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SUSTAINABILITY NETWORK

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Feature thought:

"As the public debate on the nation's energy options intensifies, more people are realising that one form of energy can lead to more centralised political and economic power in a few hands than another form of energy. The energy source that would most concentrate this power is, without doubt, atomic power. As high technology in a big package, it requires highly centralised institutions. As a national security hazard, it invites the heavy exercise of police power. In contrast, solar energy systems have major decentralising potential, few security risks, and significant opportunities for self-sufficiencies at the energy consumption site. Far from abetting the proliferation of nuclear weapons, solar knowhow could become a major humanitarian export …"

Ralph Nader & John Abbotts [1]

Dear Networkers:

SUSTAINABILITY NETWORK UPDATE – No. 61E

The two features in this Update examine in-depth the conceptual changes under way in farming systems. The trend is away from analytical science as the primary source of 'expert' farm advice, and towards greater respect for alternative, traditional, integrative and experiential knowledge. Analytical science remains an important part of the mix, but is increasingly seen in a supportive rather than dominant role. Recognition is growing that mainstream mechanised 'factory' farming is running our ecosystems down over time – that greater notice needs to be taken of 'old' and 'different' methods with proven longer-term sustainability records. Recognition is also growing that *biologically* healthy soil is a more fundamental element of the farming system than has been generally recognised. Considered together, these trends represent a welcome return of the 'good farmer' to the role of expert land manager and vital provider. Now, if we can just get good farmers' terms of trade to reflect this trend …!

Soil Fertility Management – Towards Sustainable Farming Systems and Landscapes

Dr Maarten Stapper – Maarten.Stapper@csiro.au – is a farming systems agronomist with CSIRO Plant Industry. He has lived, studied and worked in the Netherlands, Canada, USA, Iraq, Syria, and since 1982 in Australia. Maarten has an Agricultural Engineering degree in agriculture and catchment management in the semi-arid tropics, and a PhD in wheat production systems, linking crop physiology with agronomy and daily weather in simulation modeling. Quantifying production in dryland and irrigation wheat paddocks in southeastern Australia made him aware that most problems start with the soil, and thus solutions should commence there. Maarten is passionate about discovering and using the power of nature in food production systems – and the connections between soil biology, soil health, and the overall functioning of agro-ecosystems – and sees many opportunities for Australian agriculture to reverse soil degradation and regenerate soils. This feature is adapted from a presentation to the 2006 National Organic Conference of the Organic Federation of Australia (OFA).

[1] In *The Menace of Atomic Energy,* Outback Press, Melbourne, 1977 (Preface p 13) – and just as relevant today!

In a nutshell: Soil fertility is the capacity to receive, store and transmit energy to support plant growth. These processes require healthy soils – living, self-organising systems with physical, chemical and biological components all functioning and in balance. Continuous use of acidic or salty synthetic fertilisers, insecticides, fungicides and herbicides disrupts this delicate balance. Organic Farming has recognised this, but needs to follow its leaders to active soil fertility management. Carbon, in particular, is of critical importance and needs to be maximised through capture with solar energy through photosynthesis by green plants, and optimum storage and use in the soil. Before we can hope to improve systems, however, we need to understand (1) why they are the way they are, and then (2) how science and practice can help to actively manage soil biology to improve and maintain soil fertility, and achieve more sustainable, healthy and productive farming systems – even on our fragile Australian soils in a highly variable and changing climate.

Problems

The long recommended use of fertilisers, pesticides and other synthetic chemicals to address problems in agricultural production has been leading to poor soil health and resistance in insects, diseases and weeds. More soluble nitrogen fertiliser makes plants more susceptible to diseases and insects, and increases weed problem. As renowned holistic scientist Dr William Albrecht said "*insects and diseases are the symptoms of a failing crop not the cause of it*". The petrochemical solution is not working – all such production systems in the world are on a treadmill, needing more and more chemicals and fertilisers to keep yields up as natural soil processes are increasingly weakened in their role of supporting plant growth. This makes soils and plants dependent on these inputs. Such production systems are not sustainable and we currently harvest the outcomes of the gross oversimplification of fertilisation and 'plant protection' practices.

Agricultural systems have become addicted to the soluble acidic-based NPK fertilisers and this addiction, supported with the then required pesticides and herbicides, leads to soil degradation; thus keeping producers on the 'production treadmill' with 'more on' farming. The humic substances which are pivotal in soil fertility and plant nutrition have gradually been destroyed (Pettit 2006). Humus is the bond between living and non-living parts in soil and is part of the soil organic carbon that has severely declined since cultivation started. Curing any addiction is a slow process, requiring understanding, patience and commitment. This, however, has not yet been accepted by a science world which seems driven by commercial interests. Those in organic-biological farming remain the exception.

The problems arising from the petrochemical approach were first exemplified in Rachel Carson's 'Silent Spring' (1962), which exposed the effects of indiscriminate use of pesticides, and eventually resulted in the banning of DDT. Nevertheless, in spite of this warning, industrial manufacturing and widespread agricultural use of chemicals continue to affect our environment. Consequently, many registered chemicals have since been taken off the market when negatives of long-term use became apparent. Consumers concerned about effects of chemicals on food quality and health will increasingly demand food free of chemical residues. Science is becoming aware that one part per million or even one per billion could be one part too much for many.

To improve soils, farming methods in annual cropping are changing from intensive cultivation to minimum tillage and no-till systems as being environmentally better and with good returns. Such 'sustainable' systems, however, are empirical as they are developed without a full understanding of long term outcomes. Impact of associated intensive chemical use is the unknown factor. It is the combined and repeated impact of chemical use that affects the system – factors not tested in product registration process or long-term field research. Negative soil-related developments in these 'new' systems have already been identified in Queensland (Bell 2005). Brown (2004) formulated these phenomena as "For every action on a complex, interactive, dynamic system, there are unintended and unexpected consequences. In general, the unintended consequences are recognised later than those that are intended".

Current practices continue with the use of harsh chemicals and ignore the delicate balance of humus, microbes, trace minerals and nutrients in the soil. Such management has resulted in marked losses in soil organic carbon (including humus) and greatly reduced diversity and abundance of microbes (algae, bacteria, fungi, nematodes, protozoa) and larger organisms (*e.g.* mites, ants, beetles, worms) in the soil foodweb (see *e.g.* Ingham 2006). This exposes roots to harsh conditions, greatly diminishing the capacity of the soil to feed plants, as well as making roots more sensitive to saline and acid condition and the whole plant susceptible to pests and diseases, and requiring plants to be spoon-fed with fertilisers and protected by chemicals (Anderson 2000). Disruption of soil biological and chemical processes usually leads to physical problems, such as reduced infiltration, compaction and erosion. As a result, conventional farming is now searching for answers to increasing soil organic matter and microbial biomass (Bell 2005, Fisher 2005, Kirkby *et al.* 2006).

Ecosystem

A sustainable farming system is a complex ecosystem with non-linear dynamics that can exist in alternate stable states, each state having it's own threshold for change from one state to another. When a critical threshold is breached, recovery to a sustainable system will become difficult or impossible. For unstable farming systems to again become sustainable, we have to understand ecosystems before we can take the right remedial steps.

Sustainable ecosystems are resilient, having the capacity to absorb disturbance and re-organise over a wide range of conditions before ever reaching a critical threshold. They are characterized by many interactive components within and between scales. Adaptability and transformability are two other characteristics of how ecosystems respond to change. Adaptability is the capacity of 'actors' in the system to manage system resilience, while transformability is the capacity to become a fundamentally different system when the existing system becomes unsustainable (Resilience Alliance 2006).

The underlying strategies for moving towards sustainable farming systems are conservation of soil, water and energy resources to maximise food production. This goes back to the functioning of ecosystems, the dynamics of interactions between a community and its non-living environment. Agroecology is an approach in agricultural development which draws on modern ecological knowledge and methods. It is defined as the application of ecological concepts and principles to the design and management of sustainable agroecosystems (Gliessman, 2000).

Understanding the functioning of ecosystems requires a 'big picture' holistic approach. The knowledge of different groups in the living world and how they interact with other groups is here more important than in-depth knowledge of individual species. Studying the latter, however, and single issues in general, seems to be more popular and advanced. Unfortunately, we can't understand a system by combining available knowledge of component single issues. That is, the holistic 'whole' is not the sum of reductionist 'detail'. This also needs to be recognised in simulation modelling of systems.

Symbiosis – the balanced, mutual interdependence of different species – is a protective mechanism in nature, which develops in response to compatible needs. Self-organisation keeps natural biological systems in balance. Interactions between organisms are powerful evolutionary forces. Increased complexity and diversity of species and interactions within the soil foodweb promote balance and higher plant productivity. The whole should be considered as an integrated system being resistant and resilient to change through an abundant diversity of organisms.

Plants depend on beneficial soil organisms to protect them from pathogens, to help them obtain nutrients from the soil, and to break down toxic compounds that could inhibit growth. Soil organisms create a living, dynamic system that needs to be understood and managed properly for best plant growth. If the balance of micro-organisms is wrong, fertilisers and pesticides can't help recover plant vigour. Understanding soil health requires knowing which organisms occur, which ones are working, how many are present and whether they are the right kinds for the desired plants (Ingham 2006).

Soil health thus requires improvement of biodiversity in paddocks and catchments to enhance natural predation in a functional soil foodweb (FAO 2006). This can be achieved by doubling soil organic carbon (the foundation for a living soil), minimising use of chemicals, and the establishment of shelterbelts for improvement of soil surface microclimate and provision of a 'home' for an important part of the soil foodweb. Paddock soil then becomes resistant to change and, being resilient, is able to recover from disturbances caused by extremes in weather or management. Such soils will remain more productive with climate change as living soil organisms can adapt. It will also help slow climate change by sequestering carbon (Leu 2006a, Carbon Coalition 2006).

Further ecosystems improvement may be achieved by managing natural energies with permaculture (PRI 2006), Yeomans' Keyline Designs (Yeomans 2006) or Natural Sequence Farming (NSF 2006) to fit paddocks into a sustainable landscape. Natural Sequence Farming is a rural landscape management technique aimed at restoring natural water cycles that allow the land to flourish and be less sensitive to drought conditions (Newell 2006). This goes back to the natural balance of water cycles as pioneered by Peter Andrews (NSF 2006) in conjunction with biological farming principles.

Another strategy in the move towards sustainability and ecosystem protection is reducing the vulnerability of farming to the economic impact of diminishing oil availability (Peak Oil 2006) by decreasing its reliance on petrochemical products.

