Agriculture for Development

Special Issue on Urban and Peri-Urban Agriculture

A global view of urban and peri-urban agriculture
Nutrition implications of urban and peri-urban agriculture
Agriculture in the rural-urban continuum: a CGIAR research perspective
Flowers watered with beer
Nutrient value of human waste to plants
The programme of Urban Agriculture in Cuba
Crop-livestock integration in peri-urban settings
Closing the nutrient cycle: linking urban solid waste management and soil amendments
The 32nd Ralph Melville Memorial Lecture: Improving smallholder agriculture

No. 26, Winter 2015
Guidelines for Authors

Agriculture for Development

The editors welcome the submission of articles for publication that are directly related to the aims and objectives of the Association. These may be short communications relating to recent developments and other noteworthy items, letters to the editor, especially those relating to previous publications in the journal, and longer papers. It is also our policy to publish papers, or summaries, of the talks given at our meetings.

Only papers written in English are accepted. They must not have been submitted or accepted for publication elsewhere. Where there is more than one author, each author must have approved the final version of the submitted manuscript.Authors must have permission from colleagues to include their work as a personal communication.

Papers should be written in a concise, direct style and should not normally exceed 3000 words using Times New Roman font, 12-point size for the text body, with lines single spaced and justified and pages numbered. Tables, graphs, and photographs may take a further 1 page plus, but we try to keep the total length of each paper to 3-4 pages of the Journal. Good quality photographs are particularly welcomed, as they add considerably to the appearance of the contents of the Journal. We prefer high resolution digital images.

• A short biographical note about the author(s) is included, preferably with a photograph of the author(s). If still working, indicate your position and email address. If retired, your previous job (eg formerly Professor of Agriculture, ABC University).

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• A short introductory paragraph is useful describing, succinctly, the current state of work in the relevant field.

• Système International (SI) units should be used. Others should be related to SI units at the first mention.

• No full stops should be used with abbreviations such as Dr or Prof, or eg, ie, status quo, viz, and inter alia. Acronyms such as GFAR, FAO, IFPRI, and GDP do not have full stops or spaces between the letters. Acronyms should be presented in full at their first mention.

• Thousands should be indicated by a comma and no space eg 12,400.

• Use ‘s rather than ‘z’ (eg fertiliser, organisation, mechanisation).

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• Results should be presented in an orderly fashion and make use of tables and figures where necessary.

• Discussion should focus on the work presented and its relationship with other relevant published work.

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• Only papers accepted for publication or published may be cited.

• In the text, cite by author’s surname and date: (Waller, 2009) or Waller (2009) in chronological order. Use ‘&’ between names of 2 authors; use ‘et al’ for 3 or more authors.

• At the end of the paper, give full details of references in the journal style as per the examples below.

• Personal communications in the text should be cited as: initials, name, brief address, personal communication.


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The TAA is a professional association of individuals and corporate bodies concerned with the role of agriculture for development throughout the world. TAA brings together individuals and organisations from both developed and less-developed countries to enable them to contribute to international policies and actions aimed at reducing poverty and improving livelihoods. It grew out of the Imperial College of Tropical Agriculture (ICTA) Association, which was renamed the TAA in 1979. Its mission is to encourage the efficient and sustainable use of local resources and technologies, to arrest and reverse the degradation of the natural resources base on which agriculture depends and, by raising the productivity of both agriculture and related enterprises, to increase family incomes and commercial investment in the rural sector. Particular emphasis is given to rural areas in the tropics and subtropics and to countries with less-developed economies in temperate areas. TAA recognises the interrelated roles of farmers and other stakeholders living in rural areas, scientists (agriculturists, economists, sociologists etc), government and the private sector in achieving a convergent approach to rural development. This includes recognition of the importance of the role of women, the effect of AIDS and other social and cultural issues on the rural economy and livelihoods.

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ISSN 1759-0604 (Print)

ISSN 1759-0612 (Online)
Editorial

Special Issue on Urban and Peri-Urban Agriculture

Humanity’s headlong rush to environmental chaos and the destruction of life-sustaining habitat is accelerating as its population booms in parallel with the incessant clamour for continued economic growth. Here in the UK, for example, we learn that our population is scheduled to rise by 10 million (to 75 million) within the next 25 years. Against this grim back-cloth, there are patches of sanity which give some hope – and the increased interest in greening our cities is one of them. Urban and peri-urban agriculture (UPA) bring ‘life’ to inner cities and their environs. And that ‘life’ has two meanings: firstly, producing photosynthesising vegetation extracts CO₂ from the atmosphere and replaces it with O₂, while at the same time using recycled waste water and solid waste to produce biomass; and secondly, providing malnourished people, whose diets are severely deficient in vitamins and minerals, with access to fresh fruit and vegetables grown, literally, on their doorstep.

A feature of current population dynamics is the migration from the rural to the urban sector. The movement is particularly pronounced in the developing world where the current 50:50 balance between rural and urban populations is projected to become 30:70 in favour of the urban sector by 2050. This movement brings pressure to bear on communities as slums swell and crime flourishes. UPA is able to ameliorate this situation, especially if it is included from the outset in urban planning. Greener conurbations bring life to otherwise infertile environments and also invigorate urban societies as the greening movement brings people together in cooperating groups. Consequently, populations are not only better fed with fresh food grown locally and with short supply chains, but urban societies are spiritually nourished at the same time. Waste management and recycling is rapidly becoming a major ingredient in development programmes and a critical issue for achieving progress on achieving the UN’s Sustainable Development Goals.

This is a strong theme running through many of the stories that we report on. This issue of Agriculture for Development brings together the experiences and wisdom of a wide range of planners, observers and practitioners of UPA from around the world. I take this opportunity to thank every one of them for their patience and perseverance as they found time in their overloaded schedules to share with us their various, and always invaluable, insights into the benefits that UPA can bring to an inexorably rising global urban population.

The Paris climate talks

On another note, there are some hopeful indications that the UN climate talks, to be held in Paris in December 2015, may be more successful than previous events in the long series. As we go to press, Christiana Figueres (Executive Secretary of the UN Framework Convention on Climate Change) has announced that 146 countries have made public their ‘intended nationally determined contributions’ – INDCs – to limit their greenhouse gas emissions. The INDCs would, if implemented, be sufficient to contain the global temperature rise to 3°C above pre-industrial revolution levels by the end of the century. This is still far too high, but it will unleash a lot less havoc than the 5°C rise predicted if we continue with business as usual. Ag4Dev27 will report on the outcome of the Paris meeting.

Brian Sims
Guest Editor
A global overview of urban and peri-urban agriculture

Makiko Taguchi

Makiko Taguchi is an Agricultural Officer in the Plant Production and Protection Division of the Food and Agriculture Organization of the United Nations (FAO). She currently serves as part of the team on the ‘Growing Greener Cities’ programme, which promotes and provides support to urban and peri-urban horticulture in developing countries. She also serves as a co-secretary to the ‘Food for the Cities Initiative’, which is an FAO corporate initiative that addresses issues surrounding urbanisation, food security and nutrition.

Summary

Urban and peri-urban agriculture (UPA) has an increasingly important role in food security and nutrition in our world today where the majority of the population resides in urban areas. Although not captured in official statistics, UPA is being practised by a significant number of people worldwide, with the interest and need increasing. In the developing country context, it is a means for improving food security and nutrition at household level, as well as a means to generate income. However, its full potential is yet to be reached as it faces land and resource competition pressure from other sectors, and it is often not supported by government extension services that tend to focus on rural production. New initiatives can be seen in various parts of the world to tackle these issues, while an increasing number of urban planners are gaining awareness of the importance of food security and nutrition, along with the value of green space in urban planning.

Introduction

Urban and peri-urban agriculture (UPA) has been part of the urban landscape for many years, but whether it should be part of that landscape or not is often debated, while counter-arguments suggest that urbanisation occurred around agriculture. UPA has always had a role in urbanisation, although it is constantly under pressure in competition with other sectors such as industrial or residential development. It can be defined as the growing of plants and the raising of animals within and around cities (FAO, 2014a). In recent decades, there has been a surge of interest in UPA, in both developed and developing countries alike. In developed countries, it has become more popular as community gardening, or hobby farming, where people engage in farming not so much from a food security perspective, but as a way to connect with nature and for their psychological and physical wellbeing. However, there is also increasing interest in urban agriculture from a food safety perspective, as people seek to have more control over what they eat.

In developing countries, UPA has mainly evolved as a way of survival for the poor, living on the fringes of the city, growing food in the small spaces that they have access to. In this case, there is a concern for food safety and health, as these marginalised people often only have ‘access’ to land and water near sewers, or other highly contaminated areas – ‘access’ in quotations as many do not have legal access to these resources.

In 1999, FAO was asked by its member governments to address this emerging issue of UPA in developing countries, and the Growing Greener Cities programme was established in 2000. It quickly became clear that there were no global data on UPA to confirm the above mentioned trends. Thus, an attempt to better understand the status of UPA began, and in 2012 FAO published Growing Greener Cities in Africa: first status report on urban and peri-urban horticulture in Africa (FAO, 2012a). This was followed by Growing Greener Cities in Latin America and the Caribbean: an FAO report on urban and peri-urban agriculture in the region (FAO, 2014b) (both are reviewed in Bookstack, Editor). Through this process, it was confirmed that official data collection on UPA does not exist in most countries, and available information is based on ad hoc collection or site-specific research.

UPA in Africa

Urbanisation is a global trend. The urban population exceeded the rural population in 2007, and is expected to reach 67 percent of global population by 2050, with the majority of this urbanisation taking place in Africa and Asia. The most dramatic change anticipated is in sub-Saharan Africa where the urban population is projected to triple in size from 345 million in 2014 to 1.1 billion by 2050 (UNDESA, 2015). An estimated 43 percent of the urban population are poor in this region, living on less than US$1.00 per day; but taking into consideration the higher cost of living in the cities, urban poverty is estimated to be much higher, around 70 percent. The majority of these urban poor live in slums with no access to basic services. UPA is being practised as a way of survival, increasing food security and nutrition, with a significant proportion of the population engaged in horticultural production (Table 1). In most countries, UPA can be seen as women’s activity, except in Nigeria where horticulture production is considered a male occupation.

There are two basic kinds of urban production in the region: home gardening, mainly for home consumption; and market gardening in open spaces for commercial production. In places like Nigeria, commercial floriculture can be found in the peri-urban areas. In either case, most do not own the land they are cultivating, so they can be easily evicted, or face the threat of real estate development. Also, most do not have access to clean water, inputs or credits; and this lack of access to resources can impact significantly on levels of productivity.
Table 1. African capital cities with highest percentage of urban population engaged in urban horticultural production

<table>
<thead>
<tr>
<th>Capital City</th>
<th>% urban population engaged in UPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lilongwe</td>
<td>35</td>
</tr>
<tr>
<td>Yaoundé</td>
<td>35</td>
</tr>
<tr>
<td>Nairobi</td>
<td>30</td>
</tr>
<tr>
<td>Accra</td>
<td>25</td>
</tr>
</tbody>
</table>

Commercial growers often rely on informal loans from intermediaries, as formal credit is either too complicated to apply for, or they are considered ineligible. Technical assistance is also hard to get, as public extension systems in most African countries are marginal, and often the Ministry of Agriculture is only focused on rural production. Despite this challenging situation, UPA benefits millions of people either through consumption or as a means of livelihood. It is also a source of employment, and in recent years UPA has been brought under the spotlight as a “green job” opportunity for youth in the continent.

In order to take advantage of the potential of UPA, countries and cities need to create an enabling environment through appropriate policy making. The Growing Greener Cities programme has focused on assisting national and local governments to formulate policies that will foster UPA throughout the world. Of the 27 countries that responded to its survey, 21 answered that they support UPA under their agricultural development policy. In countries like the Democratic Republic of Congo, Gabon and Mozambique, market gardening has been officially encouraged for decades. However, it is only in the last decade that most countries have paid significant attention to UPA. In order to promote UPA, there is a need to integrate it into urban planning, and address the issue of land tenure. The official endorsement of the Voluntary guidelines on the responsible governance of tenure of land etc by the Committee on World Food Security in 2012 was welcome progress in this area of policy (FAO, 2012b).

**UPA in Latin America and the Caribbean**

UPA in Latin America and the Caribbean region shares similar challenges to those faced in Africa. However, urbanisation itself has reached a more ‘mature’ state than in the African continent with the highest percentage of the population in the world (80 percent) living in urban areas. Almost 70 million people are concentrated in four cities: Buenos Aires, Mexico City, Rio de Janeiro, and Sao Paulo. Although the increase in urban population is slower than in Africa and Asia, the number of urban slum dwellers remains high at 110 million in 2010. Urban agriculture has been developing as a means of survival, for home consumption and sometimes as a means for community development, while larger scale commercial enterprises can be found in peri-urban areas. Horticulture production is common for both, but intensive livestock production (eg pig farms in Lima) can also be found.

Twenty three countries responded to the survey for the Growing Greener Cities publication at national level, confirming that a significant number of people are engaged in UPA in the region. In Cuba, 40 percent of urban households are engaged in agricultural production, and 20 percent in Guatemala and Saint Lucia. In Ecuador, Quito has 140 community gardens, 800 family gardens and 128 school gardens, many of them supported by a municipal programme called AGRUPAR (El Proyecto de Agricultura Urbana Participativa). Twelve of the 23 countries have national policies that explicitly promote urban agriculture, many of them in the Caribbean. Some countries like Colombia, Ecuador and Peru do not have UPA policies at national level, yet have a significant amount of UPA activities in the capital cities.

In the region, UPA initiatives grew out of the need for food security, but with different processes. For example, in Argentina and Ecuador citizens created a movement which then was taken up by the local government. In Brazil, UPA has been incorporated into the federal Fome Zero or ‘zero hunger’ programme with support to improve family farmers’ access to public institutions and creating markets in the cities for better access by both producers and consumers (Figure 1). In Cuba, it was the pressure for maximising resources for production and delivery to consumers that led to the development of an organic farming system in the cities.

![An urban farmer explains his vision for the community garden in Belo Horizonte, Brazil](Photo: Makuho Taguchi)

**Characteristic differences between rural, urban and peri-urban agriculture**

Most people have a vision of agriculture as a rural activity, where monoculture, large scale staple crop or export crop production can be widely observed, along with some small scale producers also producing staple crops with a small patch of vegetable crops. UPA can be characterised mainly as horticultural production, with some livestock production,
Table 2. Origin of different food items sold in Kumasi, Ghana (%)

<table>
<thead>
<tr>
<th>Crops</th>
<th>Metropolitan source</th>
<th>Peri-urban Kumasi</th>
<th>Rural or import</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava</td>
<td>10</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>Maize</td>
<td>&lt;5</td>
<td>5</td>
<td>90</td>
</tr>
<tr>
<td>Plantain</td>
<td>&lt;5</td>
<td>&lt;10</td>
<td>85</td>
</tr>
<tr>
<td>Yam</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Lettuce</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tomato</td>
<td>0</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>Eggplant</td>
<td>0</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>Poultry/Eggs</td>
<td>15</td>
<td>80</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Livestock</td>
<td>5</td>
<td>10</td>
<td>85</td>
</tr>
</tbody>
</table>

Source: Cofie et al (2001)

while staple crops are not widely grown in the cities or in their peripheries but are transported in. Table 2 is an example of the mixture of agricultural and horticultural crops to be found in the markets of major conurbations.

Peri-urban agriculture can produce staple crops, but also intense commercial production of horticultural crops under greenhouse production, or large-scale animal production for urban consumption. Horticultural crops and animal production are preferred, as they can produce higher returns than staple crops. Peri-urban agriculture is situated in a dynamically changing landscape, with constant pressure for industrial or residential development. It has also been a concern for urban residents as a source of pollution due to its close vicinity to urban areas.

Urban agriculture usually comprises a very small plot, or innovative surfaces such as roof tops, vertical walls, and containers. Technologies such as hydroponics and aquaponics are used where available. Community gardens or school gardens can be set up in urban areas to create social cohesion and opportunities for education. New generation urban agriculturalists and entrepreneurs are finding opportunities for income generation through innovative pathways providing specialty produce (Figure 2). Urban agriculture also faces competition for land with other sectors, and pollution is also a concern both with the produce being contaminated, but also the high input agricultural practice contaminating the water source. Due to these concerns, in many cities, especially in Latin America, organic or ‘agro-ecological’ approaches have been mainly promoted and supported. Internationally recognised organic certification is often too expensive for many to obtain, but local solutions such as municipal government branded lines of produce that has its own standards, can be observed.

Conclusions

UPA can contribute to improving food security and nutrition in many countries, as well as providing opportunities for improved livelihoods. However, in order to reach its potential, policy support is needed for improved access to land, water, and other resources, as well as access to markets. It is also important that agricultural use, including market space and distribution pathways, are included in urban planning, to ensure the most strategic use of high value land. Often this is not included in urban planning, which can result in eventual food deserts in the cities, or high vulnerability to natural and human shocks. The new generation of urban planners are becoming aware of this, and cities are increasingly incorporating green space (including UPA and forestry) into their design.

References


News from the Field

Growing produce from the sand: Kwai Island’s organic vegetable gardens

In the tiny island of Kwai, Eastern Malaita Province in the Solomon Islands, the geographic characteristic of the land makes it inherently difficult to grow any form of vegetation, greatly limiting the kinds of food that people have access to. The increasing effects of climate change make matters even worse, with rising sea levels and unpredictable weather patterns further threatening this already vulnerable community.

**Young and malnourished**

The majority of the 120 families living on Kwai Island rely mainly on fishing and seaweed farming for their livelihoods. In the past, when a barter system was widely practised, they would exchange their harvest from the sea with produce from the mainland since banana and coconut were the only crops that they knew would grow on the island. This practice ensured a balance in their diets, but with the barter system fast disappearing, a nutritional gap emerged. For a population with 60 percent under the age of 20, this became a growing concern.

To supplement the limited food available on the island, people have been steadily consuming processed, ready-to-eat, canned products - a factor that contributes to the increase in the so-called lifestyle or non-communicable diseases in the community such as obesity, stunted growth in children, and hypertension, among others. The arduous and often dangerous journey, with at least four hours spent in a paddle boat, to reach the mainland, to buy or exchange fresh produce, is another factor causing them to opt for convenience over a healthy meal.

This alarming trend prompted Philip Manuao, a pastor from the INHIM Community Care Ministry - which has the promotion of holistic development through community-based programmes as part of its advocacy - to seek support from the government. After a series of consultations with the community, an organic farming project was identified as a viable solution to the food insecurity and nutritional deficiency in the island.

**Rise of the Sup-Sup gardens**

The organic vegetable backyard gardening project, or Sup-Sup gardens in the local Guale’ala language, began with a three-day training course in May 2010 for 120 participants from Kwai and neighbouring communities, spearheaded by Ravindra Joshi, then a senior adviser to the Ministry of Agriculture and Livestock of the Solomon Islands. The training demonstrated the process of basic composting using organic wastes from around the island. The resulting compost was later used to transform sand into a more fertile type of soil where fruits and vegetables can grow. Proper waste collection, segregation and disposal, as well as proper nutrition and sanitation, were also components of the training. A hands-on demonstration of simple planting techniques and application of the ready-to-use compost followed four weeks later.

After a month, the first batch of string beans, slippery cabbages, snake gourds, eggplants, tomatoes, chili, lettuce and root crops were ready to be harvested. “This project is for us, our children and grandchildren. It makes us proud that we can now make compost from waste and use it to grow fruits and vegetables in our backyards,” said Erastus Tom, a fisherman. Participants also confirmed that their children are eating healthier meals with the availability of greens and other vegetables. Money saved from not having to buy produce from the market is also being spent on other basic needs of the family.

Apart from having healthier communities with a new-found sense of pride, some participants are seeing other opportunities from the project. “We want to expand this unique idea to seed packaging, share its benefits with people in similar islands and eventually expand our organic gardens for cash” shared Thomas Afu, a retired government employee.

![Figure 1. Janet Toli in her Sup-Sup garden (Photo: RC Joshi)](image)

Before organic farming was introduced, the idea of growing fruits and vegetables on the island was unheard of and deemed impossible. Many were quite hesitant to participate. However, the success of the first batch of Sup-Sup gardens convinced the sceptics and encouraged further adoption of the project. Soon, the news spread to nearby communities. People became interested and began replicating it in their own backyards (Figure 1). “When I saw the changes that have taken place in Kwai, I could not wait to start my own garden” said Ms Manu, a housewife from Ngongosila.

**Why it flourished**

Several factors contributed to the successful implementation of the Sup-Sup garden project in Kwai. Involving the locals in every step of the process is one of the primary reasons. “To truly advance the cause of rural communities, we need to engage the people and closely work with them” said Dr Joshi.

Likewise, support from several organisations was crucial in launching and carrying out the project. A seed grant from the
United Nations Development Programme enabled INHIM Community Care to purchase basic garden tools. Various vegetable seeds were also given by the Kaston Gaden Association and the Taiwan Technical Mission based in the Solomon Islands. Leaflets on easy composting were produced by the Japan International Cooperation Agency, while a booklet Local Kaikai Recipes, contributed by the rural community, was printed with support from the World Health Organization.

Five years on, the Sup-Sup gardens on Kwai Island are still flourishing and continue to provide the people with nutritious produce. With the knowledge and skills that they learned, the Gula’alas managed independently to sustain a project which they once considered impossible.

Replicating success

“This organic farming model, known simply as the Kwai Island Clean and Green Project, had been adopted by the United Nations International Fund for Agricultural Development (IFAD) to address food and nutrition insecurity in small outer islands across the Pacific and other territories that are facing the consequences of climate change and loss of biodiversity” said Dr Joshi. Inspired by its success, a number of countries with small islands similar to Kwai have already expressed interest in implementing the initiative in their own contexts. With climate change posing a growing threat to these communities, a simple and cost effective solution like organic vegetable and fruit gardens is a good option to explore.

Reference


Ravindra C Joshi and Sarah Jane Velasco

Ravindra C Joshi is currently a Visiting Professor and Adjunct Professor of Agriculture with Pamppanga State Agricultural University, Philippines, and University of South Pacific, Fiji, respectively. He is also the TAA Coordinator for the Pacific region.

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Nutrition implications of urban and peri-urban agriculture

Fen Beed, Thomas Dubois, Ray-Yu Yang

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Ray-Yu Yang has headed AVRDC’s Nutrition group since 2003. Based in Shanhua, Taiwan, she specialises in the application of laboratory analytical methods to quantify essential nutrients and phytochemical contents of vegetables from tropical Africa and Asia, and the characterisation of vegetables for nutritional and functional properties, including nutrient bioavailability, anti-inflammation, and anti-diabetic activities.

Summary

Urban and peri-urban agriculture is perfectly suited to vegetable production on small plots of land where there is accessibility of labour, agricultural inputs and markets. The nutrient potential of fresh and affordable vegetables is made readily available to consumers, growers, their communities and through markets, as the need for post-harvest practices and transport is diminished in urban production systems. Community and school-based vegetable gardens facilitate an understanding of the importance of horticulture, nutrition and health, and can further be used to nurture business skills and encourage entrepreneurship. When combined with the current scenario of over half of the world’s populations now
residing in urban compared to rural environments, the need to nurture urban and peri-urban systems is further justified. This paper provides an insight into these factors, focusing on opportunities in Africa where urbanisation has occurred more recently than elsewhere; describing types of urban and peri-urban systems, and key lessons learned.

Introduction

As far back as 2003, it was recognised that 2.7 million lives could be saved annually through sufficient fruit and vegetable consumption, combined with physical exercise, and that low fruit and vegetable intake was among the top 10 selected risk factors for global mortality (WHO, 2003a). There has been a recent global trend to replace traditional, largely plant-based diets with high-fat, energy-dense diets with a substantial content of animal-based foods. It has been widely documented and accepted that vegetables contain unique combinations of essential minerals and vitamins to constitute a healthy diet necessary to overcome micronutrient deficiencies (eg vitamin A) and non-communicable diseases (NCDs) such as obesity, diabetes, cardiovascular problems and cancer (WHO, 2003b); and that children, our future, are the most vulnerable to malnutrition (Black et al., 2013). NCDs kill 38 million people per year and the burden of NCDs is expected to increase to 57 percent of all deaths by 2020 with increasingly younger people suffering as a consequence of non-nutritious diets and with both developing and developed countries suffering (WHO, 2015). In fact, 75 percent of deaths due to stroke, and 70 percent of deaths due to diabetes by 2020, are predicted to occur in developing countries. A daily intake of 400g of fruits and vegetables is recommended, with a focus on variety and fresh produce being important (FAO/WHO, 2004). Awareness needs to be raised, and appropriate policies introduced to promote fruit and vegetable consumption to overcome dietary trends of excessive fat consumption.

There are major differences among countries and populations in the types of nutrition-related problems that occur - ranging from under-nutrition and micronutrient deficiencies to over-nutrition. Intervention strategies to promote increased fruit and vegetable consumption need to be sensitive to these differences. While general trends show diets becoming less nutritious and NCDs increasing, there are exceptions, eg the Republic of Korea has largely maintained its traditional high-vegetable diet, despite major social and economic change, and as a consequence has lower rates of chronic diseases and lower than expected levels of fat intake and obesity prevalence than other industrialised countries with similar economic development (Lee et al., 2002; Kim et al., 2002). An overview of Africa is highlighted in this paper, where urbanisation has been most dramatic over recent decades but where significant opportunities and constraints to vegetable production exist.

However, what is common across all countries and regions is the potential of cost effective and well managed urban and peri-urban diversified cropping systems to nurture communities and generate incomes (Talukder et al., 2010). Ubiquitous is the need to cultivate seed and seedlings that are disease-free and to select appropriate varieties, species and cropping systems to sustain production and the delivery of nutritious diets. Urban systems will predominantly be in pots, up walls or on rooftops, in small private and public plots of land, with the common goal of providing affordable and nutritious diets to growers and their communities; and if there is surplus, to local markets for sale as fresh produce. Peri-urban systems are often larger and involve the integration of several producers across a site, thus facilitating the supply of both inputs and technical information, as well as access for outputs to urban markets selling fresh produce. The larger and more commercially based peri-urban systems can adopt screen-houses to protect vegetables from insect-borne viruses and other pests or diseases, avoiding the need for pesticide applications. Basic greenhouses can also be used to produce vegetables off season in peri-urban systems. For urban systems, trellising can be used for certain vegetables eg climbing guardis, to provide shade and reduce temperatures for more temperate vegetables to be cultivated beneath. Judicious pesticide use and development of accessible biological based solutions are critical to ensure the food produced generates profit and is safe to growers and consumers and can be sold to markets that regulate pesticide residues. Further, vegetable gardens in communities and schools encourage healthy diets, nutrient awareness, income generation and an appreciation of business skills (Holmer, 2006; 2011). In summary, vegetable production through urban and peri-urban systems, in combination with nutrition education, can make a highly effective contribution towards nutrition improvement, pre-emptive control of NCDs and promotion of community wellbeing.

Rate of urbanisation in Africa

Africa is mostly rural (40 percent living in urban areas), but the continent is set to urbanise the fastest in the coming decades, becoming 56 percent urban by 2050. Medium-sized cities in Africa (>1 million inhabitants) are among the fastest-growing urban conglomerates. The number of megacities (>10 million inhabitants) will double, while the number of large cities (>5 million inhabitants) will quadruple. It is clear that sustainable development challenges in Africa will have to increasingly concentrate in urban areas. Where cities are left unmanaged, urbanisation goes hand in hand with pollution and environmental degradation, together with unsustainable production and consumption patterns (United Nations, 2014).

Most cities in sub-Saharan Africa (SSA) are characterised by insufficient basic infrastructure, particularly in low-income areas (African Development Bank Group, 2012). As most of the migrants from rural areas are uneducated and unskilled, they populate the informal sector, essentially advancing a predominantly informal and survivalist private agricultural sector instead of a high-value one. Another challenge from Africa’s rapid urbanisation, is the increasing pressure of urban populations on natural resources and the environment. The expansion of cities is generally at the expense of forests and other natural environment or ecosystems, and increasing pollution and communicable diseases.

