

# edible boardrooms & allotments in the sky

Dave Richards introduces the RISC roof garden and makes the case for a permaculture approach to green roof design\*

**W**hen the idea of a roof garden at Reading International Solidarity Centre (RISC) began to take shape in 2001, it was a practical response to the problem of a leaking roof and how to provide sound and heat insulation for a conference hall which doubled as a venue for noisy events. Little did we imagine that our solution to a domestic crisis would create such interest; and a steady stream of journalists and thesis-writing students. It's only with the benefit of hindsight, that we realise that the story of our edible forest roof garden has a wider significance in a world of rapidly rising oil prices and the need to reduce our carbon footprint.

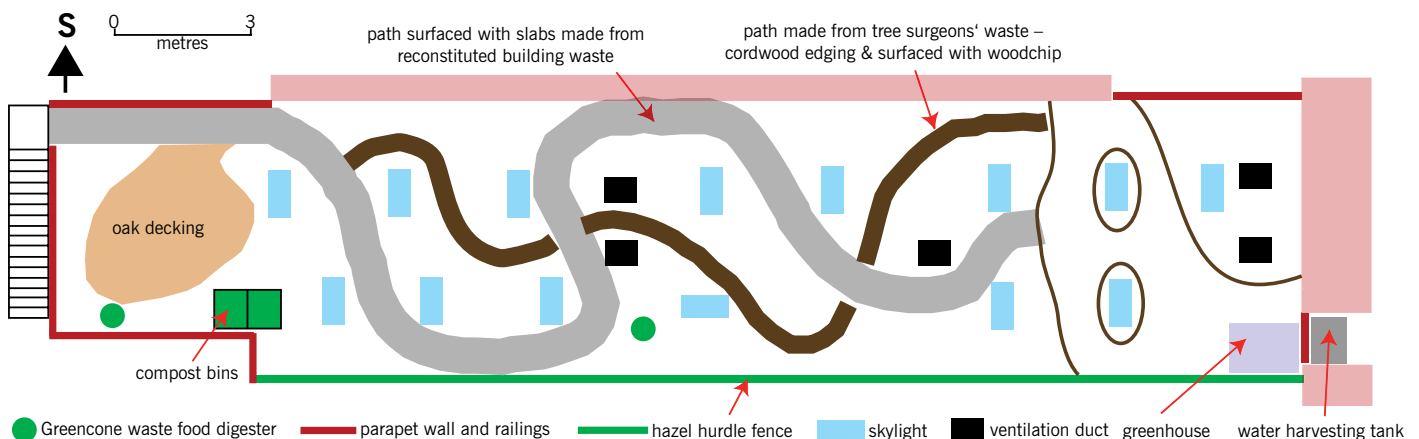
RISC is an educational charity which aims to raise awareness of global issues through working with schools and the general public. In 1995 we bought and refurbished a complex of buildings close to the town centre which dated back to the 18th century. This gave us the opportunity to reach new audiences through a Global Cafe and fair trade World Shop, as well as broadening our funding base by offering office space and conference facilities to community organisations. Unfortunately,



the shoestring budget could not stretch to replacing a large expanse of flat roof which was well past its sell-by date. Armed with a tar brush and bucket of bitumen, we fought a losing battle with the elements, and in 2001 began to look for funding to renew the whole roof.

The idea of a green roof slowly gained momentum as internet research revealed its advantages. It soon became obvious that a garden would not only extend the

*photo: the garden has over 185 different species on an area of only 32 x 6m – it is a multi-use space, providing a relaxing spot to eat lunch, hold an informal meeting or learn about plants and sustainable development*



\* This article was first presented as a paper at the World Green Roof Congress, London, 2008



photos, from top: UV light gradually destroys roofing felt – by 2001 the roof had reached its sell-by date; work raising the surrounds to the skylights and installing the water and root proofing system began in October 2001; hard landscaping and planting was finished by June 2002

scope of RISC’s educational work but also appeal to funders. The Big Lottery took the bait and provided us with £34K topped up with a grant of £13K from SEED.

### The design

The design brief for the 200m<sup>2</sup> site (32x6m) emerged from brain-storming sessions among the workers’ collective that run the organisation: a garden which could be a tool for making connections between the local and global, including sustainable development, as well as the economic, cultural and historical importance of plants. We collaborated with Paul Barney, a local permaculture designer, who adapted the forest garden idea, championed by Robert Hart in the 1970s, to our site and needs.

