



The Scottish Ecological Design Association Magazine

# Soil and Natural Capital



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## View from the Chair

by Paul Barham



### Two more years into recession sees ecological design pushed further down the political agenda - behind the

short term quick fixes of oil shale, fracking and the courting of emerging markets as new sales opportunities. And our continuing blinkered obsession with the politics of growth - economic growth - means that we lose sight of our place in the natural and evolving cycle of growth and decay.

This issue of the SEDA Magazine looks at the planet's natural capital through the focused editorial eyes of Professor Geoff Squire, from the James Hutton Institute in Dundee. Natural capital cannot be quantitatively eased, but it can be nurtured and stewarded; its currency is the soil and with its produce we go hungry.

At last year's SEDA Conference Geoff highlighted the significance of natural capi-

tal through the example of how the wealth of Scotland remains concentrated in the rich farmlands of Berwickshire, East Lothian, central Fife and Angus. He reminds us of our reliance on the soil - even today when we feel so distant from our agrarian past but are always only so many weeks away from hunger.

Walking across the raw edges of Glasgow today, my train of thought ran through the horrors of collapse and what we can do to counteract the negative forces that challenge our ethics or threaten the ideas we defend and cherish - with or without reason. Our allotment provided further reminder of our fragility: imagine if we had to rely on these 200 square metres of urban horticulture to survive the year!

Looking around us we face an onslaught of demands to review and revise our moral compass: attitudes to the welfare system, collectivity, the very basis of our sense of fairness, justice and our own humanity - all being challenged in the pursuit of "austerity" by a government of millionaires. We may find ourselves wary of biting the hand that feeds us but do we want to promote the perverse ecology of inequality and injustice? It seems now in 2013 that the challenges to ecological design are perhaps greater than ever, despite (or perhaps because of) corporate and bureaucratic subscription to "sustainability". If we carry on like this we may be left consoling ourselves that at least the gallows are made from timber from sustainably managed forests....!

Natural capital provides a focus for a more active response. This is a concept which can be brought to bear to challenge the growing influence of powerful individuals and corporations and the less visible interest groups they represent. Campaigns across the world focus on land use, from

industrialised global food production to the call for more growing spaces closer to home. The threatened cork forest ecosystems of south west Europe represent a wealth of natural capital far greater than their visible components of trees, crops and livestock. And what of the loss of natural capital represented across Scotland by the abandoned opencast sites now consigned to desertification by the demise of Scottish Coal?

Ecological design has always to look further afield, to the wider context, to examine the connectivity between people, production and places, to want to know what other people's problems and priorities are at the same time as meeting the briefs of disparate clients. How one informs the other underlies the dynamics of ecological design. Ecological design relies on scientific input to inform our choices. However the direction and reporting of that science is vulnerable to spin and influence from vested interests. This is a delicate balance and while we know that we will sometimes get our sums wrong this does not alter the inescapable fact that all of this stuff is connected.

Sadly, I must sign off my last view from this chair by paying tribute to SEDA founder and continuing inspiration, Howard Liddell, who died in February of this year. Sebastian Tombs pays full tribute to Howard in his obituary in this magazine and helps to remind us that the battles fought by Howard and by SEDA have a continuing relevance today and need to be fought over and over again on an ever-changing battlefield.



*SEDA are immensely grateful to Paul for his role as chair over the last two years and look forward to his continuing involvement.*

## HOW TO JOIN SEDA

The simplest way to become a member of SEDA is to go to our website [www.seda.uk.net](http://www.seda.uk.net) and follow the links to 'Become a SEDA member'. Alternatively please email [membership@seda.uk.net](mailto:membership@seda.uk.net) with the subject heading 'New Membership'

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Business: Large (more than 5 people) = £120.00

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This Issue of the SEDA Magazine was put together by David Seel with help from Sam Foster. Sincere thanks to all who have contributed and to the various businesses whose advertising helps to support the magazine. While we hope you find the articles and features of interest we would point out that they do not always represent the opinions of SEDA. [Cover image: Flower head of wild carrot with insect visitors. Credit: Living Field / James Hutton Institute (Living Field is the Hutton Institute's outreach programme)]



# SEDA AGM 2013: Design for Health and Well-being

May 31st-June 1st 2013

The Phoenix Centre, Newton Dee Village,  
Bielside, Aberdeen AB15 9DX

This year SEDA is in the North East combining the AGM with a range of visits & presentations under the broad heading of "Designing for Health and Well-Being".

An afternoon of talks will start with our key speaker Chris Butters, co-founder of Gaia. He will talk about his recent book "From Passivhaus to Healthy House" and present examples of innovative buildings that illustrate this approach.

This will be followed by a series of presentations summarising different perspectives of buildings where health and well-being are critical – from the Maggie's Centre, Aberdeen through to the work of Camphill Architects whose work is rooted in the ethos of the Communities for whom they design. The conference will end with the KJ Award before our guided tour of the various buildings at Newton Dee.

Saturday is a day of visits to various places around Aberdeen including Wood End Barn Arts and Growing project; Genevieve Jones' house and the award-winning SEPA / SNH offices at Torry, by Keppie Design.



**FULL PROGRAMME & BOOKING FORM on the SEDA Events page at [www.seda.uk.net](http://www.seda.uk.net)**

**SEDA was formed in 1991. Our primary aim is to share knowledge, skills and experience of ecological design. SEDA is a network and links those seeking information and services with those providing them.**

SEDA has currently around 400 members predominantly in Scotland. Members include academics, architects, artists, builders, planners, students, ecologists, landscape designers, materials suppliers, woodworkers, and many more whose work or interest is concerned with design for a sustainable future.

SEDA is a charity run by a Board of Directors who are elected at Annual General Meetings and who meet every second month. SEDA is made up of five groups, each with a separate objective:

#### **We influence Policy...**

- To represent SEDA's interest in a variety of forums
- To develop contacts with lobbying bodies, academia and research groups
- Respond to policy consultations on behalf of SEDA

#### **We inform the public...**

- To promote sustainability and ecological design issues to the wider public

- To define what these terms mean and the importance of them

#### **We promote research and innovation...**

- To record and disseminate pertinent research from a wide range of sources to members of SEDA, the public, communities, professionals and wider development world.
- To develop live and practical innovative projects that bridge the practice, policy and research of the application of ecological design.

#### **We are a community...**

- To make being a member of SEDA a lively and enjoyable thing, and to organise members meets and social events.

#### **We are well managed...**

- To ensure SEDA runs smoothly and happily
- To share knowledge and information within SEDA
- To maintain a strong professional image and presence within the SEDA committees
- To represent SEDA as an essential professional group pushing the boundaries of ecological design possibilities.

**All of these groups are run by SEDA members - if you would like to be part of a group please get in touch by emailing [info@seda.uk.net](mailto:info@seda.uk.net)**

# Soil and Natural Capital: re-connection with a wider living context

David Seel and Sam Foster

**I**n this issue, we follow up the intriguing talk at last year's AGM by this edition's guest editor, Geoff Squire, a biologist working at the James Hutton Institute, Dundee on sustainable systems, who discusses the management of the land in Scotland for the health of the countryside and the people who rely upon it.

We felt these issues worth investigating in greater depth, as this perspective puts concepts of 'sustainable development' in an important context that is seldom discussed, but which could indicate ways forward – both in how we look at use of natural resources and how we interact with them. Longer-term members of SEDA will be aware that agricultural issues are part of the wide range of topics considered by the organisation, having for example examined Permaculture in Vol 6, Issue 1 of the magazine in January 2008. Questions of the relationship between people, built projects and natural systems have been discussed regularly in these pages. Howard Liddell's last presentation to the SEDA 2012 conference, reviewed in the last issue, reminded us that much of the modern ecological movement stemmed from concerns about modern farming and the shocking revelations in Rachel Carson's *Silent Spring*. While principally addressing modern agricultural methods, Carson demanded that we consider how all modern processes can be made to work with natural systems rather than depleting them, both for their and our own sakes. The work of the Hutton Institute looks at the world of modern land management directly and, as we saw in the last issue, provides an educated standpoint on how our stewarding of the ecology affects not just wildlife, but the whole range of natural capital, including the soil, food-webs, the plants that we grow (or allow to grow), and all those who feed from them, including ourselves.

Through this edition, Geoff fleshes out themes from his conference talk, with contributions from colleagues, farmers, scientists and SEDA members. Through these we aim to give a broad view which can lead

you to see facets of how 'land management' and food production currently work, and how they could work, with an emphasis on maintaining the 'natural capital' of the soil and surrounding environment by which we all live. In his initial article Geoff sets out the issues, highlighting the seriousness of the current situation - how "systems of food production can not simply revert to a previous state – too much has changed. Rather, agriculture must continue evolving further towards a stable, resilient state or else to collapse."

To put this in context, as much as we might see a lack of energy as a problem, letting the planet's land become unproductive has even more radical consequences, with the UK being far from secure in this. According to Sir Bob Watson, former Chief Scientific Advisor at Defra, "Natural capital, along with built, human and social capital, is an important component of the wealth of a nation. Ecosystem services are essential to human well-being and sustainable development. The value of ecosystem services in both monetary and non-monetary terms must be recognised in decision making<sup>1</sup>." Equally, on an international scale, the Food and Agriculture Organisation of the United Nations note that "Biodiversity for food and agriculture is among the earth's most important resources. Crops, farm animals, aquatic organisms, forest trees, micro-organisms and invertebrates – thousands of species and their genetic variability make up the web of biodiversity in ecosystems that the world's food production depends on<sup>2</sup>." Retaining and enhancing natural capital goes way beyond the more visible flora and fauna, important as they are, to consider the very way in which we carry out the annual cycles of growing and harvesting in today's increasingly mechanized world of agriculture.

The background to this is the domination of mechanised methods promoted by large agro-industrial companies, whose mode of operation is to try to dominate food production on global scales. There is an alarmingly small number of companies that between them sell technology packages to farmers and then buy the produce which is grown to their specifications: procuring and selling the food but also sell the seeds, pesticides, herbicides and fungicides and setting planting regimes, that they say are necessary for 'healthy' crop production. One has to question what this will do for the issue of biodiversity to which the UN refer. The articles also consider what allows this situation to be perpetuated, and whether a greater level of concern from the wider public as to where their food comes from can be brought about. It has taken

headlines about the contents of frozen lasagne to make people sit up and look at what is going on to get them their cheap microwave dinners.

From his viewpoint in research and in practical involvement with land management, Geoff starts by presenting the current evidence on the situation, and some thoughts on ways forward. He also sets out how the 'natural / production systems' function at different scales, from an individual farm, up through local ecosystems, to regional and international scales of operation. The articles that follow are from people directly involved at each of these scales, all seeking to find ways to a more sustainable future for land management. Farmer Ed Baxter describes how his own crop production is guided by the Audit tool from the LEAF organisation and is "at the heart of the decision taking system which leads us to (hopefully) the right answers" for... "the twin objectives of running a financially and environmentally sustainable business". Alongside this there is an outline of the concept of Integrated Farm Management promoted through LEAF.

