WASTE REUSE STRATEGIES FOR RURAL DEVELOPMENT AND SUSTAINABILITY

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National Centre for Engineering in Agriculture
University of Southern Queensland
Toowoomba

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APPENDIX J

Proceedings of the AGWISE Forum
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Welcome to the AGWISE Organic Waste Forum. The organising committee is confident that these two days will see a synergy between participants, which will foster a better understanding of the opportunities, which exist in the efficient management of organic waste resources.

AGWISE is a Natural Heritage Trust-funded Project being conducted jointly by the following:

- Eastern Downs Regional Organisation of Councils (EDROC)
- National Centre for Engineering in Agriculture (NCEA)
- Department of Natural Resources (DNR)
- Department of Primary Industries (DPI)
- Environmental Protection Agency (EPA) (formerly the Department of Environment and Heritage)
- Department of Communication, Information, Local Government and Planning (DCILGP)

The Project has two primary goals:

- To provide a basis for planning for new and expanding intensive animal industries (which include pig-ferries, poultry farms, feedlots and dairies) within the Eastern Downs Region
- To develop viable organic waste re-use strategies within the Queensland Murray-Darling Basin.

The Project commenced in December 1997 and will run until mid-2000. During the three years, there will be two distinct but interrelated projects, one building upon the other.

The first Project will involve the mapping of intensive animal and other organic waste producing industries in the Eastern Downs region, commencing with a sub-catchment pilot study. Rather than being based upon Shire boundaries, the analysis of social and environmental issues will be examined on a catchment basis.

The second Project will incorporate findings from the first Project and study their implications for properly integrated by-product, or waste re-use, strategies.

Apart from increasing human population, the Darling Downs (particularly the Eastern sector) is currently facing other major challenges. These include increasing numbers of intensive animal and other organic waste producing industries and more critically, a severe lack of hard scientific data on the potential impact these industries may have on our way of life and our environment.

Being significant employers, intensive agricultural industries are vital components of the economic fabric of our region and our way of life. They also produce significant amounts of organic waste which is potentially re-usable. Other sources of organic waste in the region include cotton trash, timber mills, defective fruits and abattoirs and whilst waste treatment options are currently available, the feasibility of employing these is often limited by cost and the availability of markets for the end products.
The AGWISE Project will actively demonstrate viable waste re-use alternatives to primary producers and will gather the hard evidence and scientific facts on intensive agricultural and other industries to enable effective future planning and to ensure the ecological sustainability of these kinds of activities. Research findings stemming from the Project will not only be incorporated into the regional Local Government statutory planning process but will also have national and international implications.

AGWISE aims to give all of us certainty, confidence and understanding of how we can all work and live together in regional Australia whilst at the same time, protecting and enhancing our vast array of natural resources for future generations.

Bruce Green
Chair - AGWISE Project Management Committee
AGWISE Organic Waste Forum:
A Dollar Made or a Dollar Paid?

Program

Monday 20 September 1999

7:30am - 8:45am Registration

8:45am - 9:00am Opening address:
*Professor Peter Swannell, Vice Chancellor, USQ*

9:00am - 9:05am Housekeeping

**9:05am - 10:30am SESSION 1:**
Setting the scene: The environment in which rural industries operate. (Chaired by Matthew Durack).

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<td>Bruce Green</td>
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<td>9:30am - 9:50am</td>
<td>Imogen Zethoven:</td>
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<td>9:50am - 10:10am</td>
<td>Ted Gardner/</td>
<td>Community amenity issues and public health considerations for IAI and IPI</td>
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**11:05am - 12:30pm SESSION 2:**
Duty of Care implications for on-site and off-site waste processing and re-use. (Chaired by Ken Casey).

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<td>Bobbie Brazil</td>
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<td>Michael Dart</td>
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Planning and developing strategies for on-site vs off-site processing and re-use.  
(Chaired by John Hasted).

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### 3:35pm - 5:00pm SESSION 4:
On-site processing and re-use in practice.  
(Chaired by Mike Spence).

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| 3:35pm - 3:55pm | Kevin Roberts, Greg M’Veigh         | Advantages and Disadvantages in Processing Waste On-site before Re-use  
A Case-study of Feedlot Manure, Cotton Trash and Cotton Production |
| 3:55pm - 4:15pm | John Cowley/ Dominic Xavier         | An Alternative to Anaerobic Ponds for the Treatment of Dairy Waste    |
| 4:15pm - 4:35pm | Evan Stacey                         | On-site Food Processing and Waste Re-use Strategies                   |
| 4:35pm - 5:00pm | Plenary session                      | questions/comments from the floor to the panel.                      |

6:30pm -7:30pm  
**Pre-dinner drinks at USQ Refectory, courtesy of Gadens Lawyers, Brisbane**

**Forum dinner at USQ Refectory, with drinks courtesy of Thiess Environmental Services Pty Ltd.**

7:30pm  
**After dinner speaker:** Dr Brian Roberts, Natural Resource Scientist with Sinclair Knight Merz (previously Dean, School of Applied Science and Head, Land Use Study Centre, USQ).
Tuesday 21 September 1999

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<td>8:40am-10:30am</td>
<td>SESSION 5: Off-site processing and re-use in practice. (Chaired by Ed Power).</td>
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<td>8:40am - 9:00am</td>
<td>Manuel MacDiarmid Composting for the Nursery and Landscape Industries: Limitations and Opportunities</td>
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<td>Carol Holden Changing the Image: Process Definition in the Mushroom Industry and the Mushroom Growers’ Code of Practice</td>
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<td>9:20am - 9:40am</td>
<td>Rex Corsi The Economics of Vermicomposting as a Viable Waste Processing Industry</td>
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<td>John M’Veigh Darling Downs Vision 2000 Wastewater Re-use Project</td>
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<td>Bruce Green Comments on the workshop presentations and plenaries re the economic perspective.</td>
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<td>Sarah Moles Comments on the workshop presentations and plenaries re the environmental perspective.</td>
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<td>Ted Gardner/ Pat Blackall Comments on the workshop presentations and plenaries re the community amenity and public health perspective.</td>
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<td>12:05pm - 12:30pm</td>
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1:30pm-6:00pm **FIELD TRIPS** – (Very kindly sponsored by GL Palm Equipment, BR Reeve Engineering & Dowmus Resource Recovery Pty Ltd.) Visits to a Dowmus biolytic filter/ponded pasture treatment system at a dairy (Allora) and co-composting, eco-shelters & cadaver composting at a piggery (Nobby). Included will be a display of the FAN Slurry Separator and discussion on the working and maintenance of effluent pumps.
Christoph Donges was a German immigrant farmer. Like many of his countrymen he came to the Darling Downs in quest of good quality land. Back in the late 19th Century the land where this beautiful University is now situated was part of the Middle Ridge farming community. Many of the farmers were also German immigrants and traditionally mixed cropping farmers. In fact, the land on which we are now comfortably seated was part of the Donges farm which was called “The Lake Farm”. Jacob Donges, one of Christoph’s sons, was also a serious historian and he left us very detailed accounts of traditional farming folkways on Middle Ridge (see Donges 1997).

In those days Darling Downs selectors had farm holdings ranging from 20 to 100 acres (on average 80 acres). Each farm was virtually self-sustaining, producing grains, fruit, vegetables and fodder. All farms had their pigs, chooks and a number of milking cows – in fact many of these settlers were totally self sufficient and their total diet was derived from the farm. This “traditional” farm-type was the result of hundreds of years of European experience and also a necessity where family size often included more than 15 offspring. Prior to mechanisation, the large family size provided all on-farm manual labour requirements – perhaps with the exception of threshing time, when neighbours would also “pitch in”.

What happened with the animal by-products from these small intensive farms? I’ve interviewed many older farmers from this region and all tell me that on Middle Ridge (at least) they, and their forebears, fully utilized the animal wastes on the farm. In those days inorganic fertilizers were unheard of and all animal manure (and associated wastes) were spread on the farm to enhance soil fertility. The animal and plant by-products were not regarded as a “waste” but were a valued commodity to enhance farm sustainability. In fact, there is an old German-Queensland saying which goes “Meine Schwein scheiss ist mein geld.” (My pig manure is my gold).

How times have changed! Today on the Darling Downs there would only be a small proportion of farmers operating this “traditional” style farming operation. The era of specialisation arrived from the 1930’s onwards and during more than a half century since then many of the mixed farms have disappeared. The farms that will take our region into the new millenium are heavily specialized – whether in the cropping, vegetable or animal array. Piggeries, feedlots, poultry units and even dairies now contain massive animal populations – a far cry from the farm with a few house cows and the fifteen pigs! For instance some of the milking herds on the eastern Downs are in the order of 150 to 300 cows, whereas in the past a herd of 100 cows would have been considered large. Times have changed and so has the scale of operations. To illustrate the scale of these industries, I offer the following snapshot of the eastern Darling Downs region:
TABLE 1 - Estimated numbers of Animals on the Eastern Darling Downs (EDROC) Region

(* Estimates of animal numbers are derived from the AGWISE database [July 1999] and are based on calculations of Standard Pig Units, Standard Beef Units, poultry numbers and number of mature cows in dairy herds)

Although only an estimate, or a snapshot from July 1999, the figure of 1,867,000 animals for the eastern Darling Downs region is significant. In the same region, by contrast, the human population estimate (from 1996 ABS figures) was 164,870. In simple terms there is a ratio of about ten animals for every person! As we all know, animals (including humans) produce by-products (eg. manure) and if you undertook a few simple mathematical calculations you could estimate the tonnage of manure produced for the eastern Downs. Displayed below in Table (2) are estimates of annual manure production from the Intensive Animal Industry sector on the eastern Darling Downs. Although the figures are only estimates they illustrate that we are dealing with nearly two millions tonnes of manure per annum.

TABLE 2 - Estimated Animal Manure Production Within The Eastern Darling Downs Region

(* Estimates of manure volumes derived from AGWISE database in July 1999)

Of course in the traditional mixed farming systems of late last century animal by-products were able to be utilised on-farm – as the volume produced was capable of being absorbed by the system. However, with the increase in farming specialisation and the paradigm shift of “mixed farm” to “industry” (eg. intensive piggeries, feedlots, poultry units with many animals), relying on the import of food resources from external sources, the potential for the accumulation of large volumes of animal by-products is forever with us.

With the shift in farming systems from traditional “mixed” to “industrial specialised”, comes the big question of how we cope with the large volumes of these organic by-products. This is where the interactions and synergies of our Organic Waste Forum can highlight the challenges and opportunities that confront us. The time has come to do away with the word “waste” in the context of animal organic by-products. It is far more appropriate to treat the outputs as a “resource” – utilised or not fully utilised. During the coming two days we will explore topics such as Duty of Care, On-Site versus Off-Site Processing and Re-use and the Economics of On-Site and Off-Site Processing. By the end of the Forum we should have a much clearer perspective on the challenges and opportunities that our large rural industries now present us with. By the way, one of my perhaps simplistic views is that animal wastes in our region could well be used to replace much usage of inorganic fertilizers on the Downs in the future. Whether organic products could be used on such a broad scale is a topic I hope will be explored in this forum.
That would certainly bring about the paradigm shift of “waste” to valuable “resource”. I’m sure many of us will go away from this Forum with the thought of “why didn’t we all think of this 20 years ago!”

Like the early settlers of Middle Ridge, the challenges confront us, but the opportunities for enhancing the sustainability of our region are waiting to be uncovered.

The Natural Heritage Trust (NHT)-funded AGWISE Project, of which you will be made aware throughout the following sessions, is totally committed to developing and demonstrating practical methods for our region to deal with organic waste by-products.

If the only result of this Organic Waste Forum “A Dollar Made Or A Dollar Paid” were to dispel the myth that animal manures are a waste, and further enforce the growing perception that no longer can we call organic by-products a “waste” but a “resource” – then I feel we shall have had a most successful forum.

References

Setting the Scene

Councillor Bruce Green  
Chair - AGWISE Project Management Committee  
Mayor of Warwick

“AGWISE” is the snappy, catchy title being used for the very important project “Waste Re-use Strategies and Decision Support Systems for Rural Development and Sustainability.”

You can see why we needed a short title.

Over the course of the Forum - “A Dollar Made or a Dollar Paid”, you will learn that AGWISE is a Commonwealth funded project under the ‘National Heritage Trust’, funds directed to projects which support the environment and ecologically sustainable development.

AGWISE was an initiative of our Local Government organisation in our region – EDROC (Eastern Downs Regional Organisation of Councils Inc.). The actual conduct of the project is a collaboration between Qld Government, State Government Departments, the University of Southern Queensland through its National Centre for Engineering in Australia and Local Government.

You will get to understand how all these participants are working together and what has resulted. At the outset it is important to set the scene.

I guess I have this job as I have experience and an understanding of the issues. As a farmer, of crops, dairy, small crops and particularly pigs, I know about the imperatives of farming operations. I am Mayor of a Local Government area that is about to have established Queensland’s largest intensive piggery (Danpork). We want to encourage and expand our dairy, feedlot and piggery and poultry industries as well as agriculture, so we need some science to help us make the right decisions.

How do we as a Local Government (really, that is the community), provide for and guarantee the establishment and continuation of these IAI (Intensive Animal Industries)? We know that what we do will have to be sustainable. We know that what we do will be heavily scrutinised and we understand our responsibility in identifying today’s problems, and the “state of the region” if you like.

It seems to me in this life of uncertainty that there are at least two things certain:-

One - food and fibre production will be a feature of this district into the foreseeable future;

Two - pressures will increase for us to leave the world in at least as good a state in which we find it.
On the first certainty:

This rich farming district, close to markets, close to labour sources with pleasant lifestyle features and good climate will be used for Intensive Animal Industries. World demand for high quality food will continue. We will be exporting food from this region. As quality demands increase there will be increased focus put on residues and contaminates, Intensive Animal Industries will be regarded as the preferred method of production due to production methods where inputs can be controlled. This will be done for economic reasons as well.

Intensive Animal Industries control to some extent the environment (temperature, airflow quality), they control the inputs – feed and water. They control disease and can maintain SPF (specific pathogen free) herds giving productivity increases and lowering vaccinations and medications.

As the world demand for clean, green food increases, this region will be used more and more for this production. Controlled environments, genetics, feed inputs and animal welfare will be needed to produce and guarantee the wholesomeness of animal proteins: - meat, eggs, milk.

On the second certainty:

We will be required to do the right thing.

With IAI’s we concentrate nutrients onto one enterprise. Gone are the days of a balanced system on the farm. Very large quantities of nitrogen, carbon, salt, sodium, potassium and so on will be concentrated on one site. It won’t be possible to dispose of or handle all of the residues of those inputs on the production property. Export of those nutrients will be required off the farm. Most will go as animal production, some will go as gas, and some will be exported in other forms, eg. plant material, castings, compacts and so on.

It is the need to understand this imbalance and how to handle the concentrations that will exercise our minds over the next few days.

But AGWISE is broader than IAI’s. It is about any organic waste producers and how we manage their waste. The timber industry, cotton processing, horticulture and grazing all contribute to organic waste production.