Types of urban and peri-urban agricultural systems

Urban and peri-urban agricultural systems have received a great deal of attention recently, but no clear and accepted
definition exists to describe them. Several research groups have tried to further subdivide both urban and peri-urban agriculture, either based on farming systems, crop type, size, market linkages or intensification. FAO (2007) concludes that intra-urban agriculture tends to be more small-scale and subsistence-oriented than peri-urban agriculture, although it acknowledges exceptions, such as the case of vegetable production. Farm enterprises located on the fringes of the city, which would be classified as peri-urban agriculture, are on average larger than those in the city centres and more strongly market-oriented. In SSA, putting a definition or description on the terms is virtually impossible. Urban and peri-urban agriculture often occur informally and opportunistically in the ‘in-between spaces’ of towns and cities, and their heterogeneity mirrors the heterogeneity of African cities (White & Hamm, 2014).

In African cities, people typically pursue multiple livelihoods (Owusu, 2007), one of which may be agriculture-based. How one practices, and what one grows, is contingent on a range of factors. Urban and peri-urban agriculture can be market-oriented, subsistence-oriented or, as is mostly the case, serving both purposes. However, it seems that most city dwellers grow agricultural products for subsistence purposes. In Accra and Kumasi, Ghana, a survey of 120 households engaged in backyard gardening showed that only 3 to 10 percent of the households take some temporary commercial advantage from their gardening (Danso et al., 2006). However, opportunities exist to exploit not just global vegetables but also traditional vegetables that remain in the consciousness of many city dwellers as a consequence of their rural origins and diets (de Neergaard et al., 2009).

**Barriers to sustainable urban and peri-urban agriculture**

Figure 1 provides a conceptual framework of external drivers, barriers, negative consequences, solutions and interventions for urban and peri-urban agriculture, with a focus on vegetable production. A major barrier to vegetable production is water access, which includes quality irrigation. Availability of appropriate land is another barrier, coupled with landownership issues. To a great extent, urban farming is done on land that has not yet been developed or which cannot be developed (eg because of flooding). Farmers very often do not have legal access to the land they work on, and as a result, urban agriculture as a livelihood is often precarious and limited (Crush et al., 2011). In Kumasi, Ghana, typical farm sizes range between 0.05 and 0.2 ha (Danso et al., 2006). Land and water access are considered the major challenge, and these are linked: as land pressure increases, a decline in the supply and quality of the water emerges. Inadequate policy protection is also a barrier. For example in Dakar, Senegal, laws related to protection of agricultural land are not enforced, resulting in the emergence of an informal land market. As a result, agriculture is losing ground to real estate development: urban growth occurs at the expense of peri-urban farmland (Sy et al., 2014). The urban and peri-urban vegetable sector suffers from weak investment, which is the result largely of inadequate access to finance. African governments often neglect small and medium-size enterprises, which are among the key drivers of productivity, and form the fabric of much of urban and peri-urban agriculture.

**Achieving sustainability for urban and peri-urban agriculture**

This is an intrinsic result of peri-urban and especially urban vegetable production. Because of the increasing influx of people into urban areas in SSA, population density increases, land prices tend to go up and multiple land use emerges. Such changes affect the agricultural production systems, which tend to become smaller scale with more intensive production, and shift from staple crops towards more perishable crops and animal production (FAO, 2007). Lack of quality water leads to health and environmental hazards; especially the use of untreated wastewater for vegetable production has grave consequences for food safety. A microbial risk assessment in Ghana estimated a possible loss of about 12,000 disability-adjusted life years annually in Ghana’s major cities through the consumption of salad prepared from wastewater-irrigated lettuce (Drechsel & Seidu, 2011). With smaller plot sizes, commercial urban agriculture becomes very input-intensive, especially in view of pest control, resulting in high levels of overuse and misuse of plant protection chemicals, with further dire consequences for food safety.

The barriers to a productive and sustainable urban and peri-urban agricultural system are exacerbated by climate change.
Flood risk, for example, increases because permeable land is being replaced by concrete (Sy et al., 2014). Urban farming can make substantial contributions to the city beyond the provision of livelihoods and food, such as buffering and flood control (Danso et al., 2006), which will become increasingly common with climate change.

Extra investments in irrigation, e.g. through the recycling of wastewater, become necessary. Manual irrigation is the most time-consuming aspect of urban and peri-urban farming (Tallaki, 2005). The benefit of wastewater is that it contains nutrients, albeit in low quantities. Studies have shown that urban farmers with access to irrigation water are able to cultivate year-round and can reach high income levels (Danso et al., 2006). The World Health Organization now recommends implementing measures for domestic wastewater to be treated at least at secondary level for use in irrigated market gardening.

Famers must comply with good agricultural practices (GAP) and maximum residue limits (MRL). Market integration can increase food safety. In general, urban products are distributed through short marketing chains. In West Africa, women do most of the marketing (FAO, 2007), and market integration of women in vegetable value chains and webs offers great opportunities. Closeness to the market offers great opportunities to peri-urban and especially urban farmers. For example, in Kumasi, Ghana, cabbage production almost entirely shifted to urban areas, which are closer to markets and where producers have a clear advantage (Danso et al., 2006).

Policies are required for diversification of economic activities through the creation of new economic hubs oriented towards high, sustainable, value-added production and exportation (Kayizzi-Mugerwa, 2012). Policies that would enhance markets and its infrastructure would help make urban and peri-urban agriculture more sustainable and safe. For example, many traditional markets suffer from a lack of municipal support, and, as a result, are characterised by congested and unhygienic conditions, and lack even basic infrastructure, such as proper storage facilities, running water or electricity. Also, good storage facilities can help bridge seasonal shortages (White & Hamm, 2014).

Conclusions

Demonstration of the current and potential provision of nutritious fresh food from urban and peri-urban systems is a pressing global need. Further detailed and long-term studies are required to monitor food and nutrition benefits and demands, as carried out for roof-top gardens in the city of Bologna, Italy where 82 ha can potentially produce 12,495 t vegetables per year - 77 percent of the urban vegetable requirement (Orsini et al., 2014). This study highlighted an additional benefit of linking urban production sites through green corridors to facilitate availability of beneficial insects and to enhance biodiversity to reduce pests and increase vegetable productivity. Reductions in urban emissions were also reported through the capture of 624 t of carbon dioxide.

Community-based gardens have also been shown to directly contribute to improved social fabric, well-being and resilience (Olkav & Zautra, 2011). Empirical evidence is required to justify and refine policy interventions, tailored to specific locations and countries, in order to stimulate the sustained production of vegetables through urban agriculture. Examples are provided by Zezza & Tasciotti (2010) for 15 developing countries, which showed consistent links between urban agriculture, dietary diversity and nutrition adequacy indicators. Although the Millennium Development Goals included one concrete measure of nutrition (children underweight), the post-2015 Sustainable Development Goals will include multiple measures that better inform a diversity of policy and programming actions, to offer the opportunity for greater recognition and support to urban and peri-urban vegetable production (Webb et al., 2015).

There is a need to document successes and also failures to better inform future interventions and policy guidelines. Mitigation of transport costs and associated energy savings, along with reduced impacts of gardens on climate can be incorporated into economic evaluations. The nutritional benefits of vegetable gardens to communities need to be assessed and compared with capacity for scaling, to satisfy urban consumer demands relevant to purchasing powers. The benefit of home gardens to address gender inequality has been demonstrated and requires further consideration as new schemes are developed in urban environments, particularly when empowerment of women is most likely to increase family nutrition (Schreinemachers et al., 2015). The benefit of a diversified diet to promote health must also respect specific nutritional demands, food preferences and appropriate recipes for any given community (Yang et al., 2011). For this very reason AVRDC - The World Vegetable Center - is actively documenting nutrient profiles for global and traditional vegetables, along with recommending crop profiles and sustainable cropping systems to match demand. A participatory system is required to provide advice on how to manage abiotic and biotic stresses that do not jeopardise food safety eg through inappropriate pesticide use or unsafe hygiene standards (Shenge et al., 2015).

Finally, urban policies should respect and nurture the enthusiasm of individuals responsible for managing urban gardens. This requires financial support combined with appropriate information and tools, as has been amply demonstrated through an organic urban rooftop garden on the Laksi District Government offices in Bangkok, Thailand for over a decade. Household organic waste from the municipality is composted through vermiculture (as reviewed by Copie et al., 2006) to produce soil to grow a variety of vegetables, including climbing

Figure 2: Sustainable urban rooftop garden on Laksl District Government Offices, Bangkok; a demonstration for all? (Photo: Pen Beed)
vines and salad greens. The production of these vegetables has been sustained through sound agronomic practices such as crop rotation and use of raised beds, constructed from discarded street signs and other municipal waste furniture. This initiative has greened the working environment for employees, reduced greenhouse gas emissions, provided income and fresh food, and serves as a living demonstration to encourage other districts and agro-entrepreneurs to follow (Figures 2 and 3).

References


Newsflash

2015: Out with the MDGs, in with the SDGs

For the past 15 years, much of the discussion and action on human, social and economic development has been couched in terms of the eight Millennium Development Goals (MDGs). These enshrined an ambitious set of aspirations, expressed in 18 specific targets, which have provided a focus for national and international efforts to improve the lives of people in developing countries, and particularly of those living in poverty. The MDGs were launched with much fanfare and optimism at the UN in 2000. With 2015 as the target date for the MDGs, this year has seen a final summing up of achievements and the launch of a yet more ambitious and all-embracing set of 17 Sustainable Development Goals (SDGs) to guide development thinking and action over the next 15 years. The SDGs were launched on 28 September with even greater fanfare than their predecessors.

MDGs: what has been achieved?

There is much to celebrate in reflecting on how far we have come since 2000. In the words of Ban Ki Moon’s foreword to The Millennium Development Goals Report 2015 published in July, the MDGs have:

“helped to lift more than one billion people out of extreme poverty, to make inroads against hunger, to enable more girls to attend school than ever before and to protect our planet. They generated new and innovative partnerships, galvanised public opinion and showed the immense value of setting ambitious goals. By putting people and their immediate needs at the forefront, the MDGs reshaped decision-making in developed and developing countries alike.”

Key achievements include:

- an 83 percent increase in the number of people using improved drinking water sources, with over half the global population now having piped water into their homes;
- over two billion more people with access to improved sanitation;
- incidence of malaria down by 37 percent and malaria mortality rate down by 58 percent;
- under five, and maternal, mortality reduced by half;
- the gender gap in primary school enrolment virtually eliminated;
- primary school enrolment increased from 83 percent to 91 percent of the primary school age cohort;
- the incidence of extreme poverty and undernourishment halved.

But challenges remain, and new understanding has generated a greater awareness of the broader environmental factors on which sustainable development depends. The headline statistics mask the inequalities that persist and have to some extent intensified - between rural and urban areas, and between the poorest and the richest households. For example, 50 percent of rural dwellers lack improved sanitation compared to 18 percent of the urban population. Globally, 800 million people still live in extreme poverty and suffer from hunger. Regional and local conflict has slowed down progress in many areas.

Among the many lessons of the MDG experience, two stand out. First, that publicly declared commitment and concerted action at the highest levels can galvanise a wide range of actors to work together to get things done. The last 15 years have seen an unprecedented coming together of national governments, regional and international bodies, major charitable foundations, NGOs and civil society organisations to tackle issues that disproportionately affect the poor - income poverty itself, food insecurity, access to education, poor health services and outcomes, and environmental degradation which fundamentally undermines people’s ability to earn a living. Second, that it is important to set realistic, measurable targets that express the steps towards achievement of goals. In the words of the report “what gets measured gets done”. These lessons have influenced the discussions that culminated in the framing of the SDGs.

The next 15 years

Two months after the MDG report was published, 193 heads of state signed up to Transforming our world: the 2030 agenda for sustainable development, which is the founding document for the 17 SDGs. It is billed as “a plan of action for people, planet and prosperity”, one that will build on the MDGs and “complete what they did not achieve”. Eradicating poverty and hunger are seen as a prerequisite for sustainable development and are highlighted in SDGs 1 and 2. Subsequent goals highlight the importance of economic growth, but growth that is consistent with the sustainability of the world’s resources and ecosystems and with a commitment to reducing inequality and promoting human rights. This is reflected in the fact that six of the goals (SDGs 11 to 16) deal with sustainability of the resource base for development, compared to only one of the MDGs (7). The importance of the private sector, from local small businesses to global corporations, in contributing to sustainable development is also acknowledged.

Agriculture is now recognised as central to sustainable development. None of the 18 targets for the MDGs related specifically to agriculture or the sustainability of the natural resource base on which it depends. With the SDGs, the situation is very different. One of the reasons there are so many more targets for the SDGs is that they express in more detail how the various goals are to be met; in a sense, they express a theory of change that was missing from the MDGs.

For SDG 2, ‘End hunger, achieve food security and improved nutrition and promote sustainable agriculture’, four of the eight targets to be met by 2030 relate to sustainable agriculture for development, while a further two targets for SDGs 12 and 15 are also relevant:

• double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment (2.3);

• ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality (2.4);

• (by 2020) maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilisation of genetic resources and associated traditional knowledge, as internationally agreed (2.5);

• increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries (2.a);

• (SDG 12: ‘ensure sustainable consumption and production patterns’) halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses (12.3);

• (SDG 15: ‘protect, restore and promote sustainable use of terrestrial ecosystems …’) combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world (15.3).

The new agenda was presented to the world with a massive media fanfare with the express aim of ensuring everyone in the world would hear of the SDGs within a few days of their launch. There is a real energy behind the desire to see the SDGs accepted and owned by the population at large, so that they will shape discourse about sustainable development from local, through national to international levels. It remains to be seen whether this can be achieved. For now, we can be pleased that the aims of the TAA and this journal have been taken on board in such a powerful forum. Whether we will see intensified action on the ground in support of sustainable agriculture for development remains to be seen.

Chris Garforth
Agriculture in the rural-urban continuum: a CGIAR research perspective

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Dr Pay Drechsel has more than 20 years of working experience as environmental scientist in projects aiming at (i) the safe recovery of irrigation water, nutrients and organic matter from domestic waste streams, (ii) integrated natural resources management, and (iii) sustainable agricultural production in developing countries. He has worked extensively on urban and peri-urban agriculture, safe wastewater irrigation in low-income countries, as well as economic opportunities of resource recovery and reuse. He is leading the related flagship project of the CGIAR Research Programme on Water, Land and Ecosystems.

Dr Bernard Keraita is an irrigation and water engineer with over 13 years of research experience on water, health, sanitation and environment in low-income countries. His primary research focus is on safe wastewater use in agriculture, particularly on developing low-cost risk management interventions. He has previously worked with the CGIAR’s International Water Management Institute (IWMI) and is now with the University of Copenhagen.

Summary

Thirsty and hungry cities are posing significant challenges for the urban-rural interface ranging from food security to inter-sectoral water allocation. Not only is the supply of resources to urban centres a growing challenge in low-income countries, but even more is the urban return flow, as investments in waste management and sanitation, i.e. the ‘ultimate food waste’, are not able to keep pace with population growth. And where polluted water is used in irrigation to feed the cities, food safety is becoming a crucial component of food security. Most affected by resource competition and pollution are the urban and peri-urban farming systems which are often driven by the informal sector. Urban waste is not only a challenge but also offers opportunities. It is in this interface between agriculture and sanitation where the CGIAR operates through its research programme on Water, Land and Ecosystems (WLE), addressing both the challenges and opportunities of urbanisation: by exploring novel perspectives and solutions to respond to changing population dynamics, resource demands, centralised water and nutrient flows, and ecosystem services under pressure.

Introduction

By 2050, when the world population is expected to have increased to 9.5 billion, approximately 66 percent will be living in urban areas. Already within the next decade, the world’s rural population will start decreasing. Urbanisation is placing a lot of pressure on peri-urban areas, necessitating careful strategies for natural resource management at the interface of different sectors. An example is the boom of formal and informal water transfers from peri-urban and rural areas towards cities in most developing countries where urban infrastructure development cannot keep pace with population growth. Major issues arising in rapidly developing cities are water, food and energy security; an increasing number of poor at the margins of cities; a feminisation of peri-urban farming; and feeding the increasing urban population, while balancing the urban footprint on ecosystem services. These are some of the key challenges mankind is facing.

Over the years, the CGIAR has recognised the role of urban and peri-urban agriculture (UPA) in addressing these challenges. There is more than a decade of UPA research for development in particular by the International Water Management Institute (IWMI), the International Potato Centre (CIP) which for many years convened the CGIAR Challenge Programme on urban and peri-urban agriculture (Urban Harvest), and the International Livestock Research Institute (ILRI) with its focus on urban livestock (De Zeeuw & Drechsel, 2015). Key partners in these efforts are the RUAF Foundation (Resource Centers on Urban Agriculture and Food Security) and the Food for the Cities initiative of the FAO, to name just a few. Many of these studies were inspired by the pioneering work on the peri-urban interface funded a decade ago by DFID in Ghana and India (Brook & Davila, 2000; McGregor et al., 2006). In recent years, there have been renewed efforts by the CGIAR Consortium through its research programme on Water, Land and Ecosystems (WLE), which addresses both the challenges and opportunities of urbanisation, as highlighted in this paper.

Feeding the cities

Urban areas, as major hubs of consumption, induce an inflow of food from the rural to the urban areas. To meet the growing urban demand, cities increasingly have to rely on large-scale, long distance transportation of food. On the other hand, urban and peri-urban farming can contribute noticeably to the diversity of urban food supply and represent in low-income countries
the main production areas for certain, especially perishable, commodities, which have to be produced in market proximity where refrigerated transport is still not available (Table 1).

The common example is leafy vegetables which are often cultivated on larger open urban spaces in the vicinity of water (see Box 1). Aside from this type of open space cultivation, urban farming can also be manifested in thousands of backyard gardens which can have a distinct, but sometimes overestimated, contribution to urban livelihoods. The analysis of urban foodsheds (ie the geographic region that produces the food for a particular town) (Figure 1), and rural-urban food flows, are areas the CGIAR has been pioneering in data-scarce environments. The analysis of the food flows also gives insights into the urban nutrient and water footprint. For example, for the cities of Accra, Kumasi and Tamale in Ghana, Figure 2 shows the loss-gain balance of nutrients along the rural-urban continuum. Overall, the urban nutrient footprint is significant and calls for options to close the rural-urban nutrient loop.
The rural to urban shift of irrigated farming

The conventional focus of development aid and research on rural production systems is missing the increasing reorientation of resource flows to polarised consumption centres. New farming systems affected by and responding to urban demands are increasingly gaining significance. A recent IWMI study estimated that within a 20 km radius of urban centres we find globally 456 million hectares of farmland which is an area about the size of the European Union. The study showed that within cities and city agglomerations there are about 24 million hectares of land under irrigation, and 44 million hectares that are rainfed (Thebo et al, 2014). Those numbers are larger than the respective total area under rice in South Asia, the cultivated area under maize in sub-Saharan Africa, or the cultivated croplands of the Cerrados and llanos in Latin America and the Caribbean.

The ratio of irrigated farmland to rainfed production is especially high closer to the cities, reflecting strong intensification of irrigated farming activities in urban and peri-urban areas. It also reflects the challenges of increasing intersectoral water competition as well as food safety concerns arising from the use of polluted water in irrigation. In developing countries, studies from the Comprehensive Assessment of Water and Food have shown that in four out of five cities, there is extensive use of polluted water (wastewater) in irrigated farming in and around urban areas (Raschid-Sally & Jayakody, 2008). This development has major implications for rural-urban resource allocations for ecosystem services, poverty alleviation, food security and the economy at large. These are cutting across several of the new Sustainable Development Goals (SDGs) and the System Level Outcomes (SLOs) of the CGIAR Consortium.

The dark side of the urban food challenge

While cities are hungry and thirsty, the sustainable support of these green and blue resource flows into urban centres is high on the policy agenda, but it is equally important to look at the grey and brown return flows (Figure 3). Feeding the cities will not only require significant efforts into intensified farming systems to achieve food security, but also safe production approaches which minimise likely negative impacts of the urban footprint on ecosystem services, in particular from urban pollution. Urban waste management, including food waste, and the omnipresent sanitation challenges, are putting significant pressure on ecosystem services in the rural-urban corridor. Sanitation infrastructure is especially severely outpaced by population growth and the management of the ultimate food waste, ie faecal matter, is in a particularly poor state. This is directly affecting urban and peri-urban farming systems, especially those depending on water for irrigation. These farming systems are often driven by the informal sector, hardly found in any statistics, and ignored in official development plans and programmes. In fact, especially in low-income countries, urban farming is often perceived as a rural leftover and obstacle to the vision of a modern city. At best it is tolerated, but hardly supported. While this perception is being questioned, the non-acceptance of the sector is a significant obstacle in formally addressing the food safety issues UPA is facing. These can directly affect public health, and at scale (Box 1).

Box 1. Benefits and risks of urban vegetable production in Ghana

Up to 800,000 city dwellers eat exotic vegetables daily in Ghana’s urban streets, canteens and restaurants, often as a salad side dish with popular rice-based fast food. Most of the perishable vegetables are produced on open spaces in the city or its fringes; where about 2,000 vegetable farmers are able to access water for crop irrigation. This labour-intensive farming activity is highly profitable and can lift vulnerable groups out of poverty. It can also contribute to flood control, land reclamation and city greening while preventing the misuse of buffer zones. However, most farmers are increasingly experiencing problems in finding unpolluted water sources in the urban vicinity. As these vegetables are eaten raw, about 12,000 disability-adjusted life years (DALYs) are lost annually in Ghana’s major cities through the consumption of salad greens irrigated with polluted water. Comparing the risk of urban dwellers in Accra (Ghana’s capital city) from vegetable consumption, with other hazards such as contaminated drinking water, flooding, or eg swimming at urban beaches, the consumption of wastewater-irrigated vegetables appeared as the second highest risk next to the risk of children exposed to contaminated water in open stormwater street drains, which is possible everywhere in Accra. A particular risk is that this popular fast food becomes a faecal-oral pathway in times of cholera outbreaks.

Source: Drechsel & Keraita (2014)

Turning challenges to opportunities

Fortunately, the urban waste challenges also offer huge opportunities for innovation and finance, in support of closed loop processes through the safe recovery of water, nutrients and energy, from domestic and agro-industrial waste for the benefits of poor households and agriculture. However, so far, resource recovery and re-use is mostly driven by the sanitation sector with a strong focus on engineering solutions. The missing link is often the understanding of the (agricultural) demand
side for the recovered resources to develop market driven business models. This is a new dimension of research that the CGIAR WLE Flagship on Resource Recovery and Re-use (R2R) has been engaged in for the past three years. Through the combined strength of agricultural economists, waste engineers, environmental scientists, business developers, and public health experts, the R2R initiative, which is led by IWMI, is opening new doors for the CGIAR to link its profound knowledge of the agricultural sector in low-income countries, with the resource flow challenges of urbanisation.

Focusing on urbanised ecosystems, the R2R Flagship develops solutions that capitalise on waste to reduce the damage that growing cities are doing to communities and the environment. R2R aims to change the ways waste is seen and used by analysing, evaluating and promoting business models for R2R that can be applied to towns and cities of various sizes. The programme has so far screened more than 150 promising R2R cases in Asia, Africa and Latin America, analysed more than 60 of these cases in detail, and is now testing about 20 business models in 15 cities in the three continents (Otoo & Dreschel, 2015). A particular focus is on the safe management of food waste from markets, and faecal sludge from on-site sanitation facilities (septage), as well as nutrient and energy recovery from these ‘wastes’ (Dreschel et al., 2015). The research is currently also supporting the implementation of related business models in Asia and Africa, directly contributing to environmental risk reduction and to efforts towards a greener economy.

An example includes models linking faecal sludge management with agricultural development through the transformation of faecal sludge into fertiliser pellets. While composting of urban waste is nothing new, its market is often limited due to the low nutrient content of the compost. In collaboration with SANDEC/EAWAG (Department of Sanitation, Water and Solid Waste for Development of the Swiss Federal Institute of Aquatic Science and Technology), IWMI pioneered different co-composting options where dried but nutrient-rich faecal sludge is mixed with municipal solid waste. The resulting, sanitised, co-compost can be blended with locally available nutrient sources, like eg rock-phosphate, to adjust the nutrient content of the organic fertiliser to the particular needs of soils and crops, and better support the different market segments. In another value-enhancing proposition developed under the WLE programme, the (blended) co-compost is pelletised to reduce its volume and increase the comfort of its application in the field (Nikiema et al., 2014; Figure 4).

On the use of polluted water (wastewater) for irrigation, the on-going efforts of the CGIAR WLE research programme are focusing on mainstreaming the acceptance of urban farming in urban planning (Amerasinghe et al., 2013). In particular, focus has been on developing various risk mitigation practices and incentives along the food chain (a multi-barrier approach; Figure 5) where conventional wastewater treatment is absent and farmers have no alternative to the use of polluted water (Amoah et al., 2011). This work on risk mitigation is carried out in close collaboration with WHO and FAO, building on a decade of research on wastewater irrigation in the new WLE Volta-Niger focal region. It has been estimated that every dollar spent on these options for risk reduction can be recovered almost fivefold from savings on healthcare (Keraita et al., 2015).

![Figure 5. The multiple-barrier approach for consumption-related risks along the food chain as applied in wastewater irrigation (Source: Amoah et al., 2011)](image)

**Conclusions**

Based on the most recent numbers for the extent of farming in and around urban centres, there is a need to give these farming systems more attention. In developing countries, urban farming systems offer multiple benefits, in particular for crops in need of short marketing chains, like perishable vegetables. For other commodities, the urban foodsheds can be significantly larger, reaching deep into the ‘city region’, ie the rural hinterland. Of particular importance are peri-urban areas which are one of the most neglected domains in development-oriented research, where traditionally most attention is either devoted to rural areas or nowadays increasingly urban areas. As cities are growing into agricultural land, agricultural intensification is rapid, responding to market proximity and urban demands, while ecosystem services and environmental health are substantially under pressure from urban water needs and pollution.

To improve urban resilience and the sustainability of urban food supply, significant efforts are needed to reduce the negative urban footprint on peri-urban ecosystems and livelihoods. Integrated natural resource management across administrative boundaries will be essential with special attention to food safety and closed loop processes to prevent urban areas becoming vast nutrient sinks. Emphasis should be on institutional capacity development, planning across the urban rural divide, and - as currently spearheaded by the CGIAR WLE programme - sound business modelling. The latter is particularly needed where the public sector is struggling, and private sector engagement is needed to transform urban waste into an economic asset, and urbanisation from a challenge into an opportunity.

![Figure 4. Pellets from septage produced by IWMI in Ghana (Photo: IWMI)](image)
A ‘learning lunch’ on the farm

The term ‘working lunch’ is in vogue, but the concept of a ‘learning lunch’ is a novelty, connecting city-dwellers with food-producers with an aim to let each farmer-find-a-friend for renewing rural-urban relationships.

How do you get your wonderful lunch? Is it because you can afford it or because somebody has worked to produce it? Where do you think your food comes from, and where will it continue to come from in future? Far from intimidating, such questions attract hundreds of weekend tourists to Saguna Baug, the agro-tourism hub that is a little over 2-hours’ drive from cosmopolitan Mumbai and metropolitan Pune, located in Karjat taluka in the state of Maharashtra, India.

Ever since it shot into the limelight almost two decades ago, the 50-acre farm has been getting a steady stream of an average 400 city-dwellers every weekend in the quest to understand the multi-functionality of farming, combining leisure with learning. A team of over 60 youngsters, drawn from nearby villages, provide back-up services to the hordes of men, women and children who descend on the farm week after week.

Once known for its variety of captured snakes that attracted the first set of visitors to the farm, Chandrasekhar Bhadvase has since then transformed the barren landscape into a learning laboratory. Over the years, it has emerged as a platform where leisure, learning and amusement merge to create a rural-urban interface. “Saguna Baug combines the tangible (farm produce) with the intangible (rural environment) as a unique payment for environmental services model”, explains Bhadvase. From bird watching to water sports and from catching fish to learning farming, visitors not only learn the intricacies of food production but are also exposed to external pressures which demean farming as a vocation.

It is crucial to reverse the continuing decline in agriculture, restore farmers’ confidence in farming and turn around rural-urban migration. A visit to Saguna Baug works in two ways. While bringing visitors close to nature, the interactive discussions help farmers earn appreciation from unrelated quarters as well. “Appreciation not only ignites confidence but restores dignity too” quips Bhadvase. Restoring the dignity of farming as a vocation has been the key behind setting up the farm as an agro-tourism hub. Saguna Baug has been able to uplift the social status of farming, which in the recent past has taken a beating and is considered a lowly profession.