Science

Current specialisation in agricultural science has resulted in research within very narrow boundaries. This has induced linear, mechanistic thinking, which doesn't allow room for synergies, and results in confusion between cause and effect. Soils, for example, have become partitioned into separate isolated fields of chemistry, physics and biology, with further specialisation within each. Unfortunately, soil degradation and the issue of how to restore healthy soils cannot be solved with many individual research projects conducted by various specialists. It needs a big-picture approach. In nature everything is linked with everything else. These circular, web-of-life phenomena have to guide our applied field research.

Much current 'sustainability' research is fiddling at the margins of entrenched methods, working on symptoms rather than the primary cause of problems – as evidenced by appearance of new problems after implementing 'solutions. It is not simply a matter of doing better what we do. 'Best practice' locks us in status quo which is still not good enough!

If agricultural research is to deliver anything approaching sustainability, therefore, we need to change the science paradigm (Jackson 1985). Or as Dr Albert Einstein said: *"No problem will be solved with the same level of thinking that created it in the first place"*. Over generations research has become increasingly "reductionist", that is, reducing and outlining systematically the area of interest to be studied and the disciplines to be used. While this approach of fragmentation has delivered a lot of knowledge about the workings of particular crops, pastures, livestock, insect pests, chemicals, etc, focussing too intensely on closed systems with narrow boundaries – on single, isolated components of the bigger "real-world" system – means we are blind to larger cycles and patterns within which component parts exist (Stapper 2002). In this way, the biological sciences themselves fragment our understanding by creating false divisions that break the cycle of life.

New problems keep emerging as each of them are dealt with as single issues, resulting in partial solutions that don't necessarily solve the problem, for example, acidity (with lime) and salinity (with lowering ground water). Partial solutions tend to equate a single solution with the cause of the problem but lime and ground water, for example, are not always directly related with acidity (Anderson 2000) and dryland salinity (Jones 2001, 2006), respectively. Soil management related causes for dryland salinity have been derived from practical experiences in, for example, New South Wales (Wagner 2005), Victoria (Nathan 1999) and Western Australia (Paulin 2002).

Experimental results dealing with isolated individual components are thus difficult to apply to paddocks, which are complex systems in time and space. What does an 'average' mean in a paddock? Other management factors are likely to be working against the application of individual research results, thereby inhibiting change. Hence, problems continue to emerge in agricultural production systems. Science is now proposing genetic engineering as 'the' solution for many of these problems – risking yet another oversimplification in our fragmented agricultural science (Stapper 2002), a 'techno-fix' with more band-aids over the real cause of our problems – degrading soils.

The standard multi-factorial research methodology seems ill-suited to studying complex biological systems where everything is linked with everything else. To obtain functional outcomes, no factors may be considered 'constant' in trials while varying a few 'important' factors to quantify their impact. Also the boundary conditions of research objects chosen by specialists (*e.g.* pots and small plots in a growth chamber, green house or research station) are often not appropriately representative of real ecosystems (especially microclimate) and generate results not transferable to the farming-system level. Comparative analysis is needed on a commercial production scale. Questions arising from such studies then need answers through reductionist science.

New methodologies and directions of research are required in the search for resilience, to achieve reproducible and predictable outcomes in farming systems across agroecological zones. Such research needs to be planned, executed and analysed by a transdisciplinary team working across ecosystems at representative scales, that is, in agroecology (Gliessman 2000, Altieri 2006). This is to allow observation and measurement of expressions of the multitude of interacting components within and between different scales of the farming system. Plant health (Anderson 2000) and animal health (Voison 1958), for example, are dependent on availability in the right balance of minerals, but this is still regarded as 'alternative' thinking.

To reach sustainability in agriculture we have to look at the whole system and develop holistic tools within agricultural science that bring together, from across disciplines, the knowledge obtained through analytic reductionism, without getting lost in small component details of 'what single factor? – the how? and why?' Such tools are unlikely to be quantitative, hard systems, as dynamic interactions by soil organisms are too complex and too affected by small spatial and temporal changes in management and climate. Therefore, a soft systems approach is required, synthesising knowledge into management guidelines for sustainable land use combined with careful monitoring of status.

Australia's public R&D in this direction is minimal, and seems to be one of the lowest of OECD countries as was evident at the recent International Federation of Organic Agriculture Movements Congress in Adelaide (ISOFAR 2005). Nevertheless, we must search for productive agricultural systems with reduced usage of petrochemicals and energy, and not rely on 'Techno-Fantasy' to help us out. As we face a future without cheap oil, science must play a role in dealing with the profound socioeconomic change now gathering momentum around us (Heij 2006).

Management

As managers using the soils, what do we look at, what do we (want to) see? After decades of regular use of single-super phosphate some farmers and graziers stopped using it when they became aware of the detrimental impact it had on soils and trees, caused by the acidic nature of the fertiliser; use of muriate of potash (potassium chloride) has similar impact and also needs to be avoided.

We can learn to use the power of nature rather than fighting it with synthetic chemicals and unproven new technologies in a war we can't win. Organic Farming is surging and Biological Agriculture (Anderson 2000, Zimmer 2006) is emerging as a sophisticated farming system in transition between current and organic. Both benefit from reintroduction and enhancement of humic and soil biological activity, components already fundamental in Biodynamic Farming (ATTRA 2006). In contrast to the Organic standard, Biological farming allows for minimal use of the most microbe-friendly fertilisers and herbicides with humic additives and molasses or sugar to enhance effectiveness and reduce damage to microbes. This requires ever smaller quantities as the system is balancing and moving towards Organic, a process that occurs much more quickly when actively managed with biological inputs.

Management aims to balance chemistry, physics and biology in the soil aided by improved organic carbon content, appropriate mineral balance and a diverse and abundant soil life. Thus stabilising our fragile soils and creating a sponge that stores and makes available required plant foods and facilitates prolific root growth. Soil biology helps with building and maintaining soil structure to secure aeration and prevent compaction. A balanced biological soil will have the maximum levels of available minerals coinciding with maximum demand by plants.

The farming system is intended to enhance biological activity in soil and on foliage, enabling a balanced supply of required minerals for effective plant growth, providing energy to plants and grazing animals. Soils are actively re-mineralised, inoculated with soil microbes and supplied with food for microbes, all required in order to achieve and maintain an energetic balance.

Cover – With cropping and in orchards, the soil should be covered most of the time by green plants or at least stubble to protect from high temperature and water loss. A litter layer as cover will be a continuous source of carbon for soil organisms and also provide temperature insulation and water retention. Green manuring provides opportunities to convert rainfall into soil fertility.

Weeds – Weed growth is minimised with soil minerals being in balance and with lowest levels of freely available nitrogen. Mineral availability provides conditions that produce certain weeds, which can be used as an indicator of mineral deficiencies (Walters 1999). The weed spectrum changes immediately when soils are balanced using appropriate materials. For example, from stinging nettle domination (sign of calcium unavailability) one year to no nettles and some shepherd's purse as the main weed the next. This is the ecological concept of succession, with different suites of species supported on the same area of land as soil conditions change over time (see *e.g.* Ingham 2006).

Insects and diseases – Biological farming is non-pesticidal management (NPM) and uses natural techniques to prevent insect and disease damage. This is a major step ahead of integrated pest management (IPM) which aims to minimise pesticide use to prevent or delay resistance. Preventative measures are important before and after sowing but start with a healthy soil where biological activity builds internal plant resistance to diseases and insects (Callaghan 1975, Anderson 2000, Ingham 2006). Depending on the risks and size of operation, the management options are crop sequence, inter-cropping, trap crops/weeds, seed and foliage inoculation, neem and other natural repellents. Plant sap sugar content can be used as a guideline for protective sprays (see 'Tools' below).

Variety choice – Most current varieties have been selected to produce well in high-input management systems and require such treatment to perform as expected. New varieties need to be developed under organic-biological conditions to optimise production with low input on healthy soils. The first step is to evaluate 'old' varieties that were selected before nitrogen availability became a priority for plants. A variety will improve with successive seasons if the seed is retained and used again as it keeps adjusting to local soil biology.

Rhizosphere – The rhizosphere is the area of intense biological and chemical activity close to the root inhabited by soil microbes feeding off exudates from the root, thus facilitating nutrient supply to the root and protecting it from pathogens. Fertiliser applied with the seed at sowing decreases root growth, root branching and the number of root hairs. Applying microbes, humic substances and food for microbes with the seed (*ie* inoculation) generally results in a vigorous seedling with many roots, a thick rhizosphere, prolific branching and many root hairs, without the need for conventional seed-dressing. Such annual plants when pulled out of the ground at flowering still show a vigorous rhizosphere. Microbes keep colonising the roots as they grow, thus providing a continuation of that good rhizosphere. It has been demonstrated that an active rhizosphere can be created in degraded, acid or saline soils, with that neutral zone around the root allowing vigorous plant growth. Such a 'carbon pump' into the soil will improve that soil and the increasingly active soil biology will segregate negative compounds. Carbon may thus help stop dryland salinity (Jones 2006).

Inputs – The most important inputs are foods for the soil microbes, with the most effective one being carbon exudates from roots of growing plants. Maximising the time of active plant growth is therefore most important. Rotational, cell, or planned grazing (large number, small area, short time), for example, facilitates root growth and delivers more carbon to the soil than set-stock grazing. Another example is pasture-cropping where winter crops are sown into summer-active perennial pasture (Bruce 2005, Jones 2006, Seis 2006).

Residual stubble and roots are also important sources of carbon. Stubble, however, needs to be broken down to be available for soil organisms. To facilitate this if breakdown is slow, a stubble digest, containing cellulose-digesting fungi and some urea to lower the C:N ratio, can be sprayed onto slashed, spread and rolled stubble with or without incorporation. Such management decisions depend on the amount and kind of stubble, paddock history and soil biological activity – *i.e.* whether or not such bugs are already present.

Carbon can be applied as molasses, sugar, humates or brown coal (in order of decreasing availability). Humic substances, such as humus, humate, humic acid, fulvic acid and humin, are important forms of carbon for plants, playing a vital role in soil fertility and plant nutrition. Plants grown on soils which contain adequate humin, humic acid and fulvic acid are healthier and less subject to stress, and the nutritional quality of harvested foods and feeds are said to be superior (Pettit 2006).