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**"We [should] consider how all modern processes can be made to work *with* natural systems rather than depleting them, both for their and our own sakes" (Rachel Carson, 1962)**

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Moving up a scale, Bethan Stagg and Ben Heron of Schumacher College outline issues around maintaining cultural, nutritional and genetic diversity in local ecosystems, and how practical application of these principles in different parts of the world have for example "...been shown to control disease by slowing down the rate and incidence of infection". SEDA member Ulrich Loehning, former director at the Centre for Human Ecology at Edinburgh University discusses his work on pest suppressive landscapes in the local Scottish environment. Then Pete Ritchie, local farmer and a key contributor to the Nourish network, outlines his work with Edinburgh Council on "the first stage [of] shaping the city's food strategy [through] a year long process of enquiry and engagement" and their consideration of issues such as the creation of a 'circular economy' between city and country, and public procurement of food. Carolyn Lebel's article comes at the issues from a national scale but looking at the cur-



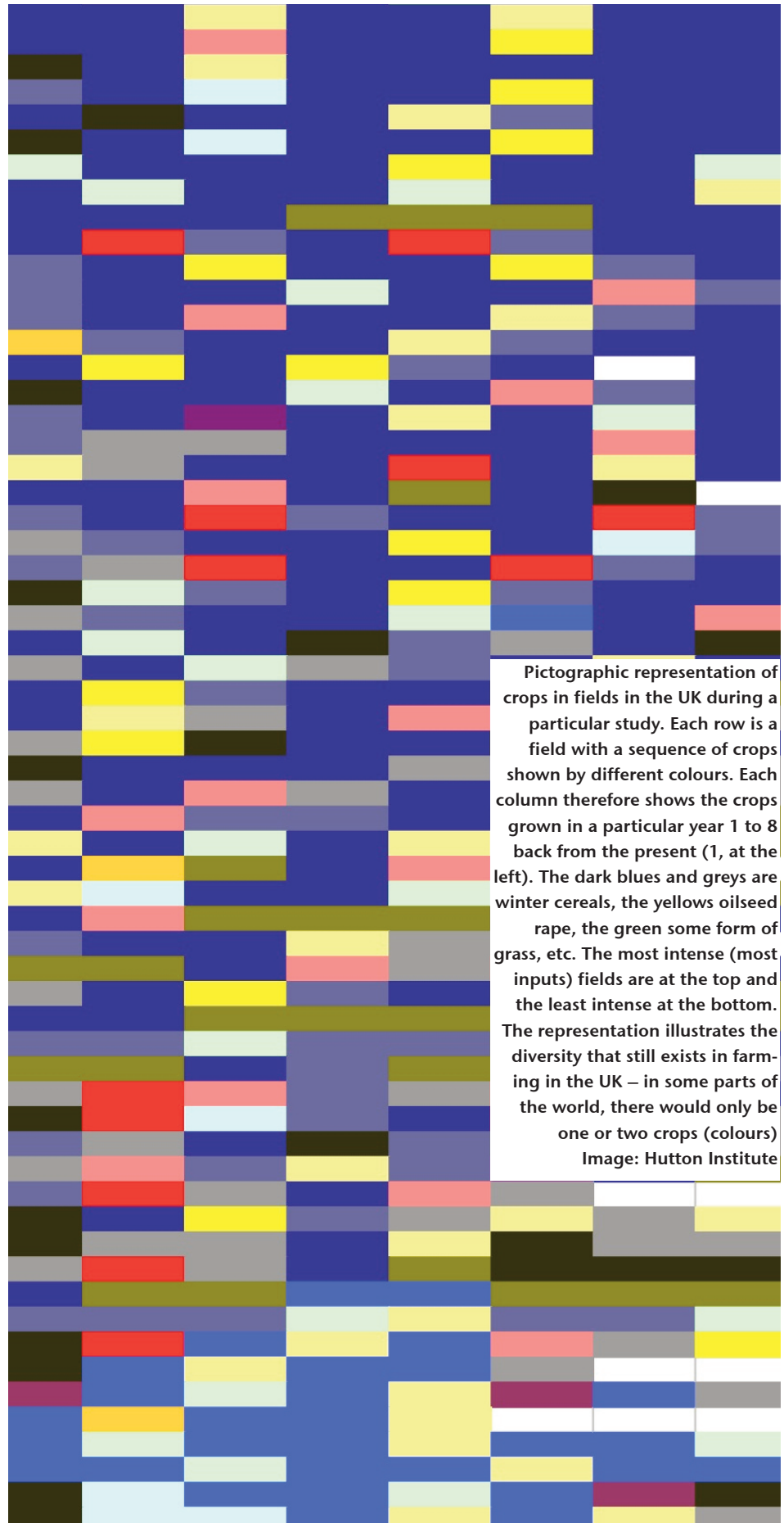
rent debate in France where, for example, a study of the state of soil “suggests that several of the elements compromising food security around the world are at play here too, from soil erosion and degradation to the loss of agricultural lands for development”.

The thread that weaves through this issue is the possible need for agricultural production to be planned better to maintain natural capital through a system similar to that used in the planning of towns and cities. There are also clear parallels between how urban and rural planning work, such as the scales of application: from individual units (field / building) up to international networks (building materials and energy / fertiliser production and food exports). There are also very clear links between the inequality of provision of basic accommodation and a lack of quantity and nutrition of food for much of the world’s population. With major population changes continuing, connected solutions for built development and agriculture are required, so that both types of land use support each other. How do we pull together the best knowledge in each (dare we say it?) field to achieve this?

Such deadpan puns were one of the many sides of Professor Howard Liddell OBE, co-founder of SEDA, who died last month and, as has already been noted, who saw the built and the natural world as being completely intertwined. Co-founder Sebastian Tombs’ appreciation in this issue highlights Howard’s importance to the promotion of human-based ecological issues, particularly in Scotland, but also his significant contribution to the debate beyond. His passing coincided with his investiture with an OBE for his services to ecological design, and the publication of his updated *Eco-minimalism* book, demonstrating how he remained busy and engaged to the last. As Sebastian notes, Howard’s challenge remains for others to maintain this level of enquiry and commitment, and we are certain that this magazine will continue to seek to play a key role in continuing to raise and debate the issues he was so passionate about.

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Pictographic representation of crops in fields in the UK during a particular study. Each row is a field with a sequence of crops shown by different colours. Each column therefore shows the crops grown in a particular year 1 to 8 back from the present (1, at the left). The dark blues and greys are winter cereals, the yellows oilseed rape, the green some form of grass, etc. The most intense (most inputs) fields are at the top and the least intense at the bottom. The representation illustrates the diversity that still exists in farming in the UK – in some parts of the world, there would only be one or two crops (colours)  
Image: Hutton Institute







# Digging Ancient Summers

Geoff Squire

**M**anaged ecosystems, such as arable croplands and grazed pasture, have been evolving for several thousand years in northern Europe<sup>1, 2</sup>

They gradually replaced much of the forest and wetlands of the region and gradually came to produce more per unit of land as a result of technical innovations. The horse and ox gave way to tractors with on-board combustion engines. Horn gave way to bronze, then iron and then to steel implements for cutting into the earth. Animal manure and nitrogen-fixing legumes gave way to mineral fertilisers, mined or made by industrial process. New crops – various grains, roots and legumes – arrived with waves of settlers from west Asia and mainland Europe. Crops were bred to become shorter and stronger in the stem so that more of the plant matter could be bulked in the grain. The very success of agriculture allowed the human population to rise and to live apart from the croplands in towns and cities.

After 5000 years, however, food production in north-west Europe faces two major threats: reliance on imports to feed itself and internal degradation of the natural capital – the soil, plants and animals that support the essential ecological processes underlying food production. To face these threats, systems of food production cannot simply revert to a previous state – too much has changed. Rather, agriculture must continue evolving further towards a

stable, resilient state or else it will collapse.

## Reliance on imports

One of the crucial issues in the survival of a profitable but well managed food chain is the balance between exports and imports. Trade has reached the point where much of the agricultural production in the north-east Atlantic seaboard is exported, while much of the food and feed for livestock is imported. It is not just food that is imported. The high yields expected of cropland rely on high inputs of nitrogen, phosphorus, and other plant nutrients, most of which originate in other countries. The increasing availability over the last 100 years of cheap mineral nitrogen fertiliser removed the need for legumes (peas, beans, clover, lucerne) that fix atmospheric nitrogen into plant protein. Consequently there is not enough homegrown legume protein to support livestock production here, which relies on imported high-protein animal feed from soybean crops, mostly from South America<sup>3</sup>.

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**“the ecosystem that is being used for production must remain ‘healthy’”**

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The present population therefore relies on trade with other countries to fill its collective stomach. So questions must be asked as to whether this imbalance is too risky. The memory of the peoples on the north east Atlantic shores does not stretch back to the Laki volcanic eruption in 1783, which caused widespread starvation<sup>4</sup>, nor to the potato famines of 1840 to 1860, nor hardly even to the privations caused by the world wars in the 20th century. No people have starved from lack of food here in the

last half-century, due mainly to technology-driven high yields and the maintenance of trade with allies. Yet throughout these decades, food stores have never been enough to last for more than a few weeks or months. We’ve been fortunate so far.

## Degradation of natural capital

The ‘ancient summers’ of the title to this article refers to the carbon laid down by previous plants. The words are taken from a song written on themes of coal and mining<sup>5</sup>, but the carbon in our agricultural soils is similarly laid down by plants that have grown and died, whether in the vegetation before crops were introduced or the crop and weeds of more recent times. This carbon combines with weathered rock to form soil, aided by microorganisms that secrete glues and form threads to bind the various particles. The soil formed by plants in turn supports more plants, which offer food and shelter for the mass of crawling and flying organisms that make farmland work. These organisms of soil and air drive the cycles of energy, carbon and nitrogen on which life depends.

All this we call Natural Capital. It is inherited and passed on to future generations. It has a price, and it needs upkeep or else it will fall to bits and be worthless. The natural capital of cropland has already been degraded or lost in some parts of the world. There is evidence of degradation and loss here – look at new houses built on prime cropland, the ‘mud on road’ signs that appear every wet harvest, the loss of iconic insects and birds. Despite this, there is no reason in principle why agriculture should degrade its natural capital. Rather, this capital should be seen as being essential to food production, making it less dependent and sensitive to external forces.

Both the reliance on imports and the



Heavy straw bales at harvest time  
Photo: Geoff Squire



degradation of natural capital make the food chain too dependent on things happening elsewhere. Agricultural output in the UK has been buffered against the weather in recent years, largely due to modern crop varieties, agrochemicals which, and advanced machinery that all promote uniform emergence and combat disease. Yet, despite these advances, the past year of 2012 - one of the wettest in the last 100 years - has seen output decrease by 10 to 20%, and even more in some crops<sup>6</sup>. By the standards of modern, developed agriculture, a 20% loss is huge and is cause for concern for the future capacity of croplands.

### Multi-functional managed ecosystems

The question therefore arises as to whether the production system is still fit for purpose. To answer that question, the purpose itself has to be defined - or rather the purposes, since the expectations of agriculture have changed from simply providing subsistence, to providing wealth through trade in commodities, and to providing a landscape in or near which most people live.

