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Building the soil and the community at Hollands Track Farm, Newdegate, Western Australia

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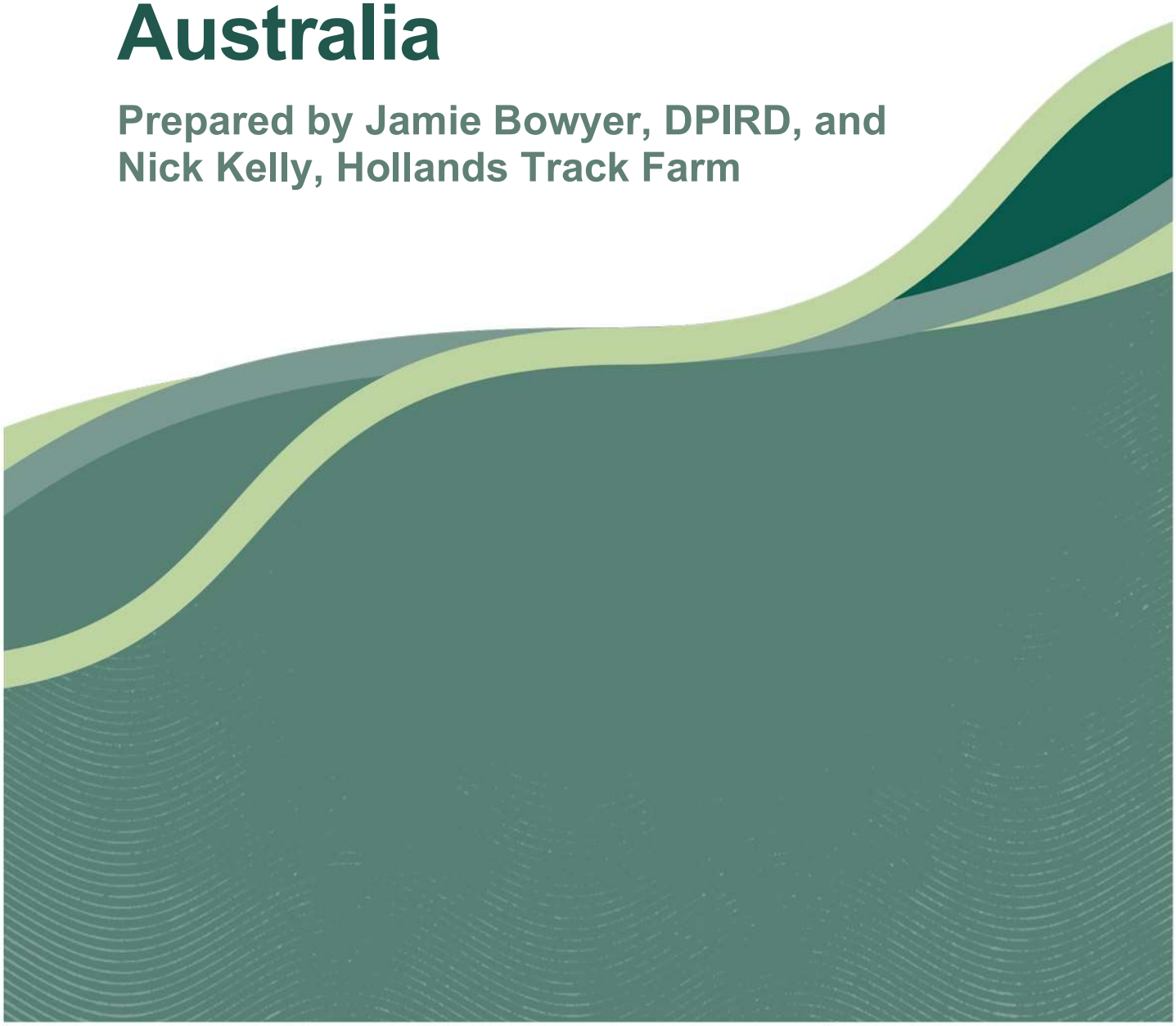

The Kelly family have been farming at Hollands Track Farm, near Newdegate, Western Australia (WA), since 1965 when Malcolm and Cathie Kelly moved from Meckering and started clearing the property. They established a mixed enterprise, producing prime lambs and wheat using a year-in, year-out cropping–pasture rotation. The Kelly's son Nick and his wife Lucy now farm in partnership with Malcolm and Cathie.

