" to "zero tillage".
Website: http://www.fao.org/organicag/

IFOAM: Definitions, principles, standards & certification

The International Federation of Organic Agriculture Movements – IFOAM – was founded in 1972, in Versailles, France. With its more than 700 member organisations in more than 100 countries, IFOAM represents the worldwide movement of organic agriculture. Membership is open to associations of producers, processors, traders and consultants as well as to institutions involved in research and training committed to organic agriculture.
The website provides a wide range of data, such as basic information like the definition and the principles of organic agriculture (available in around 20 languages) as well as information on standards and certification – including details on accreditation, the Participatory Guarantee System (PGS) and group certification for smallholders. Various publications and training manuals can be ordered, and there is an overview of past und coming events in the area.

FiBL: Research, consulting and knowledge transfer

The "Forschungsinstitut für biologischen Landbau" (FiBL – Research Institute of Organic Agriculture) has been conducting research and advisory services in organic farming since 1973. In addition to its headquarters in Switzerland, the Institute has offices in Germany and Austria; in 2010, FiBL International was founded in cooperation with institutions from Luxembourg, the Czech Republic and Slovenia. Apart from research on all aspects of organic farming, knowledge transfer assumes an extensive role – via advisory services, courses, expert reports and various publications. Furthermore, various global projects address the development of ecological research, advisory and certification services.
Information on research activities and publications can be found at http://www.fibl.org. On its Website www.organic-research.org, the FiBL presents key initiatives on organic farming research world-wide undertaken by the IFOAM Global Organic Research Network. The website also hosts homepages of several completed European and international organic farming research projects.

Global organic statistics and news

The Website www.organic-world.net combines global key data on organic agriculture resulting from a survey that the Research Institute of Organic Agriculture FiBL and the International Federation of Organic Agriculture Movements IFOAM conduct annually with the support of experts from more than 150 countries.
Data is available on the surface area under organic management and the numbers of farms as well as on developments on the global market for organic food. Special information on regions and individual countries can be called up individually. Furthermore, the website provides excerpts from "The World of Organic Agriculture 2012". In addition to up-to-date facts and figures on organic farming worldwide, the book contains an overview of the current status and emerging trends for organic agriculture by geographical region. The country reports on Australia, Azerbaijan, Benin, Bulgaria, Canada, Ethiopia, Germany, Iran, Pacific Islands, Peru, Thailand, Turkey and the United States provide more in-depth information. The latest developments in organic certification, standards and regulations are also covered.

Perspectives for countries in the South

The 2nd African Organic Conference was held in Lusaka, Zambia early in May 2012. Numerous presentations given there are available for downloading from the Internet at: www.africanorganicconference.com.
Publications on perspectives of organic farming for small-scale farmers in the South and marketing opportunities for developing countries are available on the Websites of the International Fund for Agricultural Development (IFAD; see www.ifad.org) and the United Nations Conference on Trade and Development (UNCTAD; see www.unctad.org), among others.
In addition, you will find a wide range of further reading material on all of the contributions in this focus at www.rural21.com – immediately following the respective article.

Photo: C. Danetzki

Linking smallholders to organic supply chains: what is needed?

Fostering organic supply chains is becoming of increasing interest to developing countries, since the demand for organic products is growing, providing market opportunities and premium prices for producers who comply with organic certification standards. To succeed, smallholders must be fully integrated into supply chains able to offer inputs, business and technical services via market linkages.

Organic production is particularly well-suited for smallholders as it makes them less dependent on external resources and able to rely on their traditional knowledge. Smallholders who have shifted to organic production and marketing enjoy higher and more stable yields and income, thus enhancing their food security. However, their products have to be certified by specialised agencies in order to be sold under the "organic" label and thereby obtain premium prices. This is usually costly and cumbersome for smallholders in the developing world.

An FAO study (Santacoloma, 2007) showed that alternative organic certification schemes are embedded in particular market relationships that determine specific business and technical services, inputs and post-harvest needs for the actors in the chain. Building upon these findings, FAO further investigated marketing strategies and sources of financing of support organisations for the future fostering of the organic sector in developing countries. It studied organic ventures in rice in Thailand and India, coffee and fruits from African countries and horticulture products in Hungary and Brazil.

Pilar Santacoloma
Agribusiness economist
Rural Infrastructure and
Agro-industries Division
Food and Agriculture Organization of
the United Nations (FAO)
Rome, Italy
Pilar.Santacoloma@fao.org

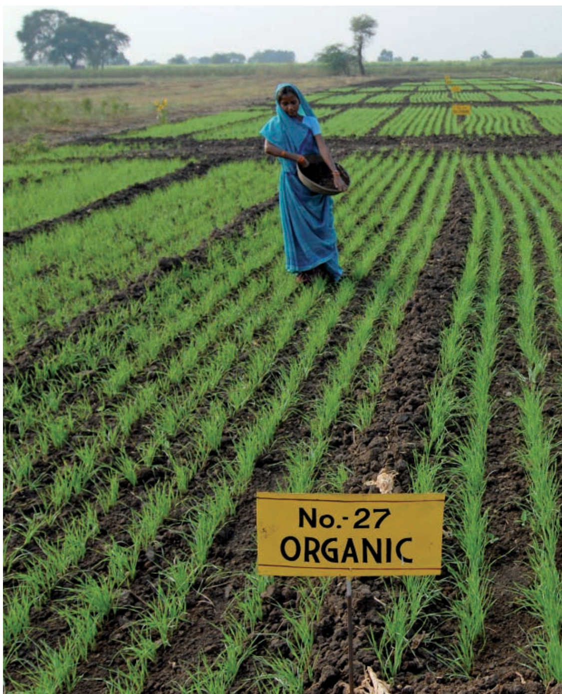
The market for organic products

The international markets for organic products continue to grow at a rapid rate of 10 to 30 per cent per annum in most countries and at a rate of over 5 billion US dollars (USD) per year globally, with fresh fruits and vegetables being the leading sector. Organic vegetables comprise over five per cent of all vegetable sales in northern European countries and exceed ten per cent in some Scandinavian and Alpine countries. The organic fruit market is reporting an even higher growth as more tropical and exotic varieties come into the market.

The global market in 2009 for organic food and drink rose to over 54.9 billion USD, with the vast majority of products being consumed in North America and Europe. Domestic markets for certified organic products in developing countries are much less developed, with the exception of China. Nonetheless, the potential for strong exchange between countries in an emerging, regional Asia-Pacific organic market is consolidating an organic industry that had originally developed to supply countries in the West. While organic premiums are high in a few export or domestic markets, there are some concerns that these may not last, as more and larger commercial producers are entering this market and consequently prices may fall in the future.

Organic supply chains

Across the study, supply chains range from very short ones where farmers market directly to local consumers, to more elaborated chains where a num-



ber of different actors are involved in moving the organic products from the farm to the final consumer while keeping the organic quality attribute. Some models are:

Farmer to consumer chains: These are very popular for producers associated with the agro-ecological movement in Brazil, who sell their products at marketplaces or ecological fairs provided by municipal governments. Prices are established through producer-group negotiation with the local municipalities and state government bodies who are responsible for the fairs. In Hungary, small organic farmers also market directly to consumers through organic public marketplaces.

Farmer to retailer or supermarket chains: In Thailand, the private retailing company TOPS markets organic produce under its own brand in its supermarkets located around the country. Rice, coconut, milk, coffee and shrimps are some of the organic products marketed under the TOPS brand. Similarly, in Brazil, organised producers collectively sort and pack fresh and processed products for shipping to supermarkets and retail stores directly.

Farmers to food processor chains: In the two basmati rice cases in India, farmers supply their paddy to a rice mill and the processed rice is shipped in bulk or filled into retail packs before exporting. In the former case, a private company organises the supply chain. A federation of farmers produces the organic rice under contract, and the company transports, processes, packages and distributes the product to domestic markets as well as to export fair-trade and organic markets in Europe. In the latter case, a state controlled commodity board arranges the production with farmers and negotiates contracts with the main buyer, who processes the rice at his own mill and packs and transports it to domestic and foreign markets.

Farmer to importer: In the case of African organic coffee, coffee cherries are cultivated by farmers, harvested and brought to a collection centre, where they are pulped to separate the beans. The beans are then dehulled and dried. Some of these operations may be also done on farm. Subsequently, the beans are bagged and exported directly to the importer. In some cases, the beans may be sent to an exporter, who will grade and repack before shipping to the importer, who will roast or sell on to the roaster and packer for retailing.

In the majority of the cases in the FAO study, the market opportunity was identified by the entrepreneur, business or exporter, who set up the business and established the supply chain to exploit it. In only a few cases did the farmers themselves initiate the establishment of the supply chain to fulfil a market demand. In a small number of cases, the supply chain and market link was actually initiated by a government or non-government organisation as a means of promoting organic farming as a smallholder alternative.

Organic quality attribute along the chain

In any agro-food chain, the maintenance of product quality from the farm to the consumer is paramount for achieving good prices and sustainable business. This means that transportation and logistics of the harvested product are important components of the supply chain. Organic products have additional demands in that handling, transportation, storage and packing must be done under certified conditions and segregated from non-organic products. Therefore, once the product leaves the organic farm, transportation and handling facilities must meet these requirements. More recently, traceability has become increasingly required by export markets as a means of ensuring product quality all along the chain. This places additional demands on producers, processors and market agents for organic products aiming at export markets.

With respect to infrastructure, there are two major issues in the cases reviewed. Firstly, the individual farmer does not have the resources to invest in transport, storage or processing facilities in order to provide good quality products for the market. Therefore, the trend has been to form farmer groups who can establish a collection centre or a group packing facility and organise transportation of the products to their processor, exporter or directly to the

Summary of farmers' participation in the organic value chains studied by FAO

Organic rice				Fruits and Vegetables			Coffee
Thailand		India		Brazil	Hungary	Africa	Africa
BRFO	TOPS	Sunstar	UOCB	Ecovida	Individual	Outgrowers	Outgrowers
218	133	500	1.200	371	20	890	8.320

Source: Panyakul, Schultz, Alam, Kürthy, van Elzakker, 2009

Photo: J. Boethling

India produces organic rice for both the domestic and export markets.

consumer. In some cases this has been extended to processing such as rice milling (Thailand, India), coffee dehulling (Africa), fruit juice processing (Brazil, Africa), fruit drying (Africa) and even retail packing of products (Africa, Brazil, India, Thailand). Generally, however, processing, storage and trucking are handled by the private sector entrepreneur, wholesaler or exporter.

