Improving a high rainfall cropping system using a more biological and sustainable approach

A report for

by Andrew Nagorcka

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EXECUTIVE SUMMARY

Key Study Topics

- A more sustainable "High Rainfall" cropping system includes much more than becoming environmentally sustainable. Other important factors vital to achieving this will include leaving land in a better condition than when it was first cultivated, financial profitability through reducing costs and better marketing.
- The "High Rainfall" cropping has some great advantages to other Australian crop areas, which we have not fully utilised.
- A shift toward benchmarking and calculating gross margins only over one season can encourage management practices which are less sustainable over the medium and long term.
- Many of our current problems are a result of our management. Rather than looking for a cure to a problem we should try to understand what is causing it. For example an annual winter crop system, min till or no-till, with few crops in the rotation, guarantees that annual rye grass resistance will be a problem. Instead of looking at different herbicide options (eg GM crops), we should look at changing the system.
- Understanding that soils are living. Soil organisms are responsible for many things which we take for granted including nitrogen mineralisation.
- Many current farming practises damage soil, and soil microorganisms. Tillage, fungicides, herbicides, pesticides and incorrect fertilizer applications all cause some level of damage; many are unavoidable, however healthy soil will recover more quickly.
- Look at changing the current system, shift thought paradigm to incorporate both winter and summer crops, as well as green manure or cover crops. By changing back to past practices to include livestock in the rotation we can improve long term farm profit and sustainability.

ACKNOWLEDGEMENTS

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- Jim and Bev Cooke, Pullman, Washington State

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- Duane Siegenthaler and Garry Zimmer, Mid West Bio Ag, Blue Mounds, WI

- John Aeschliman, Colfax, WA

- Prof. Randy Anderson, USDA, Brookings, South Dakota

- Bill Warren, Walla Walla, Washington State

- Fred Seamon, Economist, Chicago Board of Trade

* *Canada*

- Gerald & Verna Wiebe, Manitou MB

- Wally and Ruth Doerksen, Steinbach, Canada

- Don Sissons, Portage la Prairie

* *Brazil*

- Allesandra Fagaro, Monsanto, Sao Paulo

- Fabiano Ferreira, Monsanto, Goiania

AIM

My Study topic**: "Improving a high-rainfall cropping system using a more biological and sustainable approach".**

I was also interested in "How the reduction of farming subsidies in the USA and EU together with increasing production of developing countries will affect Australian Farmers"

Our family property is situated in South West Victoria, where we run a mixed cropping and grazing enterprise of 1500Ha. We receive a relatively reliable average rainfall of 720mm, with a growing season which can begin in April and continue through until December. Agriculture production has changed significantly in the past 15 years. Traditionally the main industry in our area was wool production, however, since the decline of returns from wool, growers have turned to other alternatives, the two most popular being prime lamb production and grain production.

In the past grain production has been affected by normally wet winters, together with clay subsoils leaving crops in waterlogged conditions, greatly reducing yields. Production increases have resulted in past years through better management techniques, the most successful being the introduction of raised beds. This practice uses drains formed in paddocks every 2m allowing excess water to drain freely from paddocks. There are also added benefits such as controlled traffic with machinery wheels tracking in the furrows reducing compaction. Our property has seen average wheat yields almost double from 2.5 to 4.5 tonnes per hectare since past attempts to continuous crop began. Many other growers in the area have also achieved similar results, including the added benefit of very reliable average yields even in the drier years. We have certainly eliminated our biggest production risk of too much water. The "High Rainfall" cropping area in Victoria is now one of the fastest growing grain production areas in Australia.

In the last 8 years we have experienced excellent growing conditions for grain crops. Because we are relatively new to a continuous crop regeime, we have good soil structures using herbicides that are effective, (little chemical resistance) and generally fertile soils with high levels of organic matter.

Production costs have rapidly increased since we started raised bed cropping 8 years ago, affecting our financial returns. We have been using a minimum-till sowing system since the beginning, but have seen spray costs alone increase by 300%. Slug control has also been a major problem partly due to full stubble retention and no-till practices, but I think it may also

be due to killing natural predators with insecticides as our paddocks with increased insecticide history have greater slug pressure.

The higher yielding crops have obviously resulted in much larger amounts of stubble residue, which is proving a problem and we will be challenged with managing it in the future.

The last 3 years we have been trialling a different approach to crop production with more attention to soil fertility and balancing soil nutrients. Many fertilizer recommendations advise only N,P,K,S programs, however, we question that with the high levels nutrients taken out with a ton of grain why do only 4 need replacing ? Little regard in the past has been given to beneficial and predatory insects which are being killed by continuous applications of non target specific insecticides. Weed resistance is becoming one of our biggest problems and we are concerned that there is an impact of the increasing use of herbicides on our soil biology.

We also have the usual financial concerns of an expanding family farm which includes succession planning. For our farming business, sustainability includes both financial and environmental. Our role is to leave our farm in as good or better condition for future generations to continue their farming pursuits as well as being able to support an increasing number of families.

Many other growers in High Rainfall cropping areas are faced with similar challenges and I hope to gain the knowledge to share with farmers in these circumstances.

My study goal is to find some practical answers for these problems, with a main focus of increasing soil biology and understanding how our management practices have been affecting the health of soils. How can we improve our cropping system growing healthier crops and lowering costs?

During the first part of my study I looked at how we can address these concerns and the underlying reasons causing the problems that we are experiencing. The question I want to answer is if there is a more sustainable approach or are we just going to face the fact that increased chemical input and higher costs in farming is just the reality.

The second part of my study looked at how the reduction of farming subsidies in the EU and USA, together with the increasing production of developing countries, will impact on Australian producers.

Most Australian farmers are under the impression that we will benefit from the reduced government support of overseas farmers. Increased market access is also seen as a big opportunity for Australian farmers. However, is it to the benefit of world agriculture or does it just continue the “race to the bottom” direction for world agriculture trade.

As food producers we constantly hear concerns regarding future food demand levels needed to feed the growing population of the world. My father told me years ago that when he started farming the same concerns had been raised, but in the 40 years since commodity returns have continued to fall and prices dropped, relative to costs. I am interested in the potential production capabilities of some of the developing countries especially given their closer location to large export markets.

Is there an increase in potential production capabilities in developing countries – mainly Brazil, China, and the Ukraine? If so then how much, and why are they not producing at their capacity now? How will this affect agriculture in Australia?

INTRODUCTION

The aim of my study was to gain knowledge which I could use to develop a better crop system that would give us the benefits of being more sustainable both financially and environmentally.

I studied a number of facets of crop production across the world whereby I could use the knowledge to better understand our high rainfall cropping system and where we could change it to become more sustainable.

The areas I looked at included areas of soil science, nitrogen timing and canopy management. I met with plant and weed scientists and visited farmers to discuss their system, approaches and philosophies in a number of subjects, mostly production, but also marketing.

My study led me to investigate different farming systems, from fully organic, biological and conventional and also no-till v full cultivation, to determine which has a negative effect on soil health and which is beneficial. Often these systems were conflicting in their approach, but often the goal was the same. I wanted to learn from their experiences and bring some new ideas back to our farming area.

I considered biological farming to be a more sustainable system, however in the past trials on our property have indicated it has been difficult to measure benefits in the short term. Often this approach needs a few years to see results. We have experienced a number of problems including stubble residue breakdown and pests, (particularly slugs) so in my study I visited farmers who had been using this approach for many years to see how they had overcome some of the problems which we where experiencing on our property.

To better understand our goal for a more sustainable future firstly I would like to explain what I think is wrong with our current system.

We have a system now that continues to demand increases of inputs. Chemical costs on our farm have increased 3 times over the last 8 years relative to cropping area. Consider not only the financial cost, but the cost to soil biology and health and also exposure of ourselves to more chemicals.

Do we need to understand why we have increasing weed pressure and then look at the cause of the problem.

After completing my study I realise that we need to look at changes throughout our whole farming system, many problems that we have are related to, or have caused, other problems. There are many changes needed to become more sustainable and I intend to explain my findings through this report.

PART ONE - FINDINGS

Changing the System

To make a more sustainable high rainfall cropping system we should begin by changing our whole approach and philosophy starting with our previous rotations and enterprises.

The original aim of my study was to find out how we could make our high rainfall ***continuous cropping*** system more sustainable. However, I found that the best way to make a high rainfall cropping system more sustainable is ***not to be continuously cropping.*** Our current system is gradually shortening rotations and reducing the different types of crops grown, and we now have a 3 year rotation with all winter crops. Many problems including pest, weed and disease pressure are a result of selection process based on a short rotation of long season winter crops grown for mostly grain production. For example, weeds are controlled by spraying at the same time of year, knockdown in the autumn and then selective sprays about 8 weeks later. We are continuing to challenge weeds to beat our approach by becoming resistant to spray or germinate later in the year. The same can be said for almost all our problems such as pests and disease.

