Agriculture *for* Development

Tropical Agriculture Association

No. 29, Winter 2016

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 newsworthy 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.

Format

- An informative title not exceeding 10 words.
- Authors listed, usually with first name and surname.
- 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*).
- For papers longer than 1500 words, a short abstract (summary) of 150-200 words.
- 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.
- Do not use footnotes to the main text.
- Thousands should be indicated by a comma and no space *eg* 12,400.
- Use 's' rather than 'z' (*eg* fertiliser, organisation, mechanisation).
- Commercial equipment and products referred to should name the product and company, but addresses should be omitted.
- State any statistical methods used *eg* analysis of variance (ANOVA) and ensure that the analysis method chosen is appropriate for the data. Data tables presenting, for example, mean values should include the appropriate standard errors (SE) and degrees of freedom (DF).
- 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.
- Sources of funding should be listed in the acknowledgements.

References

- Key references should be quoted, but these should be kept to a minimum.
- Only papers accepted for publication or published may be cited.
- If at one point in the text it is necessary to cite two or more references, list them in chronological order, *eg* Walker (2009), Sims (2011), Harding (2016).
- At the end of the paper, give full details of references, in alphabetical order, and in the journal style, as per the examples below.
- Personal communications in the text should be cited as: initials, name, brief address, personal communication.

Journal (article): Bajželj B, Allwood JM, Cullen JM, 2013. Designing climate change mitigation plans that add up. *Environmental Science & Technology*, **47**(14), 8062-9.

Journal (online): Osborne K, Dolman AM, Burgess S, Johns KA, 2011. Disturbance and the dynamics of coral cover on the Great Barrier Reef (1995–2009). *PLoS ONE* http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0017516

Book: Brammer H, 2012. The physical geography of Bangladesh. Dhaka, Bangladesh: University Press Ltd.

Book (edited): Fuglie KO, Sun Ling Wang, Ball E, eds, 2012. *Productivity growth in agriculture: an international perspective*. Wallingford. UK: CAB International.

Book (chapter): Warner K, 1997. Patterns of tree growing by farmers in eastern Africa. In: Arnold JEM, Dewees PA, eds. *Farms, trees & farmers: responses to agricultural intensification*. London: Earthscan Publications, 90-137.

Conference proceedings (published): McIntosh RA, 1992. Catalogues of gene symbols for wheat. In: Miller TE, Koebner RM, eds. *Proceedings of the Seventh International Wheat Genetics Symposium*, 1987. Cambridge, UK: IPSR, 1225–1323.

Agency publication: Grace D, Jones B, eds, 2011. *Zoonoses (Project 1) Wildlife/domestic livestock interactions*. A final report to the Department for International Development, UK.

Dissertation or thesis: Lenné JM, 1978. *Studies of the biology and taxonomy of Colletotrichum species*. Melbourne, Australia: University of Melbourne, PhD thesis.

Online material: Lu HJ, Kottke R, Martin J, Bai G, Haley S, Rudd J, 2011. Identification and validation of molecular markers for marker assisted selection of Wsm2 in wheat. In: Plant and Animal Genomes XIX Conference, abstract W433. [http://www.intl-pag.org/19/abstracts/W68_PAGXIX_433.html] . Accessed 20 April 2012.

Tables

- Self-explanatory with an appropriate legend above the table, without abbreviations.
- Number with arabic numerals, *eg* Table 2.
- Refer to tables in the sequence in which they are presented.
- Use lower-case letters, *eg* a, b and c, for footnotes to tables.

Figures

- Self-explanatory with an appropriate legend below the figure, without abbreviations
- Number in a separate series from the tables.
- Use arabic numerals in the text, *eg* Figure 2.
- Subdivisions within figures should be labelled with lower-case letters, *eg* a, b and c

Submission

Your paper should be submitted ready for editing and publication.
Accepted text file types: Word (.DOC or .DOCX), Rich Text Format (.RTF) or Postscript (.PS) only.
Accepted figure file types: .TIF, .EPS or .PDF.
No lecture notes or PowerPoint presentations, please. If the paper is a presentation from a TAA meeting, please let us have this or as soon as possible afterwards so that there is no last minute rush in trying to meet the next publication deadline.

Send submissions via e-mail to coordinator_ag4dev@taa.org.uk preferably in an attached file.

Copyright

Cover images

High quality colour images, suitable for the cover of *Agriculture for Development*, are welcomed and should be sent to the Coordinating Editor (coordinator_ag4dev@taa.org.uk)

Cover photograph: Farmer evaluation of cowpea varieties, Chipata District, Zambia (Photo: Jim Ellis-Jones).

Contents

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.

contact:
coordinator_ag4dev@taa.org.uk
editor_ag4dev@taa.org.uk
Tel: 01298 27957

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Editorial

Climate change progress

A former Director of Lumle Agriculture Centre in Nepal, a senior research adviser at DFID and the EC, and Assistant Director General of Bioversity International (previously IPGRI) in Rome, Paul now divides his time between paid work as a consultant and unpaid work as the Coordinating Editor of Ag4Dev.

Climate change is still the biggest problem facing the world. September 2016 was the hottest September on record, and eleven of the last twelve months were also record-breakers. With 2016 likely to be the hottest year on record, as was 2015 and 2014, it is clear that climate warming has not "paused"! A recent newspaper article "*Arctic cities suddenly on thin ice*" reported that the thawing permafrost is rendering many buildings uninhabitable. WHO reported recently that in 2014, more than one million people died from dirty air in China, at least 600,000 in India, and more than 140,000 in Russia.

But there has also been some good news. A global agreement to eliminate hydrofluorocarbons (HFCs) will potentially reduce rising temperatures by as much as 0.5˚C; the International Civil Aviation Organisation has agreed to combat the impact of flying; and an Antarctic Pact is expected to be agreed soon. Perhaps most importantly the Paris Agreement on climate change was ratified in record time, and came into force on 4 November 2016. However, the current level of pledges will result in a 3˚C temperature rise in the next 50 years, leaving much more to do if the global temperature rise is to be kept to 2˚C, let alone the 1.5˚C maximum increase requested by developing countries.

The 11th Hugh Bunting Memorial Lecture on 9 November by Professor Tim Wheeler, entitled *Climate change and agriculture – risks and opportunities for food and farming systems in the tropics*, is therefore very timely. An extended summary of the presentation will be published in the next issue of this journal (*Ag4Dev30*, the Spring 2017 issue), which will be a special issue on *Climate-Smart Agriculture*, with Bruce Campbell and colleagues from the CGIAR programme on *Climate Change, Agriculture and Food Security* (CCAFS), as guest editors.

Part of the solution is more effective use of underutilised crops, and the article in this issue by Nazmul Haq and his co-authors describes the growth of the *Lablab* bean crop in Bangladesh. The *Moringa* tree, another underutilised crop, has been described by Ravi Joshi in previous issues of *Ag4Dev*. In this issue, he and his co-authors provide a global review of the pests of *Moringa*, and their management.

Brexit also continues to dominate the UK news, and one wonders what difference it will make to the UK's farmers, farming systems, trade in agricultural products, and support for research and development of farming systems in developing countries. Like many of us, Andrew Macmillan and Peter Beeden have concerns about Brexit, but they recognise that it may provide a unique opportunity to reform food production, processing and marketing in the UK, as a model for other countries to emulate. In *The UK should seize the Brexit moment to reform its food policies (and become a role model for other countries)*, which is a follow-up to their previous article *Perhaps we should all pay more for our food*, they explain how food price reforms could benefit farmers, consumers, and the environment. Such out-of-the-box thinking does not necessarily fall on deaf ears – in a recent speech to the world's Ministers of Agriculture, the FAO Director-General introduced several ideas from *Perhaps we should all pay more for our food*.

For farmers to improve their productivity, whilst coping with changing climates and minimising further damage to the environment, effective and efficient use of mechanisation is necessary. Brian Sims and David O'Neill, in their article *More power to their elbows: increasing smallholder farm productivity*, describe how this might be done.

It is encouraging to note the growth in the TAA's Institutional Members. We welcome NIAB (formerly the National Institute of Agricultural Botany), a world class agricultural research and development institution with headquarters outside Cambridge, as an Institutional Member. Lesley Boyd (Research Group Leader and Head of NIAB International) and Tinashe Chiurugwi (Project Manager, NIAB International) provide a short description of NIAB and some of its international activities. Another new Institutional Member is Mountain Lion Agriculture, Sierra Leone Ltd. Their Vice-President (Research and Development), Alex Zieba, describes the objectives and evolution of the company to become the largest rice producer in Sierra Leone; and he also provides an article on *Yield expectations and efficiencies in Sierra Leone*.

On more internal matters, our Membership Secretary and Treasurer appeal to all members to update their recently increased membership fee payments; and the redesigned TAA Annual Reunion in January 2017 is announced.

Paul Harding
Coordinating Editor

Yield expectations and efficiency in Sierra Leone

Alex Zieba

Dr Alex Zieba is Director and Vice President, Research and Development, of Mountain Lion Agriculture Sierra Leone Ltd (www.mlbr.org). As Sierra Leone's leading rice processor, Mountain Lion provides seed loans and assistance to thousands of smallholder supplier farmers, and operates a farm upon which to discover and demonstrate best practices. Dr Zieba also teaches at Heritage College in Gatineau PQ, Canada. azieba@cegep-heritage.qc.ca

Abstract

Agriculture projects in Sierra Leone frequently take their presuppositions from foreign financial and yield records, often from North America or Europe. These successes set yield expectations and propose a means of achieving them, based on "how we do it here". In turn, funding for an agriculture project often depends on planning to farm in the 'proven' way. The induction is cogent as long as the analogues are relevantly similar. In Sierra Leone, at best this means approaching the land after a soil test with the appropriate quantities of synthetic fertilisers required to obtain expected yield; it more likely means using a 'general' fertiliser mix without a soil test. One supposes that giving developing farmers access to the technologies we are using to succeed is what it means to help them.

Introduction

This paper shares the results of our experience with synthetic fertilisers, both on our research plots and working with thousands of small farmers growing local upland country rice in Sierra Leone over the last six years. To be clear, by 'fertilisers' I mean synthetic products, such as popular NPK mixes, KCl, or urea, rather than the broader sense which includes anything that improves fertility. We have concluded that synthetic fertilisers will not work in Sierra Leone, at least not at this time, and that yield expectations should not be modelled on North American or European farms, or even other rice growing regions.

Our most extreme experiment applied three times as much fertiliser as recommended, with careful attention to method of application. While this plot should have suffered, it did no better than an adjacent plot with the appropriate application rate, which did worse than one with no fertiliser added at all. Weeds thrived in fertilised plots, increasing the labour required to weed them. The general observation that fertilisers helped weeds and diseases, but not the crop, applied to all attempts by ourselves and the farmers we have worked with (Figure 1).

These strange findings needed explaining, for which we offer several related reasons under the headings of **Rain, Soil, Sun**, **Complexity** and **Economics.** Taken together, these differences have required us to re-evaluate how we measure **Efficiency** on farms in Sierra Leone.

Figure 1. Upland rice field near Makeni, Sierra Leone. Weed competition is significant.

Rain

Synthetic fertilisers are highly soluble. When North America receives twice as much rain as usual (as has happened in recent years) the rain is blamed for washing out the fertiliser and crops are lost. In Sierra Leone, there is approximately five times as much rain as we expect in North America or Europe (notwithstanding regional variations) during the rice-growing season. There is therefore no reason to suppose that these products will be effective under wetter conditions in Sierra Leone. These same circumstances affect the performance of foliar sprays, whether nutrients or pesticides. An additional limit to most of these products is that it is illegal (where environmental regulations exist) to use them near water, because of their susceptibility to enter ground water. During Sierra Leone's rainy rice-growing season, all ecologies are flooded, and the risk of water running over the field is constant.

Soil

The soil in Sierra Leone lacks fertility and is acidic, generally between pH 4.2-5.5, with a very low cation exchange capacity owing to low contents of native clay or humus and a high proportion of sand and stones. Sandy soils low in clay or humus are known to be subject to nutrient leaching, particularly in humid environments (Glatzel *et al*, 2014). Adding sufficient quantities of fertiliser to produce a yield similar to foreign expectations often represents such a drastic alteration of soil chemistry that no crop could survive the anticipated chemical reactions. A soil at pH 4.5 requires over

10,000 kg of limestone per hectare to correct, for example, which could not be applied at once (even if you had it) without giving up on that field for a year or two. These are the conditions under which the crop (generally rice) is expected to absorb nutrient molecules, but these nutrients have no cation exchange sites to adsorb to. Those cation exchange sites that do exist are often taken up by hydrogen ions (acid) and, as with many tropical wet acid soils, iron and aluminum – which are frequently at or near toxic levels. The cost of shipping adequate quantities of lime (without magnesium, which is adequate already) is generally prohibitive relative to the value of the crop, and global supply and market conditions limit availability of chemical fertilisers (and pesticides) to those that are most popular and cost least, such as urea nitrogen and potassium chlorate.

Urea nitrogen first breaks down into ammonium, before becoming nitrate, the form of nitrogen that plants use. However, ammonium (NH_4^+) is converted to nitrate (NO_3^-) by *releasing two hydrogen ions per nitrate ion;* since hydrogen ions are acidity, ammonium acidifies the soil at exactly twice the rate at which it supplies nitrate:

$$NH_4^+ + 2O_2 = NO_3^- + 2H^+ + H_2O$$

Nitrate is an anion (negatively charged ion) and so it is not held to cation exchange sites, leaving it free to be released or bind to other free-floating cations if not taken up by plants or other soil biota quickly. The extra hydrogen ions left behind compete for and occupy cation exchange sites.

Urea nitrogen starts out pH neutral, but creates carbonic acid as it breaks down to ammonium in soil with a pH of 6.3 or less:

$$CO(NH_2)_2 + 2H^+ + 2H_2O = 2(NH_4^+) + 2H_2CO_3$$

Recall from above that five times as much rain is falling already, at a pH of 5.5, largely due to carbonic acid from the atmosphere.

By acidifying the soil, nitrogen fertilisers further inhibit cation exchange, leading to an apparent nutrient deficiency (which we are invited to correct with more inputs); bacteria and mycelia that would convert organic matter to nitrate (and other nutrients) have difficulty surviving the acid environment (more so where pesticides are applied). As a result, fertiliser that is not leached is taken up by acid-loving weeds, which then thrive and compete with the crop, requiring more labour to control. Typical phosphate fertilisers, produced by treating mineral phosphorous with acids, similarly deposit their acid in the soil as part of releasing their nutrient molecule. We have further learned that use of urea or ammonium leads to calcium leaching (calcium in the soil is dislodged from cation exchange sites via acidification and moves out of the soil with rain), which leads to an imbalance in the soil in the ratio of calcium to magnesium, which leads to soil that appears hard, and sticky. Often farmers treat these latter conditions by tiling (draining) their field, or by getting a more powerful tractor, though neither will correct the imbalance between these nutrients.

Similar nutrient breakdown problems attend potassium chloride, which applies nearly as much chlorine to the soil as it does potassium; chlorine is expected to combine with nitrates in the soil (which may have been added as urea) to produce chlorine gas, which in turn affects soil biota in an already delicate environment (Hermary, 2006). Once dissolved, the potassium is highly subject to leaching, again because of an absence of organic matter or clay based cation exchange sites. Once again weeds responded better to this fertiliser application than the crop did. While we recognise that some synthetic fertilisers may break down in a way more conducive to the crop (though still susceptible to leaching), these were unavailable to us for shipment to Sierra Leone due to global supply issues.

Sun

Sunlight provides energy required by plants to process other nutrients and grow. There is a wide variation in the quantity (photoperiod) and intensity (bright sun hours) of sunlight between Sierra Leone and the growing seasons of other regions to which their yields are often compared. Many rice-growing regions save water from winter or a rainy season and irrigate rice growing in flooded paddy during a drier but sunny season. In Sierra Leone, rain-fed upland rice is planted in May at the beginning of the rainy (and so cloudy) season, under approximately 6 hours of bright sun per day. June averages less than 5 hours of bright sunlight per day; July averages less than 3 hours; and August averages just 2 hours and 17 minutes. Rice is frequently harvested in the rain before the dry season begins. Local farmers do not want to wait to plant (planning for rice to ripen and be harvested at the beginning of the dry season) because they risk losing seed to heavy rain or to pests, as it takes longer to germinate in cooler, cloudier conditions. At the other end of the season, late planting means that if rains end sooner than expected, the crop may be lost – an unacceptable risk. In Europe or North America growing seasons feature 14-18 hour photoperiods, whereas the photoperiods in Sierra Leone remain relatively constant, between 11.5-12.5 hours over the year. Therefore, there is a deficiency in both the quantity and quality of sunlight compared to the drier and sunnier conditions under which expectations may have been formed and varieties tested. These light variables should impact calculations of optimum nutrient levels in line with observations above, as they present limits to the energy with which the plant may process nutrients, even if they are available. Substantial investment in infrastructure would be required to irrigate crops during the dry season, which would not speak to temperatures exceeding 40°C during the sunniest months, presenting a different limit to the growing season.

Complexity

Complexity affects how reasonable it is to expect local smallholder farmers to be able to use concentrated synthetic fertilisers or pesticides. They may at best have a backpack sprayer to work with, and are not likely to have access to a soil test or personal safety equipment. It is difficult to calibrate a sprayer or spreader precisely and so achieve desired application rates. A degree of education is required to start with to complete the maths, and then making that calculation a reality requires matching up the output of the spray nozzle or

spreader opening and the area to be covered to the quantity in the tank or spreader, and *the rate at which the applicator moves*. The rate at which the applicator moves is fixed in developed countries by setting the speed of a tractor. However, achieving this consistency with a backpack sprayer (or small spreader) requires the applicator to move with the regularity of a machine. The farmer has to know how fast he walks, how fast he sweeps the wand, and be able to keep those constant. Anyone assisting with the process must be able to copy the same rates, or the equipment must be recalibrated to the new body. Fertiliser is more likely to be broadcast by hand by a group of different individuals, if it is available to smallholders. By contrast, a pesticide whose instructions are to "spray leaf surfaces but not to the point of runoff" (rather than 1 litre/hectare), or a fertiliser such as compost whose instructions are "apply a 3 cm layer" are both less complex to apply and generally more forgiving of errors. While this particular problem attends the conditions of the farm/farmer in Sierra Leone rather than soil or climate, it is nevertheless necessary to resolve it for local farmers to safely and cost-effectively use technologies which suppose that the training, oversight, and application/safety equipment are also present (Figure 2).

Figure 2. Moses Faithful Samou leads the farm team for Mountain Lion, shown here preparing soil at the start of the rainy season.

Economics

One thing that remains the same is that farming is undertaken partly as an economic activity, and a Sierra Leonean smallholder or village cooperative must still receive more for a harvested crop than they spend on it. The price of rice is largely fixed by global market conditions despite their apparent remoteness, as are the costs of shipping and handling, which frequently double the final investment the farm or village must make to access synthetic fertilisers or pesticides. Under these economic circumstances, these products would need to add roughly twice as much value to a crop as they do in their foreign analogues to be cost effective. However, in a baseline survey of farmers in the Bombali and Tonkolili districts, we learned that Sierra Leonean farmers are operating with approximately US$30 of annual disposable income to invest in farming. This means that shipped synthetic fertiliser is already prohibitively expensive for most smallholders, in addition to the relative risk. We have seen farmers take out large loans in order to access promoted chemicals, which then failed to improve yields. This is a catastrophe for a small farmer, and is part of our interest in disseminating these results.

Discussion: efficiency ratios

Taken together, these differences between Sierra Leone's climate and economics, and those of other nations, suggest that we should not be modelling our practices or yield expectations on those examples. Neither then will traditional metrics be accurate indicators of efficiency – never mind that the goals of Sierra Leonean agriculture development projects include increasing the number of men and women employed, which means that dollars spent on local labour benefit the local economy more than dollars spent on foreign inputs. Reflecting on these facts causes us to challenge the practice of reporting yield on the basis of area farmed as a primary and comparable measure of efficiency. For example, let us say that we plant a hectare of a crop, and yield X/hectare the first year. The next year we prepare the soil by raking the humus off the forest floor and spreading a hectare of humus on a hectare of land. Subsequently, we would report a yield of X + N/hectare, expecting some improvement in yield in return for the additional inputs. However, the yield of X+N was not achieved from the hectare initially measured. X+N required the addition of another hectare – perhaps several years' worth of growth from that hectare – from which resources were taken, as well as the labour to move them. By parity of reasoning, neither does conventional farming achieve its yields from the area reported, but from those hectares plus additional inputs concentrated onto that area in the form of fertiliser, pesticides, equipment, fuel, and labour (and light), and many of these resources required years to accumulate, as well as the collective efforts of society. Hence, while we intend to use yield/area to measure efficiency, the equation is wrong for this purpose, since efficiency is measured as a ratio of output/input.

Salonean farmers are differentially aware of these facts. They measure yields as a ratio of yield/seed rather than yield/area. For example, 30:1 is considered very good, *ie*, yielding 30 grains of rice for every grain planted; encouraging uniform seed spacing in rows increased this ratio to as much as 100:1, and so has been received as a highly beneficial practice. The area of land used to achieve this yield is not generally considered, beyond recognising the limits of their tribal territory, whereas the quantity of seed itself, which could otherwise be eaten as food, is therefore the most precious input to consider. It is their only input, other than labour. Having more seed means being able to farm more of the available land and utilise more available labour, which means a larger overall harvest. This is not to suggest that we should ignore the planting area – the point about efficiency made above rests on recognising the off-farm area used to generate inputs – but that planting area is one variable input among many. Given their growing conditions, 'yield/hectare' is lower than we might expect from a foreign perspective, but there is no movement of resources concentrating them from one area onto another either. Where the Salonean farmers' most precious resource is seed, a Western farmer's limit, or one in China whose field was levelled for flooding centuries ago, is planting area, which

may explain why all are tempted to use a single limiting factor as a primary indicator of efficiency. Perhaps neither is measuring efficiency, but their own sense of profitability.

Conclusions

We find that popular synthetic fertilisers have not improved yields in Sierra Leone, although additional shipping and handling costs require them to perform ***better*** than they would elsewhere to justify their cost relative to the market price of rice. Our understanding of this result suggests that we should not expect them to work, but instead to exacerbate existing fertility issues through acidification and nutrient leaching. Rainfall, soil chemistry and available sunlight affect rational yield expectations compared to foreign examples, in addition to economic limits. Efforts to use seed, labour and local resources more efficiently have better improved local efficiency ratios, and so show more promise. The conventional perspective assumes that it does not matter where plants get their nutrients from, because "molecules are molecules". However, we no longer accept that it does not matter whether a person ate food or took nutritional supplements ("molecules are molecules"). As we know, the body must be both healthy and prepared for food in order to digest it, that digestive processes stimulated by food are necessary to nutrient absorption, and that supplements are not as well absorbed as the same molecules delivered under the right conditions. We believe similar relationships hold true between our crops and the soil, and are turning our attention towards cover crops, nutrient recycling, and relationships with soil biota, as holding more promise for the long-term fertility of Sierra Leone's soils.

Acknowledgments

Thanks are due to MEDA (Mennonite Economic Development Association), Sarona Asset Management, the Horsch Foundation, and the AECF (African Enterprise Challenges Fund) for funding and consultation provided to Mountain Lion Agriculture in its efforts to improve the lives of small farmers in Sierra Leone.

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Hermary H, 2011. *Effects of some synthetic fertilizers on the soil ecosystem*. Society for Organic Urban Land Care, Victoria BC, Canada. Available at: http://www.organiclandcare.org/files/education/pesticides_and_fertilizers/Effects%20of%20some%20synthetic%20fertilizers.pdf

News from the Field

BOAT
Bicton Overseas Agricultural Trust
Charity No: 1017527
www.boatagtrust.co.uk

Improving agriculture through training

Bicton Overseas Agricultural Trust (BOAT) celebrates its 25th Anniversary

BOAT is a registered UK charity which provides high-quality training to enhance the management and business skills of key personnel involved in managing agricultural training institutes or rural development projects in developing countries. In particular, it concentrates on the provision of training in skills which are transferable and which can benefit a wider group of people than those participating directly in the training.

The Trust was formed in 1991, after a group of Devon farmers collaborated with the then Principal to fund a Thai student, who was working on a Devon farm, to attend a course at Bicton College. After successfully completing his training he returned to his institute to lecture in dairy husbandry. These farmers decided to establish BOAT to fund more such training for overseas students. As we celebrate our 25th birthday this year, the Devon agricultural industry, together with Bicton College (now merged with the Cornwall College Group) are still our major partners in delivering training.

BOAT's main activity has been the organisation and funding of an annual six-week residential course at Bicton College, and more than 90 participants have benefitted from this since 1991. In the early years, participants from widely diverse countries received training which was varied and tailored to individual interests.

However, in 1997, a new approach was adopted and since then, with one exception, all trainees have come from Africa – mainly East Africa.

BOAT Trustees with substantial overseas development experience know that management and business skills are lacking as much, if not more, than technical skills in many locally based organisations charged with delivering training and development services to their smallholder farmers and rural communities, particularly in Africa. And it is these locally based and locally staffed organisations which are the prime movers in rural development in these countries.

In 2006, the Bicton course was standardised to concentrate solely on Institutional Management and Business Planning, and in 2012 was offered as a Plymouth University-accredited short course with three Level 5 Modules, each attracting 10 Credits. The course is very intensive and fully timetabled. Fifty-six senior managers (20 female) of training institutes and rural development projects have completed this course to date.

The multiplier effect of BOAT's training is considerable. For example, BOAT signed an MoU with the Tanzania Government Livestock Training Agency (LITA) and their CEO, Margaret Pallangyo, attended the 2015 course. LITA manages six Livestock Training Campuses and last year graduated 1,500 Certificate and Diploma holders. Nearly 30 LITA Tanzania staff have benefitted from BOAT Training at Bicton.

Why bring these people to the UK you may ask? It is important that this course is delivered in a well-managed, land-based college environment as this type of institution is the underlying setting for the content of the course. Being in residence during the working term enables our students to experience UK college life and management at first hand. Our students also visit other training and educational establishments, as well as agribusinesses and farmers. When follow-up training is delivered in their home institutions, our Bicton graduates are able to relate more easily to the teaching.

As a result of individuals attending the Bicton training, strong links have developed with a number of institutions and organisations in East Africa. BOAT has delivered workshops in Malawi and Tanzania, and plans to expand its delivery of in-country training as well as providing general on-going support to these institutions.

BOAT training is rigorously evaluated, both at the end of the course and six months after trainees return home, and course reports are on our website. The feedback on BOAT's work is very positive, with numerous examples of improved management and training delivery which benefits many of the poorest in their countries.

Recently the Concern Universal Malawi Country Manager wrote: "*The BOAT course has been very useful for our attendees in a number of ways:*

- *It builds their confidence in their abilities and provides new tools. Everyone we sent was already a strong manager, but their attendance at BOAT really helped solidify communication and management techniques that allowed them to manage their projects more efficiently. Without fail everyone who has attended from CU Malawi took on additional programmes and responsibilities after they attended and did so extremely well and with confidence.*
- *A great way to exchange ideas with other practitioners – all of our attendees came back with exciting new ideas and a new energy that had a huge positive impact on our programmes, Country Team and beneficiaries.*"

Further information can be found on our website ***www.boatagtrust.co.uk***

David Wendover
BOAT Chairman

Newsflash

Outbreak of wheat blast in Bangladesh

In the first reported outbreak of wheat blast in Asia, 15,000 ha of wheat were destroyed on Bhola Island in southern Bangladesh early this year. The outbreak was associated with unusually warm and humid weather, but the origin of the infection is not known. The fungus, *Magnaporthe oryzae*, affects wheat more seriously than it does its original host plant rice, affecting and killing the grain, not merely affecting the leaves as it does with rice.