Soil microbes, food for microbes and minerals can be applied as required by spreading, down the tube, or as foliar or soil spray with possible micronised minerals. To provide an optimum start of plant growth through the creation of a vigorous rhizosphere, the standard practice is to inoculate seed with microbes.

This can be done by tickling some 10 l/ha of microbe containing liquid on the seed at transfer from silo (needing less then 20 minutes to dry before sowing), or dripping a liquid containing microbes and minerals in the soil on the seed while sowing.

Microbes can be applied as compost tea (Ingham 2006) or as a commercial mix (*e.g.* the internationally well known 'EM' (Effective Microbes) or '4/20'). These mixes may contain free-living nitrogen fixers (e.g. Azotobacter), bacteria that establish in the litter layer and can provide 20 to 70 kg N per ha per year depending on moisture and carbon availability. Phosphorus solubilisers are another bacterial group that may be included to make available the P applied in the past and locked up in soil clays. The importance of Biodynamic preparations (*e.g.* 500, 501 Cow Pat Pit) and application (time and method) does not just rely on bacterial content, but also on their stimulation of the activity of other soil bacteria and fungi.

Other inputs can be organic in nature, such as seaweed, fish protein, guano, soft rock phosphate, lime and rock dust, or in biological farming, inorganic microbe-friendly fertilisers in small amounts, such as sulphate of ammonia, calcium nitrate or mono-ammonium phosphate (MAP). Lime is regularly applied (0.4 to 1 t per ha) for calcium to be available – a very important mineral requiring fungi for availability to roots (*e.g.* Ingham 2006).

Compost is an important and effective method for delivering carbon, organic compounds, minerals and microbes to the field as a readily available organic fertiliser. The best compost contains up to 90% of the carbon in microbial biomass, that is, bacteria, fungi, protozoa and nematodes (Ingham 2006). Compost tea can be extracted from good compost and sprayed in orchards and on broadacre crops and pasture. Vermicomposting is the process by which worms are used to convert organic materials into a highly effective humus-like material known as 'vermicast' and its effluent 'vermiculture'.

Trials – It is good to do trials on your own property to find out how things work. It is best to leave test strips on the paddocks, including a nil strip to see what would have happened if you hadn't done something. It is important to keep good records and markers in the field to be able to keep track of a treatment in one season and over subsequent years. Current yield monitors are providing grain growers with a good tool to quantify differences.

Monitoring – "*you can't manage what you don't measure*" – Monitoring of soil and plants is important to be able to see improvements when changing management, and to allow early detection of required management. It is important to monitor different paddocks and use these records to try to quantify different solutions to a problem. Monitoring is a great learning tool, especially when comparing a similar crop across different paddocks or on a given paddock over seasons. Keeping good records facilitates discussion with other landholders and advisors. For example, a Soil Health Card with recording instructions was developed by a Landcare group in the Northern Rivers region of NSW (NR 2006).

A home-made penetrometer (see tools) is the great tool to monitor progress in and between paddocks as an improving soil biology alleviates soil compaction, making soils more aerated and easier to penetrate by roots.

Pulling plants out of the soil is a test to help assess microbial activity. Naked roots usually mean a dense soil with little microbial activity. A thick soil layer stuck to roots (*i.e.* the rhizosphere) with prolific branching of the roots is an indication of a well aerated soil with active soil biology. Plants will have more solid stems, especially perennials like lucerne. Keep records of weeds as indicators of movements in soil mineral availabilities.

Smell the soils and discover the sweet smell of a healthy soil. Lab soil tests are the classic tool to get some chemistry numbers on what's in the soil. However, it is important to also assess the biological availability of essential elements and their balance, as provided by special labs. Deficiencies are relative, as productivity can be adversely affected by excess. Soil minerals can work together or be antagonistic to each other. An excess of one will create a deficiency of another.

Tools – Descriptions of home-made equipment are given with the Soil Health Card (NR 2006). A wire quadrat is used for soil cover estimates or weed/plant population densities, a penetrometer (from fence wire) to monitor hardness of soil, and an infiltrometer tube to measure rate of water infiltration.

Plant sap will reflect improvement in mineral availability and sugar content, and can be monitored in the field with a refractometer giving a brix reading, which needs to be above a crop-specific minimum to keep insects and diseases away (Anderson 2000). Increasing fussiness of the measurement line indicates increased presence of minerals (*e.g*. Calcium).

A pH-meter can provide you with information as to whether plant sap is at the healthy neutral level, meaning the soil is in balance energetically. In Biological Agriculture a pH-meter should also be used to make sure any herbicides are applied with a pH as low as 4, and with fulvic acid as additive, to greatly increase effectiveness.

Outcomes

Farms that have achieved healthy soils look and smell good, with dung beetles present in pastures and no slugs or snails in crops. Plants growing on such farms have less disease and insect damage, less frost damage (high sugar content or 'brix' in plant sap), have great root systems, and taste better. For example, canola and lucerne having no to minimal insect damage without pesticides after commencement of biological farming. Animals show the most extraordinary health (*e.g*. lack of foot rot, bloat, pink eye, mastitis), fertility (*e.g*. +25% lambing), and longevity. They need less fodder and graze for shorter periods compared with available conventional feed systems. Think of what could happen to humans if we ate such food!

Biological farming can reduce fertiliser use by up to 50% and eliminate fungicides and insecticides within three years of commencing. Such personal statements about achieved outcomes are available in company newsletters and articles in rural magazines but independent quantification is rare (Stapper 2004). Most methods haven't been proven scientifically, failures are experienced if methods or conditions are not right, and are therefore rubbished by many.

Improved soil biological activity becomes visible through the presence of earthworms and many 'creepy crawlers'. Common soil problems have been alleviated such as acidity, salinity, compaction, water logging and wind erosion (no dust behind sheep). Water-holding capacity has been improved, which shows, for example, on irrigated farms through a 2-3 day extension between irrigations. The retention of water also seems greatly improved as topsoil remains moist longer. Improved soil organic carbon manifests itself through many factors, but the overall benefit can be great. For example, one study in NSW quantified the value of soil organic carbon as $116 per one percent increase, resulting from better water holding capacity and nitrogen availability (Ringrose-Voase *et al.* 1997).

As in current systems, not all inputs are always effective. Success in biological systems depends on many factors working together. Soil organic carbon formation from roots and stubble, for example, requires not only the presence of microbes but also availability of important nutrients as the C:N:P:S ratio of organic carbon is similar across the world (Kirkby *et al*. 2006). Something can fail if a catalyst is missing. Nevertheless, when everything connects, we can get responses beyond expectation as synergies ('1+1=3') start to occur. We are, however, on the right track. An organic farmer from the UK, a Nuffield Scholar having visited the USA regularly, stated in February 2006: "*I have seen some truly exceptional farmers who are light years ahead of anything I saw in America, particularly where it really counts, in the practical application and making it work on farm.*"

Lal (2006) found that enhancing soil quality and agronomic productivity per unit area through improvement in the soil organic carbon pool will increase food production in developing countries, with numerous ancillary benefits. Adoption of recommended management practices on agricultural lands and degraded soils would improve soil quality including water holding capacity, cation exchange capacity, soil aggregation, and susceptibility to crusting and erosion.

Many have studied the impacts of farming methods on environment and food production. For example, studies have shown reduced nitrate leaching and enhanced denitrifier activity and efficiency in organically fertilised soils (Kramer *et al.* 2006). Impacts of herbicides on rhizobium survival and recovery with reductions of up to 60% in nitrogen fixation have been reported by Drew *et al.* (2006). Organic agriculture often is a proven good producer of food with yields comparable to those of conventional agriculture both in poor (Parrott and Marsden 2002) and rich (Maeder *et al*. 2002) countries. Gala (2005) and Leu (2006b) provide detailed accounts of studies from many countries.

With acquired knowledge, NPM is becoming successful in poor and rich countries in a move away from petrochemicals. India, for example, with three-quarters of farmers on less than 1.4 ha, is increasingly going back to traditional knowledge, which, combined with current knowledge and logistics, is leading to productive, profitable systems (Rupela *et al.* 2006, CSA 2006)

Organic technologies have been developed over about 6000 years to feed mankind while conserving soil, water, energy and biological resources. We are now able to increase yields for these low-input systems by using our breeding knowledge and methods to select higher yielding varieties adapted to local conditions (*e.g*. to improve harvest index). Among the benefits of organic technologies are higher soil organic matter and nitrogen, lower fossil fuel energy inputs, yields similar to those of conventional systems, and conservation of soil moisture and water resources – the latter being especially advantageous under drought conditions (Pimentel *et al*. 2005).

Cuba is the first country to develop agroecological systems nationwide – as a result of the disintegration and collapse of the Socialist Bloc and tightening of the US trade embargo which prevented access to petrochemicals. Cuba successfully turned to self-reliance, organic farming, animal traction, biofertilisers and biological pest-control, while retaining agricultural productivity – a remarkable paradigm shift (Funes *et al*. 2002).

The road to sustainability

While 'sustainable agriculture' has been defined in many ways, it is fundamentally a process of social learning, not led by a science that overemphasises production and neglects maintenance functions within agroecosystems. Hill (1998) sees this blind spot as one of a number of indicators of our undeveloped and distressed psychosocial state. Habits, perception and assumptions determine what we see and want to see, and correlation is not cause. This realisation is another aspect of the change that will be required in our paradigm – the way we learned to see the world.[2]

How do we find the road to a sustainable agriculture producing healthy food in a healthy landscape? How do we turn our 'Clean and Green' image into reality? Minerals and microbes are the key, in both soil and human health. Over the past 60 years, mineral density of foods has declined to less than half of former levels (Bergner 1997, McCance and Widdowson 2000). We need to increase it again through improved production systems, and keep it available with proper food processing, so that good nutrition returns to the way our foods are grown, processed and prepared. Real medicine must start with the patient's diet and, ultimately, the nutrition on the farm (Anderson 2000, 2004). Worthington (2001) and the Soil Association (2002) found genuine differences in nutrient content of organic and conventional crops – improvements which could be even greater if all organic crops are actively managed with microbes and minerals. Farmers and graziers need to be paid for such quality.

Active management of the soil foodweb, remineralisation, and substantial increase of soil organic carbon are essential to reaching ecologically sustainable production systems and a (less-un)sustainable agriculture. Such a system produces healthy food with good taste and structure (*i.e.* availability calcium and silica), and extended shelf-life.