Saguna Baug has demonstrated that methods and approaches for participatory learning and action can help re-connect farmers and citizens with the biodiversity that sustains their livelihoods and culture. It further reflects that not only can sustainable agriculture practices be promoted by engaging farmers in extension activities; but its economic value can be enhanced through eco-tourism as well. Agro-tourism’s share of total income at Saguna Baug is 40 percent.

It is important for the farming community, residing in the deep interior of the country, to interact with their counterparts from the urban areas. Agro-tourism offers the best stage for this interaction and mutual happiness (Figure 1). Farmers engage in agro-tourism at the weekend, leaving plenty of time for farm development during the week. Thus farmers have a change in their routine hard work, something to look forward to over the weekend. By directly engaging with farmers, urban
**The Serpentine Route**

Converting degraded ancestral land into a productive landscape was daunting for the US-trained food technologist Chandrashekhari Bhadavale. Trained to produce potato chips in the US for soldiers in the frontline during 1970s may have been easy, recalls Chandrashekhari, but the social reality that considered farming a lowly profession had opened up an altogether different front back home. Transforming a 50-acre patch of land, later named **Saguna Baug**, into a hub of productive agriculture was daunting.

Not only were monetary resources scarce, degraded conditions did not evoke any confidence either. Initial attempts at rearing milch cattle and enhancing canopy cover had met with limited success. Improving agronomic practices for cultivating food crops had proved ineffective on account of poor soil fertility. Disappointments were writ all across as precious time and scarce resources were fast slipping away. Losing seven years of tireless efforts in the process had been self-eroding.

Though options were fast running out, Chandrashekhari was nevertheless determined to go the distance to transform his dismal situation. Opportunity had come knocking in the most bizarre form when some villagers requested him to help in catching a dreaded snake from one of the habitations. “The challenge to triumph over failures had encouraged me to take the call” recounts Chandrashekhari. Within no time, he had acquired a skill that had turned out to be the tipping point of change.

Much to the dislike of the family, catching snakes and selling venom had soon become a profitable vocation. “At one time”, says Chandrashekhari, “I had no less than a thousand snakes of varied species to meet the growing demand for venom”. Since the innate desire was to uplift the social status of farming, profit from venom sales was ploughed back into the farm. Creating ponds for holding rain water and improving canopy cover during the late 1980s were to become the foundation on which **Saguna Baug** rests today.

counterparts learn how food is produced and in turn re-shape their own eating habits. Their involvement ranges from direct purchase at the farm, to talking with farmers about what to produce and how, to providing inputs such as labour, knowledge or finance.

![Image](http://example.com/image.png)

Figure 1. City dwellers get a taste of rural life at the weekends (Photo: Sudhirendar Sharma)

Having established its niche in agro-tourism, **Saguna Baug** is now moving to the next stage of its engagement with urban tourists. An innovative new concept **Find Farmer Friend** has been launched, enthusing interested visitors to connect with farmers for building long-term trust and confidence in each other. It is a fresh start to building a new rural-urban relationship, and to see a reaffirmation of ‘learning lunch’ amongst urban dwellers and the peasants.

(Adapted from Leisa India, June 2015). For more information on Saguna Baug, visit [www.sagunabaug.com](http://www.sagunabaug.com)

**Sudhirendar Sharma**

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Flowers watered with beer

Jeffery W Bentley

Jeff Bentley is an agricultural anthropologist. He has lived with smallholder farmers in Portugal and Honduras, and has spent the past 20 years in Bolivia. It has been his great privilege to visit farmers, extensionists and researchers in Africa and South Asia as well.

Summary

Urban and peri-urban farmers may be peasants, engulfed by an expanding city, or they may be migrants to the city, or even educated people from the city. Their products are diverse, but tend to be perishable, marketable and of high value. They farm with little land but great creativity, can make use of new information, and often have more access to extension or other forms of new ideas than do more remote farmers. Peri-urban farmers face unique problems, such as land conflicts with builders. On the edge of the city, farmers can buy a wide range of specialty, store-bought supplies (such as mushroom spores), but they also have access to quirky inputs, often industrial by-products, such as sawdust or waste water from a brewery.

Peri-urban agriculture: potential and some issues

There is a large brewery, painted a brilliant white, where the Taquifa Canyon emerges from the Bolivian Andes, overlooking the Cochabamba Valley. It takes a lot of water to brew beer, and this brewery disgorges its waste water into an irrigation network, used by the community of Central Taquifa, a former village, that has been swallowed by the city of Cochabamba. Draining waste water into the irrigation system is not a case of corporate abuse, but is an arrangement reached with the community. The brewery could just as easily dump the water onto the river bed.

Peasant communities that depend on irrigation water organise themselves to use it, with various ways of naming officers, timing the turns, and cleaning out the canal every year or so (Trounson, 2001; Lansing, 1987). This community of irrigators is no different, except that the source of their water is the tail end of a brewery. Some days their irrigation water runs soapy, if the brewery is washing its tanks. On other days, the water is filled with the spent grains of barley, or it is sweet with molasses; sometimes the water is as clear and clean as a trout stream, and at others the water looks and smells like beer, and even has a good head on it.

The farmers who use this water wait patiently for their turn to come, and then divert the water, no matter what it looks like on that day, onto their tiny, stony fields, high on the alluvial fan over the valley bottom. In a semi-arid area like this, land with abundant water can be valuable, even if the soils are rocky. These particular fields are not only stony, but they are also small: just slivers between the houses of a community which is rapidly becoming a neighbourhood of the city. Over the years, the villagers made room for many outsiders, including miners, who came down to Cochabamba when the tin mines closed. More recently, city people have moved in, attracted by the small green spaces and plentiful water.

The fields themselves are strange and beautiful; nearly all of them are planted in carnations and other flowers (Figure 1). The farmers harvest their flowers in the afternoon, after the hot part of the day is over. They tie the flowers into bunches which are bound into large bundles, almost too heavy to lift, and wrap them in plastic burlap bags.

Before dawn, two of the city bus lines reach the cobblestone streets of Central Taquifa. The flower farmers load their bundles onto the roof of the bus, take a seat inside, and take the flowers to the wholesale market of the city centre. By noon, the flowers are being placed on graves, in vases on the dining room table and are on their way to brighten someone’s hospital room. The flowers are not food, but then neither are they part of the global trade in export commodities. The flowers simply help to give meaning to life in the city.

Although I am an anthropologist, for years I missed the importance of these flower growers. I thought they were an eccentric remnant. But I was wrong. The flower growers on the edge of the city are peri-urban farmers, and they share a way of life that is becoming more important in today’s world.

In this article, I argue that peri-urban agriculture is qualitatively different from rural agriculture. Peri-urban agriculture is not dysfunctional farming, poorly transplanted to town. Peri-urban farming must adapt to scarce land. But peri-urban agriculture also enjoys unique resources, such as low transportation costs and privileged access to markets which allow peri-urban farmers to produce and sell valuable, fragile products. Peri-urban agriculture has access to unusual resources like organic wastes (sometimes bizarre ones such as water that smells like beer). Peri-urban agriculture also depends on unusual skills.
Land

Many cities today, like Cochabamba, evolved from farming communities that were built on the world’s finest farmland. As these cities expand, they leave some small plots within the city that can be gardened. The expanding cities also grow closer to peasant villages, and sometimes swallow them, amoeba-like. These farmers become peri-urban without ever migrating to the city. The city has come to them.

Kumasi is a fairly large city in central Ghana. With 1.2 million people, Kumasi has an airport, is the capital of the Ashanti Region, and a centre for cacao production. The city is also expanding onto the farm land around it. In 2014 I visited a farmers’ group with the unforgettable name of the Peace and Love Farmers’ Association. They had an extension agent who visited them regularly, another advantage of being close to town. Peace and Love had a contiguous block of land, divided into individual gardens which looked much like those of the African countryside; neatly arranged into raised beds, covered with cabbage, lettuce and onions, with papaya and bananas growing here and there. Men and women were hauling water by hand from a well and watering their seedlings with watering cans. The Peace and Love farmers were obviously taking good care of their land, and getting high yields of vegetables to sell in the city. New houses were being built on all sides of the large garden, as the city of Kumasi engulfed the farmers.

Peace and Love had a small shed where they kept some tools. They proudly showed me some of the papers that acknowledged the group’s existence, and certificates from training courses they had attended. But by far the most unusual thing about Peace and Love was the brick wall they were building around their land. They had the same kinds of problems that farmers often mention, such as too many pests, not enough credit, and fickle markets; but they were also worried that the city people would take their land away from them. Walls are expensive, and this one was unfinished, but it showed that Peace and Love was willing to invest, to assert its ownership. Government policy that protected farmers would allow them to invest their money in productive agriculture, or their children’s education.

Markets

As towns grow, they develop consumers. I have talked to farmers in Guatemala who are finding that, for the first time, they can load a pickup truck with tomatoes, and sell them in the local municipal town. They no longer have to sell in the big city. Or women living in small towns raise chickens to sell directly to their neighbours.

Low transportation costs mean that, like the flower farmers in Cochabamba, mushroom growers on the outskirts of Nairobi can also travel to the city, sell their mushrooms, and return home the same day. Paul Van Mele describes how the Muhia family raises mushrooms as their main business. They are young and well educated but gave up jobs in the city to become peri-urban mushroom farmers (Van Mele, 2014). Tending mushrooms is quite exciting; the family could lose their whole crop if they got the humidity wrong, let too much light enter the shed, or allowed other fungus to contaminate the corn cobs where the mushrooms grow. The nearby city is an opportunity to sell fancy oyster mushrooms to upscale restaurants and shops. Because the city is so close, the mushrooms arrive fresh. And the mushrooms need very little land, just a small shed, so they are a perfect crop for growing in or near a city.

Unlike rural agriculture, the peri-urban farmers can sell all of their produce and buy food with it, just like salaried people in the city. Rural farmers often live in places with such poor consumer markets that households must grow their own food commodities, even if they produce a cash crop.

Unique resources

Cities also have unique resources such as brewery water, and organic wastes from the city market, which can be composted or fed to animals. Cities also have specialised input shops, where peri-urban farmers can buy mushroom spores (‘seed’), or yoghurt culture or jars and other containers for selling products. In Entebbe, Uganda, I met farmers who bought wood shavings from city carpentry shops to use as bedding for pigs. Entebbe is a rapidly urbanising community near the capital city, Kampala. Uganda’s international airport is also in Entebbe. The little country lanes of Entebbe are rapidly filling up with houses.

In Entebbe, we met Noola Nalongo and her son Waswa who were raising pigs in a densely populated neighbourhood. The pigs were living in neat wooden pens, right next to the family home, on a plot of land no larger than a suburban garden. Mother and son tended their pigs together. They were able to feed them with vegetable scraps that they got from the many peri-urban gardeners around them. They made the pigs comfortable beds of wood shavings, which they got from the cabinet-making shops along the nearby Entebbe-Kampala highway. The wood shavings are another example of an eccentric input, which is more readily available in cities than in the deep countryside. Like the Peace and Love Association of Ghana, this household also had access to extension advice, so they had learned about micro-organisms which they applied to the wood shavings. The micro-organisms turned the pig faeces and wood shavings into a soft, odourless material, which looked and felt like soil on the forest floor. The neighbouring vegetable farmers eagerly bought this manure as organic fertiliser, whenever the family cleaned out the pig pens (Bentley, 2014).

The skills

Peri-urban farmers may live in villages that are being engulfed by the city, or the farmers may be country people who have migrated to the city, bringing their work ethics and farm skills with them. Peri-urban farms are closer to extensionists and other sources of technical ideas. Yet, as we saw with the pigs of Entebbe, farming in or near a city demands new skills. Few country dwellers have to learn to raise sweet-smelling pigs. These skills can be learned by research and shared by extension, as long as research and extension see that peri-urban farming is a unique space, with its own needs.

Some organisations do realise the importance of serving city
farmers with new ideas. The international NGO Access Agriculture realises the importance of peri-urban agriculture (as well as rural agriculture). Access Agriculture provides videos, for free, on topics of interest to peri-urban farmers, like growing African snails, grass cutters, rabbits, chickens, mushrooms, vegetables and other high-value horticultural crops (Access Agriculture, 2015).

Conclusions

Peri-urban agriculture makes intensive use of small pieces of land, and generates dignified, profitable employment by taking advantage of people’s intelligence and creativity. Often, peri-urban farmers are able to acquire new skills that allow them to start new enterprises to provide city markets with perishable, high-value products, while saving on transportation costs. The main inputs of peri-urban farming are labour and information, but this modern type of agriculture often relies on quirky inputs, like the waste from urban industries and recycles them instead of turning them into a waste disposal problem.

References


Bookstack

Growing greener cities in Africa: first status report on urban and peri-urban horticulture in Africa
FAO, 2012
Available to download at:

The inexorable move towards urbanisation in Africa continues unchecked. By 2030, the urban population of sub-Saharan Africa (SSA) is expected to reach 600 million, twice the 2010 level. The aim of this report is to help African policy makers to steer urbanisation from its current, unsustainable, path towards healthy ‘greener’ cities that ensure food and nutrition security, decent work and income, and a clean environment for all the citizens. Production of fruit and vegetables in and around urban areas has a clear comparative advantage over rural and other sources in supplying urban residents with fresh, nutritious - but highly perishable - produce all year round. It generates local employment, reduces food transport costs and pollution, creates urban greenbelts and recycles urban waste as a productive resource.

This FAO report gives an overview of urban and peri-urban horticulture (UPH) based on surveys and case studies from 31 African countries (22 of which, from Algeria to Zambia, are detailed in the publication). The issues arising from increased urbanisation include: rising urban poverty (estimated at up to 70 percent); urban malnutrition (the main cause is poverty since the poor spend most of their income on food and so food price rises have an immediate effect); disease and ill-health (resulting from densely populated and poorly serviced slums); low and insecure incomes (informal employment is the norm for urban workers); and climate change (resulting in rising temperatures, shrinking water tables, flooding and mudslides).

FAO’s UPH programme for year-round supply of fresh produce, aims to provide five major benefits: food and nutrition security (by boosting the physical supply of fresh produce); sustainable livelihoods (labour-intensive market gardening creates employment directly); a safe, clean environment (by recycling urban waste and creating green belts); healthy communities; and good governance (by including UPH in urban development plans).

Research in SSA identified two basic types of urban crop production: home gardening and market gardening. Home gardening is the most common and can account for over half of fruit and vegetable production in some cities. Community or group gardening provides vegetables for both growers and the wider community, whilst market gardening is irrigated commercial production. Urban and peri-urban market gardens may produce most of the leafy vegetables consumed in some cities and have the most potential for further development. However, there are critical aspects that require further support such as: access to land (to overcome a pervasive insecurity of tenure’); access to water (to reduce reliance on sewage water and encourage dry-season production); access to credit (eg for pumps and fencing); access to inputs (especially certified seed, fertiliser and approved pesticides); access to extension (especially for integrated pest management skills); and access to processing and markets (almost all produce is highly perishable and sold fresh).

FAO has four recommendations for the way forward in the sustainable development of UPH: 1) Provision of political and institutional support (this would normally
be through the Ministry of Agriculture and would provide extension, fund research and regulate the quality of inputs); ii) Integrate UPH into urban planning, especially through reform of land tenure systems and urban water management; iii) Increase production and improve the quality of produce while optimising the use of water and reducing reliance on agro-chemicals (through composting, rainwater harvesting and bio-pesticides as measures to boost yields and nurture agro-ecosystems); and iv) Build an efficient horticulture supply system. The starting point would be to strengthen market gardeners’ organisations via recognised cooperatives and planning for markets and cold storage. The aim is to ensure a year-round supply of fresh produce that meets the dietary needs of urban populations at a price all residents can afford. In achieving this, policy makers will be investing in the future nutrition and health of their citizenry.

Brian Sims

Growing greener cities in Latin America and the Caribbean: a report on urban and peri-urban agriculture in the region

FAO, 2014.
Available to download at: http://www.fao.org/3/a-i3696e.pdf

This is the quite remarkable story about how urban and peri-urban agriculture (UPA) have been able to transform cities and livelihoods in the Latin American and Caribbean region. By means of a comprehensive overview and detailed, sumptuously illustrated, profiles of UPA in 10 cities (Havana, Mexico City, Antigua and Barbuda, Tegucigalpa, Managua, Quito, Lima, El Alto, Belo Horizonte and Rosario), the report gives an authoritative and readable account of the development, impact and potential of UPA.

Since 2009, the urban population of the region has increased by 50 million to 500 million and is now the most urbanised region in the world, with 80 percent of people living in towns and cities. Generally, urban poverty rates remain unacceptably high. The UN Human Settlements Programme (UN-HABITAT) estimates that the process of urbanisation is ‘virtually complete’ in all countries and the region now needs to create urban centres that are environmentally sustainable, promote social inclusion, favour local employment and reaffirm the vital importance of public spaces. A starting point for such a transformation is UPA. As well as providing the urban poor with nutritious food and extra income, UPA has become a key part of strategies for reducing cities’ ecological footprint, recycling urban wastes, containing urban sprawl, protecting biodiversity, building resilience to climate change, stimulating regional economies, and reducing dependency on the global food market.

Urban agriculture encompasses a wide range of activities suited to small spaces, from backyard vegetable gardening to intensive production of flowers and raising small animals for eggs and meat. School gardens and backyard family horticulture are the dominant forms of urban food production. Most urban farmers are from low-income households and they take up farming as a means of reducing their spend on food and making extra income from sales. The main benefit is, however, improved access to food. Urban food producers and their families enjoy a more diverse diet than other urban dwellers and are more likely to consume fruit and vegetables regularly.

The main challenge facing farmers in the cities is a lack of space, followed by poor quality soils and unreliable water supplies. For commercially-oriented growers, the main constraints are lack of quality seed and the unavailability of credit for buying tools and processing equipment. In city region food systems, UPA is critical to the supply of food to urban centres. Peri-urban agriculture includes large farming areas that produce cereals, vegetables and root crops, grazing for goats and sheep, dairy farms and intensive livestock production units. For example, some 22,800 ha of farmland within the bounds of Mexico City produce 15,000 tonnes of vegetables a year. Despite its role in creating employment and feeding cities, peri-urban agriculture is under increasing pressure from urbanisation itself.

Growing greener cities with agriculture needs the support of government from national to local levels. Twelve of the 23 countries surveyed for the report have national policies explicitly promoting UPA. Cuba’s policy dates back to 1997, and in Brazil UPA is part of the Zero Hunger policy. But the real test of political and institutional commitment must be at the city level: in Brazil’s Belo Horizonte, the urban agriculture support policy recognises UPA as contributing to “the full development of the social function of the city”. A strong trend in many UPA programmes is toward agricultural technologies and practices that produce more, and better-quality food while optimising the use of natural resources and reducing reliance on agro-chemicals. To realise UPA’s full potential, producers need access to markets and technologies to add value to their produce.

The city region food system offers a point of convergence for achieving several of the new UN Sustainable Development Goals which include eradicating hunger and poverty; increasing agricultural production sustainably; improving food systems; and building sustainable cities that provide food security, economic opportunity and a healthy environment.

Brian Sims

This changes everything: capitalism vs the climate

Naomi Klein, 2015

Penguin Random House UK
Paperback, 566 pages, £8.99

This is a profoundly thought-provoking book and is, as some earlier reviewer has it, of such ambition and consequence [as to be] almost unreviewable. But I’ll do my best.

The book is an analysis of the causes and horrendous consequences of climate change and what needs to be done, now, to wean the world off fossil fuels in an attempt to rein-in the impact that the greenhouse
gases (GHGs) already in our polluted atmosphere will have. In short it may still be possible to restrict global temperature rise by 2°C to 2.5°C, but it is looking increasingly unlikely.

We are, in Klein’s view, living in a world where we are refusing to recognise the reality of climate change and are continuing to increase the emission of GHGs that are causing the problem in the first place. ‘Cognitive dissonance’ she calls it. There are ways of preventing the catastrophe that awaits us, but the catch is that this involves changing everything. We must go well beyond the grim UN language of ‘mitigation’ and ‘adaptation’. What we need is a coherent narrative on how to protect humanity (and the myriad other species that we are taking down with us) from the ravages of both a savagely unjust economic model and a destabilised climate system. What the climate requires to avoid collapse is a contraction in humanity’s use of natural resources; what capitalism demands to avoid collapse is unfettered expansion. How often do we hear the clarion call for ‘greater economic growth’? The truth is that only one of these sets of rules can be changed; and it’s not the laws of Nature.

Klein mounts a vitriolic attack on the Heartland Institute’s climate change deniers who ask of the ‘warmists’; ‘to what extent is the entire movement a green Trojan horse whose belly is full of Marxist socio-economic doctrine?’ Heartland does not publish the names of its donors - but ExxonMobil and other fossil fuel interests are certainly among them (see the review of the Institute’s Climate change reconsidered II in AGHDev22, p23 - Editor).

Other recipients of Klein’s penetrating analyses include (amongst many others): the World Trade Organisation; regional free trade agreements; the Alberta tar sands; TransCanada’s Keystone XL pipeline; BP’s Deepwater Horizon disaster; and fracking. She is adamant in obliging polluters to pay for the damage that they have caused to our planetary climate systems. She has time for climate-smart agriculture with its greatly reduced energy requirements and natural resource conservation. Extractivism, she avers, is a non-reciprocal dominance-based relationship with the earth, one of purely taking. It is the opposite of stewardship, which involves taking but also taking care that regeneration and future life continue.

The idea that geo-engineering is going to be the cavalry riding over the brow of the hill in the nick of time is discussed and dismissed. Dimming the sun is not the answer; tackling the underlying causes of global warming is the response to the crisis caused by our pollution cannot be to add more pollution. As Klein puts it, trying to fix the crud in our lower atmosphere by pumping a different kind of crud into the stratosphere, is not a clever response.

The book spends time on explaining the value of transnational popular protest to counter the continuing rape of our planet. The tragedy of the Ogoni people in the Niger Delta, the Rainforest Chernobyl in Ecuador and multiple instances of resistance to exploitation and pollution by Big Oil in the US, amongst many other examples, are all recounted in some detail - even our Balcombe anti-fracking protesters in West Sussex get a mention. “Can we live without water?” ask anti-fracking farmers in Romania. “No!” is the ringing response. “Can we live without Chevron?”; “Yes!”.

This book sets the stage for the crucial UN Climate Talks in December 2015. If the participating countries cannot agree to commit themselves to serious emissions cuts then we are in for an ever hotter future - even worse than what we must now expect from the pollution already incurred. This will require investment in green, low-carbon, energy production, rather than continuing to pump billions of dollars into fossil fuel extraction and unsafe pipelines to transport the lethal product.

Brian Sims

Nutrient value of human waste to plants

John Mullett and Lynn McGoff

Dr John Mullett is a founding director of Sustainable OneWorld Technologies CIC (SOWTech) designing waste management systems for the Global South to provide fertiliser to return nutrients and organic matter to land and to produce biogas for cooking as a replacement for wood fuel. He has over 30 years of international experience of organic waste management.

Lynn McGoff is a founding director of Sustainable OneWorld Technologies CIC. With a degree in Agricultural Botany, she has over 10 years’ experience in organic waste management having previously worked in analytical laboratories and as a Technical Editor at the Royal Society of Chemistry.

Summary

Human sewage can be an important source of macro-nutrients for plants. In the UK, over 100,000 hectares of agricultural land are beneficially treated with sewage sludge per year. However, in many countries in the Global South, this waste is not captured and used, depriving the land of a sustainable source of nutrients for plant growth. Using Sierra Leone in West Africa as an exemplar country, this paper details the calculations and assumptions made to quantify the main plant nutrients that can be potentially found in the biofertiliser produced by treating human waste in an anaerobic digestion system such as the Flexigester® system (Sustainable OneWorld Technologies CIC).
Introduction

One method of producing biofertiliser is from the anaerobic digestion (AD) of organic material. This paper deals specifically with human waste collected from pour-flush toilets. The use of human waste as a fertiliser for fields is not a new idea. The sludge from sewage treatment works has been used to fertilise agricultural land in the UK for decades. In 2007 in the UK, over 100,000 hectares of agricultural land was treated with sewage sludge (DEFRA website). By contrast, in the Global South, human sewage is seldom collected and rarely used as fertiliser.

The calculations presented here are for the three primary nutrients required by plants. It is acknowledged that these nutrients alone are not sufficient for healthy plant growth and that there are many other factors which affect growth and health of the crop, including water availability, seed variety, pests and disease. Plants also require additional secondary nutrients (e.g. sulphur, magnesium and calcium) and a number of other micro-nutrients, as well as carbon, hydrogen and oxygen for growth. Human waste contains micro-nutrients, but they are not considered here as there is limited published quantifiable data of their presence in sewage.

SOWTech are involved with projects for the collection and treatment of sewage in Sierra Leone, which have been chosen to illustrate the potential of sewage as a form of biofertiliser.

The scale of the potential in Sierra Leone

The human digestive system requires waste products to be removed from the body in the form of urine and faeces. In an ideal world, all of this waste would be collected and treated. The population of Sierra Leone, as estimated by the World Bank (World Bank website), is over 6 million people. This equates to around 3.3 million tonnes of sewage per year. At the present time, it is unrealistic to use these figures due to the problems associated with the collecting of such waste. This article focuses on three case study examples of the potential benefits of such waste from the Flexigester projects in Sierra Leone. They include: Freetown, the country’s capital; Bombali District, a rice growing area; and Makeni, the capital town of Bombali and close to a rice mill.

The populations of these areas are given in Table 1 below. Assumptions, based on the best available field data, have been made as to the amount of waste produced per person per day and the amount of macro-nutrients in such waste. Details of these assumptions are given later in this article. The amount of macro-nutrients that could be recovered if the sewage was collected from various percentages of the population are given in Table 2.

Table 1. Population statistics for areas of Sierra Leone

<table>
<thead>
<tr>
<th>Population of Sierra Leone</th>
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<tbody>
<tr>
<td>Population of Makeni</td>
<td>112,000</td>
</tr>
<tr>
<td>Population of Bombali District</td>
<td>440,000</td>
</tr>
<tr>
<td>Population of Freetown</td>
<td>773,000</td>
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</tbody>
</table>

Table 2. Potential nutrients available in t/year from exemplary areas of Sierra Leone from the sewage output from different percentages of the populations in those areas

<table>
<thead>
<tr>
<th>Percentage of population</th>
<th>tN/yr</th>
<th>tP/yr</th>
<th>tK/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>From Makeni</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25%</td>
<td>128</td>
<td>15</td>
<td>36</td>
</tr>
<tr>
<td>50%</td>
<td>256</td>
<td>31</td>
<td>72</td>
</tr>
<tr>
<td>75%</td>
<td>383</td>
<td>46</td>
<td>107</td>
</tr>
<tr>
<td>100%</td>
<td>511</td>
<td>61</td>
<td>143</td>
</tr>
<tr>
<td>From Bombali district</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25%</td>
<td>502</td>
<td>60</td>
<td>141</td>
</tr>
<tr>
<td>50%</td>
<td>1004</td>
<td>120</td>
<td>281</td>
</tr>
<tr>
<td>75%</td>
<td>1506</td>
<td>181</td>
<td>42</td>
</tr>
<tr>
<td>100%</td>
<td>2008</td>
<td>241</td>
<td>562</td>
</tr>
<tr>
<td>From Freetown</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25%</td>
<td>882</td>
<td>106</td>
<td>247</td>
</tr>
<tr>
<td>50%</td>
<td>1763</td>
<td>212</td>
<td>494</td>
</tr>
<tr>
<td>75%</td>
<td>2645</td>
<td>317</td>
<td>741</td>
</tr>
<tr>
<td>100%</td>
<td>3527</td>
<td>423</td>
<td>988</td>
</tr>
</tbody>
</table>
As can be seen from Table 2, the quantity of plant nutrients (fertiliser) that could be recovered from human sewage in Sierra Leone is large enough to be significant. For example, the total quantity of nitrogen could be as much as 500 tonnes per year for the Makoni district, from a population of 112,000. However, it would clearly be difficult to achieve 100 percent ‘capture, treatment and reuse’ of the sewage. So, for example, if only 50 percent of the sewage was included, this would still capture over 250 t/yr of N. Table 2 illustrates what plant nutrients would be captured for varying levels of sewage capture.