It appears that we are more likely to keep our system the same, trying to find other ways to correct our problem including new sprays, GM crops, rather than changing the system to reduce the problems.

We are in a unique area with our climate and rainfall, however, in the past many have chosen to follow a system based on lower rainfall northern grain growing areas with the addition of some different varieties of seed grown for longer seasons.

Perhaps the best system will include rotations based on crop and animal production, something that was popular in the past before the introduction of chemical fertilizer and sprays. Does our farming system need to change back to something of the past with the use of science to explain why?

Measuring Returns

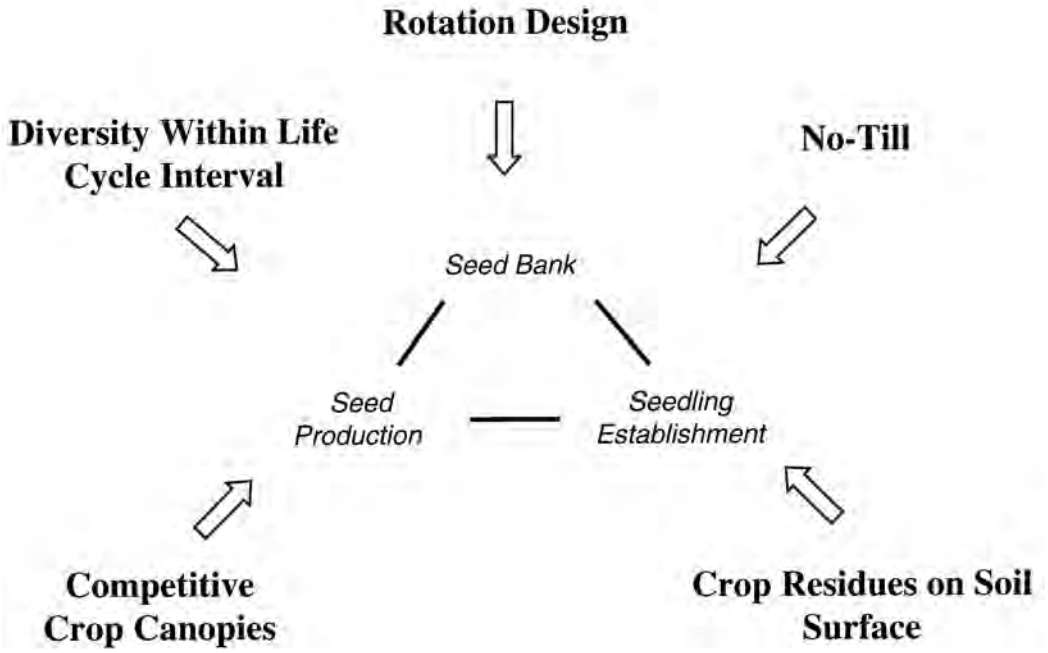
In recent years in our region more emphasis has been placed on calculating and comparing returns. One of the first things I realised from my study is that many factors cannot be measured in just one season, but take a number of years to realise the economic difference. A change to a more sustainable system may not prove to be economically better in the short term however may pay off over a few years. For example green manure or cover crops can take land out of production; however, the benefits can be seen for a long time after.

Professor Randy Anderson, a USDA scientist involved in crop rotation research, brought to my attention a study, in the US, involving farmers growing different rotations for 10 years. The rotations of crops grown were continual corn, continual soy, corn/soy, and a 4 year of different crops including corn and soy. On the 10th year corn was grown on every trial, with the best yield on the site having a 4 crop rotation. The message here was that at the start of every season corn was the most profitable crop to grow but over a long period a diverse crop rotation may prove to be the best.

Weed Management

Results from Integrated Weed Management (IWM) Research show that weed problems can be reduced by using a number of different management approaches. However, unless a number of changes are made the results will be disappointing. My visit with the USDA weed expert Professor Randy Anderson provided some advice on reducing weed pressure. A study into weed strategy programs indicated that some crop yields increased 30% with integrated weed management programs. The diagram below explains the different influences on weed populations.

Increase rotations (Rotation Design)



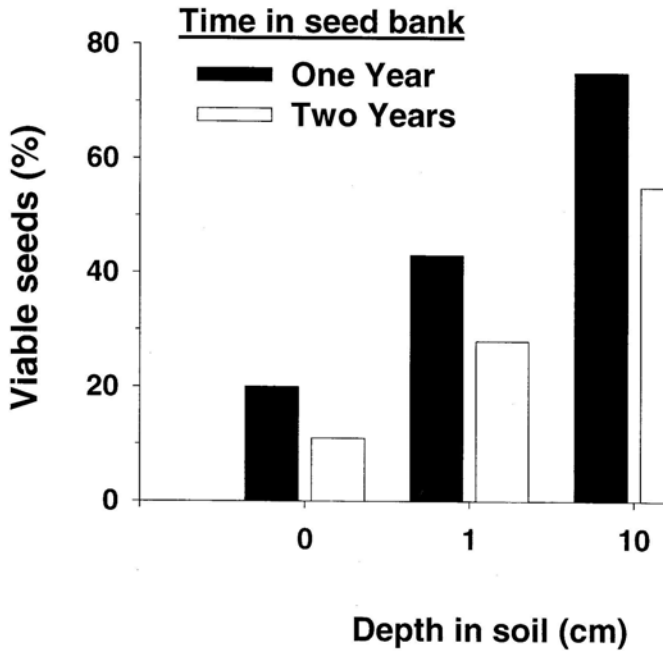
This is straight forward and something that we do now, but to make the best of our herbicide effectiveness we need to continue with at least 4 crops in rotation.

Diversity within rotation

Use both winter and summer crops in rotations – many farmers in the mid west of the United States are now only growing corn and soy in rotations. The problem is that a rotation of 2 summer crops generally results in big increases in summer weeds, with selective herbicide pressure on particular species. The most suitable rotation of 2 summer crops and 2 winter crops provides much better control of weeds. This means that knockdown herbicides are used at different times of the season which may provide better control of weeds by effecting their germination, establishment or seed set. If we compare this to our cropping system we have 3 winter crops in rotation, but should use a summer crop such as corn or a forage crop perhaps grown as part of our animal production enterprise. A crop grown for hay production or forage production may be more suitable and may eliminate the need for selective herbicides for one year which can result in reduced weed seed numbers.

Crops with competitive canopies reduce weed growth, therefore reducing weed seed production for future crops.

No - till provides reductions in weed seed banks; cultivation increases weed emergence and also tends to bury weed seed where they remain viable for longer periods of time. The length of seed viability can increase up to 4 times when buried by cultivation.



Graph of viable seed at different soil depths by Professor Randy Anderson

Stubble residue also provides a physical barrier reducing sunlight and therefore reducing weed emergence.

Most of this advice is straightforward and used commonly in Australia already; however, the most interesting information for me was the fact that there is almost no advantage in using any single strategy but where three of these measures were being used there was certainly large gains in reducing weeds. Reductions in up to 50% of herbicide cost have also been achieved using this approach.

Water use efficiency (WUE) of crops can be increased by synergism of crops in the rotation. Further research by Professor Randy Anderson showed that wheat WUE increased after corn and after peas. Peas and some other legumes can increase nitrogen use efficiently of the following cereal crop, thought to be by growth promoting compounds released by the roots of a previous pea crop.

Soil – The most important part of a healthy plant

Throughout my study one of the key messages was how important soil health is. Healthy soils grow healthy plants, which result in less insect and disease pressure. We often take for granted the role and importance of different types of soil biology however, the total mass of soil biology in every Ha of soil is amazing and should get much more attention. John Aeschliman a leading no-till farmer from Washington state, gave an example that he calculated, 22 earthworms found in one square foot = 2.5 ton per hectare. This amount of worms would provide 50mm depth of worm castings per year. Soils should be treated as being living and managed accordingly with regard given to the soil biology and management practices to promote them.

Soil Balance

Chemical - Physical - Biological

In Balance	Out of Balance
Active biological life	No life: no earthy smell
Reduced Erosion	Erosion
Good tilth, loose soil	Crusting, cloddy, hard to work soil
Good water intake & retention	Waterlogging, poor drainage
No hardpan, large root systems	Hardpan
Fewer weeds	High weed pressure
Fewer pests & diseases	Insect & disease problems
Rapid OM decomposition	Poor OM decomposition
Many earthworms	Little or no earthworm activity
Less chemicals needed	More fertilizers/chemicals needed

A list of indicators of soil balance from Mid Western Bio-Ag.

Healthy soils release nutrients throughout the year. Some soil scientists and farmers, told me not to take too much notice of a soil test as it is only a "snap shot in time"! Soil tests will not tell you what nutrients are becoming available, therefore an analogy can be made to compare a soil test to a bank balance where you know the balance on any particular day but not what is coming in or going out.

