

Climate change stalls wheat yields

By Zvi Hochman, CSIRO

A CSIRO study published in *Global Change Biology* has found that declining rainfall and rising maximum temperatures are impacting the yield potential of Australia's \$5 billion wheat industry.

The study of 26 years of data from 1990 to 2015, gathered from 50 weather stations across Australia's wheat-growing zone, demonstrated an average decline of in-season rainfall of 28 per cent, and an increase in average maximum temperatures of 1°C over the period.

CSIRO Senior Principal Research Scientist Dr Zvi Hochman said the adverse conditions have resulted in an average decline in yield potential of 27 per cent, from 4.4 tonnes per hectare to 3.2 tonnes per hectare.

"There have been good years and lean years, but the fact is that the average harvested wheat yield Australia-wide has been stagnant since 1990, at an average of around 1.74 tonnes per hectare," Dr Hochman said.

"It is important to stress that these findings are not forward projections - these are observed instances of how climate change has already impacted agriculture, and the probability of these

observations occurring by random climate variability is less than one in 100 billion."

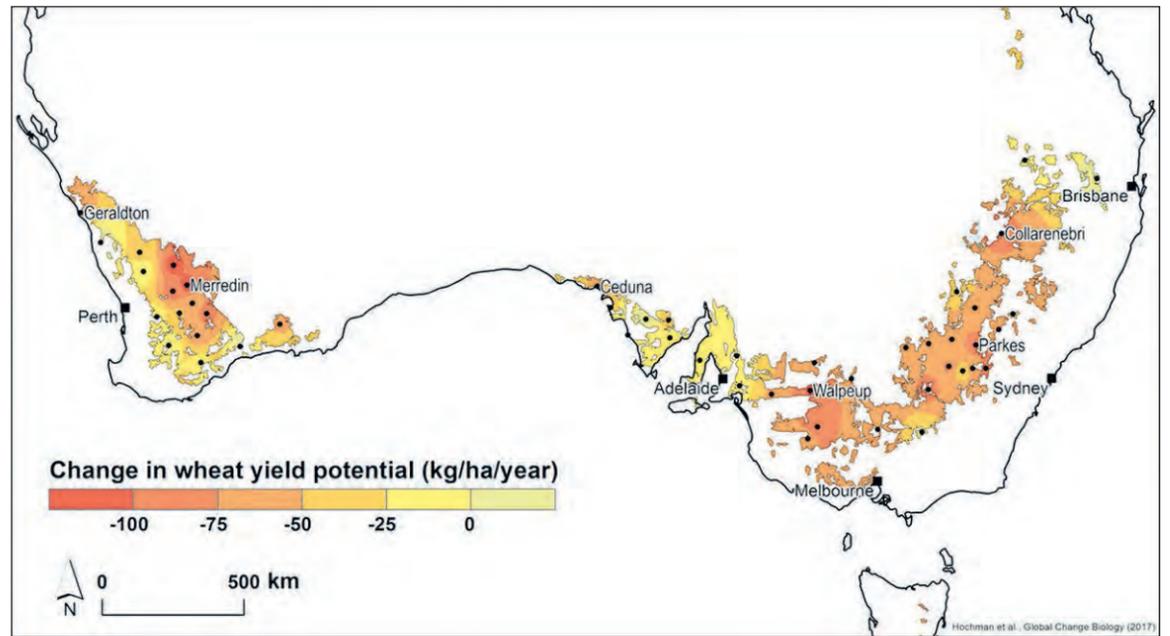
Advances in farming technologies and practices have helped to offset the decline in yield potential, resulting in the average farmer becoming more efficient. Nationally, farmers have closed the gap between potential and actual yield from 39 per cent in 1990 to 55 per cent in 2015.

"To date, farmers have done well to keep pace with climate change and not reduce their actual yields, but in effect the national average yields have seen them standing still despite all of their hard work," Dr Hochman said.

"While there is further room for the average farmer to close the yield gap, there are economic limits that effectively prevent farmers from consistently reaching a crop's full yield potential.

"Once farmers achieve approximately 80 per cent of their yield potential, it becomes economically unviable to pursue further yield gains, with costs outweighing benefits."

When asked to comment on the future implications for wheat growers, Dr Hochman said that farmers will need to continue to innovate and will have to be



The findings of the study represent an Australia-wide average across the 50 sites, where some sites have been more dramatically affected than others.

responsive to seasonal conditions to secure their futures.

"Advances in wheat varieties, and adoption of improved land and farm management practices will work in farmers' favour. However, rainfall and temperatures will continue to be the most important determinants of yield potential," he said.

"Worryingly, if the climate trend continues to negatively

impact rainfall and temperatures at the rate observed in the previous 26 years, despite further advances it's unfortunately likely that average yields will begin to fall by the 2040s."

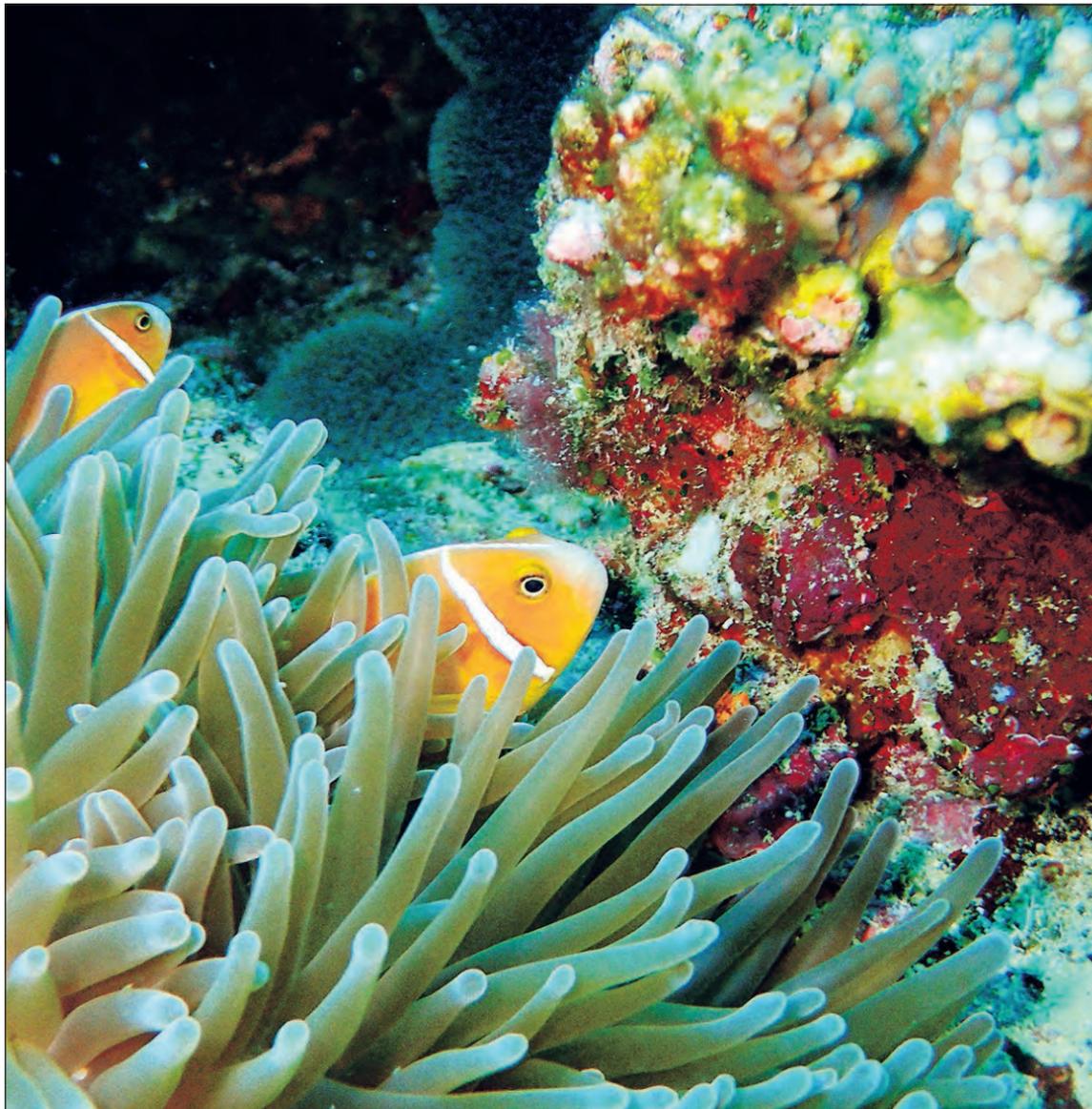
While the study's focus was on wheat production, Dr Hochman said the findings could be broadly applied to other cereal grains, pulses and oilseed crops, which are

largely grown in the same regions and during same season as wheat.

"The future of marginal growers in the more severely impacted areas may lie beyond wheat or their current crops. One possible adaptation could be an increase in mixed enterprise farming to help with cash flow during the lean years."

For more information, contact zvi.hochman@csiro.au.

Sustainable land management has flow on effects



Changes in farming practices are contributing to the longevity and productive base of farming, as well as The Great Barrier Reef's future health.

THE health and resilience of The Great Barrier Reef is a shared responsibility between all levels of government, agricultural and other industries, and the wider community.

Although climate variability is the biggest threat to the health and resilience of the Great Barrier Reef, farmers in Reef catchments are doing their part to help the Reef by improving the quality of water entering the Reef's lagoon.