Trees are important as shelterbelts in a dry, wind-swept continent. There are examples in many districts where farmers have converted a proportion (say 10%) of their property to trees and wetlands (often from say 0.5%), resulting in improved productivity through improved water use efficiency and decreased sensitivity to droughts. This will especially be the case when appropriately combined with Natural Sequence Farming (NSF 2006). Healthy, living soils will be able to adapt to a changing climate.

Organic-biological farming methods also seem promising on a landscape and catchment scale, as they result in farming systems that stimulate biodiversity, minimize the use of synthetic chemicals, stabilise the soil, and balance the hydrology, thereby reducing off-farm impacts. It is important to mix and match such systems with landscape changing initiatives such as

[2] In this context, see "Feature Resource" on p 21 of this Update.

permaculture (PRI 2006), Keyline Design (Yeomans 2006) and Natural Sequence Farming (Newell 2006) – thus increasing the knowledge intensity in farming.

In most districts today, there are properties applying sustainable practices as outlined above. These practices have been achieved with persistence by the manager – through trial and error, under financial pressure, and on fragile soils in our highly variable climate. It is now the task of science, using participatory research, to connect up these 'dots' in the landscape using appropriate concepts and principles. A typical agricultural manager is both time poor and cash poor – thereby, of necessity, readily following advise from (trusted) outsiders. Action research is needed to develop indicators that conceptualise farmer knowledge of natural resource management. This, in turn, will feed the required information-exchange networks, allowing knowledge to be transferred in time and space to achieve and maintain soil health, optimise production and minimise risk to achieving profitable farms in sustainable rural communities.

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Sustainable agriculture: what it is, what it is not, and making it pay

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In a nutshell: Modern agricultural and technology methods are presenting potentially disastrous problems to our survival. Sustainable and less problematic approaches exist, but have not been demonstrated to be profitable and practical on the large scale. Greg Donoghue's contention is that sustainability will not be achieved unless they are adopted on a broad scale, and for this to occur, they must be profitable. This article reviews the consequences of our current approach, alternative approaches including Natural Sequence Farming and Soil Foodweb, and builds the foundation for an integrated model which can demonstrate both sustainability and profitability.

Introduction

"We grow vegetables in Werribee Victoria - rich red volcanic soils, irrigation from the sewage treatment plant – it's the food bowl for Melbourne. We used to have pretty high levels of organic matter in our soils. Now our tests show we have 0% organic matter. We have to keep adding more and more fertilisers, pesticides, and herbicides, just to keep the bankers off our doorstep. We're basically just farming hydroponically." *[Victorian Vegetable Farmer, Werribee 2005]*

Nature has, for many millions of years, evolved an almost infinite variety of life forms and processes – we have discovered only some of them, and understand even fewer. Yet in our industrial age, we persist in creating machines and processes which not only ignore the incredibly intricate work of nature, but in many cases, run counter to it. We create machines which rely on resources whose supply cannot be sustained, and simultaneously ignore the only source of energy for our planet (the sun). We create agricultural systems, and produce agricultural products, which require unsustainably high volumes of fresh water, while ignoring the methods which nature have developed to maintain unimaginable biodiversity in even the most inhospitable of environments. And we insist on spoiling our own nest throughout – creating sometimes irreversible damage to our atmosphere, our soils and our waterways – again ignoring the perfect solutions which nature has evolved to constantly recycle – and expand - its biomass.

The Chemical Farming Model

In recent generations, we have developed a highly artificial chemical farming model. We find a fertile area of natural forest, and systematically remove all visible forms of life – both plant and animal. Not content with the visible biodiversity (and productivity), we also heavily till the soil, wreaking inestimable damage to the microflora and microfauna that exists in subterranean levels. We replace this biodiversity with monocultures of food species, and these monocultures thrive, at least in the short term. The outputs, however, do not keep pace with our growing populations, and we actively seek more unnatural methods of maximising productivity: synthetic fertilisers to increase production levels, and chemical insecticides and herbicides in an attempt to eliminate threats and competition to our bounty. We divert natural watercourses which have taken millions of years to develop, and we apply abnormally high levels of irrigation water to crops which are now growing thousands of miles from their endemic habitat.

Finally, we then consume the fruits of this farming system, and dump its excesses into holes in the ground (landfills) and excrete our body wastes untreated into the sea: in both instances, contributing to serious pollution problems. And all the while, we consume fossil fuels to transport our bounty over vast distances, thereby releasing copious amounts of polluting gases into the atmosphere.

This chemical model of agriculture is deceptively attractive. It increases productivity and nutrition to unprecedented levels, allowing us to feed an exponentially increasing population. But its long term effects are almost certainly catastrophic.

Worldwide, we consume more freshwater than falls on the earth as rainfall, which is only possible if we are using up freshwater reserves – clearly this cannot continue forever. The area of soils which is productive is gradually reducing every year while the population increases exponentially. Consequently, to survive, we must produce more food from smaller areas, just to keep up (or we could eat less, but that is the subject of another debate).

In Australia, we have one of the world's most difficult agricultural environments – semiarid in most parts, shallow (often near zero) topsoils, low nutrient levels and high salinity levels in subterranean soils. In the first 200 years of European occupation, Australians have reduced the fertility of much of the landscape by inappropriate farming practices, increased soil and water salinity to near catastrophic levels and reduced biodiversity by a large – but immeasurable – proportion.

Carbon levels in soils, once measuring thousands of years old, are now 2 – 3 years old – a testament to the decreasing levels of life in soils. Chemical fertilisers have been proved to harm and kill plant micro-organisms, thus eliminating the possibility of natural nutrient cycling. Combined with the application of pesticides and herbicides in an irrigated monocultural environment, such chemicals are aiding the desertification and salinisation of our once productive lands. Erosion effects – the elimination of naturally occurring flora (not to mention the microflora) has caused enormous damage to the structure of Australian soils. Together with wholesale tilling, our soils are routinely badly eroded, to the point where a serious rain season such as that experienced across Australia in the 50s may result in catastrophic removal of topsoil. Serious erosion can be readily viewed in any dryland area of Australia – ranging from minor to extreme – and the problem is worsening with all major attempts at redressing the problem being largely ineffective.

Our political and economic systems have developed such that our balance of payments [3] has been in negative territory (importing far more than we export). A significant proportion of that imbalance is the result of importing chemical fertilisers to feed our naturally poor soils. The fertilisers, while allowing for profitable crops in the short term, are contributing to the acidification and salinisation of our soils. Their excess use – in fact their very modus operandi – results in excess levels of soluble nutrients becoming available in soil, which has two effects – increased nutrient stored in subsoils, and increased nutrient loads in waterways. The former is just a waste, while the latter is the cause of untold pollution of waterways in a world with an increasing freshwater deficit.

And finally, human health

While we are feeding an unprecedented number of people, there are still significant shortcomings. Firstly, ours may be the only generation in recorded human history to not live longer than our parents – a testament to the falling food values of our diet, overeating and obesity-related illnesses in some parts of the world, and malnutrition, starvation in others. How did we get it so wrong?

The natural process

1. *There are no chemical fertilisers, pesticides or herbicides in nature.*

Organic wastes in natural forests fall to the ground where they are consumed by a plethora of micro-organisms. No-one has gone close to calculating how many species exist today, let alone what existed before human intervention, but some estimate them to be in the millions. In a complex and poorly understood web, these species interact such that one organism's by-product is another's food – and from the competitive melée that makes up our soils, nutrients and energy are constantly and sustainably returned to so-called higher plants where the process of capturing the sunlight and gases from the atmosphere results in even more life – a perfectly sustainable ecosystem, with increasing biomass. Compare this to our man-made system in which biodiversity and biomass are spiralling ever-downwards.

Biomimicry in this instance would lead us to abandon the application of excess fertilisers on our soils, and to seek to understand and apply the principles of natural, complex soil microbiology. One such approach – the Soil Food Institute [4] pioneered by Dr. Elaine Ingham – attempts to reproduce and enhance the biodiversity of soils in a specific balance whereby nutrients and energy are cycled naturally and sustainably – with similar productivity to chemical farming, but without the long term costs. Her model centres around the process of compost. In solid form, compost provides both microbes and organic material to the soil. Further, Ingham promotes the application of activated compost teas – solutions made from compost and water which is activated over a period of time in a warm, high-oxygen environment, producing a cocktail of exponential numbers of micro-organisms, in

[3] The net difference in dollar value between our imports and exports
[4] See: www.soilfoodweb.com

a harmonious balance. When applied by spraying, this activated tea introduces those micro-organisms to the soil where they create an intricate foodweb producing water-soluble nutrients which are then available to plants. This production of nutrient is both sustainable – as long as there are water, microbes and atmosphere – and completely natural. Her work has seen enormous success in practical application: elimination of chemical fertilisers, vast reductions in the use of pesticides and herbicides, and little or no loss in productivity. The net result – one which our struggling farmers will relish – is that profitability can go up, not down, by using these natural methods.

2. *There are no irrigation channels in the natural Australian landscape*

Instead, there are chains of ponds – swamps and wetlands, sometimes covering hundreds of square miles – connected only in flood times by intermittent streams. Water is retained in the landscape and does not flow unused to the ocean. Plant and animal forms have adapted to this natural sequence, and thrive in what often appears as a barren and inhospitable landscape. As plant biomass increases, the flow of water is slowed, causing water levels in the swamplands to increase, thus providing more opportunity to grow more plants – and on goes the cycle. The result – increased biomass, and increased biodiversity.

Biomimicry of this process would lead us to abandon unnatural irrigation plans, and instead focus on how water behaves naturally in the landscape. We would reintroduce extremely high levels of vegetation back to the landscape, and make a wholesale ban on killing even one more plant – the landscape needs every plant it can get, even if that plant was heretofore viewed as a weed. We would restructure our waterways such that water returned to floodplains and we would farm our floodplains in a much more intelligent way.

One such system, Natural Sequence Farming [5] has built a model on these concepts, and the results – in terms of water health, erosion prevention and rehabilitation, biodiversity and farm profitability and productivity – have been remarkable. Peter Andrews, the founder of Natural Sequence Farming, has developed a unique understanding of how water naturally behaves in the landscape. On his demonstration properties, he has built replicas of natural waterways – installing "leaky weirs" along creeks and rivers to slow the water down along its course, and allow freshwater levels to build up laterally – thus naturally irrigating the sides of the gully. The results speak for themselves – not only is erosion halted but the soil levels are actually increasing. After a rain event, Peter's properties catch and slow all running water, and the suspended soil and organic material from other properties settles in his leaky weirs. The sides of the gullies are well irrigated by the rising water levels, thus producing a green, productive oasis in an area beset by long term drought. After years of fighting bureaucracy and tradition, Peter has caught the attention of government and universities, and his model is now being researched by some of the world's best scientists.

