The Economic and Ecological Importance of Native Vegetation and Biodiversity in Farming Systems, particularly Rice

A report for

By Helen Dalton

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Foreword

Many times I've been asked by farmers; "Why should I and what's in it for me"? In this conversation we are more than likely discussing the reasons why we enhance our farm environment. Farmers usually say that they can't afford to do so but I believe that they can't afford not to. In this report I hope to convince rural producers that it is in their best interest for their farm, their society and the global community as a whole to enhance and preserve our natural environment.

In Australia, farmers compete in a global economy with little government support i.e. no subsidies up to date and with very little financial reward for environmental stewardship in a harsh environment. To add to this, commodity prices have been relatively low for the last thirty years with little growth in the real gross value of agricultural production. Increases in agricultural production have seen farmers keeping the "wolf from the door". Farmers have been on a tread mill of increased production to keep up with increases in fuel, fertiliser, machinery and general farm running costs. Many businesses have become bigger to keep up with rising costs with high inputs, increased capitalisation and energy inputs. Along with this many family farms have been sold and amalgamated into large holdings run by corporate farmers such as superannuation funds or large production based farming business. Many of these superannuation funds are looking for production increases and capital gain rather than future sustainability.

With this change, I have been concerned about the natural environment on the farm. I firmly believe that farmers are in the business of producing multiple commodities not just wool or wheat but are custodians of the environment not just for themselves but for society as a whole.

My Nuffield scholarship has provided me with an opportunity to explore this important topic and put it into perspective for primary producers. I have always had plenty to say in my kitchen about environmental stewardship but this scholarship has given me a huge platform from which to speak with a wider audience. I'm sure my family are grateful for that!

After travelling around the world twice and speaking to many scientists and farmers I am more than ever convinced that preserving and enhancing our environment is absolutely essential for our future and there are many opportunities for farmers to gain financially from doing so.

Acknowledgments

I would like to thank Nuffield Australia for giving me the opportunity to study something that I am passionate about. The chance to travel the world and to have access to the world's best and brightest people was a privilege and honour.

Special thanks must go to Rural Industries Research & Development Corporation (RIRDC) and the Rice Growers Association of Australia (RGA).

Finally I would like to thank my family and friends for their support during my time away. My husband Nayce for allowing me to undertake such a project and keeping the business back home on track. My children Campbell, Jessica, Elizabeth and Alexandra for being patient and selfless and understanding the opportunity that it presented to me. Their efforts to teach an old dog new tricks particularly when it came to dragging me into the 21st century technologically were appreciated. For my parents, Glen and Phyllis Groat for being around and the backup and support at home.

For those that I met along the way, Jerzy Karg, Neils and Elsa Christensen, Dennis Dalton, Hugh MacEnernery, Dr Nichola & Adrian Cannon, Stephane Gariephy, Gary Moore, Prof Wes Berger and Peter Joyce. These people were patient, hospitable and generous and I thank them sincerely.

Abbreviations

ABARE	The Australian Bureau of Agricultural and Resource Economics
ABHF	Australian Bush Heritage Fund
AC	Acres
ALT	Australian Landcare Trust
BMP	Beneficial Management Practices
BSE	Bovine Spongiform Encephalopathy
CCX	Chicago Carbon Exchange
CO_2	Carbon Dioxide
CPR	Conservation Reserve Program
CREP	Conservation Reserve Enhancement Program
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DU	Ducks Unlimited
ECP	Environmental Champions Programme
EG&S	Ecological Goods and Services
EU	European Union
EUE	European Climate Exchange
FEPS	Forestry Environmental Protection Scheme
FSA	Farm Service Agency
GCC	Green Cover Canada
GST	Goods and Services Tax
HA	Hectares
IPM	Integrated Pest Management

K	Potassium
LEAF	Linking the Environment and Farming
MBI	Market Based Instruments
MIA	Murrumbidgee Irrigation Area
N	Nitrogen
NAP	The National Action Plan for Salinity and Water Quality
NFF	National Farmers Federation
NFSF	National Farm Stewardship Programme
NHT	The National Heritage Trust
NWSEP	National Water Supply Expansion Program
P	Phosphorus
RGA	Rice Growers Association of Australia
RIRDIC	Rural Industries Research and Development Corporation
RPM	Revs Per Minute
SOC	Soil Organic Carbon
Su	Sulphur
UK	United Kingdom
USA	United States of America
USDA	United States Department of Agriculture
Zn	Zinc

Executive Summary

My topic relates to the economic value of native vegetation and biodiversity in farming systems, particularly rice. Is there economic gain from ecological enhancement? Is it possible for farmers to receive “Green Dollars”?

The points that I bring forward are all interrelated and intertwined and it is sometimes difficult to isolate one from the other.

Before I begin my report it is important to explain ecological goods and services or eco service (EG&S). They are the benefits that humans derive from ecosystem functions. Biodiversity, Air, Water and Land are the set of natural capital that we enjoy. Like all systems they are interacting and interrelated.

Healthy rural landscapes provide important ecological goods such as food, fibre, timber, genetic resources, pharmaceuticals, drinking water and minerals.

Eco-services on the other hand include climate regulators, water and air purification, waste treatment, erosion control, pest and disease control, pollination, soil formation and photosynthesis. Farmers are encouraged to integrate a healthy balance between natural resource management and primary production.

Agricultural producers not only produce goods that go out the farm gate such as food or fibre but also other ecological goods and services that all of society enjoy. They may however, do this at an economic loss.

As society benefits from EG&S it is probably fair that producers are fairly compensated. This may be done through Environmental Stewardship payments, taxation relief, and government policy changes so that ecological goods and services are valued.

Environmental Stewardship Payments

Environmental Stewardship Payments already exist in the USA, Canada and Europe and provide financial security to farmers.

In Australia, the farm sector is responsible for managing 60% of Australia's land with limited resources-a lack of labor, and with the drought, a lack of money.

To date , the Australian System has provided one-off 'carrot' grants for tree planting and fencing, but no ongoing remuneration for maintenance, whereas in Britain and America, farmers are recognized as land caretakers and are paid an annual sum per acre for environmental management.

In Ireland for instance, a farmer receives up to 90% of his income from subsidy and environmental stewardship payments.

The primary aim of Stewardship Payments in the UK is to conserve biodiversity, maintain and enhance landscape quality and character, protect the historic environment and natural resources and promote public access and understanding of the countryside. Over the years there has been a shift from subsidizing production to subsidizing the environment. On my travels through the UK, I didn't meet a happy UK farmer although many could see the merits of the program. Many felt however, that they were over regulated and that they were just paid gardeners.

In the States and Canada, farmers were happier but government policy was in conflict with outcomes. Governments still subsidize production as well as providing Stewardship Payments. The waterways are still being polluted with nitrates and phosphates causing dead zones in rivers and lakes. The government was paying out all the way; paying for production, paying for stewardship and compensating the fishing industry for loss of income. In Quebec province in Canada many waterways were poisoned and unusable.

Just recently the Australian government has announced an unprecedented environmental management initiative that will see farmers rewarded for their input over a 15 year period. This will address the critical gap that has existed in Australia in the provision of incentives for Australian farmers for Environmental Stewardship.

Soil Biota

The health of our landscape is determined by how we relate to all living things not just what is on top of the ground that we can see but also what lies beneath it.

The soil is the back bone of any farming system and is of critical importance for sustainability. The microscopic workers on the leaves of plants, in the leaf litter and around the plant roots are nature's helpers, building new soil. The more leaves, litter and plant roots there are, the larger the workforce and the faster new soil will be built. In this unseen world there are thousands of symbiotic relationships. If the farmer has the right balance in his soil then he or she is well on the way to balancing the triple bottom line.

The millions of beneficial flora and fauna in the soil all have an invaluable input into building soil fertility and growing plants. Nutrient recycling, water retention, disease and pest control, nitrogen fixation, building soil organic matter and soil structure, neutralizing ph are some of the benefits of microbial activity.

On visiting farms in the United Kingdom the emphasis on soil building was extremely important. The push for organic status was bringing farmers back to the basics of soil building and looking after their beneficial microbes. Many farmers were realizing that the production quick fix such as more chemicals and fertilizers was not an option for long term sustainability.

Carbon Credits

Carbon dioxide is one of the green house gases contributing to global warming.

Carbon credits are simply financial rewards for activities that aim to reduce levels of carbon dioxide in the atmosphere. A "credit" gives the owner the right to emit one tonne of carbon dioxide.

Carbon trading is a reality and here to stay. Assume a factory emits 100,000 tonnes of green house emissions per year. The government then enacts a law that limit's the maximum emissions that a business can have. Say the factory is given a quota of 80,000 tonnes. The factory either reduces its emissions to 80,000 tonnes or is required to purchase carbon credits to offset the excess.

A farmer on the other hand can earn money for carbon sequestration by enrolling eligible land in a verified programme. Land in the program must be farmed in a compliant manner, using only approved conservation tillage methods such as no till. Farmers then receive payments for storing carbon.

When we think of capturing carbon we usually think of trees but in fact soil represents the biggest carbon sink that we have control over and this offers farmers an opportunity. A 1% increase in soil carbon in just 10% of Australia's faming land could remove 10 years worth of Australia's CO_2 emissions.

Carbon dioxide on land can be absorbed from the atmosphere through forest, cropping or grasslands.

Effectively managed farmlands could absorb most of the excess carbon that is being emitted into the atmosphere turning a potential hazard into a new paycheck for land managers.

The Chicago Climate Exchange (CCX) began trading in December 2003 to allow industrial companies to purchase carbon credits to offset their greenhouse gas emissions. In Europe, 2005 the worlds first carbon futures market was established and is known as the European Climate Exchange (EUX).

When I was in Canada there was a lot of talk about putting a cap on carbon dioxide emissions from industry. Fines were going to be imposed but were low. With a realistic fine we could see an increase in the value of carbon credits.

When carbon is sequestered in topsoil as organic carbon it offers multiple benefits for the environment, increased productivity and therefore a healthier bank balance. The challenge is to keep the carbon in the soil and not have it recycling back to the atmosphere. More research and extension work needs to be done.

Integrated Pest Management

"Integrated pest management (IPM) is an approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks". (USDA).

