2019

"COLLINGWOOD" CASE STUDY: THE NARRATIVE

Prepared by

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Introduction

John Kane, his wife Jenny and their three children, Andrew, Christopher and Melissa took up an offer from two elderly uncles to manage their farming enterprise, Collingwood, near Coleraine in western Victoria in 1996. The family moved onto the property, but John also undertook work from the local council while he found his feet in managing the farm.

The Landscape

The property consisted of two main blocks comprising a complex set of titles left over from the World War 1 Soldier Settlement Scheme. One block, Evestons, is 102Ha and the other, Collingwood, is 140 Ha. There were thirteen paddocks that were set stocked with sheep and cattle. Some fences were run down and dams and watering points did not match the paddock subdivisions, a must if rotational grazing was to be introduced.

There were three paddocks totalling 36 ha under hay when John took over the property. He increased that to four paddocks totalling 48 ha as part of his feeding out strategy.

Kanes Creek runs through the property and poor land management in the 1930-40s led to the formation of a 12 metre deep erosion gully. In the 1960's, as part of Soil Conservation Service work, the creek was fenced-off and partially revegetated. Its intermittent flow carried water and soil nutrients off the property to the Glenelg River and out to sea. The creek bed was a haven for rabbits and foxes and home to a considerable number of snakes which prey on the proliferation of frogs which share the habitat.

In 1996, the enterprise carried 12 DSE set stocked on pastures heavily infested with Cape Weed and lesser infestations of Onion Weed, Rush, Wild Geranium and Dandelion. About one third of the stock was sheep and two thirds cattle. Poor quality grazing combined with poor cattle genetics and underweight calves being dropped at inopportune times of the year.

Planning and Implementing Change

Initially, John opted to improve the cattle genetics. He soon realised that he had the wrong strategy. Even with top quality bulls, poor pasture was leading to poor returns from cows grazing sub-standard pastures and dropping underweight calves. Above and beyond soil test results, poor quality pasture indicated poor nutrient density and nutrient deficient soils. John decided to improve the soil as a first priority.

In 2000, at some risk to the economic viability of the enterprise, John decided to streamline his workload by selling off his sheep and concentrating on breeding Black Angus cattle. The strategy has paid off, but he now has two fully function shearing sheds to maintain in case of a future decision to bring back sheep.

Today John's annual production cycle is geared to producing consistent numbers of high grade weaner steers (calves) that are sold locally. John's cattle are finished on farms in NSW and Queensland.

Soils and Soil Fertility

John first conducted his soil tests in 1996 to establish a baseline. Initial tests and associated observation and research highlighted an average pH of 4, an imbalance of the Calcium (Ca) and Magnesium (Mg) ratio, soil compaction, indications of over-use of superphosphate, poor soil hydrology and considerable bare ground after broad leafed annuals died off. Since that time subsequent soil tests have been used to inform progress and to adjust management regimes to improve soil condition.

John dispensed with the services of the agronomist and took over the fertiliser program himself. He opted for a program of mineral fertilisers and foliates. He introduced *Bubas bison* dung beetles, in addition to extant native varieties for greater aeration, water penetration and nutrient sequestration of the soils.

Bubas bison is an introduced winter-active dung beetle from southern Europe. Adults are active during the wet season. They bury dung in tunnels under dung pads. The tunnels can be 50 cm deep when the beetles are in breeding condition. Adult females lay eggs in the tunnels. The young live underground until they are ready to turn into adults and emerge from the soil in autumn.

In the early years John used a soil aerator to break through the hard pan that had established historically through ploughing with a mouldboard plough. Soil compaction is a thing of the past.

The fertiliser program includes regular applications of lime and recent soil testing indicates an average pH of 6. Organic matter content has increased significantly. Water infiltration has increased considerably due to physical soil aeration, dung beetle activity and rotationally resting paddocks that are dominated by deep rooted perennials such as cocksfoot and phalaris. Periodically, John renovates the pasture to increase diversity of species by direct drilling of clovers and ryegrass.

Vegetation and Ground Cover

When John took over management of the farm in 1996, the pastures were run down, they were weed infested and fertilised with superphosphate.

John's new fertiliser program has dramatically changed that situation. John describes himself as a biological farmer with a strong focus on soil function (refer to the annual production cycle below). As a result, his pastures have high nutrient mixed species of high density pastures with very little weed burden.

Most paddocks comprise improved pasture including phalaris, clover and rye. One paddock is set aside and managed as native pasture including Kangaroo Grass, Wallaby Grass and Weeping Grass.

John's uncles had begun a program of tree planting (Red Gum and Blackwood) and had, with the assistance of the Soil Conservation Service, planted some 7,000 trees. John and Jenny continued this program and planted a further 10,000 trees and shrubs of a variety of species.

Weed Management

In the early years, annual weeds and seasonal bare ground favoured outbreaks of the red legged earth mite and the Lucerne Flea. While weeds are much less of a problem today, John addresses the annual weeds with a targeted program of spraying with a broad leaf herbicide mixed with fulvic acid. John advises that "It is important to spray in Autumn when plants are small - the clover at two leaf stage - to gain maximum effect using low spraying rates".

The hay paddocks are sprayed annually with foliar sprays, trace elements, biologic agents and kelp. This spraying program encourages the growth of the pasture grasses and tends to effectively control the annual weeds through competition.

Water

When John first came to the property, the watering infrastructure consisted only of a number of dams. Kane Creek was fenced off from grazing and was not used as a source of reticulated water. Only half the paddocks had water and the fenced dams did not coincide with the number of paddocks which made John's intention of introducing rotational grazing somewhat problematic.

John has established a system of troughs in each paddock. Potable water is pumped from the dams by solar power to storage tanks on the high ground, holding 80,000 litres and 120,000 litres, respectively. This allows all troughs to be gravity fed. John achieved this through the purchase of a "Ditch Witch" machine to trench piped water 650 mm under the ground.

Water Medication

John's water infrastructure hosts his program of water medication. Trace elements and food supplements are fed into the drinking water by vacuum pumps that are worked by water pressure. The pumps require a 2 metre head of water to operate and on average they are situated some 200m below the water storage tanks. The medication is fed into the stock watering system 3 to 4 times a year. When the water medication is operating, this program ensures that each animal gets the required amount of trace elements and food supplements.

Production

John has a highly disciplined approach to farm management with his task organisation and time management of a very high order. This approach is essential as Collingwood is a one-person operation. An example of the Collingwood production management program is at **Annex A** to this report.

Cattle Production: The days of a stocking rate of 12 DSE faded into memory. In the really good seasons of 2000 to 2010, the stocking rate peaked at 18 DSE. John has reduced that to a modest 15DSE as a conservative hedge in case of a down turn in stock prices or seasonal conditions.

High Impact Hay Production: There were three paddocks totalling 36ha under hay when John came to the property. He has increased that by four more paddocks totalling 48ha as part of his feeding out strategy. John pays great attention to the fertility of the soil in the hay paddocks and to the nutrient density of the phalaris, clover and rye that comprises the makeup of the hay cut in October each year. The resulting hay production of some 600 large round bales is fundamental to John’s animal nutrition and soil biology strategy. All of the hay produced on the property is retained on the property as part of this strategy.

John feeds out daily from mid-February to the end of July, covering the crucial calving period from March to April. The dung reflects the soil fertility of the hay paddocks and the nutrient density of the hay, and is transferred into the grazing paddock soil by the dung beetles, notably the imported *Bubas Bison.* This is a flying variety that scents and flies to new dung pats, therefore expediting the burial of dung across the paddocks. This cycle is critical to John’s biological farming.

Pest Management

Over the years, the burgeoning rabbit problem has been tackled by local landholders using at different times, Sodium fluoroacetate (“1080”) impregnated carrots, Myxomatosis and Calici Virus. These operations have reduced the rabbits to negligible numbers and the foxes that also inhabit the creek bed keep them that way. There are no other pests affecting the management of the property.

Outcomes and End State

John Kane has worked both hard and smart for 22 years and Jenny was part of that effort for 18 of those years. John started with little knowledge and little standing as a farmer in the eyes, not only of his uncles, but also many of his peers. He sought knowledge through training courses, field days and practiced what he learned innovating on the farm.

John can now look across pastures and vegetation that represent his goal of 100% ground cover 100% of the time. He can see healthy, unstressed cattle in good condition grazing on pastures of high nutrient density. This ideal situation has eventuated from his initial adoption of a fertility-first strategy for his soils all those years ago.

Annex A: Annual production cycle at Collingwood (John Kane)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Cattle												
Cows are joined with bulls												
Calving												
Calves ear tagged, inoculated, castrated												
Calves are sold												
Hay sits in storage												
Mineral supplements added to stock water												
Feed out pasture hay												
Hay paddocks												
Available for grazing												
Apply mineral fertiliser and lime												
Broadleaf weeds are sprayed												
Apply folia spray												
Monitor pasture quality												
Lockup paddocks (110 acres)												
Cutting hay												
Raking and bailing hay												

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COLLINGWOOD CASE STUDY: SUMMARY ECOLOGICAL REPORT

Prepared by Richard Thackway

Key findings

Collingwood is a 242 ha Angus cattle breeding property located in the Western District of Victoria on the Dundas Tablelands. The first parcel of the property has been in the Kane family since 1878 with subsequent parcels bought in the following years. The current land manager John Kane has managed Collingwood since 1996. This ecological assessment starts in 1996, reflecting the time of current management.

