Capacity of Farmers to Adapt to a Changing Climate in the South Coast Region of Western Australia

A background paper for the Climate Adaptation Addendum to *Southern Prospects 2011-2016.*
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SOUTHCOAST NATURAL RESOURCE MANAGEMENT

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Forward

The background papers to the *Climate Adaptation Addendum of Southern Prospects 2011-16* are a series of technical documents detailing the potential impacts of the South Coast region's changing climate and how people are adapting to it.

South Coast NRM commissioned the papers in 2014 and were part of the *Australian Government's Regional Natural Resource Management Planning for Climate Change - Stream 1* project.

The background papers synthesise the current information on the effect of climate change on each natural resource theme, community capacity to adapt and how people are already adapting. They also document some of the gaps in knowledge have provided useful background information for community consultation through South Coast NRM reference groups who have used them to develop climate adaptation goals and outcomes for *Southern Prospects 2011-2016.*

South Coast NRM recommends the background papers are best read in conjunction with *A Changing Climate - South Coast Region of Western Australia (Fry 2015)* and information on the CSIRO and the Bureau of Meteorology Climate Change in Australia website - *www.climatechangeinaustralia.gov.au/en.*

Climate change planning at South Coast NRM will be flexible and adaptive, therefore information on the climate and its impacts will be continually reviewed.

- Kaylene Parker, Climate Change Project Leader, 2015.

Summary

The 2013 season was productive along the South Coast and helped ease some of the financial pressures on farms.

However, for some farmers pressures remain and they remain uncertain how to reduce debt or exit the industry. Even with a good season farm populations have decreased dramatically over recent decades.

This has social consequences and will affect how South Coast NRM can assist farmers in adapting to climate change.

Financial pressures are partly due to stalled improvement in productivity over recent decades, as measured by production per millimetre of available moisture.

There is potential for the climate change project to address this problem because it is relevant to a drier climate and because it may also expose management changes to improve productivity.

A framework to assist farmers to adapt to climate change should include ways to measure the project and development of the water use efficiency concept could be applicable.

Also, extension theory suggests ways that the climate project could address objectives of farm profitability (productivity) and adaptation to climate change.

A good place to start would be to develop case studies with selected individual farmers. Further development of these suggestions should include collaboration with other organisations which have a potential overlap of interest.

- David Rees, 2015.

Introduction

Literature about the impact of climate change on agriculture in Australia is extensive and recent.

Examples include *Asseng & Pannell (2013), Hertzler (2007), Hogan, Hanslip, Kancans, Russell and Maguire, (2008), Kingwell et al.(2013) and Stokes and Howden (2010).*

However, this literature mostly addresses policy to precede strategies to apply on individual farms, meaning that any strategies will not necessarily relate to the individual farm, or even to a majority of farms.

At least some farmers are already considering such strategies. Ideally the strategies to address climate change will overlap with other objectives of improving farm productivity, providing synergies for both objectives.

At this early stage of adoption of strategies, data for planning will be incomplete but anecdotal evidence may help.

This report attempts to provide evidence and opinion that may be relevant. It is based on some data, some material from the extension literature and experience over a number of years with individual farming clients.

What is Climate Change?

Some farmers do not accept the inevitability of climate change, but at least the term is now well established in public affairs.

In farming circles, most people probably recognise average temperatures have increased around the globe.

More certainly, different rainfall patterns are recognised in the South Coast NRM region over the past couple of decades, though some argue whether the change is anything more than random variation.

The inevitability of climate change is generally recognised at government and international levels, resulting in funding for reporting on the problem.

However, most reports on how farmers might adapt to climate change begin with suggestions for research to define the likely impact, which could then be developed to recommend appropriate management systems.

Tools to implement these systems would be a further step removed. General policy is further removed from current realities by confounding strategies to mitigate climate change such as carbon sequestration, with strategies to adapt.

The main practical problem with climate change for Australia seems to be reduced rainfall and therefore associated availability of water resources (e.g Queensland and Tasmanian reports).

