Land and Water, Farming and Biomimicry
by Bill Hill

I would like to highlight some of the environmental impacts particularly relating to our land and water assets and the effect on native biodiversity in our farming systems.

Australia has the potential to become one of the most stupid, short-sighted, short-lived civilizations in the history of the world.[1] (Paul Sheehan, 2004)
People keep talking about the historic droughts, afflicting the eastern states. Even when the rain comes the fundamental problems remain the same, the weather pattern has changed [2].
Unsustainable agricultural and cultural practices have fundamentally changed the landscape, particularly our river systems and the productive land that surrounds them.
We must find more sustainable ways to live and work with our ancient, fragile landscape.
We are finally realising that we cannot profoundly change the landscape without affecting its resilience and our weather patterns.
Australia controls the world's fourth largest expanse of land, sea and continental shelf.
We should be a world leader in ecological management; instead we choose to mine our resource base of land and water in a totally unsustainable manner.

Our stressed river systems and the agriculture that depends on them
The Murray Darling Basin has only 6.2 % of Australia's runoff but 70% of Australia's irrigation farming.
It has recently been revealed that the Murray River floodplains are so dry that up to 75% of the big old river red gums are dying from a combination of salinity and lack of water.[3]

The manner in which the Murray Darling system is currently being managed means that when an extended drought occurs, the system it is no longer robust or resilient enough to cope.
Just imagine driving from Melbourne to Sydney (1000 km), with dead trees on both sides of the highway, this is the tragic scenario for the Murray without an immediate and determined response to redress this problem.
The state and federal governments have agreed to deliver 500 gigalitres of water for the environment by 2006, but how many river red gums will survive to benefit from this water.
The desperate plight of the Murray Darling system requires immediate attention.
Cubby Station is situated on the Balonne River, a tributary of the Darling system, near Dirranbandi in South Western Queensland.

Cubby Station has the facility to store twice the capacity of Sydney harbour in its enormous on farm storages, they currently pay $3700 [4] per year for this water.
They have an eighty thousand hectare irrigation property, growing fourteen thousand

hectares of cotton as well as other crops.
For approximately $128 million the federal government could buy Cubby Station and release its water entitlements to the environment.
Thereby making a bold statement that we are prepared to bear the necessary economic pain, to make the essential environmental gain.
This approach would have a significantly detrimental effect on the economy of this area and social equity would demand that considerable money to be allocated to redress the negative economic impacts of this strategy, on that community.
The probability of such an enlightened vision becoming a reality, in the present political environment, seems highly unlikely.
Therefore we need to look at other ways of delivering clean water [5] to the Murray Darling system.

Designing grazing systems that are managed to deliver the triple bottom line.
"Frog Hollow" is part of a mosaic farming design situated around a water-course on a grazing property known Broom Hill's, Warrenbayne, near Benalla, in North East Victoria.
The excess water that runs off Broom Hill's flows into the Broken River, then into the Goulburn River and ultimately into the Murray River.

The Goulburn Broken Catchment Management Authority [6] manages the runoff water from Broom Hills' for the Murray Darling Basin Commission on behalf of the Australian people.
The total catchment of the GBCMA contributes 11% of the Murray Darling Basin's water resource and generates 18% of Victoria's water supply.
Between the GBCMA and the Murray River is the North East Catchment Management Authority (NECMA).
Although the NECMA catchment is only 2% of the Murray Darling Basin's total area it contributes 38% of total water supply to the Murray Darling System.
Between them, these two CMA's are responsible for almost half of the water contributed to the Murray Darling System.
The way we manage these watersheds has a substantial effect on water quality replenishing these systems.

Loss of native biodiversity
The loss of biodiversity within our ecosystems is unsustainable, we are killing our environmental support systems.
The earth is losing species at a rate comparable to the mass extinction of the dinosaurs. [7]
The world Conservation Union's annual Red List of endangered species, recently added another five species to the "extinct" category.
Nearly 16000 species are listed as threatened, more than 200 "possibly extinct" and almost 3000 as "critically endangered".

This list is compiled by a global network of 8000 scientists, regarded as the most authoritive statement of the planet's biodiversity and guides environmental policy around the world.
There have been five mass extinctions in history and the rate of loss of biodiversity is getting worse, we are possibly facing the sixth extinction!

