Can We Secure Our Food Whilst Maintaining Our Environment?

Dr John Williams – Sydney Theatre Company, 28th June 2010

It's about Farming without harming

I want to first acknowledge the indigenous nation who lived and nurtured this land upon which we live and offer my thanks.

My personal Story

The drive to tackle the issues we face in trying to meet our food needs while maintaining the condition of the environmental resource base which produces the food in the first place runs deep to my roots. My passion for "farming without harming" stems from my childhood on the land at Tumbarumba and Bungendore in the snowy mountains and table lands of southern NSW. My parents managed grazing properties producing fine wool and beef cattle.

- I saw the rabbit plagues when I was 8-10 in early 1950s
- I saw whole hillsides crammed with feeding rabbits move en masse

- I saw land clearing, gulley erosion, whole hillsides ripped apart with gullies and gutters as rabbits and overgrazing layed bare the soil.
- As young boy I trapped rabbits for pocket money
- . We played cow-boys and galloped horses through the gullies.
- I worked with Dad as we tried to repair the erosion damage…logs in gullies…then contour banks to spread the water and slow down the flow.
- We did turn the tide. Dad was one of the first in 1949 to fly superphosphate and sub clover in a Tiger Moth…a bag at a time….then ***myxomatosis*** arrived and rabbits came under control…
- But all the time we worked with an uncomfortable reality in what we were doing.
- One year after we dispatched 500 bales of wool after a good season I remember congratulating my Dad and his response became etched in my head**….“Yes… Son we grew some lovely wool but I'd like to do it with less damage to God's creation."**

- So on reflection now I can see that the seed was sown.
- I left the sheep station and completed a degree in agricultural science and a doctorate in soil science and hydrology from the University of Sydney.

1. So what is the problem?

Essentially global agricultural production must be increased substantially to meet rising demand, but it must be achieved with a decreasing impact on the natural resources and environment.

- To achieve this at a time when climate change impacts will be expressed and when the cost of energy, fertilizers and pesticides will continue to rise is perhaps the greatest challenge yet to face agricultural science and natural resource management.

- It is also at a time when investment in agricultural science by both the industrial west and developing nations is under significant reduction.

- Furthermore the past efforts in agricultural science have not included adequate attention to the elements of the science

which ensure the condition of the natural resources (land, water and biodiversity) which underpin the sustainability of agriculture are maintained and improved. Despite a strong rhetoric it has been a difficult task to get agricultural science to recognise that we can't just focus on production alone, that we've got to look at the whole hydrological, ecological, and energy systems to appreciate the impacts of the footprint of our food on our natural resource base.

- This was a core message from the recent International Assessment of Agricultural Science & Technology (IAASTD) report in 2008. The report highlights the huge problem we have in finding ways to produce sufficient food for a rapidly growing population and halting the damage and increasing pressure on our natural resources, our soils, our water and our biodiversity.

- Agriculture is not just about putting things in the ground and then harvesting them. It is increasingly about the social and environmental variables that will in large part determine

the future capacity of agriculture to provide for eight or nine billion people in a manner that is sustainable.

- It's clear from the emerging scientific literature and the substantive synthesis provided by Professor Robert Watson and his team supported by World Bank and UN Food and Agriculture Organisation that **business as usual is not an option.**

This talk seeks to draw out first the issues that must be faced and some of the steps necessary to take us forward.

The issues:

1. Global population pressure on the ecological systems of the planet is a key driver of the problems we face. It is projected that the current population of 6.2 billion will increase by an extra 2.4 billion people by 2050-60. When I was born there was only about 2.5 billion people on earth. As world population continues to expand, projected demand for food will require agricultural and fisheries production to **double over the next fifty years**. This means harvesting each year

food for an additional 70 million people that is equivalent to the total food production of Australia.

2. Agriculture production in major commodity exporting countries is driven by cheap oil. The green revolution greatly improved genetic capacity resulting in greatly increased yields because these crops could express their improved genetics because they had access to relatively cheap oil based fertilizers, pesticides and abundant water. The circumstances that drove this step forward are now under challenge by
    - rising price of oil, fertilisers and pesticides,
    - diminishing supplies of P, and
    - a crisis in water supply.
3. The natural resource base for agriculture is generally declining and is a constraint to further productivity gains. Many of our soils are tired, impoverished and need rehabilitation. But add to this the worldwide experience that urban encroachment onto fertile productive agricultural land is rapidly increasing and thus further reducing land for food production. This urban expansion is also drive the increasing trend for water to be moved from agricultural production to

urban and industrial use.