Wheat blast was first identified in Brazil in 1985 and subsequently spread to some three million ha across South American countries, wiping out production in some areas. In view of the potential for the disease to spread to important wheat-growing areas in northern India and Pakistan, the International Maize and Wheat Improvement Centre (CIMMYT) organised a conference in Kathmandu, Nepal, in June 2016 to review the situation and arrange relevant monitoring and research responses across the region. In Bangladesh, farmers in the affected area have been advised to treat wheat seed with one of two named fungicides or to plant alternative *rabi* (winter) crops such as pulses and oilseeds. CIMMYT and Bangladeshi scientists will monitor the situation both in the affected area and in other wheat-growing areas of Bangladesh. For more detailed information on wheat blast, see http://www.cimmyt.org/wheat-blast/

Hugh Brammer

More power to their elbows: increasing smallholder farm productivity

Brian Sims and David O'Neill

Brian Sims is an agricultural engineer with special interests in conservation agriculture and smallholder farm mechanisation. He is the former leader of the International Development Group (IDG) at Silsoe Research Institute (SRI).
BrianGSims@aol.com

David O'Neill is formerly of the IDG at SRI and until recently Chief Executive of the UK Institute of Ergonomics and Human Factors. His main professional interests are the productivity, welfare and safety of people whose livelihoods depend on rural enterprises.
doneillassoc@yahoo.co.uk

Abstract

Sustainable mechanisation means providing smallholder farmers with technically appropriate options which are compatible with their social, economic and cultural situations, and which do not deplete natural resources. Multiple options are discussed for increasing land and labour productivity, especially by improving timeliness and reducing drudgery, while at the same time avoiding an adverse environmental footprint. It is concluded that sustainable mechanisation should be made available to the smallholder farming sector as a matter of urgency via a cadre of well trained and equipped private sector service provision entrepreneurs.

Introduction

The problems of increasing world population, ensuring that the increased number of people is adequately fed, and the continuing degradation of the world's soils are the subject of continuing debate and discussion. Families with smallholdings play a vital role as farmers, and in developing countries up to 80 percent of food production results from their farming activities. Improving the supply of sustainable mechanisation inputs is a vital step towards smallholder farm productivity, and here we analyse the impacts of mechanisation and look at the potential for improving the livelihoods of smallholder farm families. For mechanisation to be sustainable it must be appropriate to the technical needs and capabilities of the smallholder family and fit well with their social, economic and cultural environment whilst, at the same time, being compatible with natural resource protection. We recognise the importance of having sustainable mechanisation options available for activities along the whole agricultural output value chain, but here we confine ourselves to on-farm opportunities.

Applying more energy per hectare to agricultural production (*eg* through the use of more powerful tractors) will not necessarily result in increased output either in terms of quantity or quality. Mechanisation, as is the case with all other agricultural inputs, must be applied judiciously and with specific targets in mind. This paper reviews the impacts that improved or increased mechanisation inputs can have by focusing on the following aspects:

- Increasing labour and land productivity, especially through improved timeliness of operations and reduced drudgery.
- Maintaining this increased productivity whilst conserving natural resources – sustainable crop production intensification.

Increasing labour productivity

As early as 1975, Giles (1975) had shown that agricultural productivity is positively correlated with farm power availability throughout the world. This does not imply, of course, that by simply distributing more power sources (especially tractors) the problems associated with low agricultural labour productivity will disappear. Associated implements and machinery need to be chosen for each agricultural power source (human, draught animal or engine) and a key goal is to raise the productivity of the agricultural enterprise with the labour available.

In a study specifically focused on sub-Saharan Africa, Bishop-Sambrook (FAO, 2005) observed that, in East Africa, the loss of cattle (used for animal traction) through disease, drought, distress sale, or theft had undermined the livelihood strategies of whole communities and had contributed to a drastic decline in agricultural production. Hoe cultivation had become the norm, resulting in smaller areas under cultivation (*ie* resulting in lower labour productivity), reduced total output, reduced cash cropping, increased food insecurity, reduced farm incomes and higher incidences of poverty and hunger. In West Africa, the loss of tractor-hire services in the communities studied had been tempered by substituting hired labour for tractors. The sustainability of this strategy will depend on the continued availability of hired labour at affordable prices.

Bishop-Sambrook concluded that farm mechanisation technologies gain considerable advantages in terms of area cultivated, crop diversity, yields, reduced levels of drudgery, opportunities to redeploy family labour and household food security. While hoe households typically cultivate 1-2 ha per year, oxen draught animal power (DAP) hirers cultivate 2 ha, households owning DAP cultivate 3-4 ha, 4-wheel tractor hirers cultivate about 8 ha, and households owning tractors cultivate more than 20 ha.

In a detailed study in Uganda, Barton *et al* (2002) found that, in the sorghum crop, hand weeding took 158 person-hours per hectare in the broadcast crop, compared to 35 person-hours per ha with DAP and line-planted crops. These savings in labour reduced weeding costs dramatically from over 50 percent of total crop production costs to 13 percent with DAP. Figures 1 and 2 allow an appreciation of the improvement in labour productivity made possible by the application of additional power using draught animals.

Figure 1. Hand-weeding a groundnut crop is both laborious and time-consuming (Photo: David O'Neill).

Figure 2. Crop weeding with draught animal power greatly increases labour productivity (Photo: Brian Sims).

It is clear that the availability of more farm power and appropriate equipment can greatly improve the output of farm labour. Legg *et al* (1993) put the importance of farm power into perspective by suggesting that a hand-hoe equipped farmer can grow enough food for three people, with DAP this can rise to six additional mouths, and with tractor power each farmer can produce food for fifty other people. There is a very wide range of simple technologies, capable of local manufacture, which can ease the effort, reduce drudgery and allow people to increase their output, maybe with less energy expenditure. Examples include: ergonomically superior hand tools, weed control with sprayers (Figure 3) and low-cost carts for human, animal and motorised power sources.

Figure 3. A back-pack sprayer adapted to a towing frame and ground wheel drive to make it into a 4-nozzle, 2 m field sprayer. The operator is distanced from the spray application which reduces the risk of contamination (Photo: Brian Sims).

Increasing land productivity

The availability of more farm power means that more land can be cultivated to produce a greater output of crops. However, cultivating more land may not be an option for a smallholder farmer wishing to emerge from near-subsistence production, if the potential for expansion is not readily accessible. The simplest way for subsistence farmers to make more effective use of their land (as well as labour) is to ***plant in rows*** rather than to broadcast. The justification often given for broadcasting is the shortage of labour during the crucial planting season so the speed of broadcasting is attractive, but all subsequent operations are hampered by the random layout of the plants and yields are generally relatively poor.

Other options to increase land productivity include:

Multi-cropping. Where rainfall and/or irrigation permit, then producing multiple crops per year on the same plot of land will raise the overall productivity of the land. Mechanisation can play an important role in facilitating multi-cropping through increasing the rapidity and efficiency of harvesting one crop and ensuring that the next crop is established as soon as possible. Increasing the available power will speed up the land preparation process. To cultivate a hectare by hand hoe can take up to 60 person-days per hectare, a job that might be accomplished with DAP in, say, 3-4 days and by a small tractor in 2-4 hours. Crop harvesting can be greatly speeded up with mechanisation. Cassava, for example, can be lifted by a tractor-mounted blade in a mere fraction of the time taken by arduous manual lifting. In China the rice harvesting system comprising two-wheel tractor-operated reaper plus thresher plus cleaner is being replaced by combine harvesters which accomplish all three tasks in one pass. One of the outstanding ways to reduce the turn-around time between harvesting one crop and establishing the next, is through the adoption of no-till or direct-seeding. In this case crop residues are left on the soil surface and specialist direct seeders or planters place the seed and fertiliser at the required depths and positions after cutting through the surface mulch and without inverting the soil. Untilled soils also provide improved trafficability and are capable of supporting both wheeled traffic and draught animals' hooves with less compaction and associated structural damage.

Precision agriculture. Precise application of valuable inputs (such as seed, fertiliser and agro-chemicals) can improve crop production and land productivity; an example is precision planters capable of placing seeds at precisely the right depth and spacing, and at the same time placing fertiliser to the side and below the crop line. Precision agriculture more generally has opened the door to crop (and animal) management systems that allow inputs to be precisely applied where they will maximise returns and keep costs to a minimum. Input use efficiency is optimised, environmental pollution is minimised and profitability is increased. It remains to be seen how quickly smallholders will respond to possibilities already available as dramatic improvements in internet penetration are leading to greater uptake of technology adoption in the developing world.

Controlled traffic farming. Soil degradation, especially through erosion and compaction, is disappointingly prevalent throughout the world (FAO & ITPS, 2015) and especially in the African continent (Jones *et al*, 2013). Degraded, compacted soils lose productivity. One particularly promising mechanisation development is controlling the traffic on agricultural soils by means of controlled-traffic farming (CTF). CTF is a way of reducing vehicle (or animal) compaction from the area where the crop is actually grown and confining the wheels (or hooves) to distinct and permanent traffic lines. One smallholder-friendly example of CTF is the use of permanent raised beds with residue retention for crop production, preferably also combined with conservation agricultural practices. Developed at the International Centre for Maize and Wheat Improvement (CIMMYT), permanent raised beds have been shown to be a sustainable production alternative to conventional tillage, with its associated high cost, both in rainfed and irrigated agriculture (Govaerts *et al*, 2007; Sayre & Hobbs, undated). Not only are yields improved (by up to 20 percent) but there are also marked savings in irrigation water use (of around 30 percent) when compared with flat-planted crops.

Improving timeliness

Insufficient farm power, especially at critical times of the cropping season, can lead to delayed operations with consequent yield penalties. Especially important in this case are the operations of crop establishment, crop care (especially weeding) and harvesting. In regions with marked seasons, crops planted outside the permissible planting window will incur increasingly drastic yield penalties which can exceed one percent for each additional day's delay. Controlling weeds early in the season is crucial to achieve maximum yields. Late or ineffective weeding can reduce yields to zero in the worst case scenario (Figure 4) and is usually the result of a scarcity of labour (farm power) at critical times. Planting crops in lines and using DAP weeders to clean the crop can have a dramatic effect on timeliness of the weeding operation and, consequently, on crop yields.

The precise timing of crop-care chemicals is of fundamental importance, not only to control the pest, disease or weed infestation that is the target, but also to ensure that the investment in agrochemical and application is not wasted. Diseases such as blight in potatoes (*Phytophthora* spp) and

Figure 4. Crop yields can be severely depleted if weeding is not effected on time (Photo: Jim Ellis-Jones).

pests like the African army worm (*Spodoptera* spp) can reduce yields to zero if not controlled in time. Field losses occurring as pre-harvest losses are, of course, dependent on the type of crop. Grain crops are particularly susceptible, whilst it may be possible to leave many tuber and root crops in the ground to be harvested when demand justifies it. In the case of grain and legume crops, losses due to delayed harvest can be the result of lodging, seed drop and predation from wildlife (especially birds such as the red-billed quelea (*Quelea quelea*) in Africa). In the USA, losses per day of delay in harvest from the optimum date have been calculated and vary between 0.3 percent per day for maize and 0.6 to 1 percent per day for soybean (Schuler, 2005). Clearly, speedy harvest at the optimum time is a requirement to reduce pre-harvest losses, and mechanised harvesting is the most logical choice.

Reducing drudgery

The drudgery associated with labour intensive traditional smallholder agriculture is a major factor driving young, able-bodied males into the urban sector in search of more rewarding work prospects. This process is ongoing and we can expect that 70 percent of the developing countries' population will be in the urban sector by 2050, compared with 50 percent now. This leaves the elderly, children and women on the farm, and it is their muscles that must do the work necessary for crop and animal production. The increasing feminisation of the smallholder agriculture sector means that attention to drudgery reduction becomes even more critical. Van Eerdewijk & Danielsen (2015) have looked at gender issues associated with the demand for farm power and they report that women who rely solely on their own muscular effort to carry out their agricultural tasks and their transport needs, whilst relying on only the most basic equipment, consider it to be physically exhausting. Reducing drudgery can be viewed as a way to increase labour productivity by permitting human energy to be more effectively converted into useful work.

If other power sources (particularly DAP, but also engine power) are not available then a logical approach is to consider whether hand-tools can be made more ergonomically efficient. Radwin (2003) considers that a tool is 'ergonomic' if it:

- Improves the performance and productivity of the operator and the quality of work.

- Reduces or eliminates the discomfort, fatigue and stress felt by the operator.
- If the design reduces the incidence of accidents or injuries.
- If the design does not diminish *any* of the above.

FAO (1994) provides detailed information on the application of ergonomics principles to the design and appraisal of agricultural machinery and equipment, and human-powered implements in particular. Making implements safer and easier to use (*ie* using less energy per unit of work output) is the overall goal. Making equipment more comfortable to use can also reduce the feelings of drudgery and tedium. The ability of a person to perform physical work and carry out agricultural tasks will depend on characteristics such as body size, strength, physical/cardiac fitness and general state of health/nutrition. This last characteristic is especially important in the context of the continuing HIV/AIDS pandemic.

The human energy demand of work can be estimated from the measurement of oxygen consumption or more simply, but less accurately, from heart rate. The discomfort (or pain) caused by the use of a particular tool (*eg* a hand-hoe) can be assessed by the use of body maps that allow the user to rank the discomfort produced at different sites on the body. There is some evidence that drudgery can be reduced and performance improved by engaging with the users of relatively simple equipment (for example, by participatory ergonomics) to identify and introduce design changes with those aims. Such changes may involve modifications to the size (linear dimensions) and shape of tools/equipment in order to improve posture (both whole body and limb posture), thereby reducing fatigue and drudgery. An alternative type of intervention may be a change to working practice such as a work-rest schedule or tool maintenance. Hand tools for digging, weeding and cutting (hoes and sickles) operate more effectively when they are sharp and this is a simple, but often overlooked, way of increasing productivity. Similarly, post-harvest processing equipment is very often amenable to design improvements to enhance throughput and ease of operation. For example changing from manual rice threshing to a pedal-powered thresher can increase labour productivity by a factor of five (O'Neill, 2007). More drastic changes to working practice may be adopted such as introducing draught animal power for land preparation and weeding. This is still labour-intensive but productivity increases significantly and so feelings of drudgery are diminished. In some communities the introduction of DAP for weeding (perceived as a mechanisation step) enables women to be relieved of this tedious task completely.

Despite the existence of some cultural barriers (as implied in the first quotation below), the most eloquent testimony for the need for an ergonomics input into hand-tool design, as well as supplying more farm power to smallholders, comes from the farmers themselves with quotes such as the following from IFAD *et al*. (1998):

"Standing up is lazy. The social issues are stronger than the engineering issues".

"Hoes with short handles make weeding easier and faster, but they give us backache. There is nothing we can do about that".

"Most tools for farming were originally meant for men, but circumstances now force women to use them".

"Without weeding do not expect any harvest. The back has to ache to conquer the weeds".

"As long as hoes are used by human power, there can be no increase in production. Improving hoes will not increase production. The only solution is replacing them with ox-drawn tools".

"*Animal traction makes the difference between night and day*".

Sustainability of production

Inappropriate mechanisation can degrade soils and can be the cause of accelerated deforestation as more land has to be brought into production to compensate for loss of land productivity and to restore output levels. Consequently, with finite land resources to produce more food, production intensification is a pressing, and on-going, necessity. At the same time we now have access to mechanisation inputs, appropriate for smallholder use, to practise an agriculture that specifically conserves and nurtures natural resources, especially soil and water.

The Food and Agriculture Organization of the United Nations (FAO) brings the twin needs of intensification and conservation into focus with the concept of sustainable production intensification (SPI). At the heart of SPI is the idea that, for sustainability, soils need to be conserved by eliminating the damage caused by tillage and this can be achieved by means of direct sowing methods. Soil surfaces exposed to rain and wind are prone to erosion so they need to be kept covered with organic matter; either through growing crops and cover crops and/or through residue retention. Organic soil cover also conserves soil moisture and serves as a feed-stock for soil biota. Soil nutrient supply is enhanced by organic matter decomposition and also by widening the diversity of crops through rotations, associations and sequences – especially through the inclusion of legumes in the cropping cycle. Implemented together these conservation practices have been shown to not only conserve natural resources, but increase cropping indices and boost crop yields over time. FAO has encapsulated the SPI concept in its *Save and Grow* book (FAO, 2011) which has been followed by more specific *Save and Grow* books on cassava (FAO, 2013) and maize, rice and wheat (FAO, 2016).

One important aspect of conservation agriculture systems is that, without energy-intensive soil tillage, the power requirement is greatly reduced. In general terms the energy needed for crop production can be halved. This means that smallholder farmers are able to expand the area under crop production and eliminate the need for the contract hire of costly, but also damaging, tillage operations.

Conclusions

The need for increased food production is clear as the world's human population heads towards 9 billion by 2050 and

migration to urban centres means that there are increasingly fewer people left in the farming sector to produce food for all. Thus, more farm power and mechanisation are going to be required as an essential input along with improved crops and animals capable of maintaining and increasing yields under the uncertain conditions resulting from climate change. Making sustainable, 'climate-smart' mechanisation available to smallholder farmers is a challenge. One of the most logical ways to ensure such provision in a scenario of high costs and low purchasing power is through well-trained and well-equipped private sector mechanisation hire services.

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The humble *Lablab* bean in Bangladesh: home garden to market

Nazmul Haq, Muhammad Saifullah, Mark A Chapman

Nazmul Haq is former director of the International Centre for Underutilised Crops. He works on all aspects of plant science research from physiology, to genetics, to realising the in-country potential of such crops. Nazmul was TAA Development Agriculturist of the Year in 2011.
N.N.Haq@soton.ac.uk

Muhammad Saifullah is a Principal Scientific Officer at the Natural Resource Management Division, Bangladesh Agricultural Research Council, Farmgate, Dhaka, and has been involved in vegetable crops research for over ten years.

Mark Chapman is co-ordinator of the Centre for Underutilised Crops and lecturer at the University of Southampton. His research into underutilised crops investigates stress tolerance for a changing climate as well as understanding the origin and diversification of the crops.

Abstract

With the threat of climate change, and a growing human population, causing food and nutrition insecurity throughout the world, researchers are identifying novel germplasm and new crops which might be able to mitigate the negative effects. For centuries, hundreds of crops have been grown locally but have been ignored by the research community. These crops grow on marginal lands and are managed by traditional famers with minimal inputs. We present here the story of one such underutilised crop, the *Lablab* bean, and discuss its history and the research being carried out in Bangladesh. It shows the emergence of a new crop from homestead to field scale cultivation through farmers' initiative.

Introduction: a need to investigate underutilised crops

The ability to nutritiously feed a growing population in the face of climate change is a concern for the scientific community and policy makers. The predicted 2°C increase in average temperatures has the potential to cause serious damage to crop production, with Bangladesh being one of the worst affected. This threat has prompted scientists to look into some traditional/indigenous crops farmers grow for subsistence since they provide food, nutrition and medicines for many people. The reason for this shift in focus away from the staples – rice and wheat – is that many of these indigenous crops are more resilient to heat and water stresses and are therefore more suitable for adapting to climate change. These crops are underutilised and their potential for sustainable agriculture and livelihoods has been reported by many authors (NAS, 1979; FAO, 1988; Haq, 2011) and in a series of publications by the International Plant Genetic Resources Institute (IPGRI, now Bioversity International).

In addition to tolerance to environmental stress, several underutilised vegetable crops can improve diets and potentially combat micronutrient deficiencies because they contain many vitamins and minerals. Enhanced use of these resources can increase income, provide assurance of harvest when other crops fail, aid in supplying nutrition, assist development through small-scale investment, improve efficiency and profitability of farm household labour use, and ultimately help alleviate poverty.

This is the story of one such underutilised crop in Bangladesh, the humble *Lablab* bean (*Lablab purpureus*). *Lablab* is most likely originally from Africa (Robotham & Chapman, 2015) and has subsequently been introduced to south-east Asia and other tropical, subtropical and warmer countries of the world. In the last few decades, the scale of production has moved from solely being grown by individual families for personal consumption, to large-scale field cultivation.

Homestead production and harvesting of *Lablab*

Traditionally, *Lablab*, otherwise known as hyacinth bean, country bean, *sheem*, *uri*, and dozens of other names, has been grown at homesteads, including in urban areas, for centuries in Bangladesh. Because of its climbing nature, one or two

stakes, depending on the number of plants, are used to support the plants, or it is allowed to climb up trees. House roofs are also used for the climbing plants to spread and they are grown mostly for family consumption. Young leaves, flowers and green pods are used as vegetables, and mature seeds are cooked to make *dhal* which has high protein content (21-29 percent).

At the village level, farmers who grow more plants in their homesteads and in small plots are able to sell any extra harvest for income. As an example of this, Nazmul Haq was collecting legume germplasm on behalf of the International Board for Plant Genetic Resources (IBPGR, now Bioversity International) in Chittagong district in the early 1980s, when he found a man and a woman selecting and processing *Lablab* beans. The beans were being grown along an *ail* (the raised earth partition) between rice fields. They were harvested every month and about 3 kg sent, along with French beans, to Saudi Arabia, where friends were employed as migrant workers. Thus a market was created through an individual entrepreneurship. Since this time the cultivation of this underutilised vegetable has increased, and it is now grown on a much larger scale, with a large tonnage of green pods and mature seeds exported to many countries, including the UK.

Towards field-scale production of *Lablab*

In addition to the pods and seeds, the leaves of the *Lablab* are used as forage for livestock and it is also grown for grazing. It makes good silage and is used as green manure because the crop can fix atmospheric nitrogen, which is then returned to the soil.

Lablab can grow in poor soil with little irrigation, but it does well in sandy loam, and clay soils are ideal provided they are well drained. It is therefore a profitable crop even when the conditions are poor. It is perennial but normally grown as an annual or biennial and is either a dwarf type or has a bushy, erect, climbing habit. It may be grown as a sole crop (see Figure 1) or in mixed production systems. *Lablab* grows well when intercropped with finger millet, pigeon pea, or maize. In north-west Bangladesh, a *Lablab*-based intercropping system provides a thick cover on the soil and forms a good mulch in orchards and plantations. Its production in multiple cropping systems is an added bonus, illustrating the versatility of this crop. Whilst harvesting in home gardens is done by women and children, at the field level both women and men are responsible for harvesting. The processing is carried out largely by women and packaging is done by both sexes.

Although the *Lablab* is an important winter vegetable crop in Bangladesh, varieties are being developed for growing in the summer; crop duration depends on varietal characteristics. For winter varieties, planting starts in June, and for late varieties it starts in August-September. Most winter varieties take 65-75 days to flower and 75-90 days to first harvest. Harvesting may continue for up to 140-150 days, making this crop extremely profitable. Summer varieties take 45-50 days to flower and 50-65 days to first harvest, and harvesting may continue for 100-120 days. In summer, yields may be reduced by flower drop-off due to high temperatures. Furthermore,

Figure 1. Field-scale production of *Lablab* in Bangladesh (Photo: Muhammad Saifullah).

summer brings an increased likelihood of pests and diseases, including fungi, mosaic virus, nematodes, pod borer, and other insects which lay their eggs in the seed or pods.

Yield varies widely depending on variety, location and management practices, but Haq (2011) reported that worldwide average seed and green pod yield ranges from 1.5 to 2.2 t/ha and 2.6 to 4.5 t/ha, respectively. Fodder yield can be as high as 5 to 10 t/ha. In Bangladesh, these numbers can be considerably higher, and in fact have risen substantially in the last decade (see below). For example, the average yield of green pods was 15.7 t/ha in 2014.

Lablab research, yield improvement and other benefits

The large number of varieties of the crop, the diverse agroecosystems in which it is grown, as well as pest and heat problems associated with attempting to grow the crop out of its normal season, highlight the need for proper evaluation of *Lablab*. The Plant Genetic Resources Centre (PGRC) and Bangladesh Agricultural Research Institute (BARI) maintain 540 accessions, and both institutions have been evaluating germplasm continuously to support farmers. This research is actively developing diverse varieties for different cropping systems (summer and longer shelf life types, short duration, dwarf varieties) and tolerance to environmental stress (drought/heat tolerance, resistance to salinity and diseases/pests). This will ensure *Lablab* is suited to different agroecological systems and meets the demands of different consumers.

These institutions have identified and improved several superior types for seed and vegetable use. Among them five varieties (BARI *Sheem* 1, 2, 4, 5 and 6) are cultivated in the winter season and two (BARI *Sheem* 3 and 7) in the summer season. In addition, IPSA *Sheem* 2 (heat tolerant) and BADC-*Porsha* (dwarf type) have been introduced to farmers.

The introduction of improved varieties to farmers has led to dramatic increases in production, and associated increases in the hectarage of land used for *Lablab* production. During the ten years 2003/04-2012/13, across 23 districts of Bangladesh, *Lablab* hectarage has increased by an average of 36 percent, and production has increased by nearly 60 percent (Bangladesh Bureau of Statistics, 2013; Figure 2). In some regions, for

example Bandarban, Dhaka, Jessore, Kushtia, Pabna and Rajshahi, overall production has doubled or even tripled. Profits have also increased relative to the costs of production, presumably because of the larger scale production and associated increases in harvesting efficiency (Islam & Karim, 1997).

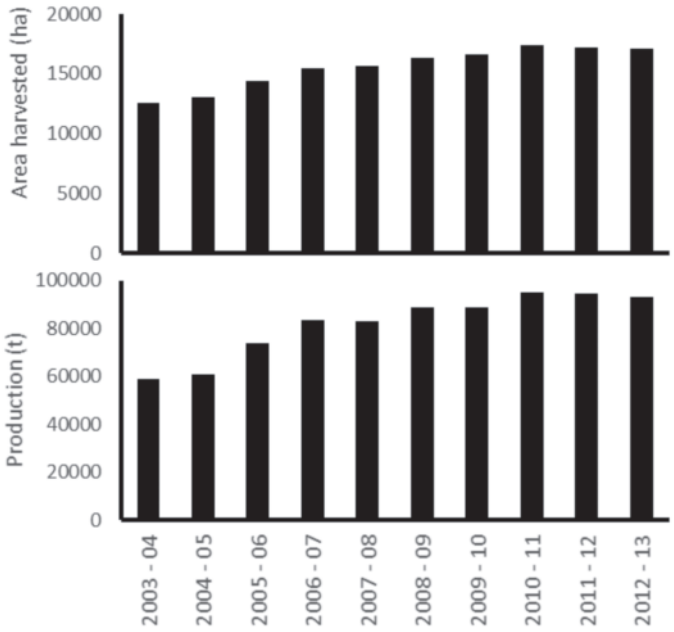

Figure 2. The increase in area harvested (ha; top) and production (t; bottom) of *Lablab* since 2003/04 (Source: Bangladesh Bureau of Statistics, 2013).

Lablab booming

Pabna district is one of the most prolific *Lablab*-producing districts and it has been pioneering *Lablab* production at field level using trellises. In addition, Pabna district has become very successful in the marketing of *Lablab*. Muladuli market in Pabna district is now a 'hub' where wholesalers come to purchase green pods from farmers who have travelled sometimes long distances within Pabna, and from nearby Natore district, to bring produce to the market. A large number (up to 80) of 5-tonne capacity trucks come to this market every day to transport beans to other districts. Because of increased demand, the production in Pabna district has almost doubled from 605 t in 2003-04 to 1,172 t in 2012-13. Farmers are interested in extending the production area, however this would require cold storage to be available in the area. *Lablab* is now exported by air to the UK and the Middle East, and by ship to Singapore, Malaysia, Vietnam, and Russia.

Conclusions

The *Lablab* bean serves as an excellent example of a crop with much potential but with little research to-date. *Lablab* is locally important in several areas of the world but has been relatively neglected by scientists. Our study demonstrates how farmers can develop markets, including international markets, through identification of consumer chains, and can bring a crop from marginal land to field scale cultivation for their economic benefit. We are at a time when research needs to be carried out on similar underutilised crops to identify novel sources of calories and nutrients. The Centre for Underutilised Crops (CUC) at Southampton University is carrying out research to develop these potential cops and is applying new technologies, including large-scale DNA sequencing.

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News from the Field

Farmers' Dialogue International: where farmers renew their calling to feed the world

As a programme of *Initiatives of Change* – a global movement of people who are changing the world for the better, starting with themselves (see uk.iofc.org) – *Farmers' Dialogue* is part of a worldwide network of people committed to the task of transforming society through change in the individuals, beginning with themselves.

For a long time, despite great differences in circumstances and climates across widely dispersed countries, there has been a common language between people who work the soil, many of whom have been at the forefront of improved farming methods and technological advances. Working cooperatively and exchanging ideas, they have played leading roles in significant agricultural developments and created lasting friendships as they share.

In 1994, several French farmers were visiting Ove Jensen, a Swedish dairy farmer, and some of his friends on their farms. The Swedish farmers questioned the visitors on what they felt about Sweden becoming part of the European Union, as this was being considered at the time. These exchanges stimulated the idea of expanding this group of farmers for debates on policy changes affecting farming issues across the world. These dialogues were the catalyst leading to the creation of the first *Farmers' Dialogue* that took place in Switzerland in 1994. Since then, nineteen *International Farmers' Dialogues* have taken place in sixteen countries.

British farmer Patrick Evans (Figure 1) is one of the initiators of *Farmers' Dialogue*. In his 1996 book *Farming For Ever*, Patrick posed the questions: *"Is farming a way of life that is past, or a powerful inspiration for the future? What is it that opens hearts and changes attitudes if not a fresh orientation of the spirit?"*

Figure 1. Patrick Evans, one of the founders of *Farmer' Dialogue*, in the Thailand meeting.