Greater biodiversity on your farm on average leads to greater productivity. Having a well balanced environment with lots of biodiversity can help control diseases and pests.

Not all insects, weeds and other living organisms require control. Many organisms are innocuous, and some even beneficial.

There is a lot of information on the pest that may invade your crop, just ask the chemical company, but there is little information about the predator of that pest. We need increased research on these predators as it offers us an opportunity to save money and enhance biodiversity.

Agri Tourism

Agri tourism to me makes a lot of sense but is in its infancy in Australia. It is highly valued overseas with millions of dollars generated annually. It offers us a huge opportunity to reconnect with our city cousins while making an economic return.

In 1960, 19 out of 20 people had a relative or friend on a farm; now it's less than 1 in 20.

There are 3 agri tourism basics - have something for visitors to see, something for them to do and something for them to buy.

If we have an interesting landscape, with lots to see and do then we are well on the way to bridging the gap between the urban and rural communities. Activities such as horse riding, wildlife watching, mustering, whip cracking, hunting and fishing are some examples of agri tourism activities.

Agro Forestry

Agro forestry is the planting of trees in combination with agriculture. It is an integrated system of rural land resources based on the deliberate combination of trees and shrubs with crops or livestock, whose interrelations generate economic, environmental and social benefits. Added to this, agro forestry systems generate additional farm revenue. It is good way for farmers to diversify their economic activities.

In Australia agro forestry is essentially not a common practice and little is known about which species to grow. Rainfall, in excess of 500 mm is needed for an agro forestry system to be productive. The system needs to be managed to achieve optimum environmental and ecological outcomes. The CSIRO has estimated that 15% of the Murray Darling Basin needs to be replanted in Red River gums to reverse the salinity problem. This will provide a fantastic opportunity for agro forestry.

Agro forestry has numerous ecological and environmental advantages. It offers an opportunity with added biodiversity benefits. Crop protection, shelter for livestock, recycling of nutrients, carbon sequestration, salinity control and it will even help to mitigate climate change.

Land Values

In Mississippi there is a 36% increase in land values as a direct result of recreational opportunities. Some land managers have made a deliberate choice to increase biodiversity for recreational opportunities and this then leads into agri tourism.

In Australia it is quite the opposite with land being devalued if it contains so called "unproductive land" such as a shelter belt or vegetated hill side. It seems strange to me that you can receive a one off grant from the government for fencing and tree planting only to see a reduction in land price when sale day arrives.

Land prices in Australia are essentially determined by the district average rather than whether the property has been looked after environmentally.

Production Enhancement

I have divided this section into native grasses, shelterbelts, pollination and crop rotations.

Native Grasses

Native grasses are extremely resilient and are becoming increasingly valued in farming systems. Australian native grasses are adapted to low fertility soils, drought and low rainfall. They have mechanisms for drought adaptation, either through entering a prolonged dormancy, or having a below-ground crown capable of surviving drought and grazing. When it does rain they are the first to respond. Perennial grasses can build soil organic carbon and microbes and provide a cover to protect soil from high temperatures as well as being a carbon sink. These grasses also protect the soil from invasive exotic weeds and provide a more even production of forage over the course of the year.

We need to educate ourselves about our grasses as they become increasingly important particularly during drought conditions, increasing biodiversity, as a renewable energy source and for building resilience into our farming systems.

In the USA many Environmental Stewardship Payments encourage the establishment and management of native grasses to provide habitat and a food source for wildlife, as a riparian buffer zone for erosion control and nutrient removal of surface water flow and for blocking the run off of sediment into the streams and rivers.

Some farmers are growing seed for commercial production and are receiving higher returns than from main stream crops such as corn or soybeans.

The demand for bio fuels has increased the demand for perennial grasses can be harvested for ethanol production. Not only are they reducing carbon dioxide emissions because of low production costs i.e. no annual planting but they provide a source of renewable energy.

In the UK, Miscanthos (a perennial grass) is pelletized and used as a heating source for homes and is becoming increasingly important as a renewable energy source.

Shelter Belts

The importance of shelter belts can't be emphasized too much although at times it is hard to quantify. The presence of shelterbelts increases the organic matter content levels in the soil. This is due to a number of reasons, including leaf fall, and migration of fauna which drop faeces and from wind erosion which deposits organic matter. There are also increases in density and composition of soil microbiology and above ground biodiversity within shelterbelts.

Shelterbelts help provide a depth of biodiversity that increases the ability of the production system to resist pests and diseases. They provide a richness of diversity that adds a balance in our farming system.

An increase in actively growing plants such as in a shelterbelt will modify the microclimate. Trees not only cool things down in summer but moderate cold conditions in the winter. Wind speed and wind erosion will also be reduced. Increases in transpiration and less evaporation are also a benefit to the environment. Old timers in Australia will also tell you that the rains follow the rivers and hills where there is abundant vegetation.

Pollination

Pollinators such as bees are an important part of our environment and play a crucial role. There are many species of bees and each of these has their own characteristics and behavioural habits. Pollinators require suitable nesting areas from which they can access adequate forage. We need diversity of habitat for pollinating species to increase quantity, reliability and duration of pollination.

Crop Rotation

Crop rotation is a very effective way or managing pest and disease in a cropping system. Different disease and pests will attack different types of crops e.g. “take all” is a soil fungus that lives on the roots of wheat and can be controlled by using a break crop such as rice. Therefore growing wheat in rotation with rice will decrease “take all” in the wheat crop the following year and therefore save the farmer money in pest management and also increase yields. As the age old saying goes prevention is better than cure. Growing a legume crop in a cereal rotation will also aid the farmer in soil re-nitrification and therefore save the farmer money in fertilizer costs the following year. This is yet another way that a good cropping rotation system is economically viable for today’s modern farming businesses.

Native grasses, shelter belts, pollination and crop rotation create a landscape mosaic which builds resilience and stability into the farming system. A mosaic of fields and shelterbelts actually keeps a rural landscape running, supporting the sustainable circulation of nutrients, water and energy. Increased habitat and food sources for biodiversity, decreased pests and diseases, wind protection for crops and livestock, erosion and salinity control are just some of the benefits of a diverse landscape.

Summary

Are there dollars for ecological enhancement? Absolutely!! For every reason we need to enhance our environment because it pays dividends for us as producers, for our environment and society as a whole. It provides us with opportunities for new income streams such as carbon credits and agri tourism.

With new Stewardship Payments I can see the gap in land management being closed and hopefully farmers receiving a fair value for land on sale day.

Reduction in costs and therefore better returns will be possible if we work with our environment. As I mentioned at the beginning of this topic is interrelated and it makes very good sense to enhance our biodiversity and native vegetation. I sometimes visit farms that are humming; everything seems to be in balance and it's a place where you want to be. It's about being part of your environment and working with it.

Our lives are greatly enriched by all aspects of stewardship; environmentally, economically and culturally and that's worth a fortune.

Introduction

Along with my husband Nayce and 4 children we own and operate our own family farming business near Binya, South West N.S.W. We are irrigation and dry land farmers producing rice, winter cereals (wheat, oats, and barley) and beef cattle. We also grow lupins as a break crop and run a small mob of sheep for lamb production.

The rice growing areas in Australia are located in South West NSW along the Murrumbidgee and Murray River systems. Our property receives its water from the Murrumbidgee Irrigation Area (MIA). Rice is an "opportunistic crop" where it is only grown when the water is available.

Along with the day to day running of the farm I operate a small native plant nursery. I have also initiated a native planting program on our family properties and this has continued throughout the years. My enterprise has expanded to a small advisory business. I have specialized in shelterbelts for operational farms, buffer zones and windbreaks for rural residential properties.

Australian native vegetation has always fascinated me and when I began propagating plants 20 years ago I was keen to break down some of the myths of native vegetation by gaining an understanding of their features and adaptive qualities. As my knowledge expanded and my business increased I began to pass on that knowledge to farmers in an effort to encourage them to plant natives on farms.

I soon began to realize that my teaching diploma was a useful tool as I began to educate people on native plants, how to prepare ground, what requirements were needed and so on. My thirst for information is ongoing and will be a lifelong quest.

Over the years my interest has lead me to organizations such as Landcare and to more recently to the Ricegrower's Association of Australia environmental policy known as the Environmental Champions Programme (ECP). I have been involved in the formulation of this 5 level programme.

The ECP is a total industry commitment to sustainable management of natural resources to address environmental, social, and economic factors. This has been achieved through engaging, educating, and assisting landholders in environmental and legislative requirements. The ECP takes an integrated approach to agriculture and to the environment.

Objectives

My objectives in my study were to gain an understanding of the importance of native vegetation and biodiversity in farming systems, particularly rice. I wanted to quantify the value of native vegetation and biodiversity and hoped to give farmers objective tool from which to lobby governments.

My basic objectives were-:

1. Provide an awareness of opportunities for farmers
2. Encourage environmental stewardship within the farm and broader community
3. Make recommendations to governments, farming organisations and farmers
4. Make effective use of public money
5. Identify opportunities for alternative income streams for farmers
6. Enhance a productive farm system
7. Quantify the benefits of biodiversity and native vegetation
8. Lobby governments for legislative change

I visited Turew in Poland at the Research Centre for Agriculture and Forest Environment, Denmark, United Kingdom, United States of America, Canada, Philippines, China, France and Brazil.

Ecological Goods and Services or Ecosystem Services

I think it is important to explain what we mean by Ecological Goods and Services (EG&S) or Ecosystem Services. Basically they are the set of natural assets such as soil, biodiversity, air and water. Like all systems they are interrelated and interacting. Healthy rural landscapes provide important ecological goods such as food, fibre, timber, genetic resources, pharmaceuticals, drinking water and minerals. Eco services on the other hand include climate regulators, water and air purification, waste treatment, erosion control, pest and disease control, pollination, soil formation and photosynthesis. As Suren Kulshreshtha, Professor of Agricultural Economics at Saskatchewan University maintains, agriculture provides both private goods and public services.

Farmers are encouraged to integrate a healthy balance between natural resource management and primary production.