Above – healthy soil at Gerald and Verna Wiebe's property in Canada

Fertilizers

"Knowing what you are using and how it is going to react with your soil" was advice I heard a number of times. Many farmers in the USA have changed to less soluble forms of Phosphorus and suggested that a mixture of Soft Rock phosphate and lime would be a good start. Dr Anne Bhogal (ADAS Gleadthorpe Research Centre) has been researching the benefits of spreading manure on crops. Manures can have a much greater benefit than just their nutrient value alone and provide better soil structure. In trials conducted in the UK show that in some cases Animal manures can be worth up to twice as much as an equivalent value of Nitrogen in benefit to soils.

Below is a photo of a mixed farm in the UK where the owner runs a small feedlot so he can use the manure to increase productivity and grow better potato, carrot and other vegetable crops. He said the feedlot only breaks even; however, the real benefit is in increasing soil fertility by utilizing the manure from the feedlot.

Above – Neil Pratt inspects some of Ed's potatoes at his Yorkshire property.

Tillage Versus No-Till

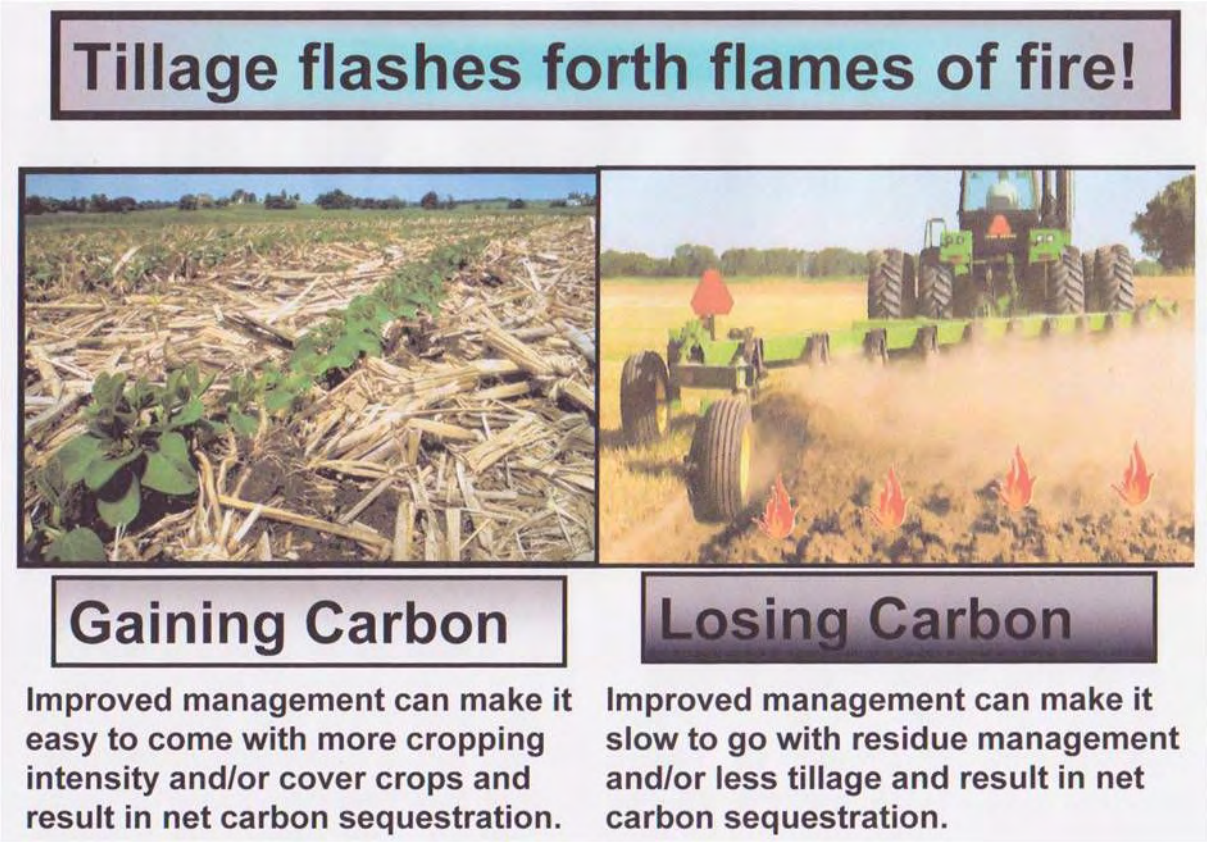
I have heard a number of differing opinions on this question throughout my travel but the best advice from Canadian Researchers was "don't treat no-till like a religion" and get caught in a routine that may benefit from purposeful cultivation in some years. However, generally the less cultivation the better; especially to encourage beneficial micro – biology.

Carbon

Carbon is one of the most important parts of our soil. Carbon loss due to cultivation has been measured by USDA scientist, Don Reicosky (Morris University), with some interesting results. His study found that mouldboard ploughing soil results in the worst carbon loss. Soils he measured lost the entire carbon input of the previous season's crop within 17 days of ploughing. Carbon loss due to cultivation generally follows the rule where the more soil that is disturbed and left loose for the air to move through it has a higher loss of carbon. If soils

need cultivation then more shallow cultivation followed by rolling gives the least carbon losses.

The total mass of lost carbon varies greatly depending on soil but it is really surprising the losses that can occur. One example of ploughing in Minnesota calculated 75 tonne of carbon lost within 24 hours of ploughing a 135ha paddock.



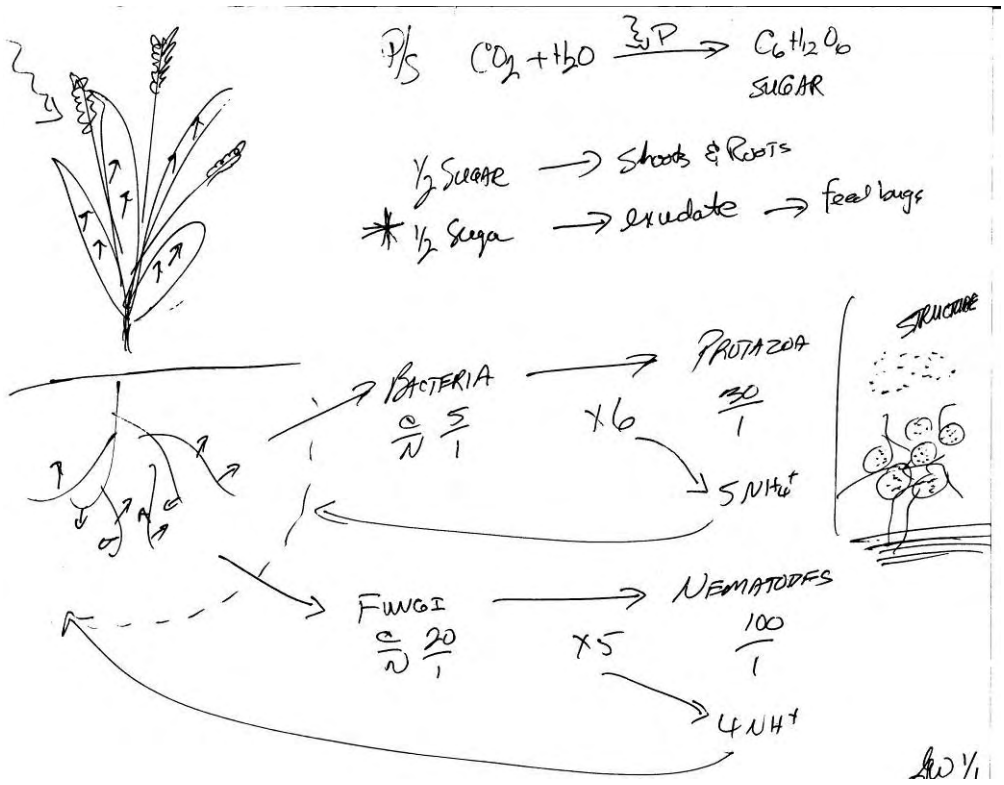
Above – Diagram from a presentation from Don Reicosky depicting carbon loss.

Soil Organisms

Microrhiza

Microrhiza is a fungi responsible for making phosphorus available in the soil and grows in soils which are low in soluble phosphorus and non cultivated. Some farmers in the North West of USA have reduced phosphorus inputs by half since establishing a full no-till system. John Aeschliman is one of the pioneers of no-till farming. His farm in Washington State has reduced both Nitrogen and Phosphorus inputs by half after years of no-till farming and a better understanding of this soil. Microrhiza need an environment that is not too high in soluble Phosphorus to survive. On the Aeschliman farm Phoshorus inputs are only 10 units per year, however, this was as high as 40 units in the past. Nitrogen inputs have also been halved due mainly to better soil structure and increased soil biology.