Farmers' Dialogue is attempting to create a space where farmers and agriculturalists can share their experiences and difficulties, their hopes and challenges, not only from a technical and agricultural point of view, but including personal aspects. Discussions are wide-ranging, alerting participants to the issues agriculture is facing, and inspiring farmers to kindle their passion, courage, hopes and ideas as they work the soil. Often, these dialogues have led to personal decisions, with significant consequences in terms of rural development on farms and beyond.

Discussions often include extreme weather events, effects of global climate change or decreasing water quality, that are having catastrophic effects on millions of lives. They also include the essential need to carefully balance these vital natural resources and food production. It is tragic to witness the unequal distribution of food and at the same time the lack of understanding farmers receive.

Figure 2. *Farmers' Dialogue* farm visit in India.

The question often arises, *"Why is there so much poverty in an industry that the world relies on? How can we encourage more trust and teamwork, and include farmers in the planning and decision-making processes of governments, agro-processing companies and consumers through the food processing and marketing chain?"* Farmers take heart when they understand that agriculture has a vital part to play in making a positive contribution to our planet, whether it concerns the necessities of daily life, work, housing or a purpose to live for.

Figure 3. Visiting a family-run small farm in Kenya.

Many smallholder farmers feel the situation is beyond their control; but when they hear stories of what farmers in distant countries are doing it gives them the confidence to take the next occasionally radical step on their own farms:

- Shailendra, a rice grower in India, attended a discussion hosted by Tata Steel, where it was suggested the participants take time to listen to what is known in India as the inner voice. Shailendra had the simple thought to apologise to his wife for neglecting her: this transformed their marriage, and relations with neighboring farmers improved.

- Duncan, a Kenyan dairy farmer with little formal education, gathered ten of his milk-producing farmer friends, and each of these farmers convinced more of their colleagues to develop a dairy cooperative, with each member donating one goat to raise funds. This cooperative began in 2000 with 210 members, and currently serves over 40,000 farmers, and plays a major part in the economic stability of their region.
- A Kenyan farmer, working for a Forestry Department, who took part in a *Farmers' Dialogue* in India, launched four different projects in his area within two months of his return, applying what he had seen during farm visits in India.
- Alphonse, who farms in the Democratic Republic of Congo, attended a dialogue in Tanzania. Two years later in Kenya, he thanked the organisers, saying what he had learnt in Tanzania had changed the way he farms. He has since received a United Nations award for the tree-planting scheme he launched in his region.

More stories can be found at www.farmersdialogue.org

The challenge of *Farmers' Dialogue* today is to enable farmers to share experiences with other farmers and make a positive contribution to our planet and to the daily challenge of feeding people. Some of the challenges faced by farmers are external: climate change, soil erosion, poor water resources, quality of food; but others are rooted in the society: isolation, rejection from society, low income, large divisions between cities and rural areas, and exploitation by large corporate companies.

To have a sustainable supply of food in the future, farming must have good governance, security of land tenure, markets that are fair for all, and effective, along with dedicated approaches to tackle climate change and improve the sustainability of agriculture. These are issues affecting our lives and addressing these is a challenge that needs the immediate attention of politicians, corporate business and urban consumers.

Figure 4. *Farmers' Dialogue* in DR Congo.

Figure 5. *Farmers' Dialogue* in France.

Farmers sharing experiences are motivated to changes of attitude and the desire to try new ideas. These developments are real and will grow. The challenge of *Farmers' Dialogue* today is to foster this process. The global challenges and difficulties facing agriculture have not discouraged farmers – the main producers of the most vital ingredient of human life. *Farmers' Dialogue* is aiming to enhance this commitment. Those of us taking responsibility for this programme continue to focus on the needs of people, and trust that we all have a part to play in feeding humanity.

Jim Wigan and Claude Bourdin

Newsflash

An update of *Bandwagons I have known*

Older members will remember Professor Norman W Simmonds (1922-2002) as an early member of the TAA and a prolific contributor to the *TAA Newsletter* (the forerunner of our journal *Agriculture for Development*). A botanist and plant breeder (particularly of bananas), Norman wrote several books and over 250 scientific articles.

The December 1991 issue of the TAA Newsletter included an article by Norman entitled *Bandwagons I have known*. Like many of Norman's contributions, this was a slightly tongue-in-cheek, irreverent review of recent developments ('bandwagons') in plant improvement, which contained more than an element of truth.

Recently, Professor Rex Bernardo, Professor and Endowed Chair in Corn Breeding and Genetics at the University of Minnesota, USA, was invited by the journal *Theoretical and Applied Genetics* to write an article for a special issue commemorating the 150th anniversary of the publication of Gregor Mendel's results in 1866. Professor Bernardo wrote and submitted an article entitled *Bandwagons I, too, have known*, which is an update of the *TAA Newsletter* article by Norman Simmonds – it focusses on post-1990s bandwagons in plant improvement.

This article has now been published (Bernardo R, *Theoretical and Applied Genetics*, 2016. doi: 10.1007/s00122-016-2772-5) and can be seen at: http://rdcu.be/kBPE

The Norman Simmonds article and the TAA Newsletter are cited appropriately, and the original article is included as supplemental material.

Paul Harding

The UK should seize the Brexit moment to reform its food policies (and become a role model for other countries)

Andrew MacMillan and Peter Beeden

Andrew MacMillan is an agricultural economist, and was formerly the Director of FAO's Field Operations Division. He has helped governments in more than 40 developing countries to prepare projects for international financing. Andrew is now retired in Tuscany, growing much of what he and his family eat. He spends quite a lot of time trying to convince people that the time has now come to put an end to hunger and encouraging them to invest in secondary education in rural Kenya. ***andrew.macmillan@alice.it***

Peter Beeden has had four careers to-date: agricultural research entomologist in Africa; dairy farmer in South Wales; agronomy consultant involved with investment projects in some 30 countries of Africa and Asia; and adviser to Somerset farmers managing land with important wildlife habitat. Now 'retired', Peter and family manage their all-grass farm with cattle and traditional breeds of sheep and goats.

Abstract

The UK, like most other countries, is facing severe food management problems which it is not taking seriously. Its food policies have led to the growth of unsustainable intensive farming systems – damaging soils, fresh water and biodiversity, and contributing substantially to greenhouse gas emissions. Its farmers would mostly go bust if they were not heavily subsidised by the EU. Food chain workers are at the bottom of the pay scale and often exploited. Consumers bin £17 billion worth of avoidable food waste each year. Worryingly, the UK is the fattest nation in Europe and will face massive future health burdens.

If Brexit really is to be Brexit, the UK could use its greater autonomy to embark on fundamental food policy reforms that would accelerate badly needed shifts to truly sustainable production systems and much healthier nutrition and lifestyles. Reforms would harness the huge purchasing power of food consumers to drive the necessary adjustments. The implied rise in food prices would be matched by an increase in social protection to safeguard the food consumption of the poorest families.

If the UK gets to grips successfully with its food management problems, its experience could inspire other countries, especially developing countries, to follow its example.

Introduction

This article is a sequel to one that we wrote under the title *Perhaps we should all pay more for our food*, published in *Agriculture for Development*, No 23. There, we set out arguments in favour of policies that encourage food price rises so as to harness consumer purchasing power to accelerate rural development and the necessary shift to more sustainable food production systems and consumption patterns. We noted the importance of associating this with expanded targeted social protection programmes, with transfers to poor families being adjusted in real time for food price rises so as to assure their adequate nutrition.

In *Agriculture for Development* No 27, Professor David Colman neatly dismissed our arguments, claiming that *"the big questions for agriculture are not about prices"*. He also warned us that *"Successful policy design is complex and seemingly common-sense proposals are often destined to fail"*.

We are stubbornly returning to the theme, convinced that food prices – and farm subsidies – play significant roles in shaping food production and consumption behaviours. Interventions in food price formation therefore offer important opportunities for shaping how food is grown, eaten and wasted.

Recently the Director-General of the United Nations Food and Agriculture Organisation (FAO) has advocated similar approaches to food policies (FAO, 2016).

In this article, we try to make the case for the UK to use its proposed exit from the European Union as an opportunity to make radical changes in its food management policies so that they 'send the right signals' to all parties involved in the food chain, from farm labourers to consumers. We conclude that, if the UK adopts such policies, it can serve as a role model for emulation by other EU members and developing countries.

We must confess our discomfort about Brexit. It encourages isolationism when globalisation requires greater collaboration amongst nations to ensure peace, sustainable use of the world's natural resources, more equitable sharing of wealth, and better human health through improving nutrition for those who are hungry and those who eat too much of the wrong foods.

But if Brexit really is Brexit, the UK should use its greater autonomy to adopt a set of food policies that will enable it to do much better in conserving natural resources and in having its people eat healthily.

The EU and the UK's food and agriculture

The European Union, in spite of its many problems, has offered more leadership on food management related topics than any single member state, acting alone, could have done. It has used its considerable convening power to develop and continually update consensus between its member nations on joint strategies towards addressing the major issues facing agriculture, food, natural resource management, climate change and human health. Many of its decisions – for instance in relation to animal and plant diseases, food quality and safety, sustainable management of fisheries stocks, water pollution and climate change – have transboundary implications and therefore require well-orchestrated actions between nations.

Many '*Brexiteers'* are highly critical of the large body of legislation, regulations and standards that the EU has generated, much of which relates to food management. Through these measures, however, the EU has played – and must continue to play – an essential role in facilitating trade amongst EU members and between them and the rest of the world, including a '*Brexited'* Britain.

The main practical instruments through which the EU has supported farming have been the two subsidy '*pillars'* of the Common Agricultural Policy (CAP) which has been evolving since 1962, now accounting for 39 percent of the total EU budget.

Pillar 1 involves direct payments to farmers, aimed at supporting and stabilising their incomes. To be eligible to receive payments farmers are meant to respect certain environmental, food safety, plant protection and animal welfare standards, but these are loosely enforced. The total EU-wide annual cost is about £42 billion, of which the UK receives £3.2 billion.

The rural development programme (Pillar 2) is much smaller, with a total annual allocation of about £12.6 billion in 2015, of which the UK share was about £333 million. The UK chose to supplement this through reallocating part of its Pillar 1 budget to Pillar 2 for the period 2014-2020.

The EU's rural development policy is "*to help rural areas of the EU to meet the wide range of economic, environmental and social challenges of the 21st Century*". Nations (in the UK, each of its four constituent countries) develop their own proposals for the use of their allocation in line with the EU's common priorities: these include fostering knowledge transfer and innovation, enhancing viability and competitiveness in farming and forestry, promoting better food chain management and animal welfare, restoring and enhancing ecosystems, promoting low carbon and climate-resilient farming, and supporting social inclusion and poverty reduction in rural areas.

England has chosen to concentrate its Pillar 2 programme on "*the better management of natural resources and the wider adoption of farming practices which are climate friendly*". Wales, Northern Ireland and Scotland have their own priorities.

The Brexit opportunity for policy adjustment

This is not the place to assess the success of the CAP, nor to examine its many weaknesses. Now that the Chancellor of the Exchequer has guaranteed that, following Brexit, funding for agriculture and rural development will be made available at levels equivalent to current CAP allocations, we need to look to the future and how best to deploy these funds.

Brexit provides the UK with a once-in-a-lifetime opportunity to get to grips with its serious food system management problems. It can emerge as a world leader in adopting a set of mutually reinforcing policies for agriculture, food, nutrition, natural resources management, slowing the processes of climate change, cutting rural poverty and improving career opportunities for its citizens in the food chain. The guarantee of sustained funding opens the door for necessary transformational shifts in policies, backed by incentives to nudge the behaviours of actors all along the food chain to adopt changes that will place food management on a truly sustainable footing and improve the UK's health through better nutrition.

In embarking on a radical policy reform agenda, the UK should look to other nations that have already trodden the path for guidance. One example, relevant to sustainable land management and familiar to TAA members, relates to the improvement of soil and water management, as well as carbon sequestration, by shifting from frequent ploughing to zero tillage. For decades, farmers in the UK have been degrading soils but have lagged behind many other countries in taking up Conservation Agriculture (CA). The latest figures show that CA is applied on only 2.4 percent of UK arable land, about the same proportion as Mozambique (2.6 percent) but less than half as much as Zambia (5.3 percent). Two-thirds of Paraguayan farmland is under direct sowing! (FAO Aquastat).

Farming and food in the UK

Our recommendations seek to respond to the following snapshot of farming and food realities:

- UK consumers spend an annual total of almost £200 billion on food, drink and catering, equivalent to about £42 per person per week (11 percent of personal disposable income, compared to over 50 percent some 50 years ago) (DEFRA, 2016).
- Five supermarket companies account for 55 percent of the value of UK retail grocery sales (DEFRA, 2016).
- Throughout Europe, farm-gate prices for foods are much more volatile than the retail prices for the same goods (OECD, 2016).
- The contribution of agriculture and fisheries to the UK economy is £10.7 billion, or roughly 5 percent of the retail value of annual food and drink consumption (DEFRA, 2016).
- Total farmers' net income from farming dropped by 29 percent between 2014 and 2015 to £3.7 billion, equivalent to £19,417 per annual work unit (DEFRA, 2016a). This drop occurred, in spite of rising output, because of lower international commodity prices, a rise in Sterling versus the Euro in which CAP payments are denominated, and the continuing supermarket price war.
- The CAP direct payments programme (£3.2 billion per year) accounts for 43 percent of UK farmers' income, enabling farmers to sell their products cheaply, thereby effectively subsidising consumers.

- Some 400,000 people work in farming and another 3.8 million in the food and drink sector (DEFRA, 2016). Many workers (one-third foreign born) are paid minimum wage rates. UK citizens are increasingly reluctant to seek work in the sector, fuelling a growing demand for migrant workers.
- Avoidable food waste is valued at £17 billion per year. Some 70 percent of food waste occurs in the home (WRAP, 2016).
- Ample food availability from UK production (76 percent self-sufficiency) and from imports, is not being translated into better nutrition:
    - Almost 25 percent of people in the UK are obese and a further 36 percent overweight (House of Commons Library, 2016). As they grow older, those affected are increasingly exposed to non-communicable diseases, including type-2 diabetes, various cancers, and high blood pressure. Future related health care and economic costs, estimated at £47 billion per year now, will grow rapidly (Patient website).
    - The UK operates a wide-ranging social security programme. In spite of this, around 200,000 people now use food banks to overcome temporary food shortages triggered mainly by benefit delays and changes, as well as by low income (The Trussell Trust website).
- Annual costs of soil degradation in England and Wales are estimated at £0.9-1.4 billion, mainly due to loss of organic matter and to compaction (Parliamentary Office of Science and Technology, 2015).
- Only 24 percent of England's water bodies meet 'good ecological status' standards, with 60 percent of nitrates, 25 percent of phosphorous and 75 percent of sedimentation thought to be attributable to farming (Global Food Security, 2016).
- Agriculture continues to harm the supply of ecosystem services, as evidenced by the declines in farmland bird populations, pollinators, biodiversity and soil organic matter (DEFRA, 2011).
- Agriculture generates 9 percent of UK greenhouse gas emissions, mostly from methane (ruminant digestion) and nitrous oxides (fertiliser use). Since 1990, sectoral emissions have dropped by 14 percent, due to lower livestock numbers and falling fertiliser use. Land use changes (especially afforestation) have transformed land into a net carbon sink, but the 9 million tons CO_2 equivalent 'saved' amounts to only about 20 percent of agricultural emissions (Department of Energy and Climate Change, 2016).
- The costs of environmental damage and contributions to climate change processes caused by food production and waste, as well as of future health care and loss of output caused by the obesity epidemic, are being left unpaid by today's consumers and a huge bill is being passed on to future generations.

It is abundantly clear from the above that there is no room for 'business as usual' in food management. The most urgent needs are to (a) stop the environmental and social damage caused by current food production systems and wastage, (b) bring about lifestyle changes so as to drastically cut the incidence of overweight and obesity, and (c) protect the food consumption of the poorest households as prices rise. While reallocation of saved subsidy funds can get the ball rolling, ultimately most of the costs of the necessary measures should be met by food consumers.

A possible policy response

It is against this background that we urge the UK to seize the Brexit opportunity to design and adopt bold and mutually consistent cross-sectoral policies that will create incentives for benign behavioural changes throughout the food management system. This bundle of policies could:

1. Connect farmers more directly to the food market

The aim would be to increasingly harness the huge purchasing power of consumers to eventually meet the full direct production and handling costs of food – including some insurance of farmers against risks due to price volatility, assurance of decent incomes for all who work in the food chain and encouragement of new investment in sustainable farming.

This would open the door for equivalent but slightly lagged reductions in direct farm payments, releasing rising levels of saved fiscal resources to drive desirable changes.

The rise in consumer prices and related reductions in producer subsidies would have to be negotiated between all major parties to the food chain with the intent of ensuring greater fairness, with progressively rising farm-gate prices more than fully compensating farmers for simultaneous reductions in direct payment support. Paradoxically, the heavy concentration of food retailing in just a few companies could facilitate reaching an agreement.

To put this in perspective (with deliberate over-simplification), a 2 percent rise in the average price of food and drink, if fully passed back to producers by retailers and caterers, would transfer £4 billion, and more than compensate for the total cost of current CAP Pillar 1 support for UK farmers and fishermen. This would add less than £1 to the average weekly shopping bill.

The reduction of direct payments would have to be introduced gradually, starting with the largest beneficiaries and progressively extending towards smaller recipients. The smallest 'active' farmers would probably continue to receive a direct payment in the long-term in recognition of their role in environmental stewardship.

These moves would:

- Begin to wean farmers off dangerously high dependence on subsidies that will prove unsustainable in the long term. (This is consistent with DEFRA's position in 2011 when they argued that "*while direct payments will continue during the next Financial Perspective, they should have a clear downward trajectory and be positioned as part of a programme of managed transition planning for their abolition*.") (Environment, Food and Rural Affairs Committee, 2011).
- Increase incentives for farmers to produce more of what consumers want, improving the match between demand and production.
- Increase competitiveness amongst farmers and encourage investments in innovation and improved efficiency.
- Save farmers the time and costs associated with accessing CAP direct payments and the related costs of delays in payment delivery.
- Enable farmers to assure decent working conditions for their labour force and acceptable animal welfare standards.
- Reduce the incentives for households to waste food.
- Possibly, but not without additional measures, reduce

over-consumption of food.

2. Gradually introduce selective taxation on foods

The initial aim would be to create precedents for food consumers to begin to pay for the environmental and climate change-related damage inherent in food production, while, at the same time, inducing dietary changes towards more healthy nutrition (*eg* less salt and sugar, more fruit and vegetables, less grain-fed meat *etc*). The basis for determining eventual taxation levels could be *true cost accounting* (Sustainable Food Trust).

Even if the combination of price rises to compensate for cutting back direct payments to farmers, and of those induced by increased taxation, were to rise to 20 percent of the total grocery bill, this would generate £40 billion per year (or only about 2 percent of total disposable personal income) in the UK alone. Induced cut-backs in food waste and over-consumption could compensate for this in better-off families.

Negotiations with consumer groups, retailers and other involved parties would have to centre on the moral justification for the principle of inter-generational equity in relation to both natural resources management and future health care costs induced by our generation's selfish food consumption behaviour.

The proceeds from significantly higher food taxation could transform farming systems across the country and alter lifestyles by scaling-up proactive measures to reinforce benign behavioural changes amongst producers and consumers.

3. Reallocate savings in direct payments and income from food taxation to promote increasingly sustainable food management systems and to protect adequate food consumption in poor families

This would apply the growing volume of fiscal resources to a wide range of measures similar to those now supported by CAP's rural development Pillar 2 (see above) but on a much larger scale.

The main emphasis would be to accelerate adoption of farming practices that would conserve and restore natural resources (soils, fresh water, biodiversity), cut greenhouse gas emissions from farming and food wastage, safeguard food quality and improve living conditions for rural communities. As in the case of CAP's Pillar 2, there would be a strong focus on identifying and propagating potentially relevant innovations and locally driven initiatives.

This would involve expanding funding of research (including farmer-led research) and extension, aimed at moving intensive farming away from too much mono-cropping and heavy dependence on external inputs towards systems that successfully harness ecosystem services while maintaining high levels of performance.

It would also provide grants towards the investment costs incurred by farmers in shifting to more sustainable systems (*eg* for purchase of equipment for conservation agriculture).

It would support the emergence of improved arrangements for food supply chain management, aimed at assuring a more equitable sharing of benefits and less volatile farm-gate prices.

Support would also be given to measures to promote lifestyle changes across the whole UK public, leading to healthier eating.

Finally, and most importantly, funds would support the extension of social protection, combined with nutrition education, to all of the UK's poorest families to enable them to eat healthily even as food prices rise. This is bound to be much cheaper than effectively, as of now, subsidising all UK consumers.

Epilogue

What we are proposing is ambitious, institutionally complicated and politically sensitive. It should prove feasible, given the strong UK national commitment to better economic performance and competitiveness, provided this is translated from stated intent into action. The capacity to manage programmes that cut across sectors has been greatly increased by the extent to which modern communications systems make it so much easier now to engage in real time, across institutions, in coordinated actions. It is significant that what is good for farming is also, in general, good for the environment and climate stability, and good for human nutrition and health – indeed good for the UK as a whole!

The falling value of the pound Sterling seems bound to impact on both producers and consumers. It will tend to strengthen demand for UK-grown food to substitute for imports and to improve export prospects. However, it will raise consumer prices for foods that continue to be imported.

If the UK were to choose to embark on such policies, it would be breaking new ground. It would serve as a role model for other EU countries as well as for developing countries that face similar challenges that demand comparable responses as they seek to attain their Sustainable Development Goals by 2030.

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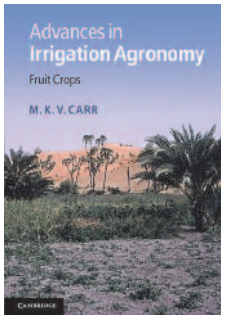


Advances in irrigation agronomy: fruit crops
MKV Carr, 2014

Cambridge University Press
Hardback, 350 pages, £70
ISBN: 978-1-107-03735-9

Many readers will remember those pre-www days when it was a considerable challenge to track down the information required to function either as a researcher or as a practitioner. How the world has changed in the 21st century! The body of scientific literature has expanded exponentially, but thanks to Google (other search engines are available), we no longer struggle to harvest information. The problem now is information overload and the challenge has become how to sift, sort and select. Well, if your interest is in irrigation science as it applies to fruit crops grown in the tropics and sub-tropics, then you need look no further. This is the book for you. In a companion volume to his earlier (2012) book on plantation crops, Mike Carr has once again expertly collated and synthesised information from a diverse range of sources with the aim of "*converting science into practice*".

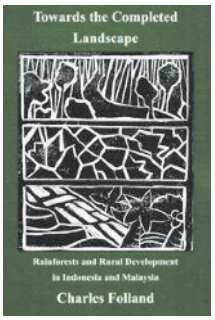
He has compiled a rich source of information on the irrigation agronomy of thirteen important fruit crops. His earlier volume covered banana and coconut; here he has added: avocado, cashew, citrus, date, lychee, macadamia, mango, olive, papaya, passion fruit and pineapple. No doubt, you will ask: why these? Well, read Chapter 1, where he explains his selection while also defining concepts of water productivity and introducing irrigation systems. In the main body of the book he provides a chapter on each of the eleven selected fruit crops. In each case, there is a brief discussion of its growth and physiology, then consideration of the process of yield formation, then discussion of plant-water relations and response to irrigation. There is a unified approach throughout these chapters as he aims to connect fundamental knowledge to its application in irrigation management. For each fruit, the reader will find a synthesis of the scientific literature together with recommendations for future research and identification of knowledge gaps. For example, who knew that for cashew, no method exists for estimating its water requirements and suitable irrigation schedules?

Each of the chapters describing a particular fruit crop is based on a review paper by the same author published in the journal *Experimental Agriculture* between 2009 and 2014. Some readers, particularly those wedded to electronic sources of information, may prefer to access these original papers. Others will see added value in having a compilation in a single source. Indeed, the final chapter provides a comparative synthesis for the thirteen fruit crops, which is not available elsewhere. In this chapter Mike examines the challenge of saving irrigation water without concomitant reduction in fruit yield and quality. He draws attention to the lack of experimental evidence on deficit irrigation. He notes the particular challenges in understanding the irrigation agronomy of fruit crops due to the large number of cultivar/rootstock combinations within a species and the range of planting densities. Biennial bearing further complicates the analysis and he urges caution in use of information from short term experiments. Indeed he concludes that "*the quality of reporting the outcomes from research in published papers is variable*". It is a pity therefore that he does not draw further upon his long experience as Editor-in-Chief of *Experimental Agriculture* and recommend the minimum dataset required for an adequate publication.

The book might be criticised for not adopting a formal 'systematic review' approach and for not providing meta-analysis of the published data. This would be unfair as this was not the intention of the author and the broad scope of the book would make it inappropriate to adopt such an approach. In any event, the information presented here meets the requirements of a well-defined methodology to identify, analyse and interpret all available evidence. What is lacking only is explicit mention of criteria adopted by the author in deciding what literature to include and what to exclude. He laments the variable quality of published papers without identifying the villains. We are left to conclude that anything not included in his extensive list of over 400 references must fall into that category.

This book (together with its companion volume on plantation crops) represents the outcome of a Herculean effort by the author over the last 5 or 6 years to bring together a solid body of scientific knowledge on irrigation agronomy and to make it readily accessible by students, researchers and practitioners. Inevitably, in this fast-moving information age, it will be overtaken by events and new knowledge will emerge. Be that as it may, in a search for relevant information, whether by irrigation practitioners, agronomists or horticulturalists, you have to start somewhere. I can think of no better place to start. Many readers will need to go no further. I congratulate Mike on his achievement.

John Gowing



Towards the completed landscape: rainforests and rural development in Indonesia and Malaysia

Charles Folland, 2015

Shadows Books, North Devon, UK
Paperback, 228 pages, £20
ISBN 978-0-99285792-9

This is a remarkable book, and I keenly recommend it to agriculturalists,

environmentalists and the wider general audience. Anyone involved in overseas land use or intending to be so, will find find useful guidelines. It describes the rapid agricultural development of recent decades in the equatorial belt of South East Asia and reflects deeply on its impact on human populations and the environment.

After a stint as a soil surveyor in Lancashire, Charles Folland came to Sabah (in the Malaysian part of Borneo island) in the late 1960s, under the auspices of the Ministry of Overseas Development. His remit was to survey the Kinabatangan catchment, then largely covered by uninvestigated rainforest. This was set-up in view of the increasing local population and an evident potential for high agricultural productivity. This book goes outside his technical publications to give a fascinating insight into long periods of life in the jungle, and the impact of these developments on the people and the countryside. He overcomes the complexity of soil classification to explain in broadly comprehensible terms, how forest ecosystem characteristics depend on the physical environment, which in turn governs the agricultural possibilities. An early important conclusion was that rather less than half the area was suitable for large-scale agriculture. His experience of more than a decade in the Kinabatangan project led to further appointments in the region. In 1982, he joined the Sabah Land Development Board to advise on soil conservation in tree crop planting. Later came involvement with projects on transmigration from overcrowded areas to newly developed lands in Kalimantan (Indonesian Borneo) and Sumatra.

The descriptions of technical and organisational matters alone justify this book, which is written in a clear and engaging style, lavishly illustrated by photographs and maps. The author takes a reasoned and mostly positive view of these projects, albeit sometimes critical of the logic of the terms of reference. He stands on an objective middle ground between "*conservation at any cost*" at one extreme, against "*development solely for immediate profit without long term environmental consideration*" at the other. Agricultural development was inevitable, given the need for food for an expanding world population, combined with the advancing technology that makes it possible. He recognises that the process can be destructive, especially initially, but with some patience and care, can settle into an environment that is productive in the long-term. This is the "*Completed Landscape*" of his title – a term used in the 1950s to describe the English landscape – good open country but virtually none unadapted by *Homo sapiens*. He relates it all to "*sustainability*". The "*Completed Landscape*" has been reached over millennia in much of the temperate world, and is taking over in the tropics 'willy-nilly'. The feared "*green desert*" has not materialised. Adverse factors like erosion can be a problem, but these occur naturally in the forest itself. As the author observes, there is no going back anyway, but here is a model for sensitive adaptation. Some developments attract particular opposition, such as the conversion of mangrove areas and peat soils, but as he shows, with suitable practice, they are amenable to sustainable productivity.