Australia is home to more than one million species, many of which are found nowhere else in the world.
About 85 per cent of flowering plants, 84 per cent of mammals, more than 45 per cent of birds, and 89 per cent of inshore, temperate-zone fish are only found in Australia.
Over the last two hundred years many species of plants and animals have become extinct. [8]
The changes imposed on the landscape and native habitat as a result of industrial agricultural practices, which are predominately monocultural, have had a significantly
negative impact on native biodiversity.

Loss of Agricultural Biodiversity.
Agricultural biodiversity [9] of all food species is a vital sub-set of general biodiversity. They have been highly threatened by globalisation of food markets and tastes, intellectual property systems and the spread of unsustainable industrial food production.
Many locally diverse food production systems are under threat and with them, the accompanying local knowledge, culture and skills of the food producers.
Agricultural biodiversity is disappearing at an unprecedented and unsustainable rate.
With the disappearance of harvested species, varieties and breeds goes a wide range of unharvested species.
Worldwide we have lost more than 90 per cent of crop varieties and half of the breeds of many domestic animals have been lost.
All the world's 17 main fishing grounds are now being fished at or above their sustainable limits, with many fish populations effectively becoming extinct.

The genetic erosion of agricultural biodiversity [10] is also exacerbated by the loss of forest cover, coastal wetlands and other 'wild' uncultivated areas, and the destruction of the aquatic environment.
This leads to losses of 'wild' relatives, important for the development of biodiversity, and losses of 'wild' foods essential for food provision, particularly in times of crisis.

Ecosystem analyst, James Kay (1994) [11] says that the study of ecosystems can be done in the context of nested holons [12] within a hierachically or holarchically organized system.
Ecosystem dynamics are complex and have a degree of unpredictability and often exhibit rapid rates of change and are continually evolving and going through birth, growth, death and renewal at different spatial and temporal scales.
Ecosystem management is an oxymoron, it is how we as humans interact with ecosystems which need to be managed.
Discussion of ecological integrity necessarily involves ethics and politics as well as scientific disciplines.
The core notion of sustainability is that humans are an integral part of the ecological systems that make up the biosphere.
We cannot live apart from the biosphere [13] but only as part of it.

Chief Seattle eloquently expressed these thoughts when he said, " Whatever befalls the earth, befalls all the sons of the earth. Man did not weave the web of life, he is merely a strand in it. Whatever he does to the web, he does to himself."
With global warming and the end of the "fossil fuel" era, life will become much more difficult for human beings to live comfortable relaxed lifestyles.
Whether we can make the necessary transition to a more sustainable lifestyle remains to be seen.

Mother nature has been sustainable since the dawn of time, but we humans have done untold damage to our biosphere in the last 200 years of the industrial age.
The ultimate irony is that the biosphere can survive the end of humanity, but humanity cannot survive the end of the biosphere.

Sir Crispin Ticknell [14] maintains, "People have become rich making a mess of the earth over the last 200 years.
They could become even richer cleaning it up over the next 200 years." (Tickell 1994,) [15]
Technology offers both threats and promises, it can ruin our planet, but perhaps it can also help to save it.

The real need, if we are to survive as a species into the future, is to be selective and develop a more balanced and sustainable pattern of living within the constraints imposed by the ecosystem.

A logical place to begin this process is with a well - designed, regulated, local sustainable economies, which are concerned equally with resource conservation, environmental protection and optimal productivity.
We should use the principles of "factor 4" by doubling "wealth" while halving resource use, through sustainable living, innovation and technology.

We must once again learn to live in harmony with nature, respectfully enhancing biodiversity, understanding that we are part of the environment rather than by selfishly exploiting it with our presently unsustainable methods.

Our personal [16] commitment is to a sustainable grazing system that is managed holistically and using biomimicry [17] , reflects and works harmoniously with the natural systems.
We are continuously refining and monitoring our management as we work toward a system that is resilient, viable and efficient.
We have been involved with tree planting and conservation as a family for three generations on the family farm.
Since the formation of the Warrenbayne Boho Land Protection Group [18] in the mid 1980's, we have planted thousands of trees.
Although it has been very satisfying to be part of a community process to address salinity, degradation and tree decline we wanted a more integrated system.