The recent coral bleaching events in 2016 and early 2017 were attributed to unusually warm ocean temperatures caused by unfavourable ocean currents and still, calm atmospheric conditions occurring over an extended period of time.

These unusual conditions made it hard for some corals to survive, particularly in the Reef's northern third. Such bleaching highlights the importance of global action on climate variability.

Another stress on the Reef's health is the run-off from agricultural practices in the Reef catchments.

Large amounts of nutrients from fertilisers and sediments contribute to the poor quality of water leaving farms, water that ultimately reaches the Reef lagoon.

Now, farmers are incorporating sustainable production farming methods into their business models in an effort to improve both the productive base of their land and the quality of water entering waterways.

This work is supported by the Australian and Queensland governments' Reef 2050 Plan.

Cane farmers are being recognised for participating in industry-led best

management practice accreditation systems, and from this, improving their farming practices.

Farmers have demonstrated that sugarcane yields can be maintained or even increased through improved irrigation methods that use less fertiliser and water, with a resulting benefit for waterways.

Some farmers are extending the amount of vegetation along rivers and creeks, providing a buffer to catch nutrients and sediments before they reach waterways.

Graziers too are participating in their own accreditation systems that focus on soil health and grazing land management, including paddock rotation.

The aim is to improve long term profitability while reducing sediment and nutrient loss into local rivers and creeks.

The new practices improve ground cover throughout the year, ensuring livestock are kept in good condition and the soils are held in place.

Waterways are being protected from livestock by fencing them off and using watering points throughout the paddocks.

Our farmers are demonstrating innovation in applying cutting edge technology and techniques to manage land responsibly, while continuing to supply global and domestic markets.

Changes in farming practices are contributing to the longevity and productive base of farming, as well as the Great Barrier Reef's future health.

For more information visit www.environment.gov.au/marine/gbr/long-term-sustainability-plan.



Our farmers are Australia's future

By Luke Hartsuyker,
Assistant Minister to the
Deputy Prime Minister

AUSTRALIA is the driest inhabited continent on earth.

We also have a highly variable climate, with rainfall that can fluctuate dramatically from year to year. Heatwaves, droughts and floods are all regular features of life on the land in Australia.

From the earliest days of Australian agriculture, we have had to adapt and improve as a matter of necessity.

This could explain why Aussie farmers have such a strong spirit of innovation and ingenuity, and a commitment to continually adapting and improving their farming practices.

This has seen Australian farmers take their place amongst the most productive and efficient primary producers in the world.

However, we are not content to rest on our laurels.

To capitalise on the opportunities presented by growing global demand for quality agrifood products, particularly amongst our Asian neighbours, we must rise to the challenge of continuing to increase productivity.

Key to this will be our ability to do more with less, by making the most efficient and effective use of the natural resources and inputs needed to support a productive, profitable and sustainable agriculture sector.

Research and development will play an important role in this, however, it is of utmost importance that R&D outcomes can be practically implemented on farm, and realised through improved farming practices.

That is why the Australian government has implemented the \$180.5 million Rural R&D for Profit

Programme, which focuses on delivering accessible and innovative technologies and research for primary producers, while fostering partnerships and collaboration across the sector.

More than \$79 million in projects have so far been announced, with more to follow under Round 3 of the programme.

For example, under Round 1 of the programme the government provided 4\$ million for the *Smarter Irrigation for Profit Project*, which aims to modernise on-farm irrigation systems for multiple industries to improve efficiency in water and energy use.

Preliminary results from the project show that significant water and energy savings can be made by adopting simple modifications to the timing and delivery of irrigated water.

In 2015, NAB Research surveyed agribusiness clients and identified energy costs, water scarcity and soil health as the top three business concerns.

These are factors that have the potential to have a big impact on the competitiveness, profitability, productivity and sustainability of our agriculture sector, and this government is committed to working with the sector to address these challenges.

The Clean Energy Finance Corporation (CEFC) is helping farmers to transform their businesses by lowering operating costs through investment in renewable energy and energy efficient equipment.

For example, CEFC finance has helped Australia's largest beef company, AACo, install solar panels across 15 grid-connected sites in Queensland to reduce grid energy consumption by 30 per cent.

To better manage our precious water resources, the government



The Hon. Luke Hartsuyker MP.

is also undertaking the most significant investment in water infrastructure in Australian history, including making more than \$8 billion available for water infrastructure across the Murray-Darling Basin.

This investment in one of our most important food-producing regions will help increase water use efficiency and secure a healthy and productive future for the Basin and the communities that depend upon it for their livelihoods.

And, of course, Landcarers across the country continue to play a critical role in helping to improve

farming practices and soil health. Since 2014, the National Landcare Programme has seen improved farming practices implemented across eight million hectares of land.

The government's investment in soil health and good soil management includes over \$800 million in projects delivered by locals to improve soil and biodiversity management on Australian farms since 2008.

It includes approximately \$85 million from the National Landcare Programme to support Landcare projects aimed at building healthy soils for agriculture, increasing

farm profitability and increasing farmers' resilience to climate variability.

We are now looking at the design of the next iteration of the National Landcare Programme, which will take the important work of this movement forward to 2021-22.

We will be consulting on the new programme prior to its commencement, and I am confident that the new National Landcare Programme will continue to deliver the positive results that have made this movement such an iconic part of many rural and regional communities.

Landcarers persevere in the face of climate challenges



Landcare Australia CEO, Tessa Jakszewicz.

By Tessa Jakszewicz,
CEO of Landcare Australia

THE theme of this month's *Landcare in Focus*, Climate Impacts on Farming Practices and Energy Efficiency, coincides with the recent Tropical Cyclone Debbie, a dramatic demonstration of the effect climate events can have on people and properties.

We send our thoughts to those impacted by Tropical Cyclone Debbie.

We all know that climate events such as this can have devastating results, including on crops, livestock, and farmers.

Landcarers are often the first to help in recovery operations and aiding communities, and I am sure many will be helping in the impacted areas.

Those affected by Cyclone Debbie can also find a resource for assistance in the recovery on page 11.

Although sometimes the outcome of such events is unavoidable, for a long time farmers have been adjusting their farming practices in response to climate variability, helping minimise the impact of extreme events when possible.

Building drought resilience, changing crop varieties and sowing dates, and maintaining groundcover are just some of the methods that are successfully used.

As climate events become more frequent and more severe, farmers need to plan and prepare; some great case studies can be found on pages 4 and 11, plus some great research results where Australia is helping out on an international scale are on page 12.

As always, thank you for being a valued reader of *Landcare in Focus*. If you have any feedback on this or any issue, please don't hesitate to email lif@landcareaustralia.com.au.

ERF brings benefits for farmers

By The Department of the Environment and Energy

FARMERS and landholders across Australia are seeing the benefits from their Emission Reduction Fund projects.

The projects are providing new opportunities to increase land productivity and generate revenue by earning credits for reducing greenhouse gases.

People participating in the Emissions Reduction Fund are undertaking a wide range of projects.

For example, piggeries are capturing methane produced by the livestock's waste, and flaring it to convert the gas to carbon dioxide, a less potent greenhouse gas when released into the atmosphere.

Farmers are planting trees in unproductive paddocks, and landholders are storing carbon in their soil.

Money is being saved thanks to lower energy bills, water quality is improving, and soil productivity is increasing.

The Australian Farm Institute estimates \$239 million a year over seven years is flowing to the land sector.

Under the Emissions Reduction Fund, farmers receive one Australian Carbon Credit Unit for each tonne of carbon that is stored in trees or soil, or avoided by a change in farm activities.

Each credit may be sold to the government, through a contract, or to

a private company. The average price paid by the government for a carbon credit is \$11.83.

The opportunity to reduce emissions by making changes to energy consumption and use is providing a great incentive for farmers to take part in the Emission Reduction Fund.

"Our members are interested in everything from how farmers can take part in the current Emissions Reduction Fund, to how we can attract more investment to innovate in adaptation and mitigation, as well as the opportunities that renewable energy represents for farmers and regional communities," Farmers for Climate Action's, Lucinda Corrigan said.

In addition to the vegetation and agriculture projects under the Emissions Reduction Fund, landowners can participate in other emissions reduction activities.

By investing in new technology, upgrading equipment or changing business practices to improve the productivity or energy use, farmers can reduce emissions and earn carbon credits.

The government committed \$2.55 billion to purchase emissions reductions.

Five auctions have been held so far, resulting in 435 projects securing carbon abatement contracts with the government, to deliver 189 million carbon credits.

This is effectively avoiding 189 million tonnes of emissions from



By changing business practices to improve productivity or energy use, farmers can reduce emissions and earn carbon credits.

entering the atmosphere and helping Australia meet its 2020 and 2030 emissions reduction targets.

More than \$300 million remains in the fund to purchase further abatement.

Landowners can also participate in the Renewable Energy Target.

The Renewable Energy Target encourages additional electricity generation from renewable energy sources and provides a financial

incentive for investment in new renewable energy projects by small businesses.

For more information on the Emissions Reduction Fund and the Renewable Energy Target, go to www.environment.gov.au.

With Australia's variable climate, farmers must be proactive

By Primary Industries Climate Challenges Centre, The University of Melbourne

'SECOND to agriculture, humbug is the biggest industry of our age' - Alfred Nobel.

It is unlikely Nobel could foresee just how ironic his words would be more than a century later.