3. *In nature, one's waste becomes another's food and is always re-used locally*

Things are used where they are produced. Everything is inter- and co-dependent, and synergies abound. Plants and animals never exist in isolation, instead they are always as part of a complex, diverse and inter-related community. Monocultures do not exist, and by-products are processed then consumed where they fall. Even an organism's by-products are exuded in such a way as to maximise the organism's benefit. Plants, for example, exude a mix of simple sugars from their roots to eliminate "wastes" – and specific micro-organisms use these to produce water-soluble nutrients which are in turn used by the plant. Everything is used, cycled and re-used in an upward spiral – with a resulting increasing biomass and biodiversity. Everything in this natural system is inter- and co-dependent, and nothing goes unused.

In our industrial, chemical model, we create foods and other products then transport them vast distances to markets, in order to participate in a market economy. The burning of fossil fuel in this process is clearly unsustainable:

[5] See: http://www.nsfarming.com/ and http://www.naturalsequencefarming.com/

a) Fossil fuel is a limited resource, and its cost will certainly increase significantly as it nears its end. Although biofuels appear to present a promising solution, at best they will provide for only a small fraction of the world's current energy needs. And when fuel crops begin to compete for space and resources with food crops, the consequences for poorer nations – which struggle to produce enough food even now - may well be fatal.
b) Burning fuels causes significant atmospheric pollution, and creates greenhouse gases which are believed to contribute to global warming.

Mimicry of the natural system in this context would see the harnessing of the benefits of local interconnectedness. Permaculture, a grass roots movement created by Holmgren and Mollison, is an example of this approach. Taking interconnectedness as a core principle, permaculture incorporates this natural phenomenon throughout its design concepts. Such designs have been applied to agriculture, horticulture, urban design and social systems – often to great effect. In Australia's cities, we see major initiatives by councils to recycle wastes from households – various recycling projects where wastes are collected by large diesel burning trucks and transported to central depots, where fossil-based energy is expended in sorting, repacking, smelting and re-transporting so that (a) the material can be reused, and (b) the use of landfill can be avoided.

Biomimicry would see the waste being reused on site, rather than transported for off-site processing. This is particularly salient in the treatment of paper and organic wastes, which in most cases, can be used on site as a garden supplement. Composting, worm farming and more recently bokashi and microbial fermentation [6] provide very simple methods for sustainably reusing resources. The more difficult challenge is to avoid the use of the "waste" materials in the first place, and this is being taken up by various organisations committed to whole-of-life manufacturing. In any event, what must happen is the return of all organic material back to the soil. Carbon, if released to the atmosphere as CO2 (where it contributes to greenhouse) is a threat to our survival. If it is returned to the soil as organic matter, it contributes to our prosperity and the planet's sustainability.

An integrated approach

What is needed is a model for agriculture that will, in fact, be adopted by a large number of agriculturalists across the world. Both Permaculture and the broader organic movement, despite their commonsense principles and local successes, have largely failed to effect significant change to industrial agricultural practices. Both 'Soil Foodweb', and 'Natural Sequence Farming' show enormous promise, but both will fail unless they are adopted on a large scale. Australia still dumps the bulk of its food waste and excrement untreated into landfill or the ocean – so even these technically successful initiatives in organic waste recycling are yet to have a meaningful impact.

None of these methods will achieve real sustainability unless they are adopted on a large scale and, for this to occur, they must be demonstrably *economically* sustainable, i.e. profitable. If engaging in sustainable practices is unprofitable, farmers and other producers will not adopt them, and only government enforcement (or, more radically, a different political system) will see them introduced.

The Glenaroua Project [7] is an attempt to demonstrate how these sustainable practices can be implemented in a profitable way. It is being established on a 40 acre property near Broadford Victoria – in an area beset with erosion, salinity and productivity problems, where most of the land is agriculturally marginal at best, and usually not in profitable production. The project will implement all of the above models, in an integrated way, as follows:

Stage 1: Farm Purpose: Apply permaculture principles and make the best, most sensible, use of the land.

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[6] See: www.eco-organics.com.au for on-site fermentation process. *[Note: This company is owned and managed by the author.]*

[7] The Glenaroua Project is managed by the author's company Eco Organics. Full details of the project can be found at: www.eco-organics.com.au by following the links to the Glenaroua Project.

Stage 2: Harnessing Water: Apply Natural Sequence principles and ensure that landscape water is prevented from causing erosion, and is instead harnessed to irrigate plants. According to Peter Andrews, this will have the bonus effect of reducing salinity in both the soil and water tables. In addition, the egress of organic material, soil and nutrients from the farm along its waterways will be eliminated, and these materials will instead be used to rebuild soils.

Stage 3: Organic Matter: Apply vast quantities of organic material. It will be sourced from off-farm in the initial stages, then grown (manure crops) as soil fertility increases. Food waste from Eco Organics and manures, composts and mulches from local composters will be used in large quantities – up to 15 tonnes per acre.

Stage 4: Natural Fertility: No chemical fertilisers, pesticides or herbicides will be applied to the property. Instead, the farm will be regularly fed with organic materials (see Stage 3) and sprayed with Activated Compost Teas to improve the biological health of the soils (numbers and diversity of microbial species). Weeds will be encouraged to grow in the poorest soils.

Stage 5: Evaluation: Measures of success will be as follows:

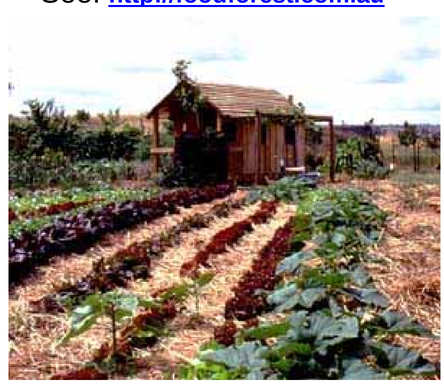
- Whole farm profitability (compared to local averages, and changes over time);
- Capital value of property (compared to local averages, and changes over time);
- Erosion levels;
- Salinity measurements (ground, groundwater, surface water);
- Biodiversity of flora and fauna (number of species, including micro-organisms); and
- Carbon sequestration (total Soil Carbon – before, after, and compared to local area).

Conclusion

Although it has served the worthwhile process of feeding an unprecedented population, our chemical industrial model of farming is clearly not sustainable. While addressing our environmental problems remains a significant challenge, the tools and solutions are available – and in many cases tested. All that is needed now is their integrated and intelligent application in a new paradigm – one where environmental sustainability can be achieved in conjunction with economic sustainability – as one cannot be had without the other. The cost of not addressing them – or not doing so in time – may be catastrophic; and not just for our own species!

Permaculture Farm – The Food Forest

See: **http://foodforest.com.au**



"Little Morsels" – Food for Thought

Downsizing the Package

We've all seen the sorts of messages on food package (such as cereal boxes) that imply that the empty space in the top of the box is only due to "contents settling in transit". Don't be fooled. I have it on good authority (from a former commercial artist employed in packaging design) that the empty space is deliberately designed in to make the package look bigger – as is the wide flat shape that maximises visibility relative to volume on the supermarket shelf. Marketing psychologists know that, regardless of the weight stated clearly on the package, larger size and bigger display will increase sales to non-discriminating consumers. Well, at last there are the first signs of a move to get rid of the "dishonesty space" in food boxes". The Canadian company Nature's Path Foods Inc., is now promoting its cereal products in smaller boxes carrying the following label:

EnviroBox – Reducing our package size by 10% lessens our yearly impact upon the earth by saving over 700,000 gal. of water, 500,000 KWh of energy, and 75 tons of paperboard.

Eco Burial - the ultimate recycling

In Update 47 (page 13) I expressed a wish for a natural burial and the hope that when my time came such a burials might be possible. Thanks to a growing number of people thinking similarly, this hope will very likely be realised (especially if I don't need to exercise it for a little while yet!). In her article "Pushing up Daisies" in the June issue of Nova magazine, Vanessa Murray reports on this trend. The following is an extract. You can read the full article at: *http://www.novamagazine.com.au/article_archive/06_06_pushingupdaisies.htm*

"Embalming corpses with a toxic mixture of chemicals, then encasing them in decay resistant coffins prior to burial or cremation, is standard practice these days. No doubt anyone who has experienced the death of a loved one will agree that we can better accept and come to terms with death by seeing, touching and spending time with the body of a loved one post-mortem. But do we really need to pump a body full of preservatives in order to make it look as life-like as possible for as long as possible?

Ironically, current post-mortem practices pose significant health risks to the living and to the environment. But things are changing. A new, ecologically sound trend in the treatment and interment of dead bodies is slowly taking root. Termed natural, eco or environmental burials, the movement represents a shift away from our social denial of the reality of death. Bodily decomposition and decay is facilitated by not embalming bodies, and burying them in a simple, biodegradable cardboard coffin or shroud. The first site in Australia was established in Hobart, Tasmania in 2003, and has been met with overwhelming interest and support, both from the local community and the Australian funeral industry.

Letting nature take its course. It seems so simple! Yet modern post-mortem practices are highly toxic. An undertaker embalms a corpse with a mixture that includes formaldehyde, a potent human carcinogen that can cause flu-like symptoms, rashes, asthma, neurological illness, and several types of cancer, and glutaraldehyde, a toxic chemical that can cause severe irritation of the eyes, nose, throat and lungs, and may induce nausea, headaches, drowsiness, and dizziness. Hospital and funeral home workers involved in embalming have a 30 per cent greater chance of catching cancer of the throat, nose or pharynx.

Today, 27 per cent of bodies are buried, and 73 per cent are cremated. Either way, it's emerging that the long-term environmental effects of prevalent post-mortem practices are lethal. It takes two to three years for embalming substances, volatile compounds known to contribute to smog, ozone depletion and global warming, to start seeping into the soil and water aquifers surrounding a cemetery. The USA alone buries 827,060 gallons (that's about 110 petrol tankers worth!) of embalming fluid per year. The UK's Environment Agency has estimated that embalmed bodies leach about 40mg of formaldehyde effluent per litre of groundwater in the first year alone. Formaldehyde above a certain level in the water supply poses a significant human health risk, and has been found to be highly toxic to aquatic life.