The Kellys were early adopters – in the 1990s – of the no-till farming system, which is widely used in WA. Around 2002, they sold the last of their sheep and moved to a continuous cropping program with increased fertiliser and chemical use. The Kellys were very good at it and the system served them well. Malcolm and Nick both really enjoy the challenge of growing good crops. The Kellys have now transitioned to a regenerative agriculture system guided by a series of soil care principles.

Farm details

Name: Malcolm, Cathie, Nick, Lucy, Jude, Nathaniel and Claudia Kelly

Location: 18 km south-west of Newdegate, Western Australia, 2,000 ha

Rainfall: Long-term average annual rainfall is 350 mm

Soils: Very shallow sandy gravel, clay and sand over kaolinitic clay at depth

Enterprises: Wheat, barley, oats, cattle, sheep, laying hens, cover crop seed mixes

Crop–pasture ratio: – 50% crop, 50% pasture

Location of Hollands Track Farm

Motivation for change

Over time, persistent weeds emerged on the farm and these – along with other constraints including soil compaction, low pH and decreasing nutrient and carbon levels – led Nick to investigate ways to solve these problems.

‘We were early adopters of the no-till farming system in the 1990s, a system that’s totally dependent on herbicides and chemical fertilisers. About 20 years ago we got rid of the last of our sheep and moved to a total cropping system. It didn’t take us long to run into problems, particularly on our shallower gravelly soils that had little resilience. We ended up with a lot of wild radish and ryegrass and we were spending more and more time on the boomspray.’

The time and financial costs of constantly spraying weeds and an increasing concern of the effect of agricultural chemicals on their personal health led them to question what they were doing. ‘I certainly had better things to do than spray weeds all day, especially repeat offenders which didn’t seem to be going away,’ said Nick.

‘At the time we thought we had weed problems, but slowly we realised that we had a general soil health issue and constantly spraying weeds wasn’t fixing it. Also, once we began to understand soil health and biology more, it dawned on us how important healthy soil was to healthy food. We didn’t start with the idea of producing healthy food, but we ended up there.’

A real catalyst for change came from Nick’s involvement in the WA No-Till Farmers Association (WANTFA). WANTFA started bringing inspirational no-till specialists to WA including Rick Bieber, a farmer from South Dakota in the United States, Dwayne Beck a research manager at Dakota Lakes Research Farm, South Dakota, and Rolph Derpsch, a research agronomist consultant from Paraguay. Nick was inspired by the stories and information they shared and started looking at summer cover crops and zero-till farming practices.

Soil care principles

Over time, the Kellys developed a series of soil care principles to guide their farm management. These principles are founded in nature, as observed by Nick:

- maintain groundcover
- minimise soil disturbance
- keep living plants with roots in the soil for as much of the year as possible
- encourage diversity – no monocultures
- integrate animals
- reduce or eliminate synthetics.

These principles are all aimed at increasing biodiversity above and below the ground to produce nutrient-dense food that is free from pesticide residues. They are based on the knowledge that biodiversity enables efficient nutrient cycling, carbon sequestration through plant root exudates and biomass breakdown, improved water infiltration through soil aggregates, and increased water-holding capacity.

Hens grazing mixed perennial and annual pasture

Changes made to achieve the soil care principles

The Kellys have introduced a wide range of new practices and made other changes to their farm operation guided by their soil care principles. All these changes are focused on increasing diversity on the farm as much as possible. This includes increasing biodiversity, enterprise mix diversity and income stream diversity.

Used single disc seeding equipment

The first change the Kellys made was to purchase a single disc seeder to minimise soil disturbance during seeding operations. Although they had been early adopters of knife points through the no-till approach, they felt that discs would further reduce soil disturbance, minimising impact of seeding on mycorrhizal fungi and other soil microbes. Discs also make it easier to seed into large amounts of winter crop stubble and biomass from summer cover crops. One problem that arose was the lack of soil incorporation, which meant that pre-emergent herbicides were less effective.