In short, the organisation of the organic supply chain does not differ much from the conventional chains. However, to maintain the organic quality attribute, stronger vertical coordination, logistics and infrastructure are required, as well as clearly defined actors roles and responsibilities. By forming groups, certification costs can be lowered and efficient procurement practices fostered.

Financing mechanisms

Setting-up and operating an organic production chain requires substantial financial resources, which are often beyond the means of small farmers and their organisations. They must rely on partnerships with buyers and other actors to finance their participation. Formal credit and loans with commercial banks and government programmes generally have no special component for organic farming operations, with the exception of Hungary with its links to the EU programmes, and Thailand and Brazil, where specific financing mechanisms for community organisations and family agriculture favour organic farmers. In general, farmers do not seek financing from commercial banks, due to their high interest and collateral demands. They prefer to rely on their own resources or borrow informally.

Private sector partnerships were the key source of financing for the organic supply chains. Their finance came from personal or internal sources and in some cases from commercial banks. In other cases, fair-trade partnerships between producers and buyers in developed countries were able to reliably finance production and post-harvest operations, through the provision of advance payments. However, in some cases this was not sufficient to pay for all the harvested crops, particularly in the case of rice. Consequently farmers' organisations still have to find more funds locally.

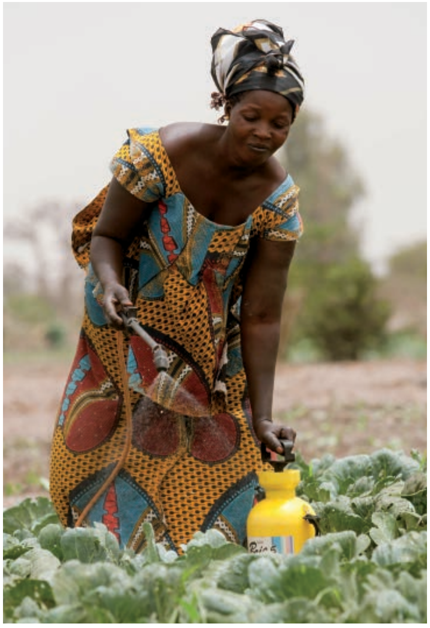


Photo: FAO/O. Asselin

A farmer in Senegal spraying a cabbage crop with an organic pesticide.

In short, financing of crop production for smallholders continues to be problematic in developing countries, whether the product is organic or not. Where private sector or fair-trade type partnerships are being developed or are functioning, it would be desirable that commercial banks and government-backed programmes be encouraged to develop appropriate financing mechanisms that will facilitate smooth functioning of all essential activities along the supply chain.

Proposals to enhance smallholder's participation in organic chains

Governments should promote an enabling environment to facilitate the development of organic supply chains for both export and domestic markets. This will require expanding extension services to include organic production techniques and post-harvest operations, developing credit lines for conversion and certification costs, and support for training in food safety and quality management, business management and associated consulting services from local private suppliers.

Governments should also promote organic products for domestic consumption through the development of organic marketplaces in partnership with municipalities and by furthering the procurement of organic products for public sector health, food and nutrition programmes.

Partnering companies should identify market opportunities in domestic or overseas markets before participating in or developing organic supply chains. Companies must also ensure they have the human and financial resources to champion the development and operation of the organic supply chain.

Financing institutions are encouraged to develop appropriate financing mechanisms that will take into account the particularities of organic production such as the conversion period and product segregation along the chain.

Support groups such as NGOs who work with small-scale farmers in organic projects should ensure that they have the capacity to deal with post-harvest, food safety and quality, finance, marketing and business management activities through their own staffing or through alliances or sub-contracts with specialist groups.

A full list of references can be obtained from the author and at:
www.rural21.com

Farming with a conscience

Initiated by non-governmental organisations and private citizens in the mid 1980s, organic agriculture is still in its infancy in the Philippines. Today, the government is providing the means towards a globally competitive yet sustainable organic industry. In this context, the Organic Agriculture Program of the University of the Philippines Los Baños supports vegetable production by smallholder farmers.

"This patch of vegetables is for our home consumption, so I don't use pesticides here. That bigger vegetable area is for selling ... of course I use pesticides and fertilisers to ensure good harvests and income."

A common response from a conventional vegetable farmer.

Greater consumer awareness of human health and environmental hazards caused by the indiscriminate use of pesticides and fertilisers has increased the demand for safe organically produced food in the Philippines. In response, the private sector, non-governmental organisations (NGOs), government agencies, local government units and people's organisations have engaged in various activities geared towards organic farming.

The University of the Philippines Los Baños (UPLB) initiated its Organic Agriculture Program in 2007. It focuses on spreading organic vegetable production among smallholder farmers not only as a technology but also as "farming with a conscience", an alternative way of life that includes personal and social responsibility. The project aims to promote safe and healthful food, protect human health and the environment, support sustainable livelihoods and harmonise the participation of government agencies and the civic sector. From 2007 to 2010, it was funded by the National Economic and Development Authority under the Philippine-Japan Grant Assistance for Underprivileged Farmers. It was piloted in three selected towns in Southern Luzon. Phase 2 of the project is currently being funded by the Department of Agriculture Bureau of Agricultural Research in another two adjacent towns from 2011 to 2013. There is collaboration with the farmers' associations, municipal and provincial authorities, government agencies, NGOs and the private sector.

Blesilda M. Calub
University Researcher
Integrated Farming Systems and
Agricultural Extension Division
College of Agriculture
University of the Philippines Los Baños
Laguna, Philippines
bmcalub.uplb@gmail.com

What has been reached?

Building farmers' capabilities: Knowledge-building among farmer groups has included training series and seminars on various aspects of organic vegetable production and marketing. Leadership and organisational strengthening have been addressed, too. Field trips, cross-farm visits, attendance of conferences and actual selling in trade fairs have boosted farmers' knowledge, skills and confidence, broadening their minds towards networking and collaborating with other agencies and the private sector. Cross-farm visits have encouraged farmer-to-farmer exchange

Photo: B. Calub

Farmers proudly harvest the organic tomatoes their family has produced.

Farmers can sell at premium prices and get to link up with other organic advocates by joining weekend markets and fairs.

Photo: B. Calub

of knowledge and techniques. Farmers have realised the value of team work and joint decision-making to overcome challenges. The initial group of 20 farmers has now grown to about 50. They are farmer leaders in their respective villages and have promoted both organic vegetables and rice farming.

Farmer partners have been trained as farmer trainers so that even if the project ends, they will be able to pass on their knowledge of organic farming to others interested. The project has produced visual aids, booklets, handbooks and a video in the local language that the trainers can use and distribute. They now regularly conduct training and seminars for new members as well as for other farmer associations, schools and civic groups. They have been invited to local and national radio programmes and national television to share their success stories on organic agriculture.

Farmers have learnt how to deal with documents, write project proposals and negotiate for funds. As a result, they have, for example, obtained livelihood funds from several government programmes.

Early on, the farmers themselves decided to install a group savings fund. They agreed to pay a minimal amount as monthly dues and set aside part of their profits from sales of organic vegetables and vermicompost.

More food security, lower production costs. Thanks to the diversified cropping system, farmers are able to harvest vegetables they can consume or sell almost every day. The calendared planting and harvesting of vegetables enables a virtually year-round supply of vegetables.

Together with the famer groups, the UPLB team has standardised the formula of organic fertiliser from fermented chicken manure. Now able to meet the registration requirements of the Fertilizer and Pesticide Authority, the farmers hold a license to manufacture, distribute and sell their organic fertiliser.

With vermicomposting, farmers can save fertiliser costs while earning income from selling compost and the worms. The project team has also successfully collaborated with the solid waste management office of two towns in the project site. Vegetable and fruit peelings from the town market are used as substrate for vermicomposting.

To ensure the source of worms (African Night Crawlers) for vermicomposting, a "pay forward" system has been introduced. An initial ten farmers receive a kilogramme each of worms to culture in prepared vermicomposting bins. After about three months, the worms have doubled in number. The farmers have to pay forward one kilogramme of worms to another interested farmer and so on, ensuring a built-in source of worms even if the project stops.

More income from direct sale. Organic vegetable production and marketing have increased household incomes thanks to increased productivity per unit area. The farmers can easily sell their organic products at prices 10–30 per cent higher than conventional ones on local markets. Organic Product Centers were set up as the UPLB team linked the project farmers' groups to the Department of Agriculture's Agribusiness and Marketing Assistance Division which also provided start-up capital for the shops. In one of the project sites, the town mayor provided counterpart funds. Linkage with the Department of Trade and Industry has resulted in marketing assistance and free training for farmers on entrepreneurship.

In addition, farmers have been exposed to trade fairs and festivals where they can sell their organic vegetables at higher prices. Here, they meet and link up with other organic farmers and potential customers. For a year now in Quezon province, the provincial governor has organised a Friday organic market which has been attracting organic farmers and buyers from nearby towns. One of the farmer groups has been invited by its town parish priest to sell organic products in the churchyard at least once a week.

Assuring organic product quality. The project initially organised workshops to install internal control systems for project sites to ensure that organic products conform with certification standards. A manual was developed to serve as a guide for farmers towards group certification under the Organic

Certification Center of the Philippines (OCCP). However, the process and documents became too complicated and expensive for the smallholder farmers. So the project team shifted to the Participatory Guarantee System (PGS; see article on pages 18-21). The UPLB team collaborated with the Office of the Provincial Agriculturist and MASIPAG, a local NGO recognised by the International Federation of Organic Agriculture Movements (IFOAM). A series of stakeholder workshops gave birth to the development of a set of organic standards and a manual of operations for the province of Quezon. Later, a PGS committee was created by workshop participants. Quezon is now the first province in the country to establish a PGS at provincial level. Farmer inspectors and members of the Evaluation and Approval Committee have already been trained. The PGS is currently being pilot-tested in three towns of Quezon province.