We were involved in the Community Grasses project, which studied these productive perennials that are infinitely adapted to our climate and soils.
As well as measuring pH, salinity and response to rotational grazing, exclosures [19] were built and together with a site within 20 metres, identified by a steel post, were monitored and measured using quadrats, over a three-year period. (1993-1996)

Between 1995 and 2000 we became involved with Peter Simpson and Col Langford, NSW Department of Agriculture, in a project called " Managing Native Pastures for Persistence and Production." [20]

The objectives of this trial were to decrease the rate of soil acidification, salinisation and erosion, and off site losses of nutrients to waterways by increasing the stability of native pastures.
The education [21] of us as landholders, to increase our ability to recognise and manage native grass based pastures, according to land capability was also a key objective.
The site was tested for pH, CEC, %Al and Colwell P [22] , then a trial; was set up with different rates of fertilizer, lime and gypsum to determine the most cost effective application rates of fertilizer to enhance production, while maintaining the native perennial pasture.
We have been involved with agroforestry trials to assess the most suitable species to plant in various configurations to achieve multiple benefits including high quality timber production [23] , woodlots, shade and shelter.
Birds have been surveyed at Broom Hills during a " Birds on Farm" survey (1995-1998) by Ken Hancock and Debbie Hill. [24]
We have an ongoing process of taking fixed point photographs to monitor change on the property, combined with continuous personal observation while rotationally grazing stock and walking the paddocks. [25]
Soil tests are taken periodically to monitor soil health and to plan for necessary fertilizer and lime applications and when sowing of crops and pastures
Water and soil monitoring for salinity is carried out from time to time.
Pasture quality and stock health are continuously monitored. [26]

There is no prescription for monitoring, measuring and managing a grazing system.
We use intuition, observation and experience to manage holistically, striving to achieve a harmonious, balanced and sustainable farming system.
Where to from here? We have been fortunate to be helped along our chosen path which has been both exciting and challenging.
We will continue to refine our system, particularly in light of energy descent [27]while sharing our knowledge, experience, wisdom and passion with fellow travellers, who wish to farm sustainably and in harmony with nature.

Agriculture and particularly grazing sytems have the ability to harness solar energy directly through photosynthesis and use animals to harvest and turn it into food and fibre.

Mosaic farming is one way to move into a sustainable future where we cannot only survive, but thrive while promoting and enhancing biodiversity.
We strive to create an environment where Mother Nature can deliver her vital ecosystem services to maintain our biosphere in a more healthy condition.
I believe that environmental management starts between our ears, we need to understand that nature is not here to serve us and that what we do to "nature" we do to ourselves.
We must understand that the only thing we can really change is our attitude.
There is no more important vocation than developing a philosophy of sustainability and having it expressed in our reality.
Those that know the way should show the way!

Definitions and descriptions
Agro-ecosystems may be identified at different levels or scales, for instance, a field, crop, herd, pond, a farming system, a land-use system or a watershed. These can be aggregated to form a hierarchy of agro-ecosystems.

Ecological processes can also be identified at different levels and scales. Valuable ecological processes that result from the interactions between species and between species and the environment include, biochemical recycling, the maintenance of soil fertility and water quality and climate regulation.

Holistic Management enables us to improve the quality of our life while enhancing the environment that sustains us all. And it's all based on a simple change in the way we make decisions. Holistic Management gives us a practical way to develop a clear, focused vision for our future, and enables us to plan how to get there in the most economically, environmentally and socially sound way. Holistic Management has its roots in land, agriculture and wildlife management. But it now extends well beyond that — to individuals in any walk of life, businesses of any kind, and to households, educational institutions, non-profit organizations, and even government agencies, because everyone makes decisions.

Biomimicry
Nature as Model Biomimicry is a new science that studies nature's models and then imitates or takes inspiration from these designs and processes to solve human problems, e.g., a solar cell inspired by a leaf.
Nature as Mentor Biomimicry uses an ecological standard to judge the "rightness" of our innovations. After 3.8 billion years of evolution, nature has learned: What works. What is appropriate and what lasts.
Nature as Measure Biomimicry is a new way of viewing and valuing nature. It introduces an era based not on what we can extract from the natural world, but on what we can learn from it.

Mosaic farming systems This project will identify mosaics of specific crops, pastures or trees (mixtures thereof) appropriately matched to soil and landscape attributes on a property in a multiple-field context.
The mosaic systems will incorporate tree crops, sustainable grazing rotations and may water harvesting where feasible.

Such spatial configurations will reduce the leakage of water and nutrients associated with traditional dryland farming.

The environmental benefits of successfully implemented mosaic farming will be assessed and farm scale economic analyses will be used to assess economic performance. Practical farm management recommendations will be delivered.

Nested systems
Natural ecosystems are perfect example of nested systems.
Arthur Koestler proposed the word "holon" to describe a basic unit of organisation in biological and social systems
Holon is a combination of the Greek word "holos" meaning whole, and the suffix "on" meaning particle or part.