Grew single and multispecies summer-active annual cover crops

In the summer of 2010, the Kellys planted French white millet as a single species cover crop. This millet has a large root ball and is quite drought tolerant. Where it established well, the millet outcompeted weeds. The millet served 2 purposes on the farm: provided soil cover over summer and secreted carbon into the soil for more of the year. They were able to sell millet seed into the bird seed market. Millet growth was dependent on summer rain and wetter summers resulted in much higher biomass.

After research on the benefits from increased plant diversity, they shifted to multispecies cover crops including sunflowers, millet, cowpeas, corn, sorghum and lablab.

Summer active cover crop seed mix

Planted perennial pastures and native plants and grazed the weeds

The Kellys' farming system keeps evolving as they discover more information, and one change they are making is to move from annual cover crops to summer-active perennial pasture species. One-third of the farm is now under perennial pastures, and they plan to increase that each year.

'We were told perennials wouldn't survive out here, but we've been able to prove that wrong,' said Nick. 'It saves us time and money because we don't have to plant cover crops every year like we used to. The perennials have thrived and provide good feed for our cattle in summer. We are conservatively stocked, and the perennials have other functions such as providing cover and secreting carbon into the ground over summer to feed the soil microbiology.' Perennial pasture species include Gatton panic, lucerne, Rhodes grass, chicory and setaria. They are planning to add a native grass called Kangaroo grass to the mix.

They no longer spray weeds on the farm. Any plants that germinate after summer rains are grazed and form part of the feed base for stock. At the same time, these weeds provide soil cover and living roots over summer. 'We're also noticing some native perennial plants returning to our paddocks in the 2 years since we stopped using herbicides. This has allowed us to increase the level of groundcover over the whole year and it keeps living plant roots in the soil for more of the year. Some of the native perennials don't have great feed value but they do provide diversity, so they're all welcome,' said Nick.

They have also planted 30,000 oil mallees and 1,500 native trees to add further biodiversity to the farm.

Winter cash crop sown into summer-active perennial pasture

Increased diversity of plants, animals and soil microbes

The Kellys aim to have a high level of biodiversity on the farm, both above and below the ground, particularly in the soil microbiome. A high level of biodiversity provides a higher level of resilience for production and economic outcomes. A greater range of plants means a greater range of plant exudates feeding a greater range of soil microbes.

Many of the practices aimed at maintaining groundcover also increase biodiversity. Multispecies summer cover crops, perennial pastures, native perennial plants and multispecies winter cash and companion crops all increase biodiversity. The Kellys have planted winter cash crop mixes, such as peas and canola, barley and oats, and chickpea and flax. Vetch and lupins have also been planted into paddocks with a mix of perennial species. ‘We are looking to always have at least a mix of cool- and warm-season grasses and broadleaf plants on the farm,’ said Nick.

At first the Kellys thought they would struggle to secure markets for their mixed winter cash crops. They now supply an organic pork and poultry farmer who wants their product if it is certified organic, and they supply a baker who uses their multigrain mix.

Used biostimulants

In 2014, the Kellys stopped using synthetic chemical fertilisers and began experimenting with compost extract and other biostimulants, including fish hydrolysate, liquid kelp, humates and fulvic acid. They understand that the biostimulants, which aim to feed soil microbes and increase their diversity, are not a replacement for the fertilisers they used previously.

They purchased a fungal-dominant compost from a WA supplier and started making their own compost extract using an 8,000 L tank with a large agitator. They introduced worms to the compost to enhance microbial diversity before making the extract. They use this liquid extract to coat seed, directly inject it into the soil at seeding and as a foliar spray when plants are at the 3 to 4 leaf stage. They set up liquid application lines to an air-seeder and injected 70 L/ha of compost extract with fish hydrolysate, liquid kelp, humates and fulvic acid during seeding.

‘We are now building an industrial-scale worm farm and will be using our own grain compost, multispecies hay and chaff to feed the worms.’