To further ensure product quality, a modified rapid test kit was developed at UPLB to detect pesticide residues in vegetables. Selected agricultural technicians and farmer inspectors were recently trained and given sample test kits to assess ease of use and reliability in the field. Refinements will be done based on their feedback.

Challenges ahead

Despite much progress already made, a number of challenges still have to be mastered:

Adaptation to climate change. Erratic weather has negatively affected production and hence year-round availability of organic vegetables. Greenhouses and rain shelters can protect crops from excessive rains. Rainwater can be harvested, stored and released during the dry periods through drip irrigation. However, these methods require capital that our smallholder farmers cannot afford.

Easing up labour demand. Organic farming requires high labour input during establishment. But with most rural youths preferring jobs in the cities, labour is hard to come by. Land cultivation could be much easier and faster with portable hand tractors and other small farm machines. But smallholder farmers cannot afford them. Credit and a form of "machinery sharing" can be explored. In some cases however, the relatively more intensive labour needed in organic farms has actually created job opportunities in the rural areas. Women have been involved mostly in seedling production, weeding, care and maintenance, harvesting, sorting, grading and selling.

Scaling up to meet growing demand. The project initially linked farmers with an assembler company which supplies organic vegetables to the big Manila supermarkets. But farmers cannot meet the demand due to production constraints mentioned above and the growing demand within their villages and towns. Farmers get better prices and thus prefer direct sale in their towns to sending their vegetables to assemblers.

Another challenge is to make organic products more affordable for common people. Increasing the availability of organic products will raise supply and result in more affordable prices.

Linking smallholder farmers to export markets. Increasing production volume and value-adding is needed for smallholder farmer groups to join the export market. There are some local NGOs in Central and Northern Philippines which have helped farmer groups to export organic raw sugar (*muscovado*), rice, bananas and coconut products. Unless they are processed, the export of highly perishable products like organic vegetables is a big challenge.

Need for research and development. Many organic farming technologies being practised and promoted lack a sound scientific basis. Research should document and evaluate claims they are based on and also lead to the discovery of new products, methods or processes useful for organic farming. Currently, the Philippine National Standard (PNS) for Organic Fertilizers as well as the PNS for Organic Agriculture are being updated. Scientific research results will serve as a critical basis for the new standards and policies.

Advocacy and information dissemination. NGOs and private citizens are at the forefront of advocating organic agriculture to the general public. The primary and secondary schools are mandated in the Organic Agriculture Act to include organic agriculture topics in the school curricula. Also, agricultural colleges and universities are being encouraged to include organic agriculture in their research, teaching and extension activities. Recently, the University of the Philippines Open University (UPOU) and UPLB collaborated to offer the first online non-formal certificate course on organic agriculture.

Review of existing agriculture programmes. At the national level, the department of agriculture runs programmes for conventional and organic farming. The aim is to provide options for both types of farmers. At the field level however, this has created uncertainty among agricultural technicians. Farmers are becoming confused because the agriculture technicians advocating organic agriculture are the same people distributing GMO seeds, urea fertilisers and pesticide samples.

For information on the UPOU/UPLB certificate course on organic farming, visit **http://www2.upou.edu.ph/academic-programs/non-formal-courses/510--organic-agriculture**

An overview of initiatives on organic agriculture in the Philippines is available at: **www.rural21.com**

Challenges and opportunities for organic research and extension

Organic farming holds the great promise to solve some of the environmental and social problems caused by conventional agriculture. To play this role at the global level, farmers need access to essential knowledge on efficient ways, sustainable means and support structures that encourage organic practices and incentives to adopt them.

Public and private support for organic farming research, extension and education lag far behind the funding, infrastructure and staff involved in conventional and biotech agriculture. While most organic agricultural research is carried out in temperate climates, the need to conduct organic agriculture research is arguably greater in the tropics, with their more dynamic and fragile ecosystems.

This research should be targeted to organic farms and their concrete challenges and not to satisfy research interest alone. Farmer education facilities are almost nonexistent and in Africa, many agricultural universities are in severe financial needs and have very limited resources available for state-of-the-art organic research and teaching.

Gian L. Nicolay
Brian Baker
Research Institute of Organic Agriculture – FiBL
Frick, Switzerland
gian.nicolay@fibl.org
brian.baker@fibl.org

To be sustainable, an agricultural system must be productive and profitable over a long time. To test such properties, the research design must take into account meaningful criteria that help measure and monitor a system's stability, resilience and productivity across a large area over many years. This requires a research design that is compatible with an ecological approach that factors in biodiversity and ecosystem services. All of these aspects make organic farming research a greater challenge than conventional research.

Where is research most urgently needed?

Among the top research priorities identified over the years by organic farmers and practitioners are weed management, plant breeding leading to locally adapted and higher yielding seed, soil fertility restoration, biological control, practical biodiversity, and marketing and policy incentives.

Weed management. Organic farmers depend on a combination of cultural, physical and biological practices to reduce yield losses from weed pressure. No-till annual cropping systems avoiding herbicides hold great promises for carbon sequestration and soil conservation, but will take years to optimise. Cover crops offer a low-cost and ecology-based method to suppress weeds when their variety selection and timing can be optimised.

Plant breeding for low-input and organic farming conditions. Varieties that are responsive to nutrients slowly released from organic matter by biological activity are needed to decrease the need for chemical inputs and increase the efficiency of nutrient cycling. Participatory breeding programmes are rapidly emerging to meet farmers' needs, but such efforts require research support.

Photo: G. Nicolay

Research has to contribute towards agricultural systems that are compatible with food sovereignty and community access to food.

Soil fertility restoration. Soil scientists have long been aware that the soil has to be based on soil organic matter and a healthy population of soil organisms in order to cycle nutrients efficiently. More beneficial species are being identified and scientists are making progress in understanding their roles in nutrient cycling, disease suppression and crop health. These ecological webs are often site-specific, depending on soil type, crop, climate and other factors. Science has still a long way to go to fully understand and address the critical issues of desertification and declining soil fertility.

Biological pest and disease control. Classical biological control – the introduction and augmentation of populations of beneficial organisms – has still not caught up with the amount of research that has gone into chemical control. Locally based farmer-researcher associations should test and improve innovations based on biocontrol agents and adapted cultural practices. Farmer associations also have a history of work in pioneering and optimising the efficient rearing, delivery and release of beneficial organisms. Optimal value addition and minimisation of crop losses after harvest is a high priority to increase the food supply and enhance profitability of organic produce.

Marketing and policy research. Farmers need market information to take optimal decisions with regard to the crops to be grown, how, and for what market. A good understanding of consumer preferences and value chain and food web functioning is essential to help both farmers and other actors to optimise their collaboration to fulfil expectations, especially among quality-conscious consumers. Social science research has to go beyond market studies. Since consumers do not pay for all the environmental services and other benefits of organic agriculture, studies should also help to develop recommendations on how to best promote organic food for consumers and policy-makers to help farmers recover the full value of the different benefits organic farming creates. And food systems need to be compatible with food sovereignty and community access to food.

Processes to reinforce

Farmer education. As a farmer-centred and grassroots movement, organic agriculture has largely relied on farmer-to-farmer networks and exchanges to disseminate information. Research has to support the linking of the farmers with the other stakeholders in the food supply chain, specifically markets for organic food in developing countries. At the same time, farmer knowledge needs to be valued as a source of experience and a base for innovation. This can be accelerated by investing in farmer education, which will also empower the rural communities.

Networking. Organic agriculture research is still at a formative stage, and needs to build related human capacities. Farmer innovators and farmer organisations grouped around value chains have to build networks to commonly solve their many problems and address their specific research needs to the scientists.

Knowledge dissemination. Organic farming research stands to benefit all farmers and consumers. Organic food should not be limited to affluent consumers in wealthy countries – as we believe that access to healthy food is a fundamental human right. Organic farmers have pioneered a number of sustainable technologies, allowing researchers to fine-tune solutions that can in turn be adopted by non-organic farmers, as was the case for the use of pheromones and the introduction of beneficial fungi as antagonists to soil-borne pathogens.

Commitment. Increased funding for research in organic farming production processes is urgently needed to develop sustainable food systems. For example, research is needed to establish the impacts of residues in food on human and animal health as well as for the definition of a public health policy actively supporting a more sustainable consumption. However, more money is not enough. Political will, civil society commitment and public determination are required to overcome the challenges posed by the changes to move towards sustainability.

International collaboration. There is an urgent need to develop strong leadership and social networks to serve as a foundation for the expanded capacity all around the world, to overcome the current limited and localised impact of sustainable agriculture. The

FiBL's research activities

FiBL has been running long-term trials in Switzerland that compare organic, biodynamic and conventional farming systems since 1978. FiBL began the trials in 2005 with tropical systems in Kenya, India and Bolivia, financed by SDC (Swiss Agency for Development and Cooperation), LED (Liechtensteinischer Entwicklungsdienst), the supermarket chain coop and Biovision foundation. While results in these tropical trials are preliminary, the experimental design will permit researchers to gather data and test hypotheses related to sustainability and productivity.

A case study from West Africa

"Syprobio" is a recent EuropeAid financed research and development project in West Africa aiming to promote farmer innovations – both technical and social – compatible with organic standards. With 15,000 organic farmers as partners in Mali, Burkina Faso and Benin, FiBL-led researchers developed a network to conduct on-farm research testing local innovations. The primary cash crop is organic cotton, but farmers in the network also produce and market specialty crops as well as grains grown primarily for home consumption. The 100 elected farmers, representing 2–3,000 organic farmers are conducting on-farm research and cooperating with 40–50 researchers and technicians in testing 30 innovative practices. Soil fertility, seed improvement, pest management, agronomy and socio-economics are the main themes. The innovations to be tested shall improve food security and climate change adaptation. Comparative research is done in order to better understand the economic and agronomic differences of organic, conventional and GMO systems in the sub-region.