The diagram below helps explain the role of different micro biology (Gerald Wiebe)



Firstly sugar is extruded by plants to feed bacteria and fungi. Bacteria have a carbon to nitrogen ratio of 5:1, so when eaten by Protazoa with a carbon to nitrogen ratio of 30:1 they release the available nitrogen back into the soil. Nitrogen is also released into the soil as Fungi are digested by nematodes. Therefore nitrogen mineralisation is greatly dependant by living soil micro-biology.

Green manure and cover crops

Cover crops are a great way to improve soils and increase soil biology. Many farms I visited involved in biological farming were using some type of green manure crop in their cropping system, usually every 3 – 6 years. However, there were different suggestions and theories as to incorporate or apply with herbicide and leave on the surface.

The Rochester Cover Crop meeting organised by the Minnesota Department of Ag showed that one of the best types of crops to use to green manure is cereal rye because of the high leaf to root ratio. Rye when growing appears to have a small amount of biomass above the ground, however it produces masses of fine roots making the overall total biomass of the crop higher than most others. Research conducted by Mid Western Bio Ag measuring the total biomass of various crops found the best green manure crop to grow is a mixture of both rye and oats. Trials measuring total biomass found that a mix of these crops grew the greatest amount of biomass.

Below are 2 soil samples that were shown by Paul Kottschade, a presenter at the cover crop meeting that I attended in Rochester Minnesota USA. He said the best way to explain the benefits of green manuring are to show a sample of soil from a paddock where he was green manuring compared to where he hadn't.

Left sample from field after green manure crop, right sample is a soil from the same field before green manure crop.

Regardless of the management of cover crops (incorporated or left on surface) it is important to leave them for at least 10 days before sowing the following crops. There are some crops that have allalopathic effects on following crops. Dying plants are more susceptible to root diseases and it is important that soil pathogens levels reduce before planting the following crop or poor root development of the following crop may result.

Some farmers in Brazil were planting Brecciate grass seed with their corn seed. The corn was a more vigorous growing plant which shaded out the slower growing perennial Brecciate grass and slowed its growth during the corn crop. When the corn had been harvested the Brecciate grass then covered the ground to protect it from erosion and provide the other benefits of a cover crop until the next season when it was then sprayed out. Other farmers in the USA were aerial seeding rye into corn crops 4-6 weeks prior to harvest giving the rye a longer growing season.

Above – Brecciate grass growing between corn rows in a crop of corn in Brazil

Stubble Residue

Fungi are mainly responsible for breaking down stubble residues. Research by Jim Cooke from the Pullman University showed that fungicides used late in the crop growing season can make stubble residue break down much slower.

Pesticide Use

Herbicide and Pesticide use can be detrimental to soil health although this is difficult to quantify. There are claims that some herbicides such as glyphosate can kill single cell beneficial soil organisms such as algae. Research by Professor Don Huber – Purdue University USA published in the "New Ag International" Magazine show that continued use of glyphosate caused reductions in available zinc, iron and particularly manganese. The study could not explain why but suggested glyphosate reduced bacteria that was responsible for making some micronutrients available. It also suggests that herbicides can have detrimental effects to microrhiza as well. The take home message from the people I visited was to use minimal applications of herbicides and pesticides. However healthy soil tends to recover quickly.

A pesticide use study conducted in the UK by DEFRA compared a long term trial on current practice pesticide use versus a lower input pesticide use, using less applications of lower rates and found:

- no clear cut pattern to effects on soil bacteria and fungi, generally the more persistent pesticides were worse. After 6 years of the trial on one site the microbial mass was 25% higher where lower input pesticides where used. This was effecting microbial recycling of organic matter. There were also effects measured from herbicide and fungicide use showing reductions in microbial biomass after applications.

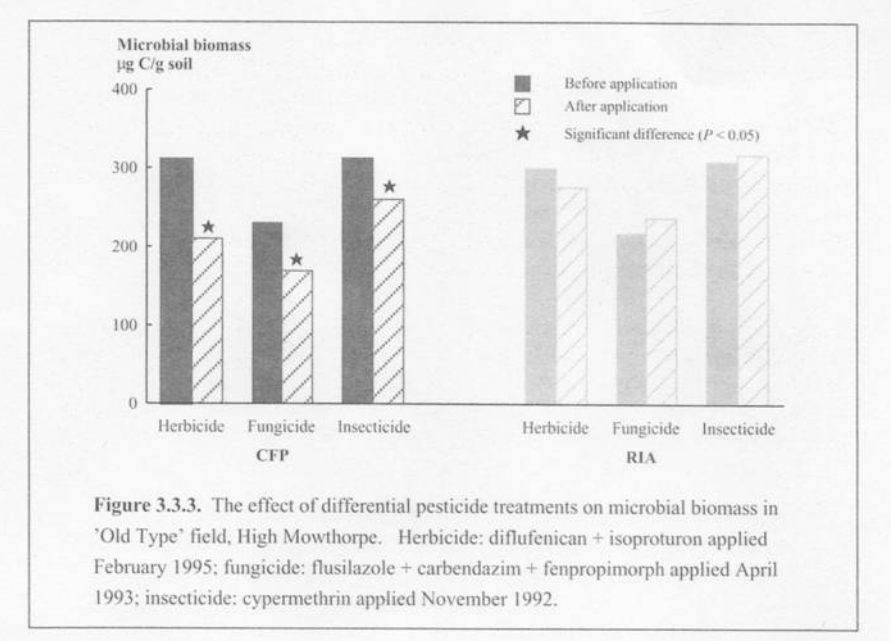


Figure 3.3.3. The effect of differential pesticide treatments on microbial biomass in 'Old Type' field, High Mowthorpe. Herbicide: diflufenican + isoproturon applied February 1995; fungicide: flusilazole + carbendazim + fenpropimorph applied April 1993; insecticide: cypermethrin applied November 1992.

- because of the relatively low financial cost of pesticides there are only small economic gains made by reducing input costs by the reduction in use, therefore most farmer use pesticides as a precaution. A better approach on pesticide use is to know critical thresholds and life cycles of pests before spraying, and using more specific short acting targeted sprays.

Slug Control

Slugs have been a problem in the UK for much longer than they have been here, so I was interested to see how they managed the problem. Almost all the farms that I visited still practiced full cultivation with mouldboard ploughs, and still had high slug pressure. The crop following canola seemed to be the worst effected, probably because of the increased numbers of slugs in a canola crop. Seed is treated with slug deterrents. The only advice I found was to use smaller bait as the key to control the number of bait per square metre.

One agronomist baits his fields directly after harvest as he thinks that the vibration of the wheels of the combines encourages slugs to come to the surface thinking it has rained. The aim is to reduce numbers of the generation prior to seeding.

One thought was to look at previous crops in the rotation to find the best crop to reduce slug pressure before a canola crop. For example a hay crop may offer a greater opportunity to reduce numbers in the previous spring by reducing feed and habitat prior to a canola crop. There was advice from a number of people I visited around the world, that increases in slug pressure is related to killing predatory insects. Integrated Pest Management trials on our property since my study are proving this.

Stubble Management

The management of stubbles selects the different microbiology suited to the environment they live in. Therefore if stubbles are continually incorporated, soil biology which is best suited to breaking down stubbles covered by soil will increase. If stubbles are left on the surface, then the micro-organisms which break stubble down in that environment increase over time. It may take a few years of the same management for soil fungi and microbe levels to build up and break stubbles down quicker. Trials of spraying mixtures of nitrogen and molasses together with live microbes, on stubbles, generally proved unsuccessful in improving the speed of stubble break-down.

Canopy Management

Canopy management and nitrogen timing have proven to be very important for high rainfall grain production in Europe, and these approaches can have benefits for our climate as well. Professor Rodger Sylvester Bradley from ADAS (Cambridge, UK) gave the advice that the bigger the canopy the more costly it is. Nitrogen applications tend to be later in the crops life than we tend to apply. For Example crops are never starved of N. Research in local areas shows target plant and tiller numbers as well as ideal flowering date; Hamilton is around the 24th of October. Professor Bradley suggests that 12t/Ha may be achievable in this area, but maybe not with the current varieties.

I think that most nitrogen timing advice fits into when the soil should be mineralising nitrogen. For example small amounts of N input in autumn, and the majority in spring. Nitrogen mineralisation occurs when moisture and warmth are available e.g. spring when the crop requires it. Past practices on our property applied large amounts of N before planting or early in the crops life. In hindsight a lot was probably waisted.