Initially John ran sheep and cattle on the property, however by the year 2000 he had concluded that the infrastructure on the property to run sheep and cattle was inadequate and he ceased running sheep to concentrate on providing high quality infrastructure for the cattle operation..

Convinced that his success as a land manager lay in improving the bloodlines of his cattle, he began buying expensive bulls in the aim of increasing production across the property. However, after some thought John realised that improving the genetics of his cattle would have little effect if they grazed on degraded pasture, at this point John's focus changed to soil improvement.

John realised that the limiting factor for improving the condition of his soil was a hard pan in the soil at a depth of 200 mm caused by a reliance on mouldboard ploughing. John turned this around by using a heavy duty soil aerator in conjunction with spreading lime, foliar sprays, mineral fertilizers and the introduction of the southern European dung beetle *Bubas bison*. The dung beetles are critical in winter and spring for dealing with large amounts of cattle dung.

The graphical summaries for each of the ecological criteria shown in the detailed Ecological Report demonstrate that there is a close relationship between the land manager's goals/ideals and the ecological outcomes in each of the four phases:

Phase 1:	Conventional non-regenerative regimes and practices
Phase 2:	Small scale regenerative trials conducted
Phase 3:	Wide scale adoption of regenerative regimes and practices
Phase 4:	Maturation of regenerative regimes and practices

Ecological assessments involve assessing 10 ecological criteria. This assessment shows that by phase 4, compared with the previous three phases, that most of the functional criteria have been nearly fully achieved or have achieved their reference state (i.e. a scores between 0.8 – 1.0). For example:

- Minimising effects of extreme climatic events, which considers the whole property and its place in the broader catchment, primarily the preparedness for drought (Criterion A); and
- Improving soil health and function. Ecological improvements since 1996 include: soil nutrients and soil carbon (Criterion B), soil hydrology (Criterion C), soil biology (Criterion D) and soil physical properties i.e. soil as a medium for plant growth (Criterion E).
- Improvements in pasture health and function include: reproductive potential of pastures (Criterion F) and ground cover (Criterion H).
- There has only been a modest improvement in the extent and composition of tree and shrub cover since 1996 (Criterion I and J).

Introduction

Collingwood is located 90 -150 m, above sea level on the Dundas Tablelands in the Western District of Victoria. The property drains to the Wannon River; which is a tributary of the Glenelg River. The annual average rainfall of Collingwood is 620mm, which predominantly falls in winter-spring.

At the time of first settlement phragmites, redgum, blackwood trees and microlena pastures dominated the landscape as part of a natural grassy woodland. The majority of the native trees were cleared and the land was developed for agricultural use. Currently there are only a few-standing trees (River red gums) remaining pre-land clearing.

Before John commenced managing Collingwood, the farm was made up of two smaller farms separated by a creek. Each of these areas has now been divided into 6 paddocks, making a total of 10 paddocks.

Today Collingwood is rotationally grazed with reticulated water (troughs) available for stock in each paddock. Animal movement is based on visual assessment of feed availability so in effect, the animals tell John when they are ready to move. The current stocking rate of the property is 16 dse per ha, hence the stocking density is high enough to avoid selective grazing. John increased his stocking rate from 12 to 18 dse in the early days and has reduced that to 16 dse after much of the farm debt was reduced.

John cuts and bales nutrient rich hay which is used exclusively on the property to feed livestock between late February and mid-August and with an Autumn break late April/early May. The management strategy relies upon the production of pasture hay in spring.

John is aware of the important role that micro-organisms play in animal and soil health so insecticides are not used on the property due to their negative impact on these organisms. He applies regular foliar sprays to the pastures to assist the productivity of micro-organisms, ensuring that the micro-organisms feed the plants, which in turn feed the cattle.

One of John's early observations was that if a high percentage ground cover layer was not maintained into summer the soil was prone to drying and cracking. This resulted in tunnel erosion and land slips due to the sodic nature of the B soil horizon on the mid to upper slopes which is prone to dispersing.

Assessment of ecological and biodiversity outcomes

Regenerating pastures and vegetated areas to minimise effects of extreme climatic events

The capacity of a property to cope with extreme climatic events is a critical measure of its resilience and regenerative capacity and this is often determined by a land manager's ideals and management regimes prior to the event occurring.

In the case of Collingwood, John has succeeded in building the capacity of the property to cope with drought events. He focused on building his soil condition to ensure that when intense rainfall events occur the runoff water is retained in the soil. This has enabled him to 'harvest water' into the soil which is critical for dealing with the summer rainfall deficit and the sporadic nature of rainfall on Collingwood.

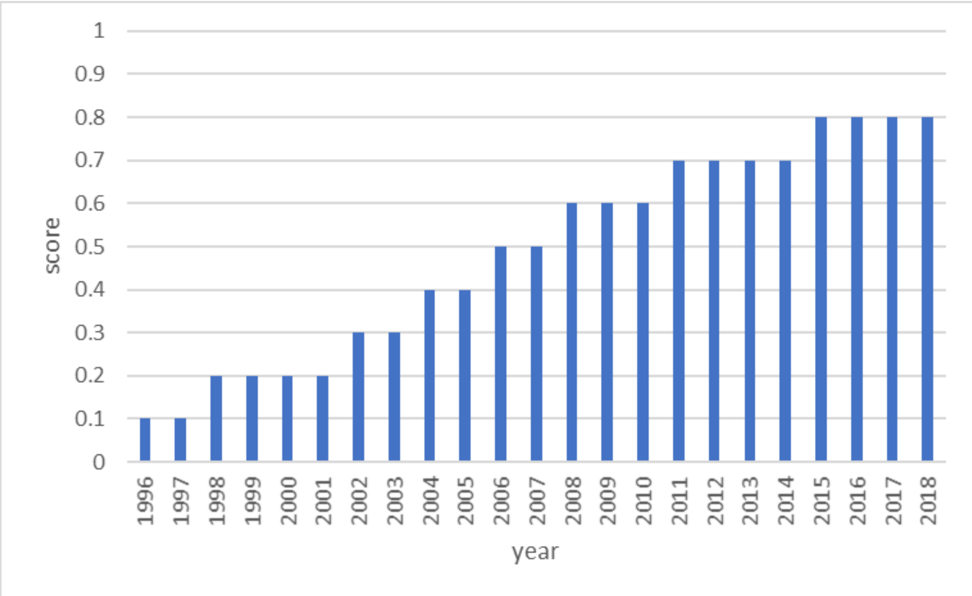

Figure 1. Minimising the effects of the extreme climatic event – flood, frost and drought - in response to changes in land management regimes.

Managing soils to prevent erosion, restore eroded areas and to maintain ecological health, productive capacity and water quality

In 1996 John found that the soil on Collingwood was nutrient deficient, lacking in biological life and with poor physical properties limiting its water holding capacity. He commenced a targeted program of land management practices to rectify these issues including aerating the soil, spreading lime, implementing a rotational grazing system, the introduction of dung beetles, maintaining high ground cover levels and the use of foliar sprays.

Since 1996, John has also controlled annual weeds and selectively introduced desired pasture species to maintain dense root systems to stop the soil from drying and cracking. As a result, John has observed increases in the pH from 4 to 6, the availability of most minerals in the soil, organic matter, improved infiltration capacity and the reduction of soil compaction.

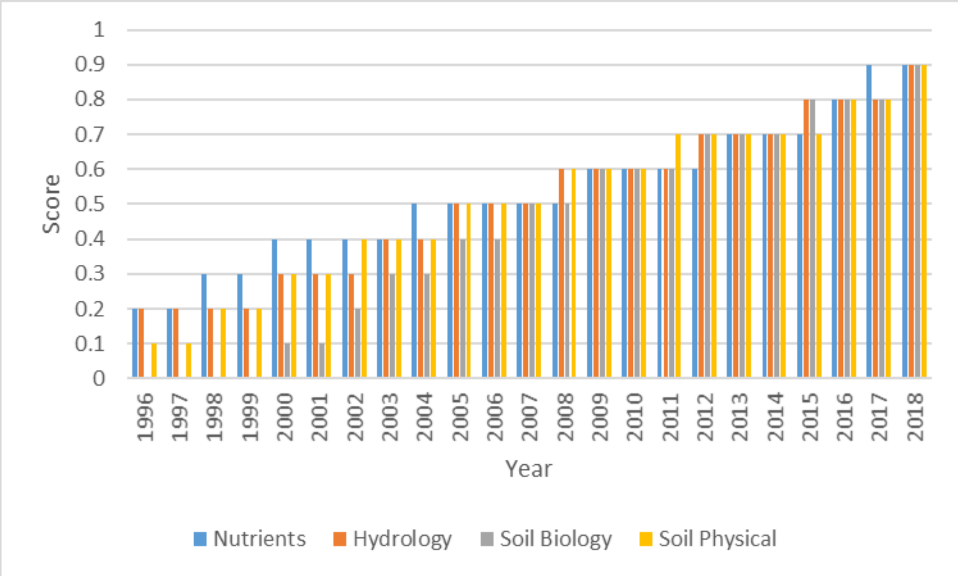

Figure 2. Status of soil indicators over time at Collingwood.