4. The natural resource base (land water biodiversity) for agriculture continues to suffer damage and the traditional low food prices have not included the cost of this environmental damage.
    - It has been borne by the environment.
    - To cost into food prices this cost to the environment will mean dearer food.
    - To fail to cost and price this damage will mean the natural resource base for producing more food into the future will decline and be as it is now a major constrain to increasing food production.
5. It is likely the pressure to increase food production by further expansion of agriculture into rainforests, wetlands, peat lands, savannahs and grasslands will mean further loss of biodiversity. The planet's ecological function will receive further damage into the future at a time when the mitigation of climate change requires repair of this function and increased carbon sequestration in natural vegetation
6. Climate change will impact by increasing uncertainty in

agricultural production.

7. The rising price of oil will continue to push the growth of bio-fuels where food producing land will be converted to bio-fuel production and further clearing of forests and natural habitat will be lost to biofuels.

Global cereal demand is projected to increase by 75% between 2000 and 2050 and global meat demand is expected to double. Global cereal reserves have fallen to their lowest levels for thirty years. Oil prices have more than tripled since the start of 2004. Higher incomes, urbanisation, and changing preferences are raising domestic consumer demand for high-value products, shifting consumption from grains to meat and dairy. Throw climate change and high energy prices in to the mix and we have a conundrum.

Historically, the answer was to bring more land under cultivation. This solved issues of population growth and market expansion. As the World Bank showed last year, increasingly in the more densely

populated parts of the world, the land frontier is closing. In other areas, pressure on food supplies is driving expansion into more marginal areas, as well as rainforests, wetlands, peat lands, savannahs and grasslands, meaning further loss of biodiversity. The planet's ecological function will receive further damage into the future at a time when the mitigation of climate change requires repair of this function and increased carbon sequestration.

"Green Revolution" Fading: The relationship between climate change and agriculture is a two-way street. Climate change is also increasing production risks in many farming systems. Factors such as changes in temperature, precipitation, carbon dioxide fertilisation, climate variability and surface water runoff will all affect productivity. Climate change is also predicted to affect the distribution of plants, invasive species, pests and disease vectors.

More recently, in the 1960s, the solution was a "Green Revolution", based on high input systems sustained by a suite of new seed varieties, pesticides and fertilisers. Evidence is now mounting that the productivity of many of these systems cannot be sustained. Productivity is being undermined by pollution,

salinisation, soil degradation and pest and weed build-up. Today, almost 2 billion hectares and 3 billion people are affected by significant levels of land degradation. So, the "Green Revolution" won't give us the get-out-of-jail free card. Surveys show we are losing land as quickly as we can find new areas to farm. Just when we need to magically increase productivity, the very land we rely on is under threat.

Aside from environmental considerations, price is quickly becoming a constraint. The price of fertiliser is going to continue to rise, due to global demand as well as rising energy prices. Monoammonium and Diammonium Phosphate, two fertilisers of choice for Australian cereal crops, more than doubled over 12 months to hit $1600 a tonne prior to the financial crisis. "Round-up" herbicide increased in price from $4 a litre to $13 in the same year. The global financial crisis has caused these prices to moderate slightly. Even the cost of tractor tyres is expected to rise as the costs of raw materials and production go up.

It is clear that the mounting crisis in food security is of a different complexity and potentially different magnitude than the one of the

1960s. There *is* a limit to the world's resources. Dana Cordell, a senior researcher at the Institute for Sustainable Futures at the University of Technology in Sydney, said in 2008 that: "Quite simply, without phosphorus we cannot produce food. At current rates, reserves will be depleted in the next 50 to 100 years. "She added: "Phosphorus is as critical for all modern economies as water. If global water supply were as concentrated as global phosphorus supply, there would be much, much deeper concern. It is amazing that more attention is not being paid to ensuring phosphorus security." Certainly the data suggests to me that peak P will take place between 2030 and 2050 at current consumption rates and way we use P is used once and then discard it.