Photo: G. Nicolay

Farmer participation in research and technology development ensures realistic and practical systems.

International Federation of Organic Agriculture Movements (IFOAM) and the Research Institute of Organic Agriculture (FiBL) announced at Rio+20 the formation of the IFOAM Global Organic Research Network (IGORN), which will foster international collaboration in organic agriculture research, exchange of information between researchers in organic agriculture, and the dissemination and application of organic research results.

Communicate that organic works. Farmers in emerging and developing countries have developed and improved sustainable techniques that have for centuries proven to be stable, resilient and productive. These systems have been challenged in recent years by urbanisation, concentration of landownership, and capital-intensive technologies. Relatively few farmers with access to land, infrastructure, credit and technology have benefitted and put many smaller, undercapitalised farmers under pressure or off their land, which tends to increasingly polarise rural communities. It remains to be seen whether organic farming can co-exist with genetic engineering, broad-spectrum pesticides and other practices used by conventional farmers.

Call for a paradigm shift

Reductionist methodologies are still the mainstream basis of the dominant paradigms: scientists provide a simplified framework of interpretation of reality and do not take into account all relevant parameters and interactions. But a more holistic approach, that is an ecological and systemic approach, fits more with the concept of organic farming, aimed to serve environmental, animal, human and societal health. Researchers in organic farming systems need to cooperate with all related biological and social science disciplines using both inter- and trans-disciplinary methods.

Creative partnerships between research and farmers will open up new markets in low-income regions as well as creating options for agro-ecological actors. Organic food is poised to catapult from a niche into the mainstream. Traditional family farms in developing countries are a key growth sector for organic food production. Organic can be considered as the most advanced form of ecology-based farming, capable of nourishing people sustainably in the future.

The promotion of organic agricultural research implies a paradigm shift away from conventional reductionist methodologies – with a limited scope on certain technological improvements – to more holistic research approaches and innovative partnerships that better capture eco-societal system dynamics. Such innovative partnerships, involving existing conventional institutions, will not only create new agricultural opportunities for low-income regions, but also contribute to an acceleration of organic market development such that organic food marketing becomes mainstream. Since organic agricultural research is mainly financed through public funding, increased organic market development – together with local food security and sustainable rural development – must be seen both as an essential outcome of organic research but also as precondition to justify private and public investments into this area. The important on-going international sustainability discussions related to climate change mitigation, food security and food safety are likely to increase investment into organic agriculture.

Organic agriculture – a development opportunity

The United Nations Conference on Trade and Development (UNCTAD) just held its last major quadrennial Ministerial conference in Doha in April this year. The conference theme was *Development-centred globalisation: Towards inclusive and sustainable growth and development*. A fundamental transformation of agriculture in the direction of sustainable agriculture lies at the very heart of achieving this goal. The outcome document of the Rio+20 conference, with its strong section on sustainable agriculture further underlines this message.

UNCTAD has been active in promoting the shift towards more sustainable and inclusive forms of agriculture, including organic agriculture. Our forthcoming Trade and Environment Review 2012 will focus on the challenge of transforming agriculture to cope with climate change and assure food security.

Organic agriculture offers an impressive array of food-security, economic, environmental and health benefits. These include higher incomes, more stable and nutritious diets, higher soil fertility, reduced soil erosion, better resilience to climate extremes such as drought and heavy rainfall, greater resource efficiency, lower carbon footprints, less dependence on external inputs and reduced rural-urban migration.

Organic farmers earn more

UNCTAD research has shown that organic farmers generally earn better incomes. Revenues are higher because of rapidly growing markets, as well as frequent price and quality premiums. At the same time, on the cost side, lower cash outlays are needed for externally purchased inputs, whose prices, as seen in recent years, can be quite volatile and are generally on the rise. Ecological/organic agriculture, in contrast, relies primarily on locally available renewable resources. This shields farmers from price shocks associated with external inputs, caused for example by rising oil prices. The reliance on locally available resources also has a positive multiplier effect in local economies by creating jobs and improving incomes.

Petko Draganov
Deputy Secretary-General
United Nations Conference on Trade and Development (UNCTAD)
Geneva, Switzerland
Contact: Sophia.Twarog@unctad.org

Good for food security

Organic production systems can also serve to increase yields. A joint study carried out by UNCTAD and UNEP of 114 cases in Africa showed that applying organic practices led to an average increase in yields of 116 per cent. This combination of higher net incomes and varied nutritious food means that organic agriculture is good for food security. It is also more likely to be sustainable in the long term because the shift to organic farming serves to build human, social, financial and physical capital in farming communities.

Let the good products flow

Some goods from organic production are certified, a means of assuring buyers that the production process was in line with organic production standards. Certified organic products can be traded internationally in robust markets. 80 per cent of the world's certified organic farms are in developing countries. Moreover, developing countries account for 73 per cent of land certified for organic wild collection and beekeeping. Countless other developing-country farmers practice organic agriculture without being formally certified.

Minor differences in organic standards and certification requirements can hinder trade. Harmonisation and equivalency – implying a mutual recognition of different standards and conformity assessment systems – are a way of overcoming these differences so that markets for organic products continue to grow. Trade in organic products should be open and based on the principle of equivalency, so as to facilitate market access. For ten years, UNCTAD has been working with IFOAM – the International Federation of Organic Agriculture Movements – and FAO on reducing technical barriers to trade through harmonisation and equivalency.

Supportive policies

All of these above reasons demonstrate that organic agriculture can make a crucial contribution to inclusive and sustainable development. We should all work together to increase awareness about organic agriculture and develop supportive policies and programmes to help it spread. UNCTAD and UNEP have developed a set of Best Practices for Organic Policy. Countries should assess their current policies, remove distorting measures, include organics in research and education programmes, and support the development of organic markets domestically and abroad.

Climate-smart agriculture: a strategy for addressing global food insecurity and climate change

Food insecurity and climate change have finally brought agriculture back into the spotlight of international development debate. For all to have enough food, productivity on existing farmlands must rise, purchasing power of those in need must increase, and agriculture must be environmentally sustainable. A climate-smart agriculture with a focus on improved productivity, enhanced resilience and reduced greenhouse gas emissions is urgently required.

Ensuring food security under a changing climate is one of the major challenges of the 21st Century. In 2010, there were about 925 million food insecure people in the world – about 16 per cent of population in developing countries. Global population is projected to rise from seven billion currently to over nine billion by 2050, creating demand for a more diverse diet requiring additional resources to produce. Competition for land, water and energy will intensify in an attempt to meet the need for food, fuel and fibre, while globalisation may further expose the food system to the vagaries of economic and political forces. Estimates indicate that global food production must increase by 70–100 per cent by 2050 to meet human demand.

Agriculture is also highly vulnerable to climate change, and more than any other major economic sector, it will need to adapt to the changing climate. Under optimistic lower-end projections of global warming, climate change may reduce crop yields by between 10 and 20 per cent. Increasing temperatures and declining precipitation are already reducing yields of grains and other primary crops in many parts of the vast semi-arid tropics where so many of the poorest reside. Increased incidence of droughts, floods and pests may also lead to yield instability and a sharp increase in prices of major food crops.

Ademola K. Braimoh
Senior Natural Resources
Management Specialist
Agriculture and Rural Development
World Bank
Washington, D.C., USA
abraimoh@worldbank.org

Agriculture's direct reliance on the natural resource base has always been a defining characteristic of the sector. Agriculture uses some 70 per cent of global freshwater and 40 per cent of global land area. Conventional forms of agricultural production are often unsustainable and, over time, deplete the natural resources on which production relies. Today, more than ever before, we understand not only the significance that climate has for agriculture, but also the enormous significance that agriculture has for the climate. Agriculture is the world's leading source of methane and nitrous oxide emissions, a substantial source of carbon emissions, and the principal driver of deforestation worldwide. Thus, agriculture is a major contributing factor to climate change – some 30 per cent of global greenhouse gas emissions is attributable to agriculture and deforestation driven by the expansion of crop and livestock production for food, fuel and fibre.

Three challenges collectively addressed

The triple imperatives of increasing productivity, enhancing resilience to cli-

Three principal investment areas for climate-smart agriculture

1) **Sustainable land and water management practices**
Conservation agriculture, integrated soil fertility management, agroforestry, intercropping, integrated livestock management, improved water management

2) **Climate risk management**
- Technologies (e.g. drought resistant varieties)
- Information systems/advisories (e.g. climate forecasts, mobile phones for weather and market risks dissemination)
- Institutions (e.g. index-based crop/livestock insurance)

3) **Transformation of production systems**
e.g. alternate wetting and drying system in irrigated rice, shift to other crops, diversification of production

mate change, and reducing greenhouse gas emissions call for alternative practices which are collectively referred to as *climate-smart agriculture* (CSA). CSA seeks to increase productivity in an environmentally and socially sustainable way, strengthen resilience to climate change, and reduce agriculture's contribution to climate change by decreasing greenhouse gas emissions and increasing soil carbon storage. CSA tackles the food insecurity and climate change problems together, rather than in isolation. It is a vital component of green growth that seeks to operationalise sustainable development by reconciling the need for rapid growth and poverty alleviation with the need to avoid irreversible and costly environmental damage. CSA strategies include improved technologies and innovation, resource efficient use of land, water, energy and other inputs, improved access to information and infrastructure, efficient markets and risk management tools (see Box on page 36).