Permaculture is about “designing sustainable human settlements through ecology and design. It is a philosophy and an approach to land use which weaves together micro-climates, annual and perennial plants, animals, soils, water management and human needs into intricately connected productive communities”<sup>1</sup>. Our design takes into account every aspect of the site, surrounding buildings and makes full use of the local resources. For example, the Centre produces large amounts of organic waste which are composted and help feed hungry plants, while minimising landfill waste. Shredded paper from offices is high in carbon, while vegetable peelings from the Café and tea bags from the meeting rooms are high in nitrogen – the perfect combination for rapid decomposition. In exchange, herbs and cut flowers are used in the café. Water from surrounding roofs is harvested for the drip-feed irrigation system which is powered by a small wind turbine and photo-voltaic array. The hard landscaping uses a combination of reused, renewable and recycled materials – old bricks destined for landfill, paths made from woodchip and edged with cordwood (tree surgeons’ waste which would otherwise be burnt), fencing and raised beds made from locally coppiced hazel and willow.

The forest garden is a variation of the permaculture approach – using a carefully selected combination of

perennial herbaceous plants, shrubs, trees and climbers in a planting scheme which mimics a multi-layered woodland ecosystem. This creates the conditions which support great diversity. Once established, forest gardens require a little pruning and lots of harvesting from early spring to late autumn. Conventional vegetable plots can also be included. The use of a 75mm layer of mulch and ground cover plants, such as herbs and strawberries, helps to conserve moisture and suppress weeds.

Our design features two winding interconnecting paths which create ecological niches for forest-edge plants, but also provides enticing access for visitors, especially children. It had to accommodate assorted skylights and ventilation ducts and shade cast by a building on the south side of the plot. Areas at either end of the site receive full sun for most of the day. One is planted with sun-loving herbs in a raised bed which surrounds a small area of decking made from local wind-blown oak. The greenhouse lives at the other end, as well as raised beds used to grow annual herbs and flowers for the Cafe. Cordoned fruit trees line a hurdle fence on the south-facing side of the garden which also gets a lot of sun. In total, about 100m<sup>2</sup>, half the plot, consists of beds.

### The structure

Victorian maps show that our site had been a courtyard garden, covered over in the 1960s. Luckily for us the flat roof structure was substantial – a series of 18cm deep RSJs, resting on reinforced concrete piers, spanned the 6m wide space. The engineer calculated that this could support the combined weight of 30cm of rain-sodden peat-based soil, hard landscaping, our intensive planting and visitors. This meant we could proceed with the forest garden design without the need for additional strengthening, which would probably have been prohibitively expensive for a cash-strapped charity. Our limited budget dictated that we had to opt for a cut-price version of the Bauder system offered by a former employee. Fortunately, the existing drainage system was easily adapted to harvest rainwater, so the new system could be laid on top of the existing decking.

### Plants for every purpose

The contractors, RAM-RGC, began stripping off the perished felt in October 2001 and completed the waterproofing in two weeks. They also supplied the lightweight soil (reclaimed potato washings we were told). RISC took responsibility for project managing construction of the main hard landscaping features – path paved with simulated York stone slabs made from reconstituted building waste (high embedded energy from cement, but lower carbon footprint than imported Indian and Chinese stone found in most garden centres), raised beds, staircase, fencing to secure the plot. Planting by a team of volunteers was completed by early June 2002.

The initial plant list had about 120 different species – mainly perennial plants from around the world, most with multiple uses: food, medicine, fuel, fibre, construction, dye, scent – chosen to generate maximum interest for visitors, from school children through to garden experts. They include the full range of layers, from roots (oca *Oxalis tuberosa*, American groundnut *Apios americana*) and ground cover (strawberries *Fragaria*, herbs) through to climbers (hop *Humulus lupulus*, kiwi *Actinidia arguta*, grape *Vitis vinifera*), small shrubs (lemon verbena *Aloysia triphylla*, blue sausage tree *Decaisnea fargesii*, Chilean guava *Ugni molinae*) and taller trees (cherry *Prunus avium*, Japanese raisin tree *Hovenia dulcis*). Most of our fruit trees are heritage varieties dating back to Victorian breeders and beyond. Notable for their taste (though not for the uniformity required by supermarkets), they will also enrich the gene pool which will create new varieties which can cope with the weather brought about by global climate change. The list has now grown to over 185 species.