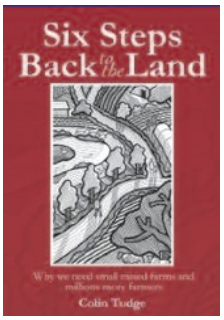
There is a comprehensive chapter on the four main tree crops of the region after forest clearance. Agriculturists who have been involved may not agree with all cultivation details, but this is beside his main intention, a brief review of their role nowadays. Coconuts have been grown from time immemorial in any unforested lands, rubber has tended to move to nearby countries with cheaper manpower, cocoa never really proved itself as a plantation crop, and has declined after expansion in the 1970s and 80s. The big one is oil palm which, after a few problems were resolved, is ideally suited. It has to be grown on a large scale (need of a capital intensive factory), and has a land area production of edible oil far in excess of any rival crop anywhere. This aside from the opprobrium showered on it as the "*destroyer of biodiversity and stability*", which he finds to be largely unjustified, and something not so prominently accorded to rice, wheat, or, oddly, soy bean.

A traveller back in the 1890s had referred to Java and Bali landscapes as "*finished*" (equals "*completed*"). Both islands have long been a productive garden for many crops, needed by, but also leading to, increasing populations. This can progress to decline in resource (loss of sustainability), and degradation here styled "*exploited*" (perhaps more accurate would be "*over-exploited*"). Transmigration to the 'new' lands was widely seen as a solution. This can relieve pressure, but on the downside there can be reluctance to migrate, and conflict with already established local inhabitants. Furthermore, agricultural potential is not always what it seemed. What may happen as populations in the new areas reach resource limits will be, no doubt, another story.

The small populations originally inhabiting the forest practised shifting cultivation (often misleadingly called 'slash and burn'). Forest patches are cropped until productivity declines, with cultivation then moving to a recovered patch, cyclically. This is linked to the issue of the fertility of cleared forest lands. It is implicit that there are two key aspects, the nutrient content, and suitability as a growing medium. The author shows that soil types under forest vary greatly and, contrary to a general assumption, may be very fertile. Thereafter, any soil will become less fertile if a crop containing the nutrient elements is continually removed. In this respect, sustainability of production is conditional on fertiliser application. The sustainability of that supply will have to be dealt with as the future unfolds, which also emphasises the need to continue work on effective recycling.

This is a wise and thought-provoking account of the progress from primeval forest (a term the author questions – is there anywhere where humans have not had some influence?), through shifting cultivation, to the "*Completed Landscape*". Then, populations may become too big for the resource available, risking degradation, and leading to emigration. Further, the book shows with admirable clarity, how work in technical fields can be accompanied by an appreciation of the wider impact of developments.

Brian Wood



Six steps back to the land: why we need small mixed farms and millions more farmers.

Colin Tudge, 2015

Green Books
Hardback, 223 pages, £17.99
ISBN 978-0-85784123-0

There is a distinct air of optimism in Colin Tudge's appeal to the ordinary Joes and Janes to take-up the challenge of farming – but be aware of the warnings that it is not for the faint-hearted or unprepared. To take-up such a challenge requires some understanding of differences he identifies between a "*neo-liberal industrial agriculture*" and an "*enlightened agriculture*". If you are of one persuasion, it seems likely that you would agree with the analysis, while otherwise the suggestions will

not appeal. But consider his essential ideas behind "*enlightened agriculture*". These embrace agroecology, food sovereignty and economic democracy, that together may drive an agricultural renaissance. Showing his pedigree as a writer for *Farmers' Weekly*, Colin provides a detailed account of soils, crops, livestock, horticulture and agro-forestry in the UK. His "*six steps*" give a vision of progression from gardening to the fully mixed agro-ecological farm, with an emphasis on organic production.

In part, this book would perhaps reflect the exasperation felt due to a lack of practical action. Implementation of the conclusions in the *International Assessment of Agricultural Knowledge, Science and Technology for Development* (IAASTD) report might have been expected by now. However, Hans Herren reported (UNCTAD, 2013) that "*Since 2009, few agricultural knowledge, science and technology policies at the national, regional or international levels have actually changed. More reports have been written, mostly only to dilute the strong key messages of the IAASTD, regarding the centrality of smallholder farmers*". The "*inappropriateness of an undue reliance on biotechnology and genetic engineering to solve the main problems*" also drew criticism. There was finally a plea "*to allow countries to choose their own agricultural trade, research and development polices*".

Colin Tudge believes there are measures of obfuscation that need to be challenged. He quotes Hans Herren as saying that "*we produce an average of 4,600 kcal per person/day – roughly double the amount needed for healthy nutrition*". Projected 'demands' serve to divert attention from the main problem of hunger *ie* the limited smallholder access to affordable food in rural areas, the means of production and resources.

Colin also reminds us that farm productivity per unit area varies inversely with the size of farm. So his first step concerns developing expertise to become a market gardener. The BBC's film on permaculture features Martin Crawford's forest garden, which may provide inspiration. Then, in step two, livestock are added. This could be like the small holding of Chris Dixon and his wife Lyn in Snowdonia, again from the permaculture film. Next, in step three, we add grazing, hopefully with the passion of the late Arthur Hollins, of Fordhall Farm in Shopshire. His daughter explains that their cattle stay out on the pasture all winter, with little additional need for feed. Now they have probably got as many as 20 different species of grass. Rebecca Hosking of Village Farm, Devon, has a similar outlook, in embracing holistic grazing and mob grazing.

For Colin, step four is to develop arable enterprises, but Tim May, of Kingsclere Estate in Hampshire, did the opposite. Putting his Nuffield Scholarship experience into practice, in May 2013, his family planted 360 ha of their arable farm to a herbal ley. Their aim was a four-year rotation of grass and then arable crops. They are initially grazing that with sheep, judged to be more forgiving when out-wintering stock. By 2014, their previously 1,000 ha arable farm, included 1,700 ewes, 2,500 lambs, 150 cows, 100 pigs, 42 rams and 2 sheep dogs. In the fullness of time, it could well become the full-blown agro-ecological mixed farm envisaged in Colin's step 5.

Then, finally, Colin would like to see a progression to farms as communities in his step six. Human nature being what it is, such communities are small but they do exist! Tablehurst and Plaw Hatch farms, close to the village of Forest Row in the High Weald county of east Sussex, are homes to bio-dynamic producers (http://www.tablehurstandplawhatch.co.uk/). Their viewpoint is that disrupting the soil with herbicides, pesticides and fungicides is a grave disservice. Stroud Community Agriculture Ltd (SCA) describe themselves as a community-led enterprise, being certified organic and influenced by biodynamic methods (http://www.stroudcommunityagriculture.org/).

Can greenhouse gas emissions be cut by an enlightened agriculture, which is productive, sustainable and resilient? Or as Colin says, with Government emphasis on the neoliberal-industrial agriculture, will "*subtlety give way to heavy machinery and industrial chemistry, and the essential qualities of polyculture and genetic diversity make way for monoculture*"? It would seem that he is an important UK representative in a chorus of voices calling for a paradigm shift from industrial agriculture to diversified agro-ecological systems (IPES-Food, 2016).

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Martin Parkes

A Strategic Approach to EU Agricultural Research and Innovation

Final outcome of the European Conference 'Designing the path: a strategic approach to EU agricultural research and innovation' held on 26-28 January 2016, in Brussels.

40 pages

Available for download at: http://ec.europa.eu/newsroom/horizon2020/document.cfm?action=display&doc_id=13292

This paper is the outcome of a one year consultative process, culminating in the conference *Designing the path: a strategic approach to EU agricultural research and innovation*, held in Brussels in January 2016. It is not a formal Communication of the European Commission but is intended to guide sectorial programming under *Horizon 2020* – the main EU instrument for financing research – in its final triennium (2018-20), and to provide input to future strategic planning of EU agricultural research.

The document identifies five priority areas under two broad themes:

Theme 1. Creating value from land – sustainable primary production

- Resource management (notably soil, water and biodiversity);
- Healthier plants and animals;
- Integrated ecological approaches from farm to landscape.

Theme 2. Enhancing rural innovation – modernising rural areas and policies

- New openings for rural growth;
- Enhancing the rural and social capital in rural areas.

The following five ***cross-cutting issues*** are identified:

- Systems approaches;
- Societal engagement;
- Information and communication technologies as an enabler;
- Enabling research and infrastructures;
- Socio-economic research.

TAA readers should note that this is an EU strategy focused on Europe, although the global dimension of challenges of food security, economic development and environmental sustainability is highlighted. However it would be helpful if differences in the nature and dimensions of these challenges at global and European level were more clearly articulated, which would lead to a clearer rationale for the priorities identified. For example, food security is correctly identified as a much more serious problem in Africa than it is in Europe, but it is unclear how the thrust of EU agricultural research should be directed to cope with this scenario. Furthermore, malnutrition is identified in the section on major challenges (section 1.1) but research to address problems of under- or over-nutrition does not feature under the description of research priorities in Chapter 2.

Few would argue that the priorities under the first theme should give rise to important researchable topics. While not denying the importance of the cross cutting issues identified, it will be important not to lose sight of some of the key technical challenges that underpin the sector. However, the second theme ventures into areas of rural growth which extend well beyond a sectorial perspective. Most of the research proposed here is around policy and socio-economic issues, although there are also technical issues around production and processing of bio-materials. This theme also includes a strong capacity building element to enhance human capital in rural areas.

The strategy does recognise the international dimension, noting that international cooperation can boost European competitiveness, that developing countries are eligible to participate in research programmes, and that there are complementarities with international research initiatives such as the CGIAR. While this is welcome, this section (3.3) would benefit from a clearer explanation of the comparative advantage that European researchers, working together with partners from the South, have to offer in addressing global challenges of agricultural research, which are typically most strongly expressed in developing countries. The document could also be more explicit in stating how proposed research and innovation activities will complement initiatives supported by the EC Directorate General for International Cooperation and Development (DEVCO), which issued a similar strategy document in 2014 (https://ec.europa.eu/europeaid/sites/devco/files/guide-approach-paper-ar4d2014_en_0.pdf).

Overall, this document is welcome as it lays out strategic direction and priorities. The European Commission is a major funder of agricultural research, and over EUR 3 billion have been committed to this sector over the seven year life of the *Horizon 2020* framework programme (2014-2020). Member States have contributed to this strategy. At the time of writing the future ability of the UK to influence the European agricultural research agenda, and to access funds in the future from EU framework programmes, is unfortunately in question.

David Radcliffe

The New Wild
Fred Pearce, 2016

Icon Books Ltd, London
Paperback, x + 310 pages, £8.99
ISBN 978-178578-051-6

Fred Pearce's main thesis is that alien species are here to stay and that species invasion has always been the norm in ecosystem evolution. There is no such thing as pristine nature. To illustrate his point Pearce takes his reader on a far-ranging journey of discovery of how humans have wreaked such a disruptive impact and what nature is doing about it. Conservation in the 21st Century should not be about trying to preserve nature in aspic; instead we should be encouraging nature's re-birth. Usually, supposedly malign invaders are simply taking advantage of ecosystems already wrecked by humans.

On exploring Ascension Island in the Atlantic, one finds a Garden of Eden of imported plants, the result of deliberate planning by Darwin's friend, Joseph Hooker, the first director of Kew Gardens. When Darwin visited the island in 1836, he complained of its "*naked hideousness*"; today it is a forested mountain greened by Hooker's plantation plans. Pearce examines the results of introducing alien species into island ecosystems and, although there are horror stories such as brown snakes on Guam and super-mice on Gough Island, generally there seems to be a more hopeful process of ecological filling. Is the success of aliens the most vivid expression of Darwin's "*survival of the fittest*" and should we learn to love (most) aliens? The majority of aliens add diversity and enrich species-poor ecosystems. There are many more islands like Ascension and Hawaii, than Gough or Guam.

Humans have played a pivotal role in the relentless shifting of species around the world. Potatoes, maize, rice and wheat have moved across continents from their origins in order to feed a growing human population – a population also accompanied by pigs, cattle, buffalo and plantation crops like rubber, acacia and eucalyptus. Pests and diseases have been strewn around the globe, including *Phytopthera infestans*, *Phylloxera* and the Colorado beetle. Captain Bligh brought breadfruit from Tahiti to the West Indies as cheap slave-food; Joseph Hooker smuggled wild rubber from South America for plantations in the Far East; Kew was a hub for spreading species far and wide, and so it goes. Pearce delves a little deeper into the story of water hyacinth which, because of its beautiful flowers, was taken from a quiet life in the Amazon swamps to eventually infest the world's waterways, including Lake Victoria where it thrived in the heavily polluted waters. Mesquite (*Prosopis* spp) has been spread around Africa by UN agencies to combat desertification. It has relished its release and created new problems by lowering the water table and killing native trees, replacing grasses and lowering stocking rates. At the same time there are winners who harvest the wood, seed pods and bark.

Nature is constantly rearranging itself as the colonisation of remote islands shows. Ocean currents carry debris which, in turn, carry hitch-hiking organisms to the four corners of the planet. Humans can 'help' too, as usual, and examples include the invasion of the Black Sea by the jellyfish *Mnemiopsis leidyi* brought from New England in the ballast tanks of ships. Cholera was taken to Peru from the Bay of Bengal in the same way. The *Caulerpa* alga that escaped from an aquarium and infested the Mediterranean is a further example. However there may be a bright side as the hyacinth, the jellyfish and the alga all exploited environments highly polluted with

sewage and ecosystems already in an advanced state of decay. Blessings in disguise it could be said.

Sometimes the efforts to eradicate an alien do more harm than good. Many examples are described in detail: the inconsequential hacking and spraying of black wattle in South Africa, reindeer elimination in South Georgia, the cats to hunt the rats and the myxomatosis to control the rabbits leading to landslips and ecosystem poisoning in Macquarie Island. It would be foolish to claim that alien species never do any harm, or that efforts to uproot them are always doomed to failure. Neither is true and advances in techniques may improve the chances of success, especially for bio-controls. A sense of proportion needs to prevail.

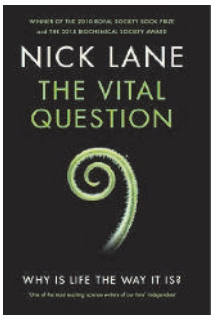
Natural ecosystems should not be thought of as well-oiled and functioning machines in which every native species inhabits a unique niche. Or that ecosystems are saturated, so that a new species will supplant a native. It is more usual for aliens to fill a niche created by some other change (climate or habitat) and Pearce concludes that the phrase 'alien invasive species' is a catchall for nastiness and a recipe for muddled thinking. In the current Anthropocene epoch, nothing is pristine, but at the same time we see that nature is resilient and resourceful and can undo the damage that we cause, if given the chance.

The notion of co-evolution – that species evolve in harmony to maximise their survival chances (such as pollinating insects and nectar-producing flowers) – has long been held to be the basis of ecosystems, culminating in James Lovelock's concept of Gaia. An alternative view suggests that nature is primarily individualistic where every species is a law unto itself. Chaos theory suggests that ecological systems are not stable. They can be subject to abrupt jumps between different semi-stable states. Punctuated equilibrium describes this viewpoint and considers that disruption is essential to evolution; nativism is not a sign of evolutionary fitness. However, the two theories are not mutually exclusive and can co-exist.

Novel ecosystems – complexes of native and alien species – are becoming the new norm. In the Galápagos, eradication of all aliens is not a viable option, although mankind can usefully undo some of the carnage it has wrought. Goats can be eliminated from islands and the resulting vegetation can bring back species, such as the Galápagos rail, from the brink. Most ecosystems can recover if humans are excluded, nature will always come back. The problem is that with the inexorable rise in human population this will rarely be possible. Hopeful examples of nature's return are orchids thriving in power station ash, the return of wolves, lynx and eagles to Chernobyl, and great crested newts to Peterborough's abandoned brick pits.

Although the extinctions in the Anthropocene are worrisome, the seeds of recovery are already visible and new species are beginning to emerge. Although we are heading towards earth's sixth great extinction, earlier extinctions led to a burst of evolutionary renewal (such as the demise of the dinosaurs giving space to mammals). The new wild, where alien species live cheek-by-jowl with natives, will exhibit transience, dynamism and contingency rather than stability, permanence or predictability. We must accept nature at its most dynamic: red in tooth and claw, rhizome and spore, root and branch. Species need to respond to the disruption caused by our activities, including climate change, industrial production and asphalting green fields, by inhabiting new territories.

Brian Sims



The Vital Question: why is life the way it is?
Nick Lane, 2016

Profile Books
Paperback edition, 368 pages, £6.99. Kindle format available
ISBN 9781781250372

TVQ (The Vital Question: why is life the way it is?) is a thought-provoking and very satisfying book in many ways. It is questionable as to whether this book should be classified as 'popular science'. The use of non-technical terms in the introduction can be counter-productive: the second sentence uses the term 'complex life' to mean cells with nuclei (*ie* eukaryotes), not what the uninitiated reader would guess. This distinction is resolved later in the book, but I think it requires from the reader a background in science subjects, preferably to tertiary level. Even then, re-reading the book and periodically resorting to the Internet to understand technical terms is likely. TVQ is written in the style of a prolonged discussion, where the implications of observation and experiments leave you feeling party to the way forward. The use of analogies and literary references is both entertaining and instructive. Lane is careful to point out when the speculations are plausible, but yet to be tested.

Nick Lane may be correct, but to say that "*relatively few biologists study microbes*" would not go down well with those studying pathogenic bacteria, viruses, *etc* and more recently, the big drive to understanding microbiomes be they in animals, plants, soil, *etc* and in the environment at large. However, it has to be conceded that until recently, we had a very simplistic view of '*microbes as enemies*', and for the remainder of the Introduction Lane gives a measured account of our increasingly sophisticated understanding of cells, micro-organisms, and evolution from bacteria and archaea to eukaryotes. It is mind-boggling to think that liver contains as many as 13 million ribosomes *in each cell* that create the all-important proteins – and a reminder that the microscopic size of cells is still orders of magnitude larger than the molecules and atoms.

Chapter 1 begins with opposing hypotheses – that the chances for life elsewhere are infinitesimally small, versus the proposition that perhaps life is an *inevitable* consequence of physics once certain ingredients are met.

TVQ moves on to describing the history of the Earth since its inception some 4.3 billion years ago, and the first signs of life, bacteria, archaea and then eukaryotes. Chapter 2 is densely packed with information and ideas. Lane has a preoccupation with the idea that whilst physics is a science with a strong feature of predictability, biology lacks such certainty in the future, but my own preference is to be reassured that our future is not fixed; something that would define us as automata! He then moves on to the slippery subject of thermodynamics and entropy, which in general literature is often unhelpfully described as the state of 'disorder'. The principle of maximum

entropy production and whether it governs the evolution of life and ecosystems is a topic of hot debate in specialist circles for those who are not afraid of heavyweight physics and mathematics. But it seems that living organisms, with their insatiable appetite for energy, on balance speed up the process of using up the 'free energy' of the universe, if less spectacularly than a star supernova. The chapter proceeds with a detailed account of how organisms extract energy from their food source, with the shunting around of electrons and protons, with quantum mechanics again making its presence felt. Put into the context of number of molecules and the need for continual regeneration of key energy ATP (adenosine triphosphate), this is nothing short of mind-boggling. All living matter depends on separation of protons from electrons. In electrical terms, the voltage seems paltry, but given the minute distances involved this is equivalent to 30 million volts per metre, and you realise just how amazing is life.

Chapter 3 tackles the question of how life might have originated, and what are the key features that make life different from say, the accretion of atoms or molecules to form crystals – growth yes, but life definitely not. Those of us older TAA members were brought up on the presumption of life's key organic molecules coming together from lightning activity on a broth of methane, hydrogen, *etc* at the surface of restless prehistoric oceans, and the brilliance of Watson and Crick (and Rosalind Franklin if we looked more carefully) with their double helix of DNA. TVQ goes further, and into an even more extraordinary, yet plausible, explanation of how life may have originated and what are the key features for replication and evolving complexity. Always with due recognition of those who have led the way in this story, from a wide range of disciplines, this emphasises Lane's ability to cross boundaries of scientific specialisations convincingly. The hypothesis that life originated in deep sea hydrothermal vents ('white smokers') in cell-sized cavities at the interface of alkaline emissions meeting the acidic prehistoric oceans to provide the original redox energy makes us wonder how we have been fooled into thinking that our oxygen-consuming way of life was the norm. Lane goes into quite involved discussion as to how this may or may not have worked, but you feel you are taking part in this journey in a privileged way.

Chapter 4 continues this journey with the emergence of bacteria (and later, the archaea), their wealth of biochemical ingenuity and ability to exchange genetic material (plasmids), alongside their jettisoning of genetic material when this is redundant and would slow their replication down. From a unique symbiotic union of a bacteria and an archaea (not necessarily just from a single pair though) the first organism with a nucleus, and multiple power units – mitochondria – from a resident ('captured') bacteria, came to pass – the eukaryote was born. Add the second endosymbiotic event of the chloroplast and from this came all complex multicellular organisms – plants, seaweeds, fungi and animals.

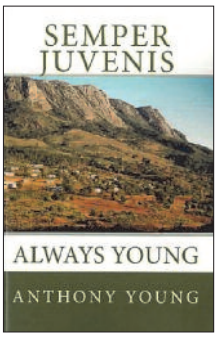
With the adoption of resident mitochondria, came both the energy to perform in ways denied bacteria and archaea, but put the dangers of damage from free radicals they necessarily produce, right inside the cell. It also imported their mechanism for programming cell death, known as apoptosis. This has benefits in getting rid of poorly-performing cells, but is another consideration in efforts to prolong human life, or at least to diminish age-related deterioration of health. Birds do better than we do, with more strict control of mitochondrial testing, probably to enable them to fly. The author embarks on issues around this quest, with warning against the likelihood of extending life beyond just over a hundred years, along with the negative effects of quelling free-radicals with anti-oxidants. Another foray into quantum mechanics – but I think this subject merits a separate article. Meanwhile, the subject of respiration and photosynthesis are dealt with to tax the minds of most of the rest of us.

The book then considers what might have been the original eukaryotic organism, nicknamed LUCA (Last Universal Common Ancestor). But whatever the details of its ancestry, the eukaryotic organism was able to increase in size and complexity, both individual cells and as a multicellular organism, and to develop all the traits we associate with multicellular organisms that are denied bacteria and archaea, along with massive ('bloated?') DNA.

Traits of multicellular eukaryotic organisms are then described in detail: notably, the division between germ cells that provide the next generation of the species, and the somatic cells that perform essential specialised roles but have no future except death. But also, the role of sex or, more specifically, meiosis, with re-combination of chromosomes to provide a secondary selection process to mutation that can sometimes enable selection between beneficial and deleterious genes. However, as Lane explains, the situation is complicated by considering whether deleterious effects only occur after the next generation is produced, in which case early procreation wins over a healthy long life. The size of DNA seems to have no correlation with the complexity of the species concerned, with the example of wheat, with over 90 percent of its DNA seemingly junk. Bacteria, archaea and viruses, by contrast, continually discard surplus DNA, enabling their rapid population increase when resources allow.

What conclusions can I draw from reading this book? Well, as a specialist in crops and economic botany in and around the Tropics, I could have wished for more examples applicable to my background and work, and livestock specialists would say the same regarding their areas of expertise. However, TVQ provides an excellent starting point for crop and livestock experts to build on.

Ian Martin



***Semper Juvenis*: Always Young**
Anthony Young, 2016

Paperback, 303pages
ISBN 1519328923
Available from Amazon, £15

TAA member Professor Tony Young has recently published his thirteenth book, which he describes as "*the story of my life, personal and professional*". He says that the personal side "*is intended for family and friends*", but the professional story "*may be of wider interest*". With an extended family and many friends, and a professional career spanning more than five decades, the potential readership may be rather large.

The book is peppered with Tony's characteristic sense of humour, from the

title on the front cover (a joke family motto) to the final pages of the book where he considers what he might or might not have been (not the Duke of Devonshire apparently). There are many amusing photographs, witty captions and droll chapter headings. It is a lesson in writing a life story, adopting a systematic and yet, at the same time, idiosyncratic approach. He lists family trees (back as far as 1558), and his sources, including CVs, diaries (from 1963), his wife Doreen's journal (from 1958-2007), letters home from 1953-1992, 7,000 colour slides and 30 photograph albums.

The first 96 pages cover Tony's early family life and education, and is often painfully self-effacing – about Tony's social awkwardness, his failed School Certificate exams, his "last photo without glasses", his "large head", his National Service in the army, and so on. These chapters contain numerous contemporary descriptions and observations of a now forgotten world, but one familiar to readers of a certain age. Like Tony, I also tried J W Dunne's *Experiment with Time* – with similar results!

The next 166 pages take the reader on an anecdote-filled journey through Tony's professional career: soil surveyor in Nyasaland (Malawi), geography lecturer at Sussex University (with some overseas trips), Professor in Environmental Sciences at the University of East Anglia (UEA) (with more overseas trips and lots of consultancies), Principal Scientist at the International Council (later Centre) for Research in Agroforestry (ICRAF), and then consultancies for a further 20 years, especially with FAO.

He joined two important institutions – UEA and ICRAF – at their outset, and left when they were large and successful. He taught both my wife and me tropical soil science at UEA, and I can still remember the opening sentence of his course: "All tropical soils are red or yellow… (pause) ... except when they are brown, grey or black". At ICRAF, he promoted and helped to popularise agroforestry; at FAO, he was instrumental in developing the Land Evaluation approach.

Chapter 18 summarises his publications: 13 books, 10 mongraphs and 130 papers, about which his conclusions are modest: "did all of this do anyone any good?" One interesting fact is that, apart from an "ill-advised" early submission, every single paper he submitted was accepted for publication – this must be a rare success rate. His biggest "non-success" was trying, and failing, "to get institutions and governments to appreciate the massive negative influence of population increase".

Chapter 19 describes ten years' worth of seeing the world with Doreen, after they had both retired, including a return trip to Malawi 40 years after first arriving there in 1958.

Semper Juvenis is an informative and entertaining stroll through the life and times of a self-confessed "synthesiser and writer".

Paul Harding

A review of the insect and mite pests of *Moringa oleifera* Lam.

Ravindra C Joshi, B Vasantharaj David, and Rashmi Kant

Ravindra C Joshi is currently Visiting Professor at the Pampanga State Agricultural University, the Philippines, and Adjunct Professor of Agriculture at the University of the South Pacific, Fiji. He is also the TAA Coordinator for the Pacific region.
rcjoshi4@gmail.com

B Vasantharaj David is presently a Good Laboratory Practice Consultant to Rotam Research Laboratory, China, and Chairman, Research and Academic Board, International Institute of Biotechnology & Toxicology (IIBAT), Tamil Nadu, India.

Rashmi Kant is an entomologist currently working at the New Zealand Institute for Plant & Food Research Limited, Palmerston North, New Zealand.

Abstract

Moringa oleifera Lam., native to the India-Pakistan-Nepal borders, is widely cultivated in other parts of both the old- and new-world tropics, including Asia, Africa and South and Central America. Moringa is a multi-purpose tree: its leaves, roots and immature pods are consumed as vegetables. All parts of the Moringa tree – bark, pods, leaves, nuts, seeds, tubers, roots and flowers – are edible, with high nutritional and medicinal values. However, a range of herbivorous arthropods can cause serious damage to the tree. This paper is a global review of the insect and mite pests in major Moringa-growing regions. Summarised information on the plant-feeding pests is presented based on the part of the plant being attacked, as well as the nature of the damage. Management practices are given for economically important species. Future research is suggested to develop region-wide ecologically sustainable pest management practices for Moringa growers. This is a condensed version prepared for *Agriculture for Development*, a full bibliography is available from the principal author.

Introduction

The family Moringaceae, includes 14 species, of which the Moringa tree (*Moringa oleifera* Lam.) – popularly known as drumstick tree, horseradish tree, *malunggai*, *kalamunggai*, *saijan*, *katdes*, ben oil tree and benzoil tree – is widely cultivated (Emongor, 2011, Prasad & Joshi, 2015, Joshi *et al*, 2016). It is native to the northern foothills of the Himalayas in northwestern India. Being fast growing and drought-resistant, it is cultivated in tropical and subtropical areas where its young seed pods and leaves are consumed as vegetables. They contain essential vitamins, protein and micronutrients. Moringa is an exceptionally nutritious vegetable. It is easy to grow and care for and it provides nutritious food, especially to the poor communities, throughout the year, rather than being seasonal as most vegetables are. It also has fewer pest problems than most vegetables (Litsinger, 2014). It is now part of the nutritional security programmes in the Pacific and other parts of the world (Goebel *et al*, 2013; Ebert, 2014; Joshi *et al,* 2016), and is being spread far and wide as a food crop by aid agencies.