The unequal distribution of food and conflict over control of the world's dwindling natural resources present a major political and social challenge to governments and policy makers. This is likely to reach crisis status as climate change advances and world population expands from 6.7 billion to 9.2 billion by 2050.

To avoid the emerging food crisis without further and increased damage to the environment we need:

- Substantial reform to the nature of the agricultural sciences.

- This must be coupled with a major injection of both national and international investment in these reformed sciences.

What must we do?

How then do we achieve the seemingly unachievable? How do we increase agricultural productivity and yet protect the natural assets that will underpin production into the future?

Holistic Science &Technological Solutions will be important

We've got to look at ecological, energy and water systems as a whole to appreciate the impacts or the footprint of our food on our natural resource base.

For too long, the emphasis of agricultural science has been on delivering innovation and technologies to increase farm-level productivity. Little attention has been paid to a more holistic integration of natural resource management with food and

nutritional security. Fortunately, there is increasing recognition that this current mode of operation requires profound revision.

We are beginning to realise that, today, more than ever, we need science and technology systems that enhance sustainability whilst maintaining productivity. To do this, we desperately need improved understanding of the landscapes in which we farm.

We must have agricultural science that understands and connects to the landscape. The flows of water, nutrient and carbon in the agro-ecosystem must be quantified and better predicted and brought into harmony with the flows that are in line with geology and natural capacities of the landscape. We need better to appreciate soil-plant-water dynamics and the agro-ecological function of mosaics of crops and natural habitats.

Policy, Institutional, Economic and Social issues are equally important

Pricing Food for Sustainability: Where we do get the science right, organisation capacity and the right policies are still required, otherwise we take two steps forward and one step back.

We need governments to adopt policies that create incentives for sustainable practices and result in costs to the environment being internalised. Traditionally, food prices do not include the cost of environmental damage. The natural resource base (land, water, biodiversity) for agriculture continues to suffer. We can't afford to keep running down the systems that feed us.

For as long as the cost of maintaining and improving the natural resource base in agricultural systems is not included in the price of food, farmers will never be able to farm sustain ably and profitably. This may mean dearer food, but it will also mean ensuring that we can continue to produce enough food.

We need market and trade policies that remove perverse subsidies. Rewarding the provision of ecosystem services is a good start. We need investment in the economic valuation of ecosystem services. With a market for these services, farmers in the future will not only be paid for the goods they produce but also for the services

they deliver through the management of healthy landscapes, rivers, wetlands and estuaries for the public good.

Agriculture, by its very nature, exploits the natural resource base. The nutrients in our food were once part of an ecosystem. It doesn't have to be an endless cycle of more and more synthetic inputs to offset ongoing land degradation. The irony is that to break this endless cycle, we need to create another. We need a system that has a closed loop, one that is resilient, that can cope with a certain amount of nutrient harvesting and yet stay healthy. Stepping off the treadmill is hard but it is necessary if we are to have both healthy and productive landscapes.

Some tough questions – Can we find new or maybe rediscover agro ecosystems where nutrient loss beyond that in the food or fibre is zero? Does achieving such agro ecosystems mean a lower rate of productivity to close this loop? Is this a measure of the cost of food when the resource base is maintained?

Last year the World Bank noted that advances are being made in tapping nutrient sources that do not depend on fossil fuels, but there is much more to be done. We need biological substitutes for

agrochemicals and bio-controls of current and emerging pests and pathogens. We must address agricultural production as an agro-ecosystem that is part of the larger-scale ecosystem and landscape processes. We need to look beyond agriculture at the whole nutrient cycle. Where does the precious Phosphorus and nitrogen in our food go?

We must recycle precious P. Globally we use 46 million tonnes of P and some 21% of this P or some 10 Millions tonnes is excreted and enters our sewerage. Use once and throw away with a element as precious as P makes no sense.

New Challenges for Science and Its Support: New crop and forage species that are bred for specific conditions will be important. However, these alone won't be enough. Improved genetics for yield cannot be expressed if nutrient, water and disease are constraints. New industries and land uses are required that can deliver economic as well as ecological benefits. There is a feedback between production and consumption, supply and demand. Addressing economic and market failures goes a long way to redressing the degradation of our agro- ecosystems.