More than anything, the ecosystem that is being used for production must remain 'healthy'. Healthiness can now be quantified by understanding and measuring the things that keep the system working and that maintain its natural capital - the bacteria, protozoa, fungi, nematodes, insects, spiders, wild plants and higher organisms of farmland. Given a buoyant natural capital, production of food and other natural products can be maintained in a way that it can switch from a state of importing to one of sufficiency within the borders. It must also be accepted that croplands are not just about production, but must provide a home, security, and place of exercise and relaxation for people, since most people live closer to agricultural land than to mountains and forests. It has to operate as a great 'filter' to trap and break down atmospheric pollutants and to absorb rain and snow and release water to the rivers at a rate they can cope with without flooding.

Of course, agriculture is not responsible for the uncoordinated growth of cities and the construction of properties on flood plains, but the arrangement of agricultural land has to be part of the solution to such problems.

### Scales of management

To be able to fulfil all such functions, agricultural land needs to be managed at a range of scales and in ways that encourage the parts to work together. No single farm,

for example, can have much effect on a river catchment, but the co-ordinated management of a mass of units will result in a reasonable balance between retaining water in soil and vegetation, preventing flooding where it is unwelcome and encouraging it where the land can cope with and may even benefit from it.

So the provision of these 'ecosystem services' as they are increasingly called<sup>7</sup>, has to be considered and planned at scales that cover the unit of management and production, the catchment or local landscape and the urban-rural complex. There is limited point, for example, in considering the containment and re-use of phosphorus (an essential plant nutrient and fertiliser) only at the scales of the field or farm. Rather the solution depends on managing the massive flows of phosphorus compounds into the country and to farms as fertiliser, into the body of crops, out of fields as diffuse pollutants and saleable produce, then into supermarkets and homes for eating and finally out of the country as exported produce or through the sewage system into the sea.

### Costing and trade-offs - the time scale

True costs are rarely estimated for different courses of action, including not doing anything. The main hidden costs are in the degradation of natural capital. To put the carbon back and restore soil functioning will take decades of restorative action, probably needing a drop in yield and in economic output as it is now understood. Those implementing the policies and management strategies whose actions lost the carbon will not themselves be paying for it.

The payment will come from those who farm the land, subsidise farming or consume the produce in future decades and centuries. This will be the same whether



Ear of bear barley, an old landrace  
Photo: Geoff Squire

the land is here or in other parts of the world that grow food and animal feed products for import to this country.

So where do we go from here? Planning and design across these ecological and commercial scales needs, first, a statement of the balance of outputs required from the system in terms of how much food it should produce for home consumption, how much exportable product, the degree to which it supports landscape, wildlife, its maintenance of a sense of 'place', and so on. The scientific community can make major contributions to setting 'safe limits' in which organisms and ecological processes may operate.

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Further references to crops and their uses, the environment and sustainable production can be found in the science pages of the Living Field web site [www.livingfield.hutton.ac.uk/science](http://www.livingfield.hutton.ac.uk/science)





# Degrading natural capital: problems and solutions

Cathy Hawes and Geoff Squire

## Food production and the food chain face major challenges:

the degradation of natural capital in soil and food webs, the impending global shortages of raw materials such as phosphorus fertiliser, the impact of crop management on losses of pollutant to air and water, the gross wastage of crops and food, the global trade in hidden, embedded resources such as water and plant nutrients, and the increasing isolation, in location as well as understanding, of rural producers and urban consumers. Each one forms a major obstacle to food security<sup>1</sup>.

Yet solutions are possible by adjustment of practice and by innovation. Agriculture, though 10,000 years old, is a new development in the history of soil and people<sup>1</sup>. Where it has not been driven to extinction, natural capital can be repaired, but of course at a cost. This article gives examples of where progress is being made in finding improved methods to particular issues.

### Reversing the degradation of soil

Cultivation of soil inevitably leads to loss of soil carbon, as the disturbance brings carbon compounds into proximity with soil microbes, which feed on the compounds, releasing carbon dioxide gas. Carbon compounds are also carried away in water, for example in surface runoff. The carbon compounds keep the soil in good condition: microorganisms live on them and in turn deposit glues and threads that bind the various parts of the soil together. Carbon is put back through the roots of plants and



Machine-compacted soil reduces space for air and water  
Photo: Geoff Squire

from leaves, stems and seeds that drop to the soil surface. In many agricultural soils, the carbon content has declined because, over long periods of time, losses outweigh gains. In consequence, soil structure deteriorates, but insufficient attention is given in mainstream farming to the loss of soil carbon. It is an unappreciated and hidden threat.

Under poor management, soil can become compacted, the space for air and water pressed out. Roots have difficulty growing in the soil, because it is too hard, has too few fine pores to hold water and not enough channels for air. In some cases, the soil is turned to a mush by heavy traffic, and thereby readily slaked by water. It is possible that one of the reasons for the levelling of yield in the past 15 years is the underlying decline in soil condition for root growth.

Further decline is not inevitable. Limits can be set both in terms of field management and soil properties. Techniques for measuring the biophysical condition of soil are increasingly available. Technologies are also being developed to encourage soils to recover. Look at almost any field after harvest and under a slanting light it will be seen criss-crossed by wheel marks in all directions, sometimes covering more than three quarters of the field surface. A solution is to limit the surface of field crossed by traffic to less than 10%. Advanced engineering and IT solutions can achieve what is called 'controlled traffic' in which vehicles are guided by satellite communications along specific routes. Then periodically, the wheel lines are de-compacted, or else sown with a crop or other plant, thereby cutting the erosion and loss of water and nutrients. As backup, perennial or annual margins put in around fields slow down the egress of soil and water. While still not widespread, such techniques are being developed and applied in farms that adhere to a formal integrated farm management such as LEAF (*Linking Environment and Farming* – see article by Ed Baxter, p10).

### Positives and negatives of weeds

Weeds are those wild plants that cohabit with crops. They were here before farming began or were brought in later, either as impurities in seed or intentionally as potentially useful plants that have gone native. These plants form a population of dormant seeds in the soil – here called a seedbank – from which seeds germinate when stimulated by certain events such as soil cultivation<sup>3</sup>. The abundance of seeds in the seedbank depends on the balance between

loss through decay and predation and gain through new seed falling from inside or outside the field.

Farming in generally tends to resent the seedbank, since some of the species compete with the crop, depress yield, interfere with machinery and lower grain quality. However, the seedbank species also bring benefits by mopping up escaping fertilisers, providing additional ground cover to reduce the impact of rain and supporting the food web, including invertebrates such as parasitic wasps that in turn benefit agriculture by controlling pests. However, the seedbank species tend to be treated as undesirable en bloc and their decline through the increased use of chemical herbicides contributes to the general deterioration of farmland habitat for insects and birds. (See also Ulrich Loening's article in the 20th Anniversary edition of the SEDA Magazine, Summer 2011.)

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**“...[weeds] bring benefits by mopping up escaping fertilisers, providing additional ground cover to reduce the impact of rain and supporting the food web.”**

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Can an optimum state be defined in the seedbank where the benefits are maximised and the harm minimised? Poisonous species and the most noxious competitors such as cleavers or wild oat should rightly be contained. At any time, however, the damaging species comprise only three or four out of typically 30-40 species in a single field, or ten out of the 300 or so weed species in the UK. Approaches to controlling the few damaging weeds, and reducing collateral damage to the rest, include diversifying the agronomy through the sequence of crops, targeting specific noxious weeds with herbicide and varying the tillage pattern. It may be that more effort is needed than just indiscriminate chemical sprays, as 40 years of chemical warfare has not worked – yet the weeds are still present and need to be treated every year. So why not take a long-term view and manage the seedbank species for their benefits? (See Bethan Stagg and Ben Heron's article.)

### Ethics – digging other peoples' ancient summers

While local action is necessary for restoration of soil, many of the major issues in food production require an understand-





ing of, and action on, international trade. In an agriculture based on trade, regional products such (in our case) as whisky and hill sheep are exported, while other products that are not available here, such as protein-rich animal food and most carbohydrates in our diet, are imported. Along with imports and exports go the nutrients, energy and water that are contained in the products and that were used to grow them. Moreover, the natural capital of soil may be degraded differentially in the land of the exporter and the importer. Food that might be cheap here could be very expensive at the point of production if the cost of degrading natural capital were accounted for. Ultimately, the feeding of people throughout the world will depend on the natural capital being maintained in all places.

Water is another example, the use of which in crops and products is quantified in terms of a water footprint<sup>4</sup>. The amount of water used to make a kilogram of product tends to be greater where it is warmer and drier, and where less of the matter produced by the plant gets allocated to the economic yield. International trade is unlikely to even out the water footprint: growing tea and coffee has a much larger water footprint than growing wheat and barley for beer and whisky. The global trade in crop products leaves some unpalatable thoughts. At least ten different crops or crop-products go into the manufacture of a simple meal such as beans on toast<sup>1</sup>. Its water footprint, based on water used in crop growth and first stage processing, is 400-500 litres – for just one meal<sup>5, 6</sup>. There are many ways to reduce the water footprint of crops: in the field, the aim should be to channel more water through

the plant and less as surface runoff, evaporation from the soil and deep drainage. Raising the soil organic matter content through composts, mulching to reduce heating of the soil surface, plant canopies to reduce evaporation and the impact of rain drops, and other micro-catchment techniques are all likely to improve the water footprint, irrespective of the crop or climate. In the two tea plantations shown below, one has been designed on ecological principles to dissipate solar energy and to capture water within the 'field' while the other has been left to deteriorate, showing much bare soil: the water footprint will be very much less in the ecologically designed system.

#### Moving on

Short-termism, the lack of cohesive structures and planning, poor understanding of ecosystems, a culture of wastage and ignoring the hidden costs of production: all have contributed to the present state of agriculture and food. The global threats we face strengthen the need to question the evolution of these systems, without any real design and at limited scales. The mainstream actors in farming and the human food chain have not yet accepted the situation, or taken firm positive steps to rebuilding natural capital. Yet there are many examples of people and organisations who are doing just this. At the James Hutton Institute, our Centre for Sustainable Cropping<sup>7</sup> is a long-term, forty-hectare research platform that aims to return the natural capital of cropland to a state that is sustainable environmentally and economically. Small changes are apparent after just two years, but major improvements in soil quality may take 10 to 20 years.