CSA implementation also entails better policies that are mainstreamed into broader public policy, expenditure, legal and regulatory frameworks. With the exception of countries where input use is currently low, price support and energy subsidies should be replaced with policies that recognise and reward climate-smart agricultural practices, provide an enabling environment for value added, and commercialisation and trade. Landscape approaches and incentives are needed for a better management of agricultural productivity, carbon storage, fresh water cycling, biodiversity protection and pollination. Such approaches allow trade-offs to be explicitly quantified and addressed through negotiated solutions among various stakeholders. There is a need to step up research and knowledge dissemination to address urgent adaptation needs. Considerable policy support and capacity enhancement is also needed for climate risk management including insurance and safety nets, as well as improved access to new drought-tolerant species and weather information. Public support which focuses on research, investments in improved land management and land tenure rather than on input support is generally more effective, benefits more farmers, and is more sustainable in the long run.

Secure land tenure is a precondition for CSA

Simple land registration systems in Ethiopia have facilitated investment in sustainable land management; providing land-users rights to trees facilitated "re-greening" in Niger; and transferring long term land use rights to users in China has played a key role in broader watershed restoration and climate smart agriculture. Land tenure regimes also demonstrated the link between sound agricultural and sound forest land use planning; land rights provide a key enabling environment for investing in sustainable intensification.

Progress on climate-smart agriculture is being achieved in different parts of the world. Burkina Faso which had previously focused on adaptation has in recent years adopted broader approaches to sustainable land management, achieving benefits in resilience, productivity as well as improved carbon sequestration through reduced deforestation/forest degradation. In Uzbekistan where the greatest problem is severe water stress, improved irrigation and drainage, land privatisation together with market liberalisation has enabled a doubling of wheat yields. In Brazil, regulatory reforms have markedly improved the incentive for private-sector investment in agriculture and forest management. In Niger, agroforestry techniques applied on five million hectares have benefited over 1.25 million households, sequestered carbon, and produced an extra half-million tons of grain per year. On Rwanda's fertile hillsides a project designed to better manage rainfall and reduce hillside erosion has almost doubled earnings to 1,925 US dollars per hectare, while the share of production sold rose from 30 to 65 per cent.

Concluding remarks

Global agriculture is at a crossroads. Hunger remains one of the most pervasive development challenges facing humanity. In this era of climate change, efforts to tackle current food deficits and future food requirement must go hand in hand. Climate-smart agriculture holds significant promise for addressing hunger, increasing food production and enhancing climate resilience. The new green growth initiative may provide a unique opportunity for integrating these development imperatives.

One climate-smart-agriculture measure: to reduce the methane emissions in rice farming.

Photo: J. Boethling

Using and protecting forests – not a contradiction in terms …

The upland regions of the Philippines are being subjected to severe deforestation. Agroforestry could promote the sustainable use of forests and thus reconcile the interests of forest conservation and climate change mitigation with those of small-scale farmers. But complicated and at times contradictory legislation stands in the way.

The upland regions of the Philippines are facing difficult development challenges. First of all, natural resources in these areas are under great pressure. In the 1950s the uplands were still largely covered by forest. Decades of commercial felling have led to a situation where now, only about seven per cent of these areas remains forested. And yet preserving the forest would be crucial for climate change mitigation, the water balance and to preventing extensive soil erosion.

On the other hand, more and more people are living in the mountainous regions of the country. For many of them small-scale agriculture is the only source of income. Landless people in particular are displaced to mountainous regions in search of land to farm. The high population density and the high concentration of property in coastal regions in the hands of a small number of large landowners are the main driving forces behind this migration.

This means that here, like in other regions of the world, two legitimate and important development goals are opposing each other: (1) to protect the environment and the climate, and (2) to reduce poverty by providing livelihoods for peasants.

Jonas Erhardt
Nele Bünner
Seminar für Ländliche Entwicklung /
Centre for Rural Development (SLE)
Berlin, Germany
jonas.erhardt@bambuprojekt.org
nbuenner@aol.com

Agroforestry as the solution?

Agroforestry is regarded as a very promising option for reconciling the pursuit of these two development goals and thus contributing to sustainable development in the uplands. While income can be generated, perennial components of agroforestry like trees, grasses and shrubs can provide many of the environmental services that natural forests offer.

All the important stakeholders in society – the Department of Environment and Natural Resources (DENR), local government departments, international donors and farmers' organisations – agree that agroforestry is a key factor in sustainable development of the uplands, yet the social framework conditions for sustainable agroforestry remain difficult.

Too many cooks …

The DENR is the most significant political actor in the use of the uplands. Almost the whole region belongs officially to the state and has been designated as "forest land". The DENR is responsible for protecting and administrating this land. This fact alone creates a potential for conflicts, as in reality large sections of the "forest land" are no longer covered by forest, but are being farmed by millions of smallholders, in some cases already for several generations.

Since the 1990s, after decades of almost unregulated logging in the upland forests of the Philippines, the DENR has intensified its efforts to protect the forest land. In 1992 the first general ban on tree felling was imposed, and has become gradually stricter ever since. Now even the felling of some trees planted by the farmers themselves is prohibited unless the trees are registered and the farmer has a resource use permit.

In the Philippines there have been and still are a large number of programmes and projects for controlled use of the uplands. They have been initiated by various government institutions such as the DENR, the Department of Agrarian Reform (DAR) and others. To some extent, these are even contradictory. In 1995, the DENR launched a large-scale programme on community land use for upland village communities aimed at ending this hotchpotch of small projects. Community-Based Forest Management (CBFM) stipulates that land placed under community control is partly used for agroforestry and partly restored to forest and protected by these communities. The term of use is 25 years. However, there are also tight restrictions on the land released for utilisation; if the conditions of use are contravened the resource use permit can be withdrawn. Nevertheless, for many farmers the introduction of CBFM means progress, since they can legally cultivate the land and they even possess a title to the land – albeit for a limited period. Yet it has to be emphasised that neither the large-scale CBFM programme nor the other programmes are reaching all the farmers, as the scope of these programmes is still by far not enough for the number of smallholders living in the uplands.

Activities of YISEDA, a farmers' organisation founded for the Community-Based Forestry Management programme.

Photo: J. Erhardt

Neither are some of the farmers interested in the collective responsibility that is part of the CBFM. This means that the majority of the upland smallholders continue to live and work without any legal protection. However, at the same time as introducing the CBFM strategy, efforts to combat "illegal" land use by unorganised smallholders have been intensified.

The decentralisation reform of 1991 further complicated the legal position of upland farmers. Local tiers of government such as the municipalities are looking to strengthen their position in relation to central government and to have a say in local development. Although officially the forest lands are still under the control of the DENR, this situation leads to bickering over responsibilities – especially as the delineation between forest land and other land that is now administered locally is often unclear and disputed. This puts the farmers concerned at the mercy and discretion of a number of administrative bodies competing for authority.

■ The consequence: less sustainability of use

The Philippine upland farmers are therefore faced with restrictive and frequently changing land-use laws, endless red tape and a power struggle between various authorities. A study by the Centre for Rural Development (SLE) in Berlin on behalf of GIZ and the World Agroforestry Centre (ICRAF) assessing the sustainability of agroforestry systems on the islands of Leyte and Mindanao revealed that this difficult situation has negative consequences for land use by upland farmers. It showed that farmers without long-term and secure land-use rights have less interest in using the available natural resources sustainably. Instead, insecurity leads the farmers to try – understandably – to draw economic benefits from their land as quickly as possible. Thus, in the study the farmers without long-term land-use titles have significantly fewer trees per hectare on their land than farmers with these titles. Trees only pay out economically in the longer term, but are often the elements of agroforestry systems providing the greatest environmental benefits. When questioned, many of the farmers without permanent land-use rights said that they would be willing to invest considerably more resources in soil protection measures like tree planting if the land from which they gained their living belonged to them.

Looking at current market prices, there would be great economic potential in planting trees for timber. But, as small-scale timber producers say, it is not only this scepticism about long-term investment, but also the long and complicated bureaucratic process for legal felling that puts them off. The registration of trees is long-winded and the regulations on timber harvesting are frequently altered. Many farmers

Photo: J. Erhardt

Coconut palms instead of forests – a common sight in the Philippine uplands.

wait several years for their resource use permits, and more than a few pay bribes to get the necessary authorisation at all. In some cases trees are felled by illegal loggers while the proceedings for legal felling are going on. Consequently it is hardly surprising that many farmers with previous experience in timber growing are not interested in planting more trees, and instead opt for profitable short-term crops such as vegetables, bananas or maize. These, however, contribute little to climate change mitigation and to preventing soil erosion. Thus in the given social circumstances the restrictive ban on felling to protect the forests results, paradoxically, in the planting of fewer trees. Since the smallholders nevertheless still need timber, the statutory regulation is actually increasing the incentive to continue logging in the natural forests.

How to escape the paradox

Therefore, to move away from this undesirable incentive structure, the social conditions would have to change. As a starting point, consideration could be given to removing the "forest land" designation from areas that are densely populated and have long been used by smallholders. To a certain extent this would merely be an adjustment of the legal situation to reality, and could have a number of positive impacts. First of all the total area of land administered by the DENR would be significantly reduced, which would make it much easier to monitor effectively the regions that are really worth protecting. Secondly, the land now no longer under central government (DENR) control could be administered at local level with the involvement of local farmers' organisations. Secure land-use rights for a longer period could improve the motivation of smallholders to use their land with care in the long term. This would mean that many farmers would no longer have to negotiate the many bureaucratic obstacles to timber harvesting on forest land and would thus significantly increase the incentive to plant trees. Ultimately, a process of this sort could be used to clearly demarcate the remaining forest lands and thus reduce potential for conflict between local authorities and the Department of Environment, as well as to alleviate insecurity among the farmers. However, this approach would result in DENR losing considerable influence. It is therefore questionable whether the Department would be interested in such a solution.

Another possibility would be to obtain ecologically important environmental services not from timber trees, but from an increase in fruit tree or rubber cultivation by smallholders. However, the management of agroforestry systems based on fruit trees or rubber is particularly complex, as the SLE study showed. To make this economically attractive to smallholders would require intensive and long-term efforts in capacity building.