The potential financial value of human waste as fertiliser has been documented in a paper by the Norwegian NGO, GRID-Arendal (Caldwell & Rosemarin, 2008), part of the United Nations Environment Programme. Mauritania was used as an example of the financial value of fertiliser in sewage. The paper states “In Mauritania, which has a population of about 3 million, the excreta from the entire population is worth annually about EUR 25 million for the equivalent amount of chemical fertilizer”.

**Nutrients in human waste**

The volume of sewage produced per person per day varies according to diet, but figures quoted in literature for Africa range from 69 to over 500 g faeces, and around 1.2 litres of urine per person per day (Aalbers, 1999; Caldwell & Rosemarin, 2008; Stanwell-Smith, 2002).

Equally, the amounts of nutrients in that sewage vary according to diet, but an illustration of the amounts that could be expected are given below (Caldwell & Rosemarin, 2008; Esrey, 2001; Timmer & Visker, 1998).

In order to extrapolate these data to a population, it is necessary to assume a single set of figures for waste arisings. The data sources show a wide range of faeces arising: 69 - 520 g/person/day. For the purpose of this article, a mid-range

<table>
<thead>
<tr>
<th>N (g/p/d)</th>
<th>P₂O₅ (g/p/d)</th>
<th>K₂O (g/p/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine</td>
<td>11.0</td>
<td>15-19</td>
</tr>
<tr>
<td>Faeces</td>
<td>1.5</td>
<td>5-7</td>
</tr>
<tr>
<td>Urine + Faeces</td>
<td>10.9</td>
<td>12.5</td>
</tr>
</tbody>
</table>

Table 4. Quantity of macro-nutrients excreted per person per year

<table>
<thead>
<tr>
<th>Amount of waste production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faeces</td>
</tr>
<tr>
<td>Urine</td>
</tr>
<tr>
<td>Faeces + Urine</td>
</tr>
<tr>
<td>Therefore in one year each person will produce</td>
</tr>
<tr>
<td>Faeces + Urine containing</td>
</tr>
<tr>
<td>4.6 kg N</td>
</tr>
<tr>
<td>0.5 kg P</td>
</tr>
<tr>
<td>1.3 kg K</td>
</tr>
</tbody>
</table>

Table 5. Macro-nutrients captured annually by a Flexigester V10 from human waste from 50 persons

<table>
<thead>
<tr>
<th>A Flexigester V10 will therefore output:</th>
</tr>
</thead>
<tbody>
<tr>
<td>228 kg of N/year</td>
</tr>
<tr>
<td>27 kg of P/year</td>
</tr>
<tr>
<td>64 kg of K/year</td>
</tr>
<tr>
<td>% nutrient value in digestate</td>
</tr>
<tr>
<td>0.31% N</td>
</tr>
<tr>
<td>0.04% P₂O₅</td>
</tr>
<tr>
<td>0.09% K₂O</td>
</tr>
</tbody>
</table>
assumption of 300 g/p/day has been used. The figure for urine generation is consistent between data sources, so a figure of 1.2 l/p/day (equivalent to 1.2 kg/p/d) has been used. The figures used in the per capita calculations are therefore summarised in Table 4.

These figures are in close agreement with those published by Caldwell & Rosemarin (2008) which state that “Humans produce roughly 500 litres of urine and 50 litres of faeces per person per year. These contain about 4 kg of nitrogen, 0.5 kg of phosphorous and 1 kg of potassium”.

Treating sewage by anaerobic digestion in a Flexigester

The process of anaerobic digestion (AD) will decompose sewage and render it suitable for reuse as a fertiliser. The Flexigester V10 (Sustainable OneWorld Technologies CIC) is an example of a modest scale AD system, designed to be connected to pour-flush toilets and capture all waste from those toilets. Water at approximately 2.5 l/day is needed to flush the waste away from the toilet. Although, this can be grey water, (including from cooking etc) and will contain additional nutrients, clean water has been used for the following calculations. So the total input to the Flexigester will be 1.5 kg of excrement and 2.5 kg of flush water, making a total of 4 kg input per person per day.

The breakdown of sewage in a digester requires time, which is dependent on factors such as temperature. A Flexigester V10, with a nominal capacity of 10 m³ (10,000 kg of waste), being used by 50 people each day in a subtropical climate without additional heating, would have an annual input of 73,000 kg of waste, including flush water, and a retention time of around 50 days for the waste.

During the process of anaerobic digestion, biogas is produced and removed, but this has an insignificant effect on the volume of material in the digester or the annual output of 73,000 kg of digestate or biofertiliser, which is equivalent to the input. Table 5 shows the nutrient content of this biofertiliser captured and recycled in a year for a Flexigester V10 system treating waste from 50 persons.

How the process of AD affects the capture and form of plant nutrients

Sewage left untreated and exposed will lose nitrogen due to the loss of volatile ammonia, however, the gas tight Flexigester means that all the potential nitrogen is captured, although the form of nitrogen changes during the AD process. In fresh excreta, 75 percent of the nitrogen is in the form of organic macromolecules and 25 percent as available ammonium compounds. During anaerobic digestion, the organic macromolecules are broken down to give more ammoniacal nitrogen, which can be readily used by the plants (Vögeli et al, 2014).

The plant-available form of phosphate (P2O5) is around 50 percent of the total phosphorus content and it is not adversely affected through losses or conversion by the AD process (Vögeli et al, 2014). Plant-available potassium (K2O) is also unaffected by anaerobic digestion. It is estimated that 75-100 percent of the total potassium would be available to plants (Vögeli et al, 2014).

Discussion and Conclusion

Human waste can be a rich source of macro-nutrients for plant growth. However, it should be noted that around 70 percent of the nutrients are found in the urine fraction compared to faeces. For the highest levels of nutrient recovery, the use of latrines is important to capture as much as possible of urine produced.

This paper illustrates the significant scope of the potential for sewage-derived fertiliser, but the figures quoted can only be indicative due to the variability of the source data. Nevertheless, reference to third party assessments show our projections are in line with other similar studies. The AD process can be a key tool in the capture, treatment and reuse of human sewage making it possible to utilise the fertiliser potential of this abundant and under-utilised resource. The Flexigester system is one example of how this can be achieved in hot low-income countries.

References


The Global Food Security Programme: synthesising knowledge to enhance food and feed security

The challenges of global food security

About 1 billion people do not have adequate food to meet their basic nutritional needs (WHO, 2015); yet almost 2 billion people are overweight, including 600 million who are obese. Poor diet has been linked to 21 percent of global deaths (IHM, undated) contributing to almost 50 percent of coronary heart disease deaths in the early 21st century (Mwatsama & Stewart, 2005). Globally sufficient calories are produced to feed the current population, but access to a safe, sufficient and nutritious diet is unbalanced around the world. The global population is expected to grow, from about 7 billion (late 2013) to more than 9 billion by mid-century, so the potential for the food security crisis to deepen seems but a formality. The Food and Agriculture Organization (FAO) has predicted that demand for food will grow by 38 percent by 2030 and by 60 percent by 2050 (Alexandratos & Bruinsma, 2012).

The challenge therefore is to meet the rising demand for food in ways that are environmentally, socially and economically sustainable; in the face of evolving world-wide markets, distribution mechanisms and global climate, leading to an acceptable, safe and nutritious diet for all (GFS, 2013). Socio-economic, environmental and political drivers contribute to uncertainty in global food security, and the Global Food Security (GFS) programme recognises that these drivers create important challenges moving forward. For example, how do we produce more food whilst using less land, water, fertilisers and energy? How do we reduce losses and waste? How can we minimise the effects of instability in the global food system that leads to food price spikes, hunger, economic and political instability? How do we help people to choose a sustainable healthy diet?

The Global Food Security Programme

The GFS programme has three themes. ‘Resilience’ examines how poor environmental and economic resilience leads to hunger, poverty and environmental degradation across the globe and how this can be addressed. ‘Sustainable production and supply’ focuses on the sustainable use of resources - improving efficiency, reducing waste and food production from crops and animals. ‘Nutrition, health and wellbeing’ examines food safety and quality throughout the supply chain, nutrition, healthy and sustainable diets, and understanding consumer behaviour. The GFS programme, located in Polaris House, Swindon, is jointly developed, designed and implemented by the UK’s main public sector funders of food-related research and training; collectively the partners in the programme spend around £350 million per year on food related research. Our partners and affiliates include Research Councils, UK government departments and agencies, and the devolved administrations. GFS takes an interdisciplinary and systems approach to the challenge of food security - a diagram of the food system is provided in Figure 1.

The Insects as Animal Feed workshop

FAO has reported that meat production already accounts for 18 percent of the 36 billion tons of CO₂-equivalent greenhouse gases the world produces every year, and it takes 33 percent of all the arable land to produce enough feed for livestock. At the same time, the rapidly expanding aquaculture industry is competing for feed inputs with other livestock - particularly the demand for fish meal, which if we carry on as we are, is likely to outstrip supply very soon. Consequently, there is an intrinsic need for partial replacements for traditional animal feeds such as soya bean, fish meal, and other processed animal protein.

The Global Food Security programme held a workshop on 7 August 2015, which brought together academics, industrialists and policy-makers to identify knowledge gaps and to scope the priorities for research around the use of insects as an alternative animal feed. Its purpose was to explore and highlight any possible issues associated with rearing insects on an industrial scale, for example the safety of insect protein in feed (allergens, zoonoses etc), consumer acceptability and economic viability. An indicative public survey indicated that nutritional information on product packaging was a key driver influencing consumer purchasing choices, followed by ‘natural/organic’ labelling and environmental impact.

At the workshop, Dr Elaine Fitches introduced participants to the research carried out by PROteINSECT - an EU funded
project examining the use of insects as a sustainable source of protein for animal feed. The project is investigating housefly larvae as an alternative to high quality fish meal, which is used in traditional feeds. The project found that fly larvae are rich in protein, with an amino acid composition comparable to that of fish meal. Farming insects as opposed to soy, for animal feed could result in a 200 fold-reduction in land-use for the equivalent yield of protein. The average yield of protein from crops (eg soy) is equivalent to 2.5 t/ha per year, whereas non-optimised fly larvae can potentially produce 25 t/ha every 8-10 days! Insect meal is a source of high quality protein with the potential to supplement the protein requirement for monogastric livestock. PROteINSECT, the Which? Government Office for Science Food System Challenges, and other projects have indicated that the public are, overall, supportive towards the use of insect meal as an alternative animal feed, but that they would like more information.

The GFS programme will now consider the report’s findings in the context of wider GFS partner investments in the general area of sustainable protein production.

References


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Website: http://www.foodsecurity.ac.uk/

Experiences of the Programme of Urban Agriculture in the city of Pinar del Río, Cuba

Ledy Díaz González and Raymundo Vento Tielves

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Dr Raymundo Vento Tielves is Professor of Agricultural Sciences at the University ‘Hermanos Saiz Montes de Oca’, Pinar del Río, Cuba. His work experience includes sustainable and family agriculture, rural extension and agricultural mechanisation. He has worked with the National Institute of Agricultural, Forest and Livestock Research (INIFAP) in Mexico, and taught at the Faculty of Agrarian Sciences of the University José Eduardo Dos Santos, Huambo, Angola. (tielv@upr.edu.cu)

Summary

In the decade of the 1990s, Cuba was obliged to carry out urgent transformations of its patterns of agricultural production. The widespread model of industrial agriculture was converted to small-scale, almost subsistence, production due to the abrupt collapse in the supply of agricultural inputs caused by the disintegration of the Soviet Union and the collapse of the socialist bloc in eastern Europe. As part of that transformation, a strong agricultural movement was developed in the cities and other urban areas, known as urban agriculture (UA). This model of agricultural production had (and still has) the goal of guaranteeing the production of fresh food items which were easily accessible by the urban population. This paper shows how the UA programme evolved and how it was consolidated in the city and municipality of Pinar del Río as a means to ensure food security for its citizens and to promote the move to sustainable food production intensification.

Introduction

To understand the emergence and development of Urban Agriculture in Cuba, it is useful to understand the process of evolution of agriculture on the island. There have been four significant periods, differentiated as follows:

First: Up to 1959 agricultural production was characterised by sugar grown practically as a monoculture, with some important commercial production of tobacco. There was
limited development of technology, and it is reported that the sector only had 9,000 low-powered tractors.

**Second:** After the Cuban Revolution in 1959, there was an urgent need to increase agricultural production to better feed the country’s population. The country decided on the path of industrialised agriculture. So, with the help of other socialist countries, and inspired by the success of the Green Revolution, the number of tractors was increased significantly, reaching figures of over 90,000 (with a range of power) by the decade of the 1980s. With the associated agricultural implements and combine harvesters, crops were completely mechanised and reached levels of sophistication on a par with those in first world countries. It also allowed expansion of the cultivated area, an increase in the diversity of crops produced, widespread use of fertilisers and irrigation, genetic improvement of crops and animals, and an intensive use of agrochemicals. All this, of course, energy intensive and required the use of huge volumes of fuel.

**Third:** In the 1990s, with the collapse of the USSR and the socialist bloc in Europe and the disappearance of the Council for Mutual Economic Assistance (CAME or COMECON), Cuba was suddenly left without access to the inputs necessary to sustain the high technological level of its agro-industrial agricultural model. At the same time, of course, the sector lost the negative impacts of the system, including the economic, energy, environmental, social and cultural impacts faced by intensive agricultural systems throughout the world. Cuba was faced with the choice of transforming its agricultural production model or perish.

**Fourth:** From the end of the 1990s to the first decades of the 21st century was a period of transition for Cuban agriculture. The trend was now toward more sustainable models of agro-ecological production and the development of the programmes of urban and peri-urban agriculture. Family farming was invigorated and production was more environmentally friendly. This is not to say that high technology production options were not pursued in specific sectors, if that was deemed appropriate.

This is the context for the transformation of Cuban agriculture, which now has the prime objective of advancing further towards sustainable agricultural options which support the economic development of the country. Over the past few years in Cuba, there has been a strong movement to develop agriculture in the cities and towns which has been denominated Urban Agriculture (UA).

UA of course refers to food production in an urban environment. Food crops are tended on roofs, backyards, in community orchards and in empty public spaces (ACTAF, 2001). The aim of the UA movement is to increase the production of diverse, fresh and healthy foods from available, previously unproductive, areas. Production is based on organic principles that do not contaminate the environment, on the rational use of the resources available at each location, and on direct sale to the consumer. This bold vision has demanded the development of a group of activities and structures to guarantee the stability of the novel productive system (Companioni et al, 2005).

In this paper, we describe the evolution and consolidation of the UA programme in the city of Pinar del Río as an alternative to guarantee the healthy nutrition of its citizens and as a stride towards achieving food security and an ecologically friendly agriculture.

### Urban Agriculture in Cuba: emergence and policies

According to Rodríguez (2014), the adoption of the Green Revolution model in the past has created a group of problems that now need to be confronted. These include:

- Seventy-six percent of the agricultural areas have low-productivity soils;
- Fifteen percent of soils are affected by salinity;
- Thirty-one percent of soils have low organic matter levels;
- There is an observable tendency towards reduced precipitation and increased temperatures. The difference between day-time and night-time temperatures is decreasing over time;
- The appearance of noxious organisms (such as phytophages, pathogens and exotic weeds) as a consequence of the biological warfare against Cuba, and climate change.

The agricultural transformation in Cuba in the 1990s has been widely considered as the biggest conversion to organic agriculture experienced in any country. To summarise, this process started as a result of the effects caused by the disintegration of the socialist economies of Eastern Europe and the Soviet Union with which Cuba maintained a barter relationship that allowed the country to develop its industrial agriculture sector. But the collapse of this relationship created a severe lack of the external inputs on which the previous agricultural production model had depended to a large degree (Funes-Monzote, 2001).

This situation forced Cuba to search for alternative forms of production and, in the 1990s, there was the spontaneous appearance amongst smallholders and cooperatives of fresh vegetable and fruit production in abandoned and fallow land in an attempt to compensate for the deficiencies of wider scale production. All this brought with it the beginnings of the use of the term ‘Urban Agriculture’, given that the production occurred within populated areas. UA constituted a popular movement for food production, with a strong base of sustainability in which the farmer is the principal actor in the whole production process, including the commercialisation of the produce (Gutiérrez, 2013).

In 1987, General Raúl Castro Ruz indicated the desirability of scaling out the organic UA units (known as organopónicos) in the country. This included the novel technologies for handling and recycling organic materials, and the investigative work being carried out by diverse research centres, resulting in the production of high quality vegetables affordable for the surrounding population. The concept of producing food in the cities and its peripheries gained pace in Cuba, starting from the disappearance of the trading agreements with socialist countries and the need to produce close to consumers, to cut transport costs, reduce the fuel import bill, and to create employment opportunities following the closure of many factories and facilities (Gutiérrez, 2013).
According to Funes-Monzote (2001), the National Programme of Urban Agriculture arose as part of the solution to the shortages of food for the urban population. The emergence was spontaneous, whereby any available plot became a place for the cultivation of crops and livestock production, both within cities and on their margins. Today, that popular movement is promoted in the National Programme of Urban Agriculture which, through its organised approach has achieved better results each year through the integration of the concepts of sustainable production intensification, the use of local materials and inputs, and the employment of the principles of organic production. The background for the development and institutionalisation of this production model lies in the fact that 75 percent of the Cuban population lives in cities and towns, which generates the ideal conditions for the development of this means of production. UA has put to work the many small areas of land that were previously not used for any useful purpose, and today they have become organopónicos (Figure 1), orchards and agricultural plots dedicated to humanity’s most important activity - food production (Rodríguez, 1994).

UA has its own characteristics that differentiate it from conventional extensive agriculture: for example, its diversity and the number of different social actors participating in its development. This allows a special type of agricultural extension where it is possible to innovate both management and agricultural models that can lead to greater levels of sustainability in each environment. It is participatory, popular agriculture in which the great heterogeneity of the conditions under which it has developed obliges producers to constantly adjust their techniques to create the best conditions for the crops and animals in production. Because of its geographical location and consumer group, it is low-input agriculture that does not permit the use of toxic agro-chemicals, is extremely economical in its use of water, and takes excellent care of soil fertility, animals and crops. For these reasons, UA receives priority treatment at the highest levels of the Ministry of the Agriculture and of the Cuban government.

The ease of exploitation of the UA units, and the yield increases resulting from perfecting the technology, have meant that it has developed in a short time to become a truly popular movement. Thus UA employs 160,000 people in Cuba from a wide variety of backgrounds, including labourers, bricklayers, mechanics, housewives, pensioners and professionals (López, 2000).

A priority for this form of agricultural production in urban environments is the population’s nutritional requirements, since starting from them, different crops can be developed. Priority has therefore been given to the cultivation of leafy vegetables and herbs. Leafy crops such as lettuce, beetroot, parsley, chives and others are not suited to long distance transportation as they quickly lose their quality. Organopónicos, on the other hand, can offer fresh, recently harvested produce and so gain the confidence and preference of the consumer, as a result of their superior quality when compared to transported products.

The implementation of the UA programme has developed the agricultural human resource, which generally has a high level

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**Table 1. UA sub-programmes in Cuba**

<table>
<thead>
<tr>
<th>1. Soil conservation</th>
<th>14. Oil crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Organic matter</td>
<td>15. Beans</td>
</tr>
<tr>
<td>4. Irrigation and drainage</td>
<td>17. Bees (Apiculture)</td>
</tr>
<tr>
<td>5. Vegetables and fresh herbs</td>
<td>18. Poultry</td>
</tr>
<tr>
<td>6. Medicinal plants and dry herbs</td>
<td>19. Rabbits</td>
</tr>
<tr>
<td>7. Ornamental plants and flowers</td>
<td>20. Sheep and goats</td>
</tr>
<tr>
<td>8. Fruit</td>
<td>21. Pigs</td>
</tr>
<tr>
<td>9. Covered (greenhouse) crops</td>
<td>22. Cattle</td>
</tr>
<tr>
<td>10. Rice</td>
<td>23. Fish farming</td>
</tr>
<tr>
<td>11. Forestry, coffee and cacao</td>
<td>24. Commercialisation</td>
</tr>
<tr>
<td>12. Plantain</td>
<td>25. Small-scale agro industry</td>
</tr>
</tbody>
</table>

Source: MINAGRI (2007)
of dynamism and innovation, to be channelled through the Municipal Urban Farms. These ‘farms’ are the organisational structure that comprise all the units of UA in a municipality and play a vital role in the execution of extension work, not only offering technical assistance but also forging a link between UA and the centres of research, teaching and services (Ojeda, 1999).

**Organisation of the Urban Agriculture Programme**

UA in Cuba is developed for sustainability by considering holistically the appropriate relationships between soil, plants, environment, animals and humans, taking advantage of the urban infrastructure and working to achieve waste recycling. The UA programme comprises 26 sub-programmes: 12 agricultural, 7 livestock and 7 of support (Rodríguez, 2003; Quintero et al, 2005). The 26 sub-programmes include vegetables, herbs, grains, medicinal plants, fruits and livestock rearing (poultry, rabbits, sheep, goats, pigs, bees and fish). The programmes are implemented in all the provinces and municipalities of the country, and the National Group of Urban Agriculture (GNAU) exists to facilitate their administration and coordination (Companioni et al, 2005). Table 1 indicates the UA sub-programmes. Each of the sub-programmes has its plan of action and established methodologies to guarantee (as far as possible) the achievement of the objectives of UA for food production and to provide food security for the population. The results of the programme contribute to the achievement of the minimum energy/protein consumption of 2,300 kcal/day and 62 grams of protein per person, of which 25 percent should be of animal origin (Companioni et al, 1997).

**UA experiences in the Pinar del Río**

Pinar del Río Province is the most westerly in the Cuban Republic, and its capital municipality, with the same name, is located in the central part of the province, bordered to the north by Viñales and Minas de Matahambre, to the south by the sea, to the east with the municipalities of San Juan y Martínez and San Luis, and to the west by Consolación del Sur. Pinar del Río municipality has an area of 489 km² and a population of 189,290 at a density of 388 citizen/km² (Rodríguez et al, 2005). According to Rodríguez et al (2005), UA is of great importance in the municipality, with 1,006 hectares employing 20,500 producers, which means that it provides employment to 11 percent of the population. UA in the municipality has 60 organopónicos covering 60 hectares (Figure 2), 43 intensive orchards on 35 ha, 1,681 agricultural plots with 854 ha, in addition to 1,422 gardens totalling 104 ha.

The forms of production systems within UA in the municipality include organopónicos; intensive orchards; hydroponics and zeponics (using enriched zeolite as a substrate); greenhouse crops; sub-urban farms; community orchards; areas of self-consumption of companies and organisations; besides production in gardens and allotments. Altogether, this goes a long way towards guaranteeing stable and ecologically-sensitive production intensification.

The network of sales points for the products of UA consists of three agricultural markets plus 51 fixed and 45 mobile sales outlets linked to the organopónicos. The yields of UA produce in Pinar del Río are already good and still have much unrealised potential, as can be appreciated from the data presented in Table 2.

These results from the city of Pinar del Río are among the best in the country and have been achieved by adhering to the guidelines of the National Group of Urban and Suburban Agriculture.

**Conclusions**

The results of the Programme of Urban Agriculture in the city of Pinar del Río demonstrate significant achievements that have improved over the years. Production indicators for the province are among the best in the country according to the evaluations of the National Group of Urban and Suburban Agriculture.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Production (kg/m²)</th>
<th>Potential production (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bunching onion (Allium fistulosum)</td>
<td>1.0</td>
<td>2.0 – 3.0</td>
</tr>
<tr>
<td>Carrot (Daucus carota)</td>
<td>2.5</td>
<td>3.4 – 4.0</td>
</tr>
<tr>
<td>Tomato (Lycopersicum esculentum)</td>
<td>3.7</td>
<td>3.0 – 7.0</td>
</tr>
<tr>
<td>Lettuce (Lactuca sativa)</td>
<td>2.5</td>
<td>&gt; 4.0</td>
</tr>
<tr>
<td>Kidney bean (Phaseolus vulgaris)</td>
<td>2.0</td>
<td>0.8 – 1.3</td>
</tr>
<tr>
<td>Cucumber (Cucumis sativus)</td>
<td>3.6</td>
<td>1.8 – 4.0</td>
</tr>
</tbody>
</table>

(Source: Personal communication from Granja Urbana, Pinar del Río, 2015)
This means that this alternative agricultural production system, which arose to combat the crisis afflicting Cuban agriculture in the 1990s, has resulted in a consolidated model of Urban Agriculture which sustainably produces food with important positive economic, social and environmental impacts.

Acknowledgements

Thanks to Brian Sims for his invaluable help with the translation of this article.

References

year, constituting about 12 percent of the nation's total annual water supply. However, the treatment process does not completely remove all bacteria, and low levels of *Coliforms* and *E. coli* can remain in the effluent, as can certain heavy metals such as copper, iron, zinc and chromium.

Recognising the potential of treated wastewater, in 2013 the International Centre for Biosaline Agriculture (ICBA), together with the Ministry of Environment and Water and Dubai Municipality, launched an initiative to evaluate the use of urban wastewater for irrigating vegetables in peri-urban environments within the United Arab Emirates. The study is looking in particular at the possible risks posed by pathogens and heavy metals.

During 2013 and 2014, carrots, lettuce, eggplant, tomato, radish, and spinach were all grown in field experiments at ICBA using both surface and subsurface drip irrigation. Results showed that the vegetables produced with treated wastewater were free from *E. coli* 0157 and *Salmonella* and that, with the exception of tomatoes that had suffered from insect attack, the concentration of *Coliform* bacteria was generally below the detection limit of 10 colony forming units/g. As for heavy metals, concentrations were mostly similar between plots irrigated with treated wastewater and control plots irrigated with fresh water. However, slightly higher amounts of iron were observed in spinach and lettuce leaves. While these findings need to be confirmed with further experimentation, the indications so far are encouraging and indicate that treated wastewater, if used properly, could become an important alternative water resource for peri-urban horticulture in UAE.

In addition to its desire to make greater use of urban wastewater, the UAE has set a goal of achieving zero waste going to landfill by 2020. With an ever-increasing population and massive economic development projects underway, an important challenge for the next decade will be how to safely dispose of the steadily increasing amounts of biosolids. The potential value of sewage sludge as a soil conditioner and source of important plant nutrients is well known. However, the environmental and human health issues that arise from the handling of sewage effluents are well recognised and have led to the establishment of global regulations and standards.

Recognising the potential of sludge and biosolids, ICBA has partnered with Ajman Sewerage Private Company Limited (ASPCL) in a project, entitled the *Sludge Valorization Feasibility Study*, to investigate the current and potential production and use of sewage sludge in the Ajman Emirate. The study estimated that the total sewage sludge production potential of UAE is about 104,000 tons/year of which about half is attributable to Abu Dhabi. Ajman produces 4,160 tons per year. The study showed that currently the greater part of the sewage sludge goes into landfills, with 100 percent doing so in the Emirates of Ajman, Ras Al Khaimah and Fujairah. Only in Dubai and Sharjah, does sewage sludge undergo further processing to be used either as soil conditioner or compost. In a survey of 38 farmers in Ajman, 20 percent indicated that they currently use sludge, of which about half use dried and half composted sludge.

The results of the project are being used by ASPCL to further its aim of supporting the goal of the UAE in general, and the emirate of Ajman in particular, to achieve a zero waste environment that does not require any of its sewage sludge to be disposed of in landfills.

### Urban and peri-urban agriculture and CABI

CABI has long recognised the importance of urban and peri-urban agriculture in the production of food for city folk and in helping create a sustainable environment. In 2001, for example, CABI published a book entitled *Waste composting for urban and peri-urban agriculture: closing the rural-urban nutrient cycle in sub-Saharan Africa*. And in 2005 CABI published *Urban aquaculture*, a book that draws together lessons learned from urban aquaculture projects in Asia, Europe and the USA.