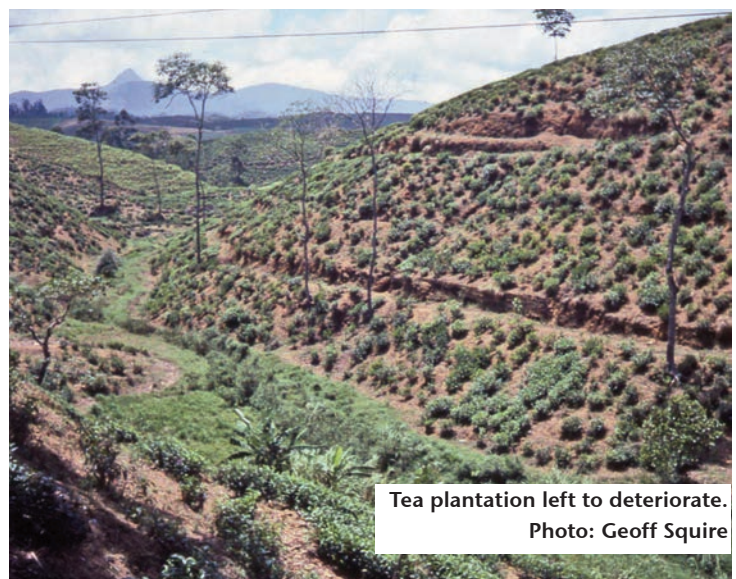
*Dr Cathy Hawes is an ecologist and coordinator of the Centre for Sustainable Cropping at the James Hutton Institute.*

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Tea plantation designed to dissipate solar energy and capture water.  
Photo: Geoff Squire



Tea plantation left to deteriorate.  
Photo: Geoff Squire

# Integrated Planning in Agriculture

Ed Baxter

**A**griculture anywhere in the world has four main functions: to provide food, to give farmers a living, to be sustainable, and (ideally) conserve and enhance the environment while fulfilling the first three functions.

Where society departs too far from these objectives the consequence is famine & failure. Either famine caused by crops' failure themselves, famine where farmers are expropriated (think of Russia in the '30s under Stalin or China under Mao in the '50s), disaster such as the dust-bowl in '30s America and in the crises faced by almost every civilization in history as they were overtaken by events - events with consequences which, with the benefit of hindsight, were avoidable. Farming systems can be inherently resilient – Mother Nature can be forgiving - but all can reach a tipping point eventually. This article looks at the forces impacting on a UK farming operation in the current context, and how planning of its operations can play a role in avoiding some of the more obvious pitfalls, but does point out where even UK agriculture is being pushed too far.

Gilston Mains, my business, is, by UK

standards a large scale farming operation. Situated in East Fife in Scotland's central lowlands, the business covers about 2,000 acres or 5 square miles of land belonging to 3 different families, and grows about 4,500 tonnes of cereal and oilseeds (wheat, barley, oats and oil seed rape), mostly for local markets in Central Scotland. The wheat goes to Diageo as a feedstock for grain whisky, the barley locally for pot-still malts used in malt whisky production and the oats to Quaker's mill in Cupar (Fife) for porridge. The oilseeds are exported to Germany for inclusion in bio-diesel. In addition to the crops we sell, there is a substantial subsidy paid to the business under the EU Common Agriculture Policy.

The nature of what we do, the crops we grow and how we grow them, the men we employ and the machines we use, are all part of our answer to meeting the four objectives outlined above. At the heart of the decision taking system which leads us to (hopefully) the right answers is a remarkably useful tool first developed by a group of farmers 20 years ago. Inspired by the Body Shop's internal audit it is now manifest as the online leaf audit [www.leafaudit.org](http://www.leafaudit.org) (more can be found on leaf and its aims in the article on page 12). To quote directly from the site:

"The LEAF Audit is a unique development, offering a complete management package to help you record, evaluate and improve your farming practices against the standards of Integrated Farm Management and

best whole farm management decisions. We are committed to ensuring that the LEAF Audit meets the needs of farmers to help you run your business to embrace the future issues. Every year we review the LEAF Audit and add in more help and references to help prepare you."

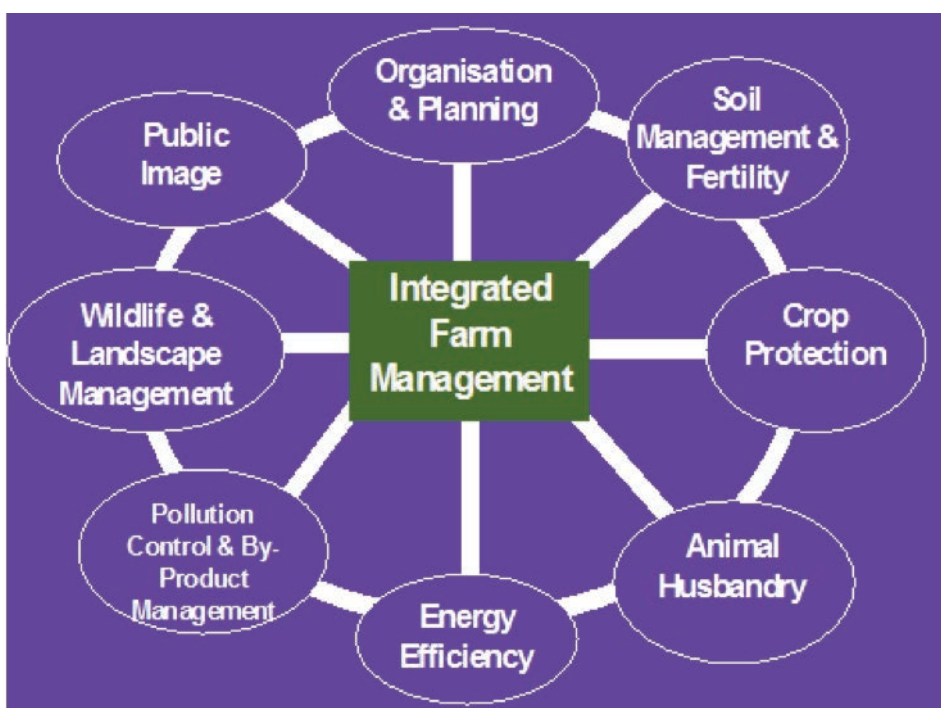
The Audit is a good straightforward tool, which allows me to conduct a formal review of the business.

"The LEAF Audit is a progressive and practical whole farm business management tool, to help you prioritise decisions and make meaningful changes to your farm practices. It is also an excellent way to demonstrate your environmental responsibility to everyone you deal with."

In my own case, I succeeded 25 years ago to the running of my family's business after a particularly challenging spell for farming. We had been Dundee industrialists in the 19th century, and bought Gilston in the mid-19th Century out of the profits from trading flax. It seemed foolish to lose the rump of that fortune farming, so a radical re-think was needed. A review of what we were doing, an evaluation of the financial and physical limitations and a new strategy were all essential pre-requisites for our continued survival. We had in place the twin objectives of running a financially and environmentally sustainable business - the audit gave structure and discipline to the policy and helped us achieve our goals. Today, after 25 years, when my family's farming operations have become an asset rather than a liability, the audit remains central to my business. It is a portal into the world of integrated farm management which brings together the very best of traditional farming practice, of science, environment and management ideology.

Integrated Farm Management (IFM) as a concept grew out of Integrated Pest Management, which had promoted a tailored rather than blanket approach to controlling pests and diseases in crops. As practitioners thought about ways to control pests and diseases in crops, it became clear that more than just the state of the crop itself mattered. Diseases and pests could be a function of rotation (crop sequences where a succession of different crops are grown in the same field from year to year), or soil, or cultivation techniques, or weather, or indeed almost any number of different influences there were on the crop and its environment. IFM, and the Leaf Audit,

Left: the 'IFM Wheel'







Typical Scottish lowland arable farm  
Photo: Ed Baxter

gives structure to the decision making process which considers these and other factors.

There are eight spokes to the IFM wheel – recognising that they are all interconnected (see diagram on opposite page).

The audit follows the same pattern with questions under each category. It is a self-assessment tool which raises awareness in people completing it by making them think about the answers they give. There are no right answers of course, because in almost every case the situation the farmer finds himself in will be different, but as I've said there is a discipline in thinking about it, which is where the value of the audit lies.

Although a planning tool for any business (and particularly valuable where a business is large and complex), it won't always deliver the best outcome in every case. The problem derives from the weight any farmer gives to the 4 functions of agriculture identified at the beginning of this article. If for example, as has happened across many sectors recently in the UK, and is still not uncommon, farmers cannot make a living by growing food, milking cows or whatever, i.e. their business is financially unsustainable, it is most unlikely that their operations will be environmentally sustainable. The expression in farming is "living off the depreciation" and it may be either the financial (machinery and buildings) or natural (soil, water, carbon) capacity of the farm which is being run down. In my business for example a prolonged period of low cereal prices, from approximately 1997 to 2011 (with a small blip in 2003/2004), meant that we were tempted to include potatoes (a high margin crop) in the rotation again after an interval of 25 years. The decision was made for sound financial reasons (we were making no money without subsidy) but the consequences of potatoes in the rotation for 4 years, from 2006 to 2009, was severe damage to our soils which will take years to rectify. Higher than anticipated rainfall in Eastern Scotland in the autumn, a consequence of climate change,

meant damage from harvesting operations (made far worse by de-stoning, a completely unsustainable practice associated with growing potatoes). Had we continued with potatoes, the damage in the last 3 years - 2010, 2011 and 2012 - with even greater autumn rainfall, doesn't bear thinking about. In our case, an anticipated return to profitability from better cereal prices (manifest in 2011 and 2012) meant we could drop potatoes from the rotation, but it was a shocking episode.

On a UK scale, agriculture's problem is that IFM is not widely adopted. Farmers do not need a licence to farm (or to receive public subsidy) and there is much wishful thinking on the part of Government and the industry about the state of agriculture and the health of UK soils. Because so much of our food is imported the problems are masked, but it can be appreciated that the same problems are likely to be common around the world. We therefore import others' Natural Capital as well as their food, and globally the long-term sustainability of agriculture in its current form must be in question.

For the future, society's demands from

agriculture will play a large part in the shape of my farming operations. Increasingly, land is expected to deliver "ecosystem services" as well as food, but these are not easy to measure. We recognise them: clean water, fresh air, birdsong ... but haven't as yet found a mechanism for paying farmers to deliver them. How we reward farmers for accruing Natural Capital (which is of benefit to us all) when it is not in the price of food is the great challenge of the 21st Century.

*Ed Baxter is a farmer based in Fife and recently stepped down after ten years as chairman of LEAF in Scotland.*

#### Further reading

- [www.eastneukestates.co.uk/the-estates/gilston-11.aspx](http://www.eastneukestates.co.uk/the-estates/gilston-11.aspx)
- [www.environment-agency.gov.uk/business/sectors/soils.aspx](http://www.environment-agency.gov.uk/business/sectors/soils.aspx)
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# LEAF (Linking Environment and Farming)

Geoff Squire

**L**EAF is an organisation that promotes Integrated Farm Management.

It encourages farmers to consider their business and the environment as an entity, to farm in balance with nature. It recognises that farming has to be a profitable enterprise, yet must not be exploitative of the natural resources at its disposal.

## Why and wherefore

LEAF has grown beyond expectations in the 21 years since its beginning in 1991. Its core objectives were and remain "Building public awareness of food and farming and developing more environmentally friendly farming systems". The basis of LEAF was aired by David Richardson, its first Chairman, in the first newsletter published April 1992<sup>1</sup>. He understood the doubts and concerns that would be raised by farmers and producers about the purpose of yet another organisation, another of those 'green things.' He countered by arguing that the objectives of LEAF were 'sensible and achievable and avoid the extremes ...', and he went on to say that LEAF does not take the view 'that crop protection products should be outlawed, nor that artificial fertilisers should be banned' but rather that 'the use of such products should be minimised, consistent with the rules of good husbandry and the vital need to make a profit'.