Agricultural producers not only produce a good that goes out the farm gate such as food or fibre e.g. wheat and wool, but also other Ecological Goods and Services that all society enjoy. They may however do this at an economic loss. (Agriculture and Agri-Food Canada)

As society benefits from EG &S it is probably fair that producers are adequately compensated. This may be done through Environmental Stewardship Payments, taxation relief, and government policy changes so that ecological goods and services are fairly valued.

Environmental Stewardship Payments

Environmental Stewardship Payments are payments for these public services. It is easy to place a value on the commodity coming from the farm but very difficult to value the health and wellbeing of the environment provided by that farmer. There have been few studies done but valuing them is usually done by calculating by how much it will cost to restore a degraded system. This estimated total economic cost can be in the million of dollars.

United Kingdom

Environmental Stewardship Payments to the general Australian farmer would appear to be the only way of receiving economic gain from ecological enhancement and at first glance that may be the only way to make a buck from the environment. The United Kingdom Environmental Stewardship Schemes provide funding to farmers and other land managers who deliver effective environmental management on their land. The schemes primary aim is to conserve biodiversity, maintain and enhance landscape quality and character, protect the historic environment and natural resources and promote public access and understanding of the countryside. There are an extensive number of these environmental programmes tailored for a particular country for a particular environmental outcome. They allow farmers to choose from a diverse menu of environmentally focused programmes and compensate them for some or all of the opportunity costs of adopting these practices. For example grass margin buffer strips, taking archaeological sites out of arable production, protection of hedgerows and stone wall etc. The list is quite extensive.

There are many incentive based programmes requiring cross compliance which attract farmers. In the UK according to Geoff Sansome (Nuffield Scholar) who works for Natural England, farmers and governments in the past, were interested only in agricultural production. However the 1970's saw a shift from production to concerns about food safety and the environment. Loss of hedge rows, increased chemical usage and draining of wetlands became concerning to the community. The public was also exposed to outbreaks of BSE, Foot and Mouth and Salmonella.

In England all farmers are eligible to receive the Single Farm Payment which requires farmers to complete a form annually. The formula for how much money they receive has been based on past crop production, and stocking rates at a certain date. All this is evaluated and you come up with a magic figure. However, the Single Farm Payment has recently changed and

you no longer need to keep livestock and grow crops to receive payments. This scheme has limited environmental gain and low level of compliance from farmers.

There are on top of that other Stewardship Payments. Farmers receive payments according to the level of commitment signed up for. There is a basic Entry level Stewardship Scheme, Organic Entry Stewardship and then a Higher Level Stewardship Scheme. For example the more challenging the scheme the greater the financial reward. Organic farming is encouraged and an increased financial reward earned. I visited Barrington Estate near Oxon. Adrian Dolby, the manager of this 7000 acre parcel of land was in the process of converting to organic status. He told me that he would receive 400,000 pounds and he was still concerned whether he would break even. I did make the comment that at least it rained!!!

In Ireland the average size farm is 39.1ha with the average age of the farmer being 53 years old. Ninety percent of farm income is derived from direct Payments/Subsidiaries and Stewardship Payments. These payments allow farmers to maintain the past with certain environmental outcomes.[1] (ENFO Sustainable Development, www.enfo.ie)

I didn't meet a happy UK farmer. Many complained about their low income, and the community's attitude towards them. It was basically the Single Farm Payment that they disagreed with. One farmer said that he hated the stigma of being what he called a "Subsidy Junky". Another said he thought the system was like a "begging bowl". Most felt that the Single Farm Payment should be abolished or rolled into higher environmental stewardship requirements. Others felt that the subsidies "anesthetised their minds". What they did all agree upon was they couldn't survive without some form of payment and they would rather it be an Environmental Stewardship Payment than a subsidy.

I visited the 5000 acre Great Tew Estate which Adrian Cannon manages. Great Tew is a very historical town where stewardship money had been provided to maintain and rebuild old structures such as stones walls, farmhouses etc. A payment of $85 per acre was also received for 2 metre grass margin.

Stone wall and grass margins

United States of America

The Conservation Reserve Enhancement Program (CREP) is a natural resource conservation program that looks at State and Federal environmental problems and tries to resolve them. It is the umbrella organisation for all other stewardship schemes. Participants can on a voluntary basis retire land that is environmentally sensitive land.[2] Under CREP other programs such as CRP (Conservation Reserve Program) receive funding in contracts of up to 15 years. [3]

In the US, CPR (Conservation Reserve Program) pay farmers an annual fee for achieving an environmental benefit such as restoration of wildlife habitat, decrease soil erosion, and protection of water quality. People involved in the program set aside land that is of low productive value, and convert the land to native grasses, trees and other vegetation. The farmers not only receive help with establishment of vegetation but receive an annual payment as remuneration for land set aside. It is the largest program administered in the US. According to the United States Department of Agriculture (USDA) there is approximately 34 million acres with CRP lands in 50 states and Puerto Rico. The American public value their farmers and rural communities much more than we do.

There is a particular CPA program for almost every situation from hardwood tree planting (CP3A) to Wetland Restoration (CP23). There are incentive payments up to $40 per acre per year and other incentive payments from organisations such as Ducks Unlimited.

Above: Set aside land/grass margin in Ohio

On the whole the farmers I met were very happy to be involved in this environmental program. They could see that setting aside low productivity land had a financial benefit for them and a public benefit for the community.

Tom Harp, a farmer I met in Ohio, decided to participate in the program a number of years ago. His aim was to rehabilitate some of his washed out country through the planting of native grasses. Tom found that the grasses stopped the continual erosion from flooding and rebuilt the topsoil on his degraded ground. Not only had he preserved and enhanced top soil but had also provided valuable habitat for biodiversity by establishing native grasses.

Canada

Like the US Canada has a comprehensive range of Stewardship Payments offering a choice of different programs that encourage the adoption of BMP (Beneficial Management Practices). You will note that the word "Beneficial" has replaced the word "Best" as it may not always be conducive to environmental outcomes.

Environmental Farm Planning (EFP), and National Farm Stewardship Program (NFSP), Green Cover Canada (GCC), National Water Supply Expansion Program (NWSEP) are some of the National Farm Stewardship Program. These schemes are designed to achieve desirable environmental outcomes depending on your location.

Australia

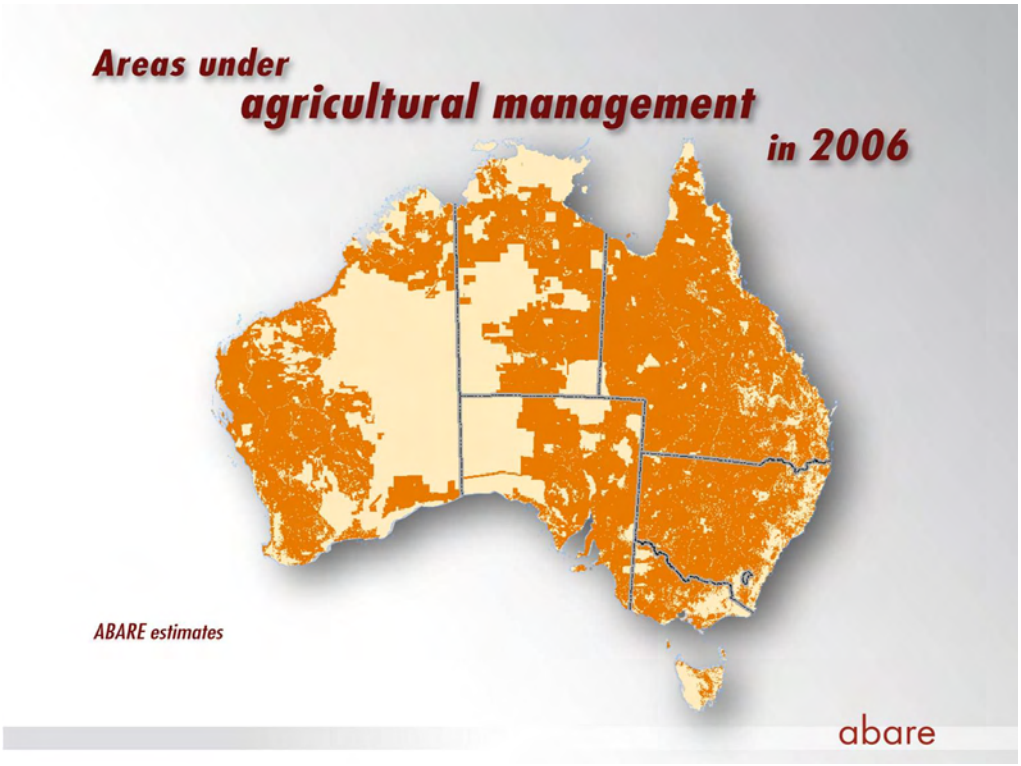
In Australia the responsibility for protecting the environment is managed through the Australian Government. Legislation, funding and regulation are provided from the Federal and State Governments and planning and distribution of these funds has been administered through the Catchment Authorities. There have been simple incentives available in the form of one off grant money and rebates.

There are many organisations such as Australian Landscape Trust (ALT), Landcare, Australian Bush Heritage Fund (ABHF), Bush Tender, and The National Heritage Trust (NHT), The National Action Plan for Salinity and Water Quality (NAP), Australian Wildlife Conservancy, Greening Australia etc. Some of these organisations also bring in private sector investment. In Australia, there is recognised need to transfer low productive marginal land back to conservation and the environmental landuse.

Over the past 30 years budgets for conservation have declined with fewer government resources to pay for weed and vermin control, re-vegetation and wildlife management. The local communities have relied on volunteers and people living around these lands.

Australia does it tough and in a way makes us the envy of the world. We are great innovators and adaptors and we are a nation of people with ideas. Our environment is a harsh task master or mistress and dishes out extreme events.

According to Australian Bureau of Agricultural and Resource Economics (ABARE) the Australian farm sector is responsible for the management of 60% of the Australian continent. Farmers are ageing and rural communities declining. In recent years there has been a shift of economic, social and educated capital to the cities. With the current drought, there is a lack of labour and a lack of money. The environment is a luxury good and when times are financially tough it is the last thing on the farmer's minds. It is hard to be green when you are in the red. The Australian farmer is a great custodian of the land but is overwhelmed by the task at hand and the financial burden.