Managing ground layer vegetation for production and to maintain ecological health

John has established a resilient and productive mix of pasture species comprising deep-rooted perennials and maintains high ground cover levels as one of his highest priorities. The productivity of the pastures is a reflection of John’s management strategies integrated into a rotational grazing regime.

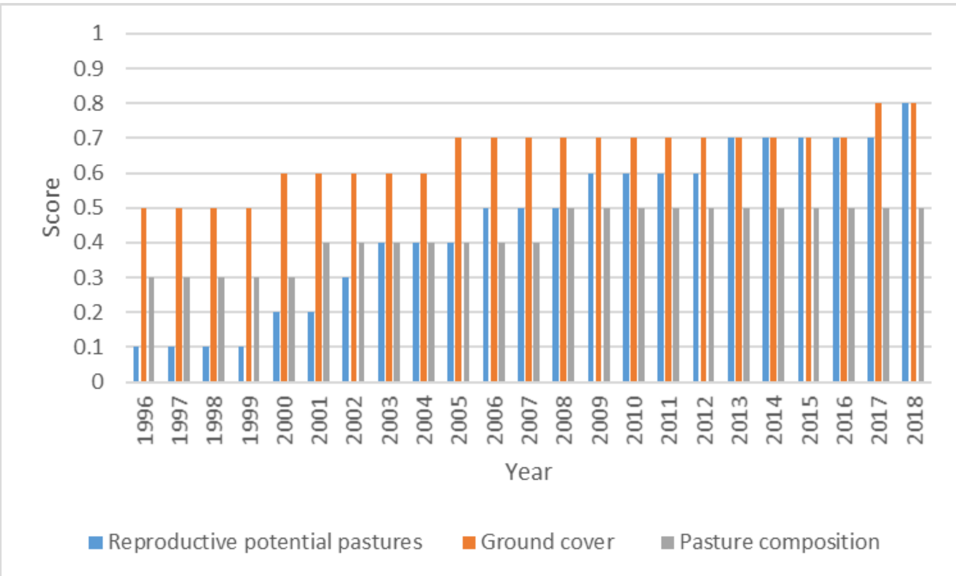

Figure 3. Status of ground cover indicators over time at Collingwood.

Managing trees and shrubs for production and to maintain ecological health of the property and watershed

Patches of sugar gums continue to persist from the period of early settlement and in the 1970 – 80's John Kane's uncle replanted red gums and blackwood extensively. The Soil Conservation Service has also planted flat-topped Yate for erosion control.

Thousands of trees support a wide range of birds which along with beneficial predator insects, control pest insects such as red legged earth mites. John strives to support a diverse ecosystem enabling balance in insect populations that keeps pest numbers below a problem level.

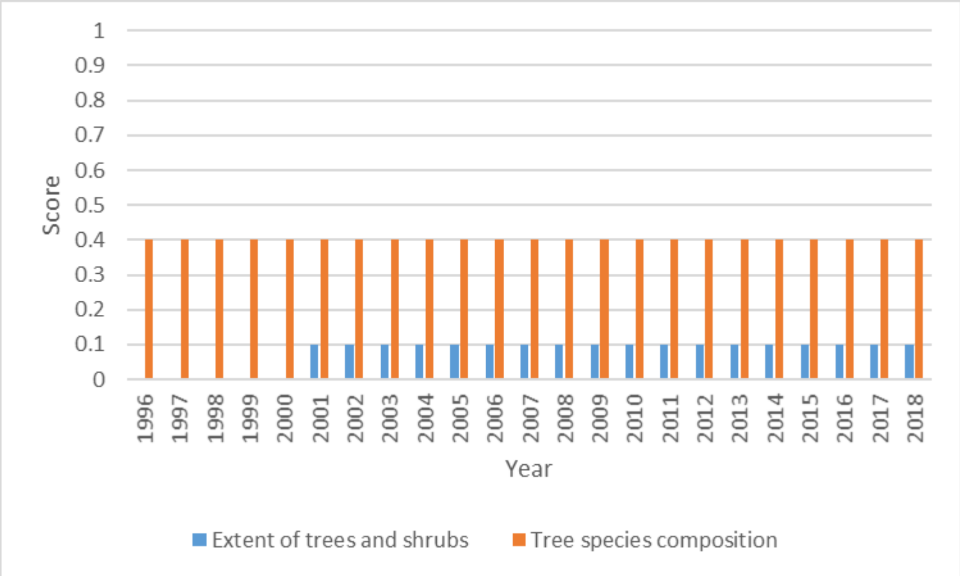

Figure 4. Status of tree and shrub indicators over time at Collingwood.

Managing natural watercourses, riparian areas, natural lakes and wetlands, to protect ecosystems that are sensitive to agricultural land management.

John has done significant work along the 5 kilometres of Kanes Creek which dissects his property. He has planted over 7000 trees to reduce the risk of erosion in the riparian zone and completely restricted livestock access by fencing the creek and dams. Livestock have access to potable dam water from troughs.

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COLLINGWOOD CASE STUDY: DETAILED ECOLOGICAL REPORT

Prepared by Richard Thackway

Key findings

John Kane's cattle breeding property "Collingwood" of 242 ha is located south west of the Grampians in the western district of Victoria. It is situated on the Dundas Tablelands and at the state and national levels the property is located within the Victorian Midlands IBRA region. Across most of the Dundas Tablelands the native woodland vegetation was historically heavily cleared and transformed for intensive agriculture, including grazing and some cropping.

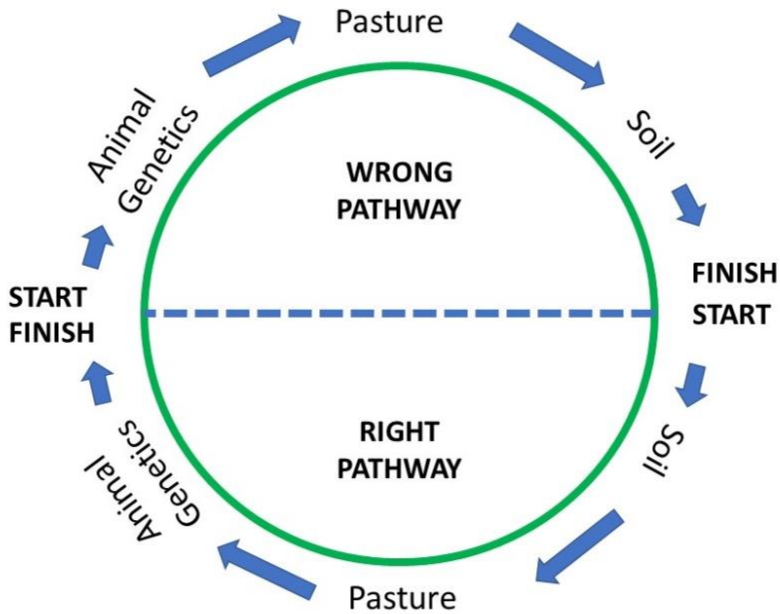
Before John commenced managing Collingwood in 1996, his uncles managed what was to become "Collingwood" as two separate and adjacent farms. A detailed chronology of production systems applying to "Collingwood" is presented in Attachment A.

John has increased the storage of winter rainfall in the soil so that pasture plants can access it during the summer. Fundamental to storing winter rain in the soil was learning how to improve soil hydrology. John found that the soil had a hardpan at a depth of about 200mm, caused by years of ploughing with a mouldboard plough.

Mouldboard plough

When John took up managing Collingwood, he started with the sheep and cattle his uncle was breeding. In 2000 John decided that he would get rid of the sheep and concentrate on improving the quality of his cattle herd, yards and fencing because the infrastructure for both sheep and cattle was inadequate. Initially he purchased more expensive bulls with proven genetics to turn off calves at a higher weaning weight and better structure. However, he decided that feeding cattle on degraded pastures was not the best strategy so undertook a vigorous pasture improvement program realising that the starting point must be improving soil fertility.

The basis of his reasoning was if you have healthy soil you can grow healthy plants and the cattle will eat the healthy pastures. It then follows: healthy soil = healthy plants = healthy stock = healthy humans. It all starts with the health of the soil.



To solve the hard pan issue in his soil, and to improve productivity John's solution was threefold; mechanical, chemical and biological.

1) Using a heavy duty soil aerator towed by a 4wd tractor was used to cut through the hardpan.

2) Adding lime to modify the pH to improve pasture growth, and

3) Encouraging populations of European dug beetle, *Bubas bison* which improves soil aeration, increases water infiltration into soil, which reduces run-off and increases root penetration.

In 1998-2000 John commenced a regular program to establish deep rooted perennial grasses including phalaris and cocksfoot using direct drill. Around this time he started a journey toward understanding and initiating biological farming and took intensive courses in beef breeding, pasture management and water management.

During this period the two smaller family farms were aggregated to create one 600 acre farm and John initiated trials of rotational grazing.

Now John does not cultivate the soil because of the high risk of soil erosion, instead uses direct drilling to seed the different grasses. He knows that to prevent soil erosion he must maintain healthy soil and healthy plants and looks to maintain dense and deep roots and high ground cover levels to prevent the soil from drying, cracking and opening-up.