Aside from being an indigenous source of nutritious food, Moringa can also be grown as an export crop. Currently, the market is estimated to be more than USD 4 billion annually, with sales in 2020 estimated to be USD 7 billion, produced from 380,000 ha (Maharshi, 2016). Andhra Pradesh in India is the leading producer of the crop (Hegde & Hegde, 2013).

There are other uses of Moringa such as a water purifier and for hand washing. The different parts of the tree are extensively used for herbal medicine in India and China. Its dried leaves, and extracts from other parts of the plant, are used against insect pests, but like any other plant, Moringa can also be attacked by pests and diseases. It is resistant to some pests,

but it can host many other pests and diseases, and outbreaks may occur under certain conditions (Litsinger, 2014).

This is a review of the insect and non-insect pests in major Moringa growing areas. Management strategies are given only for economically important pests and the summarised findings are presented based on the part of the tree being attacked.

Insect pests

Moringa is affected by many plant-feeding herbivores, as reported particularly in the literature from India (Sivagami & David, 1968; David & Ananthakrishnan, 2004; Math *et al*, 2014; Kotikal & Math, 2016; Kant & Joshi, 2016; David & Ramamurthy, 2016). The insect pests are divided into those that are adapted to the species and those that attack plants in general. Both these types of pests contribute to severe losses from time to time.

A. Leaf and shoot feeders

Insect leaf-herbivory is the most common issue for Moringa in most countries. Herbivory affects the quantity and quality of the leaves.

Lepidoptera pests

Leaf caterpillar or Leaf worm *Noorda blitealis* W. (Crambidae: Lepidoptera). This insect pest (Figure 1) was first described by Walker in 1859. The larvae remain on a thin silken web on the underside of the leaf and feed on the leaflets, resulting in the drying of the leaves into a papery structure. In severe attacks, 100 percent defoliation of whole trees has been reported. This is a destructive pest in Niger (Litsinger, 2014), Sudan (Satti *et al,* 2013), Burkina Faso (Dao *et al,* 2015), and Nigeria (Ratnadass *et al*, 2011). To manage this pest, various practices have been tried such as pesticide sprays, biological control, botanical extracts, and search for resistant varieties (Anjulo, 2009; Patel *et al,* 2010; Satti *et al,* 2013; Litsinger, 2014; Kumari *et al,* 2015; David & Ramamurthy, 2016).

Figure 1. Adult and damage to foliage by *Noorda blitealis* W. on Moringa leaves (Photos: Mahesh Math and YK Kotikal, University of Horticultural Sciences, Karnataka, India).

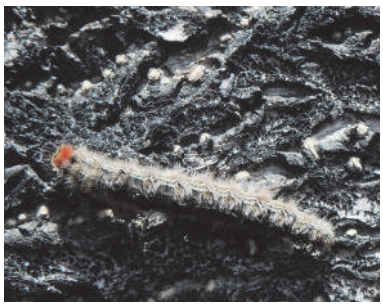


Figure 2. Hairy caterpillar on Moringa tree bark (Photo: Mark Earl Olson Zunica, Universidad Nacional Autónoma de México).

Hairy caterpillar, *Eupterote mollifera* W. (Eupterotidae: Lepidoptera). This is a common pest of Moringa that can also become serious. The larvae defoliate the trees quickly, and then collect on tree trunks and branches in groups (Figure 2). They can be killed with a burning torch; a spray of fish oil, rosin soap, methyl parathion, chlorpyrifos or quinalphos can also control the pest (David & Ramamurthy, 2016).

Itch worm/caterpillar, *Euproctis pasteopa* Collenette (Lymantriidae: Lepidoptera). This is a major pest of Moringa in Ethiopia. The larvae feed on young leaves (especially on leaflets) in a thin silken web on the lower surface (Bedane *et al,* 2013). They generally pupate in the soil (David & Ananthakrishnan, 2004), although pupation could also occur inside cracked and matured pods of Moringa (Bedane *et al,* 2013). In the mixed cropping system, maximum defoliation is observed during the main rainy season in July, reducing leaf biomass production by 31-70 percent; in the mono-cropping system, leaf biomass production can be reduced by more than 75 percent from July to December.

Hairy caterpillar, *Streblote siva* Lefebvre (=*Taragama siva*) (Lasiocampidae: Lepidoptera). This insect is known as a pest of *Acacia arabica* (Lam.) Willd., Mahogany (*Swietenia* spp), *Rosa* spp, *Zizyphus jujuba* Mill., *Polyalthia longifolia* (Sonn.), and *Tamarix gallica* L. (Fletcher, 1919). It is also a sporadic pest on *Prosopis juliflora* (Sw.) DC, and Moringa. The larvae feed on the leaves in the early stages of development and remain in groups on the tender shoots. The grown larvae are usually found on tree trunks and at times at the base of the main trunk. They are pests from July to November.

Nettle worm/caterpillar, *Metanastria hyrtaca* C. (Lasiocampidae: Lepidoptera). Moringa is just one of the plants on which this pest feeds. The larvae feed voraciously during the night and they remain crowded in the shade during the day. Management techniques include collecting and destroying the egg masses and caterpillars, using a burning torch to kill the larvae that congregate at the trunk, or by spraying carbaryl.

Leaf eating caterpillar/Miner cum webber, *Protrigonia zizanialis* Swinhoe (Crambidae: Lepidoptera). A case of infestation has been reported in India although its status as a pest is not yet known. The genus *Protrigonia* has only one species and is found in Sri Lanka and western India (David & Ananthakrishnan, 2004).

Herald moth, *Scoliopteryx libatrix* L. (Noctuidae: Lepidoptera). This is the most abundant species on Moringa and its life cycle is spread over four months. The larvae feed on leaves causing severe defoliation. It is a major pest of Moringa in Burkina Faso.

Leaf-eating caterpillar, *Ulopeza phaeothoracica* Hampson (Crambidae: Lepidoptera). This species has been reported as a serious leaf feeder of Moringa in Kano State in Nigeria (Yusuf & Yusif, 2014). The larvae feed on leaf lamina turning it into transparent parchment-like structures. Heavy infestation occurs between July and September. Pupation takes place inside a silken cocoon and the adult emerges in about eight days.

American bollworm, *Helicoverpa armigera* H. (Noctuidae: Lepidoptera). The caterpillars of *Helicoverpa armigera*, which feed on cotton, tomato, sorghum, *etc,* have been

observed to also feed on the leaves of Moringa in December and January.

Wooly bear, *Pericallia ricini* F. (Arctiidae: Lepidoptera). Feeds on leaflets and occurs sporadically.

Indian moon moth, *Actias selene* H. (Saturniidae: Lepidoptera). This larva attacks a wide range of host plants and has been reported as a pest of Moringa.

Coleoptera pests

White grubs, *Holotrichia insularis* Brenske (Melolonthidae: Coleoptera). The adult beetles emerge from the soil after the rains and start feeding on the leaves of Moringa. Usha Rani *et al* (2010) observed that the white grubs feed on roots, and the adults on leaves.

Leaf weevils, *Myllocerus discolor* var *variegatus* Boh., *M. undecimpustulatus* maculosus Desbr., *M. tenuiclavis* var inferior Marshall, *M. viridanus* (F.), and *Ptochus ovulum* Fst. (Curculionidae: Coleoptera). The weevils eat the leaflets from the edges and cause severe damage (Subramaniam, 1965). In case of severe attack, the weevils scrape the surface of the pods and cause a gummy exudation, affecting the quality of the pods.

B. Sap feeders

These groups of insects are known to cause direct damage by draining the plant sap, and could possibly be the vectors of virus diseases.

Plant lice, *Aphis craccivora* Koch. (Aphididae: Hemiptera). This small brown aphid has been observed to sporadically infest the tender shoots of Moringa from January to March (Figure 3). It reproduces rapidly parthenogenetically. Management is by spray application of dimethoate or malathion. It is known to feed on a wide range of host plants.

Figure 3. Plant lice, *Aphis craccivora* Koch., feeding on the under-surface of Moringa leaves (Photo: Mahesh Math and YK Kotikal, University of Horticultural Sciences, Karnataka, India).

Whiteflies, *Bemisia moringae* David and Subramanian, and Castor whitefly, *Trialeurodes ricini* Misra (Aleyrodidae: Hemiptera). Both of these species have been observed sporadically on Moringa by many researchers, but Palada & Chang (2003) and Okonkwo *et al* (2014) observed high prevalence.

Pentatomid Bug, *Cyclopelta siccifolia* Westwood (Pentatomidae: Hemiptera). This is a common pest on many plants, but has also been reported on Moringa (David & Ananthakrishnan, 2004).

Thrips, *Scirtothrips dorsalis* Hood (Thripidae: Thysanoptera). Thrips infests leaflets and sucks the sap. While it occurs sporadically, the infestation can be serious.

C. Flower-bud, flower and fruit feeders

In this category, most serious are the budworm and pod fly. The bud midge could become a problem in some months and locations.

Budworm, *Noorda moringae* Tams. (Crambidae: Lepidoptera). This is a destructive specialist pest only recorded on Moringa (Figure 4). The larvae bore into the flower buds and can cause shedding of up to 78 percent. The infestation is highest during summer. To manage the infestation spraying of insecticides has been suggested, but extreme caution is needed especially with use of highly toxic products (David & Ramamurthy, 2016).

Figure 4. Left: budworm larvae, *Noorda moringae* Tams. Right: damaged Moringa flower buds (Photos: (Left) Mahesh Math and YK Kotikal, University of Horticultural Sciences, Karnataka, India; and (Right) A Regupathy and R Ayyasamy, Tamil Nadu Agricultural University, Tamil Nadu, India).

Pod-fly or Drumstick Pod-fly or Fruit-fly, *Gitona distigma* Meigen (Drosophilidae: Diptera). This pest (Figure 5) was first reported in 1968. It is a serious pest of Moringa, with losses as high as 75 percent (Sivagami & David, 1968; Anjaneyamurthy & Regupathy, 1989; Ragumoorthi & Subba Rao, 1997). Various management practices have been tried, from baits to the application of pesticides (Ragumoorthi & Arumugam, 1992; Mohan *et al,* 1993; Math *et al,* 2014).

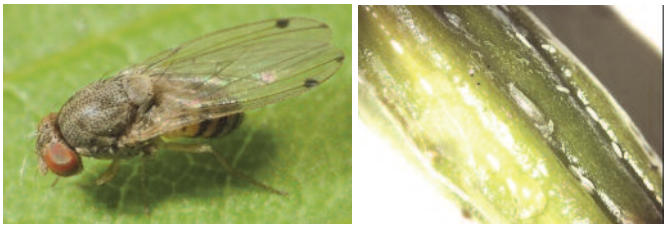


Figure 5. (Left) Adult pod- or fruit-fly (*Gitona distigma* M.); (Right) Young larvae on pods of Moringa (Photos: (Left) Tamil Nadu Agricultural University, Tamil Nadu, India; and (Right) Mahesh Math and YK Kotikal, University of Horticultural Sciences, Karnataka, India).

Bud midge, *Stictodiplosis moringae* Mani (Cecidomyiidae: Diptera). The larvae of the fly feed on the inside of the flower buds and cause them to shed. The incidence is heavy from October to January (Cherian & Basheer, 1938).

D. Stem and bark feeders

Stem borer, *Coptops aedificator* F. (Cerambycidae: Coleoptera). According to David and Ananthakrishnan (2004) this is a worldwide pest of Moringa.

Stem borer, *Phelipara moringae* Aurivillius

(Cerambycidae: Coleoptera). This pest is found in India and Sri Lanka, and infestation occurs from September to November. The insect bores into the tender shoots of Moringa causing death to the branches (Sivagami & David, 1968).

Long horn beetle, *Batocera rubus* L. (Cerambycidae: Coleoptera). This pest has been reported in Asia and Europe (CABI, 2016). Grubs make zig-zag burrows beneath the bark, feed on internal tissues and ultimately affect the sapwood resulting in the death of the affected branch or stem. The adults also feed on the bark of tender twigs. To manage the pest, the affected part can be treated with contact and systemic insecticides, or fumigated. However, the use of such highly toxic agrochemicals is currently not acceptable or recommended.

Stem and Root Borer, *Plocaederus ferrugineus* L. (Cerambycidae: Coleoptera). This pest has been reported in India (Mohapatra, 2006), Africa (Ojiako, *et al,* 2012), and Samoa (Kant & Joshi, 2016). Borer-infested Moringa branches bear fewer leaves (Kant & Joshi, 2016), but further study is needed.

Bark borer, *Indarbela tetraonis* Moore (Cossidae: Lepidoptera). The larva feeds on the bark, usually at night under a shelter of webs. It eats through the bark into the wooden part and, if the infestation is severe, the branch dies. Before undertaking any control measure, the web on the tree should first be removed. David & Ramamurthy (2016) suggested injecting chlorpyrifos or profenofos emulsion into the bored holes, and then sealing them with wet mud.

Scale insect, *Diaspidiotus* spp (Coccidae: Hemiptera). The scale covers the trunk as well as the branches giving the tree a sickly appearance with poor fruit setting. The scale insect has a colouration similar to that of the branch, making the infestation difficult to detect (David, 1961).

Scale insect, *Ceroplastodes cajani* M. (Coccidae: Hemiptera). The nymph and adult stages occur during January/February and from August to December. In case of severe attack, the tender shoots, fruits and stalks are fully covered by the scale. Eventually the shoots dry up and the size of the fruit is affected (Sivagami & David, 1968).

Non-insect pests: Mites

The spider mites (*Tetranychus* spp) (Figure 6) infesting Moringa continue to be studied (Dao *et al,* 2015; Monjaras-Barrera *et al,* 2015). Apparently, just after hatching (which takes 15 to 20 minutes) the mite remains motionless for some time and then starts feeding by inserting its stylet and sucking the sap. Olson (2014) observed in January 2014, at the International Moringa Germplasm Collection of the National University, Mexico, spider mites severely infesting leaves of *Moringa rivae*. Severe infestation of spider mites was also noted on the Moringa grown in the glasshouse at AgResearch Palmerston North, New Zealand (R Kant, Palmerston North, New Zealand, personal communication). Some Moringa species seem more susceptible than others: there has been no mite trouble with *Moringa peregrina*, but *Moringa concanensis* and *M. oleifera* are susceptible. The northeast African species seem particularly vulnerable, but even among them there seems to be variation: *M. rivae* is particularly sensitive, whereas *M. borziana* seems tolerant to spider mites.

Figure 6. (Left) Adult spider mites, *Tetranychus* spp; (Right) Spider mite damage (leaflets spotting) (Photos: (Left) Hope G Patricio, Central Philippine University, Iloilo, Philippines; (Right) Theodere J . Radovich, University of Hawaii at Manoa, Hawaii, USA).

As a control measure, the plants can be sprayed regularly with strong jets of water with horticultural oils or soaps or other non-pesticides which could be helpful, making sure that the underside of the leaves are reached. This is repeated once or twice every week to keep the mites in check.

Conclusions

This review summarises information and findings from studies and research on the major insect pests and mite pests that attack *Moringa oleifera* in different parts of the world, and the management practices carried out to minimise their effect. Pest complexes of the different edible Moringa species should be included in studies. Studies on the bioecology of the pests in the different Moringa growing areas of the world are also needed. The pesticides currently used, and how these impact on natural enemies such as predators, parasitoids and pathogens, need to be investigated, as well as the relationship between leaf damage and pod yield. This will help in the development of good field practices for safer pest management and ultimately a safe and sustainable environment. It is important to note that none of the pesticide recommendations is based on residue estimation. Thus, detailed studies are also needed to establish maximum residue levels as well as information on when to apply control measures involving farmer-applied agro- chemicals. More studies on mites are also needed.

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News from the Field

Solar-powered irrigation pumps in Bangladesh

It is reported that, since 2012, 358 solar-powered irrigation pumps of 15 kW capacity have been installed in Bangladesh, irrigating over 3,000 ha of land. Sales increased from 5 units in 2012 to 175 in 2015. Farmers' costs for irrigating *boro* paddy, the winter rice crop, are reported to be only 80 percent of costs using a diesel-powered pump. The reliability of water supply is increased by using deep-set (20 m) pumps instead of the standard surface-mounted shallow tube-well (STW) centrifugal pumps. A disadvantage is the amount of land taken out of cultivation by the solar array: see Figure 1. Studies are being made to increase benefits by finding alternative uses for solar arrays during the monsoon season when irrigation is not needed.

The company supplying the solar-powered pumps states that there can be considerable economic and environmental benefits from using the pumps. Bangladesh currently requires 320,000 tons of diesel fuel a year to power its 1.43 million diesel-powered pumps and uses 1,700-1,800 megawatts of electricity to power 320,000 electric pumps. It has plenty of sunshine during the dry season when irrigation is needed.

Figure 1. Solar panels powering irrigation pumps.

Based on a report in the Bangladesh Daily Star, 9 October 2016.

Hugh Brammer

International Agricultural Research News

Some recent developments in the CGIAR

The new CGIAR Research Portfolio

Since 2011, the CGIAR has carried out an ever-increasing proportion of its research through large, multi-Centre and outward looking initiatives referred to as CGIAR Research Programmes (CRP). Funded by many donors, each CRP aims to make a significant contribution to achieving the CGIAR's overall goals of reducing poverty, improving food and nutritional security, and enhancing natural resources and ecosystem services. The current portfolio of 15 research programmes, which together encompass the lion's share of the CGIAR's overall research effort, are all due to end at the end of 2016. The latest report on the research undertaken within this portfolio was published in September (http://library.cgiar.org/bitstream/handle/10947/4480/2015CRP-PortfolioReport_Approved 7Sep 2016.pdf?sequence=1). A new portfolio is set to start in January 2017 and run until 2022. The process of arriving at the new portfolio has been long and painstaking and has involved inputs from hundreds of research partners, numerous meetings and multiple reviews.

The System Council, the new apex, strategic decision-making body of the CGIAR, met in Mexico in September, in a meeting that was timed to coincide with CIMMYT's 50th anniversary celebrations (for more about CIMMYT at 50 see: http:// www. cimmyt .org/cimmyt50/). At the meeting, the Council reviewed and approved, with only very minor modifications, a new portfolio, comprising the following 11 CRPs and three research platforms (the full set of CRP proposals can be found at: http://www.cgiar.org/our-strategy/second-call-for-cgiar-research-programs/cgiar-research-programs-and-platforms-revised-full-proposals-submitted-for-review/):

Agri-Food Systems Programmes

- Fish Agri-Food Systems
- Forests, Trees and Agroforestry Agri-Food Systems
- Livestock Agri-Food Systems
- Maize Agri-Food Systems
- Rice Agri-Food Systems
- Roots, Tubers and Bananas Agri-Food Systems
- Wheat Agri-Food Systems

Global Integrating Programmes

- Agriculture for Health and Nutrition
- Climate Change, Agriculture and Food Security
- Policies, Institutions and Markets
- Water, Land and Ecosystems

Research Platforms

- Big Data Coordination Platform
- Excellence in Breeding Platform

- Genebanks Platform

In coming to its decision, the System Council relied heavily on an assessment of the proposals carried out by the Independent Science and Partnership Council (ISPC). The 14 proposals approved in Mexico were all rated 'good' to 'excellent' by the ISPC and were regarded by the Council as "*a solid, exceptional portfolio of CRPs and Platforms of uniformly high-quality for donor investment*". Funding will be allocated to the individual CRPs and Platforms in November.

One proposal has not so far been approved: Grain Legumes and Dryland Cereals Agri-food Systems. The Council, however, recognised the great importance of having a coherent programme on dryland agri-food systems, involving cereals and legumes, and a process has been put in place whereby a completely new proposal will be submitted for approval in 2017.

The new set of CRPs strives to retain and build on the best of the work of the current portfolio while moving away from unsuccessful activities and opening up to new ideas and partners. Thus, within the new portfolio:

- An increased emphasis will be placed on the whole value chain (the agri-food system) compared with the earlier portfolio that tended to focus more on production.
- Greater efforts will be made to coordinate the work across CRPs at the national level and specific mechanisms to help achieve this integration will be established.
- Work previously undertaken within the Humid Tropics and Aquatic systems CRPs will now be integrated into the various agri-food systems CRPs as appropriate.
- The work of the original Livestock and Fish CRP has now been refocused within two separate agri-food Systems CRPs.
- The three CRPs on Integrated Agricultural Systems in Dry Areas, Dryland Cereals and Grain Legumes will be refocused and integrated within a new dryland agri-food systems CRP.
- The CRP on Genetic Resources has now become a Platform that aims to develop and promote uniform genetic resources policies, as well as coordinating and integrating the work of the genebanks across all the Centres and CRPs.
- Platforms, to promote and integrate activities across the CRPs will be established for a) 'Big Data', to capitalise further on the vast amount of data generated by CGIAR research, and b) 'Excellence in Breeding', promoting synergies in plant breeding across the various crop breeding programmes, especially through the development and application of modern biotechnological tools and processes.

CGIAR appoints a new Executive Director

On 3 October, Mr Elwyn Grainger-Jones took up his position as the Executive Director of the CGIAR System Organisation – a pivotal component of the new CGIAR System charged with overseeing the efficient and effective development and implementation of CGIAR's Strategy and Results Framework. In his new position, he will lead the System Office.

A British national and an economist by training, Elwyn brings more than 20 years' experience and expertise in development, agriculture and climate change to the CGIAR, including previous positions at the Department for International Development (DFID), the Adaptation for Smallholder Agriculture Programme of the International Fund for Agricultural Development (IFAD), and the World Bank, where he played a leading role in establishing the World Bank's Climate Investment Funds.

Upon taking up the appointment, Elwyn indicated that he was "*delighted to be part of the leadership team, helping this incredibly important global partnership catalyse a second green revolution that unlocks the urgent need and potential for food systems to tackle poverty, improve nutrition, boost productivity, and sustain the planet's fragile ecosystem. CGIAR's unique role and fantastic technical and convening capabilities are essential in tackling these profound and interconnected challenges*."

ICARDA – a beacon in the Middle East

On 15 October Mr Aly Abousabaa joined the International Centre for Agricultural Research in the Dry Areas (ICARDA) as the Centre's 6th Director General. Aly, an Egyptian national, comes to ICARDA after a rich and diverse career with the African Development Bank (AfDB), rising to take charge of the Bank's operations as Vice President responsible for overseeing the preparation and execution of the Bank's engagement in agriculture and natural resources management, water development, climate change, green development, governance, and human development. Prior to his work with AfDB, he held several positions in the public and private sector mostly related to water development and irrigation infrastructure.

Enhancing food security in the Middle East

In spite of the indescribably horrific situation in Aleppo, Syria – ICARDA's headquarters for almost 40 years – the Centre continues to work and make an impact throughout the troubled West Asia and North Africa region. One project led by ICARDA, for example, entitled *Enhancing Food Security in Arab Countries*, aims to increase the productivity of food crops, especially wheat, across eight countries of the region. Adopting a participatory approach, the initiative tests, validates and disseminates proven innovations and technologies to farmers, including improved wheat varieties, sustainable agronomic practices such as conservation agriculture, and the more efficient use of scarce water resources.

The project also works to strengthen the capacity of farmers and researchers, with a particular focus on the next generation of scientists. A young scientist programme provides training in conventional and advanced areas of agricultural research, focused on field crops.

Recent impacts have included:

- In Egypt, raised-bed planting increased from 2,080 ha in the first season to 29,167 ha in 2013/14; the use of certified seeds increased from 2,046 tons in 2010/11 to 4,457 tons in 2012/2013; and in Al-Sharkia Governorate, wheat production reached over 880,000 tons in 2013-2014, a 58 percent increase over the previous four years.

- In Jordan, improved wheat varieties have raised yields by 10-12 percent, generating additional produce worth an estimated USD 207,000 in 2012/13, and USD 164,000 in 2013/14. Several wheat lines developed by the initiative's Egyptian programme have adapted well to rainfed conditions in Jordan – some having exceeded the grain yield of the local check, *Hourani*, by 25 percent.
- In Morocco, improved wheat production technologies have led to an increase in water productivity of between 63 percent and 200 percent. Several improved high-yielding, disease- and pest-resistant wheat varieties have been tested, with several generating yields in excess of 7 t/ha. In project areas, 100 percent of participating farmers have adopted the new varieties, which are now being sown on 82 percent of the total wheat area.
- In Sudan, improved varieties of wheat are generating yields of 6 t/ha and cover up to 85 percent of the cultivated area in some project sites.
- In Tunisia, over the past three growing seasons, the wheat variety *Maali* has produced an increase in wheat production of 1,760 tons under rainfed conditions, worth approximately USD 615,000.
- In Yemen, the rate of technology adoption among participating farmers reached 75 percent in 2013-14.

Initiated in 2011, with funding from the Arab Fund for Economic and Social Development (AFESD), the Kuwait Fund for Arab Economic Development (KFAED), the Islamic Development Bank, and the OPEC Fund for International Development, the project has now entered its second phase after four successful seasons.

A new genebank for ICARDA

ICARDA's Genebank for the Drylands holds in trust a priceless collection of about 154,000 different samples of some of the world's most important dryland food crops and forages, ready for distribution to crop breeding programmes and other users worldwide. ICARDA ranks first or second worldwide in the number of accessions of genetic resources it conserves of barley, chickpea, faba bean, *Medicago* spp, *Lathyrus* spp, lentil, *Pisum* spp, *Trifolium* spp, and *Vicia* spp, and third for wheat.

ICARDA's original collections remain in the Tel-Hadia genebank near Aleppo which, incredibly, continues to function, although the current fighting in and around the city means that it is no longer accessible. Fortunately, ICARDA had the foresight to deposit duplicates of its various collections elsewhere to ensure their safety; to partner-CGIAR genebanks at CIMMYT in Mexico and ICRISAT in India, the Swiss and Indian national genebanks, and the Svalbard Global Seed Vault in Norway. However, in addition to ensuring their long-term survival, ICARDA continues to manage the collections as a living resource. The day-to-day operations required to maintain the collections and distribute the seed are now being carried out within its genebank facilities in Morocco, and most recently in a new genebank that was opened in late September at its Terbol station in Lebanon's Beqa'a Valley.

The crop genetic resources collection in the new Terbol facility is unique. It contains rangeland and forage species, faba bean and grasspea, and is also a treasure chest of crop wild relatives from across the Fertile Crescent, including the world's largest collection of wild relatives of barley, wheat, lentil and grasspea.

ICARDA's genebank expansion has been funded and supported by the Lebanese Government's Ministry of Agriculture, the Lebanese Agricultural Research Institute, the CGIAR Consortium, the Global Crop Diversity Trust, the Arab Fund for Economic and Social Development, the Kuwait Fund for Arab Economic Development, and the German development agency, GIZ.

In opening the new facility, Dr Mahmoud Solh, the outgoing Director General of ICARDA said: "*As today's commercial crop seed industry concentrates its efforts on a narrow genetic base, these public goods genetic materials from the ICARDA collection and other CGIAR international research centres are a strategic resource to ensure global food and nutrition security. The genebank provides collections that all countries and global breeding programmes can use to develop new crop varieties that have improved yields, and can assist resource poor farmers in the fight against food insecurity and climate change.*"

Geoff Hawtin

Newsflash

TAA assists in placing student interns

For many years the TAA has assisted MSc students through grants and mentoring to help them complete their research assignments overseas, through the Tropical Agriculture Association Fund (TAAF). This year, we have also been able to assist students to find suitable placements. The two examples described below illustrate the value of the TAA global network and how it has served to enable young people to 'get a foot on the ladder' of international development.

Reading University

Earlier this year, we were discussing the Hugh Bunting Memorial Lecture with Julian Park, Professor of Agricultural Systems. He mentioned that the University was seeking help in finding overseas placements for BSc 'International Development' students, as well as higher level internships for their taught post-graduate students. We accordingly contacted our Overseas Branch organisers. Ravi Joshi, Sanjeev Vasudev, Wyn Ellis, and Bruce Lauckner identified opportunities, respectively, in the Philippines, India, Thailand and the Caribbean. The course coordinators at Reading, Sarah Carey and Jo Davies, really appreciated these opportunities and circulated them to their students. One of the students, Phoebe Russell, followed up the Thailand opening. In September, she duly took up an internship with UNEP in Bangkok. Phoebe was delighted, as she explains:

"The opportunity to complete an internship under the ecosystems department at UNEP is invaluable. My main projects consist of researching and analysing the issues with initiatives related to Illegal Wildlife Trade and supporting additional funding opportunities. The knowledge and transferable skills I'm developing during my five months in Bangkok are not only essential for future employment but also for the completion of my dissertation. Following my time with UNEP, I will be undertaking another internship in Himachal Pradesh, India, with a small NGO called EduCare. I believe this will provide an interesting contrast between large institutions and small scale NGOs and will aid me in deciding a future career path. There are endless perks to opportunities such as these, for me it's the chance to apply my international development knowledge to real-life situations as well as being able to fully experience different cultures".