Marketing

A more sustainable cropping system includes better marketing and value adding of products. Most farmers are experiencing a fall in commodity prices relative to input costs, and a better understanding of marketing and value adding will be important in the future for farming to be profitable. The future marketing of our production was something that I had not given much thought to before my trip. I have seen some great examples of value adding and the benefits of traceability of products and now understand that this is one area where we can and may be forced to explore to expand our business in the future. For example, some Organic farms that I visited had commonly been involved in value adding and got out of what seems to be a common problem of conventional farmers across the world of being price takers and forced to "get bigger" the reduce their costs. I asked many farmers if they had plans to "increase the size of their farm" which seems what we need to do at home, but mostly organic producers where the ones that replied "no" because they were big enough and would rather see capital used to expand vertical integration or try producing different products.

Garry Zimmer from Mid-West Bio Ag was developing a certification for Biological food for selling in his own organic shop. He expects it will be successful as consumers are becoming more aware of what they are buying.

The most interesting marketing success story is by "Shepherds Grain" in North West USA. This group of no-till farmers formed their own flour brand with the idea of selling a more environmentally friendly product and also demanding a premium. Starting in 2001 with around 400 ton; they are now selling 35,000 ton of flour a year, for around 20% premium in price for their wheat. They began marketing their flour as being better for the environment. After bakers had tried their flour they certainly found that it was a better quality and a more consistent product throughout the year as well as an agreed price for 12 months. Growers are also getting feed-back from bakers as to the quality of their grain and how they can improve.

Much of the increase in quality can be attributed to wheat that has not been blended to get a particular quality, as larger grain marketers tend to do. Farmers also think their wheat quality is better due to healthier soils providing better growing conditions.

CHANGES WE WILL MAKE

Below I have included a list of Management changes that we will consider in future.

Change rotation

3 crop rotations in high rainfall areas appear to be too short, especially if they are all grain production crops. We will use our long growing season to grow both summer and winter crops. I think that forage crops are the best suited summer crops for our climate. Hay crops will also continue to be used in our rotation.

Grow cover crops

Green manure crops have a huge benefit and we can use them without losing a full year of production, perhaps a crop of oats and rye sown in early autumn could be desiccated or cultivated and a summer crop could be sown in spring. I am still uncertain if cultivating is the best method but we will try both.

Pea crops also appeared to offer great benefits to future crops that couldn't be attributed to nitrogen input alone, maybe stimulating microbial activity.

Increase Livestock production

I think sheep or cattle grazing fit really well into a good high rainfall cropping system. Summer crops grown here will be mainly forage crops, partly because they are the best suited but also because no selective herbicides need to be used. Stubble residues can also be reduced without huge amounts of nutrients being removed. Intense livestock such as a feedlot may be a good way to value add our grain and hay in the future.

Calculate returns over a longer term than one season

Many farmers around the world told me that the benefits of some crops need to be appreciated after a couple of years (especially green manure crops). I feel that we sometimes loose sight of the bigger picture in farming systems when we fully calculate returns on different crops.

Consider pest levels before acting

We have been guilty of seeing pests and spraying before seeing any damage or understanding their lifecycle and therefore killing far more predatory insects.

Fertilizer

Research being done in the UK showed that animal manures can be more valuable than just their nutrient content. We will endeavour to source animal manures for some nutrient requirements even if costing up to 50% more than fertilizer in the bag. Better consideration will also be paid to plant fertilizer requirements before and throughout the growing season, maybe using less at planting, but less soluble forms of phosphorus and Nitrogen prior to planting. Calcium is one Nutrient that we will continue to use at increased levels along with other minerals like copper and zinc.

Better Marketing

We will aim to produce agriculture commodities that we can better market because they are more traceable because of our production methods, and we will aim to vertically integrate commodities currently grown such as value adding grain. We are considering changing some of our property to certified organic - well run organic farms overseas continually showed better returns after solving initial problems.

Understand that all farmers face similar problems

Regardless of which countries I visited, we generally shared many of the same problems. Falling prices, increased government regulation and rising land prices to name a few. Whether they are heavily subsidied or not, all farmers are under increasing pressure of low returns. I understand that any future move by countries to less subsidies may result in them becoming more efficient, and may be a disadvantage for us in the future. So our farming business will need to be prepared for future oversupply of world commodities.

Finally the best farming businesses in the world regardless of what they produce are run by people with a really positive attitude. We have been guilty of complaining in the past but hope to change our approach to a more positive one in the future.

CONCLUSION

We farm in a unique area, but tend not to utilise our climate and rainfall to our advantage. The best advice I could give for developing a more sustainable cropping system is to challenge some of the current thinking and practices such as cropping rotations, crops grown. There is much to be benefited from changing current cropping systems and including management practices which will give long term benefits.

Nuffield has certainly given me a great opportunity, not only to look at a specific study topic, but the chance to understand more about world agriculture production and the role that Australia plays. I would encourage anybody to apply for a Nuffield Scholarship.

PART TWO

INTRODUCTION

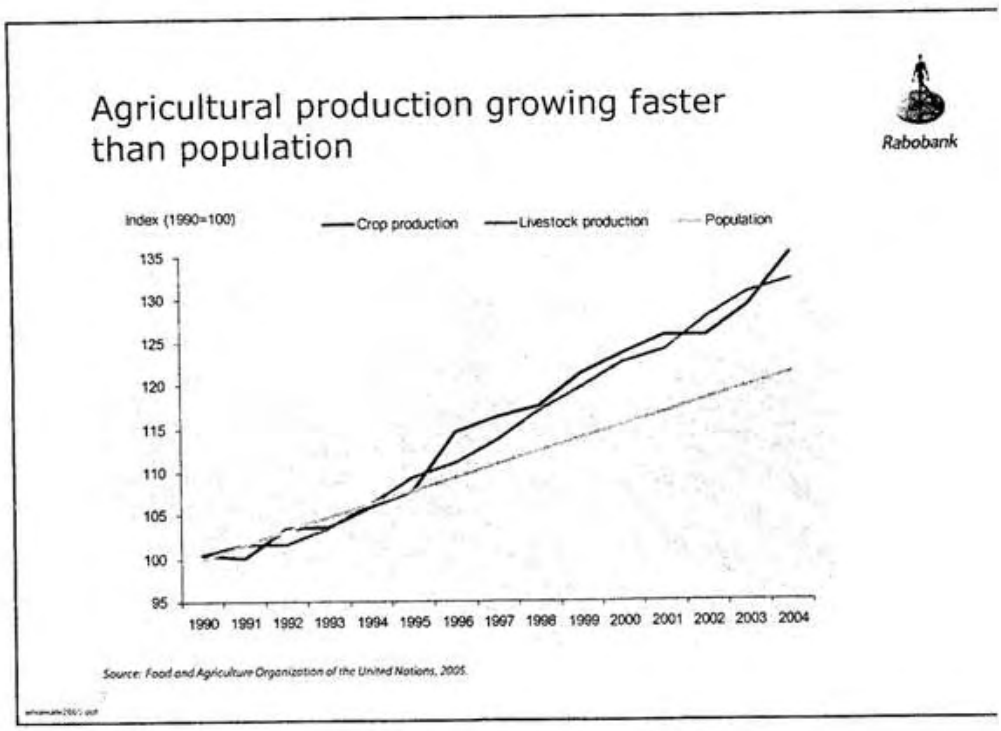
"How will the reduction of farming subsidies in the EU and USA together with the increasing production of developing countries impact on Australian agriculture?"

Australian Farmers are led to believe that we will benefit from European and American governments reducing farmer support, and giving us better access to markets, however after my trip I have a much different opinion and would like to explain my thoughts.

WORLD FOOD PRODUCTION

The Global focus aspect of the scholarship gave me the opportunity to better understand Global food production and markets. It was a great chance to speak directly to farmers in heavily subsidised countries and learn what their restraints are. I also enjoyed the opportunity to look at developing countries including Brazil, China and the Ukraine to observe how these countries are changing and what their potential is for future production.

One of the presenters at the 2006 Utrecht Nuffield Conference showed us the graph below which shows that contrary to popular belief that world food production is growing faster than population growth.



Source – Food and Agriculture Organisation of the United Nations 2005

Subsidies

The current DOHA round of trade talks is negotiating to reduce domestic support to farmers of both USA and EU. I was surprised that farmers in subsidized countries shared many common problems as we do here. Increasing costs relative to commodity prices, increasing government regulation, availability of labour, low commodity prices and the ever increasing price of land were some of their concerns.

Government support in these countries is shifting from production based payments, to "Green Box", which is less trade distorting. Increasingly farm payments are made through environmental schemes, especially in the UK where a certain level of environmental projects allows farmers to receive a minimum payment. These farmers can also participate in higher level schemes where they receive higher payments. Total farm payments in the UK are in fact higher now than ever before, although thought to be less trade distorting.