Collingwood is divided into 12 paddocks rotationally grazed with reticulated water toughs available for stock in each paddock. Animal movement is based on visual assessment of feed availability and animals indicate to John when they are ready to move. The current stocking rate is 16 dse per ha.

John cuts high-quality pasture hay for his farm and uses this as an important management strategy coinciding with the onset of wetter months. He starts feeding out hay from late February and continues to mid-August, with some breaks in Autumn as sometimes with the changing of the seasons there is a good balance of dry and green feed on offer.

	Production system
Phase 1: 1996-1997	Commenced managing 300 acres conventional grazing with crossbred sheep and angus cattle. Attended Neil Kinsey seminar in 1996 and decided to change his farming methods. Commenced regular soil tests
Phase 2: 1998-2000	Commenced a regular program to establish deep rooted perennial grasses like phalaris and cocksfoot using direct drill. Started on journey of implementing biological farming. Started courses in beef breeding, pasture management and water management. Aggregated two family farms to create one 600 acre farm. Initiated trials of rotational grazing
Phase 3: 2001-2008	Installed 120,000 litre capacity tanks on the highest part of the farm to store dam water and then reticulate to stock troughs. Implemented a comprehensive rotational grazing program as now had water in every paddock.
Phase 4: 2009-2018	Farm managed fully regenerative. John's experience enabled him to become a founding member of district's "Soil Health Group". Continued

	to replace and improve infrastructure associated with handling stock, watering stock and electric fencing.

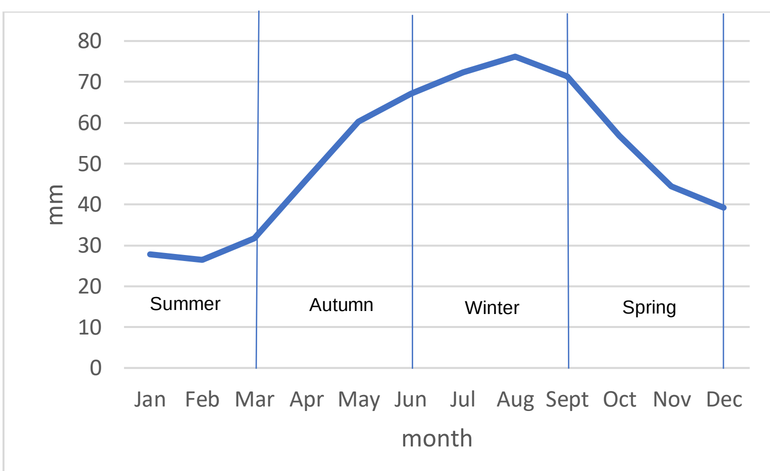
Collingwood in ecological context

"Collingwood" comprises undulating hills 90 to 150 m, above sea level, and a valley that drains to the Wannon River; which is a tributary of the Glenelg River.

The Dundas Tableland is a dissected duricrust plateau comprising a thin layer of marine Tertiary sediments overlaying a Palaeozoic palaeoplain (VEAC 2010). The geology of the Tablelands is variable, ranging from sedimentary beds, metamorphosed sediments, granites, trachyte, rhyolite and volcanics (Agriculture Victoria 1996 – 2019a).

Yellow texture contrast soils dominate in the mid and upper slopes and on the tabletops and the soils are consistent throughout the profile (Yellow or Brown Ferric Chromosols) (Agriculture Victoria 1996 – 2019a). Soils on the mid and upper slopes of Collingwood have a clay dispersing B horizon, which makes them highly prone to tunnel erosion and land slips. Tablelands soils are commonly buckshot gravels, that is soils with ferruginous nodules but they are only there to limited extent on Collingwood. Where present these soils can sometimes become cemented and can be a major limitation for enhancing pasture productivity. Black earths or cracking clays dominate in the valley floors.

The pastures rely on winter and spring rain so between May and September the soils tend to become saturated. The farm's average rainfall is 620mm, which compares to 600-700 mm across the bioregion. The farm's long term seasonal rainfall for the period 1900-2018 is variable around the mean of 620 mm with the patterns of droughts and peak rainfall events over that period indicated in Attachment B. The daily mean temperature across the bioregion ranges from 12-15˚C.



Source: Bureau of Meteorology (nd).

The dominant pre-European vegetation found on the Dundas Tablelands would have been a complex mosaic dominated by Grassy and Herb-rich Woodlands (VEAC 2010). The Tablelands was settled early by pastoralists and has a long history of growing fine merino wool (VEAC 2010). Early agricultural development of the Glenelg River Catchment has contributed to serious land degradation issues including; soil erosion, loss of native grasses and herbs, clearing and conversion of forests and woodlands to improved pastures (Kellaway and Rhodes 2002).

During the 1920s, with the introduction of subterranean clovers and super-phosphate, grazing industries in the district expanded rapidly and intensified. Following the two world wars and with new government policies, this intensification greatly increased.

Since the 1950s the extent and diversity of trees on Collingwood has increased. At the time of settlement, patches of sugar gums were planted to provide firewood and for internal building construction. John's uncle extensively replanted River Red Gum *(Eucalyptus camaldulensis)* and Blackwood (*Acacia melanoxylon*) in 1970 to 1980s and the Soil Conservation Service planted Flat Topped or Swamp Yate, (*Eucalyptus occidentalis*), a Western Australian tree, for erosion control. 7000 trees were planted along the creek and associated riparian areas.

Assessment of Response Criteria

This ecological assessment commences in 1996 - this date reflects the changing management regimes and John Kane's management ideals over time.

A. Resilience of landscape to natural disturbances – Flood, Drought & Frost

Why track changes and trends in resilience to major natural disturbance/s?

Resilience to major disturbance/s includes the following factors depending on the agro-climatic region (wildfire, drought, cyclone, dust storm, flood, frost). A major natural disaster or natural disturbance event can occur at any time. Some disturbances give a warning, such as a windstorm or electrical storm preceding a wildfire or a flood. Once a disaster happens, the time to prepare is gone. Lack of preparation can have enormous consequences on farm life including; social, ecological, economic and production.

Assumptions and definitions

Seasonal rainfall deficits are a common occurrence in Australia's agricultural systems and Collingwood is no different. Resilience of the landscape to natural perturbations (drought) is an aggregate score assigned across all paddocks within Collingwood. In this context, appropriate drought management dictates regular monitoring of stock numbers and available pasture to avoid the loss of groundcover and exposure of bare ground.

Results and Interpretation

Phase 1 - Commenced managing 300 acres conventional grazing with crossbred sheep and Angus cattle. John attended Neil Kinsey seminar in 1996 and decided to change his farming methods. Commenced regular soil tests

On average, in the key growing season the property receives variable rainfall patterns well below or above average.

In Phase 2 (1998-2000) - Commenced a regular program to establish deep rooted perennial grasses like phalaris and cocksfoot using direct drill. Started on journey to implementing biological farming. Started courses in beef breeding, pasture management and water management. Aggregated two family farms to create one 600 acre farm. Initiated trials of rotational grazing. The property experienced rainfall deficits in the two key growing seasons of autumn and winter. Rainfall in spring and summer was variable.

In Phase 3 (2001-08) - The property experienced rainfall deficits in the two key growing seasons of autumn and winter over this period except for 2003 and 2004. Installed 120,000 litre capacity tanks on the highest part of the farm to store dam water and then reticulate potable water to stock troughs. With water in every paddock, implemented a comprehensive rotational grazing program. Above average rainfall was received in summer of most of this period. Well above average rainfall was received in spring 2001 and moderate above average spring rainfall was received in 2008. Collingwood received well below average rainfall in spring 2004-06.

In Phase 4, (2009-18) - Farm managed as fully regenerative. John's experience enabled him to become a founding member of the district's "Soil Health Group". Continued to replace and improve infrastructure associated mainly with handling stock, watering stock and electric fencing. Seven of the 10 years (2009-18) received above average winter rainfall 2009-13 and 2016. Over the same period autumn rainfall was either average or slightly above average except for 2012-13 which were below average. It is interesting to note that over this period, six of the 10 years received below average spring rainfall including 2009, 2011-12, 2014-15 and 2018, with 2014-15 and 2018 being well below average.