Today, agriculture is not the 'biggest' industry, at least financially, yet it remains the most important.

'Humbug' continues to be globally rife, its ubiquity a given. In Australia, it's publicly and enthusiastically represented in the climate change arena.

Yet, with respect to agriculture, climate change humbug is progressively moot.

Why? Because, regardless of climate change humbug in politics, media and beyond, the requisite modus operandi of the farmer or land manager is to mediate challenges.

Successful farmers are adaptation experts.

They listen to what their land, plants and animals tell them, and

respond in order to optimise their business.

What informs the plants and animals? The most powerful impetus is their sensitivity to climate.

If the climate is changing, crops and livestock will respond, prompting on-farm action to accommodate the best business outcome.

Incremental changes in farming practices are inherent to good business practice.

Proactive farmers, with a history of making on-farm changes to practice 'good' farming, increase their resilience and reduce their risk to impacts of climate change.

Australia has one of the most variable climates in the world, so as a matter of survival our primary producers must operate in and respond to this paradigm of variability.

For example, when grapes start ripening earlier in response to higher spring temperatures, the harvest is also earlier.

Wine producers pick according to the optimum grape maturity for quality wine.

Producers are listening to the grapes and picking earlier than historical harvesting practices.

In 2009, modelling predicted that by 2030, dairy farmers in south-east Australia would need to harvest and silage their pastures earlier due to warmer drier weather.

Observations in 2015 indicate many dairy farmers have already started early spring/late winter harvest, rather than early summer, because the pastures have essentially 'told them to'.

Such incremental changes to variable shifts in the climate have 'made do' until now, but two extremely important considerations for agriculture in the face of climate change remain:

- Farming practice under increased (frequency and magnitude) extreme events; and
- Tenability of current farming practice/system/sector.

The range of variable parameters in the first point above will require a suite of risk management options to mitigate farm system vulnerability to extreme events including access to an improved forecasting system, practical and proven on-farm measures to mitigate the magnitude of an extreme event, and pre-event, intra-event and post-event risk management scenarios.



Wine producers harvest according to the optimum grape maturity seeing them picking earlier than historical harvesting practices.

Such options may help prevent losses such as seen recently in the Shoalhaven region, where 40 dairy cows expired during an extreme heatwave event.

The consideration of the second point above, may once have seemed like blue-sky thinking.

But, despite the humbug, is it now food for realistic fodder?

It centres on transformational adaptation, action incorporating a change in practice that is directly related to the receptiveness, capacity and access of a producer to change.

It is about major changes and actions in function, structure and even location of production, brought about by new climate opportunities.

No matter how loud the humbug roars, crops and livestock will continue to accurately translate the process of climate change and farming practice, and management will have to respond appropriately.

- Visit: www.piccc.org.au or email: piccc-info@unimelb.edu.au.



Dairy's climate changing future

TWENTY years from now, dairy farming will look and feel much different.

By 2040, farmers will have to deal with warmer temperatures and more extreme weather events, while more variable rainfall will see seasons shift and feeding strategies altered.

Summers will extend well beyond the usual summer period and dry spells will last longer.

The forecast change has prompted a team of researchers at the University of Melbourne's Primary Industries Climate Challenges Centre and Dairy Australia to apply climate modelling to specific farms to analyse how key Australian dairy regions might perform in the future.

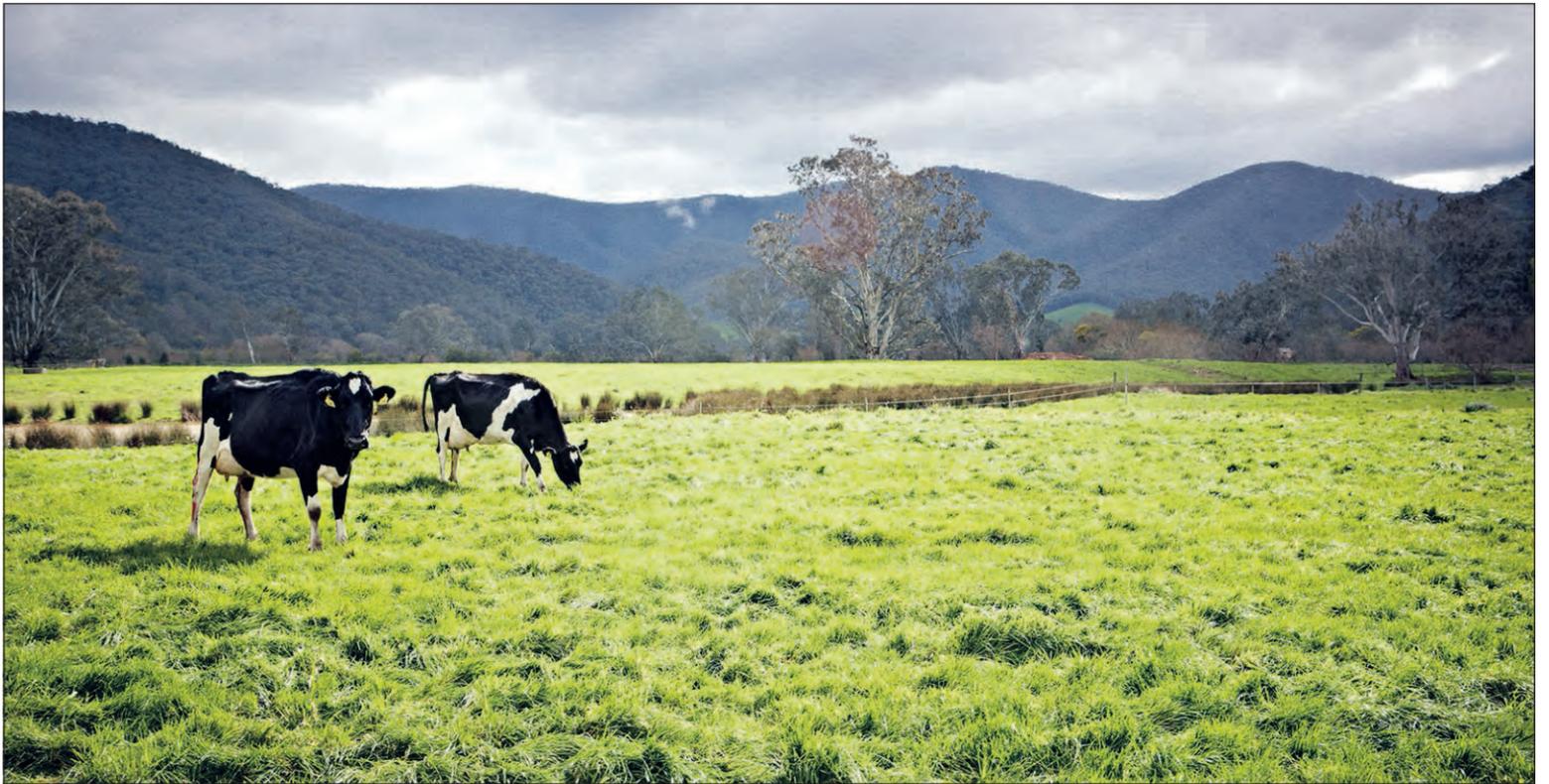
Using three farms - in Victoria's Gippsland region, South Australia's Fleurieu Peninsula, and north-west Tasmania - researchers applied climate, biophysical and economic models to develop projections for each farm system.

Researchers Dr Brendan Cullen and Dr Margaret Ayre, from the University of Melbourne, worked alongside scientists from the Tasmanian Institute of Agriculture, economists, farm consultants, and farmers from the three regions to develop a comprehensive picture of how each farm might perform.

"The modelling allowed us to predict some critical indicators of farm performance, covering everything from future climatic conditions, to pasture growth, milk production, and farm profits," Dr Cullen said.

"Most significantly, we'll see a shift in the pasture growing season.

"Growth rates will be higher in winter and early spring, but lower for the rest of the year.



Farmers have reported they are increasing the amount of shade and shelter available for stock during extreme weather events. Photo courtesy Dairy Australia.

"Overall, this means less pasture production, and that will create a real feed challenge," he said.

Dr Cullen and the team looked at a range of different business development options to explore how farmers might adapt their farms to manage challenges such as this.

The options broadly represented a trajectory from 'less intensified' to 'more intensified' dairy production.

One critical finding was climate change had a negative effect on the profitability of each farm regardless of the development option, largely because higher

temperatures and longer dry spells reduced pasture utilisation.

Across the three case study farms, the research identified a loss of operating profit of 10 to 30 percent due to climate change in 2040 if farmers did not adapt to the warmer and drier climates.

For project leader Gillian Hayman, a dairy extension consultant at Dairy Australia and dairy farmer from southern Gippsland, the project's findings have confirmed the challenges she sees ahead for the dairy industry.

"Many of the farmers involved in the research had observed and managed through variable

climatic seasons in the past," Ms Hayman said.

"Floods, bush fires, heat waves, extremely wet winters and extended dry periods have all been a part of the last 15 years for farmers.

"Dairy farmers already need to be at the top of their game, adapt to conditions and continually review their game plan from season to season.

"Climate change is yet another pressure on farmers along with milk price variability.

"One area that we're concerned farmers aren't prepared for is the more extreme changes from climate averages.

"Recent heat waves have been a challenge for many," she said.

Farmers reported they were increasing the amount of shade and shelter available for stock during extreme weather events, increasing farm water storage, and carrying larger fodder reserves from year to year.