For broadacre farms in the South Coast NRM region, this makes targets for water use efficiency a central issue.

Farm industries of minor regional significance such as horticulture and dairy may have different issues of relevance.

Other concerns about climate change include a likely increase in catastrophic weather events resulting in damage from storms, floods and bushfires.

It can also be speculated that the increase in incidence of frost damage to crops over the past decade or so, may be a consequence of global climate change.

Arguably the most dramatic consequence of climate change is declining rainfall.

This rainfall pattern is well illustrated with the graph of Cranbrook rainfall over the long term, taken from a report by Miriam Lang, Department of Agriculture and Food WA on *page 6* of this report.

The danger to businesses is not the decline in averages, but the occurrence of a disastrous dry season, as shown on the graph by the bars in red.

This problem may be worse, based on growing season rainfall, which better reflects the decline in the number and strength of winter rainfall fronts.

Such disastrous seasons will now have serious consequences for financial support of farming along the South Coast. For instance, farm expansion has been driven by economies of scale, particularly in cropping enterprises.

Farmers have therefore borrowed heavily to expand and now depend more heavily on crop income.

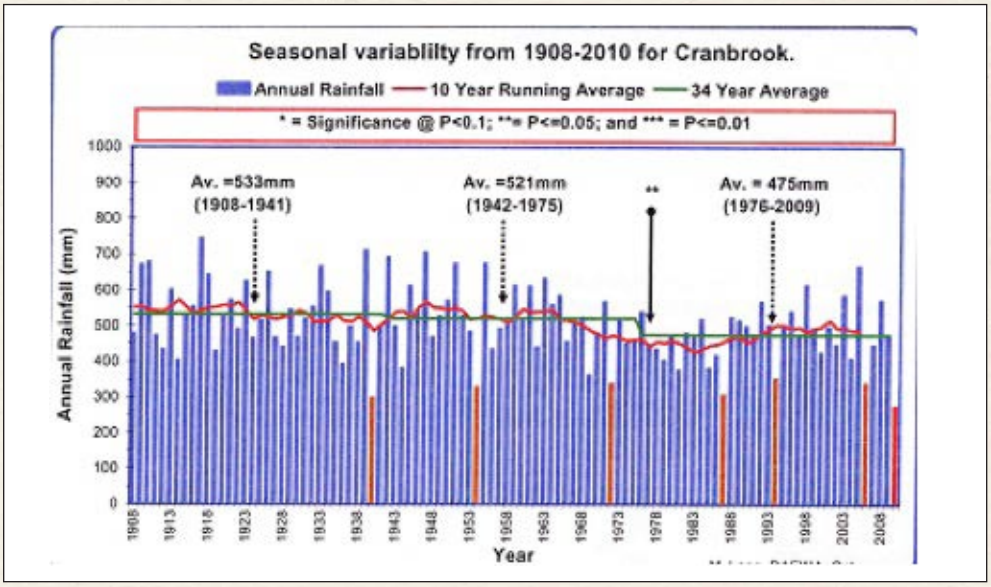

Figure 1: Cranbrook rainfall over the long term from a report by *Miriam Lang, DAFWA*. The danger to businesses is not the decline in averages, but the occurrence of a disastrous dry season, as shown by the red bars.

The combination of extra debt, vulnerability of cropping income to dry seasons and increasing frequency of dry seasons, compounds the problems facing farmers with climate change.

Furthermore, current decision support system models tend to analyse the impact of changes on individual farms, which does not adequately reflect the consequences of a disastrous season.

Such a season may be enough to make only a small proportion of farms non-viable. However, if this small proportion are forced to sell and neighbours are not sufficiently strong financially to afford to buy these farms, this could lead to a cascade of properties listed for sale, which demand may not support.

Any sales would then be at "forced sale" values. Of course, climate change will present other challenges for farm businesses. Examples include an increased frequency of bushfires, (arguably) increased variation such as more frosts and knock-on effects such as an increase in problems including non-wetting soils, wind damage to soils or encroachment of salinity. However, for most South Coast farmers, the major impact will be the reduction in growing season rainfall.