As Professor Julian Park remarked: "*This opportunity 'emerged' via TAA links, so many thanks and hopefully we can work on further synergies*".

Royal Agricultural University (RAU), Cirencester

We also received a request from Pamela Asabea Addai, TAA Student member and African Fellowship Trust Scholar at RAU, who was studying an MSc in Sustainable Agriculture and Food Security. She needed to find a suitable one-month placement to undertake research for her dissertation. Again, we circulated our Overseas Branch organisers. Chris Kapembwa, who is coordinator of the TAA Zambia and Southern Africa Branch, responded with an offer of placement at the Zambia Institute of Agricultural (ZIA), of which he is Director.

As Pamela stated in her report, she was grateful for the platform to gain experience in her field of study through this industrial placement which enabled her to gain more working experience outside her home country of Ghana.

"My sincere gratitude goes to the TAA and the TAA Zambia/Southern African Branch for offering me the opportunity to join the ZIA, which enabled me to complete this part of my programme. ZIA is an independent training, research and empowering institution with the objective of mobilising local leaders and women's groups to train them on sustainable new systems of farming. In relation to these objectives, I was sent to the Muchinga constituency in Serenje District, Central Province. The area is highly endowed with rich soils and thick forests, yet economic development has eluded the mainly subsistence farmers. My task was to:

- *Revamp women's groups and clubs in the constituency;*
- *Mobilise and train farmer coordinators on sustainable agriculture;*
- *Visit agribusiness companies in Lusaka to link market opportunities to farmers".*

Student Job-Seekers Pages

In keeping with our aim to help students to enter the overseas development field, we have added new pages to our website, aimed at providing guidance to aspiring students who are seeking work:

http://www.taa.org.uk/sub-content.asp?subId=83&sub=yes. Pamela's report on her Zambia placement is downloadable from these pages. We hope that this will encourage other students who are seeking to gain practical experience overseas.

Keith Virgo

Mailbox

Horticultural production in Botswana

Dear Sir,

Research into dry land or rain-fed agriculture in Botswana has not been successful in increasing national cereal production, mainly because of the poor distribution of rainfall, and more recently a decreasing trend in the total annual rainfall amounts. However, success in national horticultural production can be partly attributed to the work done by the Department of Agricultural Research from the 1980/90s. During 1997/98 national vegetable production was 6,900 tons which, by 2008/09, had increased to 31,150 tons. Imports from the Republic of South Africa during the 1980s accounted for 90 percent of national consumption, while imports currently account for less than 50 percent of national requirements. Over this period, the population also rose from about 1 million to over 2 million. ME Madisa and G Wiles of the Department of Agricultural Research, and Gus Nilsson of the local Garden Centre *Sanitas* in Gaborone, played a considerable part in enhancing horticultural production in Botswana.

Reference: Madisa ME, Obopile M, Assefa Y, 2013. Analysis of horticultural production trends in Botswana, *Journal of Plant Studies*, **1**(1), 25-29.

David Gollifer

Benny Warren and ox equipment

Dear Sir,

I am very sorry to hear of the death of Benny. I met him in the very early 1960s when I was posted to take charge of the new Ngetta Farm Institute near Lira, Uganda. Benny, an Agriculture Officer, had just returned from long leave and was tasked with developing ox-drawn cultivation. He was based at Serere Research Station near Soroti in Teso District.

Until then ox-drawn cultivation was limited to a team of four oxen ploughing, someone guiding the plough, and a chap either side of the team goading them with small branches. It was under-developed, labour-intensive and clumsy. A chain from the yoke of the leading pair to the yoke of the following pair, then down to the plough, was the current set-up; a bent line of draft exerting undue downward pressure on the following pair's shoulders! Benny improved this by connecting the following pair's yoke to the chain with a long length of leather strap, forming a straight line of draft. In addition, he established the fundamental necessity of linking the width of the yoke to achieve a parallel line of draft to the work. Having spent a deal of his long leave researching the issue in museums and publications, Benny set about developing a new system, largely based on Indian farmers' methods using a ridged drawbar.

The system he developed used a ridged drawbar (greater mechanical efficiency than a chain) for a pair of oxen with one operator. A nose ring was fitted, through which a cord looped around the back of the horns. Connected to this head cord was a rope rein for the operator to lightly tug for steering – a very simplified horse harness system. The oxen were trained to 'go' or 'stop' by two different noise commands by the single operator. Benny discovered just the implement to suit. From the French African colonies he discovered the *Polyculture Attelle* equipment, which was a toolbar, mounted on two pneumatic tyred wheels and with a rigid drawbar to the yoke. To the toolbar, a plough, cultivator tines, a special seeder, and even a cart body could be fitted. It was an excellent piece of equipment. Whilst at Ngetta I became a disciple of Benny's work. Four of my staff attended a week's course at Serere, and upon returning they trained oxen pairs. I bought two *Polyculture Attelle* outfits – one for the farm and one for demonstration purposes.

The work Benny achieved transformed ox-drawn cultivation about which he was tremendously enthusiastic, as he was about everything. Still, I just wondered how long it lasted. Independence for Uganda came in October 1962 and I believe Benny was moved to other things – a pity. However, Benny's work is still relevant today for those farmers who cannot afford two-wheeled tractors.

Ray Bartlett

Closing yield gaps in China by empowering farmers

Dear Sir,

The above titled article appeared in *Nature* (doi.10.1038 /nature 19368) in late September 2016.

The authors reported a great deal of work whereby teams had lived in villages in order to ascertain the reasons why farm performance was less than that on research stations. The issues included depth of ploughing, date of planting, plant population, fertilisation, irrigation, labour use and others. These factors identified as bearing on yield are not new to experienced extension officers. However, they went as far as to quantify the effect of a range of issues on yield. They compared the research station with lead farmers, Science and Technology Backyard (STB) farmers, neighbouring, and control villages – a large and thorough piece of work.

They concluded that in one region of China, the five-year average rose from 67.9 percent of the yield produced on the research station to 97 percent among 71 leading farmers, and from 62.8 percent to 79.6 percent county-wide, that being 93,074 households.

They produced a table in the Extended Data Section, Table 5 page 13, which drew together their analysis across the five categories of grower for summer and winter crops of which the bottom line is a cost-benefit ratio.

What the researchers did not do is to calculate the return per $ invested in the various categories. Doing so, I found the results quite illuminating as given in the Table below:

SUMMER MAIZE	Experimental Station	Lead Farmers	STB Villages	Neighbour villages	Control villages
Ratio of benefit	88.9	263	168	142	122
Return/$ invested	$0.8	$2.4	$1.5	$1.3	$1.09

WINTER WHEAT	Experimental Station	Lead Farmers	STB Villages	Neighbour Villages	Control villages
Ratio of benefit	27.2	98.3	68.0	57.4	47.8
Return/$ invested	$0.25	$0.9	$0.6	$0.5	$0.4

Thus it can be seen that for both crops, the Experiment Station made a loss, 20 cents per dollar for maize and 75 cents per dollar for wheat. Therefore, research stations are not the most economically efficient farms.

The Lead Farmers (only 71 in number) did well with maize, they got their original dollar back plus $1.40. However, for wheat even they made a loss of 10 cents on the dollar invested.

STB villages did well with maize and got their original dollar plus 50 cents, while with wheat they lost 40 cents on the dollar invested.

Neighbouring villages made their original dollar back plus 30 cents with maize, which while good in a large scale enterprise is hardly tempting to risk-averse smallholder farmers. They lost 50 cents per dollar with wheat.

Meanwhile the control villages made their dollar back and 9 cents on maize, while they lost 60 cents on the dollar growing wheat.

The Lead Farmers did better than the Experiment Station each time, but still made a loss on their wheat.

What this suggests is that the recommendations being promoted by STB would benefit from analysis of their economic performance, particularly when used by the general run of farmers rather than when used by the Lead Farmers.

James Biscoe

TAA Forum

Membership Update

The new annual subscription rates were applicable from 1 August 2016:

- Full Individual Member: printed copies of *Ag4Dev* sent by post £50
- Online Individual Member: online access to *Ag4Dev* £40
- Student Member: online access to *Ag4Dev* £15
- Institutional Membership: two printed copies of *Ag4Dev* sent by post £120

Separate rates for over- and under-70s have been dropped.

As with any change in subscription rate, we appreciate that it takes time for everyone to update their subscriptions, whether by amending their Standing Orders or by making higher payments on-line by PayPal, or by cheque. Ideally, we would introduce a Direct Debit payment option but this is not possible under our charitable status.

Many thanks to those of you who have already updated your subscription rates for 2016/17, by amending Standing Orders, or by payments on-line, by cheque or by cash.

The TAA membership database automatically downgrades members from 'Full Individual' to 'Online Individual' membership if their payments remain at £40. Members paying less than £40 are automatically suspended after two months grace and cease to have the full benefits of TAA membership (such as news alerts).

Please check that your Standing Order (or other method of payment) has been changed to either £50 (Full Membership) or £40 (Online Membership) for the 1 August 2017 payment, covering 2017/18; and that you have paid any relevant difference due for the current year (2016/17). Please check that any members whom you know have also done this. If you have any questions or require clarifications, please contact the Membership Secretary, Linda Blunt on membership_secretary@taa.org.uk or by post at 15 Westbourne Grove, Great Baddow, Chelmsford CM2 9RT.

Efforts are being made by ExCo members personally to contact all suspended members, but as of mid-October 2016 the membership stood at:

Full individual members = 149
Online individual members = 263
Student members = 38
TAAF members = 14
Honorary members = 2
Institutional members = 25

Total paid-up members = 491

There are currently 152 suspended members. If you are aware of any member who has not received this journal as normal, or is not receiving email updates, then please ask them to contact the Membership Secretary, who will help them to arrange and/or update their payment.

Linda Blunt
Membership Secretary

Publications and Communications (P&C) Committee Update

Next issues of Agriculture for Development

Ag4Dev30, the Spring 2017 issue, will be a Special Issue on *Climate Smart Agriculture*. We are pleased to announce that Bruce Campbell and his colleagues in the CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS) will be guest editing this issue. Members are invited to send articles, news, opinions, letters or book reviews around the theme for consideration. Please send them to the coordinating editor at paulag4dev@gmail.com.

Ag4Dev31, the Summer 2017 issue, will be an open issue. We already have some items in the pipeline for this issue, but articles, news, opinions, letters or book reviews are invited. Please send them to the coordinating editor at paulag4dev@gmail.com.

Ag4Dev 32, the Winter 2017 issue, will be a special issue on *Women in Agriculture*. We are pleased to announce that Christine Okali has kindly agreed to guest edit this issue. Members are invited to send articles, news, opinions, letters or book reviews around the theme for consideration. Please send them to the coordinating editor at paulag4dev@gmail.com.

Ag4Dev33, the Spring 2018 issue, will be another open issue.

Paul Harding
Coordinating Editor, *Ag4Dev*

Web Manager's Update

Are you receiving regular email alerts?

We send out email alerts to all registered members almost daily. These highlight new events, publications, vacancies and topical news. If you would like to receive these alerts but currently do not receive them (or have ceased to receive them), please check your system – there may be a simple problem that can be rectified:

a) The email address on your membership profile may be incorrect or perhaps you changed your address but did not advise the membership secretary? Please log into http://www.taa.org.uk/membership.asp?menuId=25 and click *'View member profile'* at top right. Check your profile to ensure that the email address is correct. Click *'Update'* as necessary. Email the membership_secretary@taa.org.uk if you are unable to do this.

b) You may have mistakenly clicked *'do not receive TAA messages'* in your membership profile. Again, go to your membership profile, go to the bottom of the page, and make sure that the *'Yes'* button is activated in the *'Receive TAA Email Alerts'* box. Click *'Update'*.

c) Some email service providers have been rejecting messages originating from …..@taa.org.uk addresses. Btinternet.com addresses have recently been doing this and we have been trying to find a resolution to the problem. If you use a btinternet.com address, but have another address, we suggest that you register under the non-BT address, using steps in paragraph (a) above.

d) Your membership may have expired, in which case the alerts will not be sent to you. Please check with the membership secretary and pay your outstanding subscription!

If members still do not receive alerts, and would like to, please contact the webmanager@taa.org.uk. The difficulty is that we do not know how many of our registered members are actually receiving the alerts.

TAA has now joined Twitter!

TAA has been 'tweeting' (and doing other Twitter things such as 'following' selected organisations) since August. The entry to the TAA's Twitter display (https://twitter.com/TropicalAgri) is in the lower right hand corner of TAA's Home page (http://www.taa.org.uk/index.asp?menuId=1).

A click on this reveals TAA's latest tweets, whose Twitter output TAA is following, who in turn is following TAA's Twitter output, and how many have said they like something TAA has put out.

We would encourage all our members to follow TAA on Twitter. Our Twitter name is @TropicalAgri. For those members who are not on Twitter, it is very easy to open an account by going to www.twitter.com and clicking on the *'Sign Up'* box in the upper right hand corner. The following link is a helpful guide to using Twitter: http://www.wikihow.com/Use-Twitter.

Once you have a twitter account, you can FOLLOW TAA by clicking on the *'follow'* box and logging in with your username and password. You can also REPLY to a TAA tweet, RETWEET a TAA tweet from yourself, declare that you LIKE a TAA tweet, and do many other things. All that you need do is click on the TAA tweet and then on any of the four symbols that appear.

Keith Virgo (TAA Web Manager)
Martin Evans (TAA Twitter Manager)

News from the Regions

TAA SW Branch joint Conference with BOAT: Rural entrepreneurship and livestock challenges in East Africa, Bicton College, 5 May 2016

Overview of agriculture and entrepreneurship issues in East Africa

John Wibberley

Professor John Wibberley is visiting Professor (Comparative Agriculture and Rural Extension) at the School of Agriculture, Policy and Development, University of Reading and at the Royal Agricultural University, Cirencester, where he was until 1989 Head of Agriculture. Since 1989, he manages his own consultancy REALM. He has worked in the Tropics for over 40 years.
ejwibberley@btinternet.com

East Africa consists of five countries: Tanzania, Kenya, Uganda, Burundi and Rwanda – the first three Anglophone and the last two small countries Francophone. Intra-regional variations in topography, climate and soils are immense, as are the diverse cultures in terms of entrepreneurship (Table 1). These East African Community (EAC) countries are impacted by contrasting political histories since independence over 50 years ago:

Tanzania set a course of State Socialism with its *Ujamaa* experiment under the first post-independence President Julius Nyerere (*Mwalimu*). A compassionate teacher, he admitted its subsequent economic failure and wisely stood down for elections rather than clinging to power, but this background retarded entrepreneurship, coupled with placid peoples and wide open landscapes. The *Nane Nane* Agricultural Fair is a public holiday in Tanzania, held annually on 8 August to celebrate the nation's farmers. The event recognises their hard work and the contributions they make to the Tanzanian economy. Stakeholders in agriculture showcase their work and innovations towards sustainable agricultural growth and development.

Kenya fought more vigorously for independence and set a course of entrepreneurship from the outset. It used its position as an *entrepôt* via Mombasa to serve the whole East African Region, with Nairobi as its aspiring economic regional capital. This status has developed unchallenged elsewhere in relative productivity and prosperity, but Kenya has sadly earned an international reputation for corruption.

Uganda suffered two decades of turmoil and immense suffering (1966-86) followed by a 'grassroots upwards' establishment of democracy through President Yoweri Museveni. However, by clinging to power he reversed that early legacy, and the positive entrepreneurship it initially engendered sadly is becoming tarnished by cronyism and corruption. Population density and ongoing border wars hinder sustainable progress.

Burundi remains the poorest East African nation, with ongoing political instability and ethnic conflict.

Rwanda has made huge economic strides since the horrendous genocide of 1994, backed by their military President Paul Kagame, with a parallel regimentation of agricultural approaches despite the persistence and crucial role of small farms in this beautiful mountainous nation.

East African Dairying. The region (including Ethiopia) accounts for about 10 percent of world dairy cows, but East Africa only produces 1 percent of the global milk (FAO, 2016). Mixed farming systems dominate; producing 5 percent of global GHG emissions, and 75 percent of total milk production from the region. Kenya is the largest producer, with 37 percent of total milk produced in East Africa and a dynamic dairy sector that has increased by 60 percent since 1990, as a response to growing domestic demand. Ethiopia, Tanzania and Uganda, with respectively 21 percent, 14 percent and 10 percent of the region's milk production, also have significant dairy sectors.

Entrepreneurship literally means 'between taking' *ie* identifying demand opportunities and seizing them by risk-taking endeavour to supply those demands. In the face of a declining public sector and other waged employment opportunities, entrepreneurship is being advocated as the leading alternative engaging youths and women into the process (Chigunta *et al*, 2005; Spring, 2009). East Africa is no exception (Olomi, 2009). However, there is a lag in providing institutional support for entrepreneurship to grow (Bruton *et al*, 2010) including among small farmers (Poole & De Freece, 2010) who are often still left to network among themselves (McDade & Spring, 2005). The 'innovation platforms approach' may prove an effective way of establishing systematic interactions among stakeholders in the agricultural sector by stimulating technical, institutional and organisational innovations in agricultural value chains. Early field testing of the *MilkIT* Programme, coordinated by the International Livestock Research Institute (ILRI), for Tanzania dairying is reported by Pham *et al* (2015). Funded by the United States Agency for International Development (USAID) as part of the global hunger and food security initiative in Kenya, the *Feed the Future Kenya Accelerated Value Chain Development* programme seeks to apply technologies and innovations within value chains, contributing to increased productivity, inclusive agricultural growth, nutrition and food security. This latest ILRI-led initiative focuses on accelerating value chain development in 23 counties in Kenya through the livestock, dairy, staple crops, root crops and staple drought-tolerant crops value chains.

Entrepreneurship can crucially sustain family livelihoods without formally entering into the trade economy (Wibberley, 2007, 2014). However, in the trade economy, where it can be measured more easily, there remain barriers to participation

Table 1. Comparative data for East African countries
(Sources include The Economist, 2016, and Whitaker's Almanack, 2014)

Statistic	Tanzania	Kenya	Uganda	Burundi	Rwanda
Area ('000 sq km)	947.0	580.0	242.0	28.0	26.0
Population (millions)	49.3	44.4	37.6	10.2	11.8
Population growth (%/year)	2.9	2.7	3.2	3.0	2.6
Infant Mortality/'000 live births	42.9	46.3	50.2	80.1	42.6
Life Expectancy (years)	63.1	63.1	60.8	55.9	66.0
Population by 2050 (millions)	129.0	97.0	104.0	28?	23?
% rural population	37.4	34.5	32.4	89.0	81.0
GDP/head/year (purchasing power parity in USD)	2440.0	2790.0	1670.0	770.0	1470.0
% pop accessing electricity	14.8	23.0	14.6	5.3	10.8
Cars per 1000 population	10.0	15.0	3.0	2.0	3
Food available (calories/day)	2208.0	2206.0	2279.0	-	2148.0
% GDP from agriculture	33.8	29.5	25.3	39.8	33.4
Least trade-dependent (% GDP)			15.8	14.4	
Most refugees received ('000)		534.9	220.6		
Most refugees leaving					83.9
Least democratic (%)			41.7	41.0	
Highest economic growth (%)			7.8		7.0

related to agricultural health standards (Jaffee, 2005) as well as marketing arrangements and infrastructure. The parable of talents (in St Matthew, Chapter 25) applies to entrepreneurship, which is to say that to be an entrepreneur one must be ready and willing to risk venturing to employ one's inherent talents rather than to bury or ignore them: a certain bold endeavour is required!

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Increasing sustainability of ruminant farming systems in East Africa

Jamie N McFadzean, Chris J Hodgson, Michael RF Lee, Jennifer AJ Dungait

(All authors are affiliated with Rothamsted Research North Wyke; McFadzean and Lee are also affiliated with the Universities of Exeter and Bristol respectively)

Extended summary of full presentation

In the developing economies of East Africa, livestock production is the most significant provider of employment and as such presents the greatest opportunity to alleviate poverty. As countries such as the United Republic of Tanzania strive to improve national productivity the livestock sector is undergoing rapid changes. The system in these regions is characterised by the traditional pasture-based extensive cattle production practised principally by native peoples in the lowlands, and the relatively more intensive mixed crop-fed dairy cows with improved genetics in upland regions. The future development of these two systems requires careful appraisal of the suitability of interventions in terms of both quantifiable economic and environmental factors as measures for total sustainability.

The most notable proportion of livestock producers in the East African region are characterised as smallholders with managed cropland in upland regions averaging between 0.2 and 2 ha, and within the lowland agro-pastoralist system the largest herd observed averaged 75 head. This lack of organisational consistency of the farming systems necessitates comprehensive appraisal of current practices, particularly in the most prolific and divergent intensive upland and extensive agro-pastoralist production systems. Without thorough knowledge of livestock systems' baseline management techniques and production goals, interventions targeting improved productivity and environmental sustainability can be inappropriate for locality- or stakeholder-specific objectives.

An increasing proportion of smallholder farmers are adopting characteristically western management techniques with the focus principally on 'improved' livestock genetics with western origin crossbreeds. Whilst the introduction of chiefly European dairy stock characteristics has substantial benefits to individual producers relative to local Zebu herds, foremost being increased milk yield per lactation, the necessary requirements to realise these positives are often overlooked. However, the suitability of these techniques for local realities can be intrinsically flawed or implemented in the absence of necessary physical and intellectual infrastructure. An issue which aptly illustrates one of the most significant challenges within subsistence dairy production systems ever-striving for increased yields, is the adoption of cultivated forages. With farm size increasingly limited in the region, the societal shift required to appreciate the benefits of giving over productive land from perceived more valuable cash crops to livestock forage cultivation is a continuing process. The issue of improving existing feed rationing within the traditional agro-

pastoralist production systems is far more difficult. Whilst intensive upland farmers can and progressively are being educated in the benefits of cultivating forage, this is an impossible prospect to the lowland Maasai producers (Figure 1). Whilst some cultivation does occur in more fertile land surrounding the homestead, this is almost exclusively reserved for maize production. This issue of traditional ranging grazing practices and the aspiration for increasingly western breed genetics within herds is unsustainable, and indeed the negative energy balance of these herds is already exacerbating existing issues such as lifetime yields and reproductive function.

Figure 1. Typical traditional Maasai lowland agro-pastoralist homestead, with large mixed genetic cattle herd driven to graze by the older children in the foreground.

Interventions aimed at improving livestock production in East African regions place predominance on rapid, if ultimately limiting, yield advancement. This results in short-term gains in milk yield or live weight that in the medium- to longer-term require significant supporting infrastructures. In the case of improving dairy cattle genetics by the introduction of western breed genetics there is a fundamental need for increased nutritional provision in addition to increased veterinary care and altered general husbandry practices. However, without a comprehensive understanding of the intricacies of the current production systems, establishing the level for application of these corresponding interventions is unfeasible. The focus of interventions is often polarised between targeting greater environmental sustainability with production systems and improved yields. The need for holistic interventions with true economic and environmental sustainability can only be achieved by understanding current production practices and implementing changes that support both causes.

This requires the express evaluation of the two predominant systems within the region. Compilation of extensive datasets, obtained from direct stakeholder participatory research and conventional surveying, allow the production of average representative baselines for both intensive and extensive production systems. The requirement for rapid and effective tools to represent current stakeholder practice to inform potential interventions is significant. While the dairy production sector in this region arguably provides the greatest potential for wealth creation, with milk prices from processers to producers being equivalent to those delivered in the UK, this is only achievable in the presence of a functioning route to the lucrative national market. This dairy production chain requires the physical infrastructure of milk collection, cooling, quality assessment and pasteurisation, before distribution. These obligations on improving the commerciality of milk production also include provision of extensive prophylactic and dynamic veterinary interventions; the advancement of both livestock feed rationing and preservation; significant alteration to basic husbandry practices; in addition to improved livestock genetics. However, improved sustainable genetics, not based solely on production metrics, impart greater resistance to climate, resources challenges and disease. Accessing the benefits of these interventions are the drivers for East-African governments and individual producers, so it must be in conjunction with these that measures to improve environmental sustainability are introduced. However there are significant socio-cultural barriers which must be engaged with, particularly within the traditional agro-pastoralist system (Figure 2) where the propensity is to increase herd size rather than to target efficiency or individual production yield.

Figure 2. Typical example of agro-pastoralist driven cattle grazing across the extensive Handeni savanna.

The implication is that rudimentary interventions such as implementing realistic health and husbandry practices, which are likely to be achieved by stakeholders, must take priority. In non-constrained regions, provision of water *ad libitum* must be practised, since this will significantly improve the health status and production. Udder hygiene should be maintained to reduce incidence of production-limiting mastitis infections, abundantly observed in extensive agro-pastoralist systems. Education for removal or destruction of infective material, such as afterbirth, should be implemented to reduce disease spread before applying costly, and currently often ineffective, vaccination schemes. Significant improvements are possible in tick-borne disease prophylactic treatment given that farmers often use inadequate application of dermal sprays and drenches. There is a need for these basic interventions to be implemented as a true baseline before more significant regional development interventions can be applied to livestock production systems.

Acknowledgements

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Full details of references are available on request from the authors.

TAA SW Group summer field visit to Wiltshire, 4-6 July 2016

Monday 4 July

Avebury

The visit, organised by Tim Roberts and assisted by John Wibberley, assembled at the National Trust (NT) Centre, Avebury where we were met by our NT guide Mike Robinson. The ancient site, contemporary with but more extensive than Stonehenge, was a revelation to most of us. The potential for agriculture led to early occupation. Seventy-two percent of the county, 3,485 km^2, is still devoted to agriculture.

Lackham College farm

Farm manager Phillip Steans told us that there has been a general decline in the profitability of 'conventional' farming – which recent former occupants of this 16th Century farm, discovered. Now, as an agricultural college (Figure 1), the drive is for more efficient land development, feed systems and biomass usage.

As the *raison d'être* of this 600 ha farm is teaching students, more staff are required than for a conventional farm. Students help with harvest and other tasks, but supervising time slows overall work rate.

Figure 1. TAA members touring Lackham College farm (Photo: Paul Harding).

The continual drive to improve the replacement rate of the 160 Holstein dairy herd from 20 percent to 25 percent, and to reduce costs per litre of milk (3.5 pence last year), is bearing fruit. Twenty heifers donated by the Limousin Society in 1999, and docile Herefords, form the beef herd. The Limousins have a much better killing-out percentage and meat to bone ratio but need regular handling to control their liveliness. The college has a token pig herd of 20 sows, the progeny of which are sold on contract as stores, and the lambs from 950 ewes are sold locally.

Maize followed by winter wheat are the predominant cereals on 265 ha of arable land. One hundred hectares of maize, increasing to 200 ha next year, will sell for biofuel.

Jane Davies, Tutor in Agriculture, Lackham College

Buoyant personality and enthusiasm defined Jane's after dinner talk. It soon became clear that the former difficulties of Lackham are a thing of the past. The student male/female ratio is 50/50, half of whom are from farming families. However, because government legislation now requires pupils to remain at school until 18, regretfully many 16 year-olds arrive, especially the males, with little interest or initiative. The genial and good natured Phillip Steans refers to them as 'challenging'. This characteristic is modified by engaging students in a collegiate rather than didactic way. Immaturity is a handicap, but the aim is to mature students so they leave 'work ready' and technically and socially competent. Jane had brought along a recent graduate, Zac, who gave us a good impression from the (good) student angle and of their opportunities these days.

Tuesday 5 July

North Farm, Aldbourne

Robert Lawton had a brief spell in Borneo, followed by service in Africa first as a VSO, then in the Colonial Service. Back in England, he and his wife Mary bought North Farm, Aldbourne, near Marlborough, in 1969. Then, the land was cheap, expecting the arrival of the M4 motorway. The land is undulating at 180-240 metres overlaying chalk. They now farm, with their son James, 1,523 ha of owned and rented land within the North Wessex Downs (NWD), an area of outstanding natural beauty (AONB). The philosophy guiding the farming system is compelling. What was striking was the continual drive to make this system efficient by reducing costs and the carbon footprint, the care and welfare of the environment and enlightened staff relationships. Their 'precision farming' involves satellite recognition to control and regulate correct fertiliser and seed application.

The Lawtons are active in Farmer Study Groups, drivers of the Kingshay Farming Trust and on farm agri-research. The Linking Environment and Farming (LEAF) integrated crop management scheme was adopted in 1991. Using Southwest

Agricultural Resource Management (SWARM) grants, diesel use has reduced by 10 percent, dairy electricity reduced and heat recovery mechanisms installed. In addition, barn roofs have photovoltaic panels and rainwater recovery equipment.