Furthermore, socio-economic incentives to make reafforestation or sustainable management of forests attractive could be considered. There are GIZ pilot measures of this sort on the island of Leyte which test the implementation of REDD+ (Reducing Emissions from Deforestation and Degradation) in the context of local authority-based management. However, whether this is worthwhile in the circumstances described above, and whether it achieves the objectives in terms of environmental and social sustainability, remains to be seen.

The last two solutions would be very cost-intensive, requiring major logistical efforts. Moreover, they would not solve the problem of the insecure legal position of farmers living and working "illegally" on forest land. A change in the legal framework, on the other hand, also requires the strong political will to accept a loss of influence in order to achieve the objective. That is why none of these approaches provides an easy answer, and why in the Philippines there is still a long way to go to create social conditions that are really conducive to the sustainable use of the upland regions.

Photo: J. Erhardt

A maize-based agroforestry field of a disappointed former timber farmer.

Photo: D. Oberländer

Acrocomia aculeata – a sustainable oil crop

The South-American palm species Acrocomia aculeata has great potential as a sustainable source for vegetable oils and provides economic opportunities for both smallholders and investors on less fertile crop- and grassland in sub-/ tropical regions with limited rainfall. Past years' research has made the plant ready for commercialisation. Now, pilot projects are needed to demonstrate its viability.

Secure supply of sustainably produced agricultural products is a major challenge of the 21st century, in particular with regard to vegetable oils. The market of plant oils is dominated by a few crops, notably oil palm (35 %), soybean (27 %), rapeseed (16 %) and sunflower (9 %).

Jens Poetsch
PlanetRenew GmbH
Tübingen, Germany

Daniela Haupenthal
Universidad Católica del Paraguay
Campus Itapúa, Hohenau, Paraguay

Iris Lewandowski, Dieter Oberländer and Thomas Hilger
University of Hohenheim
Stuttgart, Germany
Thomas.hilger@uni-hohenheim.de

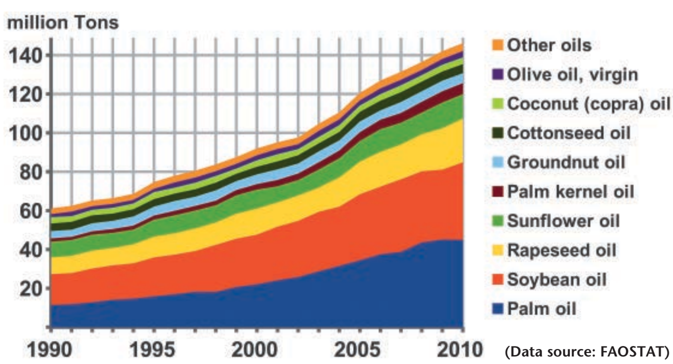
At the same time, demand for plant oils is continuously growing, in the food, energy and chemical sector alike. Global production of vegetable oils has more than doubled during the last two decades, with a particularly strong increase for palm oil (see Figure). Due to this development, supply security of plant oils is stressed even today (Oil World, 2009), leading to price increases on the one hand and to unsustainable expansion of oil crop production areas on the other. In Indonesia, the main producer of palm oil, the area under oil palm increased from about 5,000 km² in 1980 to more than 45,000 km² in 2005 (Bangun, 2006). The continuing trend is strongly correlated with the destruction of rainforest. Income from timber sales is used to finance the palm plantations (WWF, 2003; Greenpeace, 2007; Worldwatch Institute, 2010). In addition, the eco-physiological requirements of the oil palm *(Elaeis guineensis)* equal those of rainforest vegetation. Hence, oil palm production inevitably competes for land area with rainforest.

The advantage of oil palm is its extraordinarily high oil yield potential and resulting low production costs. However, due to forest destruction and drainage of peat lands, high amounts of CO_2 may be emitted, even making greenhouse gas balances negative in many cases (Greenpeace, 2007; Meyer & Dehue, 2007). Likewise, expansion of cropping area for other conventional oil crops meets its sustainability limits, as no additional suitable areas are available (e.g. rapeseed) or the crop also competes with forest or biodiversity protection (e.g. soybean in South America; WWF, 2003).

Old crop with new potential

Acrocomia aculeata is a thorny palm species native to South America and distributed in the tropics and subtropics from Mexico to Argentina. It reaches

World production of 13 most important vegetable oils from 1990 to 2010



(Data source: FAOSTAT)

Important fatty acid contents of *Acrocomia aculeata* and *Elaeis guineensis* oils

Fatty acid	*Acrocomia*	*Elaeis*
	kernel	
lauric	41.0 %	48.2 %
oleic	25.6 %	15.3 %
	pulp	
palmitic	29.0 %	44.3 %
oleic	57.4 %	38.7 %
linoleic	1.8 %	10.5 %

a height between eight and twelve metres. Few relevant pests or pathogens are known. In contrast to *Elaeis guineensis* the genus *Acrocomia* shows high plasticity with regard to environmental conditions. *Acrocomia* species occur in temperate and tropical regions and thrive under annual precipitation from 1,000 to 2,500 millimetres (FAO, 1986). For a short time, even freezing (–5 °C) is tolerated.

Acrocomia palms can tolerate fire and prolonged drought up to six months (FAO, 1986). Excluding water logging, *Acrocomia* grows on a diversity of soils (Martin, 1976), where high amounts of sand and organic matter are preferred (Teixeira, 1996), and it has been also cultivated on nutrient-poor sandy soils (Bohn, 2009).

The plant has manifold traditional uses for food specialties, animal feed, fibre or medicine. But its main products, oils from fruit pulp and kernel, may boost its importance as an economically viable alternative to *Elaeis guineensis* that does not compete with rainforest or fertile land.

Sustainable palm oil

In addition to its low costs, the oil palm *Elaeis guineensis* is favoured for its high contents of lauric acid in kernel oil used in foods and cosmetics and its low contents of polyunsaturated fatty acids in palm oil (= pulp oil), respectively. The Table above compares relevant fatty acid (FA) contents of pulp and kernel oils of both *Acrocomia* and *Elaeis*. By evidence, *Acrocomia* oils already meet a similar composition, and including genetic variation and improvement, *Acrocomia* is fully suitable to substitute *Elaeis* oils by quality.

However, because the site requirements of *Acrocomia* differ from those of the African oil palm, *Acrocomia* has the potential for a sustainable expansion of plant oil production area. In addition, storage stability of *Acrocomia* fruits is much higher than that of *Elaeis* fruits. This allows for decentralised production and storage. Its proven processing technology is comparably simple and already cost-efficient at a scale of 5,000 metric tons (MT) of fruits per year. This corresponds to a plantation area of about 250 hectares (ha), as an average yield of 20 MT of fruits per hectare and year can be expected from the fifth year after planting.

The Figure below illustrates the processing steps and typical fractionation of *Acrocomia* fruits, important uses of the products and the resulting revenues for each fraction. Market values are based on experiences in Paraguay and comparable commodities.

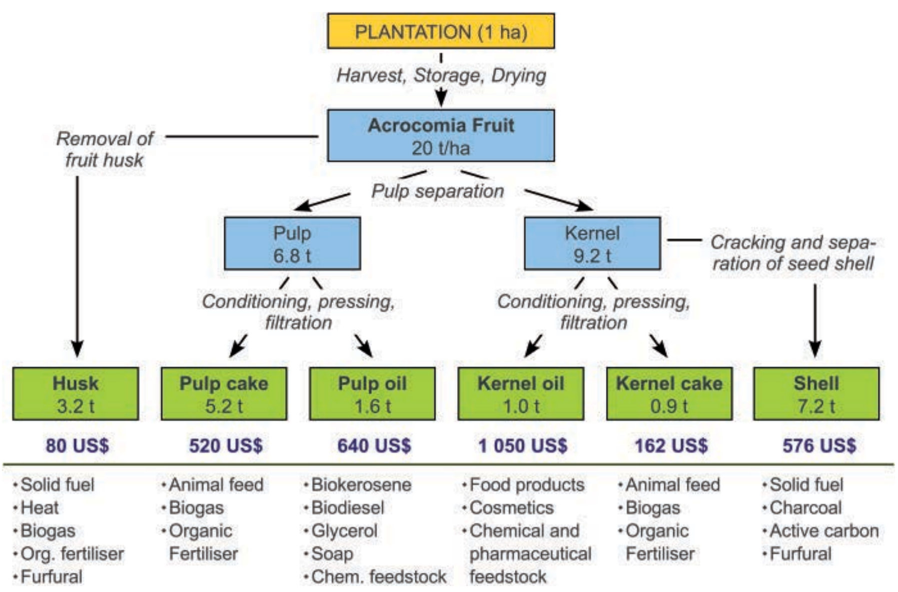
Economic chances

With a total annual yield of more than 2.5 metric tons (MT) of oil per hectare and a range of valuable by-products *Acrocomia* is also economically interesting. The Figure on page 43 shows the price development of palm kernel oil and palm oil during the last decade.

For all products derived from the *Acrocomia* oil palm there are existing local or international markets. Most of these markets promise future growth and *Acrocomia*'s product diversity entails risk diversification. These are important characteristics for investors. But its small-scale viability also makes *Acrocomia* a promising opportunity for smallholders. In many tropical and subtropical regions large areas are cultivated with few crops in capital-intensive monocultures with disputable ecological and long-term economic sustainability. Product diversity is not established in industrial production as a rule.

In contrast, smallholders frequently cultivate native plants that are rarely grown in large scales due to lack of domestication or standardisation. *Acrocomia* can even be grown in mixed cultures and processed in small quan-

Processing, yield fractions, uses and revenues of *Acrocomia* products
(about 5% processing loss)



tities. This allows for its production in small-structured, perennial and capital-extensive cropping systems that improve participation of small farms in rural development. In addition, *Acrocomia* is a profitable crop for the less fertile soils of a farm and can thus contribute to improving land use efficiency. If established on degraded land, the plant may also serve as a carbon sink and enrich the soil with organic matter during its long productive lifetime of 60 to 70 years.