Nick Kelly explaining his compost extract making process

Reintegrated animals into the farming system

Stock have been brought back to the farm to increase biodiversity, broaden the enterprise mix and increase diversity of income streams.

The Kellys now have a small cattle herd that is managed using mobile electric fencing, which allows the cattle to strip-graze the farm. This holistic grazing management approach and a conservative stocking rate allows the Kellys to rest plants, particularly the perennials, long enough for them to fully recover before grazing again. This is important for long-term persistence of the perennials in a climate zone that these perennials may not be well adapted.

The cattle add microbial diversity to the soil through their urine, dung and saliva as they graze. Cattle also help to break down crop residues and biomass by trampling them into the soil, where the increased contact with soil microbes helps to further break down residues. Cattle also provide another income stream, diversifying the farm's economic base. Under a commercial arrangement with the Kellys, another person manages their cattle, which is a part of the family's vision to rebuild their community as well as the soil.

Lucerne understorey with winter cash crop

The Kellys have established a flock of free-range laying hens, which they plan to expand to about 5,000 birds. The hens live in a mobile chicken caravan and normally go into the pasture after the cattle have finished grazing. Like the beef enterprise, the egg operation

will eventually be managed through a commercial arrangement with someone from their local community.

They have also introduced a small flock of self-shedding Kojak sheep and are planning to expand this to around 600 head. As with the cattle, these will be conservatively stocked and will serve more than one purpose on the farm.

Reduced then stopped using synthetics

The Kellys have stopped using synthetic fertilisers and agricultural chemicals on the farm because some of these compounds can reduce the biodiversity within the soil microbiome, which works against one of their soil care principles.

They have not used synthetic fertilisers since 2014. They do use biostimulants that are aimed at increasing microbial diversity and abundance, including compost extracts and biological stimulants, such as liquid fish, liquid kelp, humates, fulvic acid and Nutri-Soil®.

Removing all herbicides took a little longer because weed control was a problem in the absence of stock. The Kellys first stopped using bare earth herbicides, such as trifluralin, then stopped using non-selectives. In 2018, they used a selective herbicide for the last time.

When the family recognised the economic premiums they could secure if they were certified organic, it made a lot of sense to go down this path. They didn't intend to become organic but ended up there and it made sense to become certified to capture the price benefits.

Kept living plants and roots for as much of the year as possible

One way to get carbon into the soil is through the sugars that plants secrete through their roots. Therefore, the Kellys try to keep plants and roots growing for as much of the year as possible, within the constraints of farming in a low-rainfall environment. To achieve this, they started with single species annual summer cover crops, then moved to multispecies, and have now settled on establishing summer-active perennial pastures. They have also planted trees and oil mallees across the farm.

What’s worked and what hasn’t

‘Some failures are inevitable, but if we know what they’re going to be, we can put other things in place. And system change takes time; you can’t just expect to grow one summer crop and have everything recover.’

Living groundcover persists for more of the year

‘Our original single and multispecies annual summer cover crops grew well, depending on rainfall each summer. They certainly achieved their purpose of providing soil cover over summer and keeping living plant roots in the soil for more of the year than a winter annual crop or pasture. French white millet grew well in wet summers and developed a large root mass. Where it grew well, it held back annual ryegrass well into winter.’

‘Despite our annual summer cover crops growing well, they cost us more time and money than expected, so we’re moving to a perennial plant understorey, which lets us have living plants and roots all year round. We were advised that perennials wouldn’t work out here, but we’ve successfully established a mix of perennials and they’re persisting well. Part of the reason for that is we’re very conservatively stocked.’

Oats planted into summer-active lucerne, perennial grass pasture

Price premiums have been secured

‘We didn’t plan on moving to certified organic, but it made a lot of sense from a financial perspective and our farming system ended up there anyway. The premiums we receive for our grains and seeds are significant and offset reduced yields to a large extent. From our perspective, it also feels good to be able to grow food without using agricultural chemicals.’