Early-on the concept of salaried farm staff was adopted. Training and safety management for the manager, two staff and four students at harvest, is paramount. Robert contends the most economic feed is low input grazed grass for dairy cows which can handle forage, with an optimum herd size around 250 and two herdsmen. Clearly, the sheer size of the farm provides the opportunity for a low input grazing system. Plate meter technology (for measuring grass cover) is used to optimise grazing, together with restrictive paddocks and enclosures.

For the unit to produce two million litres of milk per year (collected by Cadburys for chocolate) the herd is block calved in autumn, and about 120 young, having wintered in a new unit, are moved out to permanent grass.

On the 1,280 ha of combinable crops, there is appropriate rotation among wheat, barley, oats, oil seed rape and linseed, with advanced mechanisation by modern capital equipment.

Crofton Beam Engine Pumping Station Museum

We went on to view this original Grade 1 listed station on the Kennet and Avon canal. Crofton's two great beam engines, designed 200 years ago, pumped water uphill past the lock keeping the highest point on the canal replenished. Defunct in 1959, the station and equipment is now beautifully restored and still works, but is not used. Water is lifted now by an electric pump. The sight was enthralling but needs more than one visit; highly recommended (www.katrust.org.uk).

Wolfhall Farm

The Blanchard family have been tenants of this 650 ha farm for 20 years. The former high concentrate-fed Holstein breed required high veterinary costs. Following a study tour by Peter's son Tom, the smaller British and Irish strain Friesians were established. These breeds can cope with high bulk, so in consequence veterinary bills have reduced considerably. The 380 cows are split into two herds, one calving in spring and one in autumn, reducing the managerial drag of constant calving.

Pasture was a problem – "grass would not grow", said Peter. It transpired this was due to compaction and maize cultivation. This was rectified, and from 2012, they have moved to a grass-based system, changing arable to grass-based leys. Unwanted calves are fed with waste barley and thus have some value. The field we visited had a lot of weed, but there is reluctance to apply selective weed killers as this would lose the clover as well as the dock. The two herds were there and looked in good state. Increasing profit has been ploughed back for continuing improvement without increasing the overdraft!

Sharcott Pennings Farm

Manager Gavin Davies showed us around. This is a remarkable example of a stewardship and commercial enterprise 'partnership'. The Stewardship Scheme, which governs the 1,401 ha estate, obtained a 10-year grant of £60,000 a year as a single payment. The list of habitat cover for wildlife is considerable. As part of the environmental stewardship, which is taken seriously, we visited a field with a 2 m uncultivated boundary clearly capable of supporting all sorts of plants and animals (Figure 2).

Figure 2. Gavin Davies explains how the Stewardship Scheme works on Sharcott Pennings Farm (Photo: Paul Harding).

Gavin acknowledged that Stewardship is profitable, but the administration and operational adjustments are burdensome. Farm Open Days are run to help reduce public misconceptions.

The former traditional mixed farm business, with an outdated 150 dairy cow enterprise losing money, *had* to be changed. Currently milk is sold below the cost of production. In these daunting circumstances a strategic plan for a new 450 cow dairy complex was proposed by Gavin Davies with considerable courage and faith in the dairy industry. The plan is based on the assumption that milk prices will improve in 12 months, because one million litres is imported unnecessarily from Ireland and the national herd number has fallen 4 percent since January. Gavin has accepted that if his assumptions are incorrect and prices remain low, the dairy enterprise may have to close!

£14.5 million was borrowed to modernise the dairy and other projects, which includes an anaerobic digester. The digester is fueled by a cow slurry (6,000 t) and maize silage (8,000 t) mixture and produces 4,290 MWh; it will pay for itself in seven years. The liquid and solid residues replace N fertiliser to the equivalent of £140,000 (300 t). Care is taken with spreading because the farm is in a nitrogen vulnerable zone (NVZ). The dairy complex however, will take *many* years to break even.

Other enterprises are a 1,500 ewe flock (2,500 fat lambs) and dairy crossbred calves to finished beef. Investment in

machinery for a contracting-out operation is another enterprise. Since the neonicotinoids ban, insecticide spraying has recommenced, the first time for five years. This and blackgrass are the main problems assailing the arable sector.

Rose Somerset, NWD AONB

Rose Somerset gave an after dinner talk about the North Wessex Downs (NWD), designated as an area of outstanding natural beauty (AONB) in 1972. The NWD, with its heritage and wildlife specifically adapted to chalk-land, is the third largest in the country (668 square miles = 1,730 km^2) but is less well-known than other AONBs. Chalk-filtered rainfall forms crystal clear valley streams (80 percent of the world's chalk streams are found in England), which cross heathland, and farmland. The chalk based landscape formed 100 million years ago, was then shaped by humans over the last 5,000 years. With the arrival of Romans, roads were built, and then the Anglo-Saxons established towns in the Middle Ages. The industrial revolution, emerging merchant class and the construction of the Kennet and Avon Canal, meant the area began to 'feed' London. As recently as 60 years ago, however, changes occurred so quickly that the wildlife environment suffered. NWD's mission is to rectify this and to raise public awareness of this lovely AONB attraction (www.northwessexdowns.org.uk).

Wednesday 6 July

Temple Farm, Broad Hinton

This farm exemplifies the fact that given enough land and enthusiasm much can be achieved within the scope of this downland area. Our ebullient host, Chris Musgrave, leaving family business connections in Ireland, became the second shepherd here in 1983; subsequently he made it the largest lowland flock (10,000 sheep) in the country. He progressed 'through the ranks', finally becoming estate manager. Then came foot and mouth, and half the estate was sold to a neighbour, who created National Hunt training stables. Under new ownership in 1983, Chris was given *carte blanche* to run the remaining 810 ha estate as his own business; this gave full scope to his energetic, innovative abilities.

Before World War 1, there were no arable crops; but chalk absorbs water and, in dry conditions, capillary action releases it for crops. Now, wheat for feed and ethanol, and barley contracted to Carling brewery and stored on farm until needed, are two sources of income. Various winter break crops yielded indifferent profits, so a contract to grow morphine poppies for a pharmaceutical company was agreed (Figure 3). This yields much better returns and we learned with great interest of the 'therapeutic aspects' of this crop. Four hundred mule lambs for gimmer (young female sheep) production run on the downland.

In 1983, the estate was devoid of wildlife; as an example Warfarin had killed all the owls. Accordingly a 10-year Heritage Lottery Fund (HLF) contract for the Downs Environment Scheme was agreed as part of the Temple Farm environmental regeneration scheme. In an extensive Nature Improvement Area competition, Temple reached the shortlist. A network of nine dewponds was created, as there are no natural water sources, new hedges laid, and one million trees planted.

Figure 3. Morphine poppies growing on Temple Farm (Photo: Paul Harding).

Annually, 1,100 horses use the trail facilities of 19 miles of gallops and 43 stables created from former cattle sheds. Income is created by public attendance (10,000 in 2015) at the three star-rated facilities. The capital investment was cleared very quickly.

A converted Grade 11 listed former barn is a wedding venue; booked for 22 weeks a year it earns well. Two shoots achieved the Purdy award for the most 'sustainable' endeavour.

Selves Farm, near Laycock

The Doel family are now the fourth generation of ownership (since 1912) of 700 hectares of owned and rented land, which receives a HLF grant as a sight of special scientific interest (SSSI). The farm has two miles of fishing.

In the dairy unit, piece-meal additions over the years had made it a cramped jumble of buildings which demanded a new plan and complete rebuild. During this process, Chris Doel made a decision to house his 300 Holstein dairy herd, a method of husbandry hitherto he would never have contemplated. Chris concluded that in wet months, heavy cattle traipsing long distances to pasture over Oxford clay is not good; for one thing it predisposes to foot troubles.

With considerable capital investment, the new dairy complex was installed in 2000 (Figure 4). The site drops a metre overall, compelling all sections of the new dairy unit to be sited in a straight line. The decision to site the mechanisms in a cellar below the parlour improved herd health. Milk falls to the milk lines instead of being sucked to overhead lines. Accordingly, lower vacuum pressure is required, exerting less teat pressure and so resulting in far lower cell counts. The average annual yield per cow is 9,500 litres.

Slurry collected in a raised lagoon pit, is pumped direct to fields up to a mile away, through an 'umbilical cord'. This is a distinct advantage over the traditional tractor and muck spreader.

Figure 4. The dairy complex at Selves Farm, with the milking parlour in the foreground (Photo: Paul Harding).

Most of the milk is sold at a fixed rate to Cadburys, where quality and traceability is paramount; the balance is sold via a milk broker. A recent new activity is to make ice-cream, which is sold locally. Because a year-round supply of milk is required, the calving pattern reflects this. A daily AI service is available and a foot care/trimming team visit regularly. The knee calluses which occur with this housed herd is a problem yet to be overcome.

Selves Farm is another example where huge investment forced a change from traditional grazing cows to a housed method. Yet again the enormous investment required to run and manage these large units is sobering.

Ray Bartlett and Brian Wood

Obituaries

Professor Paul Davies

Shortly before going to press, we were saddened to learn of the sudden death of Professor Paul Davies – a long-time member of the TAA and well-known to many members. The President has sent condolences on behalf of the Association to Paul's family. A full obituary will be included in *Ag4Dev30*, and any members with memories of Paul are invited to send them to John Wibberley (ejwibberley@btinternet.com).

TAAF News

Fourteen MSc students from nine UK universities were offered TAAF awards in April 2016 to enable them to undertake a period of overseas research for their dissertations. One student could not get research clearance and had to withdraw his application, another has deferred her research study until early 2017. The remaining 12 have written or are writing their reports: six reports are summarised in this issue of the journal, the others will follow in later issues.

Many TAAF awardees from 2016 and earlier years have signed up to a Facebook page for an Early Career Network co-ordinated by Alex Tasker. Alex received a TAAF award in 2012 and has recently become a member of Exco. The aim of this network is to enable young professionals at the start of their careers to exchange and benefit from each other's experiences, both in the field and in finding gainful employment thereafter.

Generous contributions to TAAF funds totalling more than £4,000 have been received from two anonymous donors in the current financial year. A grant of £2,000 per year, initially for two years, has also been promised by the Agricola Memorial Fund, which is managed by alumni of the agricultural development courses previously offered by Wye College, London. These contributions to our work are greatly valued: they will help TAAF to meet the growing demand for our awards and for the professional support that we can offer to awardees. Further donations will always be very warmly welcomed.

Antony Ellman and Alastair Stewart

Mia Raja, MSc Environmental Technology, Imperial College

An integrated approach for upgrading rainfed agriculture for smallholder coffee farming systems

The Hanns R Neumann Stiftung (HRNS foundation), with which I collaborated on this research in Honduras, aims to empower smallholder coffee farmers and to strengthen their ability to achieve better livelihoods. The objective of the research was to help smallholder farmers in the coffee producing countries of Honduras and Guatemala to increase productivity on their farms (Figure 1) by finding solutions in times of water scarcity.

The project has two parts. The first is an in-depth exploration of the current situation that farmers experience, which provides an insight into the needs of individual farmers (Figure 2). The extent of water scarcity was assessed in Ocotepeque and the limitations faced by smallholders were analysed. The second part of the research aims to provide recommendations to farmers and other relevant stakeholders, which will allow farmers to maximise: (a) crop productivity, (b) water use efficiency and in turn (c) profitability.

The outcome of the research demonstrates that agriculture in the third world requires knowledge and support in order to adapt to the changing climate. The effect of El Niño on coffee production has been extreme, and smallholders in Central America require updated farming methods in order to produce. Irrigation is certainly a viable solution, and in the case of Ocotepeque, with the right institutional support and resources, farmers could greatly benefit from drip irrigation on their coffee plots. In turn, this will allow them to sustain themselves and their families, and to build more cohesive communities. I feel that with a better organisation, knowledge sharing on sustainable water use would be highly advantageous for communities within Ocotepeque.

Figure 1. A coffee nursery, Ocotepeque, Honduras.

Figure 2. Mia with farmer and HRNS representative.

Justin Dupre-Harbord, MSc Environment and Development, Edinburgh

Water resource management and social interactions in Wayuu Communities, La Guajira, Colombia

For my Master's dissertation I travelled to the region of La Guajira in Colombia, to analyse conflicts over water management between mining activities and the local indigenous communities living near the *Cerrejón* coal mine (Figure 3). The mine covers an area of 69,000 hectares: it is the biggest open-pit mine in the country and one of the biggest coal mines in the world, providing 3.6 percent of global production in 2014. Every year it extracts up to 33 Mt of coal, almost all of which is exported to foreign markets. In its production process it uses between 27 and 35 million litres of water a day. Although it claims it is efficient and sustainable in its water use, this is highly contested by many of the local indigenous Wayuu people (Figure 4).

Using a political ecology approach, my aim was to determine the relations of power behind these water conflicts, how these have been constructed, and how they affect and are affected by the different opinions put forward by the various stakeholders (the mine, the state and the local people). In order to do this I focused on one case study where *Cerrejón* has diverted a stream, despite opposition by local communities who use the stream for their water.

Figure 3. Patilla pit of the Cerrejón mine.

Figure 4. Visit to Wayuu community, La Horqueta.

By conducting semi-structured interviews, taking direct observations and examining secondary documentation, I was able to unpack the discursive strategies of each actor and create an argument as to why, until now, the mine has been successful in controlling the flow of water in the region. I

learnt that, at least in this context, all knowledge has an inherently political motive and comes from very different backgrounds and ways of viewing water. In this way, no single point of view is absolutely true, but some types of knowledge (*eg* scientific) are prioritised over others (*eg* indigenous).

I conclude by making the argument that more global scrutiny is needed on mining and water in this region, so as to verify the claims made by different actors, and to ensure that the local Wayuu people's demands and concerns are taken seriously by the mine and the government.

By attempting to collaborate with NGOs, I hope that my dissertation will help to achieve this end, and will shed light on a problem that so far has remained relatively unknown. For me this experience has been great in terms of gaining concrete experience of conducting research. It has given me insight into ways of studying water, which is what I would like to work on in the future.

Hannah McLean-Knight, MSc Environmental Change and International Development, Sheffield

The future of small-scale fairtrade and organic coffee production and sustainable livelihoods in Jali, Bussi Island, Uganda

The aim of my research was to explore the future of fairtrade and organic smallholder coffee production (Figure 5) within the context of current and future climatic changes. The research was undertaken in Jali Village, which is located on Bussi Island on Lake Victoria in Uganda. It was done in collaboration with a local social enterprise, *Jali Organic*, and with the support of the Tropical Agriculture Association.

Jali Organic currently trades in organic certified dried pineapple and banana: the company is looking to expand further into the global fairtrade and organic coffee market. Through the implementation of a mixed methodology, the research findings demonstrated the significant role of coffee within the livelihoods of local smallholder farmers, as well as the impact of rising temperatures and increasingly variable rainfall as a result of global climate change. The findings also evidenced an increase in the occurrence of coffee pests and diseases and thus lower yields.

My research explored the potential role of fairtrade and organic coffee production in creating sustainable livelihoods and thus resilience to future climate changes. The research concludes by arguing that, whilst coffee production remains a significant livelihood strategy with many beneficial outcomes, livelihood diversification would also be valuable in increasing local climate change resilience.

This experience was highly beneficial to me and has allowed me to learn a lot, both personally and academically. I was able to understand more fully different theoretical aspects of international development, as well as developing specific research and professional skills. I was also able to gain experience of the everyday workings of a development organisation. Furthermore, the opportunity to conduct research and live amongst a rural community in Uganda (Figure 6) reinforced my aspirations to work in international development, and specifically, rural development.

Figure 5. Coffee cherries drying in Jali village.

Figure 6. Hannah with a local coffee farmer.

Jeneen Hadj-Hammou, MSc Biodiversity, Conservation and Development, Oxford University

The Power of Participation: statistically viable methods for a community monitoring programme of harvested crabs, Madagascar

The aim of my research was to investigate the opportunities and challenges for community-based management of small-scale fisheries in Madagascar. The generous funding I received from the TAA allowed me to address this topic through field-work on a mud crab fishery case study in the Ankobohobo wetlands, located in the northwest of the country. This location was chosen because of its known biodiversity value, presence of active conservation institutions and local NGOs, and because of the presence of the crab fishery harvesting an increasingly commercially valuable species, *Scylla serrata*.

I took an interdisciplinary approach to my research question, and used a range of research methods: wetland surveys, questionnaires and focus groups with fishers (Figure 7), a remote sensing analysis of the region, a power analysis to determine the potential for a crab monitoring programme, and interviews with NGO workers. This allowed me to gain a more holistic understanding of the socio-ecological system.

The system was characterised mainly by the threats it faced, the changes it had undergone over time, the management regimes affecting it, and whether it was amenable to a participatory monitoring programme. Ultimately, these variables were used to assess the value of community-based monitoring for the fishery resource.

While the research did produce a range of valuable findings, there were a series of hiccups along the way. One of the biggest challenges was trying to get to all the villages on a boat with a very temperamental engine, at a point in the day when it was mid- to high-tide so that the boat could travel down the river, and in time to catch the fishers for a chat between their fishing trips (Figure 8). After the first couple of weeks, this logistical challenge became a bit easier to handle, since many of the fishers in the area became aware of my project and were willing to set aside convenient times in their day in order to participate in and contribute to the research.

The interviews and focus groups also provided numerous challenges which I enjoyed working through and learning from. One of the most interesting components of these individual and group interviews was a participatory mapping exercise, in which the fishers identified their personal fishing zones and cross-village gear-restricted zones. The maps produced as a result of this exercise nicely illustrated the spatial nature associated with potential management interventions. I hope to share these images with the fishers next summer, when future researchers go back for the field season. I also intend to share other relevant findings with the NGOs that work in the region and with the executive members of the fishers' associations.

Figure 7. Interviewing a group of fishers.

Figure 8. Measuring the size of harvested crabs.

The most important finding from my research was that the majority of stakeholders involved in the system want, and have the means, to set up a participatory monitoring system, in order to better facilitate increased community-based management of the fishery. Hopefully, this research will benefit the fishers and villagers who live in the Ankobohobo wetlands, and will help to conserve the region's incredible biodiversity.

Personally, I have gained a tremendous amount from this experience. It has provided me with my first opportunity to develop hands-on skills in the conservation-development field. Moreover, my research has further inspired me to work towards achieving a sustainable future for our aquatic ecosystems and the coastal populations which depend on them.

Catherine Walker, MSc Conservation Science, Imperial College.

Understanding changes in livelihood strategies in indigenous Bunong and Khmer communities within Keo Seima Wildlife Sanctuary, Cambodia.

My study was based in Keo Seima Wildlife Sanctuary (KSWS; formerly Seima Protection Forest), in north-eastern Cambodia. Composed of evergreen and deciduous forest, a UN Reducing Emissions from Deforestation and Forest Degradation (REDD+) project has been operating in the reserve since 2008; it strives to reduce deforestation and forest degradation to preserve the forest as a carbon sink but also to produce net positive impacts on people living in the forest, who are mainly indigenous Bunong. Traditionally, people depended on farming rice rotationally (Figure 9) and on the forest for food, housing materials and income in a subsistence lifestyle. However, suggestions that the livelihood strategies are rapidly changing in the reserve warranted this qualitative study to better understand the changes and how they affect the validity of a model underpinning the 2017 social impact assessment, as well as more directly informing adaptive management of the project.

I found that there has indeed been a shift in livelihood strategies in recent years in KSWS – from dependence on rice and resin collection towards farming cash crops and illegally collecting timber for income. This shift is largely driven by increasing accessibility of villages due to government and NGO investment in infrastructure, and by an increased demand for cash crops and timber from nearby Vietnam. Legal and illegal land clearance and logging, along with threats such as the presence of economic land concessions and the over-exploitation of resources due to population increase, mean that people are less dependent on natural resources in general as availability declines.

Whilst the movement towards farming cash crops and collecting timber is associated with economic development in villages, these livelihoods are unsustainable in comparison

Figure 9. Paddy fields embedded within surrounding forest, Keo Seima Wildlife Sanctuary.

to traditional livelihoods. Villagers tend to clear increasing amounts of land to make more money from cash crops, rather than farming rotationally; and timber is a finite resource, already dwindling after immense harvesting pressure since trade to Vietnam opened in 2012/13. Compounding this, climate change associated with forest loss hampers agricultural productivity. These results will be fed back to the Wildlife Conservation Society, who implement the REDD+ project. They can not only use the understanding of these changes to ensure the 2017 social impact assessment is as accurate and insightful as possible, but directly respond to this research by prioritising their planned interventions and adaptively managing the project to promote net positive benefits for the people living in the reserve.

This study has also helped me in my career. I am keenly interested in evidence-based conservation and development projects: this study has provided me with an insight into the opportunities and challenges of such a project, particularly amidst a rapidly changing context. The relationship between people and natural resource use is highly dynamic and this study has confirmed to me the importance of reassessing the context in which a project operates, and adaptively managing the project to produce the best outcomes possible for people and wildlife within the given constraints.

Vyvyan Evans, MSc Water Security and International Development, University of East Anglia.

Right as rain? An assessment of social impacts of rainwater harvesting: a case study from southern Ethiopia

This study used the 'wellbeing approach' to identify and analyse how the practice of rainwater harvesting (RWH) has impacted on social wellbeing in the dry lands of Southern Ethiopia, in order to assess how effective RWH is as a climate change adaptation strategy in small communities in semi-arid and arid regions.

Using primary data collected from organisations and communities in Borena Zone which practise RWH, the research shows that RWH has had some negative implications for community wellbeing: for example creating social conflict, interfering with land rights, disrupting cultural values related to water and seasonal migration, and increasing the likelihood of water-borne diseases.

Yet, the research concludes, there has been a net positive gain in wellbeing as a result of RWH. In many cases, RWH has not only increased human wellbeing through improved access to water, but it has also contributed to improvements in equity, gender balance and social capital. Additionally, many of the negative wellbeing impacts that were identified can be mitigated by greater awareness of the community networks within which RWH exists, and by the incorporation of wellbeing criteria into the planning and implementation stages of RWH.

While conducting this research (Figure 10) I learnt about the immensely complex process of translating development goals and community-scale climate adaptation into practice. I came to understand how the desire to achieve the structured targets presented by the Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs) can often override community preferences and suitability of an intervention. Additionally, I learnt the importance of interpreting the development process in a synergistic manner, being alert to the interrelated nature of component parts (for example addressing gender inequalities and land

rights together, or health, crop rotations and community dynamics collectively).

More widely I also learnt the value of an iterative research approach, which can lead to more holistic conclusions. Undertaking this research project has enabled me to gain a rich understanding of the topic, country and stages involved in conducting research, whilst giving me great confidence and pride in what I have achieved.

My hope is that this research has highlighted *to the community* their resilience and ownership of their own adaptation capacity and wellbeing (rather than structuring the assessment around their vulnerabilities); *to implementing NGOs and government agencies* the need to understand the values held by communities and individuals regarding their own wellbeing, with a view to ensuring that policies adopted and adaptations promoted are more locally appropriate.

More generally the research has shown that the wellbeing approach can encourage reflection on communities' perceptions and beliefs, community dynamics and material considerations as potentially important controlling variables, with measurable thresholds which, if ignored, can lead to trade-offs, decreased resilience, and unsustainable trajectories of change.

Figure 10. Interviewing community representatives in Borena.

Institutional Members' Page

NIAB

We are pleased to welcome NIAB (formerly the National Institute of Agricultural Botany) as an Institutional Member of the TAA.

Background

NIAB (www.niab.com) is an independent, not-for-profit, company that undertakes research and development (R&D), provides field trial and analytical support, and knowledge transfer activities to support, develop and promote the agriculture and horticulture industry, both in the UK and internationally. A unique national resource, with nearly 100 years of experience, NIAB is internationally recognised for its independence, innovation and integrity in supporting the food and feed industry to sustainably supply food and renewable resources.

NIAB's traditional activities have centred on combining science-led plant variety and seed characterisation, evaluation, and quality control with appropriate agronomic research and knowledge transfer. In recent years NIAB has built on its innovative skills to engage in research relevant to crop improvement, and deliver the practical benefits of that research to commercial plant breeders in the UK and abroad. A major focus is pre-competitive plant breeding that aims to access diverse genetic variation for a range of novel traits that will ensure that current economic, environmental and societal targets are met.

NIAB has a long-established and successful reputation in delivering specialist training to government and commercial customers. These include variety and pest identification, crop inspection methods, seed sampling and testing specifically aimed at agricultural advisors and agronomists in support of crop quality assurance schemes.

The integration into the NIAB Group of The Arable Group (TAG) in September 2009, The Potato Agronomy Unit at the Cambridge University Farm (CUF) in December 2012, and East Malling Research (EMR, http://www.emr.ac.uk/) in February 2016, leaves NIAB uniquely placed to address genetic and agronomic challenges in a wide range of crops, ranging from horticultural and arable crops right through to top and soft fruits. NIAB's unique integration of science and practice is not currently found in other UK Institutes or Universities at the depth, scale or speed required for delivery into industry.

Technology transfer and knowledge exchange are at the heart of what NIAB does. **The NIAB-TAG Network** (https://members.niab.com/), a subscription-based technical services branch of NIAB, has a membership base of over 2,500 farmers and growers, influencing a larger proportion of the UK arable acreage than any other organisation. **NIAB Innovation Farm** (www.innovationfarm.co.uk/), a unique knowledge exchange facility established in 2009, helps bridge the gap that exists between scientific research and agricultural practice in the UK. Its purpose-built demonstration and conference facilities help broker connections between the industry, including farmers, the general public, small- and medium-sized enterprises, policy makers and researchers.

NIAB International (http://www.niabinternational.org/) is a division of NIAB that was established to support R&D and uptake of innovation by resource-poor farmers in developing countries. Through partnerships, and building on NIAB's extensive skills and experience, NIAB International is building an extensive portfolio of activities that will impact the lives of smallholder farmers and developing-country economies. Like NIAB, NIAB International is committed to delivering impact through innovation in agriculture directly to farmers. Our mission is to connect innovations at the genetic or varietal level with the appropriate agronomy and knowledge transfer to farmers' fields internationally.

NIAB's activities internationally

NIAB is involved in research and training aimed at harnessing bioscience to improve food and nutrition security in developing countries (http://www.niabinternational.org/activities/). These activities fall into four main areas: variety development and dissemination, education about varieties and their use, monitoring and application of seed law, and improving seed supply systems. A few of these activities are described here:

- NIAB has extensive experience of **capturing and cataloguing plant variety data** developed over many years of administering the UK Plant Breeders Rights/National Listing scheme and seed certification for a range of species, including cereals, oil seed rape, potatoes and ornamental crops. NIAB developed and maintains internal and external databases to capture and transmit this information to facilitate international trade in seed among OECD countries, as well as 58 other UN member countries (http://www.niab.com/oecdv2/). NIAB has applied its skills, expertise and experience to help develop similar systems for other countries in Asia, Europe and Africa.
- **NIAB Innovation Farm Africa**: A major constraint to agricultural development in sub-Saharan Africa, and for smallholder farmers in particular, is access to new knowledge and farming innovation. NIAB carried out a comprehensive scoping study, sponsored by the John Templeton Foundation, on the feasibility of establishing new bases of innovation in Ghana, Kenya and Uganda. Plans are now in place to go ahead with a NIAB Innovation Farm Ghana. NIAB Innovation Farm Ghana will provide a platform for the exchange of knowledge, and demonstration of innovation in agriculture to smallholder farmers in Ghana, thereby preventing marginalisation and enhancing their livelihoods.
- **R&D and Training:** NIAB is involved in numerous plant breeding and agronomy R&D projects, and training programmes (Figure 1) in Europe, Asia and Africa, including: the Sustainable Crop Production Research for International Development (SCPRID), the Programme for Emerging Agricultural Research Leaders (PEARL), the Cambridge-Africa Partnership for Research Excellence (CAPREX), and the UK-India Virtual Joint Centres in Agricultural Nitrogen (CINTRIN & INEW) initiatives. Collaborators include researchers from Uganda's National Agricultural Research Organisation, the Tanzania Commission for Science and Technology, the University of Pretoria (South Africa), the University of Egerton (Kenya), the University of Ghana, EMBPRAPA (the Brazilian Agricultural Research Corporation), the Philippine Rice Research Institute, and the Centres of the CGIAR, working on crops that include wheat, common bean and rice.

Figure 1. Plant breeding R&D and training: Kenyan Agricultural and Livestock Research Organisation (KALRO) scientists with Agri-transfer team members in a molecular biology laboratory established at KALRO's Food Crop Research Institute Njoro Centre as part of a NIAB/KALRO SCPRID (Sustainable Crop Production Research for International Development) project (Photo: Tinashe Chiurugwi, NIAB).