The study's predictions on what future climates will mean for pasture production and farm profitability highlight the critical need for the industry to foster continued and more widespread adaptation in a warming and drying climate.

Read the full study at: <http://ow.ly/GjGp30b6DgZ>.

Seasonal climate forecasting for farm decision making



BCG research manager, Claire Browne, inspecting barley disease in spring 2016, after what was the highest September rainfall on record for the Birchip district.

By The Birchip Cropping Group

CLIMATE variability plays a significant role in the profitability of broadacre farmers.

This was illustrated by the 2015 and 2016 seasonal conditions, where contrasting weather patterns influenced the growing season, production, and subsequent 'bottom line'.

The increased awareness and understanding of climate drivers has assisted the agricultural industry to better allocate resources and plan for variable conditions.

Growers are getting further interpretation of climate drivers' current influence from experts all over Australia.

In the recent GRDC fact sheet 'Using climate and weather data objectively', John Ferrier, a grower based 20km north of Birchip, Victoria, explained that he looked at multiple tools in his decision making.

This included the BoM seasonal outlook, newsletters, www.yr.no (Norway) and an information

session by Agriculture Victoria seasonal risk agronomist Dale Grey.

John also took into consideration weather station, soil testing, and soil moisture probe data.

In 2015, an El Niño climate pattern was prominent and this resulted in the Ferrier family farm beginning harvest earlier than they had ever before.

John followed seasonal climate forecasting information and reassessed inputs in April due to low rainfall to date, combined with the low rainfall seasonal outlook.

He switched from canola and lentils to higher cereal and fallow percentages to reduce farm business risk.

Using seasonal outlook information and reviewing projected tonnage, the Ferrier farm decided to reduce nitrogen application to target a 1t/ha crop and minimise herbicide applications, therefore reducing input costs.

This enabled the Ferriers to mitigate the expected reduction in income and not place any further inputs than needed.

John said it is 'best to look at the collective trends of all models and which way they are swinging' to get a better understanding of the season.

While seasonal climate forecasting information can provide insight, other information should also be considered to make a rounded decision.

Agricultural producers continue to recognise the importance of better understanding the climate drivers and the effect they have on rainfall and temperature in their districts.

In 2006, during the millennium drought, a Managing Climate Variability (MCV) project resulted in the inception of 'The Fast Break' newsletter in which 11 dynamic, ensemble, and statistical climate models are interpreted for a Victorian climate outlook.

The newsletter is produced by Agriculture Victoria and has been a popular resource throughout the agricultural community ever since.

- For more information about seasonal climate forecasting and resources produced in this area visit: www.climatekelpie.com.au.

Climate adaptation in pastures

By Adrian James and Peter Heading, NRM North

IN THE future, many livestock farmers may be left between a rock and a hard place in terms of making decisions for pasture management in light of the changing climate.

However, there are a range of adaptation options that farmers could start implementing now, where the costs and returns are favourable.

With the ongoing increase in temperatures and heatwaves in southern Australia, ryegrass pastures will decrease in productivity, except in the colder areas.

NRM North's Land Program Manager, Adrian James, said there were differences in heat tolerance between ryegrass cultivars.

"As more information comes out, this will help in making decisions," Adrian said.

"Many farmers will need to consider changing ryegrass cultivars or using more heat-tolerant grasses, clovers and forbs such as cocksfoot, phalaris, bromes, medics, lucerne and chicory.

"C4 plants like kikuyu and millet will become a more integral part of feed during warmer times, both as pasture and stored fodder.

"Despite their lower palatability compared with C3 grasses, farmers' requirements for higher heat tolerance and water use efficiency will increase their usefulness," he said.

Various studies have predicted and demonstrated changes to seasonal rainfall patterns, though these vary depending on location.



Peter Heading inspects fodder sorghum sown into ryegrass pasture in Tasmania.

One broad trend is increased summer rainfall and reduced autumn rain.

Again, heat-tolerant pastures will help, particularly those adapted to summer rain such as red clover and C4 grasses.

Growing and storing more fodder is another option, particularly where autumn feed availability is critical.

Confinement feeding combines well with this, both to rest stressed pastures and reduce fodder wastage.

Peter Sattler, a beef producer from the north coast of Tasmania, said C4 grasses were an option worth exploring.

"In this transition period, we don't know whether it will get hotter and wetter or hotter and drier, so using C4 grasses and fodder crops is a good way to cope with the unpredictability," Peter said.

One of the more observable changes is the increased intensity of rainfall events.

Maintaining good pasture cover is vital in protecting soil health and pasture composition when it really pours, otherwise the results will include erosion and weed infestation.

Putting more attention into soil fertility, stocking rates and grazing management is a good start in improving groundcover, but as the

big dumps of rain often happen after a long dry spell, fodder storage and seasonal confinement feeding can also help.

Biosecurity is a big issue for landholders, and with climatic changes, various pests and diseases will change their geographic range.

One example is a southward spread in unpalatable tropical grasses.

The adaptation option is vigilance – landowners will need to keep an eye out and act quickly to stop incursions before they get out of hand.

As the concentration of carbon dioxide in the atmosphere increases, plants will find it easier to grow.

This sounds great, but will be a very gradual process and the increase in carbon will need to be matched by an increase in other nutrients, especially nitrogen.

To take advantage of this, farmers in the future will need to be good at growing and maintaining clovers or other legumes in pastures.

While this is a very brief introduction, there are readily available options for farmers. Many can be trialled on farm now and hopefully farmers can think about ways to be more adaptive in managing fodder supplies for their stock in the future.

For more information, contact Adrian James on (03) 6333 7784.

Collaborating and researching to make every drop count

WE ALL know that water is a precious resource.

Orchardists in the Perth Hills region in Western Australia are all too aware of this, having seen a decline in rainfall and groundwater as a result of an increasingly dry climate in the region.

To help the industry adapt and survive, Perth NRM and a group of growers – the Hills Orchard Improvement Group – have set out on a project to better manage the use of groundwater and adapt practices to a changing climate.

The project last year received a funding boost of \$23,500 from the Coca-Cola Foundation through its partnership with Landcare Australia.

The funding has gone towards research and collaboration with horticulturists, water management consultants, government and industry partners.

An independent local agronomist undertook research and benchmarking on current and best practices.

A knowledge sharing forum, held last month in Fairbrossen Estate in Carmel, presented the findings and other information to almost 80 attendees, including local grape growers, nursery managers and local government officers.



Agronomist Neil Lantzke making a presentation.

Marcel Veens, renowned agronomist and horticultural adviser, spoke to the attendees about optimising water use and adapting to a drying climate.

Also speaking was groundwater expert, Martin Guimelli, who shared his knowledge on locating additional on-farm water resources.

Other topics discussed were climate and water availability trends in the region, and benchmarking results of current fertiliser and irrigation management practices.

Attendees were presented with a comprehensive information pack which included the independent

research findings as well as resources from the other speakers.

The project has allowed a large number of local producers to access invaluable information from relevant experts that will help them adapt their practices in response to some of the challenges they are facing.

Keith Pekin from Perth NRM is optimistic that the project will benefit the industry.

"Feedback from participants before and after the event has been really positive," Keith said.

"Ongoing access to water is a real concern for them and any support that can enable them to utilise this resource as sustainably as possible is really appreciated," he said.

This project is one of six funded last year by the Coca-Cola Foundation through its 10 year partnership with Landcare Australia.

One hundred thousand dollars went to the projects, which focused on helping improve water quality, habitat connectivity, community engagement and education.

Collectively, Coca-Cola has contributed close to \$800,000 towards Landcare community projects since 2006.

Last year, as part of its 2020 sustainability commitments, Coca-Cola achieved its goal to return every drop of water used back to nature, four years early.

Coca-Cola continues its efforts globally to support local environmental projects across the globe.



Successful five years of the Carbon Farming Futures programme

THE \$139 million Carbon Farming Futures (CFF) Programme is wrapping up in July after five years of research, development and extension activity that involved hundreds of farmers, researchers and extension agents across the country.

The 200 projects funded under the CFF aimed to identify, trial and encourage adoption of farming practices and technologies which reduce greenhouse gas (GHG) emissions, increase soil carbon sequestration, support agricultural participation in the Emissions Reduction Fund and enable adaptation to increased climate variability.

As the CFF programme draws to a close, it's timely to reflect on achievements of the programme.

Investment under the research stream of the CFF Filling the Research Gap, enabled a concentrated and coordinated investigation of how to reduce agricultural GHG emissions, with research projects covering agricultural emissions and soil carbon sequestration.

Amongst the many findings was that inhibiting methane production in ruminants does not affect an animal's health and can improve the growth and productivity of an animal; that storing effluent for shorter times in ponds and covering manure stockpiles can reduce emissions by up to 88 per cent; and that the widespread use of legumes in northern grain regions could save

growers up to \$22 million a year in nitrogen input costs and reduce nitrous-oxide emissions.

Researchers also gained important insights into techniques to increase soil carbon and made significant advances in soil carbon measurement and modelling technology.

Quality soil carbon data was collected across a range of agricultural systems, often for the first time.

Given the current and projected climate impacts on production systems, adaptation became an important focus of Filling the Research Gap in the second round of projects.

Options for management practices to deal with a more variable climate were identified across a range of farm business types.

Sector-specific findings included that Betaine (an amino acid supplement) improved the recovery of heat-stressed dairy cows and that targeted improvement of transpiration efficiency in sugarcane breeding would assist the development of varieties adapted to drier and hotter conditions.