Cremation is no kinder on the environment. According to the EU, 12 per cent of the UK's atmospheric dioxins resulting from combustion come from crematoria. Dioxins have been linked to skin lesions and altered liver function, to impairment of the immune system, the developing nervous system, endocrine and reproductive functions, and to several types of cancer.

Bushland Burials at Kingston in Hobart offer "a simple, informal, natural, and non-traditional form of burial or ashes placement." No vaults, durable coffins and linings or embalming are permitted at the Bushland Burials site. No memorials or structures. No herbicides. No plastic flowers. No skateboarders. Just a body, treated in an ecologically friendly way, encased in a coffin made of plain or untreated pine, chipboard or heavy duty cardboard, with native plants from an approved list buried on the site. Fresh flowers are allowed on gravesites at burial time only and will be removed after one week. It's all about "enabling people to be at one with the natural environment" and "making small footprints on the bushland area", says Stephen Jacques, administrator at the Southern Regional Cemeteries Trust, which oversees Bushland Burials.

Eco burials are a relatively recent phenomenon, the latest in the green movement's increasingly feathered cap. The first natural burial site was established in the United Kingdom in 1993, and there are now more than 100 spread across the isles. Outside of the UK, Wellington in New Zealand was the first city in the world to boast its own natural cemetery, at Makara, where an ecologically sound burial is considered "an environmental donation'. Tasmania's Bushland Burials is based on the UK model, but, as Stephen Jacques is quick to point out, inherent differences between Australian and English climates and environments mean that things need to be done differently here. "We don't have the deep soils and so on that the UK has, so we pre-dig our sites to minimise impact on the bushland environment."

There are obvious parallels between the eco burial movement and other aspects of the green movement, such as organic farming and recycling. All have emerged in the latter half of the 20th century as alternatives to the intensification of human behaviour on the natural environment, and emerging evidence that our footsteps are not treading as lightly as they should to ensure that modern living is sustainable. All are movements that began local and went global, pushed forward by a dedicated core of activists, movers and shakers who want to make things happen. And all are growing and taking hold in the mainstream as people gain awareness and begin to exercise their consumer and behavioural choices. Bushland Burials and their international peers represent a new era of openness, not only towards the subject of death, but a very real way in which we can be sure to push up daisies for years to come."

Stop – think before you fly!

Ben Rose – biroses@westnet.com.au – is a Sustainability Consultant with the Carbon Neutral Program. In the following morsel, adapted from his article "Air Travel Emissions Understated" featured by the Sustainable Transport Coalition of WA, Ben sounds a warning note on our most profligate mode of transport. Original article at:
http://www.stcwa.org.au/index.php?option=com_content&task=view&id=523&Itemid=121

Only about 1/8th of Australia's actual greenhouse gas emissions from air travel are officially reported, because Kyoto greenhouse gas national inventory reporting only includes CO_2 emissions from domestic flights. International flights are not included in the inventories. Neither are other (non CO_2) aircraft emissions, which comprise an additional 100-300% of global warming potential in addition to CO_2 (International Panel on Climate Change, 2000).

Total emissions from international and domestic flights, including CO_2 and IPCC estimates of emissions of nitrous oxides and contrails amount to between 26 and 52 million tonnes. Taking the median figure, an estimated 39 million tonnes of CO_2 equivalent emissions is generated by air travel. This is more than 8 times the officially reported figure of 4.8 million tonnes, which is CO_2 only from domestic aircraft. When all emissions are accounted for, air travel by Australians amounts to a significant portion - over 6% - of Australia's total emissions from all sources. The result of the current 'under-reporting' is that the real impacts of air travel are not officially recognized by Government. Consequently, national greenhouse reduction strategies and public education campaigns ignore air travel and the level of community awareness of the impacts is low.

Australians travel, on average half as far by air as we do by car. The average distance per head of population traveled by air is about 4940 km per year (derived from ABS international and domestic travel data, 2003), compared to about 9,900 km traveled by road. (ABS, 2005). About 70% of international flights are for holidays. Air travel continues to grow due to its low cost, as there is virtually no tax on aviation turbine fuel. It is levied at a few cents per litre compared to, for example 38c/L for road transport fuels in Australia and over 80c/L in Europe. Also, there is no carbon tax or 'cap and trade' abatement scheme applying to air transport. Such carbon taxes would increase fuel prices by a further 10-15 %. It can be argued that taxes reflecting 'intangibles', including environmental, public infrastructure and health costs should be added.

This would raise the cost of jet fuel to about 50% higher than current levels. As fuel comprises about 30% of the cost of flying, fares would rise by over 15%. This together with the spiraling cost of crude oil, would increase turbine fuel prices and help to curtail the growth in air travel. While this is bad news for airlines and those who indulge in frequent overseas trips, it is an essential step that needs to be taken for greenhouse gas abatement.

As with all transport, occupancy rate (i.e. vehicle weight per passenger) is the biggest factor affecting energy intensity per passenger. Business and first class seats take up 2.4 to 3.3 times as much space as economy seats and can therfore be assumed to account for about 2.5 to 3.5 times as much GHG emissions per passenger km. Boeing 747 aircraft with 3 class seating configuration carry 270-350 passenger whereas the same aircraft can carry over 500 and up to 600 passengers in all economy seating (seating data from www.seatguru.com). So if you have to fly and want to minimize emissions go economy class, preferably on an aircraft with all economy seating with all seats occupied. Note: Passenger numbers would have little effect on fuel used by the aircraft because only about about 60 tonnes is payload (passengers, luggage and freight) compared to around 200 tonnes of fuel and the aircraft itself weighs of over 180 tonnes.

And, on the same warning note, network member Peter Fisher – pmjfisher@bigpond.com – has sent in the following morsel entitled "Warming gives travel visionaries the chills" by Patrick Barkham in The Guardian and reprinted by the Sydney Morning Herald on 6 March 2006.

THEY are the gurus of globetrotting, the visionaries who built publishing empires from their adventures and wrote guidebooks encouraging millions to venture further afield than ever before. Now the founders of the Rough Guides and the Lonely Planet books, troubled that they have helped spread a casual attitude to air travel that could trigger devastating climate change, are uniting to urge tourists to fly less.

Mark Ellingham, the creator of Rough Guides, and Tony Wheeler, who founded Lonely Planet in Australia after taking the hippie trail across Asia, want fellow travellers to "fly less and stay longer" and donate money to carbon offsetting schemes. From next month warnings will appear in all new editions of their guides about the impact of flying on global warming alongside alternative ways of reaching certain destinations.

But the two travel publishers are refusing to give up flying and admit they are not paragons of environmental virtue. Asked if he felt guilty about the hundreds of flights he has undertaken, Mr Wheeler, who lives in Melbourne, said: "Absolutely. I'm the worst example of it. I'm not going to stop but every time I jump on a plane I think, 'Oh no, I'm doing it again'."

Lonely Planet began when Mr Wheeler and his wife, Maureen, traveled from London to Australia in the 1970s, cobbling together a guide on their way. Six million copies of 600 different Lonely Planet guidebooks are sold each year, inspiring backpackers and middle-class tourists to take long flights to exotic destinations.

Both men have also pledged to donate money to the charity Climate Care to offset the carbon emissions of their 650 staff who fly around the world every year updating their travel books. The men accept it is less easy to take an alternative route to Peru, but say travellers should spend longer in one place and cut out frivolous weekend hops. Mr Ellingham added: "We want to show that two companies who are direct rivals feel this is an issue important enough to co-ordinate and co-operate on."

[These travel gurus are not the only ones calling for sanity on air travel. We are even told that the Bishop of London now says jet travel is a sin – and how can it not be a mortal sin to contribute actively to the end of the world? See "We're all headed for the fiery furnace if we go on taking these cheap flights" by Magnus Linklater in the Times online: http://www.timesonline.co.uk/newspaper/0,,172-2285559,00.html]

Personally, I can only agree whole-heartedly with this rising awareness of the unacceptable greenhouse impact of global air travel – and awareness is certainly there. In the last month, when invited to participate in a discussion panel at a Melbourne seminar on Peak Oil and Energy Future (6/9/06), I refused to drive 200 km and take a short-haul flight from Adelaide to Melbourne to do so (even at the organisers' expense). As a result, I participated by conference tele-link. When, at the invitation of the panel moderator I explained why I was participating by phone rather than in person, the audience applauded spontaneously. I have to conclude from this that many others are aware of the need to find better ways of transporting ideas around and, hopefully, the trend from here will be a change from talk to action. E.G.H.

Feedback

Can nuclear power address climate change? – Correction

John Coulter's claim on page 2 of Update 60 (28 July) that the ACF and the Business Leaders Roundtable describe nuclear generated electricity as a zero-emission technology, is incorrect. The analysis commissioned by the ACF with the BLRT did not include nuclear power in the energy mix scenarios and made no claim about nuclear power being zero emission.

The Australian Business Roundtable on Climate Change is a grouping of six of the largest Australian companies and the Australian Conservation Foundation who came together to look at what the economic impact on the Australian economy might be of cutting greenhouse gas emissions by 60% by 2050. The Roundtable asked Allen Consulting Group to do the modelling and CSIRO to look at the climate impacts on different industry sectors based different climate scenarios.

The Case for Early Action report called for Australian Governments to work with business and the community to develop a policy framework that would allow industry to respond effectively. This policy framework specifies action on three fronts:

- Designing a 'long, loud and legal' framework to establish a carbon price signal;
- Encouraging innovation and investment in emerging and breakthrough technologies; and
- Building national resilience to impacts of climate change.

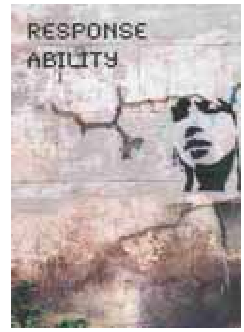
Roundtable members believe the recommendations set out in the report will create the necessary investment conditions to reduce emissions while maintaining strong economic growth. The summary analysis concluded that Australia could achieve a 60% reduction with existing technologies and that by taking early action Australia would avoid a significant economic shock. Nuclear energy did not actually appear as an option in any of the energy scenarios or in any of the reports. I invite your readers to examine this important report and its recommendations at www.businessroundtable.com.au.

Monica Richter - m.richter@acfonline.org.au - Sustainability Programs Manager
Australian Conservation Foundation (ACF) - www.acfonline.org.au/

Other Information Resources and Links of Interest

ECOS, Australia's most authoritative magazine on sustainability in the environment, industry and community is published bi-monthly by CSIRO – in print and online. See: www.publish.csiro.au/ecos.