Finding solutions to biophysical problems posed by building a resilient agriculture is scientifically demanding. This requires new ways of doing science within the imperatives of rural communities facing radical environmental, social and economic changes.

In an industry where inputs are increasingly expensive and climates continually variable, surviving is all about both precision and resilience. There are serious deficiencies and problems with our scientific understanding of the ecology of the rehabilitation process in many ecosystems and the environmental impacts of specific actions on the farm. We can't afford to keep ignoring the need for the research and development of farming systems that integrate productive land uses into the landscape in a way that is compatible with the ecological, hydrological and biogeochemical processes operating there.

The UN Food and Agriculture Organization continues to draw attention to the urgent need for governments to do more to help the world's smallholder farmers adapt to climate change. In particular, they declared support for "the establishment of agricultural systems and sustainable management practices that

positively contribute to the mitigation of climate change and ecological balance".

Investments in publicly funded agricultural research and development in many industrialised countries has stalled or declined and has become a small proportion of total spending on science and technology. Spending public funds on research that the private sector can undertake profitably, such as developing novel seed varieties, doesn't make sense. Public investments in science to address environmental shortcomings that have ramifications for society at large do.

Agriculture is not just about putting things in the ground and then harvesting them. It is increasingly about the social and environmental variables that will in large part determine the future capacity of agriculture to provide for eight or nine billion people in a manner that is sustainable.

Agriculture is being faced by what may be its greatest challenge yet. In a nutshell, global agricultural production must be increased substantially to meet rising demand, but it must be achieved with

a decreasing impact on the natural resources and environment at a time when the cost of energy will continue to rise.

It is possible to create resilient agricultural systems – to have both healthy and productive landscapes. It isn't easy, but it is essential. The present path of agricultural science is unlikely to achieve development goals for global food production and security whilst improving or at least maintaining the condition of the natural resource base and the global environment.

But there is a magnificent foundation on which to build and invest in the agricultural science needed to address these pressing issues. We need both reform of agricultural science and significant increase on our national and international investment in the new directions for agricultural science.

The respected science writer, Julian Cribb, urged recently that now is not the time for Australia to turn its back on the rest of the world and allow its investment and international commitment in agricultural science to decline further. This country has a tradition of leadership in agricultural science, and has much to contribute to this global problem.

The challenge of producing more food by farming without harming the natural resource base and environment in an era of increasingly expensive fertilizer, pesticides and energy coupled with the spectre of climate change is formidable. It is a wake-up call to our civilisation.

We must find ways to increase food production and not deliver the natural resources and environment of the planet a period of further increasing damage.

Ways forward: We must truly seek out ways to farm without harming.

1. It must be faced by agricultural science that too much of our past research has been focussing on just the production arm. We have not looked at the whole agricultural ecosystem and ensured that the natural resource base on which productivity ultimately depends be maintained and improved by the operation of the agro-ecosystem. Agricultural research and development in light of the crisis our planet faces must make this change in emphasis immediately.

2. What we've been doing is exporting the footprint of agriculture to the environment without recognising that we need to strongly reduce the footprint but at the same time increase our productivity - so we've got to reduce the footprint of food at the same time as increasing the amount and its distribution. Producing our foods and ensuring that we also reduce the number of people who are malnourished and do this in light of all the environmental pressure that must be managed is a huge challenge that we need to face.

The issue of food production, rising price and its increasing footprint and impact on the environment will not go away.

We have some big issues that have not been on the agenda. We have not priced into food the costs to environment.

We have an awful clash coming in the need for more food at lower prices yet at price that will not cost in environmental impacts.

Unfortunately our society and our agricultural science communities seem comfortable with producing more food means that impacts further on the environment. But because food security and price are so emotive issues the only outcome I can see is that the environment (land, water, biodiversity) is going to get it in the

neck again!...and make the whole problem worse again...so around and around we go...until we think along some of the lines I and others have suggested.

We must learn better to farm without harming.

Our farming communities engaging with Landcare have made courageous efforts to do this, but the rest of society needs now to realize that we must play our part in driving major reform and investment in how we buy and market our food. Our farmers need to be rewarded with price signals that foster and pay for the real costs of sustainable food production. We cannot in my view continue to expect our farming communities to provide cheap high quality nutritious food as well as look after the natural resources and environment beyond a "duty of care" without proper price signals and financial incentives.