The farm trial component of the CFF, Action on the Ground, facilitated partnerships between research institutions and farmer groups and allowed GHG mitigation practices to be applied in the field, further demonstrating their promise.

The research and development undertaken through the CFF has expanded existing knowledge and provided important foundations for future work.

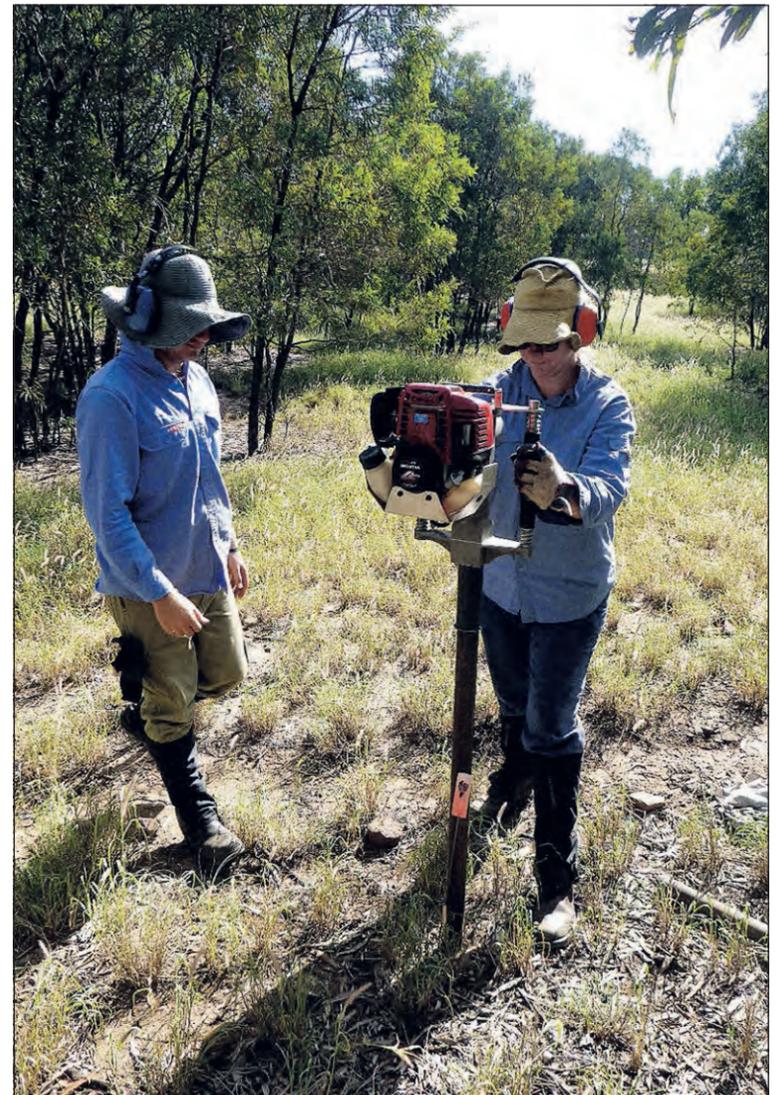
The final element of the CFF, the Extension and Outreach programme, funded agricultural extension providers to inform farmers, and their influencers, about how and why to reduce GHG emissions and how to participate in the Emissions Reduction Fund.

Project grantees developed farmer decision making tools and communication materials, as well as undertaking extensive face-to-face engagement.

In many cases, these activities delivered profound outcomes, with participants shifting their thinking, considering GHG emissions for the first time, as well as realising the productivity and profitability benefits of many GHG mitigation practices.

The CFF leaves a rich legacy, which will have enduring significance as governments and industry continue to face the challenges of GHG mitigation, adaptation to increased climate variability and improving farm productivity.

The research findings from the CFF programme are being summarised into a publication which will be available on the Department of Agriculture and Water Resources website in the coming months.



Carbon Farming Futures Programme researchers collecting soil cores to measure soil carbon stocks.

Climate effects on farming



Climate change is making cattle producers adjust to keep their business viable.

By Christopher Gillies

IN 2015, the Climate Council released its 'Feeding a Hungry Nation: Climate Change Food and Farming in Australia' report.

It outlined how agriculture would be impacted by climate change.

Landcare in Focus sat down for a Q & A with two producers to find out how climate change is influencing farming now.

Renata Paliskis, Western Australia
Renata Paliskis manages a 385-acre property located 50 kilometres east of Perth.

She runs cattle, and when the opportunity arises, a small feedlot.

Q: What do you know about the history of the property from the previous owner?

A: The previous owner told me the rain traditionally fell from the third week in May through to October, and was followed by an extended dry spell. Every five to seven years there would be heavy rain from January to March.

Q: Have there been changes to rainfall and weather events since you took over the property?

A: I'm fortunate that I can speak to the previous owner, he's told me

there were parts of the property he couldn't access in winter that I can now. Even the cyclical heavy January to March rains have become more frequent. Last year I had to buy water in, but this year I am looking at evenly distributed rain. This is really good for the pastures and helps with the spread of perennials that I've established.

Q: Has the changes influenced the way you manage the land?

A: I have to keep costs low, and I have to do more with less natural resources. I have planted more perennials on the property to provide the cattle with a good source of feed. I am letting the perennials spread naturally and I am planting green belts and leaving the remaining trees so that the livestock have access to plenty of shade when it is hot. The spread of the rainfall throughout the year means that I need to monitor the cows on the pasture at calving time because they can get too heavy which creates problems.

It feels like we are moving from different climate types so it may be that it will settle but in the meantime I monitor the land and the livestock.

Steven Martin, Queensland
Steve Martin manages a 3,000-acre property and 12,200 head feedlot that has been operating for the last 60 years.

The feedlot supplies Angus and Wagyu beef for the Australian and Asian high-end restaurant markets.

Q: Has there been seasonal changes since the operation began?

A: This year we have feed in the paddocks over winter but in previous years we've had none. There is more variability between the years, and we experience more heatwaves and intense storms, which is influencing the way we manage the operation.

Q: How have the changes influenced the way you manage the operation?

A: It's about maintaining flexibility in our operation to manage what's thrown at us. For example, earlier this year we shifted to a heat ration for six days and changed management practices so livestock were only handled early mornings or evenings. The cattle were well looked after, but didn't perform as well. The environment governs two of the three factors influencing our costs - feeder steer price and the grain price. This has become more important with changes in climate and we're putting in more risk management strategies as a result.

Our focus is to know where we are at in a given time and how we can deal with it.

But, by managing the shocks we can still grow the business. This year we are increasing the capacity of the feedlot from 12,000 head to 20,000.

Strategies for more efficient water use

By Claire Norris, NSW Department of Primary Industries

FARMERS working in the irrigation industry are no strangers to planning ahead and calculating risk, and they are taking a pragmatic approach out in the paddocks when it comes to tackling climate change.

With the help of the New South Wales Sustaining the Basin: Irrigated Farm Modernisation (STBIFM) program, irrigators are using technology and innovation to prepare for a future with less water.

STBIFM recently teamed up with a busload of knowledge-thirsty farmers to visit properties in the Gunnedah region that are using water efficient overhead irrigation technology.

James Barlow's property, Mirabinda, was a key stop on the tour.

With STBIFM support, James has installed fully automated centre pivot overhead irrigators.

He has also upgraded his pumps, water storages, and power supply.

The improvements mean James can grow more crop using less water, future proofing his farm against a potential decline in water availability.

Overhead irrigators give greater control over when and how much water is applied.

Water savings can be dramatic, particularly in the early stages of crop growth or when rain provides unexpected extra moisture.

The new system can be operated remotely and has the capacity to irrigate the whole farm.

"Growing cotton under flood irrigation was very labour intensive," James said.

"With the pivots I can grow cotton more efficiently.

"I can run the whole system and water the entire farm while sitting on the tractor."

Importantly, half of the water saved as a result of upgrading systems on Mirabinda has been returned for environmental use.

The STBIFM program provides financial support for eligible irrigators to modernise infrastructure and upgrade equipment.

The program recovers non-productive water that was being lost through evaporation, leakage, and system inefficiencies.

At least 50 percent of the water saved is then transferred to the Commonwealth for environmental use.

The remaining savings can be kept on-farm to increase production without an increase in water extraction, creating a win-win scenario for production and sustainability in the Murray Darling Basin.

Another important part of the program are grants of up to \$2,000 to undertake an Irrigated Farm Water Use Efficiency Assessment (IFWUEA).

An IFWUEA is a pre-requisite for infrastructure funding.

It helps locate and quantify on-farm water losses to help irrigators make informed decisions about improving irrigation systems.

The IFWUEA also gives the STBIFM program confidence that funded improvements will solve existing problems and reduce real water losses.

According to James, the farm planning support was extremely beneficial.

It allowed him to look at the property holistically and reorganise the irrigation layout across the whole farm.

The clear message from the Gunnedah farm tour was that upgrading to overhead systems can deliver real benefits such as greater flexibility in management and crop selection, improved operational efficiency, increased yields, and more efficient water use.

The government has invested \$111 million into the STBIFM program.

It is funded through the Sustainable Rural Water Use and Infrastructure Program as part of the implementation of the Murray Darling Basin Plan and is delivered by NSW Department of Primary Industries.

• Visit: www.dpi.nsw.gov.au/land-and-water/water/sustaining-the-basin.