Local Government needs a prosperous and progressive rural economy to build our communities. Local Government needs a decision-making framework that will give it a sound basis to assist the growth of production and processing industries. The whole community needs assurance that our activities are sustainable and not short-lived or putting our fragile environment under undue pressure.

AGWISE gives us a tool in planning for better futures. We need IAI’s, we need development. We will be used to grow food for ourselves and the rest of the world, and if we are to survive as a race, we will need to continue to do that for a very long time. I welcome the focus of the AGWISE program. It is about turning our dollar paid on organic waste into a dollar made from organic waste, and doing it on and on.
The Need for Compatibility between Intensive Animal Industry and Intensive Plant Industry Production Methods and the Environment

Imogen Zethoven
Coordinator - Queensland Conservation Council

The Queensland Conservation Council (QCC) has traditionally had a strong focus on rural environmental issues. This simply reflects the fact that agriculture and pastoralism have had enormous impacts on the Australian environment, far greater than any other industry sector.

Two issues are of most concern to QCC.

The first is the broadscale clearance of native vegetation.

Certainly, clearing in the Queensland Murray Darling Basin is of great concern and not just to the environment movement. Latest figures on land clearing show that the Condamine-Culgoa catchment has the highest clearing rate of any catchment in Queensland – by a very wide margin. On a catchment basis, twenty five per cent of the state’s clearing occurred in the Condamine-Culgoa between 1995 and 1997.

This is a shocking situation, especially considering the health of the Murray Darling downstream of the Qld/NSW border.

The second issue is the health of our rivers and the effects of dams and weirs on our river systems. We remain concerned about the Government’s dam building program and see our role as highlighting the impacts of dams and weirs on the environment. These are considerable. However we strongly support the government’s program of water management planning. We believe this is essential to ensure the protection of our rivers into the future.

Apart from these two key issues, QCC has a general interest in sustainable agriculture such as catchment management planning; the offsite impacts of chemical usage; greenhouse emissions from the agricultural sector; genetically modified organisms; and waste and effluent issues.

We have an interest at all environmental levels – the landscape, the population, the species and the genetic level, or, looking at it differently, the regional, the catchment and the property level.

Although we don’t articulate it very often, most conservationists have a broad vision of sustainable agriculture. Most would agree that ideally the farm system should be in equilibrium. Energy flows, carbon, nitrogen and water cycles and nutrient flows should all be in balance. For example, nutrients entering the system should balance nutrients being removed from the system. There should be a balance of inputs and outputs.

This may seem utopian in the face of outside influences such as the global market that can have a profound impact on the farm system through fluctuations in commodity prices. Of equal impact could be a drought, fire or flood. The health and resilience of the system can be measured on the capacity of the system to return to a state of equilibrium, after such shocks or periods of stress.
The sustainable farmer protects the farm’s natural capital – the soil, water and biodiversity. It would be inefficient to run down natural capital, as the inheritance of future generations of farmers would be diminished.

As Australian farmers know, it is important and financially smart to be efficient. And that means efficient with natural resources as well. The scientific evidence is mounting that the current level of income from agriculture is unsustainable because it is occurring at the expense of the health of our rivers, coastal ecosystems and biodiversity. This is a signal of inefficiency, of mining rather than preserving the natural capital on which we all depend.

Regulatory and market failure are major contributors to this problem. Regulatory failure exists because there is no underpinning regulatory system in Queensland in regard to broadscale agriculture.

Although the Environmental Protection Act provides for a general environmental duty of care, it does not establish a licensing system for agriculture, except in the case of intensive industries such as feed lotting, piggeries and poultry. QCC believes that all primary industries need to be brought into the regulatory system if we are to ensure minimum standards for natural resources management across the state.

We have argued at other forums for the development of an Environmental Protection Policy for agriculture, which establishes a regulatory framework for the assessment, approval, monitoring and auditing of agricultural industries. Other sectors have to meet much more stringent standards than agriculture, even though they are responsible for less environmental damage than agriculture. We’re on about an equal level of environmental protection regardless of the industry sector.

I hope the audience here today would welcome this, as intensive animal industries already fall within the licensing system, and therefore must comply with environmental conditions. Intensive plant industries, such as cotton, cane and most horticulture lie outside the system. We believe this is inappropriate, defies logic and sound science and only occurred because of politics, not good policy. Given the impact of these industries on surrounding or downstream environments, they must be made more accountable to the community via the Parliament.

Market failure occurs consistently with the environment because it is either difficult or impossible to impose a market price on a non-tradable natural asset, and because usually there is no market for the environment in its natural state (other than the tourism industry). People may be asked how much they are willing to pay to preserve a species, but there is no avenue for them to express their willingness in the marketplace, where it counts. The market only recognises market signals, being the self-obsessed beast that it is.

Market failure can also occur when there is a lack of information. This could be the case when a perceived waste product could be turned into a valuable resource, if only there was sufficient information available to facilitate this. I understand that the AGWISE project “Waste Re-Use Strategies and Decision Support Systems for Rural Development and Sustainability” is aimed at filling crucial information gaps in order to turn waste from Intensive Animal Industries (IAIs) into a valuable product.

There is no doubt that the ideal balance of inputs and outputs which I described earlier is more difficult for modern intensive agricultural industries to achieve, than it is for cropping or grazing industries. Intensive industries are less robust because they are have imposed a higher level of modification on the environment.
However, equilibrium is still possible. It’s just that it might need to be achieved at a catchment or subcatchment level, rather than a property level.

This is because a catchment may contain a mix of intensive and cropping industries that could become interdependent with each other, in a positive sense. Instead of the IAI operation working independently of the cropping enterprise down the track, with one having a waste problem and the other having a fertiliser need, the two enterprises could work together to find local solutions to local problems.

The biggest environmental problem caused by IAI industries is waste and effluent. The risks of nitrogen and phosphorus pollution leaching into our creeks and river systems is high. There has already been sufficient scientific monitoring of the Great Barrier Reef, for example, to know that N and P pollution has been responsible for the degradation of much of the inner reef lagoon.

In inland rivers, it is well known that high levels of P, combined with reduced environmental flows, result in extensive and frequent blooms of toxic blue-green algae (Federal State of Environment Report, 1996). These blooms can have very damaging impacts on aquatic flora and fauna and affect the potability of water for livestock and people.

I would expect that everyone here today would agree that the best solution to this problem is not to invest in increasingly more expensive water treatment plants to deal with the cocktail of nutrients, organic matter and bacteria produced by IAI; but to invest in removing the problem of nutrient escape in the first place.

Clearly, it is in the farmer’s interest to prevent environmental harm. Especially as the market for Australian produce is becoming more and more sophisticated in its knowledge of products that cause harm to the environment. The trend is for people to become more aware and selective about what they buy. Consumer action speaks very loudly. So it makes dollar sense to avoid harming the environment.

Conservationists are wary of the call by primary industry leaders of the need to develop a “clean green image”. We want more than the image to be clean and green! We often hear industry say that we’re clean and green now, when we clear more forests and woodlands than any other western nation, and have the biggest dam building program of any western nation. I think we have some way to go.

I congratulate the Queensland Dairy farmers Organisation (QDO) for acknowledging in their Environmental Guidelines “consideration should be given to the belief that pollution is a resource in the wrong place”. The QDO Guidelines provide considerable guidance to farmers about effluent management. But obviously the Guidelines are not a business plan for making a profit out of waste. Hopefully, the Forum today will provide more guidance in that respect.
In order to achieve compatibility between IAI and IPI production methods and the environment, there would have to be negligible levels of risk of environmental harm. Achieving this would involve:

- A coordinated information base, including an inventory of existing and projected IAIIs and IPIs in a catchment, data on existing water quality, regulations, guidelines and local planning constraints, and so forth;
- A risk assessment of environmental harm if current practices continue;
- An assessment of world’s best practice, looking at management methods in Europe and North America;
- The production of GIS maps and decision support systems (which I understand is already underway);
- Active government support for the development of catchment or subcatchment markets for valuable waste products;
- An accreditation scheme that recognises businesses that turn waste into valuable commodities;
- A mentoring program so that those at the forefront of change can assist others;
- Increased resourcing for the Environmental Protection Agency to ensure it carries out effective environmental monitoring and auditing;
- Public reporting of the results of EPA monitoring and auditing on an industry by industry basis.

With these kinds of reforms, providing a mix of incentives and public accountability, the risk of environmental harm would be considerably lower. We would be well on the way to managing our environment in a way that looks after it for future generations and for the other species that share it with us.

I congratulate the organisers of this Forum for what promises to be a very positive two days.
Community Amenity Issues and Public Health Considerations for Intensive Animal Industries and Intensive Plant Industries

Pat Blackall* and Ted Gardner**
*Queensland Department of Primary Industries, Australasian Pig Institute, Animal Research Institute, Yeerongpilly, Queensland, 4105
**Queensland Department of Natural Resources, Resource Sciences Centre, Indooroopilly, Queensland 4068

There has been considerable research into the nutrient aspects of the recycling of waste materials from intensive animal and plant industries. However, to date, there has been little research into the public health risks associated with waste re-use. In response to this lack of knowledge, we have developed a collaborative Department of Primary Industries and Department of Natural Resources research program. In this program, we use the technique of Quantitative Microbial Risk Assessment (QMRA) to assess the health risks associated with waste recycling.

In this paper, we review some of the pathogens that are of public health concern with the intensive pig and poultry industries. In considering the pathogens of potential interest, we have excluded exotic agents such as avian influenza or the recently described Nipah virus of pigs in Malaysia. Our work is concentrating on the pathogens that are likely to be present in the waste of normally functioning pig and poultry operations.

A range of pathogens is potentially present in piggery effluent. Some of these organisms are pathogens of humans, others of pigs and yet others of pigs and humans. For this paper, we will concentrate on those organisms that are pathogens of humans. The pathogens that are of prime interest as follows:- Campylobacter coli/jejuni, Escherichia coli, Erysipelothrix rhusiopathiae, Leptospira spp., Salmonella spp., Serpulina pilosicoli and Rotavirus.

The list of possible important pathogens that are a potential health risk from the waste of intensive poultry operations closely resembles that for pigs. As meat chicken production involves litter, there is a longer list of pathogens for poultry waste:- Campylobacter coli/jejuni, Chlamydia psittaci, Clostridium spp., Escherichia coli, Erysipelothrix rhusiopathiae, Pasteurella spp., Salmonella spp. and Serpulina pilosicoli.

Our research program is focusing on the use of Quantitative Microbial Risk Assessment (QMRA) as a means of providing a solid basis of information on the actual level of risks posed by various pathogens in the waste associated with IAs. QMRA consists of a 4 stage process – hazard identification (see above list of pathogens), dose response (how many organisms are needed to cause illness in 50% of people), likely ingested dose (a function of the concentration of organism and the volume of aerosol inhaled or liquid swallowed) and a formal risk assessment. We are developing computer models to perform QMRA. This QMRA approach will allow IAs to have a solid, valid scientific approach to the development of guidelines that ensure waste recycling programs are both sustainable and have minimal impact on public health.
The Duty of Care in Intensive Animal Industries

T A Streeten
Manager, Intensive Livestock Environmental Management Services, Department of Primary Industries, Toowoomba, Queensland.

Definitions

Duty of Care

In seeking to protect the environment there is a responsibility on all individuals to exercise an environmental duty of care ie. “A person must not carry out any activity that causes or is likely to cause environmental harm unless they take all reasonable and practicable measures to prevent or minimise that harm”.

In helping a person to decide on what is considered to be reasonable and practicable the Act considers the following:

- the nature of the harm or potential harm; and
- the sensitivity of the receiving environment; and
- the current state of technical knowledge for the activity; and
- the likelihood of successful application of the different measures that might be taken; and
- the financial implications of the different measures as they would relate to the type of activity.

Intensive Animal Industries

For the purposes of this paper, intensive livestock industries are defined as industries where animals/birds are raised in confined areas and rely wholly or partially on prepared or manufactured feed at levels greater than necessary for survival. Examples are piggeries, feedlots (cattle, sheep), dairies, poultry and other “emerging industries” such as emus and ostriches.

Waste

Waste includes anything that is –

a) left over, or an unwanted byproduct, from an industrial, commercial, domestic or other activity; or
b) surplus to the industrial, commercial, domestic or other activity generating the waste.

Waste can be a gas, liquid, solid or energy, or a combination of any of them. A thing can be waste whether or not it is of value.

As can be seen from the definition, waste is all-encompassing. For the purposes of this paper, only manure will be discussed in detail as its management has a major influence on whether intensive livestock industries are viewed as being environmentally sustainable.
Manure Management

Intensive livestock industries are examples of high external input agriculture where large quantities of feed and water are used with a resultant high throughput of product, whether this be meat, milk or eggs. They have been likened to agricultural factories.

The inputs and outputs from a 100 sow farrow to finish piggery are in the order of:

- Feed – 550 tonnes (80% grain)
- Water – 24 ML (drinking, flushing, hosing)
- Pigs to market – 187 tonnes (1841 pigs)
- Manure – 1000 tonnes (Nitrogen – 9 tonnes, Phosphorus – 3 tonnes, Potassium – 4.5 tonnes)
- Carcasses – 10 tonnes (657 animals)
- Gases, noise, dust - ? (sheds, lagoons, animals)

How do intensive livestock producers view manure? Is it a valuable resource in the wrong place or is it a byproduct of production which needs to be disposed of? We are seeing a major shift in attitude towards the former view, this paralleling the realisation that manure is a valuable source of fertiliser and improver of soil structure and “health” and that all industries have an environmental duty of care.

The basic steps from manure excretion to utilisation are collection, pretreatment, treatment and storage, and utilisation. This is illustrated in Figure 1. showing nutrient imports, exports and pathways within a cattle feedlot. The safe disposal of livestock carcasses is also an important consideration.

Figure 1. Cattle feedlot system diagram, illustrating nutrient imports, exports and pathways within the system. (Adapted from Gardner et al 1994)
In order to demonstrate a duty of care, a producer should with each basic step:

i) Document current practices.
ii) Compare them with recommended management practices as described in codes of practice or similar documents.
iii) Assess any potential risk of environmental harm being caused.
iv) Implement corrective action.
v) Monitor.

This approach provides the basic framework for quality assurance processes, Hazard Analysis and Critical Control Points (HACCP), environmental management plans etc.

In assessing the risk of environmental harm being caused consideration should be given to the soil to which manure is supplied, surface and groundwater, and community amenity. Soil types, nutrient loading, crop management, proximity to groundwater and watercourses, proximity to neighbours and climatic conditions are but some of the issues which will affect likely risks.

A well-considered and practiced environmental management plan will ensure that on site manure utilisation will not adversely impact on production, the environment and community amenity.

If the above is lacking, what are the likely impacts?
Potential Adverse Impacts

Production

High gaseous emissions within buildings and boggy wet conditions resulting from poor manure collection and removal processes can result in higher disease prevalence, such as respiratory diseases and mastitis, and poorer growth performances.

Environment

Poor management practices can lead to adverse impacts on soil, surface water and groundwater.

Soil impacts can include lowered pH, high soil salinity and sodicity, poorer soil structure and stability, increased soil erosion and water logging. High soil nutrient levels such as nitrogen and phosphorus are more likely to impact on groundwater and surface water through leaching and runoff rather than the soil itself.