Farm enterprise diversity has increased

‘We’ve been able to diversify our enterprise mix, and this provides the business with an increased level of resilience. We have a small cattle herd and a chicken egg production enterprise. After selling all our sheep 20 years ago, we’re now bringing back a small herd of self-shedding sheep to add more biodiversity and enterprise mix diversity to the farm.’

Yields have reduced and weeds are still a problem

‘We expected a drop in yields with the change from synthetic fertilisers to biostimulants, but the lower yields have largely been offset by reduced input costs and premium prices for our grain. However, the last couple of years have seen a big dive in yields because of weed competition. We were expecting this to happen – we understand weed succession and weeds aren’t likely to go away quickly – so we’re comfortable with it. And we know that the lower yields weren’t nutrient or phosphate related because of soil test results. So once we get the multispecies ratios right and increase the cereal rye component, most of the weeds should be outcompeted. In 2020, capeweed really outcompeted the crop in certain areas. On deeper soils, there’s less weed competition. We need to keep competing with the weeds each year so there’s gradually less weed seed set and fewer vigorous plants. We don’t mind if we always have some weeds because they’re good feed, but it would be nice to get to a point where they are causing less competition with the crops.’

‘It might have been better to make incremental changes and only change one paddock at a time, and to integrate animals into the system earlier so that you have something worth selling even if the crop fails.’

‘Yield drops don’t have to be as large as the ones we’ve experienced – we’ve pushed the boundaries as far as we can.’

‘We understand the need for yield and could be criticised because our yields using regenerative agricultural practices have seen major reductions. But we’re confident we’re on a curve and that our yields will come back. And if we start farming deeper into the soil profile with perennials, mining deeper nutrients and lifting our soil carbon, then we expect yields to increase. We don’t think anyone in WA has pushed the system far enough in a regenerative agriculture sense.’

‘In the old chemical mindset way of farming, yield is king (especially in the pub). But even in a chemical farming system the highest-yielding crop doesn’t necessarily make you the most money. It’s all about margins.’

Input costs have reduced

‘Our input costs have dropped to about $10/ha and mostly relate to diesel and spraying liquid compost. In our old system, our chemical costs were $50–60/ha so our costs are down by about $50/ha, and we get double the price for our grain (at least $500 per tonne). We have no storage and transport costs because the market comes to us, and we don’t need to store our grain at CBH. It is quite refreshing because our customers really want our grain and seed.’

Soil carbon has not changed a lot

‘In the summer of 2019, DPIRD measured our soil organic carbon and other macronutrients in the top 10 cm and there wasn’t a lot of change compared to tests done by CSBP in 2012. We’ve exported a lot of carbon through monocultures, such as lupins, but we’d like to see carbon levels increase. We expected that the large biomass yields of sorghum, sunflowers and millet over the summer would have increased soil organic carbon more than it has.’

Farmers of the future watching cattle graze

What would you do differently?

‘We’re glad we went cold turkey [with synthetic fertilisers] but we wouldn’t recommend it. It would be better to go paddock by paddock and wind things back more slowly. However, we didn’t really see big changes in soil nutrient status and organic matter until we went cold turkey on fertiliser.’

‘Another thing we’d do differently is introduce animals earlier rather than putting faith in crops alone. Having animals in the system would make the transition easier, particularly in a financial sense, and “you can always eat your mistakes”. You can harvest your crop with animals rather than machinery but because we came from a total cropping background and had removed all our sheep 20 years ago, we weren’t able to just jump back into animals. And having animals increases the overall diversity of the system.’

Where did you get information and support along the way?

The Kellys have connected with a wide range of people across the globe to find information and support.

‘We were members of WANTFA and in the 1990s and early 2000s brought Dwayne Beck and Rick Bieber out from South Dakota to WA. Both were instrumental in leading the development of no-till farming systems in America. Dr Christine Jones (soil ecologist) from New South Wales has been very informative and helpful from a soil plant microbes interaction perspective. We completed Elaine Ingham’s (soil microbiologist) soil food web course, and we’ve also worked with Colin Seis (farmer) from New South Wales. Locally, the Wheatbelt Natural Resource Management Group have been good to work with and we’ve been part of a project they have with the Cooperative Research Centre for High Performance Soils (Soil CRC).’