Above: the Australian farm sector is responsible for the management of

60% of the Australian continent Source: ABARE

In Australia there is a lot of grant money available with Governments telling farmers they need only to apply. Often the process of application is arduous and will only be tolerated by the true believer who can afford the time and money. There has not been, up until recently, ongoing payments for land that is set aside from production. Farmers are expected to participate in environmental activities while accepting the majority of the financial burden with limited labour resources available to assist.

It is also hard to pin down exactly what Environmental Goods and Services a farmer is providing to the Australian community at large. We can in most cases swim in our water, eat the fish, and breathe the air. We do however have an ever increasing list of endangered species, increase in salinity, and decreasing water quality.

In recent times, Australia has employed a market based approach to the environment. According to Gary Stoneham, (Chief Economist for the Department of Sustainability Market) Market Based Instruments (MBI) have been created to explore the feasibility of creating specialised markets for Environmental Goods and Services. This has been done through auctions of conservation contracts, tradable permits and offset programs. Tender schemes are used in regions where landholders are managing properties with important biodiversity resources. The schemes enable a greater protection of biodiversity at a lower cost. It will remain to be seen whether this motivates farmers to practice environmental management.

In the last Federal budget the Government announced The Australian Environmental Stewardship Programme. This programme aims to address what the government calls the "critical gap" in the provision of incentives for land managers within a 15 year time frame to achieve restoration and protection of targeted assets. Fifty million dollars will be allocated to encourage farmers to undertake environmental work beyond what they are expected to do within their business responsibilities. The money will be used for on ground works such as weed and pest control, fencing, and rehabilitating degraded areas.

Summary

Stewardship payments are overall very worthwhile but with the growing number of programmes sometimes you loose track of what they're trying to achieve. The environmental benefits get blurred and what should have multiple benefits (or multifunctionality) across the region has limited value. The focus at times was only on small watershed areas and not achieving optimum investment across the catchments. The fact that farmers still have production subsidies for many commodities would appear to me to negate the environmental work. For example, when I went to Quebec I met Pierre Delude who worked for Duck's Unlimited. He was clearly frustrated with the way governments and farmers were not working together. The Quebec Farmers Union was very powerful lobby group and although only1% of the population, they dictated issues. Farmers in Quebec were focused on production. High usages of both nitrogen and phosphorus were finding there way in rivers, streams and lakes causing outbreaks of blue green algae and "dead zones". In some cases the water was so polluted that it was unusable. If the farm is viewed as a producer of food and or fibre and a producer of Environmental Goods and Services it certainly is not achieving maximum benefits. Farmers needed to have a certain level of cross compliance for them to be entitled to Stewardship Payments. Governments had there hand in their pockets trying to keep the peace between different organisations. Governments paid the farmers to produce (and to pollute waterways), they paid compensation to the fishermen who now couldn't fish in many areas and they also paid out to the farmers for Environmental Goods and Services in the form of Stewardship Payments. This to me is not value for money. While Canada and the USA still subsidize production they will always have limited environmental gains. It will be interesting to see with pressure on commodity prices whether land will be taken back out from CPR to meet their energy requirements.

In the UK I felt that the farmers were almost suffocated by Stewardship Payments taking away their imagination and ability to find efficiencies. As someone said to me "they are just paid gardeners".

Australia has in the last ten years put a monetary value on water and I think it is time that we do the same with the whole of the environment. The new Australian scheme, (Australian Environmental Stewardship Programme) is a move in the right direction, but by targeting

specific high public value environmental assets under a limited portfolio, it is not providing an incentive to the majority of farmers. Private net benefits must be positive if we want landholders to adopt environmental practices conducive to biodiversity, such as native vegetation establishment.

Further the market based selection process means that not all farmers who have targeted environmental assets on their land or who have submitted a proposal will receive payments, and those who do will be taxed. In some States of America a proportion of GST has been committed to the environment with a great deal of success and this could be a more effective solution in Australia.

Soil Biota

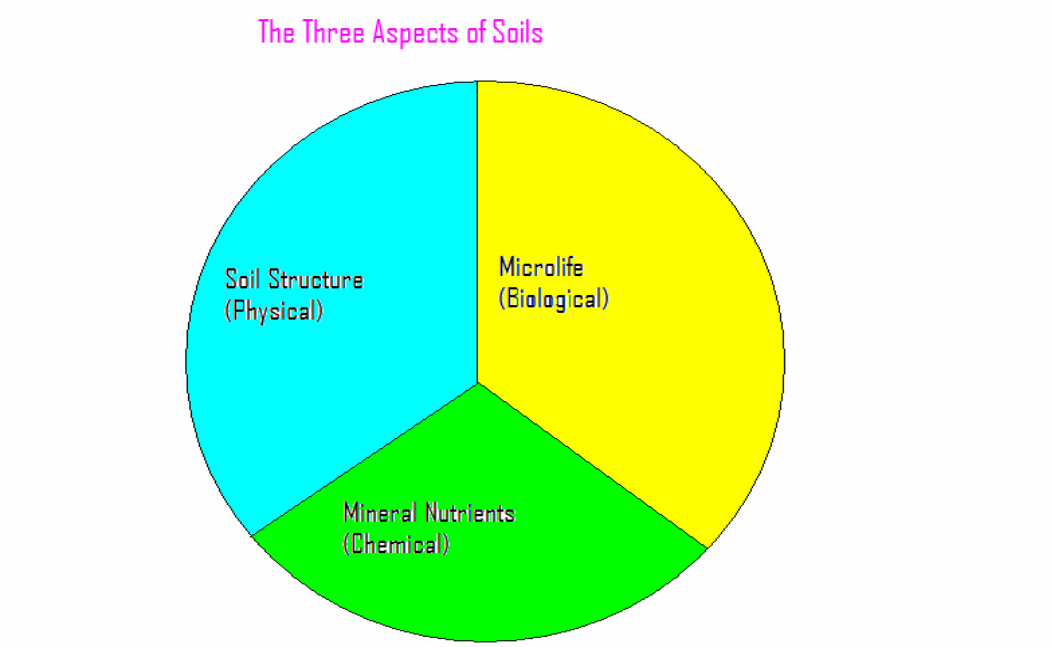
As I began my topic it became very apparent that soils are the key to everything and are the backbone and building block of any farming system. If a farmer has the right balance in his soil then he or she is well on the way to balancing the triple bottom line i.e. farm (environment), the bank (economy) and the social (family).

In the past we have focused as farmers on production and maximising yields. When yields have declined we have employed quick fix methods such as adding more urea, more water, and more chemicals to achieve the greater tonnes per hectare. Our focus has been on cleaning up our farms, clearing green timber (nitrogen fixing acacias such as Acacia pendulla), and burning unwanted dead timber, eradicating native grasses and weeds or anything which might take away from the neatest and tidiest farm in the district. This is particularly evident in the irrigation farming community where every square inch of earth has to be under commercial production. But is this focus misguided? Are we actually decreasing sustainability?

Over the years with the help of misguided government advice we have cleared our timber and ploughed our earth until it blew away. Fortunately today, even with the current severe drought we have not seen the massive soil erosion experienced in the forties when New Zealand was the net benefices of our red asset. We are slowly wising up.

Farmers today are gradually changing their practices and we are seeing reduced fallow, increased stubble retention, high uptakes of minimum till, reduction in burning, rotational grazing and increased crop rotations. We do however have plenty to improve upon especially when it comes to stubble retention of all crops, use of artificial fertilizers, knowledge in building soil structure and fertility and increasing our soil biodiversity. Our biggest challenge is understanding and working with our uniquely Australian environment.

There are 3 aspects of soil fertility. These include soil structure, mineral nutrients and micro life. See diagram below.



Source: Understanding Your Soils and Plants Workshop, Pro Ag Consulting

Conventional soil fertility programmes concentrate on Nitrogen (N) Phosphorus (P) and Potassium (K) and Sulphur (Su). A balanced fertility approach not only considers the range of chemical elements but the soil microbiology of the soil.

Growing our soil is like growing anything. It has to have water, carbon dioxide and food and comfort as well as us to manage it correctly. In the past we have tended to look after the above ground biodiversity and neglected the important soil microbiology.

The soil contains a large range of beneficial microbes such as fungi, bacteria, and plant feeding nematodes. These beneficial microbes have a major role in building healthy soils and they are constantly at work so long as all their needs are met. Microbial activity decomposes and turns over organic matter or carbon, retains nutrients, suppresses and controls disease, fixes nitrogen, builds soil structure, prevents leaching of nutrients, helps neutralise the soil ph, feeds plants and animals and can purify the soil and water and helps in water retention. They're incredibly busy, increasing our productivity and saving us money!

Building soil carbon is the answer to becoming a productive farmer. Increasing soil carbon helps feed the microbes. Basically it is the fuel for the microbes; no fuel, no work.