Dr Trevor Nicholls, CABI’s CEO sums up CABI’s position on urban and peri-urban agriculture as follows:

“There are some issues we need to address when considering the relationship between rural and urban communities and farming, and then specifically urban farming itself. Firstly, with growing urban populations in the developing world, and with growing incomes in these urban populations, there is a demand for better quality, safer food. These expanding domestic urban markets definitely represent a bigger opportunity for rural smallholder farmers than international markets, which can be more difficult to break into. Local and regional urban markets represent a good stepping-stone for rural smallholders into bigger, international value chains.

Secondly, unless we find a way of recycling waste (animal, human, vegetable waste) we will effectively be making a transfer of nutrients - carbon, nitrogen, phosphate - from rural, agricultural areas to urban areas. This transfer from the rural environment to the urban environment will somehow need to be addressed, and that could mean taking a more focused look at replenishing nutrients using fertilisers.

Finally, when considering urban farming itself, if we are to feed a global population of 9-10 billion in thirty years’ time, we will have to make good use of all available space, including in urban and peri-urban areas. Growing vegetables and fruit, in particular, in urban spaces like container gardens represents another interesting opportunity for us to explore in relation to meeting the food demand of the future.”

**Geoff Hawtin**

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Issues and options for crop-livestock integration in peri-urban settings

Makiko Taguchi and Harinder Makkar

Makiko Taguchi is an FAO Agricultural Officer and is the author of ‘A global view of urban and peri-urban agriculture’ on pages 3-5 in this special edition of Agriculture for Development

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Summary

Livestock production, especially small livestock and dairy production, in peri-urban areas is a fast growing industry. This is due to the growing demand for animal products as urban populations increase and their diets shift to include increased consumption of animal products. On the other hand, urbanisation is also generating a rapid increase of organic biomass in urban areas. These situations create an opportunity for the introduction of an efficient crop-livestock integration model in peri-urban settings to improve nutrient recycling in the urban, peri-urban and surrounding rural areas. However, in order for an efficient crop-livestock integrated system to develop, there must be an enabling policy environment, to facilitate investment in infrastructure and coordinate logistics for biomass collection and use.

Introduction

One of the characteristics of urbanisation is the change in diets of the population. The increase in income is driving the shift to increased consumption of animal products. Because of this market opportunity, livestock are often produced in peri-urban areas where poultry, dairy and pig farming can be found (Figure 1). The commercial peri-urban production of livestock is an extremely fast-growing sector, representing 34 percent of total global meat production and nearly 70 percent of egg production.

Poultry, pig, dairy and small livestock (such as guinea pig and rabbit) production can be also be found within the city limits. While these activities are located near to consumers and are thus advantageous for market access, there are several concerns that arise precisely from their proximity to densely populated areas and the dense concentration of animals in small areas. Firstly, there is a concern over environmental pollution that can be caused by various emissions and discharges from animal production. If animal excrement and other waste are not properly managed, they can pollute the water source or air in and around cities. Manure produces a large amount of various gases in the process of decomposition, including hydrogen sulphide and ammonia, that can cause severe sickness at high doses. Another environmental concern is the smell or noise caused by livestock production that may not be acceptable for neighbouring residents. The leached nitrogen (N) from manure can be converted to nitrate in the soil which, when leached into water channels, can cause health issues especially in children. Similarly, when phosphorus (P) from faeces contaminates water channels, it can cause algal blooms which decrease levels of dissolved oxygen in the water, adversely affecting aquatic life. Also, zoonotic diseases can be shared between livestock and humans, avian flu being a typical example, where risks are higher when human settlements and animal production are closely located.

Figure 1. Dairy cows being zero-grazed on the outskirts of Narok, Kenya (Photo: FAO/Ami Vitale)

In cities such as Lima, Nairobi and Bangkok, large-scale commercial livestock production and aquaculture are found in peri-urban areas. This is to take advantage of the economies of scale and to be near the market for their perishable products. However, they can be a source of large amounts of N, P,
potassium (K) and heavy metals like copper and zinc entering the water system. For example, Thachin river (a tributary of the Chao Praya), less than 50 km from Bangkok, was ranked the most polluted river in Thailand from 2000 to 2002. This was a result of contamination by waste water from pig farms and industrial plants.

In some countries and cultures, pastoral systems are found even in urban areas, where livestock is part of the urban landscape. Here, the issue of pollution and health is also present, often affecting the urban poor population living in slums who share the water supply with the animals. In some cities, efforts are made to zone areas for pastoralists, but in many cases they are unregulated or unplanned, and the pastoralists do not have legal access to the lands where they care for their animals (Figure 2).

Opportunities for raising livestock in peri-urban areas

It may seem, after the problems outlined above are taken into consideration, that livestock production does not belong in the urban or peri-urban contexts. However, if appropriate measures are taken, it can coexist with human settlements, taking advantage of the readily available market, and increasing the efficiency of resource use that is unique to more densely populated urban areas. It can also provide livelihood opportunities for the lower-income population in or near the cities. Peri-urban areas, being at the interface between rural and urban areas, provide opportunities to enhance resource use efficiency in a consortium of these three entities. Some illustrative examples of such systems are given below:

• Pig raising in Lima

Pig raising is an important livelihood activity in the district of Lurigancho Chosica which is a low-income peri-urban neighbourhood on the east side of Lima. The municipal government, supported by the work of NGOs in the area, revealed that there were about 1,600 families engaged in pig farming, with an estimated annual stock of 5,000 sows and an annual production of about 60,000 head. When there were disease and public health concerns raised by new residents in the area, the municipality facilitated a meeting between the farmers and the Ministry of Health to address the issues in a constructive way. Proper regulation and an accountability framework with permits, water quality monitoring and waste control have been achieved with training and appropriate infrastructure development.

• Animal production in China

Shunyi district, 30 km from Beijing city centre, produces 43 percent of Beijing’s total pig production, or 1.67 million pigs annually. It is known as a dominant region for animal and vegetable production, with 40,000 ha of the district being dedicated to agricultural purposes. Pig farming is one of the major causes of water pollution, and with declining reserves of ground water because of frequent droughts since the late 1990s, soil pollution along the riverside has also been on the increase. In 2000, ecologically friendly pig-vegetable mixed farms were designed and installed. A vegetable packing plant and sewage processing plant were also built to produce biogas using pig urine and faeces. By shifting to the ecological pig-vegetable system, it has been possible to significantly reduce the amount of pollution. The integration can be seen, not only at the individual farm level, but also at district level where pig farms and vegetable farms coexist and the manure is being recycled within the district. While land management laws protect arable land for agricultural use, because of the proximity to Beijing, pressure to convert land to other purposes persists. Construction of an airport and automotive industry development in the area are inducing land use changes. The ongoing changes are seen as an opportunity to grow high value products such as fruits and ornamentals (Kamphuis et al, 2004). Animal production is prioritised for its economic value and the production area is expected to increase in the district, while traditional farming, focused on cereal production, is expected to decrease.

Among the three dairy systems in China: smallholder subsistence (<10 cows per farm); cooperatives (>100 cows owned by different farmers but managed collectively); and peri-urban (>100 cows), the peri-urban system was found to be the best managed. It achieves the highest feed conversion efficiency, the highest feed-nitrogen use efficiency, the lowest use of components edible for humans in animal diet, and the highest milk yield per unit feed cost (Wang et al, 2014). These results illustrate that good management plays an important role and peri-urban dairy farms, if managed efficiently, can produce high milk yields with low emission of pollutants.

• Dairying in Punjab state, India

Punjab contributes approximately 10 percent of national milk production. Some 39 percent of the human population in the state lives in urban areas, and increasing human migration from rural to urban areas has led to increased demand for animal products, especially milk and milk products. The dairy animals have been removed from the big cities in order to keep the cities clean and to alleviate the sewage disposal problem. In order to cater for the demand for dairy products in the urban areas, the government has established seven peri-urban dairy complexes (two each in Jalandhar and Ludhiana; one each in Amritsar, Ferozepur and Hoshiarpur districts). Bakshi et al (2010) describe the conditions in these peri-urban dairy complexes as follows:
• Unhygienic, poor cleanliness, heaps of dung on ground and strong smell around the farms.
• The number of animals per unit space is very high and not letting the animals free for exercise raises animal welfare concerns. Poor living conditions could be responsible for the high incidence of mastitis in the milking herd.
• The use of the banned hormone oxytocin at high doses for milk let-down, and use of the same needle for many animals, which might explain the high incidence of abortions (up to 20 percent) in most of the farms.
• The in-house treatment of sick animals and not following strictly the recommended deworming and vaccination schedules.
• Milking of sick animals given antibiotic therapy without taking into consideration the withdrawal period.
• Feeding of unbalanced rations leading to low feed use efficiency and high pollutant emissions per unit of milk production.

All the above mentioned challenges can be overcome through proper training of farmers and enforcing existing regulations, which would contribute to improvements in animal health, welfare, and product safety. The use of proper manure management practices would further enhance the income of farmers and resource use efficiency.

Opportunities for crop-livestock integration

Livestock production in urban and peri-urban areas generates economic benefits as described above. Beyond the economic benefit, there is increasing interest in livestock production as a means to improve biomass management in cities. As the population grows, ‘waste’ (referred to as ‘biomass’ or ‘resource’ in this paper) becomes an increasingly important issue for municipalities. With rapid increases in population, the amount of such resources also grows in parallel. Re-using organic waste as animal feed is an opportunity. Examples are the use of vegetable and fruit wastes from wholesale markets, plants that are discarded in the processing procedure, or simply overstocked fruits or vegetables that do not get used for human consumption (Wadhwa et al., 2015). Agro-processing by-products, and wastes produced in the vicinity of cities, also form a substantial part of animal diets in peri-urban areas. These sources not only fill the gap between the required and available feed resources, but also help in mitigating the pollution which might arise due to their decomposition when not used as animal feed. FAO has produced a manual on production of silage and blocks from such organic wastes and industrial by-products for feeding to ruminants (FAO, 2013).

In many countries in Asia, Africa and Latin America, the pigs and poultry in peri-urban areas are raised with waste available from the city, including kitchen wastes, stale bread and tortillas, leftover tortilla dough, chicken guts, and fruit and vegetable wastes. With the rise of animal feed prices and increasing demand for animal protein, recycling of organic waste to animal feed is being tested in various parts of the world. This also includes use of organic waste to rear insects, which will then be fed to poultry or fish (Makkar et al., 2014; Tran et al., 2015). A challenge in using such biomass as animal feed is that the safety of the animal feed, animal health and welfare, and the product quality and safety, must not be compromised. The animal waste that is then produced can be recycled back to the crop production in the urban, peri-urban or rural areas.

In many countries, the compost made from animal manure in peri-urban areas has a good market for use in horticulture and floriculture in peri-urban and urban settings; sale of manure can form a substantial part of the income of peri-urban livestock farmers. In some places, the manure goes back to fields in the rural areas which are the main source for food and feed crops, thus helping to reduce nutrient export.

Obtaining resources from both ends (agroindustrial by-products and vegetable and fruit wastes from wholesale markets both within and around cities, and plant resources as animal feed from villages) can contribute to the prevention of nutrient leakages in a broader area context. This also helps to close the nutrient cycle and provide nutrients (through manure) back to villages for crop production and also to peri-urban areas.

The key to enabling this nutrient recycling is policy support from the local or national government to implement a waste collection scheme. In the municipality of Nonthaburi, adjacent to Bangkok, the municipal government contributes by collecting organic waste, which could pave the way for its use as animal feed. Similarly, other cities are addressing the challenge of diverting biomass from landfills, for higher value utilisation. The City of Johannesburg in South Africa, for example, is working on increasing the efficiency of separating waste at source to obtain biomass with the potential for use as animal feed (Nahman et al., 2012, City of Johannesburg, 2013).

Lately, innovative crop-livestock integration businesses are being developed in some countries. One of those businesses is Zoe Biotech, a company in France that is setting up cactus (Opuntia ficus-indica) plantations to incorporate into cattle feed, but also using the cactus pads for rearing black soldier flies to be fed to fish such as tilapia. Opuntia (prickly pear) can be used to rehabilitate degraded land, and is now being tested in many places as animal feed, with an extensive production of 400,000 ha each in the northeast region of Brazil and Tunisia. In Brazil, feeding a ration containing 70 percent cactus pads and 30 percent concentrate to cows has been shown to support a milk yield of 25 kg/day. The multipurpose use of prickly pear, as fruit and vegetable for human consumption as well as for animal feed, is gaining interest in countries experiencing worsening drought conditions. The potential to serve urban market needs with the variety of products from prickly pear production, and integration into livestock production, is an emerging industry for peri-urban areas in several countries in Africa and Asia (FAO-ICARDA, 2015).

Conclusions

There is a clear trend of increasing demand for animal products in urban markets. Opportunities for livestock production - mainly poultry, pig and dairy - in the peri-urban areas are being explored and established in many cities and their surrounding regions. However, as they are mainly developed at commercial
scale, the nutrients build up in the soil and water, and as a result pollution and human health issues are prevalent in many parts of the world. However, livestock production in peri-urban areas also gives rise to opportunities to set up crop-livestock integrated models that allow more efficient nutrient recycling and thus decrease the amount of pollution into the water sources and air. Because of the large scale of production, some regulatory measures are necessary, and an enabling policy environment with appropriate investment is key for successful crop-livestock production in peri-urban areas. The pressure on land for competing uses is ever present, so careful consideration of various elements such as consumer demand, environmental impact, economic development and social inclusion and protection is important in land use planning. Efforts and experiences for crop-livestock integration in various parts of the world, and emerging new technologies to support the system, should be shared widely to achieve more sustainable production to support the demands of the rising global population that are increasingly concentrated in urban areas.

Acknowledgements

The authors would like to thank Caroline Ledant, Jieun Kim and Camelia Bucataru for their support in the preparation of this article.

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Mailbox

Ag4Dev25

Dear Sir,

Many congratulations on my (recently-received) copy of Ag4Dev 25, (even though I have not yet had time to read, mark, learn and inwardly digest it all!) It looks ‘meaty’, and is very good for TAA’s image.

You may be interested to know that an article by Prof Rattan Lal (USA), A System Approach to Conservation Agriculture, which appeared in the Journal of Soil and Water Conservation, Volume 70, Number 4, cites our article in Ag4Dev 24, pages 21-25. So Ag4Dev contents get around quickly! Be reassured that your efforts are worth all the hassle.

Well done.

Francis Shaxson

Ag4Dev25

Dear Sir,

Congratulations on the latest Ag4Dev, thick and full of interest. I was particularly taken by Brian Wood naming the population dimension, ‘The elephant in the room’.

Tony Young
Dear Sir,

The latest Ag4Dev has arrived and looks good. Well done to you and the team for another excellent publication, delivered despite your work pressures. It represents real value for money, keeping recipients up to date with research and development activities across the developing world. Keep up the good work.

Jim Ellis-Jones

Dear Sir,

Another bumper edition. Well done. Format also improved.

Keith Virgo

Dear Sir,

This morning I received the latest Ag4Dev and was surprised to see corms of my old friend Amorphophallus on the front cover. During the 1980s I did a great deal of research on the species for a major UK pet food manufacturer. They were interested in the Chinese/Japanese type which contains a powerful gelling agent.

Doug Wholey

Dear Sir,

Thank you for dropping in the latest issue of Agriculture for Development. I am very impressed with this - it has the kind of ‘practitioner experience’ that does not appear in academic journals, or find a place in the corporate world of universities these days. I like very much the factual articles ‘from the field’....

WM Adams
Moran Professor of Conservation and Development
Head of Department, Department of Geography, University of Cambridge

Fiat panis - quo vadis?

Dear Sir,

Charles Bevan’s thoughtful critique of some of FAO’s activities is marred by his last sentence: a hedged non sequitur questioning FAO’s current relevance.

Much of FAO’s globally relevant work, ignored in the paper, cannot be taken over by the private sector. Examples are the standards-setting on food safety, pesticides or transboundary pests and diseases by FAO-facilitated international expert groups on behalf of all member countries; or the annual update, analysis and maintenance of the agricultural (and periodically, fisheries and forestry) datasets based on returns from all member countries mandated by the FAO Conference.

Robert Brinkman
Closing the nutrient cycle: linking urban solid waste and soil amendments

Rob Brook

Rob is a senior lecturer in agriculture and rural development at Bangor University, where he has worked since 1993. Prior to that, he worked in Papua New Guinea on agroforestry for six years, and had shorter periods in Indonesia and South Sudan. The research in India described here was funded by DFID, and the work in Bangladesh was funded by the British Council. Their support is gratefully acknowledged, but the views expressed here are not necessarily those of either of those organisations (r.m.brook@bangor.ac.uk).

Summary

The issue of management of urban waste, both solid and liquid, is a classic example of rural-urban interactions. Wastes are typically regarded as a problem, not as a resource. The work described here was conducted in India and Bangladesh, and demonstrated that, with appropriate treatment, urban solid wastes (USW) could be an extent substitute for mineral fertilisers, allowing poor peri-urban farmers to reduce dose rates of the latter. However, waste must be pre-sorted at household level prior to collection, as post-collection sorting is completely uneconomic. Even then, composted USW is unlikely to be economically viable on staple crops, although it might be on higher value horticultural crops. This article provides a summary of over five years work, so necessarily much detail is omitted.

India

I became involved in research into the peri-urban interface in 1997 when I was asked to take part in a baseline study in the twin cities of Hubli-Dhawad in Karnataka State in southern India, funded by DFID as part of the Peri-Urban Interface Systems component of their Natural Resources Systems Programme of research. Hubli-Dharwad lies approximately 400 km north-west of Bangalore (now Bengaluru), and at that time they had a combined population of 800,000. The urban centres are 20 km apart, but the space between was rapidly filling with urban expansion.

The overall purpose of the research programme was to understand how poor farmers were being affected by living in proximity to a medium-sized urban area. Two problems of note were that the urban solid waste (USW) of the twin-cities was poorly managed (as is common in many developing country cities), and that soil fertility on peri-urban farms was declining for a variety of reasons, including intensive cropping to meet market demands and worsening terms of trade due to competition from urban areas for labour which previously worked on farms. Around Hubli-Dharwad, farmers had been using this waste from the city’s open dumpsite and applying it as a soil amendment, but due to an increasing fraction of non-decomposable material such as plastic bags, glass, metal and rubble, farmers expressed increasing dissatisfaction with this resource.

In a subsequent project led by Dr Fiona Nunan of Birmingham University (who is now head of the International Development Department there), in 1998-99 we examined waste management (both liquid and solid) more closely and in particular the scope for turning the decomposable fraction into compost, and testing it with farmers to determine its effects on crop production. For more details of this project see Nunan (2000). We worked with colleagues from the University of Agricultural Sciences and the SDM College of Engineering and Technology, both located in Dharwad. In the time available, the project could be little more than a feasibility study, and only managed to test composts in the kharif (monsoon) season in 1999.

Until 1997, decomposing USW was sold from the Dharwad dumpsite via an annual auction system managed by the Hubli-Dharwad Municipal Corporation, selling waste by the pit load. The auction system stopped because of the lack of staff at the dumpsite to prepare pits for auction and to manage the auction process. Figure 1 shows a typical waste pit at the Dharwad dumpsite.

It was found that relatively wealthier farmers, who owned tractors and trailers, were bidding for the USW, and that it was difficult for smaller scale farmers to gain access to this resource. The fraction of non-decomposable materials was 40 percent, so farmers would remove and discard this at their field margins, creating a waste problems across the peri-urban landscape.

During the first year of the project, we conducted several interactive sessions with farmers (using ‘participatory’ methods such as matrix ranking of preferences for managing soil fertility, and discussion groups), and generated trial quantities of several types of compost derived from USW with various amendments. Unsurprisingly, farmers possessed considerable knowledge about soil fertility management, but it was also evident that their cropping systems were under pressure due to the costs of artificial fertilisers, inadequate supplies of manures and composts made on farm, fragmentation of landholdings, and competition with the urban area for labour at a price they could afford. Farmers preferred composts to artificial fertilisers because the former improved the workability of the soil whereas mineral fertiliser (usually di-ammonium phosphate supplemented with urea) made...
the soil ‘hard’, in their view. Therefore, they expressed ready approval of the prospect of being included in on-farm trials of composts produced by the project.

Hubli-Dharwad lies on the western edge of the Deccan Plateau, with a sharp delineation between ‘red soils’ to the west (mostly ustorthents and ustropepts) while to the east lie ‘black cotton soils’ also known as vertisols (mostly very fine montmorillonitic clays). Indeed, on the university farm, within a handful of paces, one could walk from one soil type to the other. As might be expected, cropping systems differed markedly between the two soil types. On the red soils, smallholder farmers grew rainfed rice in the kharif season followed by green gram (Phaseolus mungo) in the rabi (post-monsoon) season to utilise any residual moisture. This cropping system was marginal due to low (1,000 mm pa) and erratic rainfall, on the shallow and highly erodible soils. Although rainfall to the east was even lower (800 mm pa), the soils were deep and had a higher water holding capacity. Crops were typical of heavy land: cotton, sorghum, wheat, potato and chilli. Therefore we decided to work with representative kharif cropping systems.

USW was sourced from the Dharwad dumpsite and manually sorted to remove any non-compostable components. It took 60 man-days to sort 25 t of USW, in order to yield 10 t of compost (allowing for loss of weight due to respiration and moisture evaporation during decomposition). Following discussion with farmers, the project produced four kinds of compost:

1) sorted but unamended USW;
2) sorted USW + 25% distillery sludge + Azospirillum spp. (N-fixing bacteria) + Bacillus polymyxa (P-solubilising bacteria);
3) sorted USW + Eudrilla ugina worms + 2.5% cow manure (to get the vermicomposting process going); and
4) sorted UWS + 40% septic tank waste + Azospirillum spp. + Bacillus polymyxa.

The composting period was 3 months, and we regularly sampled the pits to determine changes. In the end, the composts were remarkably similar with the exception of the unamended USW, which had a carbon:nitrogen ratio of 20:1 whereas the others were 15:1, compared to farmers’ home-produced compost which was typically 10:1. Thus, the USW-derived composts were rather low in N. The unamended USW and USW + distillery sludge were also low in total phosphorus compared to the other two composts and farmers’ compost. Crops used for on-farm trials were common kharif season monocrops (for simplicity): rice on red soils; and on black soils, potato (Solanum tuberosum), greengram or groundnut (Arachis hypogaea). There were five farms per village (which is as much USW as we could prepare). On each farm, all four composts were trialled at a rate of 10 t/ha, in 10 x 10 m plots, arranged randomly, and compared with the normal farmer practice. The project agreed to underwrite any crop losses resulting from the application of composts, but in the event this was not necessary.

It has to be admitted that we were not expecting big effects after one season, but we did find significant yield differences in potato (lowest yields from composts 2 and 3) (mean 20.7 t/ha fresh tubers) compared to composts 1 and 4) and the farmers’ practice (mean 23.0 t/ha), and also in groundnuts, where compost 4) gave slightly, but significantly higher yields than the other four treatments. Across all farms, compost 2), USW + distillery sludge + bacteria gave the lowest yields. There were also significant effects upon nutrient uptake, but the findings were rather too detailed to go into here.

The conclusions were a) that farmers were very interested and actively involved both in our research and the prospect of application of USW to their fields, b) even in one season, effects (albeit variable) could be observed, c) sorting of USW after dumping was not economically feasible. Therefore, separation of waste at source was a pre-requisite.

Bangladesh

In 2009, an opportunity arose to follow up the Indian research, this time in Bangladesh. The funding came from the British Council through their INSPIRE programme. The research partners were Bangor University and Bangladesh Agricultural University, Mymensingh (BAU). The rationale was the same as for the Indian research, but this time the research concentrated on rice, with supplementary experiments on wheat and maize. Most experiments were conducted on the university research station, with a small on-farm demonstration.

Other research partners were GIZ-Bangladesh (Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH) who had been helping support Mymensingh Municipality with their USW management. They established a door-to-door kitchen waste collection scheme in three wards of the city (2,250 households), where the waste was taken to a composting facility and later sold as a bagged compost. Based on fees for the collection service (about 30 to 50 pence per month, depending on household size), it produced 4 t compost per month and employed 30 workers from very poor households. Interestingly, before we were aware of the GIZ work, a Bangor MSc student, Naveen Nanjundan, conducted a willingness to pay study using a choice experiment and conjoint analysis method (which avoids bias due to respondents inflating the prices they say they are willing to pay), and determined that households considered that 30 to 50 Bangladesh taka (then about 30 to 50 pence) was what they would pay for household collections of kitchen waste (Nanjundan, 2010). This was a nice corroboration of the charges levied by the GIZ programme.

Besides the problem of management of urban solid waste in Bangladesh (Figure 2), the majority of rice soils are heavily cropped, two or even three times a year. One consequence is that soil organic matter levels and nutrients have declined. According to the Ministry of Agriculture, more than 80 percent of soils have organic matter levels which are classified as low or very low. Earlier research conducted by my PhD student, Dr Nurul Quadir, showed that, over ten years, farmers had doubled fertiliser input on to rice, particularly urea, but yields (per unit area) had
remained static. Our BAU colleagues told us that crop nitrogen uptake by rice efficiency is now as low as 25 percent, meaning that 75 percent of urea ends up elsewhere in the environment. This is surely the epiphenomenon of unsustainable cropping.

We ran four seasons of experiments on rice, two in the *boro* (dry season, irrigated) and two in the *aman* (monsoon) season. These tested four levels of compost (unamended), at 20, 10, 5 and 0 t/ha, in a 4 x 4 combination with four replications, with Ministry of Agriculture recommended levels of fertiliser at 100 percent, 50 percent, 25 percent and 0 percent rates, applied each season in 2010 and 2011. *Boro* and *aman* varieties of rice differ, and accordingly so do the fertiliser recommendations. To determine longer term effects, the same crop treatments were grown on the same plots. Rice was established by transplanting and the field was flooded according to prevailing agronomic practices. Nitrogen applied as urea was applied in split doses, again according to normal agronomic practice.

A sample of the results is presented in Figure 3. Rice yields in the irrigated season were always higher than in the monsoon season due to the higher levels of solar radiation. There was a good initial response to compost (statistically significant), but the response to compost diminished in the 2nd, 3rd and 4th seasons. At zero fertiliser, the effect of compost alone decreased between the two irrigated seasons and was static between the monsoon seasons. When supplemented by recommended fertiliser at 50 percent rate, rice yields increased by an average of 38 percent across all treatments. Fertiliser reduced the effect of compost to an extent and there were indications of a slight decreasing trend in yield over time. Results for 100 percent fertiliser rate are not shown as they were not significantly greater than the 50 percent rate when applied in combination with 10 t/ha of USW compost.

Rotating rice production is likely to be economic on higher value horticultural crops such as vegetables or spices unless subsidised. We should not automatically eschew subsidies: these often prove to be necessary incentives for many environmental actions from which wider society benefits.

**Conclusions**

It is realised that the findings from these two small projects are going to be limited in scope, but nevertheless not so limited in their general applicability. Firstly, farmers are aware that the organic matter content of their soil is being depleted but usually lack access to sufficient quantities of organic matter for their needs. Hence their heavy reliance upon mineral fertilisers. Secondly, and unsurprisingly, they are very willing to try out composts when offered. Thirdly, in these experiments on continuously cropped soils, crops responded to composts in the first cropping season. It seems unlikely that composts from urban solid waste can completely replace artificial fertilisers, so their role may be as partial replacements, ideally as components in an integrated nutrient management programme. Finally, all the economic analyses we conducted (not presented here) showed that, on low value staple or cash crops, the cost-benefit of USW compost is negative even when pre-sorted prior to collection. USW compost is only likely to be economic on higher value horticultural crops such as vegetables or spices unless subsidised. We should not automatically eschew subsidies: these often prove to be necessary incentives for many environmental actions from which wider society benefits.

**Acknowledgements**

In India, thanks are due to colleagues Prof CS Hunshal, Indian project co-ordinator, and the late Dr B Basavaraj, University of Agricultural Sciences, Dharwad, and KS Shinde and SG Joshi at SDM College of Engineering and Technology. In the Bangladesh project, I wish to thank my Bangor colleagues Paula Roberts and Pryor Williams, and at BAU, my gratitude is expressed to Prof N Islam, Bangladesh project co-ordinator, Prof MM Rahman and Prof Md A Baten: also to the many students, technical and NGO staff without whose help we would have achieved little, and to the farmers who willingly acted as guinea pigs.