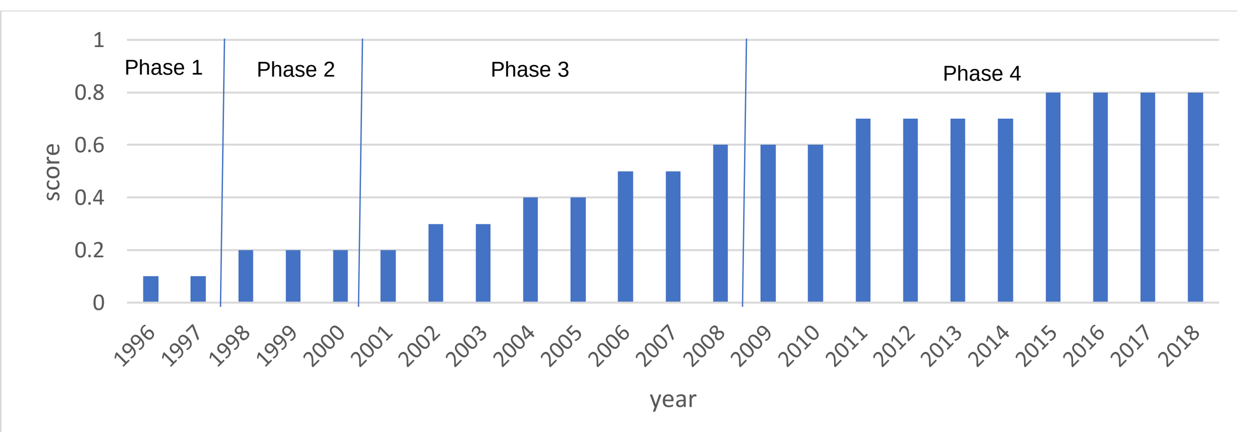
John Kane's production system of rotationally grazing improved pastures relies on autumn and winter rainfall. Despite variable patterns in rainfall reliability and rainfall deficits, Collingwood shows a steady increase in resilience to extreme climate events. John attributes the reasons for this resilience are his management of the soil and pasture. With his focus on biological farming he has learned to harvest rainfall in the wetter periods (spring and autumn) and to store this water in the soil profile. John's term, "water harvesting", describes how he has improved soil condition by overcoming the farm's soil hardpan through increasing soil aeration, increasing water infiltration into soil, increases root penetration and reducing run-off. His solutions have included:

1) using a heavy duty soil aerator towed by a 4wd tractor to cut through the hardpan;

2) adding lime to raise the pH to improve pasture growth; and

3) encouraging populations of European dug beetle, *Bubas bison* to improve soil condition.

Collectively these strategies have enabled John to maintain high levels of ground cover, year round.



B. Status of soil nutrients – including soil carbon

Why track changes and trends in soil nutrients – including soil carbon?

Soil organic matter (SOM) is the basis of soil fertility. As a general rule-of-thumb, for every tonne of carbon in SOM about 100 kilograms (kg) of nitrogen, 15kg of phosphorus and 15kg of sulphur become available to plants as the organic matter is broken down. Thus, SOM releases nutrients for plant growth, promotes the structure, biological and physical health of soil, and is a buffer against harmful substances.

Assumptions and definitions

Soil organic carbon accounts for less than 5% on average of the mass of upper soil layers and diminishes with depth. According to the CSIRO, in good soils, soil organic carbon can be greater than 10%, while in poorer or heavily exploited soils, levels are likely to be less than 1%.

Results and Interpretation

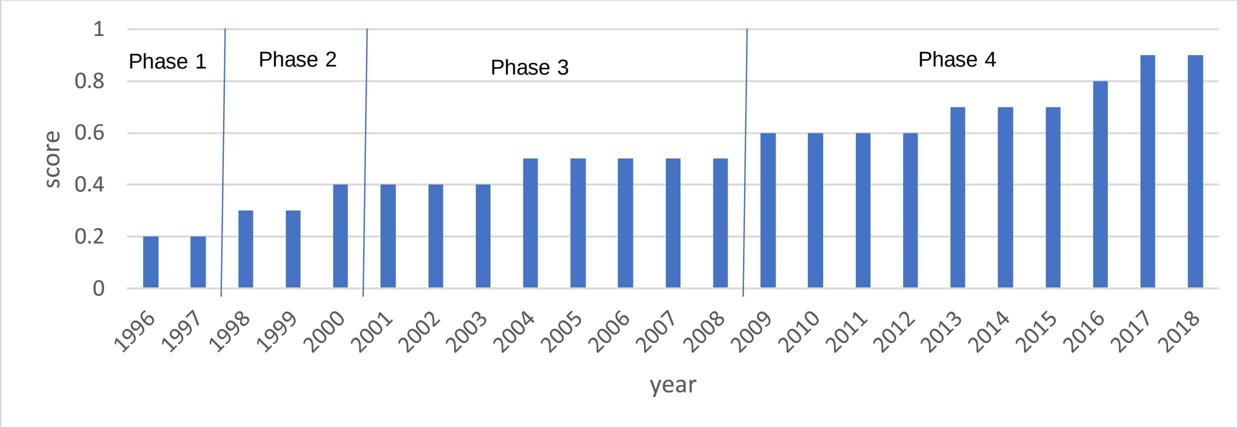
In Phase 1, the pastures were run down and carried a relatively high proportion of annual weed species. John initiated soil tests, commenced observations and research on the farm, which collectively indicated an over-use of superphosphate, poor soil hydrology and considerable bare ground after broad leafed annuals died off.

In Phase 2 John commenced a program to adjust management regimes to improve soil condition. John's fertiliser program saw the cessation of superphosphate and the use of mineral fertilizers based on reactive phosphate rock.

In Phase 3 – John commenced using foliar sprays to improve soil nutrients, pasture productivity and animal health. As pasture productivity started to increase in response to soil nutrients John observed the prevalence of cattle dung across the pastures. These dung patties, contained valuable nutrients that were not readily available to pasture plants so John purchased three colonies of dung beetles *Bubas bison* and released these across the farm. The activity of dung beetles would become a vital part of Collingwood's production system, performing several ecological functions. These functions include releasing the nutrients locked up in the dung pads and returning them to the soil for use by plants, increasing water penetration into soil with their burrowing, which in turn reduces run-off and increases root penetration and soil aeration.

Phase 4- John commenced using mineral fertilizers, biological activators, and ceased using insecticides and only used broadleaf herbicides early in the autumn break.

In 2012 soil carbon levels were as follows: Organic matter 6%, total carbon 3.4%



C. Status of soil hydrology - Soil surface water infiltration

Why track changes and trends in soil surface water infiltration?

Soil physical properties have a direct relationship to soil moisture. Soil texture and structure greatly influence water infiltration, permeability and water-holding capacity. In natural landscapes rain water will enter a soil profile, some will be stored within the root zone for plant use, some will evaporate, some will be transpired by vegetation and some will drain away. Agricultural land management regimes can modify and transform these ecological functions for example by increasing water infiltration, or adversely affecting the permeability and water-holding capacity which can lead to increased surface flows over the soil during intense rainfall events.

Assumptions and definitions

The Victorian Department of Agriculture (1996 – 2019b) has documented examples of soil deterioration and erosion associated with hydrological imbalances in the valleys and the edge of the tablelands in the Glenelg Land system. In the laterite top layers of the tableland, with bases of kaolinised rock, seepage frequently occurs into the kaolinised zone which is more permeable than the material beneath it. It may be reasonably assumed that since the replacement of the original native perennial tree cover by sparse annual pastures, the soil condition has changed and increased seepage has been initiated. Without a tree layer, more water is held in the soil than was previously the case, because of soil water being removed from the soil profile via evapotranspiration by trees and deep rooted native grass species. The increased penetration of water to the deeper subsoil and below, results in prolonged saturation of the A horizon, which in the case of these sodic soils (B horizon) has an inherently higher risk of erosion associated with the loss of soil structure by spontaneous clay dispersion, and very low rates of hydraulic conductivity (Loveday and Pyle 1973).

Seepage from the base of the laterite in the dissected areas can in isolated cases cause saturation of the subsoils on steep slopes which can initiate earth flows or slumping. An example of such an earth slump occurred on "Collingwood" in the 1940s, which is still visible today.

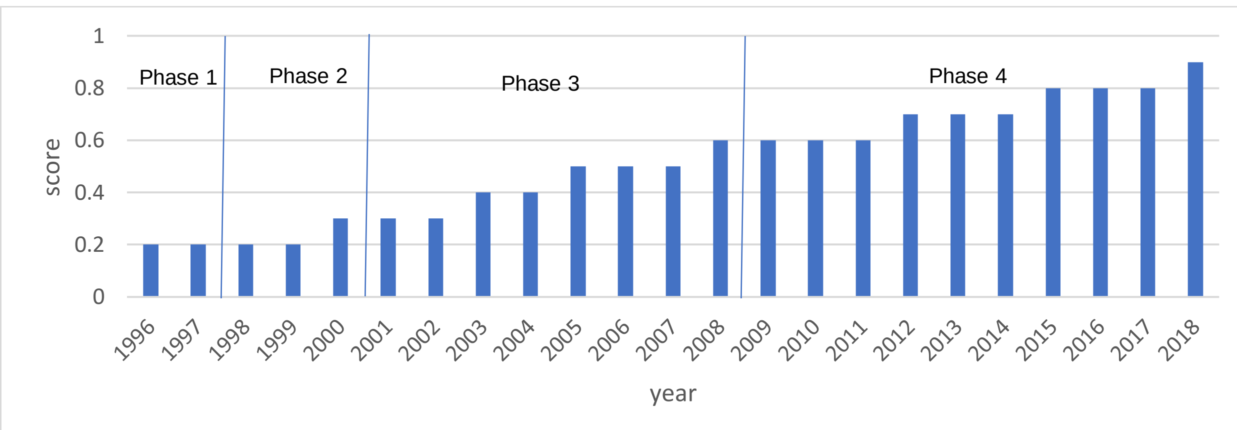
Results and Interpretation

In Phase 1, John observed considerable bare ground after broad leafed annuals died off and during intense rainfall events, rainwater flowed across the surface of the soil and was not being captured by the plants. For John, this indicated poor soil hydrological function.