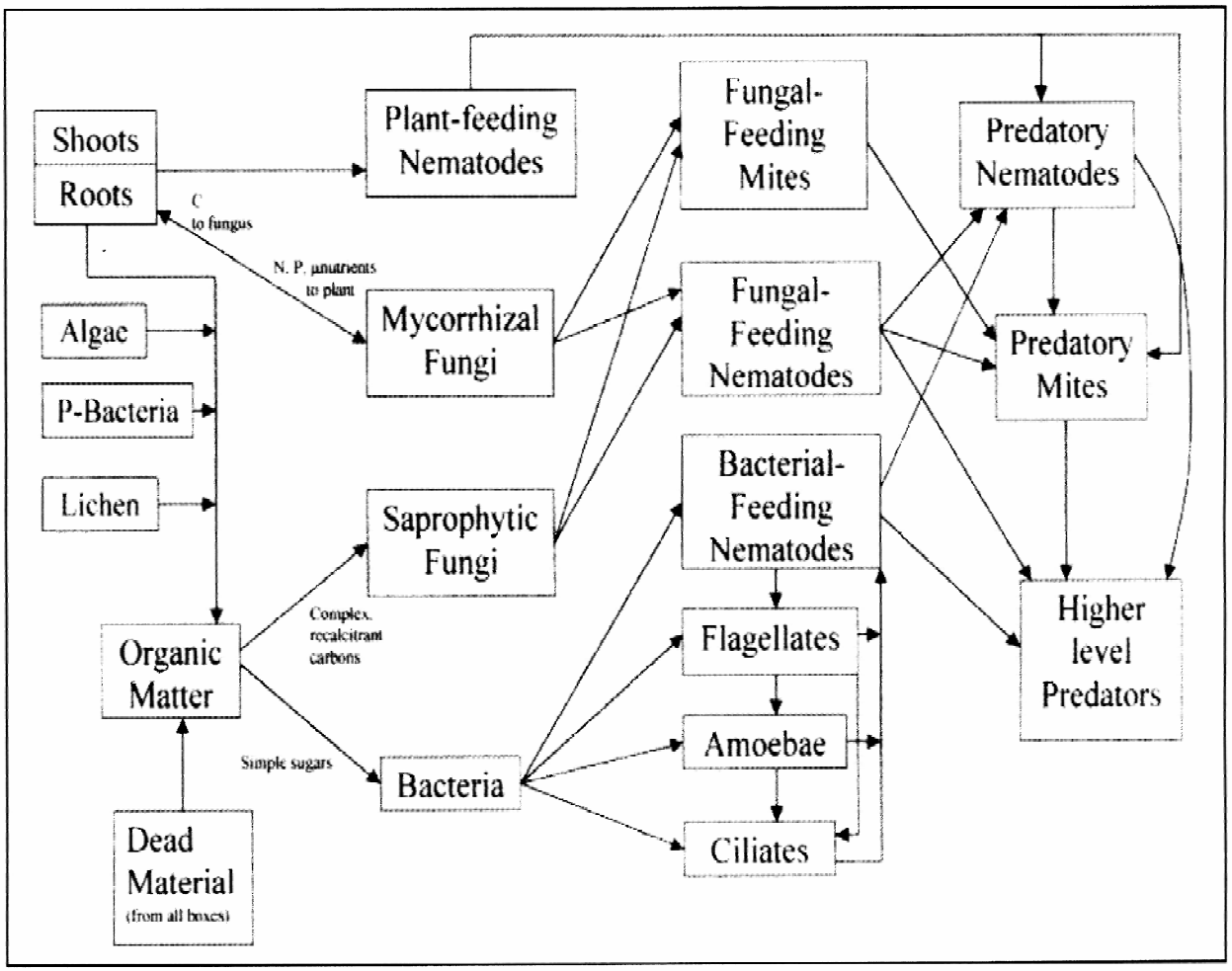
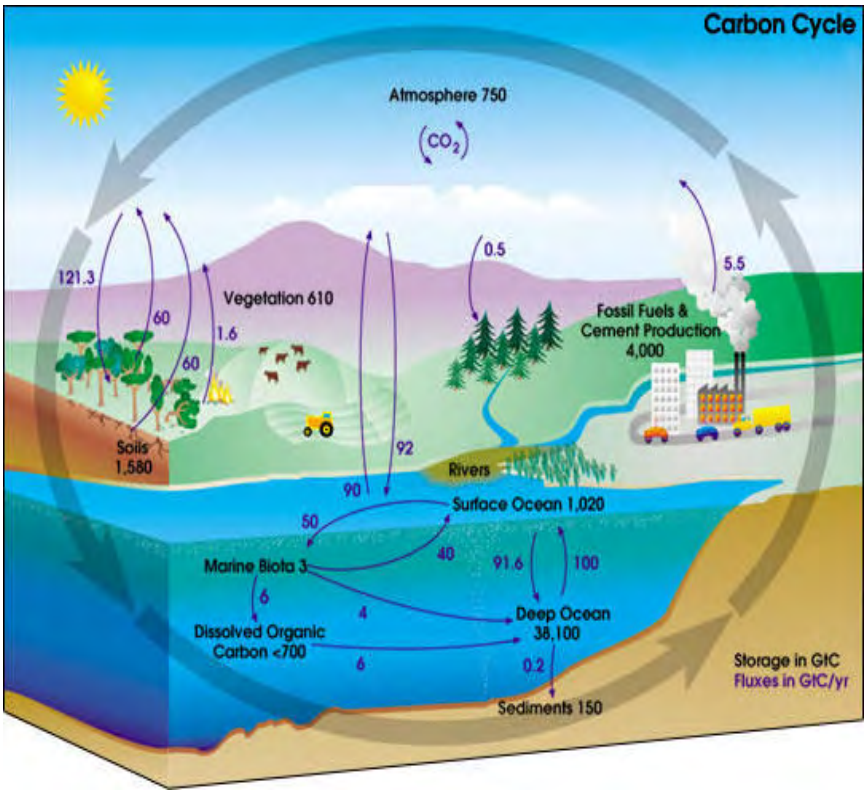


Diagram illustrating the soil food web: Understanding your Soils and Plants Workshop Pro Ag Consulting, Brian Mcleod

In the past 150 years we have lost around 50-80% of our carbon to the atmosphere due to our lack of knowledge and bad farming practises.[4] Trees sequester carbon from the atmosphere combine it with other elements and then build new wood. In the upper levels of the soil, carbon from the atmosphere from green plants combines with minerals particles to build new topsoil. When the soil decomposes it returns carbon dioxide to the atmosphere. The challenge is to maintain more of the carbon in the soil than to lose it to the atmosphere.

Diagram illustrating the soil food web: Understanding your Soils and Plants Workshop Pro Ag Consulting, Brian Mcleod



Above: Diagram illustrating the carbon cycle

Effectively managing our topsoil is done by increasing soil carbon. According to Christine Jones, ground cover is extremely important. Drought is no excuse. Plants, plant litter, crop stubble are the most important form for carbon sequestration. Jones says to build soil carbon we need to establish and effectively manage perennial grasses.

In mixed cropping and pasture enterprises new ideas such as pasture cropping can optimise year round grass cover. Loss of soil organic carbon (SOC) can also be reversed by cultivating less and by changing from a monoculture to rotational cropping. [5]

The Rice system allows us to double crop, harvesting in March- April and then direct sowing mixed species winter forage in May, (oats, triticale, legumes) with the available moisture. The problem farmer's encounter with this method is dealing with a high mass of stubble which can make sowing difficult. The burning of rice stubble is becoming unacceptable for health and environmental reasons.

Weed management rather than eradication is very important. If we can prevent weeds from choking out our crop they are actually beneficial in increasing soil fertility and health of the soil. This is why ground covers restore soil health. They return tonnes of carbon into the soil, feed the micro-organisms and reduce soil pathogens. If a farmer can manage the weeds and not use chemicals then the farm will be healthier and so will the bank balance.

If chemical (insecticides, herbicides and fungicides) usage can be reduced then great savings can be made. The use of chemicals causes a decline in micro-organisms and result in reduction of humus and increase in plant diseases. [6]

The cheapest, most efficient and beneficial form of organic carbon for soil is exudation from the actively growing roots of plants in the grass family. This also includes many crop plants such as cereal crops. The decomposition of plant roots is also an important source of carbon in the soil. The more active a plant is the more carbon is sequestered.[7]

The relationship between cropping and stock/ pasture is ancient. Working the system between the two is complex but can be achieved. In irrigation areas when water is available, good management is much easier to maximise benefits. The system can feed on itself; carbon makes carbon.

Using conventional cropping methods such as cultivation negates the benefits of carbon building by exposing bare earth. Over time carbon levels will fall and the soil will become lifeless with little water storage capacity.[8]

Minimum Till

Minimum till is a term to describe minimal soil disturbance which is usually one working before seeding. Minimum till is less than 20% soil disturbance and no till is less than 5% soil disturbance. The term no till, zero till and minimum are virtually interchangeable according to Bill Crabtree. Conservation farming does however have many variables, especially in the design of the machinery. These include effects on water harvesting, seed and fertilizer placement, herbicide efficiency, and amount of soil disturbance.

Minimum till or no till makes good economic and ecological sense. It can put dollars into your pocket by saving you money. Advantages include building of soil carbon, enhancement of microbes, reduction in fuel usage, and improvements in water retention and harvesting, decrease wind and water erosion.

Crop diseases usually start when the natural environment has been altered by loss of soil carbon, cultivation and the use of chemicals and the introduction of pathogens on equipment or planting material. Diseases can be suppressed by using natural mechanisms and utilising farm practices that enhance soil biodiversity. No till, reduced fallows, pasture crop farming, crop rotation, strip grazing, native buffer zones, and establishment of wetlands will increase the biodiversity above the ground as well as below the ground. It increases the resilience of the system and allows it to cope better.

Soil water holding capacity is critical, especially in Australia. Soil that has been conventionally farmed will have reduced water holding capacity. Infiltration of water and percolation of water downward will be much improved with no till.[9]

A soils health is improved enormously with no till. Heavy soils become soft and light and regain biological activity. Organic matter usually increases with no till and if it doesn't in the short term then it will in the long term (5- 10 years). It requires average rainfall, a rotation that is not too high in legumes or pulses as these encourage the breakdown of carbon biologically. The system then becomes biologically active.[10]

These active systems involve complex biological cycles that are poorly understood. Two documented changes with no till and stubble retention are increased free living Nitrogen (N) fixing bacteria- which fix free N from the air and arbuscular mycorrhixa which attach to plant roots and enable it to extract more water , Phosphorus (P) and Zinc (Zn). This relationship means that there may be less water, N, P and Zn may be needed in for some crops.

Traditional ploughing turns the soil, and the soil biology upside down, destroying their network. This is detrimental to soil health.

I visited Jim Halford in Canada. He had designed the Conservapac machine and had plenty of evidence to suggest that no till built up organic matter and improved mineralization. In fact, no till has been in use now for many years and is a proven sustainable way to farm. Jim showed me trial plots and research comparing conventional crop fallow cropping system to minimum till.

"Zero tillage has a definite effect upon organic matter and in turn, water infiltration; the greater the zero till, the greater the organic matter content, and the greater the water entry." (Jim Halford)

The results were impressive with increased higher yields, lower input costs and therefore greater profitability in no till systems. Jim from trial results, also showed that after 4 years of no till there was no benefit from adding phosphate fertilizer on yields. Not only that but these improvements were on going.

Jim Halford with his Conservapac

Jim drove me around his property and it was evident that great improvement in his farm environment had been achieved since the no till system had been initiated.