The bus tour visited three properties with overhead systems. Photo: George Truman.



Lower Namoi river near Gunnedah, NSW. Photo: Claire Norris.

Crowdfunding for soil health and climate research

By Guy Webb, Soil C Quest

IT TOOK a conversation between an agronomist, a farmer, a Landcare coordinator, and a professor of soil microbiology to spark the creation of 'Soil C Quest 2031', a grassroots not-for-profit Australian research institute.

It has come together through the common ideal that improving soil carbon holds the key to improving agriculture, landscapes, and climate change extremes into the future.

The organisation is dedicated to the development of practical methods farmers can employ to rapidly store large quantities of carbon in their soils.

Based in the New South Wales grain belt at Forbes, Soil C Quest 2031 is currently researching specialised melanised endophytic fungi that facilitate rapid soil carbon sequestration.

The project follows on from initial breakthrough research at the University of Sydney by associate Professor Peter McGee and Dr Tendo Mukasa Mugerwa, who discovered the microbes and their special ability to capture and build soil carbon at unprecedented rates.

The aim of the project is to create a seed inoculum that will 'fix' carbon in the soil using these specialist 'carbon capturing fungi'.

The concept is similar in principle to using rhizobium bacteria inoculum on legumes to fix

nitrogen in the soil, to which most farmers would be familiar.

Soil organic carbon levels are a true metric of soil health, influencing the infiltration and storage of soil water as well as driving effective nutrient cycling. Soil carbon is simply the foundation of fertility in any soil.

Rapidly increasing soil carbon is a sure way to reduce input costs and increase crop yields and farm profitability.

This bio-technology may also allow farmers to reliably trade soil carbon credits as carbon trading markets develop, offering a new and potentially lucrative non-extractive farm enterprise.

This biological carbon capture process has been coined 'fungal mediated soil carbon sequestration' and is fundamentally a process of capturing and concentrating atmospheric carbon (CO₂) into plant sugar and in turn converting some of that carbohydrate flow into fungal melanin, a stable form of carbon deposited safely inside soil microaggregates.

Worldwide soil carbon levels have declined by over 50 percent.

Atmospheric carbon dioxide levels have increased by 40% since the beginning of the industrial revolution.

For this reason, this biotechnology represents a very important and timely breakthrough.



Soil C Quest 2031 directors Mick Wettenhall (left) and Guy Webb (right) discuss the project with Professor Peter McGee (centre) near Forbes, NSW.

Transferring the excess carbon dioxide from the air (where it is a major problem) and securely depositing it back into agricultural soils (where it is valued) seems an obvious way to turn a big problem into a big solution.

Soil health, food security and climate stability are quite literally everybody's business, being

the foundations of civilisation, of which soil carbon can play a pivotal role.

For this reason, Soil C Quest 2031 plan to offer everybody the opportunity of sponsoring a parcel of agricultural land for soil carbon research, through their upcoming crowdfunding campaign this year.

All funds raised will go towards further soil carbon sequestration research so that one day farmers everywhere will be able to economically increase soil carbon stores across large areas of land, offering a real solution for climate change.

• For more information, visit www.scq.net.au.



Shady practice to combat sunburn

By Rebecca Darbyshire and Ian Goodwin

THE 2016/17 'angry summer' broke over 200 Australian extreme weather records.

Much like the Australian population, apples suffer under these extreme heat conditions and can get sunburnt, which ranges from yellow discolouration to burns that penetrate the skin.

Sunburn reduces market yields by downgrading quality and increasing the amount of culled fruit.

With human-induced climate change expected to increase the frequency and severity of extreme heat events, higher rates of sunburn are expected in Australian orchards.

A recent study has shown that sunburn risk will increase as climate change progresses and that netting can provide protection from this risk.

It was found that the level of risk reduction netting provided depended on the growing region and future time period.

The financial gains from installing netting will depend on the identified risk.

Benefits include lower irrigation rates, hail and bird protection, and production costs, including netting installation and production changes needed under nets.

The future risk of sunburn for non-netted and netted orchards was evaluated for 'Royal Gala' apple at 10 sites from different growing



Examples of sunburn damage on Royal Gala apples. Photo: L. McClymont.

regions across Australia - historically and for 2030, 2050 and 2090.

The risk was calculated as the number of January days that could result in sunburn.

Some sites were found to have little to no risk of sunburn out to 2090 (Spreyton, Huonville, Applethorpe).

For more exposed sites, netting provided a notable reduction in the number of sunburn risk days, generally over a 50 per cent reduction (Batlow, Manjimup, Yarra Valley, Lenswood).

For sites which currently experience high sunburn risk (Donnybrook, Tatura, Young),

netting reduced future risk considerably.

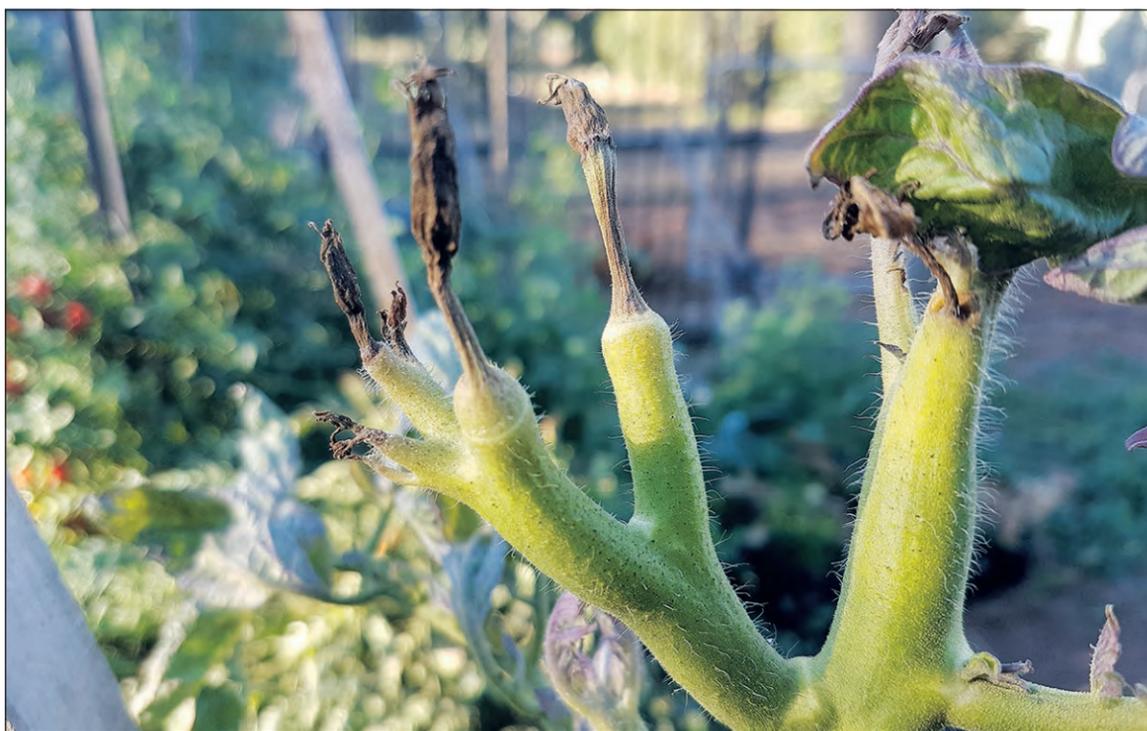
However, some risk was still recorded under netting.

For instance, risk of sunburn under netting at Young in 2090 (7.8 days) was similar to that experienced at Donnybrook for non-netted orchards now (7.0 days).

• Visit: link.springer.com/article/10.1007/s00484-016-1268-y or email rebecca.darbyshire@dpi.nsw.gov.au.

Rebecca Darbyshire is from the NSW Department of Primary Industries and Ian Goodwin is from Agriculture Victoria.

Concerned but not alarmed by tomato disease



Tomato fruit and tomato foliage affected by tomato big bud disease.

By Ian Towers

I HAVE kept a veggie garden for many years.

While I do experiment with new vegetables from season to season, I have my staples.

Tomatoes are one of them.

They make their annual appearance through my planting of seeds saved from the previous season, and those that are self-sown from the compost heap.

I followed the tradition around the Canberra district to plant out

tomatoes after Melbourne Cup day to reduce the risk of frost.

The wet, cool spring in southern New South Wales seemed to suspend the growth of my tomatoes, but in December everything took off.

After Christmas the veggie patch was almost impenetrable.

The warm weather favoured the tomato vine growth and fruit development, and I enjoyed some good harvests.

But, towards the end of February, I noticed a change in the appearance of the tomato vines that I had not seen before.

Some of the terminal growth areas and leaves looked very stunted, with some resemblance to a twiggy witch's broom.

I was very concerned about the altered growth habit, and wondered if my tomatoes had contracted a disease that could spell the beginning of the end for my crop.

I could only imagine how, if this was a new disease, it could potentially affect commercial tomato growers.

I had to find out more about this tomato disease.

I made a call to the Plant Health Australia Exotic Plant Pest Hotline (1800 084 881) and was promptly directed to Biosecurity NSW.

I emailed them some snaps of my pathogenic tomatoes and within a day they had made a diagnosis.

The culprit was tomato big bud, a phytoplasma disease that is spread by brown leafhoppers.

Biosecurity NSW advised me that the disease was common and widespread throughout south-

eastern Australia over the summer period.