Uncontrolled releases of effluent due to pond overtopping and excessive effluent application can adversely impact on nearby watercourses.

Community Amenity

The main community amenity issue with intensive livestock enterprises is odour. Other potential issues include dust, noise, visual impacts, transport and public health issues.

Prevention of adverse impacts on neighbours is best addressed through appropriate separation distances, layout, design and management. This has been evident with the feedlot industry where the number of complaints to Councils and regulatory authorities has been dramatically reduced through appropriate separation distances supported by science, and improved manure management through pen cleaning, stockpiling and effluent collection. Separation distances apply to urban encroachment on existing intensive livestock enterprises as well as expanding agriculture activities.

Public health implications have already been discussed in an earlier paper.

What is a producer’s duty of care if manure is sold and applied off-site as a fertiliser and soil ameliorant?

Proposed legislation including Environmental Protection (Waste Management) Policy 1999 and Environmental Protection (Waste Management) Regulation 1999, sets out the operational requirements for all aspects of waste management in Qld including waste tracking.

Waste tracking follows waste from its generation to storage, recycling, treatment or utilisation.

In the draft waste tracking guidelines released for discussion purposes only, the generator, transporter and receiver of the trackable waste are required to provide prescribed information to the recipient of the waste and the EPA. Records are also to be kept.
Although animal effluent and residues (abattoir effluent, poultry and fish processing wastes) are regulated wastes under the Schedule 1 of the EP Act, waste tracking provisions do not apply to:

a) the transportation of waste for use as a stock food; or
b) the transportation of waste to a farm for use as a soil conditioner or fertiliser.

However, as a current condition of piggery and feedlot licenses and approvals, where effluent or solids are removed off-site, the owner is required to keep a record of:

1) date, quantity and type of waste removed
2) name of waste transporter or waste disposal operator
3) intended use and destination of the waste

Given that it is every individual’s responsibility to exercise an environmental duty of care, the recipient (user) of the manure which has been transported off-site must exercise that care. Whilst not clearly defined at this stage, the generator of the manure (producer) would be prudent to remind the user of that responsibility. This could be through a simple handout which may also contain practical guidelines on suggested rates of application and likely crop uptake of nutrients from animal manure.

References

1) **Environmental Protection Act (1994).**


6) Environmental Protection (Waste Management) Regulation 1999 (Draft).
The Duty of Care in Local Government:  
Landfill Management - Past, Present & Future

Michael Dart  
Waste Management and Environmental Health Officer  
Local Government Association of Queensland

Across Queensland large amounts of wastes are being produced which have the potential to be recovered and re-used in other areas.

Much of the domestic and commercial waste stream ends up at landfill, most commonly operated by Local Government.

In Queensland, through the implementation of the Environmental Protection Act 1994 and associated regulations and policies, there has been a shift towards better management of landfills by Local Government. This process has been welcomed in principle by Local Government as we strive towards best practice by assessing our operations on a risk basis.

The Local Government Association of Queensland is the peak body for the representation of Queensland’s 125 Local Government and 9 Aboriginal Community Councils.

I will outline the management of landfills in Queensland, the differences between Local Governments in urban and rural areas and the risks associated with site selection, design and construction, operational standards and closure and post closure of landfills.

The presentation will be punctuated with examples of organic waste management and alternatives being pursued by Local Government and the progress they have made in this regard.
Matter – be it organic or inorganic, is the basis of the natural resources that we harness for primary production. One of the fundamental laws of physics is that matter is neither created nor destroyed. Matter can be transformed between solid, liquid and gaseous states, but we cannot create it out of nothing. Therefore to be sustainable, the transformations between different states of matter should occur within the one system, with minimal losses exported beyond that system (a closed system). Traditional mixed farming enterprises are an example of a closed system, where nutrients are recycled between the livestock and cropping phases, with plants and bacteria fixing the carbon and nitrogen gases released by animal growth processes (Figure 1). Traditional farming systems are self-sustaining, with most of the produce consumed on-site, or within the local subcatchment.

Figure 1. Specialisation in primary production. On the left, traditional mixed farming enterprises where inputs were recycled between the different livestock, green manure and cropping phases, and where outputs (straight arrows) were consumed at the local level. On the right, the livestock phase is separated from the cropping phase, with greater off-farm inputs of feed concentrates and inorganic fertilisers respectively (curved arrows).

However, over the years primary producers have increased the size and specialisation of their production systems, to satisfy regional and international economic demands. Increasingly, rural enterprises have shifted towards open systems, with a heavy reliance on off-farm inputs and larger off-farm exports of produce (Figure 1). The trend towards greater specialisation has also resulted in the production of larger quantities of ‘waste’. By definition ‘waste’ is matter that is superfluous, no longer serving a purpose. Yet it represents a resource, with the potential to be incorporated into other production systems to improve the local conservation and re-use of that matter.

Matter – be it organic or inorganic, is the basis of the natural resources that we harness for primary production. One of the fundamental laws of physics is that matter is neither created nor destroyed. Matter can be transformed between solid, liquid and gaseous states, but we cannot create it out of nothing.
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Within the Eastern Darling Downs Regional Organisation of Councils (EDROC), solid wastes with the potential for re-use include animal manure’s from intensive livestock production (Figure 2). Large producers (feedlots >1,000 head, piggeries >5,000 standard pig units, dairy herd >200, poultry >30,000 birds) may have insufficient land to re-use all the manure produced, hence alternative processing and re-use strategies may be necessary. If operating as a mixed farm, smaller producers may be able to recycle the manure on-farm, but alternatively there may be local processors keen to access the waste for sale to other end-users.

Of the nutrients in manure, the proportions in the inorganic (plant-available) form and the type of inorganic nitrogen present, varies with the animal producing it. Depending on the form in which the manure is collected, nutrient losses may occur via chemical or microbial transformation to gas, or leaching to local water bodies. For example, if the manure is too dry, nitrogen may be lost as gas. If too wet, malodorous gases may be produced, causing angst to neighbours. Processing retains the nutrient value of the manure, whilst minimising the potential for odour production and nutrient leaching. Processing most commonly harnesses the activity of microbes to capture the main nutrients in their cells, whilst reducing the volume of waste via gas production (most commonly carbon dioxide). Worms can be added to enhance the rate of carbon dioxide loss, provided the manure does not contain toxic levels of ammonia and has sufficient levels of readily available organic carbon.
Sources of organic matter low in N, P and K can also be added to enhance microbial growth to capture the nutrients, improving the **slow-release** value of the end product (co-composting). Waste products from cotton gins, sawmills and seed (grain) grading processors are ideal bulking agents for co-composting, meeting the requirements of lower NPK content and having a low bulk density. As a result the organic matter content of the manure mix increases, air passage through the pile increases, maximising microbial activity and the production of a quality **slow-release** compost. Within the Queensland component of the Murray-Darling Basin (QMDB), quantities of sawdust (**Figure 3**), gin trash and grain dust are available.

**Figure 3:** Average annual volumes of sawdust and other waste from small (annual log input of \( \leq 2,000 \) cubic metres), medium (\( >2,000 \leq 10,000 \)) and large (\( >10,000 \)) sawmills. Numbers above bars indicate the number of mills in each size class.

Surveys have shown that primary producers are keen to minimise the adverse environmental impact of management practices, provided the changes required fall within the constraints of their farming operation (**Table 1**). The impetus for changing **waste management** practices may be perceived on-farm advantages, and/or perceived off-farm market opportunities, and/or legislative pressure. Larger **waste producers** with sufficient capital and subject to specific licence conditions may find subcontracting waste processing for off-site re-use profitable. Similarly, independent **waste processors** will be attracted to the larger primary producers on the basis of the volume and reliability of waste produced, and the potential for fee for service. However, as **Figures 2 and 3** indicate, the vast majority of organic waste producers within the EDROC and the QMDB run small enterprises. Whilst there are some larger enterprises, their proximity to waste processors or end-users, and the suitability of the waste product for immediate processing may limit the opportunities for waste processing and re-use.
Table 1. Factors influencing the decision of livestock producers to change waste management practices. Table is from Hoban and Clifford (1995), in Animal Waste and the Land-Water Interface, ed. K. Steele, CRC Press Boca Raton, USA.

The economics of waste processing depends on the cost of the basic resource (cartage and handling), the labour and capital equipment required, and the ability to meet the specifications for, and the reliability of markets for the finished product. The large majority of organic waste producers within the region are small, hence low-cost on-farm processing and re-use strategies compatible with the existing farm management operation are needed (Figure 4 categories 1 and 2). The producer/processor is the end-user: hence throughput and quality control issues may be less important. However, once processing and/or re-use occurs off-site (Figure 4 categories 3 and 4), issues of product hygiene, quality control and reliability of supply become more important. For example, the three cotton gins within the QMDB each produce about 58,500 m$^3$ of trash annually, available for composting. However the spread of weeds and plant pathogens in the trash is a major risk for end-users. Co-composting with manure will improve the disinfection process, but capital and labour costs must be passed onto potential end-users. Will the performance of the product justify that higher cost, and who will pay for the chemical testing required to establish the quality of the product?

Cost margins become even more limiting where the processor is not the waste producer, and is not the end-user (Figure 4 category 4). Given that the waste producer will incur costs for alternative forms of waste disposal anyway, should the processor be paid to take the waste? If the processor is paid to take the waste, then the higher costs of pre-processing and post-processing to meet market specifications can be offset. However, if pre-processing is undertaken by the waste producer, should the costs incurred be passed onto the waste processor?
Figure 4. The 5 categories of waste producer, waste processor and end-user interactions located on and/or off-farm.

Categories 1 & 2: traditional mixed farm with waste reuse (solid arrows) and/or waste processing (oval) for reuse (stippled arrows) on-site.

Category 3: larger scale enterprise subcontracting on-site waste processing for off-site reuse.

Category 4: independent waste contractor processing waste off-site, for off-site reuse.

Category 5: local co-processing of compatible wastestreams from several enterprises for an identified end-user within one subcatchment (black circle).

In part B of the AGWISE Project, alternative waste processing demonstration sites have been developed in collaboration with key primary producers. The aim of each site is to investigate the practical costs and benefits of the alternative strategy, within the context of the existing business enterprise. The alternative strategies range from the disposal of carcasses on-farm using dry composting, to the separation of dairy solids and the nutrient-stripping of the wastewater using a biolytic filter/ponded pasture system (Table 2). Given that most of the primary producers within the QMDB are small to medium in size, the focus of these sites has been on-farm processing and local co-processing (Figure 4, categories 1, 2 and 5). Practical guidelines for co-composting and carcasses (cadaver) composting have been developed, to assist both the participating producers and others interested in using these technologies. A series of case-studies are also being prepared, to document the experience of larger business enterprises who have independently adopted alternative technologies. The focus of the case-studies ranges from on-farm processing for on-farm re-use, to subcontracted waste processing and independent waste processing for commercial sale (Figure 4 categories 2 to 4).
Table 2. Description of the demonstration sites and key objectives under study in Part B of the AGWISE project.

For the case-studies, issues relating to sourcing raw material, the costs and specifications of pre-and post-processing, and the identification of a market for the final product have been resolved. However for the demonstration sites, many of these issues are on-going, and their outcome will fundamentally determine industry’s acceptance of and the adoption of these alternative practices. If we can provide cost-effective waste processing and re-use techniques for the rural industries, then the intensity of such industries can increase without unduly impacting on the ecological and social qualities of the local environment.
Meeting Expectations – The Industry Response

Des Rinehart
Meat & Livestock Australia

Introduction

How do industries address community, consumer and stakeholder expectations in the areas of environmental sustainability, amenity, public health and animal welfare while, at the same time, ensuring that they can develop and operate in an environment free of unnecessary legislative intervention?

The first part of the answer lies in the development and implementation of self-regulatory systems with a high degree of public accountability and integrity, in the form of industry-based codes of practice and quality assurance schemes. The second part is in being prepared to undertake appropriate research to support the industry position and demonstrate compliance with community expectations and requirements. The beef cattle feedlot industry, having pioneered and proactively pursued this approach over the past ten years, has been chosen as an example of what can be achieved. The successful model that has been developed by this industry is now being adopted by other industries in the agricultural sector.

Industry Statistics

Details of the current distribution of the number and total capacity of National Feedlot Accreditation Scheme (NFAS) accredited feedlots in Australia are shown in Table 1 and Table 2.

<table>
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<tr>
<th>Feedlot Capacity (Head)</th>
<th>QLD</th>
<th>NSW</th>
<th>VIC</th>
<th>SA</th>
<th>WA</th>
<th>TAS</th>
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Source: National Feedlot Accreditation Scheme 20/07/99
Table 2. Distribution of total capacity of NFAS accredited feedlots by size.

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<th>VIC</th>
<th>SA</th>
<th>WA</th>
<th>TAS</th>
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Source: National Feedlot Accreditation Scheme 20/07/99

Points of note include:

- 86% of the total number of feedlot operations have less than 1000 head of capacity, and comprise 20% of current feedlot capacity. These in general are attached to farming and/or grazing enterprises and are operated on an opportunity basis when the economics are assessed as favourable.
- A small number of feedlot operations with greater than 1000 head of capacity that comprise the balance (80%) of current feedlot capacity. In general, these operations are more likely to be operated on a year-round basis and have developed supply contracts with domestic and export users.
- Queensland has 70% of the total number of currently accredited feedlots, accounting for over 40% of total feedlot capacity.

A 1990 survey of the Australian feedlot industry conducted by the Queensland Department of Primary Industries’ Feedlot Services Group showed that 65% of the then identified feedlot capacity of 470,000 head was concentrated in the Murray-Darling Basin (Tucker et al., 1991). This figure is likely to have increased significantly with the expansion that has occurred since that time. The recent capacity increase has consisted of expansions of existing facilities and a number of new large developments in areas adjacent to the Murray and Murrumbidgee Rivers. This survey also properly identified the factors that contributed to feedlots locating in these areas as:

- proximity to supplies of grain and store cattle, and availability of other feedstuffs;
- availability of sufficient land area for disposal of wastes;
- suitable agronomic soils for waste disposal;
- rainfall less than 750 mm per annum;
- availability of adequate water supplies (both in terms of quality and quantity); and,
- adequate separation from neighbouring houses, towns, etc.

While these are not necessarily listed in order of importance, they are still the major considerations for feedlot location at this time, explaining the concentration of feedlot activity in the major agricultural regions of Australia. Unfortunately, many of the earlier established operations, which were originally sited well away from population centres, are now coming under increased pressure from urban encroachment, an issue that needs to be addressed by planning authorities.
**Industry Initiatives**

The significant economic and market benefits derived from the feedlot sector in the form of regional growth, improved market and price stability, new market opportunities and job creation have been well documented in studies such as the 1994 Meat Research Corporation funded *Regional Impact Of Feedlot Investment*.

Industry does acknowledge, however, that development and operation must be in a manner that is sensitive to community expectations and requirements and has responded with proactive development of industry self-regulation mechanisms and initiatives to address the concerns expressed by the community, at both National and State levels. These initiatives have been undertaken in a manner that has allowed input from all stakeholders.