In summary, *Acrocomia* can help diversify income sources of smallholders as well as the portfolio of global plant oil production. There is only one disadvantage: a temporal gap between investment and profits. It takes five or six years until first harvest, and even small processing facilities need capital. While the years without harvest can be bridged by alley cropping, e.g. with camelina, groundnut, castor or cassava, a commitment of investors or financial tools for cooperatives are desirable for the establishment of *Acrocomia* factories.

Experiences from Paraguay

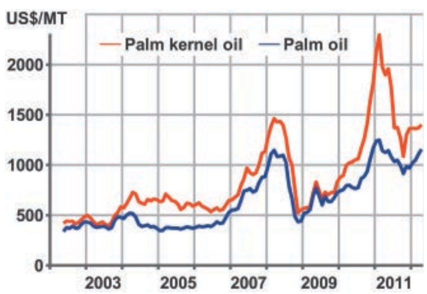
Paraguay has a strong agricultural sector. More than half of the country's area is characterised by the sparsely populated Gran Chaco in the west, a hot, mostly dry and in parts marshy savannah landscape. Twenty-one per cent of the country is forested, but illegal deforestation is still a critical issue. Numerous smallholders in Paraguay own old *Acrocomia* populations that only need to be harvested. Such smallholders can be included in the value chain merely by providing a market for the fruits. In addition, they often have idle land that can become profitable through planting *Acrocomia*, if a market perspective is given.

Paraguay is the only country where technical processing of *Acrocomia* fruits is done. It has been practised since 1940 (Markley, 1956), and in 2011 about 5,000 MT of kernel oil was produced and marketed. Today, there are ten factories that exclusively handle fruits from semi-wild collections, i.e. no managed plantations are available. Starting from this position, a cooperation between University of Hohenheim (Germany), Universidad Católica del Paraguay and the company Agroenergías SRL has been launched with the objective of understanding and domesticating *Acrocomia aculeata* sufficiently well for a sustainable, commercial cultivation. Further partners have contributed to the improvement of production processes and economic opportunities.

Significant progress has been made, inter alia, in germination and harvest technology, and in monitoring of wild *Acrocomia* plants. While the seeds naturally germinate within 12 to 60 months, it is vital for plantation establishment to control emergence of the plants in tree nurseries and produce a predictable number of seedlings. After in-depth research, a treatment is available to achieve 50 per cent germination rate within six weeks. With regard to a characterisation of fruits originating from various *Acrocomia* populations strongly varying but satisfactory results were obtained. On average, the pulp of fruits presented a fat content of 32.9 per cent with a minimum of 24.2 per cent and a maximum of 50.4 per cent, whereas the seed had a mean fat content of 58.3 per cent with a variation of 41–71 per cent (Haupenthal et al., 2011).

Harvest frequently makes up for a large proportion of agricultural production costs, which is not different for *Acrocomia*. Its fruits are not picked but fall to the ground when mature. This requires an efficient method for collecting them quickly to avoid decomposition processes of the pulp. In cooperation with agricultural equipment producers it was possible to identify and adapt simple and cost-efficient tools for fruit collection that increase the harvest rate by a factor of five.

Price development of palm oils 2002–2012



(Source: Worldbank; index mundi)

Photo: D. Haupenthal

The fruit of the Acrocomia palm.

Finally, demonstration plantations have been established successfully. The requirements for scaling up *Acrocomia* production are thus met.

What is needed?

In order to realise the potential it takes two things: 1. larger scientifically accompanied pilot plantations to increase know-how and provide security for investors, 2. first movers that are ready to invest into a future market already now.

In the context of research and optimisation, the following issues should be addressed: Breeding is necessary to optimise yields, agronomic handling and quality parameters. Extended trials with intercropping will improve land use efficiency and integration schemes for smallholders. Resource efficiency (water, nutrients, and light) of *Acrocomia* still needs to be analysed in detail to optimise input-output ratios. There is also need to analyse genotype x environment interactions in existing populations to select genetic material for breeding without having to wait more than five years for an initial screening. This is of particular interest as the genus is open- and cross-pollinating.

Further research is also needed in fruit processing and bio-refining to evaluate the diversity of potential end products and optimise value chains. For socio-economical sustainability strategies are needed to let smallholders participate in the new markets, e.g. by outgrower schemes.

Finally, a screening of other oil crops should also be included in research efforts to improve agrobiodiversity effectively. For example, Brazilian native crops Pequi *(Caryocar brasiliense)* and Buriti palm *(Mauritia flexuosa)* have a yield potential in the same range as well (Tickell, 2000).

Production of plant oils from alternative crops may largely relieve the environment and provide chances for rural development. It is vital to demonstrate success in order to realise this potential in large scales. *Acrocomia aculeata* will be a promising candidate to start with.

A full list of references is available at
www.rural21.com

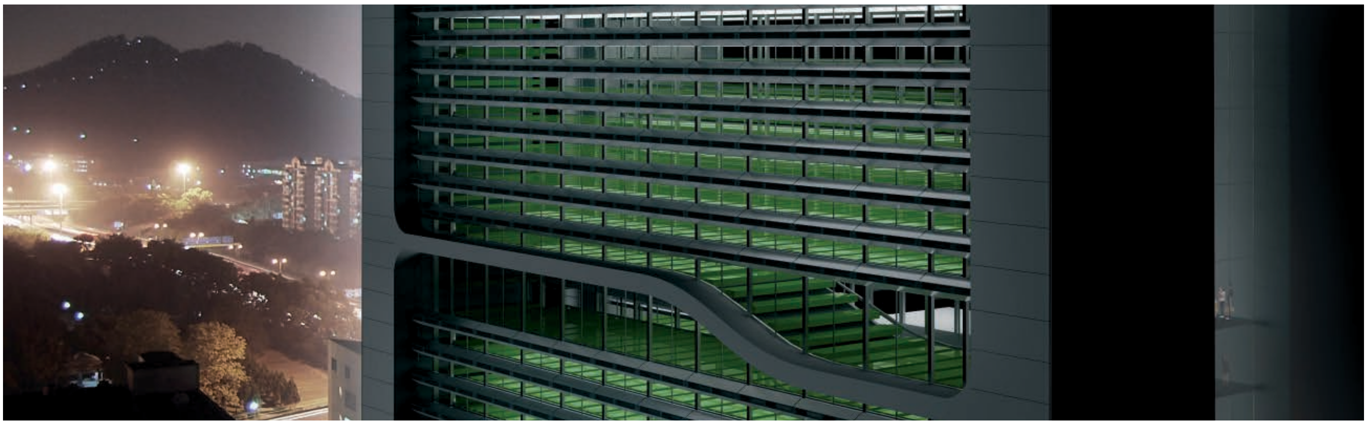


Photo: G. Schieber

Skyfarming: Staple food for growing cities!?

Megacities in Asia require millions of tonnes of rice every year to feed their growing population. Producing staple food, such as rice, directly within the city, would reduce transport requirements, would liberate large surfaces and make them available for other new ecosystem services. Skyfarming is a novel vertical farming approach to produce staple food in a multi-storey building that is largely independent of the environment and climate.

Professor Dr Joachim Sauerborn
Professor Dr Folkard Asch
University of Hohenheim, Institute of Plant Production and Agro-ecology in the Tropics and Subtropics
Stuttgart, Germany
Joachim.Sauerborn@uni-hohenheim.de
FA@uni-hohenheim.de

The United Nations predict for 2050 a global population growth up from today's seven billion to reach approximately 9.3 billion people (United Nations 2011). Within the same period, the urban population will increase by 2.6 billion, from 3.6 (2011) up to 6.3 billion people in 2050. Thus, the urban areas of the earth will absorb all of the expected population growth for the next four decades. The rural population will decrease by 300 million people within the same period. The relation between urban and rural population on a global scale is expected to change from 30:70 in 1950 to 70:30 in 2050 (United Nations 2011).

People prefer to settle at locations that have fertile soils available, leading to a competition for land between expanding urban and rural agricultural areas. Between 1.6-3.3 million hectares of land best suited for agriculture are estimated to be lost to urbanisation every year (Lambin & Meyfroidt, 2011) and, thus, the area available to food production decreases from 0.5 hectare per person in 1950 to 0.2 hectare per person in 2050 (Moore et al., 2012). Cities and urban areas have an extremely high demand for staple food. Producing this staple food is land-intensive and is located in rural areas. At present, 26 metropolitan areas with more than ten million inhabitants exist worldwide, of which 15 megacities are located in Asia.

How to reach food security in growing megacities?

Rice (*Oryza sativa*) is the second most important staple food crop on a global scale. At 154 million hectares, it covers more than 22 per cent of the global production area for cereals (FAOSTAT 2012). Rice is staple food for about three billion people in Asia (Molden 2007). Thus, megacities in Asia require millions of tonnes of rice annually to feed their population.

An example: The urban sprawl of Tokyo in Japan has about 35,000,000 inhabitants. Japan consumes about 58 kilograms of rice per capita and year (Molden 2007). This translates to about 150 grams of rice per person and day. Multiplying the number of inhabitants of Tokyo with the daily per capita consumption results in a daily consumption of 5,250 tonnes, which is the equivalent of 130 forty-tonne truck loads per day or 1.9 million tonnes per year. Translating this into rice yield corresponds to about 2.7 million tonnes of paddy rice. At an average annual yield of 6 tonnes/ha this amount corresponds to 450,000 hectares or about 2.2 times the current surface of Tokyo.

It is obvious that the ecological footprint of such a demand is beyond estimating, particularly if water and CO_2 are included. To date, 24 – 30 per cent of the freshwater resources that are used worldwide are employed in the production of rice (Bouman et al. 2007). Therefore, rice production is one of the greatest consumers of water and land. However, due to a growing demand, yields will have to increase in spite of the scarcity of water and land resources (Rijsberman 2006). In 2025, 15 – 20 million hectares of rice fields will suffer from water scarcity according to Tuong and Bouman (2003). Rice production is one of the largest emitters of methane, a greenhouse gas 3.5 times more relevant for global warming than CO_2 (Wassmann et al., 2000). Five to twenty per cent of the global methane (CH_4) emission of about 600 Tg a^{-1} (Tg a = teragram per year) derives from rice production systems (Abao et al., 2000; Kirk 2004; Jagadeesh Babu et al., 2006). In addition, transporting large quantities of staple food over long distances requires substantial amounts of fossil fuel.