Photo of trial plot on Jim Halford's property. These results show little difference with increased applications of fertilizer after 4 years of no till or zero till

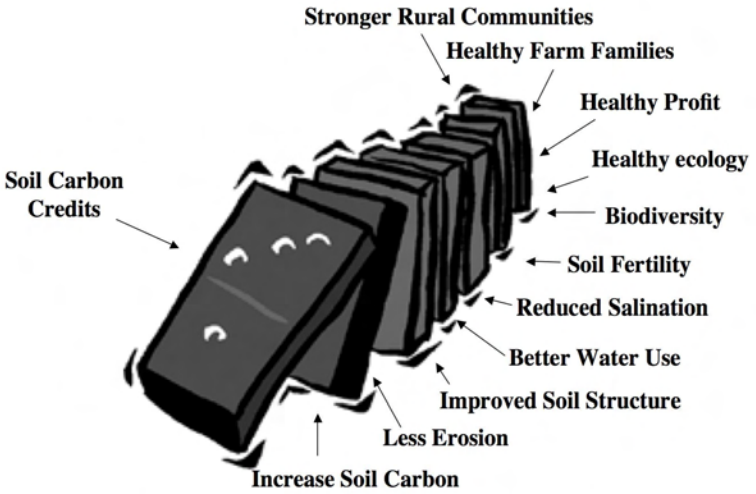
Carbon Credits

To try and discuss carbon credits and soil microbiology in isolation is very difficult. The relationship is symbiotic. Carbon sequestration and nitrogen fixing go hand in hand. The faster the plants grow, the more carbon is exuded into the soil, the larger the roots are, and so more carbon is added to the soil carbon bank.[11]

According to Rice "The simplest explanation is that plants take in carbon dioxide from the air to make oxygen and grow. The plant and its biomass grow, and the residue and the roots of the plant capture the carbon dioxide in its cells. As long as the residue is not greatly disturbed, the carbon dioxide stays in this form. The carbon dioxide, though, can be released by burning the plant mass or by tilling the soil and disturbing the organic matter."[12]

Carbon dioxide (CO_2) can be stored in the soil through no till planting, restoring wetlands, converting cropland to permanent grass or trees, planting conservation buffers and using cover crops.

An increase of 1% of soil carbon in just 10% of Australia's farmland could remove 10 years worth of Australia's CO_2 emissions. A 4% increase in soil carbon could remove 40 years worth. This offers a great opportunity for farmers to sell carbon storage to an industry group who can purchase "offsets" or "credits" to account for their atmospheric emissions. Not only can farmers benefit from enhanced soil biology, increased soil fertility, reduced salinity, increased water efficiency, improved soil structure, reduced erosion, but they can also earn carbon credits. A win win win situation!



The Benefits of Soil Carbon Credits

www.carboncoalition.com.au

Forests have limited benefits and are actually net emitters of carbon dioxide during the first years of planting and take many years to reach their potential. Not enough land is available for forests (10-20%), its expensive compared to soil enrichment, and they could not sequester enough CO_2 to counteract emissions. Fire is also an added hazard particularly in Australia. An acre of pasture can sequence more CO_2 than an acre of forest. Soil, represents the largest carbon sink.

Carbon trading is a reality and here to stay. Carbon dioxide is one of the green house gases contributing to global warming and climate change. Carbon credits are simply the financial rewards for activities that reduce CO_2 in the atmosphere. There is a large number of carbon trading schemes in the world.[13]

The Chicago Climate Exchange (CCX) began trading in December 2003 to allow industrial companies to purchase carbon credits to offset their greenhouse gas emissions. Farmers on the other hand can earn money for carbon sequestration by enrolling their eligible land with the CCX.

In Europe, in 2005 the world's first carbon futures market was established and is known as the European Climate Exchange (EUX).

While I was in Canada I met with Dr David Balfour who is the project manager for The Bio-Agtive CO_2 Exchange. He works with Gary Lewis who is a man who is always thinking and is a great innovator. Gary believes that carbon trading should be far more accountable and he wants farmers to receive a fair price for carbon sequestration. Industry and individuals don't really know what they're getting for their purchased carbon credit and farmers are not being well rewarded for carbon sequestration ($4 per metric tonne). Usually no one farmer has enough carbon to sell. At the present time you can sell your credits to aggregators who are registered carbon credit brokers. They charge 60-70% commission which makes it unattractive for farmers. Gary believes that there is a lot of offset fraud and farmers need to be accountable and also they need to be better paid. It also makes no distinction between farmers with the good carbon friendly practices and those that aren't.

The proposed scheme begins with the writing of a protocol and then gets validated and verified to establish creditability. From there you begin trading. He wants 70% of the farmers to be audited once trading has begun.

The scheme is based on quality credits and does distinguish between the farmers who are actively building soil carbon. Up front commission will be 50% (better than 60-70%) and the farmer is given the chance to reduce commission down to 15% if good beneficial practises are adhered to.

These might include:

Methods of Gaining carbon dioxide Discounts	Proposed Discount (%)
No Till	2%
Land use conservation from farming to grass land	
Fertilizer management – decrease in nitrogen. 1 tonne of N fertilizer creates 18.35t of carbon dioxide through manufacture, transportation and runoff (in high rain areas)	
Tree planting	5%
Irrigation practices	
Manure and nutrient management	
Reduce chemical use	
Use of bio fuels	
Use of Bio-Agtive method	

Depending on the situation and Beneficial Management Practices (BMP) these above categories could be changed and given a percentage discount rating. For example tree planting could see a 7% reduction in commission. The programme is yet to be refined but it does have merit.

The buyer of the credit can be linked to the farm by something similar to Google Earth and can view the farm and see how environmentally sustainable the farm is.

What needs to happen world wide, is that industry has their emissions capped and fines imposed if they are exceeded. The fines at present are low. In Alberta, Canada it is $10 per tonne.

In Australia, carbon trading has begun and with good reason. Organisations such as CO_2 Australia, Carbon Farmers of Australia, and The Australian Soil Carbon Accreditation Scheme (ASCAS) have been recently established.

There is debate about whether farmers will have a carbon liability or not. I think there are many opportunities that farmers can capitalize upon. We do need to eat, and farmers do emit CO_2 into the atmosphere but we also have a big opportunity to sequester CO_2.

The National Farmers Federation believe that "Australian farmers can make a further significant contribution to reducing the Australia's greenhouse gas emissions, but to achieve this it will require the development of a range of incentive driven, well designed policies and strategies that provide new opportunities for farmers to increase productivity and contribute to greenhouse gas emission reductions." (NFF Submission to the Prime Ministerial Task Group on Emissions Trading from the National Farmers' Federation) As Tom Nicholas, a Queensland farmer said "We should all be carbon farming: it's the answer to everything".

Rice

Australian rice is grown in temperate conditions in South West NSW. Compared to other parts of the world rice cultivation in Australia produces about 75% less methane and this makes up only 1% of the emissions from all of Australian agriculture.

In rice, methane is considered the main contributor to greenhouse gases and is produced by bacteria in the anaerobic environment. Water management, soil structure, gypsum applications and the amount of stubble incorporation that occurs can affect the level of methane emissions. In lesser quantities nitrous oxide can be produced.[14]

Australian rice farmers are continually looking at (Best Management Practises) BMP to minimise emissions so that there is less impact on the Greenhouse effect. In 2005, Leigh Vial, a Nuffield Scholar, researched Rice Systems in Relation to Aerobic and Alternate-Wet-Dry (AWD) Rice Systems. His report is now on the Nuffield Website. (www.nuffield.com.au)

Ricegrower's Association of Australia's Environmental Champions Programme, is a member of the Commonwealth Government's Greenhouse Challenge and is committed to implementing a strategy that will reduce the industries contribution to global warming. An innovative electronic scorecard has been designed, allowing farmers to input their production data and calculate their emissions in a typical year. Measures are then implemented to reduce these emissions.

The potential for Australian rice growers to earn carbon credits is there. With high yielding rice, the above biomass plus the below ground biomass via root production have the potential to store carbon in stable forms.

There is an opportunity for RGA to begin investigating carbon credits as another pay check for rice producers. Rice producers need to calculate emissions and also stable soil carbon and realise the potential for increasing carbon levels in the soils.

For a soil carbon credit and trading system to be credible we need to have reliable methods of measuring and verifying changes in soil carbon spatially and quantitatively over time. According to Walter Jehne, a retired CSIRO soil biologist, stable forms of carbon result directly from the activity of specific groups of soil fungi, not the level of primary plant carbon inputs. As carbon credits are based on the sequestration since 1990, the challenge is to accurately measure soil carbon retrospectively.[15]

In addition to this, we need to enhance further the production and retention of stable soil carbon levels. These include management techniques that prevent degradation of stable soil carbon. This may include different planting techniques such as soil cultivation, enhancing our soil microbiology, root proliferation and growth, soil cation exchange rates etc.

The Kyoto Protocol doesn't recognise soil as the biggest carbon sink. We as farmers should begin to develop legally our own methods and data for accounting for our carbon and develop our own trading scheme. This is a perfect opportunity for Australian rice growers. If we don't, we might find ourselves paying for our emissions and liabilities without receiving the financial reward we deserve.

Bio-Agtive Emissions Systems

Never heard of it I hear you say. Well this is a very new and innovative idea. You may have seen it written on the above page under BMP list. Gary Lewis, has invented a system to put carbon dioxide emissions into the soil, saving on fertilizer costs.

Gary has designed a system that takes exhaust emissions and put them into the soil through a series of pipes after being cooled down in a coolant. Cooled exhaust fumes via a blower picks up the warmed nutrient enriched seed and injects it into the ground. The seed is also coated with an organic conditioning product. This is a product that is commercially available and helps promote germination. Together with the warmed air and the organic conditioning product the seed germinates earlier than normally expected.

The internal combustion engine becomes the mobile fertilizer plant supplying the soil with basically nitrous oxide and other trace elements. Diesel fuel is made up of carbon, hydrogen, sulphur, calcium, iron, silicon and chromium.