The USA farm payment scheme is up for renewal in next year's farm bill. Past farm bills do not offer much insight to the direction that the government will take as they have no real direction. Currently the Government pays around $40 billion annually. As the UK support to farmers is tending to be more environmentally focussed, it may see increased payments in the future into renewable energy such as bio-diesel. This is seen as being better for the economy as payments are consumed domestically.

An English farmer told us that "The most profitable day of the year is the day I fill out my subsidy form". Subsidies seem to have pushed up land and input costs, and farmers in these countries have similar returns to us. One of the notable differences is that Subsidised farmers seem less productive. An example would be if an Australian farmer makes a 2% gain in production then his overall farm profit would rise by 2%. If a Farmer who receives 50% of his income from subsidies makes a 2% production gain then it would only be a 1% increase in profit and therefore less motivating.

The USA environmental problems surprised me and I believe that it is partly due to farmer payments. The culture of farmers seemed to be unwilling to do anything to improve environmental problems unless they were paid to. There are some big problems with nutrient run-off in Eastern states especially. If USA farmers could see that they were losing money worth of fertilizer then they would be more likely to stop the problem.

Reducing farm subsidies gives farmers in those countries a bigger incentive to produce more, because they have to, to survive.

Increased Production

My first impression was that reduced government support will have no real impact on Australian farmers as production levels of these countries would probably stay about the same. But after understanding of the big picture and speaking with others including a world economist changed my opinion.

I guess there is no better incentive to increase production than necessity, and this may "unleash production capabilities".

Land prices have been forced up because of the subsidy payments. The average age of farmers in the USA according to the USDA is close to 60 and high land prices tend to prohibit young and innovative farmers from entering the industry and efficient farmers from expanding.

One farmer I visited in the UK explained that he had sold his cattle and was letting one of the neighbours graze his pasture. He was not getting paid agistment, but said it was a decision based on good economics. The government payment was collected by the owner of the land. He also said that it was uncommon for land owners in the area to pay to get stock to graze their fields. This is an example that shows there is no incentive for the owner to increase the production capability of the ground.

The USA price support program sets a minimum price for some grain. Corn and Soy for example have a minimum price and the grower can receive payment for a crop during the growing season. Minimum prices and assured price schemes tend to result in monocultures, where producers tend to be focussed on annual production rather than long term sustainability. In my opinion many producers had a very complacent attitude as one of their biggest risks (commodity price falls) had been taken away. A research scientist suggested that more production could be gained from a field over 10 years with a 4 year rotation than the current 2 year rotations of corn and soy, however, growers are not prepared to get out of their current farming system.

Most farmers in the UK and USA thought subsidies had been generally bad for agriculture in their country; the UK farmers expected payments to become almost fully environmental based. However, USA farmers still expected support from the government for some time in the future as they could not see how payments could be stopped as land prices would probably crash. As one grower told me: "We have got ourselves in a mess and I cannot see how we can get ourselves out of it at least in my lifetime!"

Market Access

Does the restriction to market access harm Australian Agriculture? Probably but the real long term winner of increased market access can only be the consumer. Take rice for example, Tariffs imposed by Japan on imported rice help local Japanese small rice farmers remain viable. Japanese consumers are forced to pay more for their rice, so why should we be against that, after all isn't that what most Australian farmers complain about consumers here not paying enough for their food. Should we be pushing to ruin another lot of farmers that have been farming for thousands of years just so we can enjoy short term increases in prices.

Land out of Production

I was amazed to find in the UK there was still a set-aside land program. British crop farmers had 8% of their land out of production or producing crops for industrial uses only. Land was not allowed to be improved and fallow or cover crops are not permitted. This program was introduced to stop overproduction of food. The set aside area required is slightly less in other parts of the UK.

The Conservation Reserve Program (CRP) in the USA was introduced in the 70's to help reduce problems including erosion that had been caused mainly by conventional farming cultivation. Farm land is rented by the government for a 10 year term, where it is left un-farmed. Rent is paid usually at higher than market value. Currently 39.2 million ac (15mill ha) are in the scheme costing USA tax payers US $1.6 Billion per year. With better farming practices now than in the past many farmers in the USA don't see a need for this and expect it to be reduced especially given the federal budget deficit of around $200 billion per year.

I would expect these programs to be phased out over the next few years, due to budget constraints of the USA and industrial crops becoming more popular and profitable in the UK.

This again could result in increased world food production, or bio-fuel crops especially in the USA.

Land Ownership

As I discussed earlier, land subsidies tend to push up land prices above their production capability and therefore stop more efficient and dynamic producers entering the industry.

The French Government's land ownership laws particularly in Northern France, take this to the next level. France produces almost twice the annual production of wheat than Australia. Farmers who wish to expand require permission from the government to buy land. The French government understands that the average farm needs to get bigger but also wants farmers that are smaller than average to become larger, however farmers who are bigger than average are not allowed to get bigger. This defies common sense from a production perspective, again, as farmers are trying to achieve better efficiencies of scale. This is stopping efficient producers from getting larger.

It is possible that as support to farmers is lowered then restrictions on land ownership may be relaxed, again resulting in cheaper production of commodities through better economies of scale.

Developing Countries

Brazil

My visit to Brazil was a great opportunity to see a country rapidly developing and with huge potential production capabilities in the future. While visiting one of the biggest corporate farms in the state of Goiania I was told that this particular company estimates there is around 80 million ha available for expansion. This is the Cerrado area (lightly timbered open country). This land is now used for cattle grazing.

Picture of the cerrado area that most of the development in agriculture in Brazil will occur in.

The government is slow at building transport infrastructure including roads and rail. There are big efficiencies that can be made with better roads and a proposed port at the mouth of the Amazon. Developing a barge system from the developing central areas of Brazil to the proposed port will give produce much closer access to Europe and America.

Brazil has very tough government regulations on farmers, although these are not strictly enforced because of lack of government spending on policing. Most farmers comply as they realise it is a matter of time before the government will get serious about enforcement. All waterways must be fenced off with no stock access and at least 20% of land fenced and planted to native trees then left as reserves for wildlife. Farmers are not allowed to control native wildlife e.g. pigs that can destroy their crops. Buffer zones of up to 2km around government parks are in place where no GM crops can be grown or aerial spraying conducted.

Ukraine

The Ukraine is currently the 7th biggest wheat exporter and is expected to become the 2nd largest in the next few years. In the future it may even take over Australia as the largest. Stable government and a better business environment are needed for the Ukraine to increase agriculture production. The Ukraine is well known for having some of the most fertile soil in the world. Often the yields of the crops grown had been greatly reduced due to old machinery technology and lack of access to finance to buy better seed or sprays for weeds. In 2008 land will be able to be sold, this will be the first time since independence from the Soviet Union, and may be the first step in a more rapid agriculture development.

Above – Dave Fulwood (right) and myself inspecting the fertile soil in the Ukraine (2006)

Attached Appendix 2- report on the Ukraine

China

China is an interesting example of a developing country where agriculture quantity may not increase, but quality will. This has been in some part a result of government giving farmers the right of tenancy of the land where they can lease out the land to large business. Not only has quality of production increased but with greater investment, now better infrastructure such as better transport and refrigeration is improving product quality.

Conclusion

The future of world agriculture will be interesting. I left for my Nuffield scholarship thinking that world future food demands may not be met, and not understanding the scale of development of countries such as Brazil and the Ukraine, not to mention potential future food production of developed subsidised countries. Bio fuels and ethanol production remain an unknown and may have a big impact in the future. This trip has also raised questions for me regarding the wheat single desk and GM crops. I look forward to farming in the future and realise that our farming viability is largely in our hands, where we will endeavour not just to be commodity producers taking world prices.

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Appendix 1

BRAZIL 29th March - 10th April. 2006.

Brazil's population is around 183 million people and has a land area of 851 million Hectares. Of this 220 mill Ha is used for animal production, 62 mill Ha agriculture and has a potential 90 mill Ha land fit for agriculture production which is not yet in use. 80% of the population is Catholic and the language spoken is Portuguese. Soccer is the major sport, played and watched. It is so popular that employers let workers take the day off when Brazil is playing.

My visit in Brazil consisted of 2 main areas, firstly 5 days in the Sao Paulo state. One of the wealthiest states includes the city of Sao Paulo, (about 18 mill people) and probably has the best climate and one of the more diverse regions of Brazilian agriculture. The rainfall is around 1400mm – 2000mm and it has a tropical climate, without the extremes in temperature like further north in Brazil. The remaining 6 days were spent in the central areas of Mato Grosso (Far East side) and Goias States. These regions had much larger farms. Some of the farms were corporate, but most were private, and had a narrower range of agriculture production, mainly due to a more extreme climate. Crops grown were mostly corn, soybeans, cotton, eucalyptus and some cotton, and sorghum and cattle production.