As far as we knew, this was the first attempt to create a temperate permaculture forest garden on a roof, and so the project was something of an experiment. The biggest question was whether our intensive planting scheme could flourish on only 30cm of soil. There was particular concern that large trees would blow over. The past six years have clearly demonstrated that the leap into the unknown has paid off. The garden



photos, from top: layers in the RISC forest garden: trees - hazel (*Corylus* 'Webb's Prize'); edible shrubs - chokeberry (*Aronia melanocarpa*); herbaceous perennials - angelica (*Angelica archangelica*); ground cover plants - wild strawberry (*Fragaria vesca*); climbers - Japanese wineberry (*Rubus phoenicolasius*); edible roots and tubers - oca (*Oxalis tuberosum*)



*photos, from top: water from the garden and surrounding roofs percolates through the soil – a layer of fleece prevents clogging of the drainage layer below, which sits on insulation and the special root-proof felt; any remaining particles collect in the green sedimentation tanks and is pumped into the grey 1500 litre storage tank; in the summer water is pumped to a drip-feed irrigation system, timed to switch on at night to reduce evaporation*

has matured into a truly beautiful, inspirational oasis that has won awards, astonished the hundreds of people who visit every year and attracted great media interest. However, there are important lessons we have learnt which will make it easier for others to follow in our footsteps.

### Costs

As with most voluntary sector organisations, minimising costs was imperative for the success of the project which was grant funded. The total budget finally worked out at £50K, the majority consisting of £34K for repair and adapting the roof and installation of Root-Stop waterproofing system, insulation, drainage board, filter fleece and soil. Hard landscaping accounted for a further £6000, design and planting for £5000 and the irrigation system, including renewable energy components, cost £3000. Use of renewable and reused

materials (most notably Oxfordshire limestone originally used in the 12th century to build Reading Abbey, used a second time in an 18th century make-over of our building, and a third incarnation on our roof garden) helped to reduce the cost of hard landscaping, while our crew of dedicated volunteers helped to minimise labour costs during construction. Ongoing maintenance costs are minimal – small amounts of organic soil improvers, a new pump for the irrigation system – and covered by donations from visitors.

### Water

The biggest problem is water, both because we aspire to being a zero-carbon garden and the rising cost of being part of Thames Waters' revenue stream. Despite our water conserving methods, the garden is like a huge hanging basket and does not hold water very effectively. The intensive planting has high water requirements during the summer which cannot be met by our meagre 2000 litre storage capacity. With global climate change predicted to produce drought conditions every three years on average and huge water demand in the South-East, we need to be completely independent of mains water to guarantee the garden's survival. During the dry summer of 2006, when it did not rain for six weeks, the garden was severely stressed and survived only because, as a business, we were able to use hose-pipes. Unfortunately, the garden is not metered separately so we do not have accurate data for water consumption during dry periods, but we estimate 500-750 litres/day when our storage tank runs dry. On the plus side, water which percolates through the soil is recycled through the irrigation system.

When funding allows, our solution is to bury a large cistern in the car park. The footprint of the whole Centre is 420m<sup>2</sup> which would yield about 13m<sup>3</sup> of water in July, Reading's driest month, averaged between 1971-2000. For most of the year this will be used to flush toilets but can be used on the garden during dry periods. This will ensure that we do not have to turn our temperate forest into a Mediterranean garden.

### Maintenance

One of the virtues of a forest garden is

that it is low maintenance because it uses predominantly perennial plants, which look after themselves, and there is permanent ground cover, which reduces weeding. The first year after planting is the most time consuming. We created a biodegradable membrane from old copies of the *Reading Evening Post*, topped with a layer of woodchip. This kept watering and weeding to a minimum while plants became established. The garden is maintained by one volunteer, a skilled horticulturist, who occasionally mobilises a larger group of volunteers for two Sundays a year to apply a spring dressing of organic horse manure and harvest willow to repair raised beds.

During the winter months Mary spends 2-3 hours/week on general maintenance, including pruning of the large number of fruit tree, shrubs and climbers. Spring is the busiest time of year taking 7-8 hours/week propagating plants for sale to visitors, thinning unwanted self-seeded plants and planting gaps. Routine summer maintenance falls to 3-6 hours/week, watering when necessary, harvesting and clearing rampant growth from skylights.