The thermal efficiency of the engine determines the chemical make up of the emissions. If a tractor is running too clean an additive is put into the fuel to make it "run dirty". It's dependant on the type of fuel, injection settings, operating temperature and the revs per minute (RPM) used by the tractor.

The Bio-Agtive Emissions System stimulates soil microbial activity and raises carbon dioxide within the soil which in turn increases soil fertility.

Gary believes that this technology will replace the need for salt fertilizers. Testing of crops across the US and Canada (20,000 acres, 50 farmers, and 2 scientists) indicate that the crops are adjusting better to climatic conditions and give a higher than average yield.

Gary uses this system with irrigation water, injecting the pump motor exhausts fumes into the water. It is in effect adding urea into the water. This has tremendous potential for irrigators.

At the moment this technology is in it's infancy but I can see the system being refined and having huge benefits for agriculture and the environment.

Both photos showing Gary Lewis' Bioactive emission System

Integrated Pest Management

Integrated Pest Management (IPM) is an approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks.[16]

Rice is one of the world's most important agricultural crops with half the world's population dependent on rice production.[17] The integration of the rice cropping system with biodiversity, is essential for sustainability. In agricultural environments, soil microbiology, pollinators and predators of pests are all necessary part of biodiversity, helping to provide a balanced system.

Often farmers have a high level of knowledge about the pests that attack their crops but very little knowledge about their predators of these pests. This has meant that solutions have been heavily weighted towards chemical usage without knowing what the impact is on other insects. Many chemicals can often make the pest worse, putting the biological system out of balance.[18]

Rice fields incorporate both aquatic and terrestrial biodiversity and often support higher levels of biodiversity, which play an important role in the agricultural productivity of these systems.[19]

Direct drill sowing of rice offers more flexibility of pest management such as grazing of barnyard grass for sheep and minimization of bloodworm infestation. Delaying the application of permanent flood on paddocks also delays the germination and development of aquatic weeds and allows the rice seedling to compete. Minimal disturbance of soil has also less impact on microbial activity and less of disturbance of weed seed.

Australian temperate rice systems fortunately have few pests but the two major ones occur are during establishment. These include blood worm and aquatic snail. The blood worm is a major limiting pest and chews the rice seedling roots and shoots and can uproot the seedling. Blood worm can be wiped out with bacterial insecticides but this is expensive, around $40 per ha compared to a chemical such as Lorsban which is around $3 per ha. The problem with chemicals is it is often non selective impacting on other biodiversity.

Aquatic snail is native to the Australian rice growing area. Normally they are abundant around ditches and rice crops performing an essential task of feeding on rotting organic matter. Aquatic snails fed on the roots and shoots of the rice plant also.

If they are allowed to over-winter in mud and the seasons are wet then populations of them will increase. Farmers that are aware of their life cycle can control them by drying out channels over winter and having a long rotation. This strategy requires no chemicals, minimal cost and no impact on other biodiversity.

An emerging late season pest is the stink bug and it feeds on the developing rice grain. This pest is found in warmer areas and is not a problem in southern NSW due to the cool winters and low humidity. With the advent of global warming and the higher than average temperatures the stink bug could be considered a potential pest. Again little is known of its habit but its impact could be devastating on the industry.[20]

With the pressure of water efficiency on rice farmers, mid season dry down is becoming a technique to save water and at the same time achieving a small increase in rice yield. Draining rice bays mid season does have its disadvantages as it changes the microclimate, decreases the humidity and as a result destroys the aquatic biodiversity. When water is reapplied, mosquitoes colonise quickly whilst their predators are slow to re-establish. Where the practice of mid season dry down is implemented the incidence of mosquito carrying diseases has increased.

Mid season dry down may also increase the numbers of serious pests such as the stink bug, parasitic wasp and army worm (attacks the stem). Water savings may be achieved with mid season dry down but it has the potential to incur added costs in order to control these pests.

Water savings are also going to impact on rotations. Farmers are going to choose the most suitable land for rice production (low permeability) resulting in the abandonment of crop rotations. Increases in pests, higher dependency on chemical usage, and decrease in soil nutrients will all affect the aquatic and terrestrial biodiversity on rice farms.

Land Values

The question of whether a farmer gets financially rewarded with higher than average returns for a farm that is environmentally sustainable depends on where you are in the world. Unfortunately few studies have been is done and so information is hard to find.

I began by asking the local rural property real estate agent and valuer, Lawry Owers who works for Ray White Real Estate in Griffith. Were aspects such as the practice of minimum till, wildlife corridors, shelter belts, wetland restoration, building soil carbon and biology taken into consideration when valuing properties? Lawry believes that many rural property purchasers down grade the value of land if there are trees and shelter belts on the farm. Particularly with the new clearing laws, irrigation farmers want to make every productive acre count. If the average price per acre in your district is $1200 for irrigation land then regardless of whether you have farmed with conservation in mind has little bearing on price. In fact, if that irrigation property is timbered with shelter belts it is likely to be heavily discounted by between $200 and $300 per acre.

Farmers are looking at production efficiencies, location of markets, and arable land available when purchasing property. Lending institutions are also looking for the same thing taking into consideration whether the farmer has the productive ability to service his debt.

I also spoke to Phil Rourke, State Real Estate manager for Landmark to get a State perspective on values. He certainly backed up what Lawry Owers said, maintaining that it was all depended on the area average price. Carbon credits were still in their infancy and little was known about it by the average farmer. The wildlife value of hunting was not a consideration due to the new gun laws and lack of gun culture and this resulted in a lack of interest. Prospective property buyer generally do not do soil tests to measure ph or soil microbiology. In Australia we are concerned about production and productive ability. In a sense, because we don't harvest our wildlife it is actually detrimental to wildlife conservation. As I found out in America, wildlife harvesting is valued and many farmers conserve and enhance biodiversity to make a dollar. It is a multimillion dollar business and has multiple benefits for all. Establishment of grass margins for deer and quail habitat, flooding of rice fields in winter for duck habitat and riparian buffer zones, growing of suitable grain for birds are all practices in order to increase biodiversity. This is a mutually beneficial situation for the farmer and the environment.

I recently saw a property brochure advertising a 30,000 acre property in the Cobar area in New South Wales. The advertisement said that there was 3100 acres of farming land ready to be "ploughed". Perhaps the real estate agent was well out of touch. Somebody certainly was. No where on the brochure did it mention anything to do with environmentally sustainable practices that may have been implemented on the farm.

In America, land values were certainly linked to ecological enhancement. Studies in Mississippi showed that if recreational uses of the land were enhanced then this contributed to $808.73 per ha or an increase of 36% in property value. Property characteristics that influenced sale price were hectares of pine wood forest, bottomland hardwood forests, agricultural row crops, wildlife supplemental food plots, and rabbits.

Conservation and management of wildlife and fish resources can produce quantifiable increases in land values and sales proceeds, and the consideration of value added outdoor recreation is part of the cost-effective approach to sustainable economic development in Mississippi.[21]

Photo, showing a man made lake that is in construction to provide wildlife habitat. Note: the old irrigation pipe which is use to provide fish habitat.

Agri-Tourism

Agri – Tourism includes a huge range of activities that we in Australia are just beginning to capitalise on. These activities include- bed and breakfast, off road access for 4 wheel drive vehicles, wildlife watching, ecotourism fishing, and horseback riding, mustering and hunting. It offers us a chance to reconnect the urban community to farmers while being rewarded financially.

In 1960, 19 out of 20 people had a relative or friend living on a farm. In 2004, the figure had decreased, to one person in 20 knowing somebody living on a farm.[22]

Farmers in Australia may need to adopt a new outlook and switch their thinking away from total production toward giving today's consumer's what they want. That might include value added products and farm tours.

American citizens spend 100 million dollars annually on consumptive and non consumptive use of fish and wildlife. In England, the LEAF (Linking the Environment and Farming) programme organises demonstration farms to open to visitors (Open Farm Sunday). "We had 2,200 visitors to the farm" said Ian Piggot from 'Annables Farm' "and conservative estimates suggest that 155, 000 people called on farms across the country"

"It gave urban people the chance to find out everything they wanted to know about life on a farm, where their food comes from, how it is produced, and the extraordinary lengths to which farmers go to preserve and promote our wonderful countryside." On "Annables Farm" visitors were offered tractor trailer rides, a nature trail to explore, machines to look at, and farmers to talk about farming and the countryside.[23]

There are three agri – tourism basics: Have something for visitors to see, something for them to do, and something for them to buy. Research shows that tourists will tend to buy food, drinks and souvenirs. [24]

Recreational activities in Australia are only limited by your imagination. As Australia's population continues to become urbanised, the demand for rural recreational activities will continue to increase. Abundant biodiversity and native vegetation are important components and can produce recreational and income benefits to landowners. Australian rice producers may want to look at duck hunting in a different light.

Above- Rice crop grown in Mississippi in harmony with the natural biodiversity

Above – Mississippi, recreational fishing

Agro-forestry

Agro-forestry is the integrated system of rural land resources based on the deliberate combination of trees or shrubs with crops or livestock, whose interactions generate economic, environmental and social benefits.[25]

In Australia, agro-forestry is in its infancy with farmers having limited information about which species to grow. A fully integrated system needs to be explored so that the environment in general can benefit. Agro-forestry has numerous ecological and environmental advantages. They protect crops, stimulate biodiversity, provide shelter for livestock, cycle soil nutrients, contribute to carbon sequestration (after the first 2 years), help combat salinity, and even mitigate climate change. Basically all the advantages you gain with a shelter belt.

The CSIRO has estimated that up to 15% of the Murray Darling Basin will have to be replanted to trees to reverse salinity and other land degradation problems.

When planning for agro-forestry it is important to look at the farm as a whole. A farm plan is needed and integration of many species of plants such as under-storey, shrubs and trees is essential for balanced system which needs to be well managed. In this way optimum environmental benefits can be achieved while maximising an economic return. You would of course have to apply to the Department of Conservation and Land Management for approval to harvest any trees growing on these lands.[26]

Trends and fads come and go in the timber industry so careful thought and research is needed in selection of suitable species that target specific markets.

In Australia about 90% of Australia's total plantation area is located in rainfall zones greater than 700 mm per year. In the Murrumbidgee Irrigation Area (M.I.A) there has been a significant increase in forestry plantings but not in agro-forestry. The forestry is not integrated into the farming system and is essentially a monoculture. The success of these forested areas will be dependant on irrigation water which is vital for their survival.