Employment: The Government only offers unemployment benefits for 4 months and there is roughly 10% unemployment. There is a very large difference between the minimum wage and high income earners. For example, the minimum wage is approx R$250 (US$120) per month with professional people making about R$2500+ (US$1200). It was also very interesting to note a type of pay-role tax of 70% that employers have to pay to government. As well as employees paying income tax mid range 27%. There are no unfair dismissal rules just a small payout which I think is a few weeks' wages. Companies or small employers get an income tax benefit for employing staff so it is still in their best interests to have a lot of employees. Most small farms have at least 5 staff with the bigger ones employing 50 – 100. There are still about 300,000 people harvesting sugar cane by hand in the Sao Paulo state! A farm similar in size to ours would have about 30-40 workers.

Government: The election is only a few months away and there is a current left wing (president Union Background) government who has a reputation of being corrupt. It will be a very close election. Many people discussed this with me and it seemed like people take a fairly big interest in politics. Voting is compulsory over the age of 18. 16 and 17yo are allowed to vote but it isn't compulsory. Taxation accounts for the major part of the Brazilian economy.

Government Infrastructure: Roads in particular are in a very poor state. In Sao Paulo state some main roads have been sold to companies who repaired them and then set up toll ways. At least every 30 min there is another toll gate to go through. Locals seem really happy with the concept as they don't mind paying if the roads are good. The rest of the country's roads desperately need repair, I think a combination of poor construction, and lack of money allocated for road repairs is the reason. At one point of my trip, we stopped to help push a vehicle out of a huge pothole in the road. The government owns almost no grain handling facilities. Most grain is transported south to 1 of 2 ports. This means up to 2000km freight, mostly by road. The rail system is very small. There is currently talk of a company to finance a port to be built near the mouth of the Amazon, and then barges would be used to freight grain to this proposed major port, like the Mississippi River in the USA. If it precedes this will cut down the cost of freight and will mean having a Port much closer to the major export markets of USA and Europe, a definite advantage.

Machinery used on farms: One of the first things I noticed was that despite some of the properties being very big (6000ha to 20000ha) machinery used was usually very small, and not very new. It was normal to see ten, 150hp tractors in a shed and ten, 20 row seeders in another, instead of maybe a couple of 400hp Tractors and two, 50foot air seeders. I saw 16 men unloading corn silage from a truck into a beneath ground pit using pitch forks and rakes, instead of the truck tipping. I think this is due to the low cost of labor.

Interest Rates / Farm Debt: Current interest rates are in the range of 15% - 30% pa. Homebuyers can get cheaper loans if they meet criteria. There is no cheap finance for farmers wanting to buy land, therefore most farms had no or very little debt. Interestingly, land prices directly reflect commodity prices, in some areas land prices have fallen by 10 – 20% in the last 12 months. On the other hand farmers can get cheaper finance to plant crops, R$25,000 and also to finance machinery, capped at a certain value. 9% finance, but not subsidized by government, but Lending organizations are told by government that they must offer this! (Apparently at a cost to the lender and not the government). Most land is purchased privately; farmers seem to wait until they have enough cash to purchase land.

Main Crops and Enterprises: The main crops are Soybeans, Corn, Sugarcane, Oranges, Coffee, Eucalyptus, Wheat, Rice, Dry Beans, Cotton, Cattle (although foot and mouth disease has caused a ban on most exports, and prices to fall greatly) more goats than sheep, and a vast range of fruit and vegetables. Brazil has a huge Alcohol (ethanol) industry. Made from Sugar Cane, this explains the increase in Cane production and price over the past few years and has made cane growing one of the most profitable industries in Agriculture in Brazil. Petrol contains 26% alcohol, and pure alcohol can be purchased at most service stations cheaper than petrol. New cars can run on duel fuel, alcohol, petrol or a combination of these. Brazil is now self sufficient in fuel usage, with ethanol, and oil fields in the Amazon area. The number of Eucalyptus plantations surprised me, it seems to be profitable with yields of 250 cubic m/Ha harvested at year 5 and 10 with wood being used mainly for paper production and some for heating grain dryers. I was told that Brazil produces 80% of the exported orange juice in the world. Surprisingly in Sao Paulo state you might be able to see most of these crops within 1-2 km drive, all non-irrigated. This really shows you the diversity of agriculture in Brazil, and the possibilities for further crops and agriculture production.

Agribusiness companies: Like I mentioned above, the government has little to do with infrastructure, particularly in Agriculture. The main grain companies are Cargill and Bunge. They own large storage facilities scattered across the country and growers deliver directly to these companies. Also the Coinbra Co-op handles grain as well (see below). Monsanto and Pioneer are the largest of a number of seed companies. There is a really interesting grower – company relationship particularly with Monsanto. Unlike Australia, Monsanto sells products directly to large growers; other farmers can buy products from sellers who stock Monsanto products. There are only 2 steps at most from Monsanto to farmer (unlike Aus where we have a lot more, maybe up to 5 or 6). However producers buy seed or chemical, Monsanto provide Agronomists to give advice directly to growers, it seems to work really well, and very impressive. I think it would be fair to say that most of the agronomists were better educated than in Australia, with most having studied Agronomy, English and many were now studying Administration or some other masters degree part time. There are most other Multinational chemical companies available such as Bayer, BASF, and Dow agri.

Soil Type and Characteristics: This must be explained before Environmental aspects can be explained. The soil type that I saw was mostly a reddish type of silt without much content of clay so therefore very prone to erosion. As I expected, soils are very deep. They could be from 2 – 6 meters deep. It was very hard to see any subsoil where there had been earthworks recently carried out. Also, like I expected soils are very well drained, because of the depth of the topsoil. However, I didn't expect soils to have a low Organic Matter, less than 2%, mainly

caused by rapid Organic matter breakdown due to the temperature and rainfall, and maybe the way soils were formed (maybe silt?). They also have low fertility particularly Potassium, Zinc, Boron and Copper mainly due to leaching. However soils are low in PH so unlike USA, Phosphorus is locked up in the soil and does not generally leach into the waterways.

Environment: This will take a while to explain and has really surprised me. Firstly to start to explain, Brazil would have some of the toughest regulations about environment that I have seen, particularly, when they get no assistance or compensation for their efforts. Any rivers or waterways have to be fenced off without any access to stock, and if not already then they must be planted to native forest (jungle). A stream or river 10m wide must have 30m planted each side to forest. If a river is greater than 50m wide then 100m must be fenced off each side. In addition to this, in the southern states, farms need 20% (Reserva Legal) left to native forest. This regulation increases in other states with the highest regulations being in the northern region (Amazon areas) where 80% of farms must be native forest, Jungle. If farms have a river or rivers that meander through their property and further regulations, then potentially they loose a large productive area. These regulations have been in place for about 30yrs, they are not strictly enforced but most farmers are complying as they realize that Government auditing will happen soon. Bigger and corporate farms are more likely to comply. As mentioned there is no assistance from the government, in one case I saw a 400Ha area recently planted to native trees with the farmer paying all the costs. There are really strict laws on killing native wildlife; nobody I spoke to did any hunting. In some areas, native animals such as wild pigs cause a great deal of damage to crops. Farmers just try to fence to the minimise damage. You cannot get permits for culling and it is illegal to run-over any animals or birds on the road. There are contour banks in almost all paddocks with slope. There are no regulations to put them in, but farmers realise that their top soil is worth the effort of building banks. On one property near National Park, there is a proposed government plan to ban GM crops within 2km of the boundary, also there is no aerial spraying allowed within 2km of the park.

GM Crops: Roundup ready Soy was illegally introduced from Argentina about 10 years ago. 5 years ago the government allowed legal growing of GM Soy. There is currently In Guard Cotton growing in Trials ready for release soon. Other GM crop releases seem to be some years off as there is resistance from the Government to allow them to be grown. I don't know if this is International pressure, or consumers, or if they have just taken it upon themselves not to allow them. I was told that a few weeks before my visit there was an anti GM protest outside one of the Monsanto seed plants in central Brazil.

Irrigation: There were some properties that had some irrigation and a couple with large-scale irrigation systems. All irrigation that I saw was centre pivot spray and the main crops under irrigation were potatoes, cotton, coffee, and corn. Most of the water used was pumped out of private dams or rivers. Apparently, farmers can put a levy across a river as long as 80% of water can still flow through. Farmers just need a license to build a levy bank, and don't have to pay for any water used! Water is not measured when pumped either. Farmers think that they will have to pay in the future but are not worried because of huge flows of water in rivers.

Minimum Till, Ground Cover: Because of erosion problems, most farmers practice at least some type of minimum tillage. I saw some crops under sown with Brecciate grass, (similar to Phalaris) sown with corn or sorghum so that after harvest there is a crop already growing, stopping erosion by covering the soil. Some farmers seem to be a lot further ahead of us in no-till and cover crops, probably because of their environment demanding it.