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Figure 4. Two Bangor colleagues (Dr Paula Roberts and Dr Pryor Williams) with two BAU farm workers demonstrating effects of compost (in worker’s hands) from urban solid waste on maize (minus in foreground, plus in background) (Photo: Rob Brook)
TAA Forum

The 32nd Ralph Melville Memorial Lecture, delivered 10 December 2014 at the Royal Overseas League

Improving smallholder agriculture

Mike Bushell
(compiled by Elizabeth Warham from Powerpoint presentation)

Dr Mike Bushell is the Principal Scientific Advisor for Syngenta, a world leader in plant science. Mike has a chemistry PhD from Liverpool and the University of California at Davis, and is a Fellow of the Royal Society of Chemistry. Following postdoctoral studies at Cambridge, he joined ICI in 1980, based at Jealott’s Hill International Research Centre in Berkshire. He has held a variety of technical leadership and management roles over more than 30 years, including Head of R&T Projects, Head of Discovery, Head of External Partnerships, and Head of Jealott’s Hill. He is also the secretary to the Syngenta Technology Advisory Board. Mike was recently appointed as a Visiting Professor at Nottingham University and to the Board of Trustees for the SCI.

Summary

The world’s population is increasing and by 2050 there will be two billion more people on the planet. Food demand is already outstripping supply. Farmers must grow more from less so we need to help make that possible. This article highlights Syngenta’s The Good Growth Plan with six commitments to help grow more food using fewer resources, while protecting nature, and at the same time helping people in rural communities live better lives. As part of this, Syngenta has made a commitment to creating a US$1 billion business in Africa by 2022, contributing to the transformation of agriculture by increasing access to technology and enabling the development of rural communities. Several case studies illustrate the type of partnerships that Syngenta is using to improve smallholder agriculture in Africa.

Background

The challenge of feeding a growing population has been a subject of concern for centuries. Every day the world’s population increases by 200,000 and 870 million people go to bed hungry with 70 percent of them depending on farming. Therefore, the global challenges of providing food, energy and water security for a population of 7 billion today, and 9 billion by 2050 are enormous. The key concept to addressing these challenges from the UK Governments Foresight report was sustainable intensification of agriculture, defined as producing more output from the same area of land while reducing the negative environmental impacts and using all inputs (including land, water and nutrients) more efficiently.

We need to act now to enable farmers to grow more food, so they can feed themselves and provide a reliable food supply to a growing urban population. Even today the use of natural resources is beyond what our planet can sustain, so productivity gains alone are not enough but must be part of a holistic view of the environment and the way farming is carried out.

Integrated systems approaches

Farmers must contend with many external environmental impacts including climate change and weather volatility, water scarcity and land degradation. Environmental stresses are increasing, with two thirds of the world’s surface facing high or medium climate change. These global challenges make it an ever more changing environment for farmers to work in. Population growth and land scarcity will lead to the need for a further increase in people fed per hectare of land. So while one hectare could feed two people in 1950, by 2030 it will have to feed five.

Neither Syngenta nor indeed anybody else has all of the answers to meet the global challenges of food security, but collectively we can find the solutions. Breakthrough ideas and achievements come from collaborating beyond boundaries in strategic collaborations to deliver research and development, complementary technologies, better and safer farming practices, and an improved food value chain. In Syngenta, we continuously engage with stakeholders around the world to shape our understanding of the responsibility issues we must address in our everyday business. We need to further engage and collaborate with governments, NGOs, policy makers, food companies and others to make the “New Vision of Agriculture”
real. Syngenta encourages transparency and an open dialogue with governments and the independent research community on continuing research collaborations, and thinking about agricultural systems through mechanisation including irrigation, modern fertilisers, better seed varieties, and crop protection chemicals.

Farmers think about their land and their crops in a holistic, integrated way. By doing the same, we can equip ourselves to create truly innovative and transformative technologies focused on a crop rather than a specific scientific discipline. Syngenta is looking beyond single products and yield alone to create complete solutions that benefit both the land and the people who live on it (Figure 1).

In The Good Growth Plan, Syngenta has made six commitments to help grow more food using fewer resources, while protecting nature, and at the same time helping people in rural communities live better lives (Figure 2):

- **Make crops more efficient.** Syngenta will increase the average productivity of the world’s major crops by 20 percent without using more land, water or inputs. This will grow more food with increases in yield without increasing the land area under cultivation or the volume of water and pesticides used.

- **Rescue more farmland and help biodiversity flourish.** Syngenta will improve the fertility of 10 million hectares of farmland currently on the brink of degradation through practices such as minimum tillage and crop rotation. The biodiversity on five million hectares of farmland will also be enhanced with the introduction of buffer strips and species protection programmes.

- **Improve health and reduce poverty among smallholder farmers, and improve worker safety.** Over the next seven years Syngenta aims to reach 20 million smallholders and to enable them to increase productivity by 50 percent. Syngenta will train 20 million farm workers, especially in developing countries, on labour safety, while looking after every worker by striving for fair labour conditions throughout our entire supply chain network.

Syngenta’s progress on each of the six commitments will be monitored through on-farm surveys and audited by third parties; with progress reported annually using a variety of different measures (Figure 3).

**The Good Growth Plan**

Syngenta’s corporate advertising campaign: The Good Growth Plan, is about helping farmers feed a hungry planet. The research carried out to develop the plan highlighted some of the dilemmas farmers face in the pursuit of the goal of greater sustainability. Most respondents said that more arable land, water and human labour are needed. However, we need to ask what impact this would have on, for example, rainforests and natural parks; competition for other uses of water (household and business) given agriculture already uses 70 percent of the world’s fresh water withdrawals; and the fact that many farmers are already unable to find the workers they need because of ongoing urbanisation.

**Business development in Africa**

Syngenta believes that Africa has the resources not only to feed its growing population, but also to become a major world food exporter. Syngenta announced at the 2012 G8 Summit a commitment to build a US$1 billion business in Africa over the next 10 years (Figure 4). This involves investments of over US$500 million; recruitment and training of up to 700 new employees; and an integrated approach given there is no single technology solution. Syngenta will also:

1. Learn more at [www.goodgrowthplan.com](http://www.goodgrowthplan.com)
• Act as an aggregator and catalyst to mobilise players along the value chain;
• Identify and develop business opportunities and business models that will accelerate the pace of African agricultural development;
• Validate business opportunities through the implementation of pilots and define blueprints to achieve scaling up of the model; and
• Complement the approach with acquisition or building pieces of the value chain outside of Syngenta’s usual remit.

The acquisition of the Maize Research Institute (MRI) Seeds in Zambia will give Syngenta ownership of a leading and diverse portfolio of white corn germplasm with extensive production areas and contract grower relationships. This will create a corn seed hub to serve East African markets with additional opportunities in wheat and soybean. MRI is a leading distributor of both chemicals and seeds and will be a springboard for our growth throughout East Africa, allowing Syngenta not only to gain share but also to expand the market, including the introduction of integrated solutions.

**Case Study 1 - The Smallholder offer in Kenya**

*Project objectives* - Smallholders account for 80 percent of Kenyan farmers. The *Uwezo* (or ‘capability’) project aims to help these farmers increase yield through access to crop protection products and extension services. Syngenta gains in higher sales and market share.

*Business model* - Since 2005, Syngenta has offered crop protection products for staple and high value export crops in affordable pack sizes that fit one knapsack sprayer and are priced for ‘cash in pocket’. Seeds are also offered. Syngenta provides information and training to farmers through field teams and mass media, and trains retailers to enable them to provide better service and advice to the farmers.

*Key achievements* - Access to products and advice has enabled growers to increase their yield and income, and move from subsistence to commercial farming. In 2011, total sales for *Uwezo* were US$ 4.64 million and 600 retailers have already been trained. The project has been introduced in Egypt and will be rolled out in an additional African country each year.

**Case Study 2 - Southern Agricultural Growth Corridor of Tanzania (SAGCOT)**

*Project objectives* - To support the development of large and smallholder farmers in the southern corridor of Tanzania. Building markets and infrastructure will facilitate Syngenta’s operations in the area.

*Business model* - Since mid-2010, Syngenta has collaborated with the Tanzanian government, companies such as Yara and Unilever, and development agencies such as the World Bank and USAID, to develop the Southern Agriculture Growth Corridor of Tanzania (SAGCOT) for agricultural transformation in southern Tanzania. The current focus for Syngenta is working with the Kilombero Plantations Limited (KPL) rice plantation in the Kilombero valley. This includes supplying products to KPL and developing 5,000 smallholder farmers to increase their productivity and sell the rice produced to KPL. Innovations like weather-indexed input insurance are also being considered. Demo days are held on each of the sites at harvest time with 50-100 farmers from each community attending and the Syngenta/Yara protocol is explained.

Each of the 11 maize and rice sites selected compare Yara/Syngenta protocol with farmers’ practice and the controlled maize and rice sites at Sokone University of Agriculture in Morogoro; and Dakawa Research Institute, respectively.

*Key achievements* - A strong public-private partnership and investment blueprint has been developed by SAGCOT and a catalytic fund is being developed. The KPL partnership is being defined and deployed.
Case Study 3 – ‘Kilimo Salama’ in East Africa (Syngenta Foundation project)

**Project objectives** - To offer affordable, weather-indexed input insurance to Kenyan smallholders, enabling them to safely invest in better inputs, thereby increasing their yields and profitability. Kilimo Salama means ‘safe farming’ in Swahili.

**Project model** - Syngenta Foundation leads this project, with support from Syngenta and other partners including UAP Insurance and the Swiss Re Group. Smallholders can insure selected farm inputs at their local retailer and pay half the premium (input companies pay the rest). Retailers use a camera-phone to scan a bar code on each input and an SMS confirming the policy is instantly sent to the farmer’s cell phone. Local weather stations set up by the Foundation measure rainfall - if a station reports insufficient or too much rain in the season, affected farmers receive a payout via Safaricom’s mobile payment system MPesa. Currently the programme targets maize, wheat, sorghum, bean, potato and coffee farmers.

**Key achievements** – The pilot phase in 2009 insured 200 maize farmers. Given the drought at that time, farmers received a payout and saw instant benefits of insurance, reducing mistrust. In 2010, 11,000 farmers were insured in Kenya, rising to over 23,000 in 2011 and likely to be over 50,000 in 2012. In 2012 the project expanded to Rwanda where it currently insures over 13,000 farmers. The goal is to expand across Kenya as well as to other African countries.

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Transforming rural livelihoods

There is no single big idea to transform rural livelihoods but more joined up thinking across the different stakeholders in the food supply value chain with a focus on:

- **Feeding the poor** - increasing access to affordable food, raising incomes, and growth in economies through agriculture and trade, while reducing demand for western diets and food waste.
- **Local knowledge and innovations** - empowering local communities with information and ‘local cooperatives’ blending new technology with traditional wisdom in local solutions, investing in agricultural extension, and making farming more professional and economically attractive.
- **Agriculture as more than food** - more research into sustainable production, food industry partnerships, infrastructure investments, help for agricultural businesses to get capital, functioning input and output markets, and limiting climate change through genetics and crop husbandry.

- **Modern technology and systems biology approaches** to provide new traits to crop varieties and livestock breeds increasing productivity and quality; better control of weeds, pests, diseases, resistance, and safer storage; improving soil fertility to reverse yield stagnation; more efficient use of natural resources and inputs, land, nutrients and water; and higher standards to safety in use of modern crop protection chemicals.

In summary, national strategies are needed for food security and coordinating infrastructure investment and market development, and more supportive political climates. This will need improved decision support tools for land use locally, nationally and internationally to help improve smallholder livelihoods.

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New ExCo members

**Coordinator for Corporate Members**

Dr Martin Evans recently joined the ExCo as the new Coordinator for Corporate Members. Martin obtained BA, MA and PhD degrees from Cambridge University in natural sciences and agricultural economics. Following spells as a lecturer, and a project economist for the Asian Development Bank, Martin spent almost 30 years in increasingly senior positions in the private sector, working for companies such as Booker Tate Ltd. Since retiring in 2004, Martin has sat on, and chaired, various private sector and NGO Boards, and has continued to work as an independent consultant. He is ideally suited to the role of Coordinator for Corporate Members, in which he will encourage Corporate Members to play a more active role in the TAA, to benefit more from their TAA membership, and to share more news with the TAA.

Email: corporate_membership@taa.org.uk

**Coordinator for Regional Branches**

Dr ‘Nathan’ Duraisaminathan Visvanathan recently joined the ExCo as the new Coordinator for Regional Branches in the UK and overseas. Nathan has BE, ME and PhD engineering qualifications from universities in India, as well as chartered status with three professional bodies. Nathan has more than 22 years of experience as a water engineer with Atkins in Africa, India and Bangladesh. He is now based in the Atkins UK office. As Coordinator for Regional Branches, Nathan will encourage and support the development of regional and overseas Branches, and seek news from the Branches for sharing with TAA members.

Email: branch_coordinator@taa.org.uk
Local TAA members Robin and Maxine Humphries organised an outstanding three days in the Purbecks for this year’s SW Group field visit. Twenty-eight TAA members participated in the visit, all of whom were most grateful to Robin and Maxine for their detailed planning and extensive briefing notes.

**Monday 29 June**

**Purbeck National Trust HQ**

We enjoyed a very comprehensive presentation by David Brown the senior NT Property Ecologist.

*The environment: opportunities and constraints*

The unusual characteristics of the Purbeck environment define the biology and govern the means of its exploitation, including agriculture. Much of the area is in the hands of the National Trust, since it was bequeathed to them in 1981 by the Bankes family. At 10 km², it is their largest single estate.

David explained the unusual geology ranging from Tertiary clays and gravel, a Cretaceous chalk ridge, and the coastal Jurassic strip. This results in a thin, nutrient poor soil, ranging from calcareous to acidic, which makes it the most botanically diverse in the country. Heathland, dry and wet, is the most conspicuous environment. It reflects the interaction between man and ‘nature’, from the felling of the trees over thousands of years, through to the grazed and heathland characteristics. It must now be managed to maintain low fertility and stop progress to climax vegetation.

The Purbeck area has only low potential for productive farming and the National Trust sees it as ‘heritage’. The six tenants, former dairy farmers of about 2,500 ha in total, now earn their income from conservation and stewardship schemes. The reduction of dairy cattle led to a natural regeneration of gorse, but currently Red Devons are grazed as a management tool, with attendant development of beef production. Other drivers of change over the past few decades have included replacement of the salt marshes between the two ridges by freshwater bogs and a lake (‘The Little Sea’). The ingress of tourists helps the economy, but generates some less favourable environmental pressures.

The NT is evidently moving more into environmental management. During the 1930s, Captain Cyril Diver was the first DG of English Nature (which in 2006 amalgamated with related organisations to form Natural England). He was a pioneer of ‘conservation’ needs, and became the first champion of the Purbecks. He left an immense record of notes and specimens. A two year project is underway to catalogue his work and to map the changes since then.

**Wildlife**

The NT covers many working areas (including woods), and their dependent floral and faunal complexes. There are around 600 flowering plant species recorded, including 9 orchids, with about 400 rare protected species, including the early English gentian. There is a huge variety of insects, including 30+ breeding butterfly species. Current projects include:

- Reviving long neglected coppicing (which has resulted in the return of the white admiral butterfly) and finding best culling levels for Sika deer. These attack young growth; hence the talk of reintroducing top predators like wolves and ocelots to restore some population balance.
- The relationship of grass species to grazing; relative numbers of representative butterfly species as a factor of monitoring climate change. Of particular interest are two butterflies, the Lulworth skipper (Thymelicus acteon - unique to the area) with a larval food-plant of horseshoe vetch (Hippocrepis comosa), a species characteristic of calcareous grassland, and Adonis blue (Polyommatus bellargus) on tor grass (Brachypodium pinnatum).
- Cataloguing ‘veteran’ trees. The most interesting oaks are those in decline when they support a wide array of wildlife, some rare and endangered, such as Bechstein bats.
- Looking at the possibility of re-establishing the red squirrel.

As many as 250 bird species exist in the range of environments. Inland migrants include over-wintering redwing and fieldfare which feed on berries. Over summer migrants include whinchat, blackcap and chiffchaff. These feed on insects. Seabirds such as razor bills, guillemots, gulls, shags and fulmars are conspicuous on the coast. Britain’s most easterly puffin colony is found here. The Anvil Point lighthouse near Durlston Castle is a point on the run of migrants, for example, 8,000 redwing were observed recently. Ringing is done in spring and autumn, and radio tagging is being investigated.

**Geology**

The Purbeck sedimentary rocks were deposited in shallow lagoons in the Jurassic and Cretaceous epochs. Purbeck stone is used in buildings locally, and it features decoratively all over the world. The various layers form stone of different character and colour, identified as blue, grey, and green, largely due to the fossils they contain. Although it is often termed Purbeck ‘Marble’ it is hard limestone and not a true metamorphosed rock marble. Stone quarried in other places is often termed Purbeck, but nowadays, definitions are subject to strict mineral controls. Those working are known as ‘marblers’ and belong to the ‘Ancient Order of Purbeck Marblers’.
Holme Nursery and Holme Priory Farm

Situated near Wareham, Simon and Stephen Goldsack developed separate careers from their father and his original 12 ha dairy farm. Land prices are very high, with Grade III and IV land for sale at £25,000 per ha, making agricultural use unsustainable. Simon, enthused by horticulture, created a nursery beside the original farm, plus tea rooms and a shop. He has planted an arboretum of 270 tree cultivars plus 160 apple and 120 pear trees. He has also become a consultant garden designer for construction companies.

Older brother Stephen took over his father’s tenancy at Holme Priory Farm in 1995, by which time it totalled 92 ha, additional land having been acquired with two herds of 230 cows. The limits of quotas and poor feed advice resulted in the herd last making a profit in 1995; so it was sold, with the quota, in 2003.

Stephen is now paid to be a custodian of the land. He benefits from the Basic Payment Scheme, and a Countryside Stewardship payment to manage the water meadows; sluice gates, of doubtful efficiency, were installed to create a wetland for waders. The meadows, no longer fertilised, are grazed and cut for hay; the rushes are cut once a year. Stephen thinks he is “being paid to farm badly”. This income is very limited, so 130 continental dairy breed beef suckler units are grazed and/or sold as store cattle. Maize and barley are grown on contract; but low fertility means low profitability. Farm buildings are sub-let for business. The cottages have been converted for holiday lets and B & B is available in the farmhouse.

Holme Priory

The Bond family can be traced in Cornwall back to the 1300s, migrating to the Purbecks in the 1600s. They “did well from the Civil War”, buying the now East Holme Priory of 600 ha. The Roman remains of the original Priory built by Robert de Lincoln have recently been traced. A more modern historic curiosity: a recent forbear was at school with Ian Fleming who evidently used his friend’s name in certain novels!

Ultimately, the low fertility meant unprofitable farming. Ball clay and aggregates mineral extraction were the income source in the 20th century. Current owner William (Will) Bond is an ‘ecological contractor’ with UK wide interests. The biomass boiler, fired from estate waste wood, provides hot water for the entire village, including the church. Photovoltaic cells on low productivity land covers 30 ha. About half of this land is grazed by sheep and there is some wheat grown. By comparison wheat production on this area would feed 400 households whereas the energy generated supplies 4,000. Will is bothered about climate change and is “doing something about it”. He wonders whether the Romans created water meadows to counteract the too fast draining land.

Back in the hotel, an excellent after dinner talk about the Purbeck stone industry was given by Trev Haysom from Landers Quarries (which we visited later).

Tuesday 30 June

Bere Farm

Bere Farm is situated in Litchett Matravers. Our host, Oliver Chamberlain, was asked to reflect upon his many years as a land agent in the area. He explained that most Dorset Estates are capital rich but cash poor; land management is essentially the same but the ‘business scenery’ has changed. All the small tenanted dairy farms have gone because of low profitability.

This visit viewed the ‘changes of use’ granted for a former dairy farmyard and out-buildings to light industrial/office units, and a farm shop. The shop would provide an outlet for local farmers with the emphasis on organic products, also with employment opportunities. Unfortunately, the initial success of the farm shop ended because of the recession and the cost of organic produce. A serious fire (when experimental batteries fed by windmills exploded) in 2009 disrupted everything. After several relaunch attempts the site was split into three: the Barn Café, Dorset Charcuterie, and the Whitepepper Cookery School. The rest of the units are occupied by light manufacturers. The project seems to be successful again now. A far cry from dairy farming, but good to see the buildings put to good use and offering employment.

Vitacress Salads

Welcoming the group, manager Mark Newton said that watercress, Nasturtium officinale (Brassicaceae), has assumed the status of a semi ‘super-food’, with more carotene than carrots, more iron than spinach, and pectin which is alleged to have anti-carcinogenic properties.

The crop depends on pure spring water from the local chalk bed. Growing beds are created by digging to the chalk then spreading 10mm of gravel for the roots. Seedlings, grown in coir for 14 days, arrive here from Lincolnshire and the ‘plugs’ must be planted within 24 hours. Fast growing in four weeks, and regenerating from roots, it is harvested three or four times at 10-14 day intervals. Fertilisation is by ‘organic’ (treated against pathogens) chicken manure; ‘conventional’ liquid manure proving too expensive. After flowing through the beds, water discharges into the river having been sampled to detect any contamination. A 2 m wide mechanical harvester track straddles the bed. Cress is cut in 100 kg batches, washed twice and vacuum cooled to 3°C. They are despatched to a
Hampshire farm and packed for Sainsbury’s the next day. Very little is sold in bunches now.

There are 5 ha of organic and 3 ha of conventional watercress on the site, yielding 700-800 grams and 1.2 kg/m² respectively per single cut. The farm, originally owned by Gesty, was sold to a Portuguese company, and is now part of a salad crop complex of farms in Portugal and the UK. Vitacress is a member of the Watercress Growing Association, which requires its members to abide by a number of regulations. Most stringent are those for protecting staff against Liver Fluke – if rainfall floods the beds, the site is stripped for cleaning.

**Trigon Estate**

Giles Sturdy’s forbear Dan moved to London in 1842 from his northern milling business and established Sturdy Brothers corn merchants at the time of the Corn Laws change – and made good. He bought the Trigon Estate in 1881, at the age of 50. The estate is currently 560 ha, of which 192 ha are farmed. Dan’s son (Giles’ grandfather) worked in the tropics, returning to England in 1899. He became a founder member of the NFU, and his son (father of Giles Sturdy) after working as an Agriculture Officer in Tanganyika, and then Director of Agriculture in Jamaica, returned to the farm in 1950. Giles Sturdy took over the farm in 1968, and went on to become prominent in the NFU.

In 1965, there were 60 cows producing 3,000 litres of milk. In 1990, 100 cows were producing 6,000 litres of milk, but now they have gone. Some conventional livestock farming remains, with 100 Simmental suckler cows calving in April/May, weaning at Christmas, and sold deadweight the following winter at 20 months. Other forms of income have been developed. It is designated an area of Outstanding Natural Beauty and land management is now in line with current government legislation. The woodland cycle of Scots pine and Sitka produces 1,000 tons of timber a year; and harvesting of broadleaves as biomass, supports a 100 tons a year woodchip business.

Solar panels have been installed, producing 10 MW. Efficiency is rising and costs are falling, but economic storage of electricity is needed to counteract erratic supply. Some 20 ha of old clay pits have been recently landfilled (another source of income), and commencing in 3 years’ time, they will produce 1 MW/hr of gas for 10 years. Local clubs shoot on the estate – generating a modest but useful income.

A very interesting feature of the estate is the traditional red brick house built in 1900, but with wings of stone added. These were built using the stone from the demolished original Wareham Bridge. Giles Sturdy’s grandfather bought it for £100, including the Norman arches of the original bridge.

**Trigon Fish Farm**

Manager Jim Adami gave the group an introduction to fish farming. The river, higher than the water meadows, now feeds fish tanks before discharging onto the fields. The travails of fish farming are many, since “fish make a profession of dying” – one year flying ducks broke overhead power cables, the broken ends dangled in the water, electrocuting the fish!

The fish farm started small in 1984, with gravel laid in the ponds. Unfortunately roach ate the gravel, which damaged processing machinery, so concrete floors were installed. High O₂ levels are a necessity, with an ideal temperature of 14-16°C. Birds, body parasites, fungal and bacterial diseases are ever present. Fewer antibiotics are used (mixed with feed) than most fish farms, and the consequent waste from 10-12 percent mortality is disposed of by a specialist company.

The water is good but not good enough to breed fry, so 25,000 are bought at 7-8 grams for 10 pence each. It became difficult to compete with supermarkets, but fortunately the Jewish market in London requires a 350-500 g fish, so the farm caters for this market. Some 100 tons of fish are produced in a year, at a 1:1 food conversion rate.

That evening, the group enjoyed a fascinating after dinner talk by Giles Sturdy on his research into his father’s time in Tanganyika in the first half of the 20th century.
Wednesday 1 July
Godlingston Manor Farm

Located near Swanage, Ben Bowerman’s farm has been in the family since 1949. It is a very good example of a former dairy farm which has moved with the times and is achieving income from modern diversification. The house and farmstead were ravaged by fire early in the 1800s and the extensive replacement buildings are very pleasing on the eye. The farm, as with much of the Purbecks, is very flora species rich and attracts the attention of wildlife conservationists. Ben showed the group around his farm.

Landers Quarries

The group visited Trev Haysom’s stone quarry and museum. Quarrying has continued from Roman times, initially by surface, and then by shaft and pit, locally known as ‘quarrs’. This is no longer practised, but remains are widely visible. In the 1700s industrial quarrying covered Durlston with hardly a patch of turf to be seen. Purbeck limestone was quarried for cap (roofing) stone and similar. From the sea quarries, a Portland type stone was mined and rowed to Swanage, for shipping to such destinations as the Martello towers, Dover harbour and colonial buildings in Jamaica.

Until 1948 one could dig anywhere and pay the local squire a fraction of every stone, but now, surface mining (usually by blasting) can be seen in three stages. First, a plot is designated as intending to open for active mining; second, the quarrying is done; and third, when completed, it must be refilled with the spoil. Digging cannot start in nearby designated plots until previous refilling has been completed. When working this particular quarry, several tunnels were discovered as evidence of past workings, which featured in the museum. Very large stone cuts, by drilling and hammering in spikes, had been abandoned. Speculation has been of plague and other reasons for withdrawal, but probably they were simply not up to standard, and so left.

Durlston Country Park

Durlston Country Park is on the coast on the outskirts of Swanage. A Park Ranger gave the group an informative talk, from which we learned that the park covers 112 ha at the eastern end of the Jurassic Coast World Heritage site. It features the castle built as a restaurant in 1886 by George Burt. He had worked in the quarries before joining his uncle John Mowlem’s stone business in London. He prospered, and on return became a benefactor in the Swanage area. The castle was restored in 2011 and is owned by Dorset County Council, which instead of funding from taxes is trying to run it as a business; but making money from a wildlife park is difficult. The castle has been restored by grant funding and has now become a thriving arts centre and an increasing source of income.

Durlston has some of the best wildflower hay meadows in the country. Some species compete with each other, so the aim is to establish a patchwork of habitats for biodiversity. The range of fossils is huge, but with only occasional intact specimens. In 1857, a well-known palaeontologist, Beccles, found 13 crocodile species each linked to a particular rock age and colour. The castle has a museum of many relevant items, and steps down to the sea, where the strata can be observed. In 2009, a complete crocodile skull from the early Cretaceous was exposed and found by the Earth Science Manager of the Jurassic Coast site. It is named Gonioholis kiplingi (after the author, for his interest in natural science). It is in the Dorset museum, and a cast can be seen at the Visitor Centre.

Ray Bartlett and Brian Wood
East Anglia Branch visit to Tony Reynolds at Thurlby Grange Farm: no-till farming in the Lincolnshire fens

Visits to see progress of no-till Conservation Agriculture at Thurlby Grange Home Farm have become regular, and keenly anticipated, events for TAA members and others, organised by the TAA's Land Husbandry Group in collaboration with the East Anglia Branch. They are always successful, principally as a result of the meticulous preparation and generous execution of the programme by Tony and his wife, Ruth, with help from their children and grandchildren. This visit was no exception.