### Fertility and plant health

Like any allotment, our garden demands large amounts of nutrients. Despite annual dressings of compost and manure which increase the moisture retaining organic content of the soil, nutrients are quickly leached from the relatively light soil, although they are recirculated via the irrigation system. We monitor the health of plants which provides the surest indication of deficiencies. Although the shallow soil depth has had a *bonsai* effect on larger shrubs and trees, most are extremely healthy and display vigorous growth. Our tallest tree, a self-fertile cherry, *Prunus avium* 'Stella', has grown from a scrawny two-year old, 1.5m sapling into a robust 6m specimen, which has had to be cut back to reduce its wind resistance. Our experience is confirmed by research which shows that although trees and shrubs have root systems which extend many metres in all directions, 90% of roots are found in the top 45cm around them.<sup>2</sup> Michael Guerra has also shown how limited soil depth is no barrier to highly productive fruit and vegetable growing<sup>3</sup>.



Every year or so, we apply a spring dressing of powdered seaweed, a slow-release source of nutrients. We have also added ground Scottish granite which replaces minerals and trace elements which have been shown to promote plant health. A few plants, notably currants and hardy kiwis on the edge of the garden, have not thrived in the conditions, but this is probably due to stress caused by unreliable watering.

### Pests

Pests have not been a serious problem. There are many plants which attract beneficial insects which not only aid pollination, but also help control aphids and other unwanted insects. The garden attracts birds such as blue tits which consume large volumes of caterpillars, though not enough of the rose chafer beetle and sawfly larvae which find some of our plants especially tasty. Thankfully, slugs and snails appear to



photos, from top: organic waste from the garden and Centre is composted; soil fertility is maintained with an annual dressing of organic horse manure (note the Green Cone waste food digester which breaks down all kitchen waste, including cooked food, into nutrients which feed the surrounding beds); nice but naughty – the rose chafer beetle eats flowers, but its larvae are useful in breaking down dead wood



photos, from top: the garden has become an integral part of RISC's mission to raise awareness of global issues: it is open to the public on five weekends as part of the National Gardens Scheme; school groups come to the garden on field trips which allow them to discover the importance of plants in our lives, and have fun out of the classroom; performance of *Crow!* which explores Man's relationship to the environment

suffer from vertigo because we rarely see them. Another observation is that fungal disease is minimal. For example, interplanting seems to benefit commercial varieties of strawberry which have spread and prospered, even though it is recommended that they are replaced every year to prevent infection.

### Use of the garden

From the outset, the garden was intended as a tool to communicate RISC's local-global message to a wider public. It has been an overwhelming success from this point of view. We have about 750 visitors a year, mainly in summer. For a time, we left the gate open so people could just drop by, but discovered that junkies also found it an agreeable place to begin their voyages of discovery. So now it is open by appointment for school and gardening groups, and to the general public for four weekends during the summer as part of the National Gardens Scheme which raises money for cancer care and research. In addition, groups using the RISC's conference facilities and meeting rooms often use the garden as a break-out room or respite from intense work-shop activities. Performance artists have also used the garden in their productions.

Visitors can have a guided tour which explains the principles behind the garden and the stories behind some of our favourite plants. The ultimate must be Emmer wheat, *Triticum dicocum*, first domesticated in the Fertile Crescent 10,000 years ago, and the foundation of several civilisations. Our interpretation materials have improved – all-weather UV resistant information panels, detailed labels listing uses and leaflets. We have added new elements to the garden which demonstrate sustainable gardening techniques – siphons to empty bathwater, low cost rain-fed irrigation systems using 200 litre containers used to import pickled onions and porous pipe made from recycled car tyres. In 2006 our water conservation methods featured on the BBC's *Gardeners' World*. Our website has become a mine of information though, like the garden, many of its treasures are found in hidden corners.

### Education

The garden has been incorporated into

RISC's formal education work, particularly how the 'outdoor classroom' is an ideal resource for helping to deliver all areas of the curriculum. Participants in Initial Teacher Training and Continuing Professional Development courses run by RISC visit the garden as a demonstration of how school grounds can be used to meet the government's strategy for sustainable schools.

We have developed activities for children which encourage them to explore the garden and discover the importance of plants. Being asked to be on the lookout for the plant which could kill them is a foolproof way of focusing young minds. The leaves of American pokeweed, *Phytolacca americana*, undermine the immune system, but in the USA the toxins are neutralised by cooking and the spinach-like leaves canned and marketed as poke salad, inspiring Tony Joe White's 1969 hit, *Polk Salad Annie*, which was part of Elvis Presley's 1970s repertoire). One spin-off from our education work has been the construction of school forest gardens inspired by the RISC model, nine to date, though all on terra firma<sup>4</sup>.