Caroline Drummond, now LEAF Chief Executive, recalls her first day at starting work with LEAF in 1991, running a three year project to promote the concept of integrated management and to improve the public perception and understanding of modern agriculture. "Equipped only with a desk, pencil and paper ... I remember starting my first day at LEAF, taking a deep breath and thinking 'what do I do now?'"<sup>2</sup>

## LEAF audit and demonstration farms

The basis of LEAF since 1991 has been the development of practical guidance on integrated management. Central to that guidance was the LEAF audit, which began in 1993 as a self-assessment form to monitor and evaluate farming prac-

tices, and the accompanying Practical Guide to Integrated Farm Management. The article by farmer Ed Baxter in this issue describes the IFM 'wheel' and gives an indication of how it can be applied in farming. The Audit has been repeatedly revised over the years to incorporate experience, technical developments and scientific advances in farming. Further to the Audit, LEAF has produced a series of advisory tools for the assessment and management of biodiversity, water, soil and drainage systems. The Green Box<sup>3</sup> is a practical tool for monitoring the environment on farms – in soil, water, biodiversity and air - allowing farmers to record and keep track of biodiversity. The LEAF Water Management Tool, available to members, helps farmers 'map water use, assess risks, improve efficiency and find new ways of saving money and protecting this valuable resource'. Simply Sustainable Soils<sup>4</sup>, launched in 2011 describes simple steps to assess and improve the state of an agricultural soil.

But audits and advisory tools are by themselves not enough, and from the beginning, demonstration of best practice was thought essential and came into being through LEAF's network of Demonstration Farms, of which there are now more than 40 throughout the country. The farms host events for farmers and agronomists (as well as the public, see below) to explain and explore the principles of Integrated Farm Management.

The Audit, advisory tools and demonstration farms form the backbone of the LEAF effort in growing crops on the farm. LEAF has also been active in establishing a quality assurance marque and the means by which the public can experience farms and farming first hand.

## LEAF Marque

Given a resurgence of public interest in food during the 1990s, the time was felt right to take LEAF to the next level. A LEAF food label was envisaged that both rewarded farmers for commitment to the environment and gave consumers a choice of buying food that was produced to high environmental standards. So the LEAF Marque was born in 2001. To become LEAF Marque certified, growers have to complete the LEAF audit, implement IFM and comply with the

LEAF Marque standard and then enter a certification and inspection scheme. They were expected to be ahead of their peers in issues such as energy efficiency, waste recycling, water and soil management, as well as 'social' issues around food production.

By the end of 2003, 150 farmers had signed up to the scheme, while food with the LEAF Marque began to make its way to shops and supermarkets. Waitrose was the first supermarket to get behind the LEAF marque. Today 20% of UK horticulture is grown to LEAF Marque standards. Yet the LEAF Marque is still in its infancy. Only 3% of the total farmed area in the UK is LEAF marque certified.

## Getting the message across

Many of LEAF's 40 demonstration farmers hosted public events to bring people on to farms and to show them the principles and practice of integrated farm management. Other initiatives followed. The Virtual Farm Walk, launched in 2001, provided the means for anyone with access to the Web to get a feel for farming and food production. The Speak Out initiative was introduced to offer farmers help and toolkits to get their message over to the public.

However, the idea of having an annual open day for farming brought the message to a very much wider audience. LEAF Open Farm Sunday<sup>5</sup>, which began in 2006 with 300 farms opening their doors, has enabled hundreds of thousands of people to visit a farm, enjoy the countryside and learn about crops and farm animals. Typically, 180,000 people visit a farm on Open Farm Sunday each year. The event is growing - in 2012, the numbers were up 25% on the previous year.

Visits and open days counter the disconnection that many people feel between themselves and the countryside. One particular initiative, Let Nature Feed Your Senses<sup>6</sup>, in collaboration with the Sensory Trust, encourage disabled and older people to experience farming and the countryside. It was funded by a lottery grant and administered by Natural England, with the aim to offer sensory-rich approach to farm visits. To date, the project has enabled visits by almost 12,000 people.

## Market opportunities



LEAF has never shied away from engaging with industry and politics. Its ethos has never been confrontational – rather it seeks to encourage people to come on board. And with this attitude it is able to construct partnerships with many companies in the business of growing and processing food. Recently, for example, it has joined with Unilever UK to increase the use of LEAF Marque certified oilseed rape, for spreads, margarines and mayonnaise, by increasing the amount of oilseed rape farmed to LEAF standards. Among other developments in 2012, AtlasFarm – one of the UK's largest farmer-owned cooperatives has joined and is encouraging its 1250 farmers to become members; and Florette, a leading salad brand, is displaying the LEAF marque on its produce<sup>7</sup>.

#### The future

LEAF's interests are not confined to

the UK: it is an active participant in EISA - the European Initiative for Sustainable development in Agriculture - a network of organisations in France, Luxembourg, Germany Sweden and Austria – who share common aims. The LEAF Marque now operates in 47 countries.

There is still much to be achieved: despite successes in engaging the farming community in considering both the economics and ecology of farming, there is a long road ahead. LEAF still represents only a few percent of the farms in the UK. But by targeting politicians, growers, technology companies, food processors and the public, it can change attitudes and farming practices for the benefit of the countryside and people's health.

*Based on material supplied by Caroline Drummond and Kathryn Mitchell of LEAF*

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# Botanical Diversity – natural capital for food production

Ben Heron and Bethan Stagg

**W**hile agricultural monocultures have been used to increase yields and

improve the livelihoods of farmers, the narrowing of cultivated plant diversity has put the world's food production in greater peril. Many of the functions performed by energy-intensive inputs used in monocultures are inherent features of a diverse agro-ecosystem. With an understanding of the function of, and relationships between, different plants, it is possible to plan and initiate natural synergisms that provide ecological services such as pest control, soil

fertility and weed management without the use of harmful agrochemicals. Encouraging botanical diversity at three levels—ecosystems, the species they contain and the genetic diversity within species— can benefit sustainable food systems.

## Genetically diverse crops

Growing a mixture of crop varieties, or varieties that exhibit genetic variability within the crop, is proven to provide greater resilience to unpredictable weather patterns and incidences of pests and diseases. This is because the crop mixture will contain a higher number of functional traits and characters, will have greater attractiveness to pollinators, and more resistance to certain pests and diseases, or

environmental stresses like drought or early frosts. This genetic diversity helps spread the risk of crop losses, since whatever the environmental condition, there will always be some varieties that can cope with them.

Crop varieties that exhibit high genetic variability are often traditional varieties or landraces (crop varieties bred for local environmental conditions), whereas modern hybrid crop varieties have sacrificed genetic variability in favour of high yield and efficiency when coupled with intensive inputs. However, Dr Thomas Döring, from the Organic Research Centre, highlights that new avenues are being explored with modern varieties to increase genetic diversity. "Our research on wheat confirms that resilience is measurably increased when we boost the diversity in the field".

The use of genetic mixtures of a crop with varying levels of susceptibility to diseases has been shown to control disease by slowing down the rate and incidence of infection. Farmers in China who planted a variety of disease-susceptible rice with resistant varieties found that the disease-susceptible variety had 89% greater yield and the rice blast was 94% less severe than when grown in monoculture. The experiment was so successful that the farmers stopped using fungicides by the end of the two-year programme as no longer required.

## Polycultures

There are many ways of creating a genetically-mixed polyculture, including intercropping (where complimentary species are grown in alternate rows or groupings), row cropping, crop rotation and Agroforestry. Polycultures are not a new concept in the tropics, where fruit trees, vegetables and other useful plants rub shoulders in the traditional home garden. The patchwork of allotments that is a familiar sight in many British cities often displays a glorious jumble of crop diversity interspersed with microhabitats like ponds and garden hedges.

Species complement each other by occupying different niches, for example in a crop rotation the 'root' stage will deplete a different soil horizon and spectrum of nutrients to the 'brassica' stage. The success of intercropping relies primarily on ensuring that different species are not competing in the same ecological niches. If they do start competing for nutrients, water or light, crop yields of at least one of the



Agroforestry in Mexico  
Photo: Bethan Stagg



species will be negatively affected. A slight reduction of yield in one of the crops may not be an issue if it is compensated by the overall yield and efficiency of land use. In an intercrop of yam and maize in Nigeria, the yield of the maize was unaffected, whereas the yam yield was less. Most significantly, the overall yield per hectare was significantly higher than if the land was used for growing either of the crops on their own.

An example of a diverse and resilient food production system is Martin Crawford's forest garden adjacent to Schumacher College, in which more than 500 species of useful trees, shrubs, perennial and annual plants are grown in a multi-layered ecosystem. In September 2012, following a season of unusually heavy rainfall and high incidences of pests and diseases in surrounding farms, the forest garden displayed virtually no damage. Crawford believes the absence of pest damage is due to a number of reasons, including diversity and abundance of insect predators and the use of aromatic plants to mask host plant odours. A forest garden, like the home gardens of the tropics, is primarily designed to provide produce such as fruits, nuts, vegetables, medicinal plants and other non-timber forest products for one's own use and consumption.

'Push-pull' approaches to controlling insect pests and weeds are now common in many African countries, where plants that repel insect pests ('push') are planted amongst the crop, coupled with diversionary trap plants around the field boundaries to attract the pests ('pull'). In some systems, the 'push' plants amongst the crop also provide weed suppression and prevent soil erosion, whilst the trap plants around the boundaries serve as a forage crop for farm animals.

## **“Growing a mixture of crops is proven to provide greater resilience to incidences of pests and diseases.”**

### **Habitat mosaics**

Retaining or creating habitats in and around cultivated areas, for example ponds, hedgerows or wildflower margins, is proven to provide a variety of benefits to system productivity. In Costa Rica the rate of bee



Fruit rows mixed with grass alleys, Wakelyns  
Photo: Bethan Stagg

visitation to coffee flowers and the amount of pollen deposited were significantly higher in sites within 100m in forest fragments than sites located further away. It was also found that the diversity of bee species was much higher in plantations located closer to forests, whilst sites located further from forests depended more on introduced honeybees. Supporting a diverse ecology in cultivated areas leads to food web interactions that keep pest and disease populations in check. In the US, pest crop losses due to the European corn borer were much lower in edges of maize fields adjacent to wooded areas, than in field interiors, because of higher incidences of predatory ichneumonid wasps.

### **Nutritional diversity**

One of the basic principles of nutrition is dietary diversity, yet, of 50,000 known edible plants, only fifteen provide 90% of world food energy intake. A diet rich in plants is proven to be highly beneficial to health and the importance of wild or locally cultivated food plants is well established, as sources of micronutrients and 'phytonutrients' (plant secondary metabolites). Since humans started domesticating plants and animals 12,000 years ago, agricultural biodiversity has been the foundation for food production, nutrition, health and livelihood security all over the world. Foraging for wild foods, cultivating locally adapted varieties and eating from the local

ecosystem continue to be common practices for many subsistence cultures. Even modern crop varieties are dependent on high genetic diversity, and its conservation, for their inception.