That was news to me and I thought I was an experienced gardener.

In hindsight, I should not be surprised that there was an increased risk of new pathogens infecting my veggie plot in the wake of the unseasonal conditions.

In 2016, NSW started very dry throughout summer and autumn and it was the warmest year on record for the first six months.

When winter arrived, it did so with vengeance, pouring with rain 20 per cent above the average amount across the state.

The wet conditions did not abate with the arrival of spring, which also meant cooler temperatures, resulting in the coldest spring in over 20 years.

With the second warmest December on record, followed by above average temperatures in both January and February 2017, my tomatoes might have been enjoying good growth, but the preceding conditions were rife for pathogens.

In the face of climate change, and with it greater weather extremes, I guess I'm in for more surprises in my veggie patch.

Carbon: The problem and the solution

By Reef Catchments

WE ARE on the cusp of an uncertain, but exciting time in agriculture.

Farmers are at the coalface when it comes to climate variability and carbon.

Successful business strategies identify threats and apply problem solving to drive opportunity.

But could carbon be both the problem and a solution?

The research is confirming carbon held in soil is the key to fertility and water holding capacity.

It also provides a buffer in times of variability of climate change.

The destruction from recent Tropical Cyclone Debbie exemplifies predictions of increased significant weather events and increased severity of events.

Preparation to handle such events has been underway for some time.

The Mackay Whitsunday Isaac Climate Sustainability Plan 2016-2020 was a highly collaborative partnership with CSIRO, James Cook University and Reef Catchments, thanks to funding through the National Landcare Programme.

The plan identifies some of the main risks associated with projected climatic conditions such

as predicted temperatures, rainfall and freshwater availability.

As well as regional actions, which cover strengthening ecosystem health and biodiversity, community education, risk management and economic sustainability.

The plan also explores the opportunities for farmers to tackle this global problem through local solutions.

Not just through increasing their soil carbon asset, but strengthening local markets and economies, biodiversity, crop diversification and potential bio-based industries.

Development of adaptation resources can be strengthened through farmers' localised observations of the effects of climate variability, given their ongoing relationship with the land.

Leaders using best management practice and pushing the boundaries of current knowledge provide a guide for the other adopters of new farming practices.

Improved farming practices are an unintended consequence of meeting the challenge of climate uncertainty.

Reef Catchments is supporting farmers in this time of change through Landcare initiatives in their region.

• Contact Tegan McBride at tegan.mcbride@reefcatchments.com



A presentation at the Health Field Day.

Multiple environmental and community benefits from bio-link project

IN 2009, a council environment officer, a researcher, and a Landcare staffer-in-the-making took a drive together down a dusty country road in south-west Victoria.

As they drove, the researcher mourned the loss of a native grassland on what had been a former railway siding, and the other two talked about how to prevent the same fate for the rest of the lots.

The Green Line Project was hatched, and has since become a determined example of how to ensure the long term relevance and preservation of one of the most significant Victorian Volcanic Plains remnant reserves.

The Green Line is a 37 kilometre linear reserve bio-link that runs between Koroit and Minhamite, where Victrack is the land manager.

In its 110 hectares, it boasts a range of soils, topography, and vegetation types.

On ecological splendour alone it houses the kinds of state and national treasures that makes one wonder how they managed to endure on a 30 metre width in the heart of the best agricultural land in the state.

But they do, and project coordinator The Basalt to Bay Landcare Network is working with Victrack and Landcare Australia to

ensure the unique biodiversity of the site continues to survive and improve.

Victrack's partnership with Landcare Australia is delivering more than \$250,000 to help manage and preserve native vegetation and fauna on closed railway lines, and has delivered \$30,000 to Basalt to Bay to continue its work on the Green Line.

Lisette Mill, who now works for Basalt to Bay, is starting to feel confident that the model of asset enhancement combined with skills training will ensure that the nature of The Green Line will not be lost.

To date, Basalt to Bay has removed over 400 large pine trees, treated the entire 37km for Briar Roses, and added over 150 new flora records to the Atlas of Living Australia.

Another important element of the project is connecting with and educating young people in the community.

"I can yak on about VVP Banksias until your ears bleed," Lisette said.

"Talking about an 8km length of increasingly rare trees on The Green Line won't build more lengths of them on nearby farms or encourage young people in our communities to recognise the importance of protecting this 8km of Banksias."

Since 2016, the network has partnered with the Hands on



Students from Brauer College gaining knowledge and skills at the Green Line project.

Learning Program at Brauer College in Warrnambool.

Two classes of Year 8 to 10 students attend the program once a week, sometimes travelling to The Green Line outdoor classroom.

The students are developing a range of skills and knowledge.

They have helped add 200 trees in the Koroit site, and witnessed what a tenacious coloniser gorse can be.

They have learned about direct seeding using Blackwood seed and sand mixes in the gaps between rocks.

There has been an impressive range of weed control techniques demonstrated and the corridor is now growing banksias, she oaks, mana gums, and blackwoods.

This year they will be fencing, conducting remote sensing camera surveys, and presenting survey data to members of the Warrnambool Field and Game Group.

The students are likely to see southern brown bandicoots, with the possibility of a spotted quoll or powerful owl.

"Witnessing local fauna in their new habitat will give the

students the feeling they are making a positive difference to something that up until recently, they had never known existed," Lisette said.

"In feeling a part of something having such a great impact and learning skills they can use for life, we are keeping the importance of this type of work strong in the hearts and hands of the next generation of environmental custodians."

• Visit www.basalttobay.org.au/strategic-plan/33-green-line-project.



Landcare In Focus

May 2017 ~ www.landcareaustralia.org.au

Bush tucker, butterflies and a bumper 'hands-on' harvest

BUILDING on 12 years of support of Junior Landcare programs and initiatives, 13 projects funded by Yates Australia in 2016 have engaged more than 1,100 students and 100 volunteers in a variety of hands-on, outdoor learning experiences.

A food forest, a butterfly garden, a native sensory garden, a rainforest project, and an outdoor classroom are just some of the exciting projects that have come to fruition in schools across five states as part of last year's Design and Be Inspired in the Garden Program.

Students in Queensland's Agnes Water State School learnt a valuable range of diverse new skills through taking part in seed collecting, planting, mulching and harvesting, and preparing tasty treats from the food grown in their own garden.

The school's Enviro Group and Garden Club did an amazing job converting corrugated raised beds into wicking beds and planting them with seeds, digging additional beds for a food forest, and caring for the garden until the food was ready.

Kate Lucas, a teacher at the school was impressed with how the students learnt while working on the project.

"The Enviro Group students really enjoyed collecting the seed from plants that had gone to seed," Ms Lucas said.

"It was a discovery for them about how plants flower and then seed differently, and they talked to each other about the best way to gather the different species.

"We have now a good stockpile of seeds for cooking and replanting such as marigolds, dill, coriander and lettuce."

Victoria's Beaumaris Primary School had fantastic involvement in its native sensory garden and outdoor learning area project, with

500 students and 40 volunteers getting their hands dirty.

The school had two working bees, inviting the whole school community to be involved, and saw great turn-outs.

In preparation for the first working bee, weeds were removed, and garden areas were dug and levelled.

The working bees saw garden beds marked out, Indigenous grasses planted, seating areas completed, and mulch laid, ready for the whole garden to be planted.

Garden Club Coordinator at the school, Vanessa Fitzgerald, witnessed how excited the students were to be part of the project that provided the opportunity to get involved on a hands-on level from the ideas stage right through to completion.

"Lunchtime and recess sessions in the new garden have been very popular, with digging and watering being the favourite activities or simply asking questions about what happens next," Ms Fitzgerald said.

Projects like these are a hugely important element of the Junior Landcare program, which focuses on not only educating children about their natural environment, but engaging them in hands-on activities as a way of learning and become environmentally aware.

The Yates funded program also offers schools the flexibility to realise projects that meet the needs of their own communities, landscape and resources.

Alongside the project funding, Yates provides gardening products that suit the specific projects as well as a consultation with a gardening expert, offering invaluable expertise and knowledge to help the project succeed.

Through immersing themselves in these projects, students have learnt new skills and knowledge



Students at Agnes Water State School in Queensland celebrate a bumper harvest.

focussed on growing, where food comes from, biodiversity, healthy ecosystems, and working towards a more sustainable and resilient natural environment.

With Junior Landcarers like these in action, the future of our environment is in great hands!

The good news for schools and day cares who like the sound of these Garden Grants is that the Design and Be Inspired in the Garden Grant program is running again this year.

Applications are now open. You can find out all the information you need about this program as well as free step-by-step guides to help kick off a Junior Landcare project in your school or community.

Visit www.juniorlandcare.org.au.

Yates is also now providing healthy community fundraising solutions.

RAISE A Patch is all about providing a way for kids to raise much-needed funds for their school, sporting club or community group, while also having fun growing things in the garden and learning about healthy food choices along the way.

The initiative helps provide kids with an opportunity to learn

about *where* their food comes from, encourages more children into the garden, and increases awareness of sustainable living, all the while raising *double the money* for important projects and helping families save on grocery bills.

Visit: www.fundraising.yates.com.au.



LION DAIRY PRIDE LANDCARE GRANTS
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Australian dairy farmers



Learn about the recent projects we've funded at www.landcareaustralia.org.au

The economic and environmental rewards for cotton growers

THE installation of a solar diesel hybrid irrigation bore pump on a cotton farm in central west New South Wales has led to cuts in fuel costs, greater irrigation efficiencies, and a massive reduction in greenhouse gas emissions.