What made this 6 June 2015 visit even more absorbing than usual was the predominance, amongst the 40 or so attendees, of farmers, farmers' sons and grandsons with practical knowledge of, or a keen desire to learn about, no-till Conservation Agriculture. It was an additional pleasure to have farmer/equipment designer Tony Gent and Simon Weaving of Weaving Machinery (www.weavingmachinery.net) present to explain the genesis and unique advantages of the new Weaving GD inclined disc no-till drills to be officially launched at Lincolnshire’s Cereals Exhibition on 10-11 June 2015.

Tony abandoned his ploughs and harrows in 2006, to transform his farm from high energy-and capital-demanding plough-based agriculture to 100 percent low-energy no-till farming system1. After an initial dip in fields with higher clay content, his yields of cereals and oilseed rape (OSR) have regained and surpassed pre-switch levels, as the soil regained its health and vigour. OSR yields are now 5 ton/ha and the combine has recorded wheat yields hovering around the 13 ton/ha mark. The rotation applied at the moment is as follows:

- 40 percent first (ie autumn-sown) wheat
- 20 percent second, (ie autumn-sown) wheat after wheat
- 20 percent oil-seed rape
- 20 percent spring-sown beans, oats or lupins (Figure 1)

As witnessed during the VI World Congress on Conservation Agriculture (see AgDev23 p28), there is now a strong recognition of the value of cover crops - a crucial component of Conservation Agriculture - to improve both the soil quality and crop yields. Oats, direct drilled after harvest, is gaining popularity as a cover crop in the UK (and is practised by Tony Gent).

Tony takes pride in divulging the detail of the benefits of no-till agriculture. For example, the 2013 level of soil organic matter at Home Farm reached 6.26 percent which is way above the average figure for the type of soil as recommended by DEFRA. The requirements for added P, K and lime are now practically zero, and the aim is to halve N applications (although that target is still being pursued). Earthworm counts are currently at 153/m² compared with 25/m² under conventional tillage (Figure 2). Water infiltration has improved exponentially and, of course, wild life numbers (of, for example, hares, lapwings and skylarks) are soaring. Crop production costs have plummeted (from £266 to £30/ha for wheat): an important component is overall fuel use, which has dropped from 96 to 41 litres/ha over ten years.

Figure 2. Tony takes care to make sure that the benefits of no-till are well understood. Here he demonstrates the high earthworm population in undisturbed soils

Blackgrass (Alopecurus myosuroides), which has become a barely-controllable menace in the UK's cereal growing regions, has been practically eliminated on the farm. As Tony explains, 80 percent of blackgrass seeds perish each year in undisturbed soil, so only 20 percent of the previous year’s seed bank will germinate. After 10 years of no-till, the remainder can be hand-rogued as required. This is just as well given the only herbicide controlling the weed is Bayer’s Atlantis which is fast losing its efficacy. And, of course, crop rotations are fundamental to the eradication process.

In the Weaving GD6000T (Figure 3) no-till drill, seed (and fertiliser if required) is delivered (via the pneumatic metering system) to the double offset disc soil openers. The novel aspect of this machine is that the discs are inclined at 25° to the vertical and trail the machine through being mounted on a king-pin system (Figure 4). The discs slice the soil and lift the top slice, allowing the seeds to be spread over a >50 mm band before the soil slice falls back in place (Figure 5). A rear compacting wheel leaves the soil looking practically undisturbed with minimal straw hair-pinning. Tony believes that the machine represents a quantum leap forward in no-till drill technology; and with a price tag of £60,000 (other sizes are available at a price of around £10,000/m), adopters will hope that it lives up to its promise.

Figure 1. No-till lupins in wheat residue

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1 Reports of previous visits (in June 2011 and March 2014) with more detail on the farming operation can be found on the TAA website under Publications and Land Husbandry Group Reports.
Although no-till has demonstrably and dramatically reduced N, P and K requirements, these can largely be met by the laying hen enterprise. There are 16,000 free-range Lohmann brown hens which are brought in at 16 weeks old and sold off at 72 weeks. The poultry house is automatically cleaned twice a week and produces 6-7 tonnes of manure/week. The birds consume 3,000 litres of water and 2 tonnes of food a day whilst producing their eggs destined for the supermarkets of the UK. The manure, on the other hand, is destined to raise the fertility of the farm’s soils in a neat integration of enterprises.

Acknowledgement

Very many thanks, as always, to Tony, Ruth and their family for their very special and generous hospitality.

Brian Sims and Amir Kassam

New TAA Zambia Branch

At the Executive Committee (ExCo) meeting on 29 September 2015, the new TAA Zambia Branch was formally approved. Dr Chris Kapembwa has been the driving force behind this venture, with earlier encouragement from the late Bill Reed, while Chris was studying at Bicton College. Chris has an MSc in agronomy from the University of Zambia, and a PhD on project management from Liverpool University. He has worked as a production manager, consultant, agronomist, project manager, and programme coordinator. Chris is now establishing the Branch, based in Ndola, with support from local agriculturalists and members of the Ministry of Agriculture. He is looking for support from other TAA members in Zambia.

Email: Zambia_organiser@taa.org.uk
Bill Reed, 1928-2015

Bill came from a farming family in North Devon and went up to St Catharine’s College, Cambridge in 1949 to read Agriculture. Part of the course involved one year of study of tropical agriculture at the Imperial College in Trinidad. Whilst in Cambridge, he was an active member of the student body at both sport and music. He rowed in the Fairbairn Cup race in his first year, and later coached the 2nd eight in 1952. He sang in the University Male Choir and was also a member of the Emmanuel Congregational Society. His love of travel began whilst in Trinidad at ICTA, when he sailed around the Lesser Antilles islands and then travelled through the USA by Greyhound bus.

Following graduation, he was posted to Nyasaland (now Malawi) in 1954 where he worked as an Agricultural Officer until early 1964, leaving just before the country achieved independence. This period, when he met Mavis his wife, was to be a big part of Bill’s life and he remembered that time fondly. He was involved with the construction of the Chelinda Dam on the Nyika Plateau shortly before he left, with wild animals including lion abounding. His daughter Catharine went to work in Malawi 25 years later and on visiting Nyika came across the family’s name in the visitors’ book. On pointing it out to the watchman the latter replied “Ah Madam - the tall huana”. This demonstrates the impression he made on people at the time and all through his life.

On returning to the UK from Malawi, Bill became involved in British agriculture once more as a representative for a poultry firm marketing day-old chicks. He travelled widely in the South West but he and Mavis established the family home in Marnhull in 1971, the small village in North Dorset where he was eventually laid to rest. He played an active part in all community events in the village, was always ready to welcome newcomers, and participated fully in the local church and with the village school. He was a charter member of Blackmore Vale Lions Club, serving two years as President and being the District 105D Governor from 1993 until 1996. He was a keen bird watcher and in later years he and Mavis worked as National Trust volunteers at Stourhead. He kept up his love of music by singing in local choirs and with family visits to the Royal Albert Hall, the most recent occasion being shortly before his death.

Although these activities would appear to take up all his time, in fact one of his main delights during the last two decades has been his involvement with the TAA and the Nyika-Vwaza Trust, rekindling his love for Africa and Malawi in particular. He was initially a committee member for the TAA South West branch and then represented us on the national Executive Committee for many years. He played a major part in encouraging new members and was very persuasive in marketing the TAA tie! When Mavis died suddenly four years ago he was obviously grief stricken but demonstrated his indomitable spirit by holding an impromptu TAA meeting at her funeral, of which she would have no doubt thoroughly approved. He also joined the SW members a few weeks later on a visit to Cornwall, which he confessed helped him to get over his grief. In July this year, when recovering from a spell in hospital, he was bitterly disappointed not to be able to join the group for its visit to the Purbecks, but he did come down for lunch on the last day, which for many of us was to be our last meeting with him.

An abiding interest in Africa was obviously passed on to his children. In the late 1980s, Bill and Mavis returned to Kenya and Malawi for the first time in a quarter of a century. They spent a month with their son John in Malakisi, western Kenya, where he was working with small-scale tobacco farmers for BAT, and they went on to Blantyre, where Catharine was teaching at St Andrew’s Primary School, for another month. Thereafter, whenever they could, they took the opportunity to travel, visiting Catharine at Turi School in Kenya, and travelling to see John in Kampala, Beijing and Kuala Lumpur. Catharine still teaches in the Cayman Islands.

In recent years Bill has used these occasions to form links for the TAA with Moi University in Kenya, and the Caribbean. In fact he was still promoting the latter during his most recent visit to Cayman in March this year. He was surprised and thrilled to be a VIP guest at the Annual Ash Wednesday Cayman Agricultural Show the day after his arrival.

There is no doubt that Bill was a true gentleman who lived life to the full with remarkable determination, pride in his family, and a firmly rooted Christian faith. This spirit he retained through his brief illness and up to his death on 12 August.

The decision of the TAA to honour him with a posthumous Award of Merit at our 2015 AGM is in recognition of the passion and effort that he gave to our organisation. His enthusiasm and helpful encouragement are sorely missed.

Tim Roberts
(with contributions from Catharine, John and Sarah)
Maurice Purnell, 1930-2015

“‘The thing I most remember about Maurice was his commitment and dedication - technically on issues such as land evaluation, and institutionally in his work for FAO’s Pensioners Association.’ There can be no better way of starting than by this tribute, written by a colleague.

Following an Oxford Geography degree, in 1953 Maurice Purnell was recruited by CP Charter to the newly-established Soil and Land Use Survey of the Gold Coast (now Ghana). This was one of the first British overseas territories to establish a strong national survey, and it is notable how many of their staff went on to follow distinguished careers in soil science. This was followed by four years with Hunting Technical Services, extending his experience to Iraq and Pakistan.

In 1961 he joined FAO, with which he was to spend the rest of his career. Initially this was with their field staff, providing soil surveys for projects in Brazil, Fiji, Myanmar (then Burma) and the vast surveys for the Jebel Marra area of Sudan. The most distinctive was a survey, 1970-73, in Myanmar, where he worked with Russian colleagues Rozanov and Gazunov, being able to communicate with the latter with a shared fluency in Spanish. In 2006, when writing my history of Colonial soil surveys, Thin on the Ground, in answer to a request, Maurice wrote, “Our project was the development, with irrigation, of the Sittang Valley - a pretty huge area and, if I say it myself, I did some the best field survey work I ever did in pretty difficult conditions, and trained the locals pretty well too. We were constantly under armed guard to protect us from insurgents.”

In 1977, he joined FAO Head Office in Rome as a Technical Officer in AGLS, the Soils Service of the Land and Water Development Division, with which he was to spend the rest of his working life. FAO was nearing completion of the first Soil Map of the World, and the question arose where to go next to translate this knowledge into terms of development potential. A meeting was called at which the approach of land evaluation developed by Netherlands Scientists Klaas-Jan Beek and Robert Brinkman was adapted for FAO use, leading to the landmark publication, A Framework for Land Evaluation (1973). Maurice was to take a leading role in extending the Framework into detailed land evaluation guidelines for rainfed agriculture, irrigated agriculture, extensive grazing, and forestry. One could say he was FAO’s ‘Mr Land Evaluation’.

Subsequently he turned his efforts to the more complex issues of land use planning. On one occasion he recognised its complexity by reproducing MC Escher’s drawing of men endlessly trudging up circular steps without ever reaching their objective.

On reaching FAO’s retirement age in 1992, his services to them were by no means finished. He was active in FFMA, the association of professional staff, concerned particular with pensions. Besides representing staff in negotiations he was editor of their Newsbrief, bringing out an issue of this only a few weeks before his death.

Lacking personal ambition for top-level administrative posts, Maurice was especially helpful to younger staff, and hospitable to many visitors to Rome. From the earliest field projects he was also solicitous in training local staff. A former colleague writes of, “His capacity to maintain a calm working climate in his team… and a sustained interest in their well-being.”

He kept a flat in London to which he would retreat during the midsummer heat of Rome. His leisure interests were art and wine. A lifelong bachelor, Maurice would follow the lives of his brothers and sisters. Speaking at his funeral, his nephew said, “He was very proud of his family.”

Anthony Young
(with contributions from Hugh Brammer, Robert Brinkman, David Radcliffe and FAO Personnel Section)

Dr Peter R Goldsworthy (1931-2015)

Peter Russell Goldsworthy was an agronomist and a crop physiologist who spent most of his long professional career working overseas in the tropics as a research scientist and manager for agricultural development. Peter was born on 18 October 1931 in Kenilworth, Warwickshire to parents John and Elizabeth who also produced two daughters, Patricia and Nancy. Peter died on 19 September 2015, the day of his 62nd wedding anniversary, while pot fishing for lobsters, at Salcombe, south Devon, where he and his wife Jean Elizabeth built a house in the early 1960s.

Even as a schoolboy, Peter loved the countryside and spent much of his spare time, while he was at Warwick Primary School and Blundell’s School in Devon, on a farm that belonged to the family of a close school friend. Peter’s father was an engineer with Alfred Herberts, a machine tool company in Coventry; and his work was in heavy industry in the north of England. During his school holidays, Peter travelled with his father to steel mills and foundries in the 1940s and was able to see firsthand the grim living conditions of working people in the industrial region. The contrast between the country and urban environments led Peter to choose agriculture as his career. He was required to spend two years (1949-51) on farms
before going to university, first on a hill sheep farm in the Pennines, and then on a mixed farm in the Vale of York.

Peter took a BSc (Hons) degree in Agriculture at Leeds in 1953, followed by a 2-year post-graduate course in Agricultural Sciences at Cambridge and in Tropical Agriculture in Trinidad to prepare himself for an overseas post in the colonial service. While at Leeds, Peter met Jean who was a nurse at Leeds General Hospital, and they were married on 19 September 1953. At Leeds, Peter joined the University Air Squadron and learned to fly, which he kept up through much of his life. Peter was also a passionate yachtsman, a hobby he took up at an early age, becoming competent enough to sail across the Atlantic in his yacht, the Paradise Flycatcher, several times from Salcombe to Antigua and back.

Peter and Jean were together in Cambridge and Trinidad, and during all their overseas assignments subsequently. Jean brought a good Yorkshire realism and humour to their lives. After completion of his post-graduate studies, Peter moved to Nigeria where he worked from 1955 to 1969. Initially, he occupied the post of Agricultural Officer with the Ministry of Agriculture, Northern Nigeria, 1955-1958, based in Ilorin, Kano and Katsina, working on development and extension activities related to food and cash crops throughout the Savanna zones of Northern Nigeria. The work provided Peter with experience and acquaintance with a wide variety of agricultural and ecological regions of Nigeria that were typical of other parts of West Africa.

Peter then moved to the post of Research Fellow (Agronomist), 1958-1965, in the Research Division of the Ministry based in Samaru, Zaria. During this period he was responsible for agronomic trials as part of a programme to find ways of economically improving yields of food and cash crops throughout the savanna zones. He organised the data processing from several hundred trials, and in 1965, part of that work was submitted for an MSc degree at Leeds, and was accepted with Distinction.

Peter’s next assignment, from 1965-1969, was as Senior Research Fellow to examine the physiological causes of the low grain yield of West African sorghums. The work involved eco-physiological studies of growth and yield of long-season West African sorghums, short season sorghum from the USA, and locally developed hybrids. By then the research station at Samaru had become part of the Institute of Agricultural Research (IAR) of the Ahmadu Bello University, Zaria. The results of the research on sorghums were submitted for a PhD degree at the University of Reading in 1969, which Peter defended successfully. This work was part of a larger research programme at Samaru, which was benefitting from scientific advice and oversight from Professor Harry Darling, the Institute’s Director, and Professor Hugh Bunting and Dr Jeremy Elston at Reading University. Research at Samaru was aimed at explaining the phenological and eco-physiological basis of adaptation and yield of photosensitive sorghums in West Africa, which had been shown by Dr David Curtis, a collaborator of Peter’s, to exhibit adaptations to latitude and time that precisely related to the end of the rains at their home localities. Peter’s research on growth and yield physiology made a significant contribution to understanding the ‘source-sink’ relationships in sorghums in West Africa. During this period, he also served as the Head of the Agronomy Section at IAR, where his major contribution was to organise the experimental and statistical procedures for undertaking agronomic research and record keeping, all of which greatly improved the quality of field research at IAR.

On return to the UK in 1969, Peter was appointed to a position of Crop Physiologist at the Grassland Research Institute at Hurley in the Thames valley. The work was aimed at increasing the productivity of perennial grassland involving agronomic and physiology field studies including the measurement of carbon exchange of grass swards using a gas analysis technique and apparatus developed at Hurley. The project involved extensive use of a computer and of computer modelling. Although the work was interesting and provided Peter with an opportunity to use methods that were unavailable in a developing country environment, it seemed theoretical in comparison with what he had been doing. He was thus anxious to continue to work overseas.

In 1971, he joined the International Centre for Maize and Wheat Improvement (CIMMYT) in Mexico, as Crop Physiologist in the maize improvement programme. CIMMYT is an international research centre supported by the Consultative Group on International Agricultural Research (CGIAR). Peter spent an enjoyable and instructive six years there. It was while at CIMMYT that Peter had the first opportunity to become acquainted with the agriculture and research systems in many countries in Central and South America and in South and South East Asia.

In 1976, Peter moved back to Nigeria, as Assistant Director and Head of the Grain Legume Programme at the International Institute of Tropical Agriculture (IITA), Ibadan. At IITA, he was responsible for the direction and development of IITA’s Grain Legume Improvement Programme, which involved research by a large group of scientists from different disciplines, on three tropical grain legume crops (cowpea, soybean and Lima bean). Work was conducted in collaboration with national scientists at a series of sites representative of different major ecological zones in West Africa, and it extended to several countries in East Africa, and to collaborative programme of work with EMBRAPA (the Brazilian national agricultural research organisation) and regional institutes in Brazil.

From 1981 to 1986, Peter served as Deputy Director General (Research) at the International Centre for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria. He was responsible to the Director General for guidance and supervision of ICARDA’s resident research programme aimed at improving the productivity of agricultural systems in the dry Mediterranean environments with limited winter rainfall. The appointment gave him further experience in the organisation and management of a large multi-disciplinary team of scientists, economists and sociologists, and it extended significantly his earlier experience, mainly in the tropics, to an environment that was climatically and culturally quite different. It provided extensive opportunities for contacts with senior members of governments, donor agencies and with the directors and staff of other centres in the CGIAR system.

The experience gained at CIMMYT, IITA and ICARDA set Peter up for his next important assignment as Senior Scientist at the International Service for National Agricultural Research (ISNAR) in
The Hague, another CGIAR centre, where he served from 1987 to 1996. His responsibility was to advise national research programmes on the management of their research systems, and included a broad range of research management topics, with assignments in Latin America, North Africa, Asia, and the Pacific regions. These assignments included diagnostic reviews of complete research systems, or components of systems. The position involved work in inter-disciplinary groups, with biological scientists experienced in the management of research complementing others with backgrounds in management, economics, and social sciences. Peter was also responsible for an interdisciplinary programme to address the implications for agricultural research institutions in developing countries of integrating natural resource management and environmental issues into the research agenda.

During his busy career, Peter displayed admirable statistical, organisational and managerial abilities, and his good manners with people of all cultures and nationalities. Peter retired from active service from ISNAR. At the farewell party, the Director General, Dr Bonte-Friedheim, observed that Peter had gained the kind of experience one could not buy. For his long and dedicated service to tropical agricultural research and development, Peter was awarded an MBE in the Queen’s Honours List. Peter made a significant contribution to analytical agronomy and crop physiology of tropical field crops, especially sorghum and maize, as well as to the use of systems research methods in agriculture and management by national systems in developing countries. He grew enormously in stature as a scientist and as a research manager as he moved forward and upwards in his career, but he always kept his feet firmly on the ground. He always took a special interest in data management, statistical analysis and computer processing. He was a keen writer and published widely his work in agronomy, crop physiology, systems research and research management.

Peter will be remembered by many of his colleagues around the world, particularly in the CGIAR system and in national research organisations, for his cheerful nature, professionalism, hard work, courage, openness and collegiality. He was a kind and unassuming person, deeply committed to helping developing countries.

Peter is survived by his wife Jean Elizabeth, two sons, John Anthony and Michael Stewart, and six grandchildren.

Amir Kassam (with contributions from Michael Goldsworthy, Jeremy Elston and David Andrews)

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**TAAF News**

Nine MSc students and one final year BSc student from five UK universities received TAAF awards in April 2015 to enable them to undertake overseas research for their dissertations. The full list of awardees and the subjects on which they planned to work was shown in the Summer 2015 issue of the journal, *Ag4Dec 25*. Summaries of five reports by these awardees appear in this issue of the journal. The remaining five will appear in a later issue.

One long term award was given in October 2015 to Hannah Wright, a PhD student from Lancaster University, for a 6 month study of the effects of alternate wetting and drying on phosphate availability, uptake, crop yields and water use efficiency in lowland irrigated rice in Madagascar. Hannah has just started work in the field, where she will collaborate with scientists from the Africa Rice Centre, Radio-Isotope Laboratory of the University of Antananarivo, Lancaster University and Rothamsted Research.

Links have been forged with Writhlington School, a comprehensive school in Somerset, which has an interesting collaboration with an agricultural college in Rwanda on an orchid propagation project. It is anticipated that students from this school may apply for TAAF awards in the future, once they have completed their university studies.

The 2015 Ralph Melville Memorial Lectures will focus on the changing demand for UK natural resource specialists in international development today. Four TAAF awardees - two from 2015 and two from 5-10 years back - will make presentations on their work as awardees and on their subsequent employment, to throw light on the part that TAA and TAAF have played in launching new graduates on their careers. It is hoped that this will spark off discussion on how TAA and TAAF can adapt to a changing environment and become more effective in generating an ongoing cadre of UK specialists in natural resource development.

TAAF’s contributions to its awardees, both financial and professional through the mentoring service that we offer, are clearly greatly appreciated by the award recipients. As ever we struggle to raise the necessary funds to keep the award scheme going.

The financial contributions made by individual TAA members are greatly appreciated. We hope that they will continue to flow in, and we will put them to excellent use. We would like also to remind members of the plea made in the Winter 2014 issue of the journal (*Ag4Dec 23*, p 59) to “Remember TAAF in your Will”. Such legacies would put TAAF on a much firmer financial footing. They would also bring significant tax benefits to donors and would cost family beneficiaries very little. Please look again at our appeal and consider if you can make this generous gesture and ensure the future of TAAF’s important work.
James Alden, MSc Environmental Technology, Imperial College

*Designing and evaluating a tool to aid science-led decision making for smallholder coffee farmers in Central America*

James writes: “In 2014, the total global export value of coffee for producing nations well exceeded $20 billion; despite this seemingly vast sum, we are currently in the midst of a ‘coffee crisis’, with producers being hit hardest. Breakdowns in the International Coffee Agreement (ICA) and influxes from newly emerging Asian markets have resulted in an oversupply of poor quality coffee and destabilised, low prices. These issues have been magnified by increasingly volatile climatic conditions, and a lack of access to credit for farmers, which force them to grow poorer quality, easily cultivated coffee varieties, adding to the already harsh market environment. Farmers are being forced to sell assets, reduce expenditure on food consumption and school fees, and in some cases migrate to cities in search of alternative income, and these trends are continuing to worsen.

Our project set out to pilot a new methodology, aimed at improving coffee farm net present value, through the use of an environmental data collection toolkit and a computer simulation model, providing farmers with greater information to make better farm and crop management decisions. My specific goal was to develop and pilot the physical toolkit to enable cost-effective and accurate environmental data to be collected from farms. The data collected would be used to provide farm-specific decision support on how to maximise yields and yield quality, and to determine which adaptation strategies used to face climate change would be most appropriate for each farm. During this study, the approach was evaluated for potential efficacy, through communication to farmers and specific trials in the field.

With the support of the TAAF award, and with the help of the Hanns R Neumann Stiftung (HRNS) foundation, Fairtrade and Becamo organisations, I was able to pilot the developed toolkit on a number of farms in Honduras. Whilst the approach being developed is still a work in progress, the pilot study enabled us to gauge exactly which parameters should be measured using the physical toolkit, and the most practical and cost-effective methods to do this under real field conditions. This will ensure that the toolkit is completely appropriate for the farms and farmers to which this project is directed.

The pilot also allowed us to talk to the farmers and understand where decision support was most needed, and to gauge whether the approach being developed would be accepted and incorporated by the farmers and cooperatives themselves. The response was positive, and our experience showed that empirical data from farms to guide decision making was severely lacking in this sector, supporting the continued development of this approach. We really believe that if this project can be implemented fully, we will be able to support coffee, and other smallholder, farmers in a personal, practical and effective way that has not been attempted before, to enable farmers to increase production and income despite a deteriorating economic and environmental climate.”

Paul Baranowski, MSc Environmental Technology, Imperial College

*Development of a decision support system for smallholder coffee farmers in Central America*

Paul writes: “Smallholder coffee farmers are being hit by pressures intrinsic to the coffee business, such as low unstable prices, and the extrinsic pressure of climate change. Global warming, local warming and shock events have combined to dramatically lower production and coffee quality. With their limited resources smallholders are particularly susceptible to these trends and consequently cannot achieve a sustainable income.

NGOs, governments and companies have tried to aid farmers by implementing three main approaches: farmer education, reducing climatic uncertainty and reducing price uncertainty. These have had measurable positive increases, but are not sufficient for the level of complexity incurred by climate change. Advice is commonly top-down, lacks specificity and does not account for the uncertainty presented by climate change.

The TAA funded two projects this year (James Alden’s and Paul Baranowski’s theses) that aimed to augment these current approaches to address their limitations through the development of a scientifically-based Decision Support System (DSS). This DSS used environmental data taken
from farms and combined them with farmer socio-economic data and farm characteristics (such as size and variety of coffee) to generate a simulation of how a farm’s Net Present Value (NPV) may change under different climatic scenarios and how the use of adaptation techniques could allow farmers to achieve a sustainable livelihood.

These projects combined experimental and qualitative research in Western Honduras to scope out the issues involved in the creation of such a DSS and outline how it can be developed and scaled up to be of practical use. James’ thesis focused on the methodology used in taking the data for the DSS, and Paul’s thesis focused on how this data could be used by the DSS.

Three major lessons were learnt from Paul’s thesis. Firstly, it is both possible and useful to combine environmental data, socio-economic data and farm characteristics and use them to provide guidance to smallholder coffee farmers. Secondly, it is necessary to develop a toolkit that can automatically collect environmental data from farms. Taking data manually results in a poor quality dataset unless considerable time and money is expended. Furthermore, the data collected by the toolkit will be central in filling in the knowledge gaps found in the contemporary scientific literature. Thirdly, we can use computer-modelling techniques to simulate how a farm’s NPV may change under given climatic scenarios and different adaptation techniques. Farmers can understand the output of the DSS and it is of practical use to their decision making.

The central conclusion of both James’ and Paul’s theses was that the DSS can provide a hugely valuable service to smallholder coffee farmers. James and Paul are now both working to use the lessons learnt from their theses to develop the DSS and scale it up. We are working with Fairtrade Labelling Organisation and HRNS and hope to have a prototype DSS constructed within the next three years.

The funding from the TAA was invaluable to us beginning this journey since without it we would not have been able to travel to Honduras to conduct our research. We are extremely grateful for the TAA’s generosity and for the expertise of Jonathan Stern and Antony Ellman who provided extensive guidance and encouragement throughout our projects.”

Sean Denny, MSc Conservation Science, Imperial College
An investigation into the factors driving agricultural burning practices bordering Amani Nature Reserve, Tanzania

Sean writes: “My Masters research and TAFF award took me to the Eastern Arc Mountains (EAM) of Tanzania, where I investigated the threat of agricultural burning practices to forest within Amani Nature Reserve (hereafter referred to as ‘Amani’). Not only are Amani’s forests home to some of the highest densities of endemic plants and vertebrates on Earth, they also provide water, hydropower, and favourable climatic conditions for tens of thousands of subsistence farmers. Through my research I sought to better understand the most prominent threat to these forests: fires emanating from the bordering agricultural communities that surround the reserve. Every February and March, many (but not all) subsistence farmers living on the edge of Amani burn their agricultural fields to clear them for cultivation. Often, these fires are poorly managed and, as a consequence, they sometimes spread into the reserve, destroying large swaths of forest and preventing the regeneration of previously burned areas.

