

# **QAAS Dinner Address 16/7/08**

## **Futures in Agricultural Science**

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# Agricultural Science

- Could be considered one of, if not, the oldest of scientific endeavours, commencing rather informally and developing to the highly sophisticated science of today
- An integrating science, that brings together a wide range of disciplines – biology, chemistry, physics, mathematics, statistics, ecology, soil science, entomology, plant and animal pathology, animal sciences, economics, management etc
- Interfaces with Food Science, Food Technology and Human Nutrition, thus the Health Sciences

# Agricultural Science

- An applied science in plant and animal production and utilisation
- Can be considered the 'first' environmental science, since the 'environment' is a fundamental resource for agriculture, Agricultural Science pre-dates Environmental Science as discipline
- Very much a 'sunrise' science – in modern times, first or among the first to develop applications of computers, decision support systems, integrated management systems, biotechnology, Genetically Modified Organisms

# What has Agricultural Science Delivered?

In short, ***huge productivity gains*** in plant and animal industries currently running at 1 to 3%pa (round figures of course) in Australia and in many other countries

*[An example – Maize yield has increased at over 100 kg/ha/yr in advanced countries for the last 30 years or so, less in developing countries, but has declined in a few countries]*

***That have released people for other activities and continue to do so around the World***

*We should remember the green revolution – principally due to advances in plant breeding and plant nutrition, especially use of Nitrogen and Phosphorus fertilisers – and the central role of Agricultural Science in it*

# But there are downsides too

For example:

Energy consumption – to replace labour, to provide N fertiliser – nitrogen fertiliser is very energy intensive

Massive exploitation of phosphorus reserves – easily mined and processed guano based deposits nearly exhausted – rate of price increases will much exceed the rate of increase in oil prices

Monoculture, land degradation

***To be a bit provocative – more people, more food needed, more production needed, more demand on resources, question of sustainability – do the answers lie only in agriculture? What is the role of demography?***

# The Recent Context in which Agriculture has operated

An apparent anti-production 'paradigm' in advanced countries – but those same people still want to eat and eat well!

Urban populations increasingly remote from their food sources and food production realities

The drought and proposals to change the basis of Drought relief (Australia, other drought prone countries)

Agriculture often receives bad press – including accusations of environmental exploitation, damage to rivers, over-clearing, land degradation, eutrophication of water bodies, sedimentation of rivers and Great Barrier Reef Lagoon, excessive emission of greenhouse gases and so on

More broadly, science also sometimes suffers bad press – though Health Sciences usually get good press

# BUT PARADOXICALLY

1. Farmers (8<sup>th</sup>) and Scientists (13<sup>th</sup>) rank among the most trusted 40 professions in Australia
2. The community wants agriculture to deliver quality food and plenty of it at declining real prices

AND

3. The community wants scientists to provide the answers to its problems

# The Recent Context in which Agriculture has operated

Starting and ongoing salaries for agricultural science have been in the lower end of professional scales – not competitive – must be addressed by employers

Sociological desire to stay near the coast - preferably very close to it!! And live in big cities for lifestyle choices

Resistance of professionals to serve in what is considered the outback – a problem that applies to all professions, but probably more so to agricultural science as its client industries are mostly located some distance from the coast and big cities

# The Consequences

Agricultural Science not seen as desirable

Demand for and enrolments in Agricultural Science (and related disciplines) have been declining for many years - Major decline since about 2000

Universities closing courses and programs, Agriculture Faculties and Schools being incorporated in others, sometimes with loss of identity and thus visibility (This is an International trend)

There is a whole 'missing generation' of agricultural scientists, now recognised by some in Industry as well as Government, salaries starting to rise

# The Consequences

Major concern to profession – Australian Institute of Agricultural Science and Technology running a major publicity and political effort to attract students to agricultural science

Council of Deans of Agriculture discussing the issue with Federal Government

Forward demand predictions for Agricultural professionals by Federal Government cannot be met from current enrolments – projections of demand for graduates up to 2012 well in excess of current enrolments ie students who will graduate in 2008 to 2012

Agriculture and Agricultural Services Industry needs to engage with Universities and Governments in a way that the Mining Industry has to support and promote agricultural science

# The Future Context

*OR What are the major drivers affecting agriculture and agricultural science?*

A non-exhaustive list:

Climate Change

Water Supplies

Economic advancement in Asia especially

Peak Oil – and fuel prices

Biofuels – Food and Feed Grain diverted to Fuel (portable energy)

Carbon Sequestration

Food Prices

Environmental Stewardship

Sustainable Agriculture/Catchments/Communities

Biotechnology

# A look at drivers and possible responses

## Climate Change

Adaptation in the short and medium terms by agriculture is essential – mitigation is longer term and largely outside capacity of agriculture

How to adapt – Change to crop sequences, varieties, agronomic practices? Relocation of cropping areas? Different crops altogether? Change feed supplies for animals? Enhanced N fixation by legumes and grasses in association with symbiotic organisms? Role of free living diazotrophs? Change animal production practices? Are current assumptions on consumption of animal protein soundly based and is the projected consumption sustainable?