Production Enhancement

In this last section of this report it is important to mention production enhancement. I have divided them into 4 sections.

Native Grasses

Australian Native grasses are those grasses that occurred in Australia before European settlement. Many native grasses are perennial, deep rooted and tolerant of acidic soils. They help solve problems with soil and water erosion, induced soil acidity and salinity. They restore degraded environments and increase biodiversity.[27]

Australian native grasses are adapted to low fertility soils, drought and low rainfall. They have mechanisms for drought avoidance, either through entering a prolonged dormancy, or having a below-ground crown capable of surviving drought and grazing. When it does rain they are the first to respond. Some grasses are high in protein and respond well to fertilizers and grazing while others are quite the opposite.

Perennial grasses can build soil organic carbon and microbes and provide a cover to protect soil from high temperatures as well as being a carbon sink. These grasses also protect the soil from invasive exotic weeds and provide a more even production of forage over the course of the year.

In the UK and USA grasslands have become a very important aspect of an environmental approach to farming and plantings are encouraged through Environmental Stewardship Payments. The establishment of grasslands provides forage and habitat for invertebrates, birds and mammals.

Photo showing depth of native vegetation; grasses, shrubs and trees around soybean crop

Native seed production is an emerging industry with very lucrative returns. Some farmers are growing seed for commercial production and are receiving higher returns than from main stream crops such as corn or soybeans.

The demand for bio fuels has increased the demand for perennial grasses as these can be harvested for ethanol production. Not only are they reducing CO_2 emissions because of low production costs (no annual planting) but they provide a source of renewable energy.

In the UK, Miscanthos (a perennial grass) is pellatised and used as a heating source for homes and is becoming increasingly important as a renewable energy source.

We need to educate ourselves about our grasses as they will become increasingly important especially for drought conditions, increasing biodiversity, as a renewable energy source and for building resilience into our farming systems.

Shelter Belts

The importance of shelter belts can't be emphasised too much although at times it is hard to quantify. The presence of shelterbelts increases the organic matter levels in the soil. This is due to a number of reasons including leaf fall, migration of fauna who contribute faeces and organic matter deposition due to wind erosion. There are also increases in density and composition of soil microbiology and above ground biodiversity within shelterbelts.[28]

Shelterbelts help provide a depth of biodiversity that increases the ability of the production system to resist pests and diseases. They provide a richness of diversity that adds a balance to the farming system.

Studies on shelterbelts around the world show that outflows of water from fields can contain high levels of nitrates and phosphorus but can be significantly lowered by shelterbelts which provide an environmental buffer. In Poland, UK, Canada and USA this is an important tool to control water pollution in waterways.

An increase in actively growing plants will modify the microclimate. Trees not only cool things down in the summer but maintain warmer conditions in the winter. Moderating the microclimate also provide protection for livestock from severe weather conditions such as wind and snow during the cold winter months and provides shade during the hot summer months.

Recently, science has shown that large areas of vegetation produce vast quantities of bacterial cloud nuclei that multiply in the stomatal cavities of leaves. These bacterial nuclei rise in the transpiration flux and carry water and heat from the earth's surface and help in condensation and cloud formation. These bacterial nuclei are highly effective at enhancing rainfall.[29] This might explain why old timers in Australia including the Aborigines tell us that the rains follow the rivers and hills where there is abundant vegetation.

Pollination

Shelterbelts provide valuable habitat for pollinators such as bees. There are many species of bees and each has their own characteristics and behavioural habits. We need diversity of habitat for pollinating species to increase quantity, reliability and duration of pollination.

When I visited Calgary, Gary Bank from Agriculture and Agri-Food Canada re-enforced the importance of pollination in commercial crops and stressed how important it was to have adequate habitat for pollination species.

Native insect pollination saves the United States agricultural economy 3.1 billion dollars annually through natural crop production.[30]

Pollination of crops has become an environmental issue, due to the trend towards monocultures, misuse of pesticides, new diseases and parasites of bees, clearing urban encroachment, and removal of habitat from farms. Monocultures require greater concentrations of pollinators at flowering time than ever before.

Gary Bank catching bees for study into bee diversity at Red Deer, Canada

Crop Rotation

Crop rotation is another important management strategy for farmers which can achieve an increase in productivity. Generally speaking if you have greater biodiversity than on average you will increase productivity.

Crop rotation is a planned order of specific crops planted on the same paddock overtime. Crop rotation also means that the succeeding crops are a different genus, species, subspecies or variety than the previous crop e.g. Barley after wheat, row crops after small grains, grain crops after legumes.[31]

Planned rotations may be for a 2 to 3 year period or longer. The advantages of crop rotations include-: improve or maintain soil fertility, improve soil tilth, reduce soil erosion, reduce insect and disease problems, reduce reliance on chemicals, increase soil water management, and increase net profits.

Rotating different crops such as wheat or barley usually result in higher grain yields compared to continuous cropping.

Integrated Pest Management is important and can prevent or partially control many pests with reduced reliance on chemicals. Insect numbers will also increase where only one or two crops are grown continuously but where several crops are grown in a region, insect infestations will be minimized.

Disease pressure changes with changing environments. Crop rotation has huge impact on reducing the transmission of particular diseases.

Rotations can be used to shift weed populations and correct rotation management can suppress weeds.

Soil nitrogen can be increased by having a legume in the cropping rotation system. Symbiotic nitrogen fixing bacteria called rhizobia form nodules on the roots of the legume and convert or fix atmospheric nitrogen to organic carbon. Fixed nitrogen not removed from the land by harvest becomes available to succeeding crops as the legume tissues undergo microbial decomposition.

Crop rotation is also a risk management strategy. Revenue from more than one crop type can smooth out income variation, target a number of niche markets and has the potential to use labour efficiently by manipulating peak labour demand within the growing season.

Not only is crop rotation important for increased productivity but a variety of crops in the landscape also provides resilience in the environment. Wall to wall wheat or rice or any other crop year in year out opens itself up to a break down of the system. The diversity in soils, paddocks and communities producers a mosaic effect and this builds in a healthier more vibrant and sustainable system. The relationship between shelter belts and cropping systems is important and beneficial for a range of reasons. Increased diversity of plants and animals adds a balance to the environment that will assist to sustain us financially.

In California farmers were specialised and concentrating on a particular crop. I visited a lettuce producing farm where production of lettuces was the primary activity. Production of other Ecological Goods and Services was not on the agenda. Problems with dust, soil infertility and structure, and non-wetting soils were apparent and we could see that the environment was fragile. Resilience was not built into this system.

Conclusions

Farming will continue to have a significant impact on the environment. With the world's population increasing there is pressure on the agriculture sector to increase production from the land available. Intensification of land use may increase our reliance on chemicals and artificial fertilizers. These trends can adversely effect the environment with huge impacts on our biodiversity.

Farmers need a greater awareness of their environment. Australia is a unique country with a unique environment. For too long we have had European expectations about what our surroundings can produce. With our ancient soils, low fertility and in some places low rainfall our expectations in the past have sometimes been too optimistic. If we push our land too much we may find large areas of degradation such as dry land salinity. It is important that we work with our environment and allow our biodiversity to support us.

Governments have put in place policies with little knowledge of the consequences, and in the recent past have provided only token support for farmers. They have tended to use the stick approach rather than financially rewarding farmers for good stewardship.

A huge responsibility rest with farmers and they need to be supported both financially and morally from the urban community. Farmers produce multiple commodities, not just the one that they truck out from the farm gate but other things such as native flora and fauna. Farmers need to be respected and supported with sound knowledge and financial assistance as the whole of society benefits from environmental stewardship.

However, all is not lost. We already possess a lot of the information about how to farm in Australia in a sustainable way. Australian farmers are adaptors and innovators and with changes in attitude, this is leading to changes in government policy.

Recommendations

- Governments should allocate a percentage of the GST to environment. This could then be used to fund ongoing payments for farmers that have taken land out of agricultural production.

- I believe there is an opportunity for Ricegrowers' Association of Australia to be an aggregator for carbon credits. We need to start building and measuring our soil organic carbon and calculating our greenhouse emissions. There may be an opportunity to earn carbon credits. A carbon scheme could be established through the Environmental Champions Programme then sold on to industries that have high CO_2 emissions.

- Greater research needs to be done on the economic and ecological value of native vegetation and biodiversity. Researchers tend to concentrate on their own specific study without broadening their outlook. A more holistic approach needs to be taken.

- Often there are multiple benefits that can be obtained from ecological enhancement. Try to integrate your farming with your environment.

- Get a relevant education. Learn more about soils, native grasses etc. The microbiology of the soil is a huge area which needs to be enhanced and looked after.

- Try to become involved in organisations that influence government policy.

- Begin to bridge the gap between the urban and rural populations. Encourage school excursions to your farm. These kids will be our future leaders!

- Don't sell yourself too cheaply. You're a professional with great ideas and you are the best custodian of the land. Too often farmer are portrayed as just collecting the eggs and chewing on a piece of straw.

- Farmers need to educate themselves about what's on their farm. Often they don't recognise some of the biodiversity on their farms and the impacts some farming practises are having on this biodiversity.

- Find out what's going on and what grants are available. Try to capitalise on incentives by working with stake holders. If money is not available make a start anyway.

- Be open to different ideas and be in touch with your all your senses. Open your eyes and ears to what's around you.

- Make use of everyone's interest and skill set on your farm. Involve members of your family in all aspects of enhancing native vegetation and biodiversity.

- Think outside the square with everything you do. Question traditional ideas and practises and don't be frightened to be different.

- Get used to having a farm that may not be tidy. Not everything needs to be manicured. The odd log and hollow tree is often great habitat for animals.

- Manage and make use of your fenced off areas. When plants are mature enough then light grazing by stock is beneficial.

- It's a good idea to get an aerial photograph of the farm so that you really get the overall picture of the farm and surroundings. All of a sudden a broader perspective can be gained. Native vegetation corridors can be planned and linked with your neighbour.

- Don't go broke doing it. Remember it's an integrated approach, just work with your environment rather than against it.

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