FEATURE RESOURCE



Response Ability – New book by Frank Fisher[8]

This new book is about understanding 'the world as we know it' – that reality is socially constructed and that 'the world as we know it' is the only world that we can ever know. In our interactions with the world, especially in our conversations with other people, we literally construct 'the world as we know it' and it, in turn, constructs us, as we know us. Understanding how we socially construct our own reality is important because it is a guide to taking effective action for social change. When we reveal how real-life problems are constructed, we also reveal how to *de*-construct them. To put it another way: if we think of problems as knots, in learning how they are tied, we've untied them. In this book, author and Network member Frank Fisher takes a number of broad social and sustainability issues, such as energy, conservation, transport options and disability rights, and shows how they can be deconstructed in this way. How does deconstruction work? Take the Greenhouse effect as an example. Burning fossil fuels leads to a build-up of greenhouse gases in the atmosphere. Accordingly, an examination of how energy demand is constructed points to ways to decouple that demand from the use of fossil fuels, which would clearly be a powerful way to reduce greenhouse gas emissions. Similarly, to increase water efficiency, we might question our agricultural and eating traditions. Once we realize our needs for energy and water are socially constructed, we can see the possibilities for new alternatives. This process, rather than 'fixing' problems, dissolves them using alternative social constructs. As Professor Ian Lowe says in his foreword to the book, "The future is not somewhere we are going, but something we are creating … so we urgently need a new approach that addresses our thinking. … I welcome this book, which should be on the desk of every thinker and in the shoulder holster of every activist. We should be taking responsibility for our future; this book, as the title suggests, provides us with Response Ability. [Published 2006 by Vista Publications – vistaef@mbox.com.au – ISBN 1 876370 10 6] See details of Frank Fisher's new project "The Understandascope" at Monash University – under "Social Sustainability" below

AGRICULTURE – ORGANICS

Export markets for Australian organic produce

www.psmaff.gov.au/releases/06/06036sl.html

In this press release on the website of the Parliamentary Secretary for Agriculture, Fisheries and Forestry, organic production is flagged as one of the fastest growing sectors in the global food industry, with an estimated global market value of $38 billion a year. Data are quoted from *Export Potential for Organics — opportunities and barriers,* a new report from the Rural Industries Research and Development Corporation (RIRDC) – www.rirdc.gov.au, which identifies opportunities for Australian organic producers in a number of expanding markets. The organic market in the USA caters to nearly 145 million consumers each year, and is growing by 20 per cent annually. In the UK, three-quarters of the population of 60 million purchases organic produce each year, with a market growth of 11 per cent. There are also growing consumer markets in the EU, Hong Kong, Japan and Singapore. The organics industry also sits across the traditional sectors, like beef, lamb, broadacre grains and horticulture, as well as many of the emerging sectors. Regardless of whether one sees the future of food trade as international or local, the organics industry is a growing part of the future of farming.

CLIMATE CHANGE

Top scientist's fears for climate – BBC news article

http://news.bbc.co.uk/2/hi/science/nature/5303574.stm

In spite of the Bush Administration's attitude to the Kyoto protocol, the voices of alarm being raised in the USA are becoming more strident. In his first broadcast interview as president of the American Association for the Advancement of Science, John Holdren has stated that the climate is changing much faster than predicted, and that if the current pace of change continues, a catastrophic sea level rise of 4m (13ft) this century is within the realm of possibility; much higher than previous forecasts.

ENERGY

[8] See also previous information in Update 57, 17 March 2006, at: www.bml.csiro.au/SNnewsletters.htm

Energy's Future Beyond Carbon – Special issue of Scientific American

This dedicated issue of the popular science journal *Scientific American* contains feature articles on: A Climate Repair Manual; A Plan to Keep Carbon in Check (strategy); Fuelling our Transportation Future (automotive answers); An Efficient Solution (energy efficiency); What to do about coal (carbon capture & storage); The Nuclear Option (role for fission); The Rise of Renewable Energy (clean power); High Hopes for Hydrogen (fuel cells & more); Plan B for Energy (speculative technology). I have a PDF of the whole issue (6.5 MB), which unfortunately, thanks to its security settings, I can't divide up into single articles. However, if you have fast broadband email capability, the requisite mailbox capacity, and would like to read the whole issue, send me a message to receive it as an email attachment – Elizabeth.Heij@csiro.au

Cutting aluminium energy bills using designer solvents

www.minerals.csiro.au/main/pg2.asp?id=37878

In an age of rising energy costs, technology that can help to reduce power consumption is critical. Aluminium production accounts for about 15% of Australia's energy consumption. New joint CSIRO-industry research into ionic liquids could cut this consumption by 30%. The key to ionic liquids' power is their low melting point, compared to solvents currently used to produce aluminium from alumina. Aluminium is currently produced through electrodeposition, where the alumina is dissolved in a molten cryolite bath at 1000°C and an electric current applied to separate aluminium from oxygen. The high temperatures needed to keep the cryolite liquid consume large amounts of energy. In contrast, ionic liquids typically melt below 100°C. Used in place of molten cryolite, they could significantly reduce the energy needs of aluminium production. Aluminium processing, however, is just one of many potential applications of ionic liquids. Others are in lithium battery manufacture, gas absorption (e.g., CO2 recapture in power plants, desulfurisation of fuels, dissolving spent nuclear fuel rods, and even perfume production.

SOCIAL SUSTAINABILITY

The Understandascope at Monash University

www.understandascope.com

When he retired from a formal staff position at Monash University in 2005, sustainability thinker and teacher, Frank Fisher (see "feature Resource" above) set up *The Understandascope* (after Australian Cartoonist Michael Leunig – image on right). Following Frank's social-constructivist approach, the *Understandascope* creates static, travelling and virtual exhibitions, and courses and in-house seminars that reveal the social constructions of everyday phenomena. As the *Understandascope* home page describes it, "Social constructs are the invisible intellectual and organisational frames that shape everything that humans do. Recognising this and the explicit social constructs within which things happen facilitates a new level of responsibilty-taking and circumspection." The website provides access to a number of information resources, including a regular electronic newsletter.

SUSTAINABLE LIVING

Householders' Options to Protect the Environment (HOPE)

www.hopeaustralia.org.au & office@hopeaustralia.org.au

Help HOPE to promote sustainable living practices in your community by becoming a member of this network organisation. Membership is free and open to anyone, including individuals, families, businesses and organization. HOPE's principal focus is waste minimization and the conservation of energy and resources using three main strategies (1) raising awareness – letting people know about the issues, (2) education – suggestions on how to tackle the issues, and (3) showing – how easily it can be done. The HOPE website, Convened by Network Member Frank Ondrus, is a resource you can use in your campaign to think globally and act locally.

Calls for Input & Participation

Call for papers to contribute to a new book on the "Urban Energy Transition"

Cities represent a major share of the emerging market for efficiency and renewable energy measures and technologies - and a major challenge in the coming global energy conversion. This international book publication will focus on urban development and design in an age of climate change, mounting conventional fuel supply risks, and the transition from fossil to renewable forms of urban energy. Invited are scholarly, high-quality English-language contributions of 6,000 to 12,000 words, documenting current, previously unpublished research and findings. Images and diagrams are welcome. Publisher is Elsevier Science Publishers, Oxford; editor Peter Droege – info@wcre.info – University of Newcastle, Australia, and Asia Pacific Chair, World Council for Renewable Energy. Further information at: http://www.reeep.org/groups/urbanenergytransition. Proposals for contributions or expressions of interest can be submitted by 27 September 2006; final papers are due by 27 February 2006. Also welcome are suggestions of potential appropriate contributors. Send contributions or expressions of interest to urbanenergytransition@reeep.org.

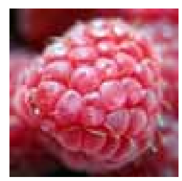
Water savings awards – the 2006 *savewater! awards*®

The call is now being made for water-saving stars to enter the 2006 Victorian savewater! awards® program, which recognises and rewards outstanding achievement in water conservation. **More information and entry details at: www.savewater.com.au**. Last year the water savings of the 21 finalists equated to ***a massive 832 Olympic sized swimming pools!*** Entries are invited in the following categories: Built Environment; Community Action; Education Programs; Garden Management; Government; Manufacturing; Primary Industries; Product Innovations; Regional Business and Service Providers. Nominations for this year's awards close on 18 October 2006 during National Water Week. Winners will be announced on 23 March 2007.

The Rolex Awards for Enterprise

The Rolex Awards are open to anyone of any age, nationality or background whose innovative project in science & medicine, technology & innovation, exploration & discovery, or environment & cultural heritage meets the programme's criteria of improving the human condition and human knowledge with originality, feasibility and the potential for real positive impact. The Prizes are biennial and entries are now open for the 2008 Awards. **Closing dates are 31 May 2007 for Asia, the Pacific and North, Central and South America; and 30 September 2007 for Europe, the Middle East and Africa. For more information see: www.rolexawards.com.**

And a big fat RASPBERRY to all of us for heading in the wrong direction with energy usage!



Data recently released by the Australian Bureau of Statistics in its report on Australian Social Trends 2006 show we are living longer, working harder **and using more energy. "Despite new homes becoming more energy efficient, Australians are using more energy per person. Average household energy consumption per person increased by 17% between 1983-84 and 2003-04."** We have to turn this trend around; so let's hope that the next survey will at least show a slowdown. *[http://www.abs.gov.au/ausstats/abs@.nsf/mf/4102.0?OpenDocument & Media Release]*

Courses in Sustainable Development

Marking the UN Decade of Education for Sustainable Development 2005-2014

ANU: SRES Intensive short courses in Eco-Innovation and Sustainable Development

Contact Janis.Birkeland@anu.edu.au or http://sres.anu.edu.au/programs/postgrad.html.

ANU: ACEL Courses in Environmental Law

A selection of courses can be taken as PD short courses or as part of a graduate degree in the Law Faculty at the Australian Centre for Environmental Law (ACEL), ANU. See: http://law.anu.edu.au/acel. Courses in Environmental Law are also taught in Melbourne. See http://law.anu.edu.au/postgraduate

Central Queensland University – Graduate courses in sustainable environmental management

Postgraduate programs in the Institute for Sustainable Regional Development and the Centre for Environmental Management: www.isrd.cqu.edu.au

Charles Sturt University

Distance Education postgraduate courses are available in: Ecotourism; Environmental Conservation; Environmental Management; Parks, Recreation & Heritage; Restoration Ecology; River Restoration &

Management; Sustainable Agriculture; and Sustainable Management. See www.csu.edu.au/courses/ and follows the links for postgraduate courses in the Faculty of Science and Agriculture; or email enquiry@csu.edu.au.