Attracted by the drop in the price of solar panels in recent years and the prospect of the system paying for itself in less than four years, Andrew Gill and his family decided to install a solar diesel hybrid system at one of the pump sites on their Narromine farm.

The move has led to a cut in pumping costs from \$76/megalitre to \$41/ML and slashed diesel use by between 45,000 and 55,000 litres a year.

Over 25 years, that equates to a saving of more than 1 million litres of fuel and a reduction of over 3000 tonnes in carbon emissions.

Jon Welsh, a technical specialist with the cotton industry's extension program, CottonInfo, and Janine Powell, a cotton research economist, worked through project economics costings and carbon emissions profiling with the Gill family during feasibility.

"If potential productivity gains and environmental benefits exist,

we need to share this technology and information with the wider cotton industry," Jon said.

Andrew said that while the environmental achievements were important, the clincher was the economic viability of the project which promised a quick return on investment.

"Diesel prices are the lowest they have been in 12 to 13 years, but it's not going to be cheap for the next 20 years, it's only going to go one way, and that's up," Andrew said.

"Solar is a way for us to have a better handle on what our input costs are going to be throughout the next 20 years of production. It is not often you can get that."

The Gills run sheep and cattle, and grow summer and winter dryland and irrigation crops, including 300 hectares of cotton each year.

"For people who can use solar energy every day, it's just mad not to do it," Andrew said.

They have no access to river water, only bore water.

Their irrigation pumping system has traditionally been run exclusively by diesel pumps.

"For the past few years we have been trying to get better fuel

efficiency out of our diesel turbine pumps," Andrew said.

"We found our turbines were at their highest efficiency point already.

"We couldn't really achieve much more efficiency, so we looked at cheaper ways to get the water out of the ground."

The Gill's decided to install the solar diesel hybrid system at one of their bore sites that provides year-round pumping into a large irrigation reservoir.

The new installation consists of 400 solar panels on four banks, producing 100 kilowatts of power to run a submersible pump.

Being a hybrid system, the pump is run on solar energy when there is sufficient irradiance from the sun, then switches to a diesel generator when the irradiance falls away.

Andrew said he was continuing to look into ways to fine tune the system and improve its efficiency.

Convinced that solar is the way of the future, he plans to introduce more solar pump stations throughout the farm.

• Visit www.cottoninfo.com.au/energy-use-efficiency.



Cotton farmer Andrew Gill on his property. Photo: Clare Gill.

Innovative online map to support recovery

QUEENSLAND government scientists have developed an online map to assist the recovery of agricultural lands hit by Tropical Cyclone Debbie.

The map shows the land uses that are affected by the destructive wind zones and subsequent weather event.

It was produced using satellite and aerial imagery, informed by on-ground data collected with a purpose-built app.

Interested members of the public can find the web maps by searching the ArcGIS website (www.arcgis.com)

for 'TC Debbie - Impacted Land use' and 'Horticulture Tree Crops - Cyclone Debbie.'

The companion app, Land Use Survey by QLUMP, allows citizen scientists to upload photos and observations to improve maps.

The app can be downloaded for iOS from the Apple app store or for android from the Google play store.

The Department of Science, Information Technology and Innovation developed the map and app as part of the Queensland Land Use Mapping Program (QLUMP).

App development has been funded through a national tree crop project supported by Horticulture Innovation Australia and the Australian government Department of Agriculture and Water Resources' Rural R&D for Profit programme.

QLUMP is the Queensland contribution to the Australian Collaborative Land Use and Management Program, a consortium of Australian, state and territory government partners developing nationally consistent mapping.

Funding is provided by participating agencies and the National Landcare Program.

Current work includes mapping in Queensland (Mackay and Whitsunday), the Northern Territory, Tasmania, the Goulburn Murray Irrigation District and Victorian Pest Free Area, and South Australia's Greater Adelaide region.

The data will be published in the catchment scale land use mapping update for 2017 later this year.

Mapping of banana plantations, along with other horticulture, was

recently completed for northern Queensland, New South Wales and Western Australia.

Land use maps can provide critical information for planning, responding to and recovering from the impact of natural disasters such as cyclones, floods, bushfires and droughts.

The maps are also essential sources of information to support agriculture, natural resources and biosecurity risk management.

Visit: www.agriculture.gov.au/abares/aclump/land-use/land-use-mapping.



Heat your home with wood and save on bills

As gas and electricity costs continue to rise, homeowners are looking to alternate solutions for heating their home this winter.

Wood heating offers a low cost source of heating that is also an environmentally responsible solution.

With the cooler months fast approaching, now is the time to think about combating the increasing cost of bills by heating your home with wood.

To find out more about the Australian Home Heating Association visit www.homeheat.com.au





Australian research guides climate change adaptation in Vietnam

By The Australian Centre for International Agricultural Research

AS CHANGES in weather patterns are being felt across the Lower Mekong Basin in Vietnam, the impacts of climate change are now being seen.

Studies show that the basin is vulnerable to several climate change impacts that include a predicted mean temperature rise of approximately 0.8 degrees Celsius by 2030, as well as a regional increase in annual precipitation of 200 millimetres.

However, adaptation initiatives are underway, focussing on water management, agriculture, and natural disaster management. Working together with farmers in Australia and the Mekong Delta, Australia's leading agricultural research for development agency.

The Australian Centre for International Agricultural Research (ACIAR) has identified crop management technologies that would help these farmers cope with climate variability.

One research project has proven that the water-saving irrigation technique of alternate wetting and drying is a win-win innovation.

This involves the farmer only irrigating just before the soil has dried so much that the plants will be excessively stressed, and as we know helps farmers to cope with water scarcity.

Alternating wetting and drying also reduces methane emissions from paddy fields by up to 50 per cent, as well as saving water.

Currently many farmers in the Mekong Delta grow three crops of rice per year.

ACIAR's research showed farmers that by replacing one rice



The green rice crop would normally indicate good growth and success. The severe soil salinity associated with a drought has affected the capacity of the rice to flower and produce seed.

crop with an upland crop, such as a pulse, increases farmers' income due to the high value of the upland crop, and reduces the irrigation water demand.

The research also discovered that farmers in the Mekong River Delta have been applying too much phosphorus fertiliser to their fields, resulting in substantial phosphorus accumulation in the soil.

As we know in Australia, decreasing fertiliser applications increases farmers' net income and

limits the environmental footprint of agricultural production.

In the saline zone of Bac Lieu Province, traditional rice farming is based on a long-duration local variety (called Mot Bui Do) grown during the wet season and maturing in the dry season.

After the wet season finishes, flow in the Mekong reduces and saline water moves upstream, and this can happen early enough to impact on the rice.

Through ACIAR's research, farmers were introduced to short-

duration high-yielding varieties reducing the salinity risk to the rice.

Some farmers were also supported to utilise the saline water to grow saltwater shrimp in the field after the rice season, during the dry season, supplementing their income.

As the Mekong Delta is one of the most important food producing areas in the world, and one of the most vulnerable to climate change, the Vietnamese government felt it was important for them to be

proactive in the understanding and mitigation of greenhouse gases.

Mega-deltas are vital food producing areas.

It is through changes to productivity on these deltas that climate change may have the biggest impact on global food security.

Many people and organisations are chipping in to address these problems globally.

Research is a village and ACIAR has been working on this for 35 years.

• Visit aciar.gov.au.



Landcare Australia CEO, Tessa Jakszewicz, and former Prime Minister, Bob Hawke, raise a glass at the launch of Hawke's Lager in Sydney.

Every sip is a quid for Landcare

THERE WAS much excitement last month when former Prime Minister, Bob Hawke, launched Hawke's Brewing Co, and announced that his share of royalties from the company would go to Landcare projects.

A partnership between Landcare Australia and Hawke's Brewing Co will see a percentage of profits from beer sales go towards funding on-ground projects.

Mr Hawke's involvement with Landcare is well known.

Following a joint submission to government from the Australian Conservation Foundation and the National Farmers Federation, the Decade of Landcare was launched by then-Prime Minister Hawke in Wentworth, New South Wales, in 1989.

Since then, the movement has evolved to one of Australia's largest volunteer movements, with more

than 5,000 groups working to preserve the health of our land and water.

Mr Hawke spoke at last month's launch about the importance of supporting this work.

"We live at an absolutely unique time in human history," Mr Hawke said.

"For the first time in history we are at a point where we can do one of two things - two paths are before us.

"One is that we can lift the standard and quality of life of every human being on this planet.

"Or we can destroy life on this planet as we know it.

"In our small way here, we're going to be doing our best to ensure that Australia and the world goes down that first path."

Landcare Australia CEO, Tessa Jakszewicz, also spoke at the launch,

seizing the opportunity to bring the Landcare message to the masses.

"We're delighted to form this partnership with Hawke's Brewing Co to help raise funds to support community groups working across the country to protect the health of our land," Tessa said.

"Mr Hawke played an important role in the establishment of Landcare nationally almost 30 years ago and it's really great to see his continued support of the movement today."

Hawke's Lager is the first product from Hawke's Brewing Co and is currently available at 10 pubs in Sydney and one pub in Newcastle, making up Hawke's First XI.

Hawke's Lager cans, bearing the Caring Hands logo, are available in the First XI pub venues and Camperdown Cellars bottle shops.

• Visit: www.hawkesbrewing.com.