Capacity of South Coast NRM Region Farming to Adapt

Several aspects of current farming practice are particularly relevant to strategies to adapt to climate change and overall farm management.

Farm Finances

Arguably, the most urgent assistance needed for farmers to adapt to climate change, is to address finance needs. This principle particularly applies to conservation practices offering short term cost and benefit that is uncertain and likely only over the longer term. Adapting to climate change would be in this category.

Also, when finances are strong, innovation is more likely to be tested and implemented. For example, the wool boom of the late 1980s funded adoption of no-till machinery along the South Coast though awareness of the need was established beforehand.

Farm finances in the region have been boosted by the highly productive 2013 season. However, this was because of an unusually favourable season - decile 10 rainfall in some cases. *Figure 2* on *page 6* of this report illustrates the cumulative rainfall figures for Ravensthorpe in 2013.

Anecdotally, cereal crops are producing averages across the whole farm of three to four tonnes per ha - some 50 to 100 per cent above budget.

Despite this, many farm businesses will still struggle with a heavy debt load. Over the next few months, it remains to be seen how much the one good season can restore debt to conservative levels.

Rural lenders have certainly become more cautious in lending with the result that most farmers now aim to reduce debt levels, rather than expand chasing economies of scale.

This attitude to debt and financial risk has arisen since the global financial crisis, and this cycle in farm businesses may take several years to pass.

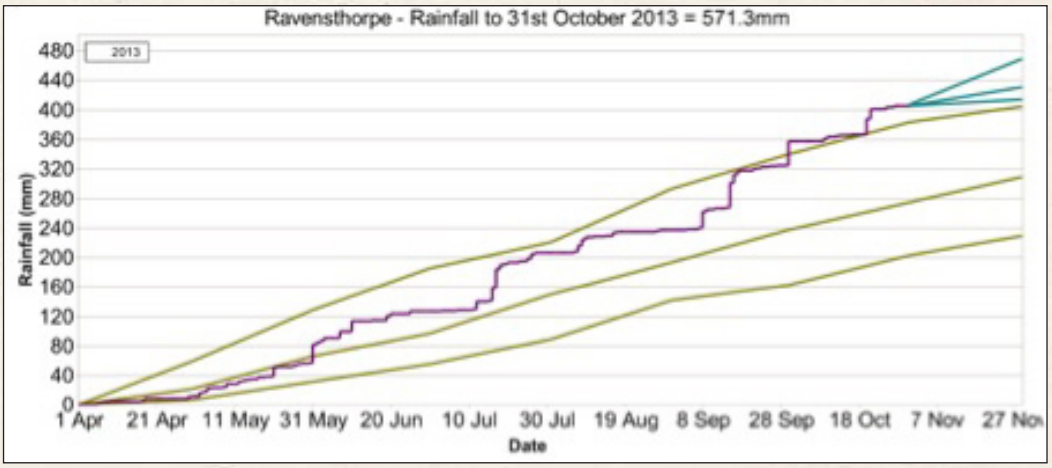

Figure 2: Cumulative rainfall figures from DAFWA for Ravensthorpe in 2013.The upper line is for decile 10, the lower, decile 1 and the middle decile 5. The stepped line is the actual cumulative rainfall.

Farm Demographics

Even if the 2013 season restores borrowings to a comfortable level, this may in fact worsen some of the social problems facing farming areas.

There is a backlog of farm sales from the last few years and some will take the opportunity to sell land or exit altogether. This will further reduce the number of commercial farm businesses and probably reduce overall farm employment.

To put this trend in context, CBH delivery cards have dropped from around 10,000 in the year 2000 to some 4,000 today. Furthermore, the average age of farmers is increasing and fewer younger farmers are returning to the land.

These trends will be relevant to planning action to assist farmers to adapt to climate change. For example, with fewer farmers in each district, there will be less support for activities such as field days and local seminars. Along the South Coast this combines with reduced staff levels for DAFWA.