Skyfarming – producing rice in the city

Innovative rice cultivation systems such as skyfarming have a high potential for mitigating greenhouse gas emissions and climate change, while at the same time avoiding water and nutrient depletion.

Producing staple food such as rice directly within the city would reduce transport requirements, would liberate large surfaces and make them available for other, new, ecosystem services. However, since all farming systems, traditional, conventional or organic alike, produce horizontally and mostly outdoors, agriculture is the only industry whose production is dependent on weather conditions in the respective region, rendering annual yields potentially unstable. Thus, since horizontal production within city limits would not be feasible, the only way is up! Production needs to shift to indoors, capable of producing high quality products, as fully resource-efficient as possible with resource flux cycles (water, nutrients, energy) as closed as possible, and with

Photo: G. Schieber

A plant module. An aeroponic cultivation system ensures the supply of water and nutrients.

a minimum of environmental pollution.

Skyfarming is an alternative concept for crop production following an efficiency strategy, i.e. minimisation of resource use per unit produced (Germer et al. 2011). In a multi-storey, fully controlled environment, crops are produced indoors with the following objectives:

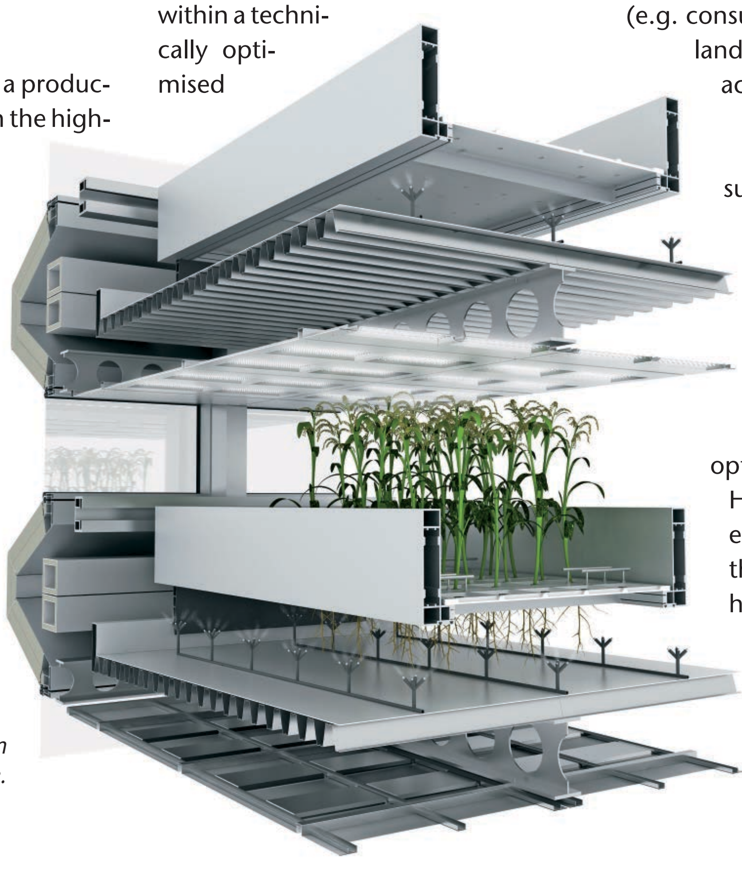
1. Multiplication of yields through optimal growth conditions (water, temperature, radiation, nutrients), several harvests per year, and avoidance of yield losses through competitors such as weeds or pests and diseases.
2. Optimised energy-use efficiency through optimally adapted illumination systems and minimised illumination duration, as well as energy cycling within the building and the use of renewable energy sources.
3. Reduction of environmental pollution through reduced input of e.g. nitrogen and phosphorus into natural ecosystems, increased water-use efficiency through the feedback of transpiration water, and less pollution with pesticides.
4. Short transport routes by a production shift to locations with the highest demand.
5. Efficient use of by-products for energy- and material applications.
6. Stable and continuous production and consequently low price fluctuations on the international crop commodity market.

The challenge is to develop a functioning and resource-efficient production unit within a building envelope which can be produced in series in a cost-efficient way. "Vertical Farming" is discussed in the USA (Fischetti 2008, Vogel 2008) with partly futuristic architectural designs that, however, do not relate to the cultivation techniques. All previous approaches have focused on specialised crops in the high priced segment, partly in combination with fish-farming and/or small animal husbandry, and therefore not addressing the most pressing problem of food security in cities for the two decades to come.

With skyfarming, the emphasis is given to a staple crop for the first time. Unlike the previous approaches, the skyfarming concept pursues an efficiency strategy which means reducing the resource use per generated product unit through technological innovation while maximising recycling. The crop and its physiological requirements are in the centre of the overall scientific concept. From sowing to harvest, the rice is continuously moved via a conveyer system within a technically optimised building envelope into the respective environments (radiation, temperature, humidity, etc.) that are optimised for its respective growth stage. Instead of soil or hydroponics, an aeroponic cultivation system has been developed for the supply of water and nutrients (supply of nutrient-rich mist to the roots). The crop's light requirements will dictate the light source to be selected, the quality and duration of illumination, as well as the direction. Energy efficient LED technology is being developed to satisfy rice requirements for light energy and quality at any given development stage.

Aeroponic systems, the transport and carrier system for the crop, new insulation methods, innovative energy supply, efficient re-cycling technology for energy, water and nutrients, and pest- and disease-free crop cultivation are special technical challenges that require a highly interdisciplinary cooperation and research. In addition, questions will arise with regard to the building itself (e.g. statics, insulation), the management of the production system (e.g. logistics, informatics), and its socio-economic embedding (e.g. consumer behaviour, urban and landscape planning, as well as acceptance).

Once this technology has successfully been tested for rice production, the system can be adapted to other staple food crops such as wheat, potatoes or even maize. There are many open questions still, and alternative options are being discussed. However, particularly with emphasis on feeding cities in the 2050's, technology that holds the potential to do just that needs to be developed and tested today, so that when the need arises, a solution can be proposed.



The plants are continuously moved via a conveyer system into the respective environments that are optimised for the given growth stage.

Photo: G. Schieber

Focus on food security and sustainable development

Both in Germany and at EU level, numerous events are taking place in autumn 2012 addressing food security, agriculture and rural development as well as the conservation of natural resources required to this end. Here is a small selection of them:

October 2012: European Development Days (EDD)

Since, 2006 the European Commission has held the European Development Days once a year, in the autumn. Its aim is to bring together development advocates, decision-makers and practitioners to exchange ideas, benchmarks and best practices. The EDD 2012 are to focus on "Supporting inclusive and sustainable growth". Around 6,000 guests representing 1,500 organisations are expected to come to Brussels in mid-October to discuss the thematic fields of "Development, agriculture and food security", "Engaging the private sector for development" and "Empowering people for inclusive growth". The following are among the events planned:

- Engaging the private sector in sustainable agriculture development
- Growing a better future for farmers
- Post Rio+20: Which strategy for sustainable and inclusive growth?
- Free humanity from hunger
- Promoting biofuels, creating scarcity?
- Resilience: the nutrition dimension
- How can we maximise inclusive growth and development?
- Disaster risk reduction
- The role of the private sector in transforming African economies
- A global compact for fragile states

The European Development Days 2012 will take place from October 16th to 17th 2012, in Brussels, Belgium. For more information, visit: http://eudevdays.eu

November 2012: The First Global Soil Week

Even though soils are managed and owned locally, their degradation is a key global issue, as their functions transcend national boundaries. Actions towards sustainable soil management are urgently needed. Given this challenge, the First Global Soil Week, taking place from the 18th to the 22nd November, provide a platform to initiate follow-up actions on land and soil-related decisions made at the Rio+20 Conference in June 2012. The topics to be treated include:

- Soils and soil management in the food system
- The soil and water nexus for sustainable livelihoods
- Soil contamination
- Rural-urban linkages
- Green Belt Movements
- Ethiopia's Tigray Project and Australia's Landcare Movement
- Voluntary Guidelines on Land Governance & Land Conflict Resolution
- Large-scale land acquisitions
- Soils and payments for ecosystem services

The First Global Soil Week is being organised by the Global Soil Forum, which was launched by the Institute of Advanced Sustainability Studies (IASS) in 2011. It will take place from November 18th to 22nd 2012, in Berlin, Germany.
For more information, visit: http://www.globalsoilweek.org/

December 2012: Conference on food security

The German Federal Ministry for Economic Cooperation and Development (BMZ) is to hold a development conference on the topic of "Food Security" in Berlin /Germany on the 11th December 2012. More information on this will soon be available at www.rural21.com.

Imprint

Rural 21 –
The International Journal for Rural Development

Published by:
DLG-Verlag GmbH
Frankfurt, Germany

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Editor in chief:
Silvia Richter, s.richter@dlg.org

Editorial staff:
Angelika Wilcke, a.wilcke@dlg.org
Ines Lechner, i.lechner@dlg.org
Olive Bexten, o.bexten@dlg.org

Editorial office:
DLG-Verlag GmbH
Eschborner Landstraße 122
60489 Frankfurt, Germany

Translated by:
Michael Gardner
Christopher Hay
Tazir International Services

Distribution, advertising:
DLG-Verlag GmbH
Eschborner Landstraße 122
60489 Frankfurt, Germany

Layout:
Petra Sarow,
Munich, Germany

Printed by:
Schleunungdruck GmbH
Eltertstraße 27
97828 Marktheidenfeld
Germany

FSC www.fsc.org MIX Paper from responsible sources FSC® C105039

Rural 21 is published four times per year. The subscription rate is 33.– Euro (Germany), 37.– Euro (EU countries), 51.– Euro (non-EU countries) and 8.30 Euro per issue, plus postage.