The following provide details of the proactive approach adopted by industry in developing Codes of Practice and quality assurance (QA) systems. Also included are brief details of the licensing requirements that apply in Queensland to give a feel for the degree of regulation (both self and external) that exists in the industry.

1. **National Guidelines**

Concerns that the lack of uniformity of regulations, relating to the establishment and operation of feedlots in Australia, was hindering the development of the industry led to the development of the *National Guidelines for Beef Cattle Feedlots in Australia (National Guidelines)* in 1992.

The development of the *National Guidelines* brought together representatives of all parties that had a stake in the industry, including Local, State and Federal Government Departments, industry and animal welfare organisations. These representatives worked together to ensure that feedlot development could occur in a way that maximised the benefits for all parties.

The *National Guidelines* were reviewed and a second edition published in 1997.

2. **National Feedlot Accreditation Scheme**

Community pressures on the Australian feedlot industry required the industry to either put in place a self-regulatory system with a high degree of public accountability and integrity, or accept the imposition of government regulation. Industry required a quality assurance system that met community expectations by delivering industry compliance with national management standards.

In 1993, the *National Feedlot Accreditation Scheme (NFAS)*, an industry self-regulation scheme involving the development of quality assurance systems, was introduced. The *NFAS* was the first quality assurance system introduced by a rural industry group, an approach that is being increasingly adopted by other rural industries at this time.
The NFAS complements the National Guidelines and is based on compliance with three Codes of Practice:

3) The Australian Veterinary Association’s Code of Practice for the Safe Use of Veterinary Medicines on Farms.

Currently, there are 600 accredited feedlots in Australia with a total capacity of 770,000 cattle, as indicated previously. Industry information is that this represents over 90% of commercial feedlot capacity in Australia. Linking eligibility for export grainfed beef certification under the Export Control Act, administered by the Australian Quarantine Inspection Service (AQIS), with feedlot participation in NFAS, ensures participation in the scheme. Participants in the scheme are subject to an annual external audit of their quality assurance system, ongoing accreditation being dependent on satisfactory performance. NFAS is administered by AUS-MEAT Limited, a company jointly owned by Australian meat producers and processors, and overseen by the Feed Lot Industry Accreditation Committee (FLIAC) comprising representatives from government and industry.

3. National Feedlot Environmental Code of Practice

Lack of uniformity of current and intended future environmental legislation from State to State, and the lack of agreement between legislative bodies within a particular State on parameters for assessing specific aspects of environmental performance, again necessitated a proactive approach by industry in addressing these issues in 1998.

Industry proposed the development of a National Feedlot Environmental Code of Practice to draw together divergent opinion and consolidate it into a single approved document that forms the basis of future environmental activity. This approach was consistent with that employed in the successful development of the National Guidelines and the implementation of the NFAS, satisfying the requirement to achieve a balance between self-regulation and public accountability.

The National Feedlot Environmental Code of Practice (the Code) was developed by the Australian Lot Feeders’ Association in consultation with all Commonwealth/State/Territory departments with responsibility for agriculture and/or environment, the Cattle Council of Australia, the lotfeeding industry, the Feed Lot Industry Accreditation Committee (FLIAC), the Meat Research Corporation and environmental groups.

While the Code has been developed to address the legislative requirements of States and Territories with respect to environmental matters, it is intended that it will be used primarily by feedlot management and staff. It specifies environmental performance objectives, operational objectives and practices that provide ways of achieving compliance with the environmental duty of care. The Code also provides the community and regulatory authorities with a means by which they can assess the industry’s performance.

FLIAC has adopted the Code, as a replacement upgrade for the ALFA Code of Practice for Protection of the Environment, ensuring that all NFAS accredited feedlots must now comply with the newly developed Code. The Code is currently in the final phase of endorsement by the Standing Committee for Agriculture and Resource Management (SCARM).
Queensland Regulations

Guidelines

In 1989, the Queensland Department of Primary Industries, in consultation with industry, developed the *Queensland Government Guidelines for Establishment and Operation of Cattle Feedlots* (the *Guidelines*). The purpose of these Guidelines was to present a range of recommended practices for the siting, design, construction, operation and ongoing maintenance of beef cattle feedlots. These practices were primarily intended to minimise the risk of adverse impacts of feedlot operations on the environment and community amenity.

The *Guidelines* are currently being reviewed to reflect current industry best practice, the results of industry funded research and operational experience within the industry. It is envisaged that the revised *Guidelines* will provide the specific detail required by Queensland feedlot operators to meet the environmental performance objectives set down in the National Feedlot Environmental Code of Practice and comply with Duty of Care requirements.

Licensing

In conjunction with the development of the *Guidelines*, the Queensland Government amended the *Stock Act 1915*, by incorporating provisions for a feedlot licensing scheme, administered by the Department of Primary Industries in consultation with local authorities. All feedlots with a capacity greater than 49 head were required to be licensed under this legislation.

Since July 1996, the environmental performance of feedlots has been subject to licensing under the *Environmental Protection Act 1994*. The Department of Primary Industries has been delegated the responsibility for assessing new applications, monitoring ongoing performance and investigating complaints regarding feedlot operations, under this legislation.
Industry Research and Development

The second element of the proactive approach by Industry to addressing community environmental concerns, has been its preparedness to fund and undertake environmental research and development.

Between 1989 and 1996, the Meat Research Corporation funded a large research program that was conducted by the Queensland Department of Primary Industries. The results of this research have made a significant contribution to the understanding of feedlot hydrology, the process of odour generation and the design criteria and operational management practices required to minimise the environmental impact of feedlot operations. The practical management and operational outcomes of this work have been readily adopted and implemented by Industry. The project outcomes are also being utilised in the current review of the Queensland Guidelines.

An extension of this work is currently being undertaken at the CRC for the Cattle and Beef Industry (Meat Quality) located at Armidale. The project titled “Safe Utilisation of Feedlot Manure and Effluent” commenced in June 1997 and will finish in June 2000. The objective of the project is to define environmentally sustainable manure and effluent application rates for particular cropping systems and soil types. This will ensure that Industry and potential users extract the maximum value from what we know is a valuable resource with minimal environmental downside. Much of this research effort is being undertaken on the Darling Downs.

Industry Performance

Significant advances have been made in the areas of feedlot site selection, design, construction, operation and management in the past 10 years. Skerman et al (1996) reported a substantial reduction in complaints and a better overall perception of the industry by the community. The feedlot industry can take considerable credit for this improvement, thanks to its proactive approach in the areas listed above.

NFAS also prepares an annual report that is available to community stakeholders to review compliance data, and participation levels. The level of non-compliance has been reducing as illustrated by the data from the past two years, shown in Table 3.

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Non-compliance by Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Animal ID and Animal Records</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>Veterinary Medicines</td>
<td>26</td>
</tr>
<tr>
<td>3</td>
<td>Animal Environment</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>Feed Quality Standards</td>
<td>32</td>
</tr>
<tr>
<td>5</td>
<td>Environmental</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>QA System Management</td>
<td>130</td>
</tr>
<tr>
<td>7</td>
<td>QA Manual</td>
<td>21</td>
</tr>
<tr>
<td>8</td>
<td>Not Recommended for Accreditation</td>
<td>125</td>
</tr>
</tbody>
</table>

Source: National Feedlot Accreditation Scheme 20/07/99

While these figures may be viewed by some as indicating an unacceptable level of non-compliance, they should more properly be viewed as an indicator of a scheme that has some real ‘teeth’.

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Conclusions

This paper details the proactive approach that the beef cattle lot-feeding industry has adopted in addressing issues of concern, both from an industry and community viewpoint. Furthermore, it highlights the success that has been achieved by this industry and the reason this approach is now being seen as a model for other rural industries to follow.

The real proof of the success of the approach will be seen when other State governments follow the Victorian example, and rely on feedlot accreditation through the NFAS as certifying enterprise compliance with State government regulatory standards.

References


The Role of Public Interest Groups in Promoting On-Site Re-use Strategies

Sarah Moles
Condamine Catchment Management Association
Toowoomba & Region Environment Council

Introduction

Waste management is now a key issue for both of the Toowoomba based non-government community groups with which I am actively involved. With a population of some 90,000 people, Toowoomba is one of the largest cities in the Murray Darling Basin, and the cumulative impacts of the wastes each of us generate every day are significant. Furthermore, our location at the top of the system means that we have the potential to affect all down stream (or downslope) members of the community, and the environment. For the Toowoomba and Region Environment Council (TREC), the only environment council in Queensland west of the Great Divide, the focus has tended to reflect the enthusiasm of our resident waste activist Frank Ondrus on the minimisation of urban waste through education and awareness activities.

For the Condamine Catchment Management Association (CCMA), an organisation concerned with the sustainable use of our catchment’s natural resources, waste has only recently been accepted as a priority issue. The CCMA commenced compiling its Strategic Plan early in 1995. The process involved surveying stakeholders, particularly Landcare and rural industry groups, as to the relative importance or urgency of the natural resource issues they faced. Waste was not one of those identified by the catchment community. In spite of some intensive lobbying on the part of a couple of people who felt that waste was a priority, waste management remained a non-issue for the Condamine for almost a year, until a Natural Resources Management Strategy (NRMS) for the Queensland Murray Darling Basin (QMDB) was compiled. As part of this larger, regional process, a concerted effort was made to engage the 29 local governments located in the QMDB. And in every case where local government contributed to the strategy, waste management was identified as one of the top two issues. Accordingly, a waste management strategy was incorporated into the QMDB - NRMS, and a draft waste management strategy added to the revised Condamine Catchment Strategic Plan (CCSP).

Waste management is one of the big ticket items for local government and a statutory responsibility. And while for inland southern Queensland there is plenty of space for dumps, the disadvantages of landfill disposal of waste are obvious to most people. The loss of various resources is accompanied by water pollution, odour and vermin. So it is with some concern that the CCMA regards SEQROC’s plans to transfer its wastes into our region. Australia must find creative solutions to the global problem of waste while protecting the natural environment on which all economic activity and social well-being ultimately depends.
The CCMA Waste Management Strategy

The Condamine catchment is largely dependent on rural industries. The CCMA waste management strategy aims firstly to promote personal responsibility for waste management and waste minimisation by all sectors of the catchment community, and secondly, to minimise all wastes and their impact on the soil, water and vegetation of the Condamine Catchment. Waste is defined as ‘a by-product of a production system with no end use.’ All land occupiers and land users in the catchment are waste producers. The CCMA waste management strategy therefore includes a range of necessary actions for both urban and rural situations.

Wastes are produced in all areas of human activity in the catchment - domestic, commercial and industrial, demolition and construction, clinical and agricultural situations. These waste streams can be divided into four categories:

- Waste streams which can be re-used with minimal adverse environmental impact. e.g. stable manure, household and green waste)
- Waste streams requiring processing before re-use with minimal adverse environmental impact (e.g. abattoir, dairy factory waste)
- Waste streams which cannot be re-used readily and/or have an adverse environmental impact (e.g. plastic mulch, pesticide drums)
- Toxic waste streams requiring intensive processing to counteract adverse environmental impacts (nuclear, Scheduled wastes)

The CCMA would discourage plans to dump waste from streams 3 and 4 within the catchment, but would probably regard wastes from streams 1 and 2 as potential development opportunities, particularly if they could be supplied both reliably and economically.

The potential for on-site re-use or processing of waste depends on the volume, biological reactivity, land capability and the management focus of the landholder or land user. In addition to the urban/rural situation, priorities for management of these wastes vary according to economies of scale and environmental impact.

Integration of Natural Resource Management Issues

The Natural Heritage Trust encourages a co-ordinated and integrated approach to natural resource management. Funds are not made available for ‘single issue’ projects. The CCSP identifies a number of issues that have direct or indirect links to waste management, and which present opportunities for waste producers, processors and users. For example, pasture decline, nutrient decline, soil compaction and poor water infiltration are issues affecting many parts of the catchment. The organic wastes produced in the catchment (and indeed outside it) could be processed to provide valuable soil conditioner and help to improve productivity.

Similarly, any treatment that improves the quality of our water resources would assist in achieving other important environmental objectives. Many wastes are ‘mobilised’ by water. The Condamine River flood plain is regularly inundated, and flash flooding occurs sporadically across the catchment, with all major population centres experiencing severe flooding every 5-10 years.
Toowoomba City Council’s Gowrie Creek Project will include constructed wetlands as combined stormwater retention basins and wildlife habitats, which will also improve groundwater infiltration. The amenity value that this project will bring to Toowoomba is considerable, while the removal of gross pollutants, heavy metals, oils, fertilisers and pesticides from the waste stream will benefit the environment and all downstream water users.

**European Experience and Examples**

The environment movement in Germany had a very strong influence in the 1980’s and Greens elected to local government carried a groundswell of support for recycling and re-use opportunities straight into the governing bodies. In 1990 the State of Hesse passed legislation requiring the separate collection and processing of organic waste as well as its beneficial use. Source separation and composting/anaerobic digestion is now established in some 75% of German councils. Some 5 million tonnes of compost is generated per year in 550 composting plants and anaerobic digestors.\(^1\)

Some districts have opted to integrate organic waste management with agricultural industries, thus forming a component of a regional development strategy aimed at revitalising the rural sector and providing some additional income for farmers. This is something the Darling Downs region needs to examine closely.

Researchers at the Elm Farm Research Centre (EFRC) in Berkshire, England, realised that the limiting factor for many municipal waste composting schemes, was the cost effective utilisation of the large amounts of compost generated. Agriculture is the one industry most capable of using these volumes. EFRC aimed to meet the objective of “integration of the waste management sector with the agricultural sector, in order to allow the former to provide a cost effective and environmentally sound method of disposal of organic waste, while allowing the latter to economically utilise material of an acceptable quality.” The EFRC pilot scheme was established as close as possible to the source of municipal waste, minimising transport costs, and involved about 2000 volunteer households. The resulting windrow composting system utilises existing farm infrastructure, machinery and labour as far as possible.\(^1\)

The British government introduced a landfill tax (ten pounds/tonne) in 1996, but combined with a lack of legislative and financial support, it will be insufficient to reduce waste by the target of 25% by 2000. The new EU landfill directive requires the UK to reduce its biodegradable waste going to landfill by 65% by 2020. Current landfill taxes range from 25 to 35 pounds per tonne in rural areas, and up to 50 pounds per tonne in major urban areas. This has produced a strong push for on-farm composting.

Changes in emissions regulations have been another catalyst for accelerating innovative methods of waste disposal in the UK. 20,000 tones of animal manure per year is produced by race horse stables in the Lambourn area of Berkshire. Over 25 tonnes per day is now collected by the owners of Sheepdrove Farm, who are paid to collect it from the stables’ skips, and paid again for composting it. They believe the projects’ success lies in its convenience. “When changing takes effort, people put up a fight,” they say. “This is incredibly user friendly.”

Meanwhile in Devon, the idea of turning offal, fallen stock and slurry into electricity and heat is fast becoming a reality.

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\(^1\) Johannes Biala, EFRC. (pers comm)
Planning permission has been approved for a power station that will use 108,000 tonnes of IAI waste to produce two megawatts of electricity per year (enough to power 2,000 homes). Slurry will be placed in a digester to convert the carbon to methane using anaerobic bacteria, and the residue will be returned to the supplying farms as fertiliser. The cooling water will be used to help heat schools, hospitals and houses in the nearby town of Holsworthy.