The South Coast NRM project to assist farmers would therefore have to consider that provision of information through public events would be more difficult than in the past and an individual approach could be relatively more effective.

Outside Investment

A flipside of the declining number of family farm businesses has revealed a trend along southern coastal farms, for investors to purchase land.

This has been led by a several large purchases, such as the Chinese-backed company *Beidahuang* controlled *Heilongjiang Feng Agricultural* (Websters farms, north Ongerup - some 6,500 ha in these blocks), *Hassad Australia,* (an Australian company, apparently backed by Qatar-purchased Amarinya, 14,672 ha 2012), *Lawson Grains* (Siviour farms - 5,787 ha, $9.7 million) and *Westchester* (purchased Imberti farmland).

This investment structure will change the approach to farm extension for issues such as adapting to climate change.

The Productivity Plateau

A simmering issue underlying the problem of tight farm finances is that productivity improvement has plateaued over the past 20 years or so *(Nossal, Zhao, and Gunasekera, 2009).*

Poor seasons have contributed to the productivity plateau, but my own data (unpublished) as well as data supporting DAFWA programs such as *Bridging the Yield Gap* show the trend in production per millimetre of rainfall - water use efficiency has also plateaued.

This measurement theoretically removes the effect of season. This stalled productivity is even more alarming, considering that an innovation (such as no-till) takes at least several years and perhaps a decade to be adopted. Few local farmers have clear plans to re-invigorate productivity improvement.

Communication Technology

Problems arising from declining rural population may be offset by improvement in communication technology, including tools such as social media.

With the ageing farm population, adoption has certainly not penetrated the community and it is not yet clear how this might be utilised. However, the opportunities to assist the region's farmers adapt to climate change using social media tools, could be considered.

Potential Tools for Adapting to Climate Change

"If you Cannot Measure it, You Cannot Manage it"

The debate about whether climate change is a permanent phenomena or random variation of seasons, suggests that for a conservative community like South Coast NRM region farmers, the motivation to accept any innovation to adapt is not necessarily strong.

In any case, *"if you cannot measure it, you cannot manage it"*, so a starting point for South Coast NRM's involvement would be to encourage using a measurement technique with production benefits for farm businesses.

Various ways to measure climate change impact on farm businesses can be imagined. For example, the ideal measurement would be simple, preferably already being monitored by farm businesses and sensitive to changes in farm profitability as well as to direct effects of climate change. The choice of measurement could be developed further, but water use efficiency is suggested as a suitable choice. This would be as relevant now as when climate change and lower rainfall impact on farms.

It can be applied as a target for crops or for livestock enterprises, with calculations of productivity per mm of rainfall, or more correctly, per mm of available moisture. The concept gained currency in the late 1970s based on UK targets of 10 tonne per ha. Ambitions for Western Australian crops with rainfall limitations were more modest. At one time, local targets were 3-tonne per ha (eg. newsletter, 3-tonne club, published by the *Rural and Allied Industries Council, 1980).*

The principle was more clearly established with the French and Schultz papers of 1984 *(French & Schultz, 1984a and 1984b).* These papers observed a more precise potential water use efficiency target of around 20 kg per mm of available soil moisture and an intercept of 110 mm (evaporation loss).

The French and Schultz conclusions of these papers was more recently confirmed by Yvette Oliver and others *(Oliver, Robertson, Stone, and Whitbread, 2009),* though with some suggested minor modification.

This review suggested that with simple modification, these basic targets were accurate enough, even compared to more complex models, such as the CSIRO APSIM.

Along the way, the value of this measurement and therefore the implied production gap was recognised by the DAFWA *Bridging the Yield Gap* project which developed from the department's 2009 *Plan to Support the Grains Industry.* This project promised partnerships and held 17 workshops in medium to high rainfall areas in 2010 *(Glenn McDonald, DAFWA Crop Updates 2011).*

However, from personal scrutiny of this project in the rural press, there has been evidence of direct impact. One explanation for the lack of adoption of the concept of water use efficiency could be the decline in public funds to support extension, in particular through DAFWA.