The aim of my study was to determine whether certain social, economic, and demographic factors, as well as particular beliefs or attitudes among villagers, are related to whether a subsistence farmer chooses to burn his or her farm, and, if so, by which of two methods. In doing so, conservation efforts aimed at improving fire management in villages surrounding Amani can be better targeted to certain individuals, groups, or even villages that are particularly prone to fire use and poor fire management.

Two months of field work involving household surveys and focus groups revealed that normative beliefs - specifically whether or not a farmer perceived other farmers in the village to be burning farmland, and, also, whether village leaders approved of such practices - were highly related to whether a farmer burned his or her own farmland. Wealth was also found to be related to agricultural burning practices, with the poorest households burning farmland most often and disproportionately employing the more destructive of the two burning methods. Such findings can be used in future conservation and development efforts to improve fire management and the overall sustainability of agricultural practices around Amani Nature Reserve for the betterment of both globally-important biodiversity and tens of thousands of farmers reliant on Amani’s forests for their livelihoods.”

Figure 3. Fire on the border of Amani Nature Reserve

Figure 4. Approaching East Usambara Mountain from the south
**Natasha Howard, MSc Conservation Science, Imperial College**

**The value of different land use types in providing wild-harvested products to local communities in Madagascar**

Natasha writes: “Rural people in many parts of the world depend on products harvested from the wild for their livelihoods. Most of the literature focuses on the importance of forest in providing these products, but I wanted to focus on the role that other land uses including agricultural land (such as fallows in the swidden cycle) play in providing these valued products.

My project was a mixed methods study based in the Ankeniheny-Zahamena Corridor (CAZ) region of Madagascar’s Eastern Mountains rainforest and was done in association with the Malagasy NGO Madagasikara Voakajy (linked to a larger project called p4ges: www.p4ges.org). I have produced a thesis from this work and am now working with my collaborators to write this up into a paper. My colleague from Madagasikara Voakajy, Njaka Randrianarisoa, will be returning to the villages early in the New Year to disseminate the results (along with other results from a related project I was linked to). This information will also be disseminated to national scale policy makers interested in how conservation and other land management decisions influence local livelihoods.

We found that forest closed canopy is essential for products used in construction, but that other land uses play important roles in providing food and other products that are used on a more daily basis. All products are not available from simply one land use: a mosaic is needed to meet the communities’ requirements. As pressure from deforestation and protection rises on the remaining forest fragments, alternatives to wild products harvested, wherever they can be found, need to be developed.

![Figure 5. Natasha and Madagasikara at work in the field](image)

I really enjoyed the three months I spent in Madagascar collecting data with Madagasikara Voakajy. I learnt how data for such an extensive project are collected and managed, as well as meeting so many dedicated and hardworking conservationists. This project also brought home to me just how complex a field situation can be, and how vital it is to combine local knowledge and opinions with quantitative data to generate a true understanding of the situation on the ground.”

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**Callum Scotson, BSc Plant Biology, Aberystwyth**

**The genetic variability of cauliflory in Theobroma cacao accessions**

Callum writes: “It has previously been demonstrated that the cauliflorous flowers (flowers present on the trunk) of *Theobroma cacao* (cocoa trees) will produce a greater yield of cocoa than the flowers present within the canopy. The aim of my research is to investigate the heritability of cauliflory in *T. cacao* by studying flower distribution in over eighty genetic accessions at the International Cocoa Genebank, Cocoa Research Centre, University of the West Indies (UWI), Trinidad and Tobago.

While the data analysis is still ongoing, that which has been undertaken thus far suggests that the density of cauliflorous flowering is to some extent influenced by the variations in resource allocation within the plant that result from alterations in the branching structure. The branching structures appear to vary by accession group which may indicate that this is a genetically controlled trait. If this is found to be the case it would suggest that accession groups typically found to have only a single primary trunk, such as the TRD and MQQ accession groups, may allocate greater resources to this region and therefore produce a greater density of cauliflorous flowers, which may in turn increase yield.

The research project has expanded significantly since visiting the UWI - I am now coordinating a multidisciplinary, inter-institute research project which will involve the application of novel computed tomography image analysis techniques that I have developed over the summer. This will hopefully allow me to assess variations between cauliflorous and canopy pod and bean morphology. This is particularly exciting because the application of computed tomography
techniques has so far been limited within plant science research and, as far as I am aware, this will be the first instance of its use within a tropical crop science research context. This research will hopefully contribute towards ensuring that Trinidad and Tobago remains an international leader in the research and development of cocoa production.

Throughout the project I have developed numerous technical skills, but what has been of most value is the experience this opportunity has provided of working within a professional tropical crop research environment and of making contacts within both industry and the academic world. This would not have been possible if it were not for the TAA MSc Award. I am grateful for the support and generosity of the TAA and its members, without which this research would not have been possible.”

Antony Ellman and Alastair Stewart

Corporate Members’ Page

New Corporate Member: The Centre for Agroecology, Water and Resilience (CAWR), Coventry University

The provenance of the Centre

That Coventry University is not a traditional agricultural establishment arguably provides the intellectual freedom for the Centre for Agroecology, Water and Resilience (CAWR) to emerge as a cutting edge force for transformation in the sector. Some TAA members may know Prof Phil Harris, who founded the Centre in 2011 along with staff from the International Programme of Garden Organic (formerly the Henry Doubleday Research Association). On Phil’s retirement, the Directorship has been taken over by Dr Michel Pimbert, formerly of the International Institute for Environment and Development (IIED), and this has steered it firmly in the direction of agroecology, food sovereignty, participation and transdisciplinarity. Currently with 40 academic staff from a range of natural and social science disciplines, plus 25 doctoral students, and offering an MSc in Agroecology and Food Security, the Centre is based in eco-offices at Ryton Organic Gardens, just south-east of Coventry city centre.

The Stabilisation Agriculture Unit

Perhaps of most interest to TAA members is the unique Stabilisation Agriculture Unit of the Centre. The name was inspired by DFID’s Stabilisation Unit, and the Unit, headed by Dr Andrew Adam-Bradford, aims to enhance the ecological and social resilience of agricultural communities to withstand and respond to adverse conditions in countries affected by natural and human-induced disasters. In the pre-disaster phase, agroecology can, for example, be used as a land management tool in disaster risk reduction programmes, while in the post-disaster phase the aim of Stabilisation Agriculture is the swift re-establishment of primary food production systems that are more resilient than previous systems (Figures 1 and 2). Sustainable agriculture and food is thus used both as a means to bring about peace and stability, and as a means to avoid conflict or disaster.
The six main components of Stabilisation Agriculture comprise:

- Integrating and mainstreaming agroecology through programmes, policies and institutions, for disaster risk reduction (DRR).
- Agroecology for refugee camps and settlements.
- Urban agriculture for dispersed refugees and host communities in urban areas.
- Facilitating transitions: food aid to food production; combatant to farmer; refugee returnees to resettled refugees.
- Sustainable management of abiotic stresses in agriculture, such as drought, salinity, contaminated land and climate change.
- Sustainable management of biotic stresses in agriculture, such as invasive plant species, insect plagues.

Stabilisation Agriculture embraces an integrated and participatory approach to the management of agriculture in disasters and emergencies. As a result, programme ‘beneficiaries’ are transformed into pro-active agents of change, through processes that empower local communities, including refugees, internally displaced people (IDPs) and host communities. Integration is achieved at the programme, policy and institutional level, thus building capacity for local governments, non-governmental organisations (NGOs) and UN-Agencies, to support communities to scale-up and facilitate Stabilisation Agriculture interventions.

The Programme is able to draw on a range of disciplinary experts from within CAWR, covering humanitarian relief, gender, soil fertility, therapeutic horticulture, participatory approaches, invasive species, farm economics, organic production, fair trade, biodiversity, nutrition, food security, drought mitigation and dryland farming, rainwater harvesting and water resources, sustainable livestock, and urban agriculture. In addition, it draws from the University’s Centre for Trust, Peace and Social Relations, that includes expertise in peace building and conflict resolution.

**Invitation to join us!**

Notwithstanding the above skillsets, the Unit is developing a roster of consultants for occasional international consultancies and would love for those members of the TAA who take an agroecological perspective to come forward to join our ranks. Taking a transdisciplinarity approach - that is a unity of knowledge beyond disciplines - requires the inclusion of the highly skilled and experienced elders and seniors who have more often than not been marginalised from contemporary development projects, which we feel is both wrong and perilous.

So, if you would like to know more about our work or to join our Roster, please contact:

Dr Andrew Adam-Bradford PhD
Senior Research Fellow in Stabilisation Agriculture
Email: ab3805@coventry.ac.uk
Centre for Agroecology, Water & Resilience, Ryton Gardens, Wolston Lane, Coventry, Warwickshire, CV8 3LG, UK
Direct line: +44 (0) 24 7765 1601
Visit www.coventry.ac.uk/cawr

Andrew Adam-Bradford and Julia Wright
In at the deep end again

At the end of my reminiscences on soil surveying in the Gold Coast/Ghana (Brammer, 2013), I stated that FAO had recruited me for a soil survey in the Amazon Basin. Having hooked me, FAO changed my destination to East Pakistan. I recall being very disappointed at this switch. That prejudice was reinforced as I flew into the Province in September 1961 when all I could see below was water and wondered what I had let myself in for (Figure 1). I could not have been more wrong. The Amazon survey never took off as originally planned; and in East Pakistan, we eventually found a great diversity and complexity of soils, and identified wholly new soil-forming processes. It was a challenging and exciting place to be in the 1960s.

Preliminary observations

Given my ignorance of the environment in which I had come to work, it was fortunate that project operations did not begin immediately. That allowed me to travel the Province to get ahead of my intended trainees. An FAO agricultural team was still working on the Ganges-Kobadak Irrigation Project in the west, so I took the opportunity of paying them several visits to learn more about the soils and agriculture. I well recall my first visit in October 1961. Farmers had cut through the newly-built flood embankment alongside the Ganges river in over 40 places, believing that it would prevent fertile floodwater from benefitting their fields (the embankment had, of course, been built without local consultation, as was the practice in those days). So I had to take what seemed to be an aluminium bathtub for my journey from the end of the road at Kushia to the project HQ at Bheramara several miles upstream, a nerve-wracking experience on the swirling, fast-flowing Ganges.

The Province’s road network was poorly developed at that time. I enjoyed several visits to the south on the ancient, Rocket, paddle steamer. Travel to the North-west was by train: passengers had to cross the mighty Brahmaputra on a large ferry boat, walking across extensive areas of newly-deposited sand between trains and boat in the dry season with hundreds of other passengers and lines of coolies carrying cases and goods. I was highly embarrassed on my first trip by my servant Andrew asking an elderly Bengali to leave the spacious first class compartment for the sahib (me), which the judge (for so he was) quietly did – 15 years after British rule in India had ended!

On my arrival in Dacca (now Dhaka), I had found that my former next-door-neighbour in Kumasi, Ghana, was in East Pakistan, leading a Canadian team carrying out a soil and land use survey of the Chittagong Hill Tracts. So I paid them several visits over the next year, making sufficient traverses across the region with them - they had a helicopter for making quick access to traverses across the steep hill ranges - so that I could later distil their multi-volume report and maps into our District report format without our having to survey the region ourselves with more limited facilities.

The Water Board also had soil and agriculture survey teams, trained by earlier members of the FAO Ganges-Kobadak project team, now working in proposed irrigation project areas in other parts of the Province. Visiting them gave me the opportunity to gain a growing knowledge of important differences in the Province’s geomorphology, soils and agriculture. On one of these first field
visits, to an area near the foot of the Shillong Plateau (in India) and just before the main (amaru) rice crop harvest in November 1961, I recall arriving in a small town in the late afternoon and my Water Board companion being unable to buy more than a single egg in the market for our intended evening meal (I forget now how we survived). I witnessed poverty that I had never seen in the Gold Coast/Ghana.

In fact, I recall feeling, for the first few months in East Pakistan, as though I was falling without a parachute. The social environment was so different from that in Ghana where, especially in the south, the people were very outgoing, and women played an important role in society: indeed, ‘mammies’ ran market operations, and banks and trading companies willingly advanced them many thousands of pounds to operate their businesses. Conditions were quite different in East Pakistan. Poverty was manifestly more prevalent, and women were ‘concealed’. It took me time to adjust my sensors and gradually to appreciate the customs and tickle-points of my new colleagues and society.

**Brain stretching**

In the winter of 1963-64, the training programme gradually merged into the reconnaissance soil survey of Dacca District. Even near the capital, road communications were poor at that time. Much of the District had to be surveyed from boats: a hired launch to live on (Figure 2); fibreglass dinghies with outboard motors for access to field traverse start and end points (sometimes a daunting experience on rivers as big as the Ganges and Brahmaputra, and later on tidal rivers in the estuary and delta). I well recall my first view of the confluence of the mighty Ganges and Brahmaputra rivers: a high career point for a geographer!

During 1964-65, three other FAO staff members joined me, so that henceforth we were able to operate three District surveys each year. My role then changed to visiting each of the field parties several times each field season (December-May), maintaining soil correlation and later assisting with report preparation and editing. We were able to use excellent airphotos on 1:30,000 scale, quite different from the virtually unusable RAF post-war airphotos in the Gold Coast taken in the hazy harmattan season. Our project headquarters was at Lahore in West Pakistan which I visited for project meetings every two months throughout the project, sometimes enjoying magnificent views of the

![Figure 2. Floating field base, Meghna river, 1963](image)

flapped its long wings across northern India. From 1968, I became Project Commissioner responsible for the surveys in both wings, but I continued to live in Dacca. I confess that I never developed an interest in arid soils.

My experience in Pakistan was broadened by field trips while attending international soils congress meetings: in Australia and New Zealand in 1964 (supplemented by private visits to Hawaii and California on my way to Britain on home leave); in southern Spain and Portugal in 1966; and in Russia preceding the meeting in Bucharest, Romania, in 1968.

This was an exciting time to be soil surveying, especially in the tropics. Every day, one was moving into *terra incognita*, setting up and testing hypotheses attempting to explain one’s findings, and recording one’s information on maps and eventually in reports. Much of what we found in East Pakistan was new to soil science. We found that the Province’s floodplains were mainly flooded by rainwater ponded on the land when rivers were flowing at high levels, not by silty river water. That had important implications both for soil formation and for soil fertility. The alluvium was exposed to the air for sufficiently long in the dry season for rapid soil development to take place, and seasonal flooding with rainwater rapidly leached topsoils. Therefore, instead of the boring raw alluvium that I had expected to find, we found a great diversity and complexity of soils developed on the country’s different floodplains, terraces (actually uplifted blocks) and hill ranges, and we identified a wholly new soil-forming process (ferrolysis) which my colleague Robert Brinkman worked out later on a PhD thesis study. It was both challenging and rewarding, too, to be on the front line of an international network that was then developing successive iterations of what eventually became the USDA Soil Taxonomy and the FAO/Unesco Soil Map of the World.

Interesting and important as were our scientific findings, our surveys always had a practical objective: to provide the basis for increased agricultural production, farmers’ incomes and food security. I spent much time thinking of and developing ways to provide our new information in formats that could be understood and used by government planners, extension workers and students. That, too, was a challenging task, and one that I was fortunately able to carry forward in a following incarnation in Bangladesh (to be described later). I pulled together our findings in East Pakistan in my final FAO reports, in a new physiographic map of the Province and in the first soil map of the Bangladesh-to-be, later summarised in Brammer (1996).

### Traumas in 1970-71

Coastal East Pakistan was struck by a mega-cyclone in November 1970. Cyclones had seemed a normal part of the climate: there had been nine in the 1960s, one of which affected Dacca in May 1965 (when I happened to be out of town). The 1970 cyclone was much bigger: it was estimated that 300,000 (perhaps 500,000) people lost their lives. UNDP put me in charge of organising UN agricultural relief and rehabilitation efforts. We had carried out soil surveys of almost all the affected areas by then, so I was familiar with the different environments and what might be appropriate measures in different areas. I did what I could …

… but I never found out the extent to which my information and advice were used or usable. Political conditions were deteriorating in late-1970 and early-1971, culminating in political strikes and eventually the Pakistan military crackdown in April 1971. To cut a harrowing story short, I was evacuated to Rome. For six months thereafter, I was seconded to the World Bank in Washington to assist with the East Pakistan Land and Water Sector Study then in preparation, making the first land use and hydrological maps of the Province. The Bank then sought to attract me to a project in Mexico. Fortunately, at the critical point when I had to make a yes/no decision over the telephone, I was out of my room back in FAO headquarters, and before the second call came from Washington, FAO had offered me a post in Indonesia and I was able to decline the Bank offer. About that, I’ll reminisce in a later instalment.

### References


# Upcoming events

## Annam National Food & Agro-biodiversity Festival & Seminar on Food, Health & Agro-Biodiversity: Changing Paradigms

**Dates:** 10-14 December 2015  
**Start Time 1st Day:** 10:00  
**Details:** Food is the essence of cultural heritages and a reflection of the great diversity of life in our planet. In India food is revered as God and eating together ensures family and community cohesion. However, in every part of the world, communities are awakening to the devastating effects of corporate driven foods and farming systems.

This National Seminar focuses on the changing paradigms in food and agro-biodiversity and the impacts on health, social, economic and environmental scenarios. Other subjects for discussion include innovations in promoting locally produced food and processing technologies, the health benefits of indigenous foods, agro-biodiversity and nutritional security, food as medicine, traditional knowledge of food. For more details please visit our website.

**Venue:** Rajendra Maidanam, Kochi, Kerala, India  
**Website:** [http://cisa.co.in/activities/projects/annam/annam-2015-3/](http://cisa.co.in/activities/projects/annam/annam-2015-3/)

## TAA Curry Club Talk: ‘Not Just Wood’

**Date and Time:** 10 December, 2015  
Arrive 11:30 for registration and coffee.  
**Details:** The December talk will be presented by TAA member Mikael Grut, a forest economist. The talk ‘Not Just Wood’ will be about forestry today, including its interfaces with agriculture and animal husbandry and a consideration of climate change. More details to be announced later.

**Venue:** Strand Continental Hotel India Club, 143 Strand, London WC2 RJJA  
**Contact:** Terry Wiles  
email: southeast.convenor@taa.org.uk

## Oxford Real Farming Conference 2016

**Date:** 6-7 January 2016  
**Details:** The two-day Conference will offer a mix of practical farm-scale advice, showcase new techniques and discuss the global context in which farming takes place, including the economy and the policies that affect farming. ORFC delegates will hear from the many people across the UK and beyond who are showing that new models of farming work. Of benefit to those just starting out as farmers and a chance to hear from those who have been farming for some time.

**Venue:** Oxford Tower Hall, St Aldate’s, Oxford OX1 1BX, UK  
**Website:** [http://orfc.org.uk/orfc-2016/venue/](http://orfc.org.uk/orfc-2016/venue/)

## Contested Agronomy: Dynamics, Cases and Implications (Conference)

**Date and Time:** 23-25 February 2016, 10:00  
**Details:** A conference about the battlefields in agricultural research, past and present, addressing the politics of knowledge within the field of agronomy.

The attendance fee is £150. Some limited financial support is available for people based in developing countries.

**Venue:** Institute of Development Studies, University of Sussex, Brighton, UK.  
LEARNING, ACTION RESEARCH AND OUTREACH FOR INCLUSIVE DEVELOPMENT COURSE, WAGENGEN

Date: 29 Feb-18 March 20016

Details: ICRA (International Centre for development oriented Research in Agriculture) strengthens innovative capacity by providing training and coaching to individuals and teams from different backgrounds. This course is for professionals in tertiary agricultural education to prepare as competent graduates ready for the job market. In addition, you are requested to do action research that contributes to innovation for food security, and provide services for rural communities that support inclusive development. Are you ready to make your courses more interactive and interdisciplinary? How do competency-based learning approaches affect the way you design your courses? How do you determine what services to provide to surrounding communities? To what extent is your research relevant and useful to farmers and agribusiness? This course helps you find the answers to these questions. It is challenging and hands-on with a range of activities such as trainer-assisted group sessions, role play, case studies and excursions to Dutch universities.


Venue: Wageningen University, P.O. Box 9101, 6700 HB Wageningen, the Netherlands

ROYAL SOCIETY OF BIOLOGY UK PLANT SCIENCE CONF

Date: 11-12 April 2016

Details: Please save the dates in your diaries for this two-day conference, the national plant science event of the year! TAA is an organisational member of Royal Society of Biology and Ian Martin is our representative on the Advisory Panel of the RSB’s specialist group UKPSF

Venue: John Innes Centre in Norwich, NR4 7UH, UK

40TH ANNUAL CONFERENCE OF THE SOIL SCIENCE SOCIETY OF NIGERIA 2016

Date: 14 March 2016

Details: The urgent need for Nigeria to sustainably increase agricultural productivity and food security for the country’s 178.5 million people in the face of climate change, environmental degradation and declining soil fertility is a challenge that the Soil Scientists in the country are committed to solving. Conference theme: "Promoting use of Nigeria’s Soil Resources for Sustainable Ecosystem Services, Climate-Smart Agriculture, Food and Nutrition Security”.

Venue: University of Calabar, Cross River State, Nigeria

Contact: sssninfo@gmail.com

10TH INTERNATIONAL SYMPOSIUM ON AGRICULTURE AND THE ENVIRONMENT (AGROENVIRON 2016)

Date: 23-27 May 2016

Details: Our environment continues to evolve, as factors such as global climate change and atmospheric warming alter local weather and growing conditions for agricultural crops. To some extent increasing carbon dioxide levels and higher temperatures may enhance plant growth, but other factors such as more variable and extreme precipitation events, flooding, drought, and excessively high temperatures may act to diminish crop production.

This symposium seeks to provide a forum for scientists to present new research on environmental studies, agricultural research, processes of soil erosion by wind and water, conservation policies, and innovative practices to preserve and protect the soil, water, and air resources while at the same time providing for a sustainable agriculture.

Venue: Purdue University in West Lafayette, Indiana, USA

Further details: http://topsoil.nserl.purdue.edu/AgroEnviron2016/
**INT’L CONFERENCE ‘NEW HORIZONS IN PLANT SCIENCE**

**Date:** 9-11 June 2016  
**Details:** The Plant Physiology conference 2016 aims to gather renowned scientists, professors and research professionals across the globe under a single roof, where they can discuss their research, achievements and advancements in this field. This conference will lay a platform for the interaction between experts around the world and aims to accelerate scientific discoveries and major milestones in the field of Plant Physiology. The theme of the conference is “Novel Innovation, plant derived therapeutic agents and GM crop in plant science”.  
**Venue:** Dallas, USA  
**Registration:** [http://plantphysiology.conferenceseries.com/registration.php](http://plantphysiology.conferenceseries.com/registration.php)

**INTERNATIONAL CONFERENCE ON CONSERVATION AGRICULTURE AND SUSTAINABLE LAND USE**

**Date:** 31 May-2 June 2016  
**Details:** The conference aims to share knowledge of conservation agriculture (CA) internationally and across different scientific fields. Main topics:  
Soil science and geomorphology in CA Systems; Agro-ecological research in CA Systems; Yields and economy; Climate change and CA Systems; CA Systems and carbon cycle; Sustainability assessment of land use and cover change.  
The conference will include two days of plenary sessions with keynote speeches and a one-day field trip. Detailed programme will be available later. The application of CA Systems is spreading worldwide. New results in the field of scientific and practical applications are accumulating continuously and therefore it seems to be important to present and discuss about the new achievements.  
**Venue:** Hungarian Academy of Science, Budapest, Hungary  
**Further Details:** [http://caslu2016.mtafki.hu/registration.html](http://caslu2016.mtafki.hu/registration.html)

**LINKING RESEARCH TO INCLUSIVE DEVELOPMENT FOR FOOD SECURITY, COURSE, WAGENINGEN**

**Date:** 6-24 June 2016  
**Details:** ICRA (International Centre for development oriented Research in Agriculture) strengthens innovative capacity by providing training and coaching to individuals and teams from different backgrounds. This course is for researchers to make their work relevant for the inclusive development of involved communities, if it is to have any value. Agricultural professionals, farmers and their organisations may lack up to date information on how to most effectively improve food security.  
The course is challenging, varied and hands-on, including trainer-assisted group sessions, role-play, and field visits to research and development projects in the Netherlands. Training is tailored to participants’ needs and builds on their experiences, ensuring that the relevance can be applied most effectively in other situations. Class sizes are kept small, between 12 and 20 participants, to maximise trainer-trainee ratios and to enhance trainee interactions and opportunities for exchange.  
**Venue:** Wageningen, P.O. Box 9101, 6700 HB Wageningen, The Netherlands  

**21ST WORLD CONGRESS OF SOIL SCIENCE (WCSS)**

**Date:** 12-17 August 2018  
**Details:** The theme will be “Soils to feed and fuel the world”. The WCSS is the main event of the International Union of Soil Science. It takes place every four years and is open to all members of the IUSS and other participants.  
**Venue:** RioCentro Exhibition and Convention Centre, Rio de Janeiro, Brazil  
**For further information:** [http://www.21wcss.org/](http://www.21wcss.org/)
EcoSummit 2016 - Ecological Sustainability: Engineering Change

Details: The Summit will centre on the ecology of terrestrial ecosystems and all habitats that are integrated within those ecosystems, including river networks, wetlands and coastlines. Focus will be placed on fragile ecosystems that are more likely to suffer the consequences of climate change and anthropogenic pressure. However, in the current context of an increasing world population, changes in social habit (increasing world consumerism) and climate change, it is evident that agriculture is being intensified but with a growing awareness of the need to preserve and use sustainably world resources. Therefore, we will also address how terrestrial restoration can be carried out when the massive demand for food results in fragile ecosystems, forests and marginal lands being turned over to agriculture. Abstract Submission deadline: 29 January 2016.

Venue: Le Corum, Montpellier, France.

Further Information: http://www.ecosummit2016.org/

Registration: http://www.ecosummit2016.org/conference-register.asp
Confirmation of changes to membership subscriptions

The proposed changes to membership subscription rates, presented on page 68 of Agriculture for Development 25, were discussed and approved at the TAA AGM on 11 November 2015.

The new subscription rates reflect the improved content, presentation and quality of Agriculture for Development, and the significantly enhanced services provided to members. The membership structure is also simplified, which will facilitate administration by the volunteers who manage TAA membership. The new rates are effective from 1 August 2016.

We therefore request that the following new annual membership subscriptions are paid from 1 August 2016:

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PLEASE Set up a Standing Order (our preferred means of payment)

To all members: to ensure ongoing membership, please either amend your current Standing Order, or set up a new one, for your new annual payment on the 1 August each year. This will ensure that you receive the journal and other membership benefits.


If you have not yet signed a ‘Gift Aid’ form, please consider doing so since the TAA will then receive an additional 25% of your subscription from HMRC.

Thank you for your co-operation
How to become a member of the TAA

If you are reading someone else’s copy of *Agriculture for Development* and would like to join, or would like to encourage or sponsor someone to join, then please visit our website at [http://www.taa.org.uk/](http://www.taa.org.uk/)

**Step One - Application:** Applications can be made on-line at: [http://www.taa.org.uk/membership](http://www.taa.org.uk/membership)
Alternatively an application form can be downloaded, completed and sent to:
TAA Membership Secretary, 15 Westbourne Grove, Great Baddow, Chelmsford CM2 9RT.

**Step Two - Membership Type:** Decide on the type of membership you require – see the details and subscription rates below:

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**Step Three - Payment:** Payment details are on the website with ‘Bank Standing Order’ being the preferred method since this ensures annual payment is made and is one less thing to remember!

Payment can also be made by bank transfer, on-line using PayPal, or by cheque. 
Bank details are available from: treasurer@taa.org.uk

**Step Four - Access to website and Journals:** When application and payment has been received then the Membership Secretary will contact you with your membership number and log-in details for you to fully access the website and journals.
The latest journal will be sent to full members.

For membership enquiries contact: membership_secretary@taa.org.uk
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TAA is a registered charity, No. 800663, that aims to advance education, research and practice in tropical agriculture.

PUBLISHED BY THE TROPICAL AGRICULTURE ASSOCIATION (TAA)
ISSN 1759-0604 (Print) • ISSN 1759-0612 (Online)

TAA, Montpelier Professional Services, 1 Dashwood Square, Newton Stewart, Wigtownshire DG8 6EQ
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