### **Cultural diversity**

It is important not to forget the cultural significance of botanical diversity, as Anna Lewington, author of 'Plants for People' explains: "We need diversity in our lives and in horticulture for so many reasons. When we plant or sow old varieties of garden vegetable or fruit, for example, we're acknowledging skills and wisdom passed down to us over many generations from people all around the world, giving us options to make the best use of our soils and outwit pests and diseases, as well as bring nutritious food to the table. Botanical diversity and cultural diversity go hand in hand. The revival of interest in community orchards and 'Apple Day', in particular, is evidence of the increasing value we are placing on local distinctiveness, on linking the food we eat with where it was grown, and in observing, tasting and celebrating the many different apple varieties that have helped shaped our local landscapes and traditions."

*Ben Heron is a student on the MSc Sustainable Horticulture and Food Production and Bethan Stagg is lecturer in ecological horticulture at Schumacher College, Dartington.*

# Edible Edinburgh: Re-Connecting Urban Food to the Land

Pete Ritchie

**E**dinburgh City Chambers, January 2013. We're talking about food security as part of developing a sustainable food strategy for Edinburgh.

Forget energy, forget transport ; there's just no point in talking about sustainable cities if we don't talk about food. It's not just that food accounts for 25-30% of global greenhouse gas emissions, or that the eating power of cities is putting natural capital under increasing pressure, but also that while (rather too late) we are stress testing the banks, it's not clear who's stress testing the food system. A proliferating crack in this tightly geared, just-in-time global web could have far worse consequences.

I'm here as chair of Nourish Scotland and a local organic farmer – at 16 miles from City Chambers we've been part of the city's food supply at least since 1806 when the farm dairyman married a young woman from the city. It's just as well Edinburgh wasn't banking on us, though: the wettest summer in 100 years saw vegetable yields halved. During the worst of the floods we saw 50 tonnes of topsoil slide down a newly seeded field and

come to rest against the roadside hedge. We managed to keep this soil on the farm, but worldwide topsoil is disappearing from 10 to 40 times faster than it's being made. On the farm, we've been able to respond with measures like replacing cattle with sheep which do less damage on wet ground: but making the global food system more resilient is a more complex task.

As Carolyn Steel points out [in her book *Hungry Cities*, reviewed in the last issue of the SEDA Magazine], we take for granted the everyday business of keeping cities fed. Major cities get through billions of meals a day, with food appearing and waste disappearing and almost no visible connections to food production. There's minimal intervention or planning by the city authorities.

This isn't new. Western cities - especially coastal ones – have always been able to grow larger and eat better than their immediate 'foodshed' would otherwise allow, by trading food internationally. In the time of William Wallace, much like today, merchants in Leith enlivened the local diet with wines, spices and figs from France and Flanders in exchange for beef and salmon. Wheat came up from East Anglia along the coast.

But what is new is the scale, scope and concentration. It's not just that more than 3.5 billion people live in cities

worldwide; in Scotland and the UK, the urban food system operates in every town and village, run from the same big sheds. And the tens of millions of street traders and small producers have been replaced by a handful of global conglomerates. The global food distribution system is a triumph of logistics, but in disconnecting nearly all of us from the physical and biological realities of producing food it seeks to absolve us of our civic responsibility to think or care about where next winter's food is coming from, or the winter after that. The smaller the planet gets, the faster the system runs.

So what's the point of one small city talking about redesigning its food system? How could some 21st century adaptation of Patrick Geddes's town planning theory contribute to reducing entropy and increasing resilience? If we struggle to manage the trams, should we be messing with the tractors?

The food strategy in Edinburgh is an integral part of the City's wider commitment to Sustainable Edinburgh 2020 . The first stage in shaping the city's food strategy is a year-long process of enquiry and engagement. We're looking at six themes – food culture, land use in and around the city, food and health, food's environmental impact, public and community procurement, food jobs and skills. In exploring each theme, the City Council will be engaging with businesses, communities, NGOs and other public sector bodies to develop broad ownership of a long-term strategy for a better food system. Three key themes are already emerging – the circular economy, the importance of co-production and the role of the public kitchen

## The circular economy

The current system operates on the linear principle (as evidenced by the term 'supply chain'). At each point in the chain, it makes sense to minimise what you pay for, and maximise what you get paid for. The consequences upstream and downstream are externalised – other people and future generations pay these costs but not the producer.

Product labels may tell us the nutritional composition of the food, but it usually doesn't tell us where the water came from to grow this product, or what the impact was on soil carbon. In 2011 the good news was that only 2,400

Edinburgh allotment-grown vegetables, 2012  
Photo: Rik Hart





square miles of Amazon rainforest was destroyed – around five times the area of Fife. Organic farms do better on natural capital – they lock up more carbon in soil, maintain more biodiversity, and leave the water cleaner. While organic yields in Europe are around a third lower, in many parts of Africa simple organic techniques are doubling production.

## “A sustainable food strategy depends for success on participation from the community.”

In a circle, what goes around comes around. Traditional organic farming systems regarded every output as an input – summed up by Albert Howard as ‘the rule of return’. The most obvious feedback loop is nutrient cycling. Relatively cheap synthetic fertiliser – based on mining fossil fuels and mineral reserves – have encouraged a linear model. The nitrogen fertiliser applied to agricultural land in Europe increases crop yields, but also ends up in groundwater and as nitrous oxide. The economic cost of nitrogen to the environment (€70-320bn) is greater than the economic benefit from increased food production. (EUROPEAN nitrogen assessment). Most of the nutrients in food waste and sewage are currently lost to the local system. Both the digestate from anaerobic digestion plants and sewage sludge incorporated into biochar could be used strategically to maintain and enhance fertility in food growing areas around Edinburgh, though this only recovers a fraction of the energy embedded in the food waste cycle.

The circular economy is about money as well as nutrients. The more food is sourced locally, and value added locally, the more money is available for local recycling. The hospital which employs an extra cook and cooks meals from fresh using local food is adding more local value than the hospital which spends the same amount but buys in pre-cooked meals from a factory hundreds of miles away.

### Co-production

A sustainable food strategy – even more than an energy or transport strategy – depends for success on participation

from the community. The cultural change required is similar to a massive modal shift in transport – to cycling becoming the norm rather than the exception in going to work. In a sustainable food culture, more people grow some of their own food, more people cook from fresh using local and organic ingredients. People eat less and better meat, far more vegetables and cereals. Restaurants, cafes and takeaways offer a more sustainable menu. Much less food is wasted. There are more communities involved in sourcing food directly from farms and more co-operatives are involved in processing, cooking and distributing food locally.

But co-production means that Government has to do its part by building the equivalent of cycle lanes. On the production side, it can support organic production and create short routes to market. On the consumption side, it can provide smart subsidies that improve access to good food for low-income households, and lead by example in its own practice.

### Public kitchens

Public food accounts for between 1 and 2% of all food eaten in Scotland, but plays an important role in efforts to improve the food system. It is within democratic control and it touches many lives. In Edinburgh we’ve made a practical start. The City Council, NHS Lothian and the University of Edinburgh have established a joint local procurement project with support from the Soil Association Scotland’s Food for Life team. Several establishments are already changing their menu to source more local, seasonal and unprocessed food.

We’ve also been learning from Copenhagen’s ambitious programme of cultural change in the public kitchen. Working directly with kitchen staff to change menus and practices, Copenhagen’s House of Food has managed to move that city’s public food to 75% organic within the same procurement budget. This has strengthened the local organic production and processing system. Public food has become a source of pride, while having a positive impact on health and the environment.

### Next steps

It’s early days: the ‘Edible Edinburgh’

project is still finding the lie of the land. There is plenty of good stuff to build on, from backgreen growing to award-winning sustainable restaurants, from established healthy food businesses like Nairns oatcakes to soup companies and bakeries crowd-sourcing their start-up funding.

We will need to find a balance between encouraging many small practical projects and creating long-term policies and structures. We have to do enough ‘thinking globally’ to make good choices about how to ‘act locally’ on food – and one city’s actions towards a more sustainable food economy will work better if all Scotland’s cities work together.

The recent Horsegate scandal has exposed the length and vulnerability of our food supply chains, but we’re missing the elephant in the room. Along with horse DNA, we’re importing (and exporting) much more important traces of environmental damage. The food we eat tells a story of degraded natural capital as well as lost social capital in the loss of small farmers and growth of migrant labour.

We need to tell a better story.

*Pete Ritchie is founder of Nourish and runs Whitmuir Organics, a community-owned organic farm and business just south of Edinburgh*



Redcurrants  
Photo: Barbara Seel

# Living Soil

Carolyn Lebel

**W**e live on a rock...  
well not exactly.

We may sit as kings on top of a richly diversified food chain, but our existence depends on soil and the hidden life that dwells within it. A vast habitat that evolved inch by inch over time spans scientists qualify as geological, ultimately making life on Earth possible. As Rachel Carson wrote in 1962, "without soil, land plants could not grow, and without plants no animals could survive."

Soil is not an inert substance, but a vast repertoire of hidden life. Billions of microorganisms are present in just a gram of dirt, while one hectare can hold up to five tonnes of animal life. Dig a little into the dirt and you discover an intricate and fascinating universe brimming with activity. Our underground biota may largely be single-celled, but their communities administer the very building-blocks of life, delivering food, inspiring medicine and purifying water, grinding up organic matter, decomposing it, reducing it to its most basic elements, and thus releasing the essential nutrients needed – nitrogen, potassium, phosphorus and other minerals – for plants and crops to grow.

In France, a country whose culinary tradition has been declared a world heritage by UNESCO, the divide between fine dining and famine is rooted in about a metre thick of this dirt. Thin-skinned but fertile, French lands, along with the tools of modern agriculture, have made the country Europe's leading agricultural producer across many sectors. During the past decade, however, agricultural production has been stagnating. Crop yields have also plateaued across the whole of the European Union during this period; and many agro-economists, including Marc Dufumier of the Paris Institute of Technology for Life, Food and Environmental Sciences (AgroParisTech), believe this to be a lasting structural shift under way in all countries that benefited from the 'Green Revolution'. Or, as Lester Brown calls it, the food bubble.

If this only meant that production would stabilise at about 75 quintals (7500 kg) per hectare, all would not be so grim. France is a country largely capable of food sovereignty, making up in quantity what it might

lack in variety. And globally there are more than enough calories produced worldwide to feed the planet's 7 billion inhabitants. But stability is not where things seem to be headed. A landmark study on the state of soil in France published at the end of 2011 suggests that several of the elements compromising food security around the world are at play here too, from soil erosion and degradation to the loss of agricultural lands for development. Cities along with their infrastructures are steadily encroaching on the most fertile farmlands. In France, it is estimated that some 6,000 km<sup>2</sup> is lost to urbanisation every 7 to 10 years. "The priority is always given to development," says Lionel Vilain, an agronomist with France Nature Environment, an environmental protection group. "Disneyland, for instance, is located on the country's best [farm]lands." With steady population growth in France, it's only natural that more space might be needed for housing. But the rate of land take appears to be outpacing that of urbanisation. Soil sealing, as it's called, not only compromises food supplies for future generations, but also renders cities impermeable. Which is very bad news in a world already and increasingly subject to extreme climatic events.