The applicability of such schemes for us here in rural Queensland is limited by a comparatively small population and a large land area. Meeting such challenges may require us to question how we value clean, healthy rivers, a broader economic base, our ability to meet at least some of our regional energy needs, and opportunities for rural youth to perform socially useful and meaningful work.

**Best Management Practices**

Australian primary producers are now required to meet certain standards to protect the environment, particularly if they conduct an Environmentally Relevant Activity (ERA). The Queensland Farmer’s Federation has encouraged all commodity groups to develop their own standards, which often take the form of Best Management Practice manuals.

It is accepted that managing manure and wastes can improve the overall farming operation while improving the environment and reducing fertiliser costs. A waste management system should be part of a total soil and water conservation plan for all farms, but especially those producing livestock and poultry. A nutrient management plan is an important part of the total waste management plan. The nutrient management plan allows farmers to more fully use the nutrients in animal and poultry waste to produce crops in an environmentally friendly manner.

Soil and waste testing are required in order to match the crop needs to the nutrients available. Sufficient storage area is needed to allow processed waste to be applied when the available nutrients give most benefit to the crop. The storage and handling methods along with the method of application can make a considerable difference in available plant nutrients, and in the quality of any runoff reaching our ground and surface waters.

**Legislative and Economic Issues**

The resource recovery and resource efficiency industries will undoubtedly be among the growth industries of the next century. However, here in Australia, some regulatory and economic issues need to be addressed if these new industries are going to ‘get up to speed’ and begin delivering the healthier environment we so urgently need.

Green activists believe there is an urgent need to establish uniform national environmental regulatory standards, for air and water quality and uniform national legislation to ensure clarity and enforcement of environmental protection legislation. This is something that some current, complex intra-agency operational arrangements do not do very well.

Government should also provide a clear national regulatory framework for environmental protection to encourage industry to commit to major, long-term ecologically sustainable projects. This must include the ‘polluter-pays’ principle. It is simply unacceptable for polluters to receive tax breaks and subsidies, and for the taxpayer to then contribute to expensive clean up operations.
The first step is to stop paying the polluter by phasing out tax breaks, subsidies and other government policies that encourage resource waste, pollution and environmental degradation. These should be progressively replaced with positive incentives like tax deductions, rebates and enhanced depreciation allowances to enterprises investing in technology or capital expenditure which reduces resource use, waste and pollution.

Decisions relating to the impact of industrial activities on the environment are complex and must be supported by accurate, detailed and timely data. AGWISE is addressing this need for the inner Darling Downs. Organisations such as the CCMA have an important role to play in setting the strategic framework for such projects and in ensuring that the resulting projects meet the eligibility criteria for funding bodies such as the Natural Heritage Trust.

Other non-government organisations such as TREC and Householders’ Options to Protect the Environment (HOPE), which are recognised as key stakeholders in the CCMA waste strategy, have roles to play in ensuring the wider community is kept informed of progress in waste management. We are building a critical mass to ensure that all waste producers can easily and economically avoid, reduce, re-use, recycle and only then, dispose of their wastes. HOPE has recently produced an Ecology Audit booklet. Essentially, this is a tool for primary school teachers to use to increase students’ awareness about the wastes that are generated in the home, and the impact these have on the wider environment. Both groups are also lobbying for the legislative and economic changes outlined above, and for statutory recognition for the regional, catchment-based planning process.

The information AGWISE is now delivering strongly suggests that this is the most appropriate tool for Local Governments to use in assessing development applications. It is slightly ironic that waste, an issue only recently regarded as not a priority for natural resource management in the Condamine, may be the catalyst for delivering the ‘whole of government’ approach to catchment management, that Landcare and catchment management groups have been working so hard to achieve.
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Hammond C (undated) Animal Waste and the Environment. The University of Georgia College of Agricultural & Environmental Sciences. www.ces.uga.edu/
Advantages and Disadvantages in Processing Waste On-site before Re-use

Kevin M Roberts
General Manager
Sandalwood Feedlot

Feedlot manure is a valuable fertiliser. Feedlot manure is a valuable source of Nitrogen, Phosphorus and Potassium as well as trace minerals such as Zinc and Sulphur. The value of feedlot manure as a fertiliser source can be summarised as follows:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>DM %</th>
<th>Dry Value</th>
<th>Value 70%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>2.20</td>
<td>18</td>
<td>13</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.85</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td>Potassium</td>
<td>2.40</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>$55</td>
<td>$39</td>
</tr>
</tbody>
</table>

Source: Evan Powell 1999

Processing of manure on-site can be categorised into three main categories, minimal, moderate and composting.

Minimal

This process refers to manure being carted direct from the feed pen to a stockpile close to the spreading site. Once dumped the manure is left to “cook” for about three weeks before being stooked up into a larger pile where further breakdown continues. The advantages of this method are $2/T F.O.T., minimal extra cost and improved manure characteristics for spreading. Disadvantages include loss of some nutrients from non-compacted stockpiles, requires time to break down in the pile, and shrink of product resulting in increased cost.

Moderate

Manure can be processed from a compacted stockpile in a number of ways, these include screening, rotary hoeing and/or discing. The advantages of this method are reduced odour during storage, reduced chance of spontaneous combustion, improved manure characteristics for spreading, maintain or increase the concentration of some nutrients. Disadvantages of this process are, increased cost (approx. $7/T F.O.T.), strong odour when processing and shrink of product results in increased cost.
Composting

Composting at Sandalwood Feedlot consists of two separate operations.

1. Composting of manure, grain dust and straw
2. Composting of cadavers, manure, grain dust and straw.

The advantages of composting manure, grain dust and straw are numerous and include:
• Utilisation of grain dust from feedmill
• Value-added product, suitable for a greater number of uses
• Renewable resource
• Reduced odour
• Easily spread

Disadvantages of composting include a high cost of production, machinery required, labour required, time for process to complete, and shrink of product.

The advantages of composting cadavers are also numerous and in addition to the above advantages mentioned for composting. These include:

• Complete disposal of carcasses
• Saved cost of death pits
• Reduced odour
• Fresh area to autopsy each animal

The disadvantages of this are that specialised machinery may be required and that a suitable area is required for the process.
Managing cotton trash, manure and waste water is a problem farmers are willing to help out with, but at a realistic asking price. Too many times, farmers are called upon to experiment with such products only to find out that these products are of a useful nature and are then told to bear unrealistic prices for the product. Such an example is that of gypsum in particular (a by-product of super phosphate) which used to be only $4-5/tonne, but as you are all aware, once this became a good soil conditioner, the price escalated and now we as farmers are not using it. I myself have cut back as this product does not increase yield. It does help soil structure, but its prices if used to the quantity really needed for any benefit, that is 3-5 tonne/hectare, is just as expensive as artificial nitrogen, which is of an enormous benefit. For example:

<table>
<thead>
<tr>
<th>Nitrogen cost</th>
<th>47c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gypsum cost</td>
<td>5c/kg</td>
</tr>
</tbody>
</table>

Manure, cotton trash and waste water are all by-products of beef, cotton and other industries. We all rely on these products to live, hence the question arises – Why do farmers have to pay excessive prices for really doing mankind a huge favour? That is – getting rid of waste – solving huge problems – stockpiles of manure, cotton trash and waste water. Of course we all know about the waste water problem.

My main topic is – Do we really need manure or cotton trash as a soil enricher or could we do without it? Well we could do without it, and rely on artificial fertiliser. I have, however been experimenting with manure mainly, now for 5 years or more, and in actual fact, have not found any real benefit yet in dollar terms. I have noticed that by crop does stay a lush green for longer when manure is used.

In saying this, my main belief is that in the long term maybe we will benefit. I have had areas laid aside that will produce enough cotton for a cotton module, that can be weighed, ginned and classed and found that an economical rate of spread manure did not increase yield the first and second year. However, when I increased the level of manure from 10 tonne/hectare to 15 tonne/hectare and then 20 tonne/hectare, I did notice an increased yield difference:

<table>
<thead>
<tr>
<th>Nil per ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 tonne/hectare – 13.04 tonne module weight</td>
</tr>
<tr>
<td>15 tonne/hectare – 13.68 tonne module weight</td>
</tr>
<tr>
<td>20 tonne/hectare – 13.90 tonne module weight</td>
</tr>
</tbody>
</table>

However, economically, the 15 tonne/hectare did work out the best, but to transport the manure, to pay to get it spread and outlay for the cost of manure was a huge up-front cost. Having my own equipment does offset a lot of cost, but to be fair it is still an expense and it must be put in perspective of a cost structure.

Compared to artificial fertiliser – anhydrous, which is delivered, transferred by pump to machine and then directed to the ground, manure and cotton trash have to have transport, spreader, end loader and more labour (time of spreading).
To me, manure is a huge benefit to the soil in the garden where most people see the effect, but this is all too often 50% manure, cotton trash and 50% soil as most people do a small area. Thus the lush vegetables and sweet corn etc. But have you ever had a look behind a spreader and actually seen the manure or cotton trash without having to look really hard? Over a hectare, there is not much to see. This comes back to economics of quantity spread. If you could spread what the gardener does, yes we could have terrific crops. This is why I feel hopefully manure will, after a few years of use, start releasing its benefits. So far, I have not cut back on my artificial fertiliser rates. I have a graph of Deltapine cotton variety trials which are very accurate. Because Deltapine were doing these trials, I doubled my gypsum, manure rates and you can see by the graph that there is no difference at this stage. Take note, the Delta Emerald was the variety over the whole 88 hectare paddock and it averaged the same 2.4-2.5 bales/hectare.

Farmers like myself are also faced with this all too often dilemma (PRICE). Something we cannot get a hold on and something we accept reluctantly, but as in other industries, we are looking at moves to change this attitude. No longer can we accept what everyone else tells us what we can pay for an input product and get for our produce, otherwise there will be no food, no clothes and maybe no farmers.

Why I am saying this is because manure and cotton trash should be like our products that we sell. If we sell sorghum and the moisture is too high, the grain too light, protein levels are low or if it contains foreign seeds – we get docked, and severely I might add! Wheat, barley, all crops are the same.

Now these are the crops that the feedloter buys from us and he, like all buyers, does love those dockages. Well I say we should be on the same standing. Manure in particular can come to the property with rocks, small gravel, excess moisture, insufficient moisture or nutrient levels varying, but no, we cannot dock them. We have to accept this. (Getting someone to hand sieve manure for foreign objects could be a problem though.) When stones come in my manure, they get spread over hundreds of hectares. My farm is on a treeless plain (no sticks, no stones, just very high value land). Why contaminate it with stones? It may not mean much at the moment, except for the risk to slasher blades and barefoot bug checkers in the wet, but years down the track, cotton, maize and sorghum may not be grown here. In this highly fertile soil it could be low to the ground crops such as vegetables, to accommodate the growing population. Stones are a no-no in this sort of soil type. This is why penalties should occur if manure is contaminated. Well, at the moment I am not prepared to accept this and a lot of other farmers are talking about getting together and setting the price, or do not use this product.

My supplier, who incidentally is sitting beside me, has an understanding with me about the problem and we are trying to overcome this. However, this does come at a cost to get uncontaminated manure. Now he tells me that they are selling the manure at cost. I have no reason to doubt him as cost of excavation and screening are expensive, but the base price a couple of years ago was negligible. Because we farmers have made this product useful, the price has soared – just as the price of gypsum did.

Now I do want to emphasise that we are getting rid of a waste product that is not wanted by the lot feeder. If we do not use it what a stockpile there would be. I like to use manure, because it is a great product, but at a realistic price. So to be fair to the farmer, lotfeeder and the environment, cost plus a little profit doesn’t cause a problem, but it must be pure manure just as our sorghum has to be free of all contaminants including chemical residues now.
Cotton trash I have used and found it to be rich in trace elements and nitrogen. As long as it has had time to decompose (without help – 5 years) it becomes like a friable soil and is easy to spread. I found no difference in yield compared to manure. Same transport, spreading costs etc. I only used it on one strip two years ago but have since stopped using cotton trash as I am afraid of *fusarium* and *alternaria* diseases that could be present in non-composted cotton trash. The first two years I knew where the trash came from but since the widespread uptake of cotton growing, the gins are getting cotton from everywhere, hence I have stopped. The risk of contracting one of these diseases in your ground would be disastrous.

Finally on the subject of waste products, I know the old proverb “if you don’t want it someone else will.”. Well that is starting to sound a bit hollow with we men of the land. Maybe we should all get together to form a buyer resistance group. However farmers like to be independent and this does create a problem as far as unity is concerned. I ask all waste makers not to take us lightly as we ultimately, will be the end user of waste water, manure and cotton trash. So be careful in your costings as we may say *NO*. 
An Alternative to Anaerobic Ponds for the Treatment of Dairy Waste

Dominic Xavier  
DOWMUS Resource Recovery Pty Ltd

Traditionally dairy farmers have spent vast sums of money annually on water and fertiliser. These two essential commodities play a major role in the nutrition and health of dairy cattle, which is reflected in the quality of milk produced. An alternative is an environmentally friendly system engineered by DOWMUS Resource Recovery, capable of producing wastewater of high quality that can be recycled for irrigation etc., thus effectively reducing your overheads and the production cost per litre of milk.

In the past dairy farmers have used several methods to dispose of the spent water from their dairy sheds and holding yards. These methods include the use of drainage trenches feeding to lower paddocks, silt traps or diversion into anaerobic dams and ponds. The use of these anaerobic dams and ponds does not give the farmers the opportunity to use the resources in the wastewater to their benefit. Wastewater treated through anaerobic ponds is often of poor quality and nutrients are lost in the anaerobic process. This meant that the farmers could not re-use the wastewater for irrigation or re-use the nutrients to fertilise their paddocks.

The anaerobic treatment of waste using anaerobic ponds is slow, and as a result the pond must be large to provide for the longer retention times. Alternative conventional aerobic systems are costly to purchase, operate and maintain. The DOWMUS Bioreactor Ponded Pasture option will allow the farmer to reduce the organic content and nutrient concentrations in wastewater to a level suitable for irrigation. By utilising plants that thrive in high nutrient aquatic environments in the ponded pasture system, nutrients are reduced in the water and the plants can be harvested as high value cattle fodder.

The centre of the DOWMUS system is a Bioreactor with a natural ecosystem and worms within the chamber. The Bioreactor is designed to treat all organic wastes, both liquid and solid, by retaining the solid wastes on the surface of a passively aerated compost bed. In the Bioreactor solid waste is broken down, treated and converted to stable worm casts. The compost bed itself acts as a trickle bed filter to aerate the wastewater. The specifically selected species of worms further increase the biological activity in the system by increasing the rate of treatment of the organic putrescible solid waste.

The system requires no mechanical aeration devices, ie. fans, compressors and air pumps. This feature of the DOWMUS system virtually eliminates running and maintenance costs. The passive aeration of the system makes it more reliable than conventional mechanically aerated treatment plants. The DOWMUS Commercial Bioreactor system is a much simpler, more reliable and energy efficient alternative to aerated waste treatment systems. The treatment plant at the trial site is designed to treat a total of 5000 l/day of wastewater. The influent entering the system contains a Biological Oxygen Demand (BOD) of 4000 mg/l. The effluent leaving the system will contain a BOD less than 500 mg/l.