Phase 2 - John discovered that the soil had developed a hardpan at a depth of about 200mm, caused by years of ploughing with a mouldboard plough. John returned to the farm to prepare the soil for re-establishment of improved pastures for the property.

Phase 3- John purchased a "superworm" mechanical aerator to help crack the hard pans created across the farm as a result of using the mouldboard plough. This machinery proved highly successful through increasing soil aeration, water infiltration into soil, root penetration and reducing run-off. Dung beetles were introduced and these too have improved the soils hydrological properties.

Phase 4- as above.



D. Status of soil biology - Soil biology

Why track changes and trends in soil biological activity?

Soil biology affects plant (and animal) production as it involves the physical, chemical and biological environment within which plants grow and persist. The ratio of fungi to bacteria is important for land managers to understand - too many bacteria can indicate an unhealthy and unproductive soil. Soil fungi contribute to:

- natural processes (litter transformation, micro-food web participation and soil engineering);
- the decomposition of organic material resulting from compost applications and

disturbance from cattle grazing; and
- enhancing nutrient distribution for plant health and productivity.

In healthy soils, there is a good balance between fungi and bacteria and the presence of invertebrates such as arthropods and worms. Collectively these form a vital part of a soil food web.

Assumptions and definitions

The activity of dung beetles is of vital importance to Collingwood's production system, performing several ecological functions. While native and exotic species of dung beetle are found on Collingwood, in John's view it is the southern European dung beetle *Bubas bison* which is critical in winter and spring.

Doube, B. (n.d.) describes *B. bison* as active in the wet winter months burying cattle dung and they can bury most of the dung produced during these wet months in tunnels under dung pads. When the beetles are ready to breed, they dig 50 cm deep tunnels (Doube B). Adult females lay eggs in the tunnels and the young live underground until they turn into adults and emerge from the soil in autumn. *B. bison* is temporarily inactive when there is an extended dry/mild winter season.

When *B. bison* numbers are plentiful over the winter months, dozens of beetles can land on the moist dung pads, which can be completely buried over a few days, otherwise it can take several weeks.

Results and Interpretation

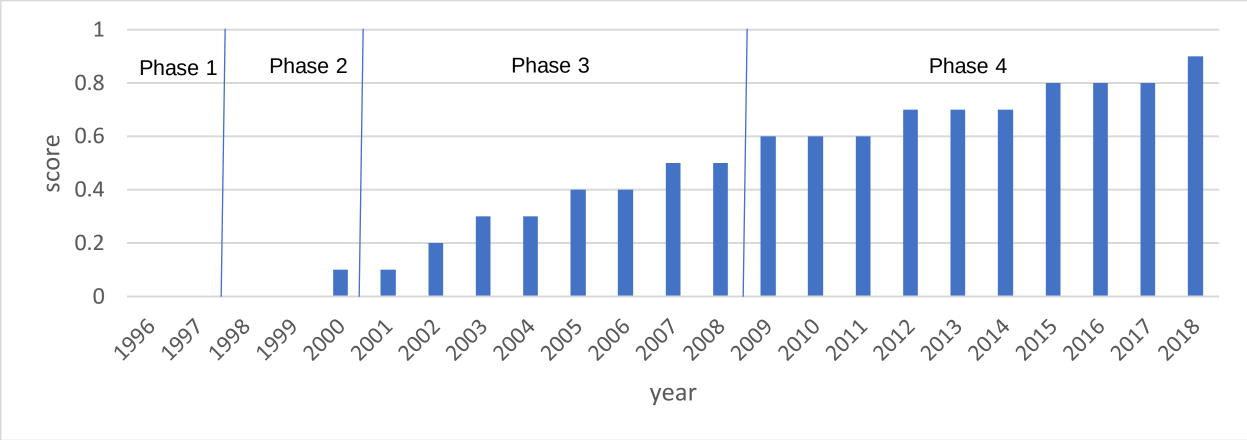
In Phase 1, John commenced observations and research on the farm, which collectively indicated an over-use of superphosphate, poor water holding capacity and considerable bare ground after broad leafed annuals died off. For John, the presence of the annuals and other issues indicated poor soil biological function.

In Phase 2- John commenced courses to educate himself about proper soil fertility, beef breeding, pasture management and water management.

In Phase 3- John commenced using foliar sprays to improve soil biology, soil nutrients, pasture productivity and animal health.

John's production system relies on applications of both granular mineral fertilizers and liquid fertilizers which also improved the gut health of cattle and also improves soil health. This liquid fertilizer aims to build a healthy mix of micro-organisms involving free-living soil microbes fixing atmospheric nitrogen.

Phase 4 - John's goal for pasture management is to maintain 100% ground cover all year around and he is getting close to this. In most years a broadleaf herbicide is added to the foliar spray containing trace elements applied to improve soil biology in the hay paddocks.



E. Status of soil physical properties – as a medium for plant growth

Why track changes and trends in soil physical properties?

Soil is a medium for plant growth, given the right environmental conditions.

Assumptions and definitions

Indicators of improving landscape function over time include soil surface rain-splash protection, cryptogam cover, reduction in soil surface erosion type and severity, reduction in washed/deposited materials, presence of biological structures e.g. perennial tussocks to intercept and retain resources during surface flows, and ground cover complexity which influences permeability.

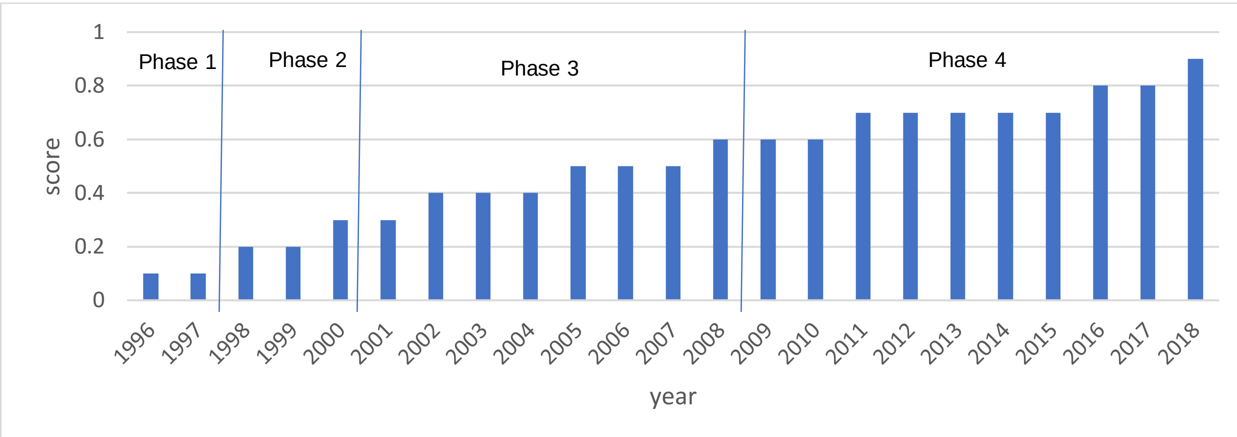
Results and Interpretation

In Phase 1 - After the broad leafed annuals died off there was considerable bare land and during intense rainfall events rainwater flowed across the surface of the soil. For John, these indicated poor soil physical function.

Phase 2 –John discovered that the soil had developed a hardpan at a depth of about 200mm, caused by years of ploughing with a mouldboard plough.

Phase 3- John commenced using a “superworm” mechanical aerator to help crack the hard pans created all over the farm. This machinery increased soil aeration, increasing water penetration into soil, increased root penetration and reduced run-off. Dung beetles were introduced and these too have improved the soils physical properties.

Phase 4- John’s practice of maintaining close to 100% ground cover is essential to prevent drying, cracking and opening-up of the A and B soil horizons in these sodic soils. The development of a grazing land management system that combines resting pastures, applications of biological fertilizers and the maintenance of high ground cover levels have seen noticeable improvements in the physical properties of the soil. In addition, dung beetles continue to improve the soil's physical properties.



F. Status of plant reproductive potential

Why track changes and trends in reproductive potential of plants?

Assumptions and definitions

Development of regenerative land management regimes leads to lower costs of production over time. An understanding of plant reproductive potential involves managing germination, establishment and development of plants.

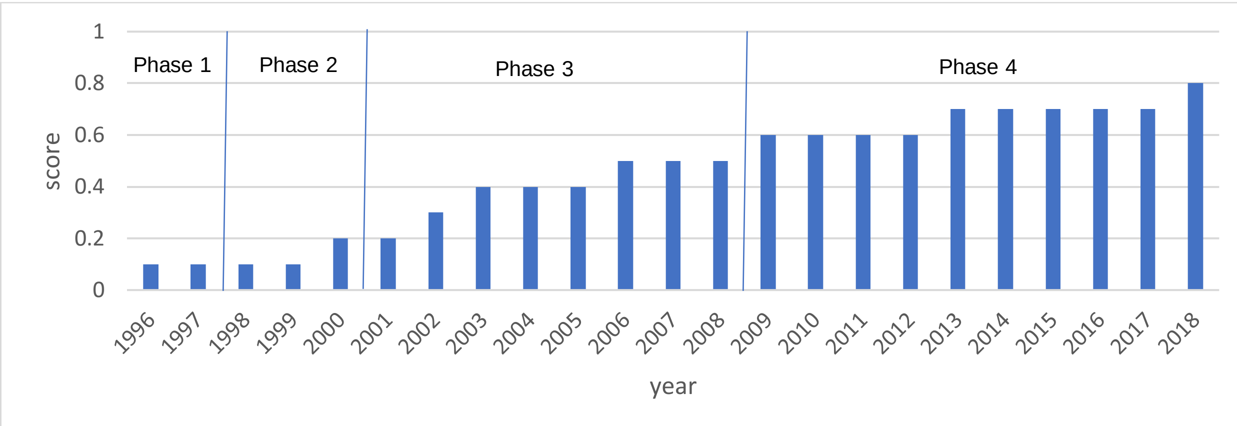
Results and Interpretation

In Phase 1, the pastures were run down and carried a relatively high proportion of annual weed species and the soil had poor water holding capacity in part due to a hardpan at 200 mm. These indicated a rundown of plant reproductive potential.