Future Agriculture Expansion: Interestingly, the main expansion area in Brazil is the Cervada area in central Brazil, not the Amazon. This was originally lightly timbered with short small trees. Most of this has already been cleared, and most of the estimated 80mill Ha is already used for cattle grazing. This is not particular fertile soil but can be improved; the current low beef prices are probably driving the change from grazing to crops. The Amazon on the other hand is very poor soil, very unproductive once cleared. I was told that only the smaller, poorer farmers are the ones that are clearing the Jungle and trying to farm. There is still at least 80% of the Amazon left untouched. (After 300 years since it was discovered).

Attitude toward Further development: Most farmers are very frustrated with regulations imposed on them. The pressures of other countries and organisations like Greenpeace have been particularly annoying. Future projects like further 1% water for irrigation from the San Francisco River have been put on hold. Also, on one property a large scale developed Rice enterprise has had to be abandoned due to new government regulations. Farmers consistently asked me how much of farming land in AUS had to be left to native forest! They also made comment of how dare countries such as the UK and USA tell us we cannot develop our agriculture, when there is only 5% native forest in the UK and only 3% in the USA while Brazil still has 33% of their land left to native Forest. They seem especially frustrated given that their country needs further development to help improve wages and employment.

Visiting Brazil was a real eye-opener for me. Future potential in agriculture is huge, both with land to develop, and mechanising current farming practices, and increasing the size of machinery can offset increases in labour costs. Also freight costs could be greatly reduced with improved roads, a better rail system, or with the building proposed for the northern port. Future grain and horticultural development will probably come by reducing the grazing cattle industry, but cattle feedlots may increase especially if disease restrictions are lifted on exported cattle, so cattle numbers may stay static. I would expect an even more diverse horticulture industry in the future, some of the fruit I tasted on farms I have never heard of before. Maybe Brazil may fill the void left from the land lost through urbanization of California and other major horticulture.

Appendix 2

UKRAINE

The Ukraine has a rich and amazing history. It was one of the earliest areas of know agriculture. It is believed that agriculture started there around 750BC. Since then the Ukraine has been occupied by a number of different countries, and involved in a number of civil wars. The Ukraine became officially independent from the Soviet Union, after an interesting past which involved 2 artificial famines in 1922 and 1933 in which it is estimated that over 8 million people died.

The country is divided with many people in the south and east that still speak Russian and associate themselves more with the East, while in the north and west the population speak Ukrainian, are more patriotic and connected more with the west. Russia still has a huge naval base in the south of Ukraine,

The population is around 48 million, but unlike many developing countries the population is falling at a rate of almost 1%. The economy is growing steadily after huge inflation of the late 90's, since then the currency has been changed. Last year wages have increased by nearly 30%. Agriculture accounts for a large part of the economy, around 23% of GDP. The lending rate varies greatly like all developing countries, officially 9% but mortgage rate 15% - 18%.

There were elections held a few months ago, but no party held a majority, in the months since no parties have been able to form a coalition and form government. The deadline for forming government has now passed, and new election will be held again soon. The locals are very cynical, saying that regardless of who wins the government will still be corrupt.

Like many developing countries infrastructure such as roads are in a poor state. There is one road from Odessa to Kiev that is as good as anywhere in the world, however the rest are challenging to drive and must cause restrictions and increased road transport costs.

The soil in the Ukraine is renowned as some of the most productive in the world. During WW2 German trains carried many thousand of tonnes of top soil back to Germany. Soil ranges from very fertile black clay loams about 1.5m deep, to a sandy loam that is very fertile and great for vegetable production. Most agriculture is arable, with some irrigated land, mainly vegetables. Irrigation infrastructure has been poorly maintained since Soviet times, but now things seem to be improving but irrigation equipment was old.

Collective farms were formed under the Soviet Union. This type of farming typically were very large around 2000ha – 5000ha, with anywhere to 1000 people working on each farm. When the Ukraine became independent in 1991 the collective farms were divided up amongst the workers, with all of them receiving a share that until now they have been unable to sell, just pass down to their children. The average size of owned land is typically 2 – 10ha, and almost all collective farms are still run as a large farm but not necessarily as collective farms, many have been leased out usually to large Ukraine businesses of foreign farmers. 90% of farms are classified as large farms, and a few owners are running their own land. (43,000 farmers account for the last 10% of farmed land). These smaller farmers are decreasing each year.

Collective farms that are rented out typically have 500 – 1000 owners, that agree to a rental rate, however many require payment in grain, hay or straw as the villagers still may milk 1-2 cows or have small vegetable garden. (70% of milk production comes from farmers with less than 3 cows). Rent payments vary from $30US per Ha to $50 for irrigated land. Length of rent has to be between 5 and 50 years, usually 7 – 20 years.

The Ukraine government encourages foreign investment into agriculture, but will restrict land ownership to locals in the future, when lands become saleable.

In 2008 land will become tradable, however only Ukraine nationals will be able to purchase land. The government does understand that foreign investment is important for financing agriculture development, so I think there will be some sort of concessions or incentive for future finance into agriculture by foreigners.

Crop production occurs on 30mill Ha, this has been reducing in the past 10 years as the government tries to meet environmental targets of 10mill ha of forest and native pasture. Grain production of Ukraine averages 30 to 40 million tonnes however it varies greatly from year to year. Of this Wheat production is 5mill Ha and will produce 10 – 15 million tons. Average wheat yields are only 3T/Ha but the leading farmers are achieving yields of 8-9T/Ha. Oil seed production is increasing sharply with Rape planting increasing 3 times this year as a result of higher oil prices and speculation on Biofuels.

Animal production has decreased to less than 30% of what it was under Soviet rule. This reflects the costs and efficiencies of animal production in a country of weather extremes (sub 0 winter, 30+ summer). There are concerns that lack of animal production is putting pressure on crop rotations that in past had fodder production that reduced weed seed burdens, and also animal manures that provided cheap fertilizer. Also concerns over reduced need for labour causing larger unemployment.

Future grain production growth is huge. Grain consumption of the country is steady. Therefore almost all increase in production will be exported. Both grain growers, government researches and grain marketers all agreed that there is huge growth potential. Most agreeing that a 3x increase is achievable in the long term. They enjoy a price advantage for exporting grain into the Middle East through the Black Sea, and both into Europe and Russia. At the moment the EU imposes a tariff of 30% for importing wheat. Russia has recently stopped buying Ukraine grain. This is purely political with no quality concerns; just past disagreements over other issues.

The country seems to have big fluctuation in grain yields and production. This would tend to tell us that there is a large opportunity for growth in the future. Many farms cannot afford new machinery, fertilizer and lack the knowledge to increase production. The lower input farmers have a much bigger grain yield fluctuations, where the better farmers with better technology and better fertilizer have not only increased yields but less variation from season to season.

Increases in grain production will not be short term, rather medium and long term, and will come with a more stable and less corrupt government. Access to finance is a big issue for farmers with high interest and a history of big fluctuations in rates. General better business environment will hopefully flow from there. Farmers then will be able to access technology, e.g. fertilizer is still used in 50kg bags. Wage rises can be off-set through better mechanization and reduced tillage, access to better farming practices.

Because most farmers don't own the land they farm there is little incentive for long term improvements in fertility. Crop rotations lack legumes, and often land has heavy weed burdens. Continual soil cultivation has been responsible for large problems with soil erosion; a large scale tree planting program 20 years ago is now addressing the problem.

We visited a few really well run enterprises including Agri Soyus. Basically a huge scale (14500ha) grain production farm that has associated Machinery Company so they demonstrate their no-till technology there and prove the system can work. Yields that they are achieving are much higher than district average, the farm would compare with best farms around the world. They held the record for the largest area of crop sown in one day by one machine.

Like some other leading farms they also value added grain by running pig, ostrich and a 1500hd dairy operation.

The Dnieper River provides great access for ship freight south to the Back Sea. There are a number of very large grain handlers that have built huge storage facilities, with plans for expansion. Unlike the farmers the grain handlers seem to be close to worlds best practice, storage, cleaners and dryers, as well as a more stringent grain testing regime (includes radio activity test) Farmers tend so sell grain at harvest, they generally have limited storage and need finance to put the following crop in the ground. A lot of land had been ploughed within days of harvest.

Of all the countries I have visited this would be the only one where I think there are good opportunities. Like I mentioned, future stable government will be the catalyst for a thriving grain production industry. The Ukrainians have to separate themselves from Russian ties, and then the EU may be a life line by inviting them to be members in the future, although this is not being discussed yet. World grain industry commentators expect Ukraine to come from the 7^{th} biggest exporter to the 2^{nd} behind Australia in the next 5 – 10 years, after that they have a chance at being the biggest.