The dairy farmer collaborative with this project considers the re-use of water for irrigation and access to high quality fodder, key features of the DOWMUS system. If capital cost can be kept below $10,000 this will be a cost effective alternative to anaerobic ponds.
Composting for the Nursery and Landscape Industries:

Limitations and Opportunities

Manuel MacDiarmid
ORGRO

Introduction

For the past 20 years I have been involved in the landscape supply industry, originally as a retailer and, currently, as a “manufacturer” of growing media. During this time it has become increasingly difficult, if not impossible, to obtain soils on a long term environmentally, sustainable basis, hence the need to “manufacture” soils. It is no longer acceptable to extract topsoils such as lantana soil, or even red soil, from areas within or outside Toowoomba.

I look at organic materials in the waste stream as a resource, not as a waste product. I am in the green organics processing industry. I am not in the green waste disposal business. It may be that the processing costs of the majority of these products are greater than their value at the end of the process. This means that we need to be paid to receive these materials before we start processing.

Opportunities

Disposal Costs - the Driving Force

Organic materials constitute a high proportion of the waste stream (30-50%) and offer real opportunities for diversion from landfill to value added marketable products. In 1991, the Commonwealth Environment Protection Agency set an objective for 50% reduction in the volume of solid waste disposal to landfill by the year 2000. This ambitious strategy was abandoned before it even got started. The Queensland Government had set a target of a 30% reduction over 1999 levels by the year 2004, this also appears to have been abandoned. NSW was proposing a ban on organic material going to landfill commencing July 1998; this has been deferred to late 1999. Organics are banned from landfill in most states in the USA. To achieve these targets, green organics must be removed from landfill. Once removed from landfill, composting is one of the processes of converting these wastes into a marketable product. It must be remembered that composting is only a process and not a disposal option.

With the introduction of Environmental Protection Policies (EPP) local authorities may be forced to introduce “user pays” for waste management. User pays requires that all identifiable costs associated with the use of a resource should be included in the market price of goods. Generally, landfill charges do not reflect the full or true costs of their operation. Apart from costs associated with leachate and gas production, there are post-closure costs which no one wants to know about. According to the Queensland Environmental Protection Agency (EPA) a facility that would serve 100,000 people and have 20 years post-closure maintenance, would cost about $2.30 for every tonne of waste accepted at the landfill. This means $210,000/year (based on a per capita annual generation rate of 900 kg). For example, where will the funding come from for the estimated $4,000,000 post-closure costs for Toowoomba’s Bedford Street landfill?
Brisbane’s landfill charges are:

- Bulk $62/tonne
- Cars carrying refuse $5.00
- Single axle trailers and utilities $12.00

It is my guess that these charges are as high as they appear because Brisbane’s landfills meet current environmental standards. When waste generators start paying these sorts of fees there are opportunities for green organics processors.

Toowoomba City Council estimate that 14,700 ton (38,700 m$^3$ of mulched material) of reen waste is landfilled at the Bedford Street landfill annually. Added to the 16,000 m$^3$ of biosolids generated by Council’s waste water treatment plant, Toowoomba has a large quantity of material from two waste streams alone.

Direct application to land of animal manure is set for heavier regulation due to the threat of spreading diseases and water quality issues. Large animal feeding operations will be required to develop and implement nutrient management plans as part of farm waste management strategies. Manures are not an item to be discarded at minimal inconvenience and cost. Land disposal of manure must be based on plants ability to “take up” the nutrient being applied. Composting and “co-composting” animal manures with other materials is seen as a viable solution to current practices and may lead to greater opportunities.

Marketing Recycled Organics

The landscaping industry is currently the largest user of compost. Compost is used to manufacture all sorts of garden soil and lawn top dressings. The nursery industry is more inclined to sell compost to their customers than use it in their own operations. For nurseries to use compost themselves (rather than pine bark based mixes) they must be assured that the compost is of a very high standard. All users require a reliable supply and a product that at least meets Australian Standards.

In the Greater Sydney Region, the Garden to Garden program is in its second year. The program links all sectors of the green organics industry and helps the completion of the recycling loop. Over 100 outlets stock Garden to Garden products from 4 manufactures producing over 21 co-branded products for retail and commercial markets.

Agriculture and horticulture offer further opportunities. These industries can absorb much larger quantities than existing markets. If composted products are to be taken up by these markets, then the current mindset of “what is the N:P:K” needs to be replaced. Gardeners and farmers should be looking at compost to supply quality organic matter which will improve

- air-filled porosity
- water penetration and storage capacity
- aggregate stability
- cation exchange capacity
- biological activity
- nutrient holding capacity
For these reasons agriculture is an enormous potential market. All that is required is to make the product available “at the right price”. This could mean that generators not only have to bear the processing costs but also transport costs to farm gate. Landfilling at $60/ton may not be an alternative.

Limitations

The greatest opportunities are also the greatest limitations. To me one of the greatest opportunities is the local landfill and this is currently the greatest limitation. Nothing is as reliable, as accepting and as cheap as a “dump”. Ratepayers have been making free trips to the local dump for generations. They think it is a free service provided by the local council. We will soon be in the year 2000 and we must realise there is no such thing as a free lunch. Waste generators don’t think that the waste they generate is their problem.

The decision to adopt the user pays principle lies with the elected representatives of our state and local authorities. They are reluctant to introduce these charges knowing that they are going to upset ratepayers. We have all heard the cry “what are we paying rates for” when the prospect of gate fees at landfills are discussed.

Councils accept large volumes of green organics, which they may process at the lowest price and believe the problem is gone. The shredding of green waste and composting is not a disposal option, it is only a process. Gardeners do not buy compost. They buy soil mix, lawn topdressing, potting mix and soil conditioners with compost in them. They want an immediate solution to their problem. They don’t want to be told to buy compost, take it home, dig it in and plant into it in two weeks time. The product has to be taken further down the line in order to find a home for it. Don’t forget it is the consumer who calls the shots.

The quality of the input material is clearly a major factor in determining the quality of the finished product. There is no point in having a green waste disposal area at a landfill if there is no close supervision of the material as it is being unloaded. Contaminants such as plastic, glass, steel and concrete cause problems when the stockpile is shredded and can produce a product that cannot be even given away. A large plastic bag with grass clippings in it, once it has been through a shredder, becomes 10 to 20 pieces of plastic. These contaminants don’t go away during composting, and may not be removed during screening. Glass can be another problem. These contaminants must be removed at the start of the process. The community must be educated about proper source separation of all materials for recycling. Promotions such as “A Shared Responsibility” are vital, so that clean material can be made available to processors.

Transport costs are a further limiting factor. Compost sells for between $15 to $20 /m$^3$ which is about $9 to $12 /tonne. It doesn’t have to be carted too great a distance before the freight component can become higher than the cost of production. I can’t market compost in Brisbane, but it also means it is difficult to ship it to Toowoomba as long as the disposal costs are similar in both cities - which they aren’t at the moment. This restricts the geographical spread of markets.
Conclusion

Demand must lead supply. If it is the other way around we have big problems, as is currently the case with the curbside recycling programme. This is costing taxpayers $30 million per annum after the sale of materials.

Markets do exist and must be developed, but they need to be in our own backyard.

The critical element lies not in the collection and processing of raw materials, but in the establishment of sustainable markets for the material once produced.

References


Changing the Image:
Process Definition in the Mushroom Industry and the Mushroom Growers’ Code of Practice

Carol Holden
Darling Downs Mushrooms
Chairman of AMGA

I am a mushroom farmer. As a mushroom grower, a mushroom spawn maker and a mushroom substrate producer, I have been part of the mushroom industry since I began work in 1964.

I love being a mushroom farmer. Mushrooms are a fascinating crop for many reasons, not the least of which is that they can grow in the dark without the need for sunlight and still be a highly nutritious and tasty food. To be a mushroom farmer, the first step one would take is to build a shed. Mushrooms grow best in a protected environment in which temperature, air flow and humidity can be closely controlled.

The other fascinating thing about mushrooms is that they cannot digest their own food and need to have a specially prepared substrate as a predigested and nutritious medium on which to feed and reproduce. It is this aspect of mushroom culture that has led to me being invited to talk to you today as my husband and I are the owners and operators of a mushroom substrate supply facility at Wellcamp on the outskirts of Toowoomba.

Like most other primary industries, the mushroom industry has made great strides in technology and efficiency in the past fifty years. Yields which could support a family and let the farmer retire at an early age back then would send one broke today. Although mushrooms had been eaten by ancient Egyptians and subsequently grown in caves in Europe, the first Australian mushrooms to be commercially cultivated were grown in a disused railway tunnel at Wynyard in the Sydney CBD in the 1930’s.

The baton was then taken up by farmers in the Hawkesbury District west of Sydney which was then that city’s breadbasket. Mushrooms are now grown in every State of Australia, near every capital city and near most major country towns.

I have already mentioned that mushrooms need a ready made substrate on which to grow and this was historically made by each farmer just down the back from his mushroom growing sheds. The substrate is made in two phases.

Phase 1 is an outdoor phase where the ingredients, wheat straw, chicken manure, stable bedding, cottonseed meal, cottonseed hulls and gypsum are blended with water and turned. It takes approximately three weeks until the substrate is ready for:

Phase 2 which is an indoor phase lasting one week where the substrate is pasteurised with steam to kill off any unwanted insect and mould pests and then conditioned and cooled ready for planting.

Although this process was originally done on individual farms, by the 1970’s advances in technology and economies of scale led to specialist substrate makers preparing Phase 1 substrate for many smaller farms. Nowadays, even phase 2 substrate is available for commercial farmers who then only need to build the actual mushroom growing facilities and can devote their time solely to tending their crops.
It is Phase 1 of this process which concerns us today. The mushroom industry prides itself on being the original re-cyclers. Long before this was fashionable, we were using “waste” products or as we prefer to term them, by-products, from other rural industries, producing a wonderful food, and at the end of the process being left with a product which is ideal for nourishing the growth of green plants and for use as an additive in the newer potting and mulching mixes.

Once larger and larger amounts of substrate were being prepared in one location, the odours emanating from the piles or ricks began to be a problem. The old farming districts were being settled more and more by escapees from the city rat race. It has been our experience that these people have the highest bar none expectations of neighbourhood amenity, as they have just moved from the city to escape all the noise, dust and smells. Most also seem not to acknowledge that rural life has been doing its thing there for many years before their arrival and if any of it interrupts their new enjoyment, they want it to cease or to jollywell pack up and go.

This is not to say that our industry was slap-happy in its practices but when your nearest neighbour is a couple of miles across the paddock, it hardly matters what either of you do. In the new urban fringes, it starts to matter greatly.

Governments, both local and state, have also had to react to the new realities and in all states, environmental laws have been passed requiring anyone who has a waste product which is seen to have an impact on the environment to have a licence to operate.

(Show Video)

In a mere ten years, our own company has gone from having an “as of right use” on our property to having to hold and comply with an Environmental Licence.

Our industry is very fortunate in having a very active industry Association, the AMGA, and through that organisation, we have made representations to the various planning bodies in most states in order to ensure the ongoing viability of our industry.

Remember, without the substrate, nobody can grow mushrooms.

When the environmental licensing laws were being formulated in Queensland, we recognised the need for individuals to be licensed and by attending various forums with other intensive rural industries, we saw that if we developed a Code of Practice for Mushroom Substrate Preparation this would not only lay down guidelines for producers by encapsulating industry best practice, it would also help legislators to recognise responsible operators.

This then is part of the rationale for our Industry Code of Practice: -

Our general environmental duty as stated in Section 36(1) of the Environment Protection Act (1994) says

“A person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practical measures to prevent or minimise the harm.”
There are various practical measures to be considered when interpreting the general environmental duty including:

- the nature of the environmental harm,
- the sensitivity of the environment being harmed
- technical knowledge available
- the availability and practicality of alternative measures
- the financial implications of those measures.

In addition, the Environment Protection Act establishes as unlawful various acts or omissions that result in environmental harm.

In the case of unauthorised environmental harm and where relevant, contravention of EPP or other subordinate legislation, a defence against prosecution can be mounted on the basis that the activity was lawful and the defendant had complied with the general environmental duty – “by complying with the relevant code of practice (as approved) by the Minister.”

Our Code of Practice has been prepared by industry members and our own Association using the services of Peter Watts from FSA Environmental, who had already had experience in the intensive livestock industry. It has been presented to the DPI whose input was included. The draft code is now lodged with the EPA and is in the queue awaiting approval, submission to the Minister and subsequent gazettal.

In preparing the Code, we have endeavoured to make it commercially realistic – ie. not so restrictive as to prevent industry from carrying out its function. We have refrained from naming and describing specific processes so that individual businesses will be able to use new technology as it becomes available. We have done this whilst bearing in mind our primary aim - ie. to ensure that substrate preparation is carried out in such a way as to have as little impact on the environment as possible.

For example - at our yard we make between 150 and 200 tonnes of mushroom substrate per week. This is done by mixing together all our raw ingredients with water and stacking this mix in ricks where it is turned using custom built machinery.

We know that this should be done on a concrete slab and this is a primary requirement of our Code of Practice. *(Show slide)*

We know that such a mix can quickly become anaerobic and thus emit quite foul odours so it is a requirement that heaps be turned regularly to keep them aerobic. *(Show slide)*

We know that even a small puddle can emit odours a hundred times worse than a dry area and industry best practice is not to have leachate lying around. *(Show slide)*

We know that trucks delivering materials and taking away the finished produce create dust and so it is part of our Code to keep dust to a minimum by watering or sealing internal roads. *(Show slide)*

And so on…

So to revert to the topic of this Forum - Organic Waste - a Dollar Made or a Dollar Paid? - have we made a dollar out of what we do?
We have always had an end user for our product and so, because we only make this product to order, we never have any problem selling it.

We did begin by obtaining most of our materials for nothing but this only lasted for about a minute. As soon as the farmers recognised that there was a market for their by-products, they began to charge us for them. Today, we pay the wheat farmers a royalty for their stubble which would otherwise have been burnt. We pay the chicken farmers for their manure which was once an embarrassment to them. We pay for cottonseed hulls for which there was once no market.

Like most primary producers, mushroom growers are price takers and not price makers. The only way in which mushroom producers have been able to maintain their viability is by increasing their turnover. Our Association has been very active in the promotions arena to increase per capita consumption of mushrooms and maintain sales. The industry has enjoyed a 10% per annum expansion rate over the last 25 years and this has of course led to an increased demand for mushroom substrate. Growth is now levelling off as supply approaches, and in some instances, exceeds demand. We cannot raise the price of our substrate if growers cannot obtain more for their mushrooms. There are costs in complying with our industry Code of Practice but certainly in our own case at least, these have been minimal. Our own common sense had already dictated that we used what we knew to be industry best practice.

Our Environmental Licence costs us $400 per annum.

Our Australian industry’s mission statement is “Mushroom growers are responsible primary producers dedicated to providing wholesome food for the community. AMGA exists to provide effective leadership to a united industry and to foster an environment in which the fungi industry can grow and prosper.”