Curtin University of Technology – Courses in Sustainability Management & Cleaner Production

The Centre of Excellence in Cleaner Production offers two world-class, multidisciplinary professional Masters programs – Sustainability Management and Cleaner Production – in addition to specialized undergraduate units in sustainable production & consumption and engineering sustainable development: See http://cleanerproduction.curtin.edu.au

Flinders University of SA – Postgraduate Environmental Qualifications

A range of courses are offered towards Bachelors and Masters Degrees and Graduate Diploma and Certificate in the School of Geography, Population & Environmental Management. See: www.flinders.edu.au/courses/areas/environment.html.

International – Blekinge Institute of Technology, Sweden

Applications are open for the 2006/07 Masters of Strategic Leadership Towards Sustainability program. This is a trans-disciplinary program taught in English based on an intellectually rigorous and scientifically relevant model for systematic progress towards an attractive sustainable society. See: www.bth.se/tmslm or email sustainabilitymasters@bth.se

IWES – Short courses in water management, wastewater treatment & environmental management

www.iwes.com.au

Macquarie University, Sydney

Offers courses in Environmental Education and Sustainable Development. See www.mq.edu.au. The University also hosts ARIES, the Australian Research Institute in Education for Sustainability – See www.aries.mq.edu.au/index.htm for publications reviewing policy and practice of environmental education for sustainability. ARIES is also in process of developing an Education for Sustainability (EfS) portal at: www.aries.mq.edu.au/efsportal.htm to provide an introduction to this vital area of learning and a site where key EfS documents, programs and case studies can be posted.

Monash University: Linked Postgraduate Coursework Programs in Environment and Sustainability

Each offers opportunities for students to study electives and undertake projects in topics of special interest. [For more information contact Sharron.Pfueller@arts.monash.edu.au] (a) Master of Environment & Sustainability – www.arts.monash.edu.au/ges/postgrad/mes.html; (b) Master of International Development & Environmental Analysis – www.arts.monash.edu.au/ges/postgrad/midea.html; (c) Master of Corporate & Environmental Sustainability Management – www.arts.monash.edu.au/ges/postgrad/mcesm.html

Murdoch University – The Institute for Sustainability Technology & Policy (ISTP)

Undergraduate Degrees in Sustainable Development, Masters by Coursework Degree in Ecologically Sustainable Development, an associated Masters in City Policy, and PhD programs covering a wide variety of sustainability issues from a policy perspective. A feature of the ISTP approach is the involvement of students in practical applications of sustainability (e.g., the recently developed WA State Sustainability Strategy). See: http://www.sustainability.murdoch.edu.au/ or contact ISTP Head, Professor Peter Newman – P.Newman@murdoch.edu.au or email wwwistp@murdoch.edu.au

Permaculture Research Institute of Australia: Permaculture Design Certificate – 13-day residential courses taught by Geoff & Nadia Lawton. Adelaide: 27 November. See: www.permaculture.org.au under "Courses". Enquiries about Adelaide event to ecoresources@bigpond.com

Rangelands Australia – at the University of Queensland, Gatton Campus

Australia's only postgraduate coursework programs in Rangelands Management for land managers, government advisors and facilitators. Qualifications include a Graduate Certificate, Graduate Diploma, and Masters of Rangelands Management. For information visit www.rangelands-australia.com.au or contact rangelands@uqg.uq.edu.au or Janet Kieseker – j.kieseker@uq.edu.au

RMIT: Graduate programs in Rural & Regional Sustainability

www.rmit.edu.au (Use "Rural & regional sustainability" in the search facility.)

Swinburne University of Technology: Graduate Certificate in Sustainability

Courses developed at the National Centre for Sustainability Technology in response to industry demand for staff able to address the key sustainability challenges - www.ncsustainability.com.au/?id=courses

TNEP – The Natural Edge Project: Engineering Sustainable Solutions Program: Training materials and courses available. See www.naturaledgeproject.net/

University of Melbourne

Graduate Environmental Program 2006 – a multi-disciplinary, cross-faculty program that helps students turn their interests and concerns into practical actions for environmental sustainability, social equity and profitability. See www.environment.unimelb.edu.au or contact: query-environment@unimelb.edu.au.

University of New South Wales - Institute of Environmental Studies: Masters, Graduate Diploma & Graduate Certificate in Environmental Management, based on a sustainable development framework. Visit http://www.ies.unsw.edu.au or contact Mark Diesendorf – m.diesendorf@unsw.edu.au.

University of New South Wales - Mining Research Institute: A range of graduate diploma and certificate courses with relevant sustainability content. Contact Kim Russel – K.Russell@unsw.edu.au or visit www.mining.unsw.edu.au

University of South Australia – Institute for Sustainable Systems & Technologies (ISST)
The Institute includes the Sustainable Energy Centre, Transport Systems Centre, Agricultural Machinery Research & Design Centre, and Centre for Industrial & Applied Mathematics – See www.unisa.edu.au/isst. **Graduate Certificate in Energy Management** is offered by the Sustainable Energy Centre - Contact Wasim.Saman@unisa.edu.au.

University of Sydney – Orange Campus – Postgraduate courses in Sustainable Management
Degrees, diplomas and certificates in Sustainable Management & Sustainable Agriculture:; and www.orange.usyd.edu.au

University of Western Australia: Fully online Graduate Certificate in NRM Policy & Planning –. Especially suited to people in rural and regional areas. Examines key issues, institutions and policies for NRM in Australia as well as local and regional NRM planning. Contact ird@fnas.uwa.edu.au or Ph: (08) 9842 0808.

Conferences, Workshops & Events

Water Conferences listed by the International Water Association (IWA): See: www.iwahq.org under "Events"

Conferences and courses listed by the Australian Centre for Groundwater Studies
See: www.groundwater.com.au/ or http://groundwater.com.au/conferences.html

International Events listed by the Forum for Science & Innovation for Sustainable Development See: http://sustsci.aaas.org/event.html

Corporate Social Responsibility – Workshops and Conferences listed by ACCSR
See: www.accsr.com.au

Crisis? What Crisis? Are we fiddling while Rome burns? Waste & Recycle 2006 Conference
Fremantle WA, 19-22 September. www.wasteandrecycle.com.au

EcoSTEPS Sustainability Workshop
Sydney, 21 September. www.ecosteps.com.au

10th International Conference on Wetland Systems for Water Pollution Control
Lisbon, Portugal, 23-29 September. www.wetconf10.adp.pt/

3rd International Conference & Exhibition on Ballast Water Management (ICBWM 2006)
Singapore, 25-26 September. Info from kTan@ntu.edu.sg & also check www.visitsingapore.com

Innovations in Coping with Water & Climate Related Risks – IWA Conference
Amsterdam, Netherlands, 25-27 September. www.moorga.com/Climate%20Change/Conference3.htm

Sustainability Expo – Baulkham Hills Shire Council
Castle Hill, Sydney, 13-14 October. Info from Lisa Kennedy at: lkennedy@bhsc.nsw.gov.au

Walk 21 – the 7th International Conference on Walking & Liveable Communities
Melbourne, 23-25 October. www.melbournewalk21.com.au

Water Pricing – Re-assessing the true price of water in Australia
Sydney, 24-26 October. www.iir.com.au/resources

1st International Symposium on Water & Wastewater Technologies in Ancient Civilisations
Crete, Greece, 28-30 October. www.nagref.gr/Symposium/

Marine Wastewater Discharges and Coastal Environment
Turkey, 6-10 November. www.mwwd.org

15th NSW Coastal Conference
Coffs Harbour, 8-9 November. www.coastalconference2006.com/

Building performance simulation in achieving a sustainable built environment – IBPSA Australasia 2006
Adelaide, 20-21 November. www.adelaide.edu.au/ibpsa2006

5th Australian Conference on Life Cycle Assessment
Melbourne, 22-24 November. www.alcas.asn.au/lca_conf/

Challenges for architectural science in changing climates – ANZAScA 2006
Adelaide, 22-25 November. www.adelaide.edu.au/anzasca2006

Sustainable Materials in the Built Environment – AASMIC Conference
Melbourne, 18-20 February 2007. www.materialsaustralia.com.au/SMB2007

Ozwater Convention & Exhibition 2007
Sydney, 4-8 March 2007. www.awaozwater.net/o7/

6th Int. Conf. on Sustainable Technologies & Strategies in Urban Water Management – Novatech 2007
Lyon, France, 25-28 June 2007. www.novatech.graie.org/a_index.htm

2nd IWA-ASPIRE (Asia Pacific Regional Group Conference & Exhibition)
Perth, 28 October – 1 November 2007. www.awa.asn.au/events/aspire

And Finally – Notes and Reminders

Our web site at www.bml.csiro.au/sustnet.htm has CSIRO's "P@NOPTIC" search facility installed – and also features short content summaries for archived newsletters.

The *SustNet* website is maintained by Trudi Prideaux at CSIRO's Black Mountain Library – Comments and suggestions welcome. Contact Trudi at Trudi.Prideaux@csiro.au.

- **To SUBSCRIBE to the Sustainability Network, visit www.bml.csiro.au/SNabout.htm or send me an email request: Elizabeth.Heij@csiro.au**
- **To find back issues of Sustainability Network newsletters directly, go to our web archive at: www.bml.csiro.au/SNnewsletters.htm**
- **Pass it on!** The Sustainability Network is intended to be inclusive rather than exclusive. If you know someone who might be interested in this newsletter, by all means forward it to them or give them our web address.
- **Want to make contact with scientists?** If you can see an application for the science featured in these newsletters and need to contact the scientists involved, let me know by email.
- **Want to see a particular area of sustainability science featured?** If there is a particular area of sustainability-related science that you would like to see featured as a "spot" in a future newsletter, send me an email or call me by phone to discuss it.
- **Give me your feedback.** I am interested in your comments as to whether these newsletters are interesting, useful, and pitched at the right level for your particular purposes. Do you have suggestions? Thanks to all those who have already sent in comments and alerts.

Sincerely,

Elizabeth Heij

Network Facilitator

Network Milestone:

Our Sustainability Network has over 12 hundred members.

Parting Shot

Political cycles are far too short for effective focus on the large, long-term issues of sustainability.

Cartoon by Nicholson in the Australian (2/9/06)