### The industry

Another category of visitor are professionals who are interested in green roofs. We open during the Royal Institute of British Architects' (RIBA) Architecture Week and receive a steady stream of students, facilities managers and other people interested in the growing field of sustainable landscapes – particularly green walls and roofs and Sustainable Urban Drainage (SUDs). More recently, there has been increased interest in the food growing aspect of the roof garden, as part of a strategy to promote healthy lifestyles and reduce food miles by encouraging urban agriculture<sup>5, 6</sup>.

### Lessons

In 2001, a roof garden was an intriguing idea. The journey of the past seven years has been an unexpected revelation and opened up new worlds which enrich the lives of so many people, from those of us who are intimately involved in its continuing evolution, to the children who have eaten day lily flowers and adults who have gone on to grow their own forest gardens. Feedback from visitors



describes a space that feeds the soul and all the senses. It is a valuable oasis in a concrete, tarmac and block-paved jungle, a means for people to re-connect with Mother Earth. We become slightly different people when sat in a garden, more relaxed and less formal – it creates a well-documented, health-enhancing sense of well being.

So, the main message is: where land is available it is probably preferable to reduce costs and use low maintenance sedum or other extensive planting to gain the benefits of green roofs. In an urban context where land is often at a premium, green roofs have a part to play in urban agriculture. City Farmer, Canada's Office of Urban Agriculture, has produced an extensive list of successful aerial allotment projects from around the world<sup>7</sup>. However,



photos, from top: view of the layers of planting; the bed of useful native plants



photos from top: globe artichoke (*Cynara scolymus*) is a both a delicacy and a sculptural plant; Ellison's Orange (*Malus domestica*) was bred in Lincolnshire in 1904; extracts from the purple cone flower (*Echinacea purpurea*) are used in many herbal remedies; Solomon's Seal (*Polygonatum*) are best known as a shade-loving ornamental, but the young shoots are delicious; root ginger (*Zingiber officinale*) produces beautiful flowers; right: ancient Emmer wheat (*Triticum diccocum*) is used to make organic wholemeal pasta in Italy

like conventional allotments, this form of productive green roof is relatively labour intensive. Our experience has shown that an intensively planted forest garden is a viable low maintenance option for owners, architects and developers to add to their palette. Such a garden scores highly on the habitat creation, amenity and food production levels, but requires higher capital spending, especially on structural strengthening and sustainable irrigation systems. A balance between keeping these costs to a minimum while creating the conditions best suited to a demanding planting scheme such as ours, would be to have 30cm of soil over the majority of a site, increasing to 50cm or more in areas devoted to trees, ideally on the south-facing edge which could take the additional loading and provide full sun for fruit trees.

In towns and cities, the additional cost of incorporating an element of a forest garden on a new-build project or a complete refurbishment of an existing building, is marginal, especially when compared to the value-added. Just imagine if forest gardens rather than sedum mats had been planted in Canary Wharf. Edible boardrooms might put city folk back in touch with the real world, prevented the credit crunch and give the human race a realistic chance of juggling the challenges of global climate change and Peak Oil in a way which gives the planet and all its peoples the possibility of a sustainable future. 🌱

<sup>1</sup> Bill Mollison and Reny Mia Slay, *Introduction to Permaculture*, Tagari Publishers, 1991

<sup>2</sup> Robert Kourik, *Roots Demystified*, Chelsea Green, 2008

<sup>3</sup> Michael Guerra, *The Edible Container Garden: fresh food from tiny spaces*, Gaia Books 2005

<sup>4</sup> Dave Richards, *The Outdoor Permaculture Classroom*, Permaculture Magazine, Number 54, 2007 [www.permaculture.co.uk](http://www.permaculture.co.uk)

<sup>5</sup> *Edible Cities - A report of a visit to urban agriculture projects in the USA*, London Food Link 2008

<sup>6</sup> Andre Viljoen, *Continuous Productive Urban Landscapes: Designing Urban Agriculture for Sustainable Cities*, Architectural Press, 2005

<sup>7</sup> [www.cityfarmer.org/subrooftops.html#roofs](http://www.cityfarmer.org/subrooftops.html#roofs)

**Dave Richards** has been involved in the development of the RISC roof garden from concept to reality, and is the present garden coordinator. Building on this experience he has set up *Eco gardens* which provides sustainable landscape design and construction services for forest gardens on roofs and *terra firma*.

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