By taking a proactive stance and formulating our Queensland Code of Practice, the industry has endeavoured to change the image of our substrate producers from one of the back yard operator (who mixed up a few stacks of material in the back paddock) to one of a technologically aware farmer of the nineties and indeed the new millennium: a farmer who endeavours to make a high yielding substrate in a manner which has the least possible impact on the environment.

Yes, it has cost us money to do it and we are keenly aware of our “Dollar Paid”.

By defining industry best practice, we believe that we are being responsible primary producers

We have acted to protect the environment and by so doing we have also protected our industry viability.

We trust that this will maintain our “Dollar Made”.
Vermicomposting as a Viable Waste Processing Industry

Rex Corsi
Geham Valley Worms

Introduction to Vermis (the worm)

Much has been written about the benefits of the worm to mankind but little evidence is available to explain its contribution. Anecdotal and observational evidence is strong and persuasive in support of the hypothesis that the existence of worms in the soil is a good indicator of the health of the soil and the environment.

Healthy soil, according to Aristotle, is a living organism and the earthworm "the intestine of the earth" that assists in its maintenance. Charles Darwin, in his 1881 publication "The Formation of Vegetable Mould Through the Action of Worms with Observations on Their Habits", argued that "of all animals, few have contributed so much to the development of the world, as we know it, as earthworms."

The worm working in harmony with bacteria, viruses, fungi, insects, spiders and other soil animals, constitute a biota as related to soil. Where this biota is large, the soil will be rich in humus. This will be evidenced by lush, healthy plant growth and "soft" soil.

Fertile agricultural cropping lands have been found to have a worm population of 500 per square metre with the accompanying members of the biomass reaching a mass six times that of the worm. If the average weight of the worm was 1 gram, then in soil covering:

\[
\begin{align*}
1 \text{ square metre} &= 500g \text{ of worms} + \text{biomass of 3000g;} \\
1 \text{ hectare} &= 5 \text{ tonne of worms} + \text{biomass of 30 tonne.}
\end{align*}
\]

On these figures the biota of 35 tonne working under the soil would be equal to nearly 90 head of cattle per hectare on top of the soil. The worms, if encouraged, will eat 25-100% of their body weight daily and will work the soil, aerate and fertilise at the rate of 55-180 kilograms per square metre each year.

If we take the lower figure this represents 550 tonne of soil per hectare being worked by these worms. This soil will be softer, more moisture retentive and more productive.

Handrek and Lee noted that in Europe worms can deposit a 200mm layer of “topsoil” in 100 years whereas in our more degraded and worm deficient soils the deposition rate is estimated to be between 25 to 40mm. Moisture no doubt plays a significant role in explaining this difference. However, farming and land use practice play an equally important role.

Typically our most fertile soils are found on water courses and their deltas. Much of these lands have been lost to agriculture to accommodate our developing cities, and their supporting infrastructure. In moving to less fertile soils we have frequently failed to remember why some soils are more fertile than others. We have attempted to overcome moisture deficiency by irrigation and plant nutrient deficiency by chemicals, often with disastrous results.

Most of our available soils are ancient and degraded and low in moisture content. Not an ideal scenario for a health biota and healthy soil. When combined with practices that destroy the biota it is little wonder that in many areas we suffer severe environmental damage.

*The good news is* - We can do something about it!

*The bad news is* - There is no short-term remedy.
**Vermicomposting and Composting**

Composting is the breakdown of organic matter to form humus, the composition of which is a function of the content of the matter used. Compost made principally with sawdust will be low in nitrogen and essential plant nutrients but high in carbon. Such humus may be a useful soil conditioner but lacking as a source of plant nutrients. Alternatively, compost made from manures from grain fed animals will be rich in nutrients but relatively low in carbon. Such humus will be a useful source of plant nutrients and act as a soil conditioner in providing both organic matter and microbes to the soil.

The best composting process will combine "food" sources to produce a humus that is rich in nutrients and has a "balanced" carbon/nitrogen ratio.

A further dimension of the attempt to DRAMATISE the use of waste to "save a dollar or make a dollar" is to add WORMS to this process. The worms in collaboration with the bacteria and viruses facilitate the decomposition process and in so doing not only reduce the time dimension but add additional enzymes and bacteria that are beneficial to plant growth.

Our responsibility as stewards of our section of the environment is to ensure that future generations can enjoy a lifestyle equal to or better than the one given to us by our predecessors. This may require looking for longer-term environmentally friendly solutions to the waste that we produce. Such solutions will only be achieved if we follow the philosophy of our predecessors that we can achieve what we want with a little BLOOD, SWEAT and TEARS.

Without wishing to DRAMATISE the BLOOD and SWEAT involved in vermicomposting, it does involve a further dimension of "livestock" management. Worms are living things that need to be managed like other livestock if they are to assist in producing nutrient rich vermicast on a continuing basis. It is therefore essential to understand some basic worm facts.
Compost Worms

All worms are hermaphrodites and the compost worms have the capacity to double their population every 30-45 days in an ideal environment. Two mature worms in ideal conditions can multiply to 1500 on one year.

Compost worms are characterised by:

- Their ability to consume their own body weight in a day
- To pass the consumed waste as vermicast every 24 hours
- Mate and deposit fertilised capsules every 4-14 days
- Each capsule will contain 2-20 worms that will be sexually mature in 2-3 months
- Capsules usually hatch in 14-16 days but may last up to 6 years.

The three principal species used in vermiculture and vermicomposting are reds, tigers and blues.

**Reds**

They are of European origin, have a high tolerance of cold and will adapt to life in an organically rich soil. They are prolific breeders with up to 100 capsules each year.

**Tigers**

Also of European origin, similar to the red but does not adapt well to pastures. They average 50 capsules per year.

**Blues**

A native of South East Asia that can tolerate a wide range of temperature and environment. They can adjust to nutrient poor soils and pastures. Exact fertility is not known.

Worms do not mate between species as they are genetically incompatible.

The fourth species used in Australia - *Eudrilus eugeniae* (African Night Crawler) is commonly bred for the bait trade and is not considered here because of the greater management difficulties and its vulnerability to extreme cold.

Worm Management

The ideal worm breeding and eating environment contains ample organic matter, with about 40% moisture content, a temperature between 20 and 27 degrees centigrade and a pH of between 6.5 and 7.2.

If worms are to be used for vermicomposting, as opposed to breeding worms/vermiculture, then several options exist.

**Option 1**

Purchase worms and introduce to compost when the compost is worm compatible (see above). The compost could be in pits or windrows. This would require salvaging sufficient worms when harvesting the vermicast to continue the process.
Option 2  Purchase worms and establish a breeding operation to supply worms to the vermicompost operation. Surplus worms may be available for sale. Salvage of worms from cast is less important.

Option 3  If practicable, relocate waste to an established vermicomposter.

Whilst compost worms are remarkably hardy, they do require management and management requires time. With the right organisation and equipment this time factor can be reduced significantly. Most of the resources required can be available from existing agricultural equipment. It would be prudent not to invest in vermiculture specific equipment until the technology of vermicomposting is known and experienced.

Previously an attempt was made to DRAMATISE the BLOOD and SWEAT involved in vermicomposting. In addition we need to consider the TEARS involved in "livestock" management. Many heroic claims have been made about the returns from breeding worms (vale Steinmark, Wally Worm, Network Compost Systems etc) and from the sale of vermicast and liquid vermicast. But evidence exists to suggest that investors in such schemes at best recovered their outlay and more frequently received no return.

To achieve the objective of "saving a dollar or making a dollar" by converting waste to cast requires some knowledge of the output of vermicomposting viz vermicast.

Vermicast

The castings produced by worms act as a fertiliser and soil conditioner. A proportion of insoluble minerals passing through the worm’s digestive system is converted into a plant available soluble form and cellulose is partially broken down. This process is carried out by enzyme producing bacteria and when the castings are excreted, the bacteria and enzymes are excreted with them. These bacteria are soil benevolent and continue working in the soil to convert minerals into a plant available soluble form and breaking down cellulose, making humus (D Murphy, 1997).

Whilst there is some evidence that there are more available minerals in vermicast than the parent soil, the mineral content is a function of the minerals in the food source in which the worm lives. Worms do not add minerals but they do change the form of the minerals so that there is more available as plant food.

Murphy detailed the results of a typical analysis of cattle manure before and after worm ingestion reported in Edwards.

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<thead>
<tr>
<th></th>
<th>Before</th>
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<tbody>
<tr>
<td>Nitrogen as Ammonium</td>
<td>117.1 ppm</td>
<td>141.5 ppm</td>
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<tr>
<td>Nitrogen As Nitrate</td>
<td>8.8 ppm</td>
<td>259.4 ppm</td>
</tr>
<tr>
<td>Potassium %</td>
<td>0.19</td>
<td>0.41</td>
</tr>
<tr>
<td>Phosphorous %</td>
<td>0.11</td>
<td>0.18</td>
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<tr>
<td>Calcium %</td>
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<td>0.59</td>
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<tr>
<td>Magnesium %</td>
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Murphy also provided an interesting summary of research which indicated that a 90 times dilution of vermicast resulted in less than 5% fall in the fertility index. This also has implication for potential application of cast in agriculture and requires further testing.
Worm cast added to the soil helps the development of the micro-environment essential for a health soil ecosystem. Parle (1959) found that bacterial growth in and around worm cast was 100 times greater in freshly deposited castings than in the surrounding soil. Parle found a significant increase in the proportion of stabilised plant available nitrogen following the application of cast to the soil.

Buckerfield and Webster conducted controlled tests in viticulture and found significant increases in yields (34-55%) in the vineyards where a vermicompost/mulch combination was used. They concluded that the mechanisms responsible for enhanced yields are not obvious, but it seems likely that the relatively rapid responses to vermicompost may be due to a stimulation from a biological rather than a chemical component.

The Buckerfield and Webster study is a useful starting point in conducting controlled tests in the use of vermicompost but leaves many questions unanswered and a range of challenges to the scientific community to conduct more controlled tests.

**Financial and Economic Considerations**

There appears to be no published data on the economics of vermiculture or vermicomposting as a means of waste disposal. To evaluate the economics of a given approach to processing waste we need simply compare the alternatives.

The difficulty in developing a generic financial model is the propensity to develop low cost (in terms of capital outlays) approaches to composting/vermicomposting using existing resources. The danger of high cost systems is the highly specialised nature of equipment which frequently means that once acquired it has an opportunity cost of zero. For instance if you buy a system for $20000 and it can perform no other tasks, then it is difficult to recoup this cost other than through use. The payback or cost recoupment from such equipment needs to be quite short term.

It may be prudent to limit such outlays and use simpler low cost technologies until the economics are more certain.

Some possible equipment options for vermicomposting are outlined below.

**Compost and/or Worm Systems**

In larger scale operations a mechanical approach to handle the raw waste and the output compost/cast is essential. On a smaller scale, up to 1-2 tonne of waste per week, it can be done manually. In a feedlot application producing about 1 tonne of manure per day, the manual option is not viable. However, removal of the waste from the operating area is an existing activity and is usually mechanised.

The new activity may be the organisation of the waste for composting/vermicomposting in a system of beds or windrows. The principal difference between composting and vermicomposting for handling the waste will be the depth of material. For worm processing, temperature, moisture and aeration need to be more strictly controlled. An option of vermicomposting using beds/pits or windrows has the advantage of small set-up costs.
**Beds/pits** can be on the ground, with or without a liquid collection facility and constructed of any available medium (timber, concrete blocks, tin). For temperature control and moisture retention, some covering of the beds makes management easier. This is the best facility for breeding the volume of worms required to process large quantities of waste. If used on a large scale it is advisable to space beds to allow easy mechanical access for feeding, aeration and cast harvest.

**Windrows** are the lowest cost option and may be developed straight on the ground and provided an adequate watering system is available need have no covers. The windrows should be organised to allow easy mechanical access for feeding, aeration and cast harvest.

It is best to allow sufficient space between windrows for the next windrow to be laid parallel for worm extraction and cast harvest. Care needs to be taken with windrows not to exceed 1 metre in height, otherwise the heat will prove fatal to the worms.

In both beds and windrows, new "feed" needs to be introduced weekly and should not be applied to a depth of more than 10cm. As the compost worm tend to be top grazers, food greater than this depth may remain uneaten and eventually cause an "acid" build up in the bed. This may partially be countered by an application of dolomite or agricultural lime.

**Shredders/Aerators**

If the waste is already in a worm digestible form it can be fed directly to the worms. For example manures which have been through a digestive process and are already partly decomposed. Subject to the risk of a heat build up and knowledge of whether the manures are from animals that have been "wormed", manures can be fed directly onto the beds/windrows. The use of shredded paper or old grass will assist in keeping the "beds" aerated.

If the waste is not in worm digestible form, for example fresh vegetable waste, then processing through a chipper shredder and partial composting will speed up the rate of consumption by the worms.

Aeration of beds/windrows can be done manually, with a garden fork, or mechanically with a fork lift (or other modified machines).

**Worm/Cast Harvest Machines**

On small scale applications worms can be harvested for re-use manually either by baiting with high protein meal (such as bran, pollard or millrun) in strips on the bedding or the use of bait racks (bakers' trays) filled with fresh food after a period of limited food. In either case they cause intense congregation of worms for easier harvest.

Alternatively, worm harvest machines are available that will extract up to 90-95% of the worms. The cost of such machines is a function of size and ranges from around $2500 to $7500. An advantage of these machines is the quick extraction of worms and the additional processing of the cast makes it more friable for easier handling.

**Bobcat or Tractor with Scoop**

In larger operations this will probably be an existing piece of equipment. It will be essential for handling feed, aeration of feed and beds and harvesting the cast. Some growers have modified existing equipment to perform other specialist functions.
Recurrent Outlays

Worms

The scale of the worm system is obviously a function of the size of the waste output and the nature of the waste. One advantage of vermicomposting is the speed of conversion of waste to cast once the waste is in a worm consumable form. It is in this form that the worm can consume its own body weight daily in moisture and food. In larger applications this waste to cast conversion is more likely to be based upon the worms consuming about 25% of their body weight per day.

Therefore an operation producing 1 tonne of waste per day would require:

\[
\text{Volume of worms} = \frac{\text{Waste tonne}}{\text{Worm Waste Consumption \%}}
\]

\[
= \frac{1 \text{ tonne}}{25\%}
\]

\[
= 4 \text{ tonne (4000kg)}
\]

If the worms were operated at 2 kilograms per square metre then you would need a bed/windrow surface area of around 2000 square metres. With more intensive management a higher volume of worms per square metre and an increase in waste consumption could be achieved.

To purchase these quantities of worms would require both a large outlay of funds and the ability to find a supplier. Market prices for bulk worms range from $20 to $25 per kilo with occasional instances of $15 per kilo. If we assume $20 per kilo then from the above tabulation 4 tonne of worms would cost $80000. Given the risks involved with managing such a large body of worms and the difficulty of finding a supplier the better strategy would be to develop an "on-site" breeding program.

For example at a reproduction cycle of 60 days (a conservative figure), a base stock of 500 kilograms of worms could be grown out to 4000 kilograms in less than one year.