Koestler observed that, in living organisms and in social organizations, entirely self supporting, non-interacting entities did not exist.
A holon is a functional unit, that is often part of a larger unit (supersystem) and consists of other holons (subsystems)
A holarchy is a hierachy of holons, a nested system.

The strength of holonic organization, or holarchy, is that it enables the construction of very complex systems that are nonetheless efficient in the use of resources, highly resilient to disturbances (both internal and external), and adaptable to changes in the environment in which they exist. All these characteristics can be observed in the biological and social systems of the inter-relationship of all life.

Ken Wilbur, in his seminal work, "The Theory of Everything", uses an "All Quadrant , All Level" methodology to describe the actions and reactions within and between holons and holarchies.
His theory allows the integration of nested systems to be expressed through space and time.

References
[1] Nothing to show but a wasteland, Paul Sheehan, www.smh.com.au/articles/2004/06/27
[2] It seems that with the impact of climate change on our weather patterns, we can no longer look back with confidence to predict what the weather will be like in the future. We need to develop systems that efficiently harvest the rain when and how it falls, building fertile soils and a mosaic of perennial plants (including trees and understory) is both desirable and necessary to manage it effectively and efficiently.
[3] ABC radio AM program -Up to 75% of Murray River red gums are sick or dying. www.abc.net.au/cgi-bin/common
[4] sao.cliq.org 2004
[5] salinity and nutrient free
[6] www.gbcma.vic.gov.au and www.necma.vic.gov.au
[7] Species dying 1000 times faster, Sebastian Berger, Bangkok, The Age, 18/11/2004

[8]http://www.deh.gov.au/biodiversity/threatened/
[9]http://www.ukabc.org/ukabc3.htm
[10] The Holstein Friesan cow is the most line bred/ inbred farm animal, with little genetic diversity left.
The American turkey can no longer naturally reproduce itself because of its excessive breast, bred to produce more meat.
[11] The ecosystem approach, Ecosystems as Complex Systems and State of the Environment Reporting, www.fes.uwaterloo.ca/u/jjkay
[12] A holon is a functional unit, that is often part of a larger unit (supersystem) and consists of other holons (subsystems)
A holarchy is a hierachy of holons, a nested system
[13] Biosphere 2 was an ecological test project, a 'planet in a bottle', in Arizona, USA. Under a sealed glass and metal dome, different habitats were recreated, with representatives of nearly 4,000 species, to test the effects that various environmental factors have on ecosystems. The eight "bioneers" were unable to sustain life in isolation of "biosphere 1," for the full two-year duration of the experiment. CO2 became intolerably high and they were forced to evacuate. Biosphere was built at a cost of more than $US150 in the late 1980's.
[14] Convenor of UK Government'sn Panel on Sustainable Development
[15] Elliott, David. Energy Society and Environment p297, Routledge, 2003
[16] Debbie and Bill Hill
[17] Nature as model, mentor and measure
[18] As a pilot project for the Landcare movement
[19] Pearson, Craig. Community Development of Perennials grasses for Multiple Ecological Uses.
Project M 4043a, Murray Darling Basin Commission 1996
!0' x 10' square enclosures that completely restrict grazing. (no animals at all) These have been in place since 1993 and have been an invaluable opportunity to watch how these ungrazed areas have responded to successional changes over time. The most interesting observation is that the healthiest grass is just inside the perimeter, where part of the plant can be grazed that protrudes outside. There are 12 of these exclosures in 5 paddocks with different aspects and soil types and all have a different composition of natives, exotics and weeds
[20] Simpson,P and Langford C, " Managing Native Pastures for Persistence and Production." DDO316:95, NSW Agriculture (2000)
[21] We were then, more capable to share our knowledge with fellow travellers.
[22] Acidity, Cation exchange capacity, Aluminium toxicity and available phosphorus
[23] We employed silvercultural contractors to prune pines, spotted gums and ironbarks etc
[24] Dr Geoff Barrett, Birds on Farms, Coordinator, Birds Australia (Letter 1999) See slide 40 in Powerpoint Presentation, Land and Water Assignment.
[25] The best fertilizer is the footsteps of the farmer, Confucius, 500 BC
[26] Worm tests are routinely carried out prior to drenching sheep.
[27] World Oil production has peaked and we are entering the ara of energy decline, where energy will become scarcer and more expensive.