This problem is recognised by the organisation with attempts to build industry partnerships such as *Bridging the Yield Gap.* Even if real funding levels are not being reduced, it may be the case that supporting partners such as farm management consultants, agronomists and grain marketers have not embraced the project.

Reasons can be speculated, but sometimes day-to-day issues such as farm succession planning dominate farm management consulting.

More recently, the CSIRO APSIM model has been developed commercially by the Victorian Birchip Group at the Yield Prophet service. This was promoted for the South Coast in 2012 and 2013 with funding from the Grain Research and Development Corporation.

This promotion has been to encourage crop monitoring sites which can match crop performance against predictions by the model. It seems that scientists recognise the importance of knowing crop targets, though the farming community has not yet embraced the concept. This history shows the principle of crop targets for water use efficiency is seen as valuable, but the extension of this principle has been unsuccessful to date.

Farmers readily appreciate good crops can be grown in good seasons, but in general discussion, water use efficiency is never (or rarely) used to compare management practices across different seasons and districts. Instead, absolute yields are quoted, which confound successful management with favourable rainfall.

As well as demonstrating a *yield gap*, this history also appears to demonstrate an *extension gap*. South Coast NRM objectives of assisting farmers to adapt to climate change could therefore focus on the extension gap, as well as the productivity, or yield gap.

Other extension effort may have been unsuccessful, but given the potential seriousness of climate change, lessons from these attempts could now be used to frame another attempt.

Specific Tools to Assist Farmers to Adapt

Of course, a measurement tool such as water use efficiency will be of no value, unless it is applied to management techniques to improve it and therefore to assist farmers adapt to climate change.

Some examples of tools that may help farmers to adapt to climate change are listed below. These examples are technology that would currently be suspected of being of value but not necessarily implemented to full potential possibly because of uncertain economics or practicalities.

- Liming. The balance needs to be found between liming and traditional reliance on phosphorus.
- Non-wetting management, such as clay spreading, mouldboard ploughing or application of wetting agents.
- Soil biology is touted as an opportunity to improve efficiency of inputs such as fertiliser.
- Precision Agriculture tools such as GPS monitoring of operations will allow better targeted application of inputs.
- General sound management such as weed control, appropriate varieties and stock husbandry go without saying. Some practices such as new varieties are readily adopted, but other issues such as weed management have to be integrated into a complex system.
- Alternative crops and pastures. Such novelties often require decades of developing farm systems to be successfully implemented.
- Livestock productivity is constrained by feed availability and labour costs. Many of the tools to improve crop productivity of crops will also apply to pastures. Labour-saving technology will assist the profitability of stock, which might only mean that livestock is retained in the system, but this will diversify income sources and at least for some farmers will assist in adapting to climate change.
- Re-greening farms. Over a number of years effort has been devoted to re-greening with tools such as new fencing layouts and tree planting. This may be of benefit to productivity for some farms, but would also benefit biodiversity in a changing climate.

Theoretical Framework for Extension

From extension theory, it is likely different tools will be relevant to different farmers. Also, part of the extension process would be engagement with individual farm businesses choosing their own tools to adapt, but with perhaps assistance to monitor the effectiveness of the chosen tool.

From the background provided for this report South Coast NRM has a potential leadership role in a traditional farm extension program. Extension was heavily supported by government funding several decades ago on the assumption the farming community was disadvantaged in access to education and training resources and therefore was not able to capitalise on available scientific knowledge.

Circumstances have changed, such as with heavy investment in privately funded extension like sales agronomy, but the principles of extension remain relevant. A fundamental of such programs was theory developed in the 1960s by Everett Rogers, then at the Ohio State University for Rural Sociology *(updated, Rogers, 2013)*.

This theory proposed an innovation would be adopted at various stages by different groups in the community, categorised as innovators, early adopters, early majority, late majority and laggards. The implication for assisting farmers to adapt to climate change would be to focus on the group most likely to implement any changes; the innovators or early adopters.