# A look at drivers and possible responses

## **Fresh water Supplies**

These are declining in total and per capita  
Increasing variability of supplies – interface with climate change  
Agriculture uses about 75% of fresh water  
Overextraction from rivers – rivers drying up!  
Need improved water use efficiency  
We need a BLUE (Water) Revolution to sustain Agriculture and Environment  
(We have had green revolution in Agriculture, why not a blue revolution in Agriculture and Environment)

# A look at drivers and possible responses

## **Economic Advancement in Asia**

Agricultural and Industrial productivity improvements – urbanisation of China, India and elsewhere

Demand for Westernised diets – more animal protein, greater variety – can the current production systems meet the demand? If so at what cost?

# A look at drivers and possible responses

## **Peak Oil, biofuels and Food Prices**

All linked! (Ignore link at our peril)

Peak Oil – feeds into input prices so output prices must rise

Biofuels – a competitor for energy, therefore impacts on food prices

Much debate – point is all are linked and responses must take whole of system approach

# A look at drivers and possible responses

## **Carbon Sequestration**

Could lead to diversion of productive land to 'carbon forests'

Can we reverse the trend to declining soil C? This is a big challenge, and will mean significant changes to production systems and soil management

Could be competition from biofuels – cellulose (crop residue) based bio-crude reducing availability of C for sequestration, competition with residue retention for land management

Another major area for debate

# A look at drivers and possible responses

## **Environmental Stewardship Sustainable Agriculture/Catchments/Communities**

These all linked – and complexity of systems challenges a lot of current thought

Too much 'black boxing' by interest groups and therefore lack of understanding of the challenges

In short – if we damage the environment, we could well lose the capacity for sustainable agriculture/catchments/communities – MDB could be the crucible in Australia, Yellow River Valley in China

A challenge for us all – what is the human carrying capacity of the planet? At what standard of living? (which essentially equates to consumption of resources)

# A look at drivers and possible responses

## **Biotechnology**

Is this the great 'White Hope'?

There have been successes – Ingard Cotton (for control of Heliothis), Roundup Ready corn, cotton, soybeans, canola (for weed control), golden rice (human nutrition benefits)

AND

There are promises – Symbiotic nitrogen fixing organisms with grasses (pasture grasses, sugar cane, maize, sorghum, rice, wheat etc), enhanced rhizobium effectiveness with legumes, pest resistance, enhanced water use efficiency, enhanced photosynthetic efficiency, better food quality (nutraceuticals, functional foods)

Question is whether these can be realised and when.

# The Future in Agricultural Science

How good is our crystal ball?

Where do we place the boundaries?

Is there a future at all, or will Agricultural Science be subsumed into something else?

# The Future Context and Its Implications for Agriculture and Agricultural Scientists

The future context implies a number of paradigm changes – some limited to agriculture, some much more widely applicable (just consider energy supply, form and cost, Nitrogen supply, use and efficiency of use)

Virtually all items listed in previous slides are relevant to agriculture  
Virtually all listed items demand a response from agriculture

We can soundly assert that the 'tectonic' changes being forced by 'climate change' and 'peak oil' will impact across human activities AND that currently we don't have the answers

***So in Agriculture there will be need for much enhanced research industry development and social responses***

# The Future Context and Its Implications for Agriculture and Agricultural Scientists

Responses to the challenges will range from quite simple (say single factor adaptation) to very complex - and most will be the latter

Consequently, responses will demand multidisciplinary and integrating approach – a strength of traditional BAgSc degrees that have basic and applied sciences, animal and plant sciences and production practices, economics and management – this approach needs reinvigorating

Agriculture will become more technologically advanced and dependent on professional services – this has been occurring for 3 decades, and will become more intense

# The Future Context and Its Implications for Agriculture and Agricultural Scientists

Capacity to deal with variability will demand enhanced conceptualisation, analytical and managerial skills

Reducing Institutional Research Capacity is short sighted and will be counterproductive

Downsizing of University Faculties and Schools (worldwide phenomenon driven by low student demand and economically rationalist funding models) will lead to intense future shortages in Academic and Research workforce in agriculture – it is occurring already – and pipeline effects will ensure it intensifies

# Agricultural Science in the Future

So there is a future for agricultural science!

There are big opportunities, and plenty of them!

We are on the cusp of a shift - arising from the centrality of agriculture to many of the drivers listed and vice versa

**And** very importantly food is now a supply and price issue in the public consciousness

# Some Likely Areas of Future Demand

In no particular order:

Agricultural Education

Climate Adaptation

Carbon Sequestration in Soil

Soil Management

Water Use Efficiency

Nutrient Use Efficiency

Pest Management

Biological Nitrogen Fixation

Functional Foods

Plant Products for Nutraceuticals

Agricultural System Sustainability

Biotechnology

(And combinations of these and of course others that will emerge)

# And Above All

## Working as part of teams

THANK YOU