## **"Soil biologists fondly refer to worms as 'soil engineers' "**

The state of our soils will play an important role in whether we can mitigate and buffer the effects of climate change. Soil is a potentially vast carbon sink, second only to the world's oceans. Yet on the whole, French farms have become net carbon-emitters. And while soils cannot entirely avert the worst flooding, their capacity to absorb water plays a role in dictating the extent to which a deluge might turn to flood. On a given parcel of land, the fertility of soil determines whether water is more likely to infiltrate the Earth's crust, slowly percolating down to the aquifer, being purified along the way by microorganisms specifically designed for the task, or whether it will run off the land, potentially washing away largely non-renewable topsoil into rivers and waterways. This kind of soil erosion represents a permanent loss of soil capital, a problem that affects a fifth of French territory and about a third of the

world's cropland.

"On 20% of our lands, soil loss is superior to what Nature can generate by alteration. Which means this is not sustainable. Will it take a hundred years or a thousand? We don't know but one day, there'll be nothing left," says Arrouays.

According to Paul van Dijk of Alsace's Association for Agronomic Renewal (ARAA), changes in the types of crop produced in the region, along with the gradual exodus of animals on farms, which contributes to the depletion of soil organic matter, are among a host of factors "all headed in the wrong direction". He explains: "In this area, there's a tendency towards an increased use of summer crops such as corn. So many of the fields are now without cover when the storms come in the spring." Bare lands mean there's nothing to hold the soil down. "Crop choices are dictated by the market and aid systems. Awareness of problems comes with a delay."

Soil biologists today assign worms to a community they fondly refer to as "soil engineers" for their role in creating galleries that allow water to infiltrate, oxygen to circulate and roots to penetrate in the confined darkness of the underworld. Worms belong to that category of subterranean fauna whose role it is to maintain the structure of the soil. And while their abundance may not always be a perfect indicator of healthy soil – some highly contaminated lands abound with earthworms – their declining numbers are a cause for concern. The earthworm is one reason why a group like van Dijk's encourages farmers in Alsace to adopt reduced- or no-till practices. For it's easy to imagine that the plough literally turns a worm's world upside down. "It destroys their habitat," says Antonio Bispo, of the French Agency for Environment and Energy Management (ADEME). "It can obliterate entire populations."

After 50 years of deep ploughing, heavy fertiliser use and chemical warfare on French farms, the 'green' revolution has taken its toll on life underground. "Farmlands are for the most part biologically dead," Claude Bourguignon, a renowned soil biologist, told the country on the evening news on 15 October 2008. "We've destroyed about 90% of biological activity on our lands. Take a species like the earth-



worm. In 50 years we've gone from 2 tonnes per hectare to 50 kilos. The destruction is profound," he warned. According to Vilain, about 40 tonnes per hectare of organic matter have been lost in the great cereal plains of France: "In thirty years, organic matter content has gone from about 3–4% to about 1–1.5%. Below 1% is when we start having real problems with infertility. We are not there yet. But that's where we're slowly headed."

Soil organisms may well be going hungry for want of organic matter. 'Malnourished' is perhaps a better term, for variety is sorely lacking in fields that cultivate the same crops year after year. "The more we have monocultures, the more we deplete microbial presence. Vineyards present the lowest microbial biomass," says Lionel Ranjard, Director of Research at the French National Institute for Agronomic Research (INRA), who participated in the sampling of some

2,200 soils in France. "At what point do we lose so much biodiversity that the soil shuts down from a functional point of view? This is an important question."

With average yields still reaching an impressive 70 quintals per hectare, it's difficult for farmers to really see there's a problem. Heavy fertiliser use over the past half-century has masked fertility problems. Soil has come to be looked upon as a mere physical support for crops – a factory floor of sorts. But the world must prepare, in agriculture as in other industries, for a dearth in the natural resources that have sustained a half-century of growth in wealth and waistlines. "Phosphorus is scarce on large parts of French territory, and we know world reserves will run out over the course of the century," says Arrouays, of the mineral fertiliser mined in just three countries – Morocco, China and the US. Production of synthetic fertilisers is

also dependent on oil reserves that are also peaking. "The day will come when we'll have to limit fertiliser use," says Bispo. "We'll have to depend on the biology of the soil to take over. We'll have to supply the organic matter." In other words, we'll have to feed the life that feeds us.

*Carolyn Lebel is a Paris-based freelance journalist specialising in investigative reporting on environmental and social issues.*

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## Professor Howard Liddell OBE, 1945 - 2013

Sebastian Tombs

**H**aving been unaware of Howard's short illness, I was quite unprepared for the news of his death.

Shock affects folk differently - but my immediate reaction was one of: 'Too soon, too soon - DEAR Howard. No more ebullient repartee, and table thumping about what REALLY matters in life'. Howard was a sort of 'conscience' figure, someone who, even though he wasn't there, I would fly an idea by, or wonder what he'd say about some aspect of my approach to things. I will still do that, of course. He was the kind of man who would always be generous with his knowledge and experience. So I will miss him, but rejoice in having known him, a little. And as I continue to try thoughts out, I know his beneficial influence will remain. At

times like this, the big questions return to mind: about life, relationships, meaningful action, joy and sadness. In all these spheres, Howard's zest for an enquiring, joyous and purposeful life was an inspiration.

Howard was a big man. I remember thinking this, as we wound our way up the very tight stairs to the low-ceilinged attic at RIAS headquarters, where my small eyrie-like office commanded an eastward view over Rutland Square towards the City Centre. I don't recall when this was exactly, but probably around 1989/90. I had come across Howard's work in and around Aberfeldy, and it seemed to me that here was a man who was in tune with my own thoughts about taking a more 'holistic' view of design and the environment. We had a few very long chats on the telephone; and at last he came to see me. It was a squeeze fitting us both into the room!

Howard was an enthusiast. The conversation ranged around design sensitivity; material specifications (as Practice Director I'd

been promoting wood certification schemes in Practice Information); user involvement in design; getting the message to clients; and, even more importantly, getting the message to architects. And that was where the RIAS came in. We had the network for communicating to practices through the quarterly Practice Information updates, and while Howard thought it would have been impossible to work with the RIBA on such a topic, he viewed the RIAS rather more dynamically!

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**“He persevered when others might have faltered. We have much to thank him for.”**

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Howard's excitement about the possibilities for things to change for the better led to our hatching a plan to set up an inclusive, trans-disciplinary group, which we called the Scottish Ecological Design Association. Not all architects were keen, but enough were; and from the outset our idea was to attract makers as well as designers, health practitioners and artists; who knows, even the odd politician?

Howard was ambitious - for his ideas to take root, and flower into new ways of thinking about our responsibilities to our environment. SEDA launched after a short incubation period, with an event at the RIAS, at which a Minister appeared. Talks were given - the first floor was packed - and some refreshments were enjoyed. The aim was to learn continuously from a series of such events, sharing news via a magazine, and gradually persuading numbers to join. I had always hoped that the need for an organisation like SEDA would fade over decades. Not a bit of it!

Howard was a pioneer: never content with one achievement, SEDA attracted folk with energy and passion: student competitions were run for many years with the six Scottish Schools of Architecture; the greatest impediment to their success was the lack of interest from the staff! Howard always worked his magic on students - teaching was a delight all round, it seemed. There will be many practitioners who put their own pioneering spirit down to his inspiration.

Within the architectural profession during the early 1990's - a period of reflection during a major slump - interest was growing; I worked with Howard to adopt an 'Environmental Statement', which recognised larger themes informing practice. I recall the Practice Committee having difficulty with expressions such as 'inter-generational'. However, it was successfully





launched by Fraser Morrison, on the first day at an RIAS Convention in Inverness, held at Findhorn. It was aspirational - intended to encourage a demand for better design.

Howard was certainly demanding! Never content to rest on his achievements, he was always pushing forward - into research, projects, teaching, consultancy, and the children's Eco-City projects, a number of which I witnessed: a brilliant combination of practitioners, students, teachers, and the key players, 9 to 12-year old pupils from different schools, who worked with pupils they had not known before, on large 8 x 4 ft format models, all of which had to 'join up', and encapsulate their ideas. Amidst the turmoil and noise, Howard would stride about, rather as I imagine Napoleon commanding during a battle, gathering energies and distributing encouragement. The moment when the models were unveiled and the children showed visitors round their creation, was a truly moving occasion. Somehow, Howard's intrinsic faith in the young - and the young in all of us - had enabled him, with his collaborators, to facilitate a minor miracle. The children glowed, Howard glowed; the world could indeed become a better, happier, more balanced place.

Howard was very proud of his projects; I remember him taking me around the Bourne (or was it the 'Bourne-again?) House in Weem, chewing over the degree of solar gain likely; the challenges of persuading the National Trust for Scotland to run with his ideas of using untreated timber at the Glencoe Visitors Centre, and the neat flooring details to enable easy maintenance. Fairfield Housing in Perth helped to transform a community - and that quarter of Perth as a whole - and later, with groundbreaking 'allergy-free' homes. And then Raymond Young's straw-bale office in Dunning. All such efforts were accompanied by research - hugely boosted upon Sandy Halliday's happy arrival on the scene, when they moved to Edinburgh - by the writing of articles, the giving of lectures.

Howard did get angry, though. Occasionally, I felt the result of his frustrations when, again, he wasn't selected as a keynote speaker, or selected for a job, or when later on, his message was being hijacked by commercial interests. He coined the acerbic 'greenwash' and 'eco-bling' labels for such disappointing outcomes, inventing a new language to cope with the challenge! Sometimes, his fury lost him a friend or two. But the negative energy was soon dissipated, and redirected anew to positive effect.

One outcome of this was the RIAS Accreditation in Sustainable Design, which recognised actual (rather than theoretical or academic) professional capacity in this sphere of work. It remains one of a few such accreditation schemes within the UK; and, naturally, Howard's was the level of accreditation to which all others aspired!

When Architecture and Design Scotland (A+DS) was preparing a Statement on environmental aspects of design and urban planning, SEDA assisted in drafting material; and I was pleased that the final document incorporated Gaia International Chris Butters' diagram showing how an integrated, wider set of criteria could helpfully be taken as a starting point for assessing different design strategies.

As Chris [Butters] stated in his Guardian obituary in March, Howard was a natural follower of Patrick Geddes, whose three-fold approach exemplified in: 'head, heart and hand', and 'folk, place and work', demonstrates ways to value aspects of design which can be judged, but not measured. If Howard

has left a legacy, it is surely in the sphere of values. He was a big man, in many senses of the word: big-hearted, generous with his time and spirit, with a huge sense of fun, and zest for life. He set high targets; he inspired (and usefully irritated!) many; he led in a field of endeavour when it was a lonely path, yet he persevered, when others might have faltered. We all have much to thank him for.