In Phase 2 – John decided in 1997 to commence a regular program of direct drilling deep rooted perennial grasses like phalaris and cocksfoot into the pastures. John observed the effects of varying the recovery times for pastures following grazing by using a system of paddock-based rotational grazing.

In Phase 3 – John commenced using foliar sprays to improve soil nutrients, pasture productivity and animal health. Pasture productivity and plant reproductive potential started to improve in response to soil nutrients, soil aeration (physical and biological) and rotational grazing.

Phase 4- John had developed a biological approach to farming including a grazing land management system that combines resting pastures, applications of biological fertilizers and the maintenance of high ground cover levels. Dung beetles continue to play an important role as does harvesting and feeding out nutrient rich pasture hay.



G. Status of tree and shrub structural diversity and health

Why track changes and trends in extent of tree cover?

Tree cover in agricultural landscapes provides important ecosystem benefits including;

- mitigation of soil erosion, shelter for pastures, improved animal welfare,
- enabling added revenue from stacked enterprises,
- habitat and breeding sites for pollinators and predatory insects, birds and animals,
- improved salinity management,
- improved interception of rainfall and improved aquifer recharge management.

Assumptions and definitions

At the time of settlement, patches of sugar gums were planted to provide firewood and wood for internal building construction.

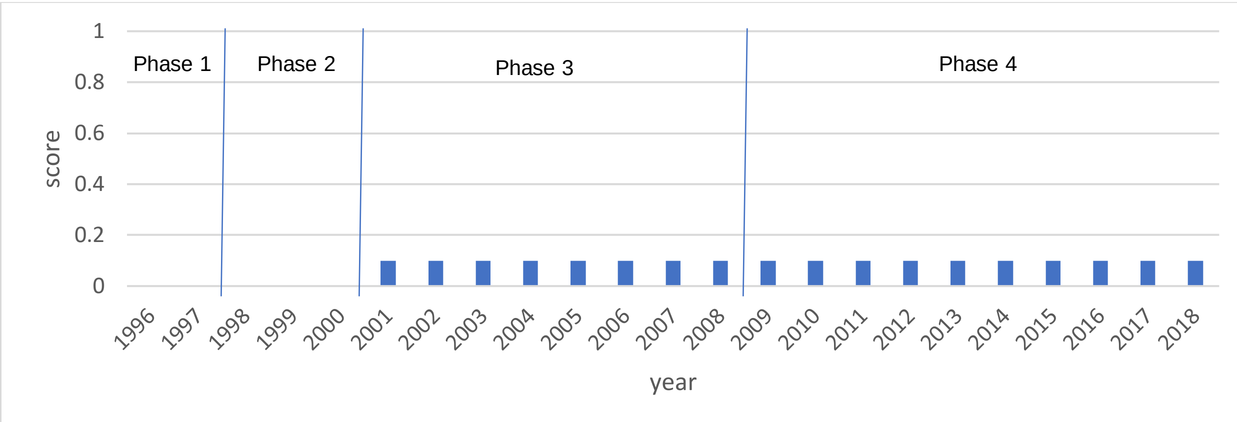
Results and Interpretation

Phase 1 - Since the 1950s the extent and diversity of trees on Collingwood has increased. John's uncle extensively replanted (River red gum *(Eucalyptus camaldulensis)* and Blackwood *Acacia melanoxylon*) in 1970 – 80s and the Soil Conservation Service planted Flat Topped or Swamp Yate, (*Eucalyptus occidentalis*), a Western Australian tree for erosion control.

Phase 2– as above.

Phase 3 – John planted 7000 trees along the creek and associated riparian areas.

Phase 4 – Trees and shrubs planted in Phase 3 have matured and now provide a network of connectivity across the property supporting a wide range of birds. Birds and beneficial predator insects control pest insects such as red legged earth mites. While more trees and shrubs could be planted John considers that the current extent of woody vegetation supports a diverse ecosystem enabling balance between birds and insect populations that keeps pest numbers below a problem level.



H. Status of grass and herb structure - Ground cover

Why track changes and trends in ground cover?

The quality of ground cover provides essential protection to keep the soil cool against direct, searing summer heat by reducing evaporation, protecting bare soil against raindrop splash and wind erosion. A dense matted ground layer of pasture grasses slows overland flows during the intense rainfall events and assist with infiltration of rain, thus mitigating water erosion and replenishing soil moisture.

In Collingwood's intensively managed perennial pastures, dung beetles play an important part in the maintenance of a uniform grass sward, by spreading the dung and by incorporating nutrients into the soil profile, thus maintaining a high level of pasture productivity.

Results and Interpretation

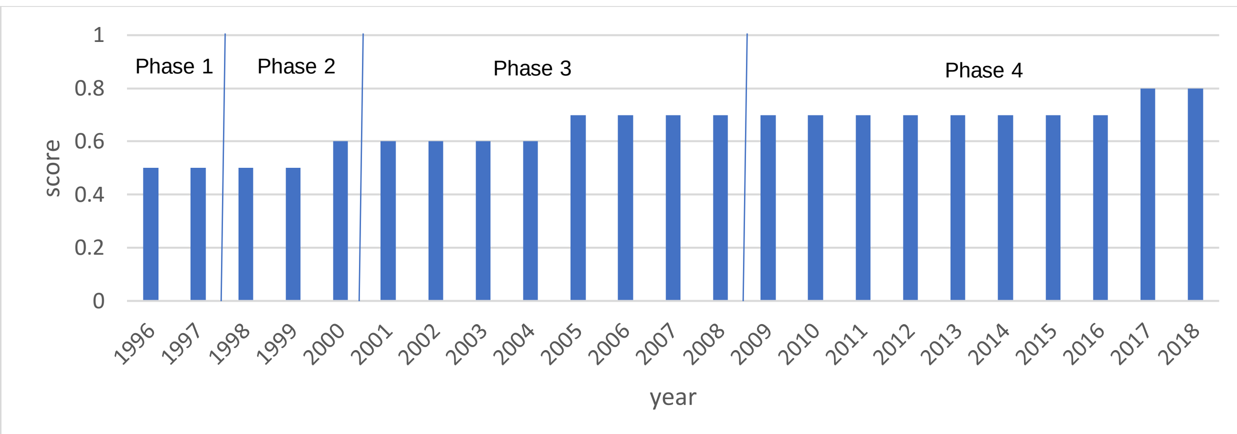
John practices a conservative grazing management regime, which promotes a dense grass sward.

Phase 1- In 1996 the interactions between soil condition and pasture health were poorly understood so developing an understanding of the importance of maintaining high levels of ground cover throughout the year was critical. In 1997 John decided to commence a regular program of direct drilling deep rooted perennial grasses like phalaris and cocksfoot into the pastures. John observed the effects of varying the recovery times for pastures following grazing by using a system of paddock-based rotational grazing.

Phase 2– as above. This production system was progressively modified and improved to develop pasture quality and quantity, which was resilient to rotational grazing under variable rainfall.

Phase 3- as above. The pasture-grazing land management regime was progressively modified and improved using applications of foliar sprays, combining liquid fertiliser kelp and broadleaf herbicide as well as direct drilling pasture species and spelling pastures after grazing.

Phase 4 - John's goal for pasture management is to maintain 100% ground cover all year around, and he is getting close to this. Since 2010 John has renovated the majority of paddocks with deep rooted perennials including cocksfoot and phalaris. He intends to maintain dense and deep rooted vegetation and high ground cover levels to prevent the soil from drying, cracking and opening-up.



I. Status of tree and shrub species richness and functional traits

Why track changes and trends in the status of tree and shrub species richness?

Grazing land management regimes typically result in a reduction in the numbers of species of trees and shrub species as the landscape is modified for pasture production. Grazing animals can inhibit the regeneration of trees and shrub species.

Definitions and Assumptions

Functional traits refer to the types of species inhabiting a place and their roles in that place, and functional diversity reveals how evenly the species are distributed in an area. A decrease in functional richness and evenness decreases an ecosystems productivity and stability. As a generate rule, the more functional traits of plants found in an area, indicates that an area is not intensively managed.