Though seemingly obvious, a common failure of extension programs has been the assumption that all farmers have similar attitudes to risk and innovation.

Also, Rogers proposed that for different innovations, his categories of adopters would contain different farmers from the same population. An individual farmer might be an early adopter for one innovation, but a laggard for another innovation. Furthermore, some innovations will be implemented more quickly than others. An example would be the adoption of a new crop variety, compared to a practice such as application of lime which is much more expensive and only has a payoff after several years.

This body of evidence suggests that for South Coast NRM to assist farmers adapt to a changing climate, at least initially, it would be desirable to work with potential early adopters, probably on an individual basis. In the case of innovation for adapting to climate change, assuming suitable tools are clearly apparent, the benefits of tools adopted are likely to be evident only over a longer time period. This makes this innovation more comparable to an environmental benefit, such as a landcare practice.

In a review of adoption of conservation practices, *Pannell et al. (2006)* suggest that adoption is more likely when the innovation has a large relative benefit to the farm business. This would apply to adoption of WUE measurement, with arguably, some 20 to 30 per cent yield improvement possible, and consequently probably a much bigger impact on profitability.

Another characteristic likely to encourage adoption which is suggested by *Pannell et al.* as well as by the general extension literature, is that the tools for adapting to climate change would be readily trialled. This could also apply to WUE measurement.

Consequent Strategies for South Coast NRM

Several specific proposals arise from applying extension theory to elements of current South Coast farming and the need to adapt to climate change:

- **Clarify the problem.** In the case of adapting to climate change, it may be possible, with relatively little commitment of resources, to explain the problem in terms of WUE targets.

- Part of this process would be to address the farmer question of *"what's in it for me?"* In Rogers' terms this would establish a clear *"relative advantage"* that's *"simple and easy to use"*. If this advantage could be established for innovation that would assist with climate change, it would encourage experimentation with tools to mitigate.

- **Other questions relate to motivation.** For instance, as with the literature on adoption of innovations, it cannot be expected that every farmer would wish to participate at the start. Anyway, the need is to target only those with a long term commitment. When judged by the lack of adoption, the WUE concept is complex enough to have prevented widespread adoption years ago, so targeted extension with selected individuals will be more appropriate initially. Case studies, perhaps in collaboration with the Yield Prophet program, could be a starting point. A case study approach is supported by the principles of Rogers and declining numbers of commercial farm businesses.

- **Communication technology.** An obvious opportunity in promoting adaption to climate change would be to utilise new communication technology. However, while this may be part of a program, as accepted by literature on adoption of innovation *(Rogers 2013)*, it would only be a component and not a substitute for peer-to-peer networks.

- **Improving feedback from the farm back to the scientist.** A gap that is obvious from field experiences is the importance of what the farmer can contribute to the scientist. This may be why extension of WUE has only had partial success in the past.

- **Funding?** Declining public funding is a problem for extension. Paradoxically, adoption may improve if farmers can be encouraged to contribute to the program, such as with initial case studies. It is contended that such involvement could re-invigorate management, not add to the pressures of running a farm. Ways of fostering participatory action research could be reviewed and tested.

Suggested Further Work

This report is limited in scope but informal support has been indicated by a number of the following sources.

- The recent announcement by Barnaby Joyce of a White Paper on opportunities for agriculture could benefit from concepts suggested in this report.

- From informal discussion, it appears DAFWA is reviewing strategies and it has been indicated that ideas to improve extension would be of interest.

- CSIRO is attempting to extend the use of the Yield Prophet model which is based on WUE principles.

- The Grains Research and Development Corporation is attempting to involve farmers with closer ties at grassroots level.

- The School of Agriculture and Resource Economics University of WA has been approached for participation in research in this general area.

Objectives of these organisations are broader than farmers adapting to climate change but the principle of WUE is a core for all these interests. It may therefore be timely for South Coast NRM to take a lead role, as the region's farmers have done in past innovation.

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