Part of this will be paying the provision of ecosystem services. We need investment in the economic valuation of ecosystem services. So that perhaps a GST on food would be one way of recognizing the cost of sustainable agriculture and internalizing environmental

costs into the market to some measure. With a market for these services, farmers in the future will not only be paid for the goods they produces but also for the services they deliver through the management of healthy landscapes, rivers, wetlands and estuaries for the public good

3. Arising out of all of this is the need for increased investment in agricultural and agro-ecological research ...at a time when research in agriculture is being wound will back in all developed industrial nations as well as in most developing nations. To see continuing reductions and erosion of research capacity in agriculture and natural resource management at this time is alarming as the challenges outlined above are so stark. It is particularly disappointing when we know that Australian agricultural science can contribute significantly to international leadership and, as it has done in the past, could contribute much to the global problem we now face.

4. The present path of agricultural research and development is unlikely to achieve development goals for global food production and security, but there is a solid foundation for improvement and

investment. We need both reform of agricultural science and significant national and international investment in the new directions for agricultural science and natural resource management. This must be done in conjunction with reforms to trade and markets for our food so the environmental costs of sustainable food production are properly incorporated into the real costs of our food.

In Conclusion

But what can you and I do about this major issue facing our society and the civilization as a whole.

First and foremost I see the evidence pointing to the fact that from a science and technological perspective this huge problem can be solved. As *Bob the Builder* says *" We can do it...scientifically"*

But I am not convinced we will solve it not because we can't but because we choose not to.

In the end it is social, economic and values problem. Will we have the will, the courage and the determination?

So it is in our hands, here in this theatre what we choose to do.

You and I have 21 opportunities each week to determine what happens.

Each time we eat we have an opportunity to determine the impact we have on this planet by the food we eat.

As you see tonight the footprint of our food is perhaps the biggest impact we have on the ecology and environment of the planet.

If we had a steak, salad, and glass of wine then tonight we have consumer some 4500 litres of water.

If we were determined to only eat food which had been produced in the most sustainable way possible… each of us would make a difference and begin to turn the tide.

This does not mean we need to be vegetarian…while that may help it would not help if that vegetable was grown in a non sustainable manner.

I ask you to think ask and ponder how your food was produced.

Did the water to grow it destroy a river?

Did it growth require a native woodland to be removed?

How many kilograms of soil was washed into a stream while it was produced?

We worry about and regulate how much cadmium is in our chips and the mercury in our fish..but we don't seem to care if the

potatoes growth caused red basalt soil to be lost to the estuary to damage an oyster farm or of the fish came from aquaculture that damaged an estuary or a river or from an over-fished fish stock.

You see there are 21 times a week that we could tell society that we wanted our food to be produced sustainably.

We should legislate that just like we have for the E.coli levels in our oyster. Not only do we want a zero E. coli count but we also want the oyster from an estuary that is not damaged by its production.

We can drive the change to insist that food to be marketed it must satisfy basic sustainability standards.

It is time for change

- We cannot afford to be "asleep at the wheel!"
- It is a time for turning Challenges into Opportunities.
- We will have to make choices.
- Adaptation and innovation will be important.
- It is not the time to panic!
- But it is the time to think and change

- And understand what we eat and how it was produced will be a major issue determining the fate of this lovely blue planet.

Summary: As world population continues to expand, projected demand for food will require agricultural and fisheries production to double over the next fifty years. This means harvesting each year food for an additional 70 million people which is equivalent to the total food production of Australia.

Whilst it is a huge call for food production to be increased substantially, the more demanding challenge is to make these huge increases while decreasing detrimental impacts on natural resources and the environment.

This is a time of rising costs for energy and diminishing supplies of essential nutrients such as phosphorus within a spectre of climate change. To avoid a global food crisis without further damage to the environment, we need substantial reform to the operation of agricultural and natural resources sciences, coupled with a major injection of both national and international investment.

This urgent need to give priority attention to food production whilst maintaining the quality of the resource base from which it is produced is perhaps one of the greatest scientific challenges ahead and certainly one that has apparently slipped from our gaze.

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[1] This talk build on work of myself and Fiona McKenzie some of which was published as Farming without Harming, Australasian Science, Vol 29, No7, 31-34, August, 2008.