NIAB International case study

Technology transfer and knowledge exchange: NIAB leads a two-year technology transfer project supported by the

Biotechnology and Biological Science Research Council (BBSRC) and two UK charities: the Malaysian Centre for Commonwealth Studies (MCSC) and the Cambridge Malaysian Education and Development Trust (CMEDT). The project is in partnership with the Kenyan Agricultural and Livestock Research Organisation (KALRO) and involves NIAB, KALRO, MCSC and CMEDT staff working with extension officers in Narok and Nakuru counties, Kenya. The overall aim of the project is to engage with smallholder farmer communities in Kenya to improve wheat production, through improving knowledge transfer to smallholder farmers. In the longer term, it is hoped that this pilot project will generate useful information that can inform good practices in knowledge transfer and training to improve smallholder production of wheat and other appropriate smallholder farmer crops in Kenya, as well as other developing countries.

Project activities include:

- **Farmer-managed wheat trials and demonstrations**: Demonstration plots were grown on a farm in the Njoro Ward of Nakuru County, about four kilometres from KALRO's centre in Njoro. The farm was jointly leased and managed by a smallholder farmers' group called *Tuiniane* that paid for the land and provided labour for manual operations on the farm, while the project provided all bought-in inputs and machinery. The aim was to test and demonstrate agronomic practices (land preparation methods; pest, weed and disease control; fertiliser choice and application rates; impact of seed quality; *etc*) and new wheat varieties.
- **Wheat Agronomy Manual**: All the major operations and practices carried out on the demonstration farm were documented to create audio, video and photographic learning/training material. This material was developed into a digital wheat production guide (including information on off-farm activities such as agro-economic planning, marketing, processing and value addition) in the form of a mobile phone application. At the same time, the project team has developed a printed wheat production guide, an updated version of an old KALRO production guide last updated in 2003. The project will compare the efficacy of the digital and the printed production guides as training platforms to identify the optimal approach for instructing smallholder wheat farmers in the practices of wheat production.

Figure 2. Farmer-managed demonstrations and seed multiplication: *Pambazuka* farmer group with Agri-transfer team members in the seed multiplication plot in Mau Narok, January 2016 (Photo: Tinashe Chiurugwi, NIAB).

- **Farmer-managed certified seed production**: Seed multiplication plots of the KALRO wheat variety Eagle 10 were sown in Mau Narok Ward of Nakuru County (Figure 2), about 30 km from KALRO's centre in Njoro. This was carried out in collaboration with the smallholder farming group called *Pambazuka*, teaching them how to produce certified wheat seed under contract from the KALRO Seed Unit, while multiplying seed for their own use.

Lesley Boyd (Research Group Leader and Head of NIAB International)

Tinashe Chiurugwi (Project Manager, NIAB International)

We are pleased to welcome to the TAA new Institutional Member Mountain Lion Agriculture, Sierra Leone Ltd. Dr Alex Zieba, the Director and Vice President, Research and Development, describes the development and philosophy of the company.

A Brief History of Mountain Lion Agriculture, Sierra Leone Ltd

In 2008, Donald Ola Smart (a native Sierra Leonean farmer) and Jason Dudek (a Canadian businessman) hatched a plan to bring a rice mill to Sierra Leone, as the core of a market chain intervention intended to revitalise the agricultural sector in an economy still wavering in the wake of a decade-long civil war. They assembled a team on which I was fortunate to be included. I had met Jason several years earlier as a student in my Philosophy class at Queen's University (Kingston, Canada) where I had been teaching alongside running a community shared agriculture project (and I now like to tell my current crop of students that he's become my boss). After much planning, consultation and deliberation, Mountain Lion Agriculture Sierra Leone was born, producing and supporting the local, heritage red country rice varieties that have been grown as a staple food here for centuries. By 2012, we had demonstrated a successful pilot intervention which led to

partnerships with the Mennonite Economic Development Agency, Sarona Asset Management, the Horsch Foundation, and the African Enterprise Challenge Fund, allowing us to become the largest producer in the country in 2013-14.

Figure 1. The Mountain Lion team with CFO Jason Dudek (far left) and Alex Zieba (front right).

Our business model has been deliberately structured so that we cannot profit without achieving our social purpose (to improve the lives of small farmers), for example, by purchasing rice paddy through a local small-farmer network. We were offered USD millions early on if we would abandon our small farmer network and grow the rice ourselves. However, local farmers' possession of their land was based on a tribal right rather than a paper deed, and so 'buying' property was a privilege which only foreigners could arrange. Producing our own rice would therefore push villagers off their land and turn subsistence farmers into migrant workers – this might be good for short-term profits and GDP but is hardly in small farmers' interest. So while we maintain a research farm upon which to determine and demonstrate best practices, a growing network of 5,000 supplier farmers is the pride of Mountain Lion, as vital a link as the mill itself in our market chain intervention. It has turned out that local farmers have much to teach us about growing rice in Sierra Leone, as they do in maintaining a sense of community amidst adversity.

We believe the fact that we work only with *partners* (rather than, say, 'beneficiaries') proved during the Ebola crisis to lend us the resilience of a Salonean farmer. Our CEO and COO are native Sierra Leoneans, along with all of our middle management. This became pivotal when Ebola-related travel restrictions were put in place, as most other businesses lost their foreign management and had to cease operations as the

Figure 2. Mountain Lion CEO Ola Smart.

months wore on. By contrast, our fully-trained team completed the construction of the mill and carried out the collection and processing of over 1,000 metric tons of local rice – the very first 1,000 tons – without any direct foreign assistance (isn't that the goal of development after all?). Most of this was distributed by the World Food Program (WFP), whose mandate included sourcing local food wherever possible: in an economic crisis such as this, answering food security with free, imported rice amounts to a further attack on the local economy and the local farmer, so the urgency to feed people was matched by the urgency to do so through the local economy, rather than in spite of it.

Mountain Lion also offers local farmers training, tractor services, and interest-free seed loans (repayable in raw paddy). Currently, Mountain Lion operates a 2-ton/hour rice mill in the outskirts of Makeni, Sierra Leone, with over 100 employees, as well as employing women to par-boil the rice. We are in the process of establishing a loans programme for small traders who sell by-the-cup in local markets. Mountain Lion Par-boiled Country Rice is exceptionally nutritious, locally preferred, and sold variously to local institutions, the WFP, and is available in local grocery stores and markets – we've even put together a little commercial for local television: https://m.youtube.com/watch?v=PKEmPJUpK5E.

For more about Mountain Lion Agriculture Sierra Leone Ltd see www.mlbr.org

Alex Zieba
Vice-President, Research and Development

Reminiscences and Reflections

Nigeria, Botswana, Western Samoa, Malaysia and Indonesia, 1964-1977

Basil Hoare

Basil Hoare worked in industry with Monsanto and Bayer for four years and spent six years in the Gold Coast (later Ghana) and The Gambia with the Colonial Service. This was followed by sixteen years with UN agencies (International Labour Organisation – ILO and Food and Agriculture Organisation – FAO) carrying out assignments in agronomy, horticulture, agricultural education, and training and extension in seven countries. A period with the consultancy company ULG, with assignments in Malaysia and Indonesia, was followed by ten years of freelance consultancy. Basil is a former TAAF Chairman.

Western Nigeria, 1964-1968

I was based in Ibadan in Western Nigeria with the International Labour Office (ILO) of the UN. However, I was responsible to FAO for reporting on all technical matters.

The team consisted of six individuals and included specialists in education and infrastructure, two economists and myself as the agronomist. The project was concerned with rural employment and was aimed at discouraging young people from leaving rural areas to move to the cities such as Ibadan, the largest African city south of the Sahara.

In the first instance, we looked at a new type of Farm Settlement programme which was supposedly low-cost, compared to those implemented previously and which had been investigated by FAO. The first of these areas was located at Ejura, and the team did a detailed review and investigation at this site. It was clear that these settlements were far from low cost and were politically motivated. We wrote a very detailed report which included much economic and statistical data to support our findings.

The above was not part of the original plan for our programme. The intention was to find an area to implement the project and the team investigated various districts and we finally decided on the Ifo Ilaro, Otta region, which lies between Abeokuta and Lagos.

As the agronomist on the team, it was important that I investigated the work being carried out by the various specialists based at the Federal and Regional research centres in Ibadan. There was a need to decide on suitable programmes for the future project area and which crops to encourage, for example. After a number of visits, and a detailed look at current farming activities, I developed a number of proposals with the assistance of other team members. Those we considered to be the most important included the increased and more efficient production of kola nuts, a crop multiplication scheme for new and more productive varieties of maize and rice, and the initiation of a nursery for new types of cocoa.

Kola nuts were a very important crop in the area. They are customarily used for weddings and other ceremonial occasions, not only in Nigeria but also in other parts of West Africa. As a result, a project was set up using some of the new and more productive varieties which had been produced at the research centre.

Figure 1. Yoruba Farmer with new cocoa variety.

A site was chosen and developed for the cocoa scheme and some improved material imported and planted in the nursery Figure 1). The crop multiplication programme was also initiated and planted with rice and maize at a later stage. I also carried out some extension activities and was particularly involved in the distribution of improved cassava varieties and various types of fruit and vegetables.

Western Samoa, 1970-1972

I was appointed as an extension specialist in this FAO development project with a team of eleven, including an economist, a livestock specialist, a food processing specialist, a soil scientist, a surveyor and an agronomist. I was also asked to spend some time both assisting the agronomist and in some teaching at the Alafua College.

There are two main islands in the country, Upolu and Savaii, with the capital Apia being on the former. There are more than three hundred villages with the majority being on Upolu.

I taught extension, crop husbandry and horticulture to students originating from various Pacific islands. It was important that they had a good understanding of conditions in rural areas and we undertook a number of field trips.

An area was developed on the south of the island at Togitogiga for the production of a variety of field and tree crops. I was involved in the importation and growing of various items such as macadamia nut seedlings. One month was spent on a mission to Fiji and Hawaii where I was asked to look at macadamia nuts in particular. Time was spent on the large

island known as Hawaii Island and visits made to Maui and Kauai. Visits were also made to the University and to research stations to gain information on improved types of other crops such as papaya, banana and citrus and some vegetables. I was able to bring back a selection of young macadamia seedlings and other crops.

I was fortunate to be awarded a title and am known as Chief Seumalii. In the first instance, I modestly refused to accept, but I was informed that having such a title would make me a more effective worker and assist in the overall programme. At the same time, one would be expected to be good at making speeches, and I had much practice at a later stage. A healthy appetite, particularly for fish and corned beef – the latter being a traditional dish in the country – would also be most advantageous. An elaborate ceremony was held at the installation (Figure 2).

Figure 2. Chief Seumalii at installation ceremony.

Botswana, 1972-1975

My next posting with FAO was to Botswana as Vice-Principal and Director of Studies at the Agricultural College. There were some one hundred and fifty students and more than twenty staff members, a number of whom were expatriates. The job was something of a challenge, since I had not previously taught in a formal situation.

My subjects were crop husbandry, horticulture and agricultural extension. The purpose of the latter was to train the students to undertake fieldwork with farmers as I myself had done in my first postings in Ghana and The Gambia. Most of the students would become field workers and a minority would become research staff. The job also involved a considerable amount of administration.

The two years of study led to the award of a Certificate in three disciplines – Agriculture, Animal Health and Community Development. Animal health was very important in Botswana due to the large number of cattle in various parts of the region, and the students were given a very good grounding in husbandry and veterinary practice by a teacher who was a highly qualified veterinarian.

There were seven hours of teaching per day and some fifty percent of the overall time was given over to practical work. My teaching load was between twenty-five and thirty hours per week. The extension teaching involved field work in three local villages, where students were exposed to the real farming situation and had to deal directly with farmers. They were ably led by my counterpart and, together, we were able to visit them in the field and study their progress with class discussions the following day.

I also organised a seminar, *The Training of Botswana Farmers*, which proved to be a success and involved staff from FAO in Rome. There was much work in the organisation of this exercise and a number of papers were delivered.

Some of the students, who were both male and female, came to the college almost as children. However, at the time of graduation they had become, in the main, mature and responsible individuals (Figure 3). A number of the more successful students went on to the University of Botswana, Lesotho and Swaziland (UBLS) to study for a diploma or even, at a later stage, a degree. I made a number of visits to Swaziland to help in the development of this programme.

I undertook a study tour of Malawi and Kenya to visit agricultural colleges and institutions. This was a very instructive tour and the visits to the Colby College in Malawi and Egerton in Kenya were particularly valuable.

One of the staff members was an amateur pilot and he was able to take several of us on a memorable trip that included Victoria Falls, the Chobe and Moremi Game Reserves and the Okovango River.

Figure 3. With students at the College.

Malaysia and Indonesia, 1976-1977

During my time with ULG Consultants, I participated in two programmes, the first being in Malaysia. There were ten consultants from a variety of disciplines, with myself as the agronomist. This was a World Bank funded development project concerned with the upgrading of agriculture and other resources in the States of Kedah and Perlis in the north of the country, on the border with Thailand (Figure 4).

Figure 4. Lost in the jungle with the Malaysian army – near the Thai border.

My main concern was to gain an overview of agriculture in this region where rubber and rice were the main crops. Rice production was already prominent with the Muda scheme covering a considerable area, particularly in Kedah. An assessment of the rubber situation was undertaken in liaison with the rubber replanting authority and the Rubber Research Institute in Kuala Lumpur.

The Indonesia project was part of the World Bank funded transmigration programme for settling farmers from overcrowded areas of central Java in particular. A considerable area had been cleared for resettlement and one acre was to be allocated per farmer for cropping plus a quarter of an acre for housing. My main job was to recommend which crops should be grown and we considered rubber, rice and cassava in particular.

Upcoming events

Tropical Agriculture Association

Registered Charity No. 800863

Notice of the Tropical Agriculture Association's 2017 Annual Reunion

VENUE: The Royal Over-Seas League, Park Place, St James's Street, London, SW1A 1LR

DATE: Wednesday 11 January 2017

AGENDA commencing at 6.00 pm

1. Introduction by Chairman
2. TAAF Awardee Presentations
3. TAA Honours Awards
4. TAA Development Agriculturalist of the Year Presentation

ANNUAL SOCIAL REUNION will be held from 7:30 pm

A hot fork buffet will cost £25 per person. The cash bar will be open from 6.00 pm.

Members, spouses and friends are welcome for an enjoyable evening, with an opportunity to meet old friends and new.

How to get to the Royal Over-Seas League

Tube to Green Park (Piccadilly, Jubilee or Victoria Lines), take the exit marked Buckingham Palace, walk past the Ritz Hotel turning right on Arlington Street. At the end of Arlington Street there are some steps, and down the steps is the front entrance (approx 5 minutes).

Buses 8, 9, 14, 19, 22 and 38 stop outside Green Park tube station on Piccadilly, running west to Hyde Park Corner, Victoria and Knightsbridge, and east to Piccadilly Circus and Holborn.

Registration

Please register for the event by advising the General Secretary at general_secretary@taa.org.uk

Cost

There will be a charge of £25 per person, payable at the door, or in advance to the General Secretary, TAA, c/o Montpelier Professional Services, 1 Dashwood Square, Newton Steward, DG8 6EQ.

Note

This year, the AGM will be held at Reading before the Hugh Bunting Memorial Lecture on the 9th November, and the Ralph Melville Memorial Lecture will be held on the 7th March in Cambridge (Please see TAA website for further details).

TAA South-West meeting & AGM

Date and Time: 10.00, 3 January 2017

Venue: Exeter Golf & Country Club Topsham Road, Exeter EX2 7AE, UK.

More information from the TAA SW Secretary, Ray Bartlett email: ray@bairstowe.myzen.co.uk

TAA Annual Reunion, Honours Awards, DAY presentation, TAAF presentations and social

Date & Time: 18.00, 11 January 2017

Details: This will focus on an annual review, award of TAA Honours, a presentation by the Development Agriculturalist of the Year, and presentations by TAAF awardees. The event will conclude with a reception and buffet supper. There should be plenty of time for interaction and informal networking. Please mark in your diaries, and check Events on the website for more details.

Venue: Royal Over-Seas League, Piccadilly, London.

General enquiries: Elizabeth Warham general_secretary@taa.org.uk.

Next steps for UK agricultural technologies - investment, research and priorities for Agri-Tech Strategy

Date and Time: 09.00, 7 February 2017

Details: The Westminster Food & Nutrition Forum Keynote Seminar. Presenters to include Helena Busby, Head of Agri-tech, Innovation and Resource Efficiency, Food and Farming Strategy and Innovation, DEFRA; Tina Barsby, Chief Executive Officer, National Institute of Agricultural Botany; Prof Janet Bainbridge, CEO, Agri-Tech Organisation, Department for International Trade; Andy Cureton, Head of Business and Innovation, Biotechnology and Biological Sciences Research Council; David Flanders, Chief Executive Officer, Agrimetrics and Calum Murray, Programme Lead, AgriFood, Innovate UK. Follow at https://twitter.com/WFNFEvents
Live Agenda at http://www.westminsterforumprojects.co.uk/forums/agenda/agri-technologies-2016-agenda.pdf.
Delegates will receive copies of the full seminar transcripts.

Venue: Central London, exact venue to be determined and will be available here: http://www.westminsterforumprojects.co.uk/forums/event.php?eid=1337

Registration: http://www.westminsterforumprojects.co.uk/forums/book_event.php?eid=1337

Ralph Melville Memorial Lecture: *Interdisciplinary food systems training to address global food challenges*

Date and Time: 18.00, 7 March 2017

Details: The 34th TAA Ralph Melville Memorial Lecture will be delivered by Dr John Ingram, Food Systems Programme Leader of the Environmental Change Institute, University of Oxford. His topic will be on Interdisciplinary food systems training to address global food challenges. John Ingram leads IFSTAL, a learning community and interactive resource designed to improve post-graduate level knowledge and understanding of the food system. The event will be co-hosted by the Cambridge University Strategic Research Initiative on Global Food Security. The lecture will be followed by a wine reception and networking opportunities.

Venue: Sainsbury Laboratory, Cambridge University, Bateman Street, Cambridge, CB2 1LR, UK (close to railway station).

Location details: http://www.slcu.cam.ac.uk/about/contact

Registration: No charge but we will welcome charitable donations to our Tropical Agriculture Award Fund (TAAF). https://www.eventbrite.co.uk/e/34th-ralph-melville-memorial-lecture-tickets-27775082018

TAA Seminar: *Transfer of crop research knowledge to small farmers, with emphasis on Sub-Saharan Africa*

Date and Time: 13.30, 16 May 2017

Details: The annual TAA East Anglia seminar will be held in collaboration with NIAB International (Cambridge), the University of Cambridge Global Food Security (GFS) initiative and CambPlants Hub. Two main papers are envisaged: (i) Tinashe Chiurugwi of NIAB International will present a paper on Supporting smallholders in improving wheat cultivation, drawing on outcomes of NIAB's KALRO ago-transfer project in Kenya. (ii) Peter Emmrich of the John Innes Centre, Norwich, will describe his current research on grass pea, aimed at developing it as a drought-tolerant crop for Ethiopia.

More Details:
http://www.taa.org.uk/assets2/seminar_2017_flyer%20%20ver2.pdf
Keith Virgo: eastanglia_convenor@taa.org.uk
Tea/coffee and biscuits will be available and there will be an opportunity to visit the research glasshouses on the adjacent NIAB Innovation Farm, especially wheat and ornamental plant breeding.

Venue: Cambridge: Sophi Taylor Centre, NIAB Innovation Farm, Villa Road, Histon, Cambridge CB24 9NZ). Parking plentiful; Guided Bus service from railway station/city centre (car shuttle service will meet at 'Histon & Impington' stop).

Location details: https://www.innovationfarm.co.uk/sites/innovationfarm.co.uk/files/imce_uploads/NIAB-Park-Farm-Map.pdf

Registration: We request donations of at least £5.00 per person to cover the costs of the venue and refreshments. https://www.eventbrite.co.uk/login/?referrer=/preview%3Feid%3D28041906096

The State of the World's Plants II

Date and Time: 09.30, 25-26 May 2017

Details: Kew, a TAA Institutional member, invites you to the second two-day annual symposium with key themes including: Threats to plant health; Climate change; Useful plants; Invasive plants; Protected areas; Extinction risk. Join us to take stock of the world's plant diversity, research and trends, including impacts on agriculture.

Further Details and Registration: closer to the time please consult http://science.kew.org/state-worlds-plants-symposium
email: sotwp@kew.org

Venue: Royal Botanic Gardens, Kew, TW9 3DS, UK.

European climate change adaptation conference: *Our climate ready future*

Dates: 5-9 June 2017

Details: The aim of this conference is to inspire and enable people to work together to discover and deliver positive climate adaptation solutions that can strengthen society, revitalise local economies and enhance the environment. A gathering for the people who will deliver action on the ground – from business, industry, NGOs, local government and communities – to share knowledge, ideas and experience with researchers and policymakers. Set in the cultural city of Glasgow, at the heart of a city-region that is putting climate adaptation and climate justice at the core of decision-making, ECCA 2017 offers a unique opportunity to visit many innovative local adaptation projects and share experience of how climate adaptation can work in practice. Sectoral themes: urban, energy & infrastructure; agriculture & forestry; water security & flooding; biodiversity, ecosystem services & nature-based solutions; health & wellbeing. http://ecca2017.eu/conference/

Registration: https://confpartners.eventsair.com/ecca-2017/reginterest/Site/Register

Venue: SECC, Glasgow, UK.

21st IFMA Congress *Future farming systems*

Dates: 2-7 July 2017
Pre-Congress Tour: 25 June-1 July 2017
Post-Congress Tour: 8 July-14 July 2017

Details: IFMA (International Farm Management Association) hold a week-long International Congress every other year which is organised, wherever possible, by the member organisation that covers Farm Management of the host country and a partner educational establishment. The IFMA Congress allows ideas, experiences, best practice and knowledge covering farm management and agricultural education/training to be exchanged through presentations, visits and demonstrations.

More details including registration:
http://www.ifma21.org/congress/

Contact: Richard@iagrm.com

Venue: Edinburgh, Scotland UK.

21st World Congress of Soil Science (WCSS)

Dates: 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.

Further information: http://www.21wcss.org/

Contact: fcamargo@ufrgs.br Flavio Camargo, Vice-President Congress.

Venue: Rio Centro Exhibition and Convention Centre, Rio de Janeiro, Brazil.
http://www.riocentro.com.br/

Tropical Agriculture Association
Registered Charity No. 800663

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/

Step One - Application: Applications can be made on-line at:
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:

Type of membership and annual subscription rate			
Full Individual Member (printed copies of *Agriculture for Development)*	£50	Online Individual Member (online copies of *Agriculture for Development)*	£40
Institutional Member (printed copies of *Agriculture for Development* and online access for staff)	£120	Student Membership (online copies of *Agriculture for Development)*	£15

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

TAA Executive Committee

OFFICE HOLDERS

President: Andrew Bennett, Chroyle, Gloucester Road, Bath BA1 8BH.
Tel: 01225 851489;
email: president@taa.org.uk

Chairman: Keith Virgo, Pettets Farm, Great Bradley, Newmarket, Suffolk CB8 9LU.
Tel: 01440 783413;
email: chairman@taa.org.uk

Vice-Chairman: Paul Harding, 207 Lightwood Road, Buxton, Derbyshire SK17 6RN.
Tel: 01298 27957;
email: vice_chairman@taa.org.uk

General Secretary: Elizabeth Warham, TAA, c/o Montpelier Professional Services, 1 Dashwood Square, Newton Steward, DG8 6EQ, UK.
Tel: Mobile 07711 524 641,
email: general_secretary@taa.org.uk

Treasurer/Subscriptions: Jim Ellis-Jones, 4 Silbury Court, Silsoe, Beds MK45 4RU. Tel: 01525 861090;
email: treasurer@taa.org.uk

Membership Secretary/Change of Address: Linda Blunt, 15 Westbourne Grove, Great Baddow, Chelmsford CM2 9RT.
email: membership_secretary@taa.org.uk

Institutional Membership: Martin Evans, 35 Cavendish Avenue, Cambridge, CB1 7UR. Tel: 01223 244436,
email: Corporate_membership@taa.org.uk

Branches Coordinator: 'Nathan' Duraisaminathan Visvanathan, WS Atkins, Western House (Block C), Peterborough Business Park, Lynch Wood, Peterborough PE2 6FZ. Tel: 07834 507380,
email: branch_coordinator@taa.org.uk

Agriculture for Development **Editors:**

Coordinating Editor:
Paul Harding, 207 Lightwood Road, Buxton, Derbyshire SK17 6RN.
Tel: 01298 27957,
email: coordinator_ag4dev@taa.org.uk

Technical Editor:
Elizabeth Warham,
email: editor_ag4dev@taa.org.uk

Technical Editor:
Brian G Sims,
email: editor_ag4dev@taa.org.uk

Website Manager: Keith Virgo, Pettets Farm, Great Bradley, Newmarket, Suffolk CB8 9LU.
Tel: 01440 783413,
email: webmanager@taa.org.uk

Award Fund Chairman/Enquiries: Antony Ellman, 15 Vine Road, Barnes, London SW13 0NE. Tel: 0208 878 5882, Fax: 02088786588;
email: taa_award_fund@taa.org.uk

Honours Panel Chair: Paul Harding, 207 Lightwood Road, Buxton, Derbyshire SK17 6RN.
Tel: 01298 27957,
email: chairhonours@taa.org.uk

Vacancies Team Members:
Alan Stapleton, Michael Fitzpatrick, Bookie Ezeomah.
email: vacancies@taa.org.uk

UK Regional Branches

Scotland

John Ferguson
21 Pentland Drive, Edinburgh, EH10 6PU.
Tel: 07734249948, email: scotland_convenor@taa.org.uk

North of England

John Gowing, University of Newcastle upon Tyne, 1 Park Terrace, Newcastle upon Tyne NE1 7RU.
Tel: 0191 222 8488; email: northernengland_convenor@taa.org.uk

South-West

Tim Roberts, Greenways, 15 Marksbury, Bath, Somerset BA2 9HS
Tel: 01761 470455; email: southwest_organiser@taa.org.uk

London/South-East

Terry Wiles, 54 King George Gardens, Chichester, West Sussex PO19 6LE. Tel: 07971 626372; email: southeast_convenor@taa.org.uk

East Anglia

Keith Virgo, Pettets Farm, Great Bradley, Newmarket, Suffolk CB8 9LU. Tel: 01440 783413; email: eastanglia_convenor@taa.org.uk

Specialist Groups

Agribusiness

Roger Cozens, Coombe Bank, Tipton St John, Sidmouth, Devon EX10 0AX. Tel: 01404 815829; email: agribusiness@taa.org.uk

Land Husbandry

Amir Kassam, 88 Gunnersbury Avenue, Ealing, London W5 4HA.
Tel: 020 8993 3426; Fax: 020 8993 3632;
email: landhusbandry@taa.org.uk

Environmental Conservation

Keith Virgo, Pettets Farm, Great Bradley, Newmarket, Suffolk CB8 9LU. Tel: 01440 783413; email: environment_conservation@taa.org.uk

Overseas Branches

TAA India: Sanjeev Vasudev, S-154, Greater Kailash II, New Delhi 110048, India. Tel: +91 98101 12773. email: india_organiser@taa.org.uk

TAA Caribbean: Bruce Lauckner, c/o CARDI, PO Box 212, University Campus, St Augustine, Trinidad & Tobago
Tel: +1 868 645 1205/6/7; email: caribbean_organiser@taa.org.uk

TAA SE Asia: Wyn Ellis, 4/185 Bouban Maneenin, Ladplakhad 66, Bangkhen, Bangkok 10220, Thailand. Mobile: +66 818 357380;
email: seasia_organiser@taa.org.uk

TAA Pacific: Ravi Joshi, Visiting Professor of Biology, University of the Philippines, Baguio, 2600 Baguio City, The Philippines,
Mobile tel +63-919 955 8868/+63 998 578 5570
email: pacific_organiser@taa.org.uk

TAA Zambia/Southern Africa: Chris Kapembwa, Plot 30 Kaniki, Ndola, Zambia. Tel: +260 977 536 825,
Email: zambia_organiser@taa.org.uk

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TAA, Montpelier Professional Services, 1 Dashwood Square, Newton Stewart, Wigtownshire DG8 6EQ
Web site: http://www.taa.org.uk

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DESIGN, LAYOUT AND PRESS-READY FILES
Robert Lewin Graphic Design
Tel: (01353) 722005
lewin994@btinternet.com

PRINTING
Altone Limited
Tel: 01223 837840
info@altone.ltd.uk
www.altone.ltd.uk