This would require good management practice and optimal breeding conditions. The management of such a program would be quite time consuming and beyond the capacity of many people with little free time available after completing their primary activities.

The introduction of the worms to the waste would be part of this breeding cycle provided the waste is presented in a "worm friendly" form. This would principally mean ensuring that both heat and moisture can be controlled.

Based upon these projections most "waste producers" would be best advised to experiment with a smaller scale "prototype" to gain experience in managing a large mass of worms. In addition they would need to gauge the time involved in managing a vermicompost operation of this magnitude.

The other dimension to consider is the vermicast extraction and management. Typically the conversion rate of organic waste to cast is about 75% by weight. Therefore at the rate of 1 tonne of waste per day the annual cast production would be about 274 tonne or 23 tonne per month.
The imputed "value" of this cast at $200 per tonne is $4600 per month or $54800 per year. However as most cast producers discover, systematically selling this cast may prove problematical.

Storage and handling the cast will depend upon whether it is to be recycled "on farm" or sold. In either case the working bed moisture content of around 40% needs to be lowered to 10-15% to make the cast friable and to prevent large clods forming as it dries. The cast can be dried in the beds after extraction of most worms and periodically aerated to facilitate drying.

In order to maintain the health of the cast micro-organisms it is important that it be managed after harvest and stored under covers or applied and covered, preferable with mulch, to achieve maximum benefit. Because cast has the capacity to absorb large volumes of water (water retention can be a high as 100%) drying the cast will significantly reduce its volume by weight. This in turn significantly reduces movement costs and facilitates agricultural application.

Some cast buyers (retailers and nurseries) require sterilisation of the cast to ensure that it is free of seeds and worms. This can be achieved by the use of methyl bromide, steam, or you can solarise the cast (Handreck and Lee). However, some writers claim that this process does not harm the bacteria (Murphy) whilst others state that this kills the microbes (Windust). The sterile cast in my opinion is sterile.
Labour

Careful planning of the system prior to implementation will allow labour inputs to be kept to a minimum. In particular this planning must ensure mechanical access to all beds/pits or windrows. Automating watering systems to maintain an appropriate moisture and temperature level will significantly reduce management time. Labour inputs may be generally categorised as follows:

*Weekly* - Feeding, watering (more frequently in hot weather) and observation of heat, pH, water content and rate of waste consumption.

*Monthly* - Aeration of beds/pits or windrows.

*Quarterly* - Bed splits and cast harvest.

Materials

Depending upon the nature of the waste some additives may be necessary to maintain the health of the worms and the "quality" of the casts.

In wastes that tend to compact and create a low oxygen environment, better aeration could be achieved by mixing the waste with other high carbon wastes (paper, cardboard or waste straw). This can be layered on top of the bed/pit or windrow and new waste spread on top. This ensures a higher oxygen level in the fresh waste and will speed up the rate of consumption by the worms. It also helps to achieve a more balanced carbon/nitrogen ratio in the resultant cast as the worms will also consume the paper/cardboard.

The pH level of the waste must be monitored to ensure that the beds/pits or windrows do not become too acid. A pH of 6 or less may prove toxic to worms as anaerobic bacteria become dominant and the worms will display one or more of the following symptoms:

- Excessive yellowing
- "Coiled" clustering on the surface
- "Sulking" and dying deep in the bedding
- Disappearance (death or migration).

Regular pH readings will help to ensure a balanced pH is maintained. The worms are usually comfortable in a pH range from 6.5 to 7.5. Some growers maintain more alkaline beds (pH of 7.5 plus) to minimise the presence of other composters (red and white mites and white worms) who seem to prefer a more acid environment (pH of 6.5 or less). Dolomite or agricultural lime provides calcium carbonate which aids the worms digestive process and can be gradually introduced to adjust the pH towards neutral.
Power and Fuel

The only inputs would be those of operating machinery and watering systems. Where machinery or equipment is "shared" with other activities time logs should be maintained to apportion operating costs to the vermicompost operation.

Conclusions

If one assumes that there is a waste problem that must be solved then an evaluation of the alternatives must consider:

Capital Outlays

- Does it involve specialist equipment or resources?
- Can existing equipment, with or without modification be utilised?
- Are specialist construction or buildings required?
- Is there an adequate water supply?

Labour

- Can the system be operated with available labour or time resources?
- Is there technical support available for advice or problem solving?

Raw Materials

- Is the method of waste disposal self-sustaining?
- Are all inputs free to the system?

Costs and Benefits

- What are the incremental or additional costs of installing and operating the system?
- What are the incremental or additional benefits and/or revenues to be achieved by using the system?
- Is the financial viability of operating the system dependent upon revenue generation?
- Is the benefit the minimisation of the costs of complying with externally imposed regulations?
- Can the output of the system be used to reduce input costs to other activities?
- Is the benefit socially responsible in meeting environmental expectation of the industry?

Composting and vermicomposting are natural, environmentally friendly solutions to the disposal or handling of any organic matter. The economics of these approaches can only be judged by comparison of the cost and benefits of other alternative approaches. The economics on the benefit/revenue side would be enhanced by more scientific testing of the use of cast and the promotion of the results of such testing through private and government agencies.
References


After Dinner Speaker - Dr Brian Roberts:
Waste Not, Want Not –
Population, Pollution and Resources

Brian Roberts
Land Use Study Centre, University of Southern Queensland
Sinclair Knight Merz

Background

The issue of organic wastes may be approached from several equally appropriate directions – economic, social, technical, environmental, legal or political. The challenge given to me is to put this issue into its broader context in a way which on the one hand recognises the criteria of both efficacy and equity of waste disposal policy, while on the other hand takes heed of private gain and public cost.

In a young country like Australia we tend to see competition for land, water and space as something new, something which has come upon us a result of local competition for resources, notably water. But as my professor at Nottingham told me long ago, “Before we can decide what is new, we must first decide to whom it is new”. In our present context it is fairly clear that the pressures we are now experiencing were obvious for all to see (or at least predict) some decades ago.

Most of us would have been aware of the way in which animal wastes have been an integral aspect of small scale farming for centuries. But when Anthony and Iona Green of Karara gave me a copy of the Latin texts of Cato and Varro, written over 2200 years ago, it really came home to me what slow learners we are on some matters. As one Greek philosopher said, “What man learns from history, is that man doesn’t learn from history.”

Today’s Big Picture

If we classify all our environmental problems we can group them into three major categories:

1. Population
2. Resource Depletion
3. Pollution

With global population increasing at about 94 million per year, and with average doubling time of about 34 years, food and clean water supplies are under increasing pressure. At the two extremes, there are African countries with a 17 year doubling time while West Germany is below Zero Population Growth.

The World Resources Institute tells us that the best estimates indicate that each human being currently has 0.14 ha of cropland available. When I left school, this figure was 0.23 and we have also been losing cropland area through erosion, salinity and urban expansion at the rate of 14% per decade. To give you an idea of the rate of change, when I was born in the Great Depression, global population was 2.0 billion – its now about 6.0 billion. In this time some 24% of the world’s irrigated land has gone saline and thus out of production of its original grain crops.
I ask you to excuse me if this sounds like a segment from “This is Your Life”, but I have been privileged to work in many developing countries in Africa, China and Indonesia, and to represent Landcare Australia at the Rio 92 Global Forum. It was at this gathering of 450 community groups worldwide that the realisation that we really do all live in a Global Village, came home to me very forcefully. Ours is a finite planet in which the interconnectedness of our systems is affecting us all.

So what’s all this got to do with organic wastes in our local region? Well, for one thing it teaches us that despite our perceived resource planning problems we are in a very favourable position relative to many of our neighbours. For another thing it emphasises that of all the worlds nations, Australia probably has a better chance of developing a sustainable society than any other country. Finally, a knowledge of the present global situation should highlight for us, the need for good land use policy and for respecting the difference between political expediency and lasting vision.

Let’s consider a few fundamentals like the condition of our land and how we measure progress. It was these inter-linked trends that caused us to initiate the Landcare movement by finding the common ground between the National Farmers Federation and the Australian Conservation Foundation.

The organic wastes issue is no different from other land-based issues when policy options are considered. In other words we can bring about change in operators’ practices by three major approaches:

(i) Information and education
(ii) Incentives, rewards
(iii) Codes, guidelines, regulations and laws.

In the past we have made the mistake of too often putting our faith in one of these while ignoring the other two.

We have tried, during the Decade of Landcare which is now coming to an end, to gain adoption of good practices through first gaining commitment to the need for corrective action. We should try to answer the questions, ‘What if we don’t take action? Will our family and community have a future if we continue present trends in land use?’
The Issue
How should we measure the health of our land? By:

- Loss of farmland
- Trends in forests and fish harvests
- Changes in animal carrying capacity
- Ratio of harvest relative to replacement
- Pollution trends
- Disruption of water supplies
- Trends in grain yield
- Recycling of raw materials.

So what constitutes success in solving complex resource issues? This depends on which school we belong to:

- The Productivity School.
- The Resource Stewardship School.
- The Social Community School.

The Productivity School has come to realise that unlike earlier days, full costing of off-site effects is required.

The Resource Stewardship School has come to appreciate that unless sustainability includes economic availability, wealth generation will cease.

The Social Community School has come to recognise that if left to the market place, many quality-of-life attributes of progress disappear.

So in our efforts to meet what are invariably listed as our economic social and environmental goals, we have developed regulations, codes of practice, impact assessments and monitoring guidelines. These now function against a background of common law rights and emphasise once again how the previous freedom of landholders to act independently has had to meet new values in our society. The new values pertain particularly to a much wider definition of Stakeholders and a clearly defined Duty of Care.

Rather than spoiling your evening by going into the Environmental Protection Act and its policies (EPPS) for wastes and water, it may be more useful to say a few things about how we can move from being part of the problem to being part of the solution to conflicts associated with intensive animal industries.
The Solution

As a starting point we have to accept that a number of new criteria have become part of our development, planning and management requirements. This has led to equity, and the consultation which goes with it, becoming essential elements of land use strategies, and being recognised as measures of success. But the other side of organic waste management is potentially a very positive one, that is, the opportunity to convert costly waste disposal into significant financial benefit.

In Landcare we often ask the question, “How can we change Conservation costs you, into Conservation pays you?” In simple terms, we start by recognising the value (in our case the plants nutritional value) of our wastes. So for accounting purposes we list them as byproducts on the credit side of our business plan. There are few actual toxic substances in our byproducts (depending on our feed and animal health programmes), and as a result, the most damaging thing which our by-products can cause is by being in the wrong place in the wrong concentration.

Many of the organic, or biological or permacultural production methods indicate that the best way for the operator of the system to gain the full benefit of efficient use of organic wastes, is to use an integrated system in which the recycled nutrients are part of a closed system, i.e., a system in which the costs and benefits are internalised. Such systems are very different from those which not only tend to waste nutrients through living off our land capital, but which also externalise the costs of degrading neighbouring ecosystems. King, in his book “Farmers of Twenty Centuries” paints a clear picture of Chinese sustainable agriculture using closed systems and a minimum of export of nutrients. With all the talk about the complexities of answering the questions “How do we know when a production system is sustainable?”, the USQ Land Use Study Centre has come up with the answer in the form of the acronym STONE.

S is for soil lost
T is for toxin build up (including salinity)
O is for organic matter and its affects
N is for nutrients, notably N & P
E is for economic efficiency.

We suggest that the causes and corrective actions for each form of degradation are sufficiently well known for practical and economical remedies to be confidentially advocated, assuming cost sharing proportionate to ‘public good’ benefits is available.

In the case of organic wastes from intensive animal production, we now have codes of practice and established guidelines for virtually all rural industries. Developing such codes is the easy part; the difficult part is to strike the balance between incentives and regulations which lead to early widespread adoption.
The Dilemma of Community Values

Since the conservation movement started in Australia in the late 1960s it has been concerned primarily with things rare, beautiful and furry. From this approach has grown a polarisation into cockies and greenies on the one axis, and development and anti-development on the other axis. Similarly the optimists and pessimists have been stereotyped and the realists and idealists contrasted.

Those of us who have been patiently working away at gaining acceptance of the so-called Land Ethic for some decades were heartened by the official acceptance of this notion by the emerging Landcare movement in 1988. We had hoped that the ownership of the new movement by the landholders and producers would encourage even the most conservative and independent operators to join Landcare and work for the achievement of its objectives. To date we have about 4500 Landcare Groups representing about 36% of landholders as active members. We have no statistics on the representation of feedlots, piggeries, poultry and aquaculture in this nationwide community activity, but I suspect they are seriously under-represented.

“So what?” I hear you say. So the sooner our intensive animal industries are seen to be part of the same community which is taking ESD seriously, the sooner their voice will be heard sympathetically.

The present standoff between intensive production and other landholders must be replaced by a more understanding agreement to cooperate in working toward mutual common goals. This in turn means acceptance of improved policy based on what is now called Multiple Objective Decision Support Systems. Almost invariably such an approach means that the idealists in each camp or stakeholder group must accept either a substantially reduced victory for their sectional objectives, or a geographical separation of competing land users.

1. In the meantime we are heavily dependent on timely, comprehensive and unbiased impact studies to guide local government decision-makers. Such impact studies are undertaken by consultants selected by and paid by the applicants for development of new intensive industries. My personal views on the shortcomings of the current EIS process are probably known to many of you, but suffice to say that the new Integrated Planning Acts (as of March 1998) not only does not actually improve integration but creates serious loopholes in the decision-making process, to the extent that many public servants are weary of giving unambiguous interpretations of the meaning and spirit of this legislation.

It is my view that many of our local conflicts are caused primarily by a lack of both strategic planning and the kind of lateral thinking that is required at a higher level if our development applications are to be considered in a wide enough context for sound decision-making.

While this type of philosophising may seem far removed from the perceived immediate problems of organic wastes, the tyranny of small decisions will continue to deliver negative accumulated outcomes in this and adjoining regions. Whether it is unwise subdivision or polluting industries, the signs are everywhere to be seen, that quality of life and resource health will become increasingly serious if we continue to only pay lip service to ESD in our local planning decisions.
Our statistics for the Murray Darling Basin show clearly how the proportions of phosphorus and nitrogen entering the system from agriculture or urban sources or industry, vary greatly between dry and wet years. Similarly the number of cases in which ‘secure’ retention dams malfunction indicates that both design and management of waste needs serious attention.

Thus, while the so-called precautionary principle is regarded by some as nothing more than an unworkable idea which threatens progress, we will need to hear the voices demanding greater responsibility from us in agricultures and rural production generally.

In any ‘cowboy economy’ driven directly by Keynesian economics where supply responds to demand and price is determined by both these drivers, it is not surprising that high growth rates remain the prime aim. So when Herman Daly proposed his “Steady-State Economics” principles and Schumacher published his “Small is Beautiful” in the mid 1970’s it was hardly surprising that they received a cool reception from the movers and shakers of the day. In the meantime several European and Scandinavian countries have shown us that if we care to measure national and social progress by measures other than GDP, we can in fact attain a sustainable equilibrium and a high quality of life.

The way we go about our business of cycling nutrients becomes a crucial element in our success in developing a sustainable society.

References
(Source Materials from the Land Use Study Centre)