When we look around at the state of the art of design; or the state of the environment here or overseas; or wonder about the seriousness with which society is actually addressing the challenges he was deliberately berating us all about, we can question how far have we come since 1991, when SEDA was hatched in that attic? Certainly not as far as many of us would have wished. So the mission for which Howard was rightly known, and honoured, remains to be grappled with. Let Howard's spirit enliven our efforts!

*Sebastian Tombs is a co-founder of SEDA.*

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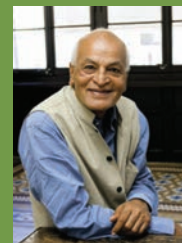
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## Design by Nature: A new Agricultural Revolution

Dr Ulrich Loening

**T**hirty years ago, years after Rachel Carson's *Silent Spring* was published in the UK, I found some adverts for pesticides and herbicides at an agricultural show in France:



These pictures draw on popular appreciation of the beauty of nature, yet boast an attitude of total domination over it; those romantic beautiful 'weeds' are destroyed with the "confidence of the conqueror" to clear the land totally, right up to the distant village church, with not a green thing left in sight. The third advert for a pesticide has an insect at the mercy of the power of modern science. Such an attitude of modern agriculture is what Rachel Carson exposed. Perhaps humanity, or at least Western civilisation, shares deep roots that combine reverence for nature with pride in its conquest. These advertisements represent the apogee of the success in agricultural science over the past 200 years, the answer to Malthus's calculation that a growing world would not be able to feed its population. No wonder, with this attitude of conquest, that many people become worried by such scientific advances. Even if there is now more than enough food for all, the achievement has endangered the survival of much of life on the planet. Fifty years after Rachel Carson, it is a sign of some progress that such advertisements would not be acceptable in modern Europe now. But while attitudes are changing, pollution and exploitation continue, and the same company that makes the "neo-pyrethroid" Decis (Bayer) now also produces neo-nicotinoids, which threaten bees and much other insect life.

Old attitudes still colour scientific research; one example is the science of how plants achieve their own protection against pests. To put this in perspective, I digress briefly to describe how plants have an amazing range of defences against pests and diseases. Obvious and widespread among these are diverse poisons or anti-metabolites; many of these have become well-known drugs for use in medicine, such as digitalis from foxglove as a heart stimulant, the malaria drug artemisinin from *Artemisia*, and vincoblastin from a tropical periwinkle as an anti-tumour drug. Others we regard as poisons, like nicotine. The latter is an excellent insecticide, which disappears from the environment in a day or two; it is safe to use if we keep it out of our way, unlike the new derivatives of nicotine, the neo-nicotinoids. These persist, and poison all manner of aquatic arthropods, as well as bees.

The ingenuity of plants is never-ending: almonds and cassava make cyanide, the latter in sufficient amounts that it needs to be washed out the root before you can eat it. Some plants exude a hormone that mimics aphids' danger signals and so repels them, but attracts ladybirds, which eat aphids. Very clever, so much so that biotechnologists are experimenting with inserting that system into wheat. Bracken makes a molecule like insect moulting hormone, which interferes with the development of

any pest grub. The range of strategies is fascinating. One can see an evolutionary arms race between the plants that produce new poisons and the pest organisms that learn to resist them, just as there is now an arms race between agricultural poisons and pests or weeds that learn to survive them. I suggest that this understanding colours, and thereby maintains, what we do to kill pests, and that this bias lets us miss the most important strategies that plants have evolved to protect themselves in nature.

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**“The ingenuity of plants is never-ending.”**

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This was brought to light in a book by Francis Chaboussou, first published in French<sup>1</sup>, and subsequently translated as *Healthy Crops, A New Agricultural Revolution*<sup>2</sup>. Chaboussou was a biologist at the French National Institute for Agricultural Research (INRA, mentioned also by Carolyn Lebel here). He spent his life observing pests and diseases and what causes them. Over about 50 years up to 1985 he showed how and why farming practices often not only fail to prevent but actually stimulate the proliferation of pest and disease organisms, be they fungi, bacteria or insects. Why is it that these are getting worse, despite the successful develop-





ments of farming technology? He came up with a simple biochemical explanation, which he termed trophobiosis. This is that most fertilisers, pesticides and herbicides, far from solving problems, actually create conditions under which the pests can proliferate; chemicals do this by interfering with the balanced flow of nutrients during growth. It is a tragedy that his work was disparaged and neglected, even within INRA.

Modern farming practices seem to have led to many pests and diseases becoming worse or more aggressive over the past decades. Have they all become more resistant to our methods, or are we in some other ways preventing our crop plants from exercising other protective measures? The answer is mainly the latter. Modern farming creates, in the ways described below, the very conditions that help pest and disease organisms to proliferate and thrive. To get around this has been the motivation for organic agriculture, promoted by many innovators in the early years of the 20th century, notably Sir Albert Howard<sup>3</sup>. It was Chaboussou's book in 1985 that provided a scientific rationale.

Chaboussou's idea is that the nutritional state of a plant determines its resistance to pests and diseases. The latter can only thrive when sufficiently supplied with nutrients, especially soluble amino acids and reducing sugars like glucose. Under conditions of active growth in naturally fertile soil, the synthesis of protein from amino acids, and polysaccharide from glucose, keeps the cellular amounts of these soluble nutrients at a minimum. Since most pest and disease organisms depend for their growth on free amino acids and sugars and cannot grow so readily using protein and polysaccharides, they find themselves inadequately fed in healthily growing plants. However, almost all conventional chemical agricultural methods increase the amounts of soluble nutrients in the plant cells, thus creating favourable conditions for the proliferation of pest and disease organisms. Similarly any pesticide or herbicide in recommended concentrations inevitably affects the crop plant, the main effect being a temporary reduction in protein synthesis - this most sensitive of metabolic processes. The reduced rate of protein synthesis then results in the temporary accumulation of amino acids. Therefore, while the immediate attack by a pest may be reduced by a pesticide, the susceptibility of the crop is increased and

ultimately pests will multiply.

In a healthy soil, rich in organic material, most nutrients are firmly bound and not soluble. The nutrients are released to the plant as needed by symbiotic mycorrhiza or by other soil microorganisms. Under these conditions the plant grows well and the amounts of soluble nutrients in the cells are kept low and pests find it hard to multiply. Many agrochemicals inhibit these symbiotic helpers, as well as repelling earthworms. Organic growers often find that care of the soil also minimizes pests. Chaboussou explains why this is so. Other factors also influence plant growth and metabolism. The stage of development of the plant, the strains imposed by flowering and fruiting, the balance of elements in the soil, the availability of a wide range of micro-nutrients or trace elements like copper, manganese or boron, the adequacy of light to maintain protein synthesis; all these affect the soluble nutrients of the cell and hence susceptibility to disease. For example, the widely used Bordeaux Mixture works not so much by poisoning the mildew as by stimulating protein-synthesis, and thereby depriving the fungus of amino acids which are its food source. Since 1986, several growers have had success by following this interpretation of Trophobiosis - notably a vine grower in Bordeaux who is again able to grow vines on their own roots, without attack by Phylloxera<sup>4</sup>.

Perhaps there is a further reason why Chaboussou's work has not been recognised. Just avoiding feeding pests does not seem like a mechanism - it is merely a consequence of the biochemistry of plant growth, unlike the poisons that plants make, which have evolved to control pests. We should note that the nutrient resources of the natural biosphere are scarce but modern farming has doubled the amount of soluble nitrogen. This leads to the dilemma of modern farming: its very purpose is to enrich plant growth by over-riding natural scarcity, yet that leads to more soluble nutrients and more pests and diseases. This can be achieved in a rich soil where nutrients are bound by humus and clay and become avail-

able only as needed. The scientific insight that I describe points to the necessity of maintaining good soil and high yields without feeding the pests.

Several discoveries are emerging that help this along: for instance, a number of organic decomposition residues serve as protective agents, evidently by improving the nutrient balances in plant cells<sup>5</sup>. These include anaerobically digested waste materials, whey, dilute urine, some sea-weed extracts. These appear to act a bit like hormones that help to maintain nutrient balances during growth. Some of these are commercial products but the highest priority remains care of the soil, which is the core component for plant health. At last we are learning how science can, in the words of Ian McHarg, help us to "design with nature", by following "designs by nature".

*Dr Ulrich Loening is former Director Centre for Human Ecology and molecular biologist at the University of Edinburgh.*

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# Endpiece: Loving the land and what we eat better - what can be learnt?

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**Whether you 'work on the land' or not, it's likely you will have an effect on food production in some way,**

whether through controls on development through the Planning system, or the way you plan out the land used for activities or building, or through the choice of food you buy and where from. Different 'production systems' can seem utterly separate - urban versus rural, bricks versus crops - but you only need to look at where the timber or cement for so many houses comes from, to see the competing demand on land and how design decisions influence natural and man-made environments. If anything, this issue's articles question where man-made ends, and how we can better plan the whole environment we live in and use.

While all of our authors highlight the unsustainability of much modern farming and the huge danger if not addressing the state of the soil, they advocate a range of different approaches. They all walk a line between innovation and tradition, under pressures from the need to make a living and to supply the food we need.

Connections to consumers are crucial in influencing what happens in the future, and to re-establish the idea of everyone's reliance on the soil. Organisations like Nourish and the Fife Diet are finding ways to communicate and engage with people, addressing public health as well as environmental issues. The attitudes of many who rely on the food economy is only changing slowly, and we have to admit that most people do not yet know or care about how we are mining a declining natural capital. As has been said before, the notion that food can be 'cheap' has to disappear, as does the acceptability of massive waste in the food system. This is not just the act of the public throwing good food away, or the commercial distribution system sending it to where it's not needed, but also of recapturing the goodness, now lost when consumed, by making sewage and waste part

of a circular nutrient cycle which includes farming, processing and consumption.

## **There needs to be a plan – or at least more of a plan**

While it may sound like a cry for Soviet style planning, there is a strong argument that agricultural production and consumption could do with a dose of strategic planning. Throughout northern Europe, and in Scotland no less, strategic planning for the repair of natural capital and for the right export-import balance has never been done at all the scales necessary. To be successful it has to be implemented at a wider, regional level. We need to use methods, high- or low-tech, that work with the natural processes of the land to help restore it to genuine vitality.

This is not to say that the imposition of a master plan is the best or only way ahead: the piecemeal evolution of the north-east Atlantic seaboard is not without merits. It has resulted in a diversity of crops, products and methods of farming that is probably unrivalled in northern temperate latitudes and has resisted the dominance of one type

of crop over others. However, the increasing evidence that this production system is degrading through its own practice means that it now needs serious appraisal.

Importers, farms, consumers, retailers, exporters and urban planners will need to consider themselves as parts of one production-consumer system.

It is essential that the various requirements of agricultural production and consumption have to be defined both at a high level of governance and by each individual. The actions of lobby groups and special interests will not solve the problems. We can all choose to help the situation through our food consumption and materials specification, so we reward the people who chose to produce them in ways that will support the land alongside the other developments we need or want. As ever, the power to make a difference is within our grasp; the question is whether we have the motivation to try to do so and the integrity to stick with it rather than reverting to 'business as usual'.



Loess Plateau restoration project  
Photo: Jim Richardson/National Geographic