Results and Interpretation

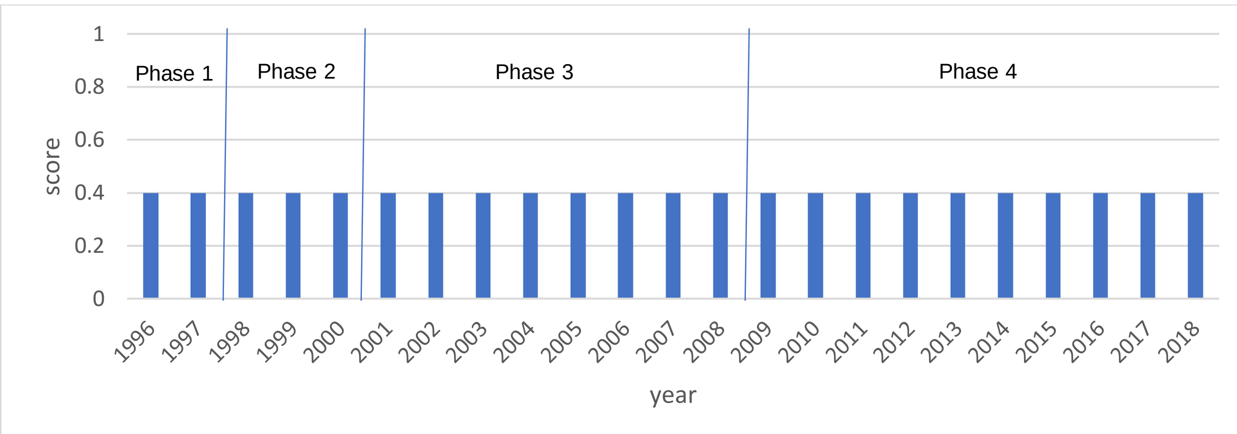
Prior to phase 1, John's uncle worked with the Soil Conservation Service during the 1960's to revegetate the creek lines and riparian areas with a range of tree and shrub species. These tress and shrubs were planted to stabilise the banks and mitigate against further soil erosion and also to provide habitat, food and nest sites for birds and other wildlife.

Phase 1- John maintained and improved the fences to protect the stream banks and the enclosed trees.

Phase 2– as above.

Phase 3 – John planted 7000 trees and shrubs along the creek and associated riparian areas.

Phase 4- John continues to maintain and improve the fences to protect the stream banks and the enclosed trees and shrubs.



J. Status of grass and herb species richness and functional traits

Why track changes and trends in grass species diversity?

In many grazing land management regimes, the variety of pasture plants (annuals and perennials) can improve production, protect natural resources (soil and water) and build the capacity of farming systems to adapt to future production and environmental challenges. The intensity of the grazing management system will determine the health and vitality of pastures and their longevity.

The selection of the perennial pasture species for a grazing production system, should be based on considerations of climate, soil conditions and performance of pasture species under different management regimes.

Assumptions and definitions

In an agricultural setting, functional traits refer to the diversity of plant species found in an area and this closely related to productivity and stability.

Results and Interpretation

Prior to Phase 1 the Victorian Soil Conservation Authority, identified Coleraine and Ararat districts as the worst soil erosion hotspots in Victoria. A major capital works program was undertaken on many other farms across the district to rectify this and on Collingwood the fencing capital works were undertaken by the Soil Conservation Service in 1960's. In 1995 these fences were repaired by John's uncle.

In 1995 the interactions between soil condition and pasture health were poorly understood and as a result Capeweed was prolific. Capeweed *Arctotheca calendula* is an annual or perennial plant native to South Africa. At times Capeweed can provide feed but its leaves cover wide area which when the plants die in early in summer leaves large areas of exposed bare ground and provides haven for red-legged earth mite and lucerne flea.

Phase 1 – John commenced eradicating Capeweed when he took over managing the property in 1996. He determined that it was important to spray in autumn when plants are small allowing low herbicide application rates. He mixed the spray with fulvic acid to improve the efficiency of the Broad leaf herbicide. Onion grass was also controlled using herbicide.

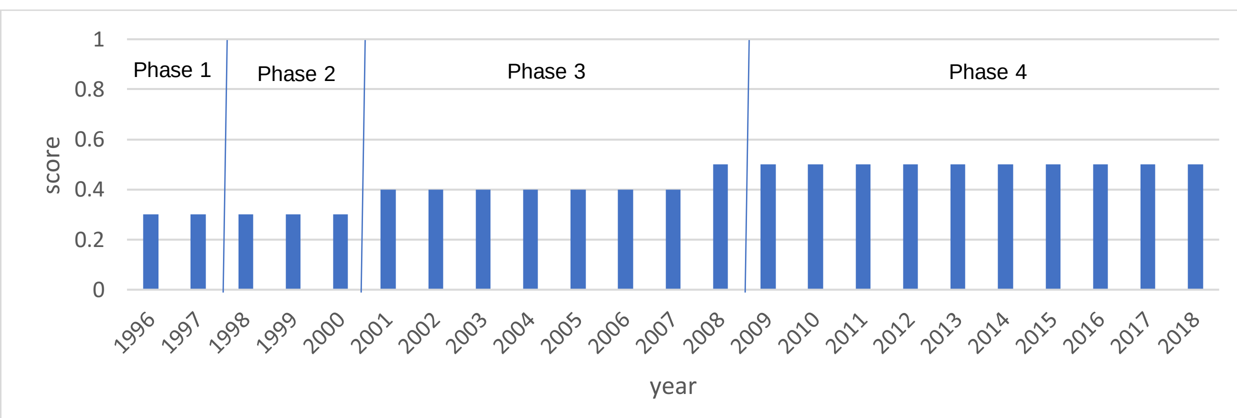
The extent of Capeweed population was reduced by 95%.

Phase 2– as above.

Phase 3- as above.

Phase 4 - John's goal for pasture management is to maintain 100% ground cover all year around. In most years a broadleaf herbicide is added to the foliar spray containing trace elements applied to improve soil biology in the hay paddocks.

Since 2010 John has renovated the majority of paddocks with deep rooted perennials – cocksfoot and phalaris. John does not plough the soil because of the high risk of soil erosion, instead preferring direct drilling clovers, phalaris, cocksfoot, ryegrass, into pastures to build diversity i.e. pasture composition.



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Attachment A

Chronology of production systems and land management regimes at "Collingwood"

Stage 1: 1880's and 1900's – Farm slowly established

1878	First parcel of farmland purchased by my great grandfather, Daniel Kane, who emigrated from Ireland in 1866.
1905	My grandfather purchases additional land from a very large squatter station, "Winninburn" which is broken up into 158 separate blocks of land.
1909	Daniel Kane dies and his land is divided between his seven adult children, including my grandfather. "Collingwood" now consists of about 133 acres and is run as a dairy farm supplying butter fat to the local factory.
1916	Grandfather marries my grandmother and they have 3 boys, including my father.
1930	Grandfather purchases another 50 acres to make the farm size about 153 acres. Milks more cows.
1946	Three Kane boys go off to the second world war. Grandparents sell all the dairy cows. During this particular year there is an enormous flood in the district which cause huge soil erosion problems that we are still dealing with today. Landslips occur and gullies become eroded creeks with v shaped walls up to 15 metres deep!
1950's	My uncle, Tom, farms with his father after returning from the war. Converts the farm operation to sheep and the wool boom takes off from the mid 1950's. Subsistence farming up until now, but the wool boom allows more machinery, fertilizer, fencing etc to be purchased.
1960's	Small parcels of land are purchased to make the farm size about 285 acres. An agency of the Victorian Govt called the Soil Conservation Authority, identifies Coleraine and Ararat districts as the worst soil erosion hotspots in Victoria and a huge amount of capital works are carried out on our farm and many others across the district.
1970's	Droughts and low commodity prices make farming very difficult.
1980's	Farm converted to angus beef breeding operation along with some sheep.

Stage 2: The erstwhile public servant takes over!

1996	After being employed in the Victorian Public Service for 25 years in senior management across 5 different Departments, my family and I take over the management of the farm, which is about 300 acres at this stage. My uncle is 75 years of age. Lots of arguments … you know how it goes!! Decide to work real hard and spend a lot of money on modernising the farm from now until I reach 65 years…and then ease off the pedal. I think I achieved that goal!
1997	We lease 300 acres from my other uncle who farms next door. He is my mother's brother. We now farm about 600 acres, which is a good sized farm considering the excellent soil fertility potential of this area. One of the founding members of the local Landcare Group…which operates for a decade. Decide that deep rooted perennial grasses like phalaris and cocksfoot will be direct drilled on a regular basis across the farm. Ground cover for the entire year is critical.
1998	Decide that I need to educate myself about proper soil fertility and attend a life changing seminar in Naracoorte, South Australia, with the guest speaker being an American agronomist named Neil Kinsey. Also at this time I decide to undertake extensive courses in beef breeding, pasture management and water management. I am absolutely committed to now using mineral fertilizers, biological activators, not using insecticides at all and only using broadleaf herbicides early in the autumn break. The die has been set! I decide to have many soil tests done across the farm – the first time such tests have been done.
2000	My uncle dies and we purchase the 300 acres we have been leasing over the past three years. Finally we have some land that we own and can do anything we like with it! Decide to purchase my own second hand hay making equipment. This was a pivotal decision because everyone wants their hay cut, raked and baled at the same time. I'm now in control of the timing and quality of my hay production!

Stage 3: Farm Modernisation

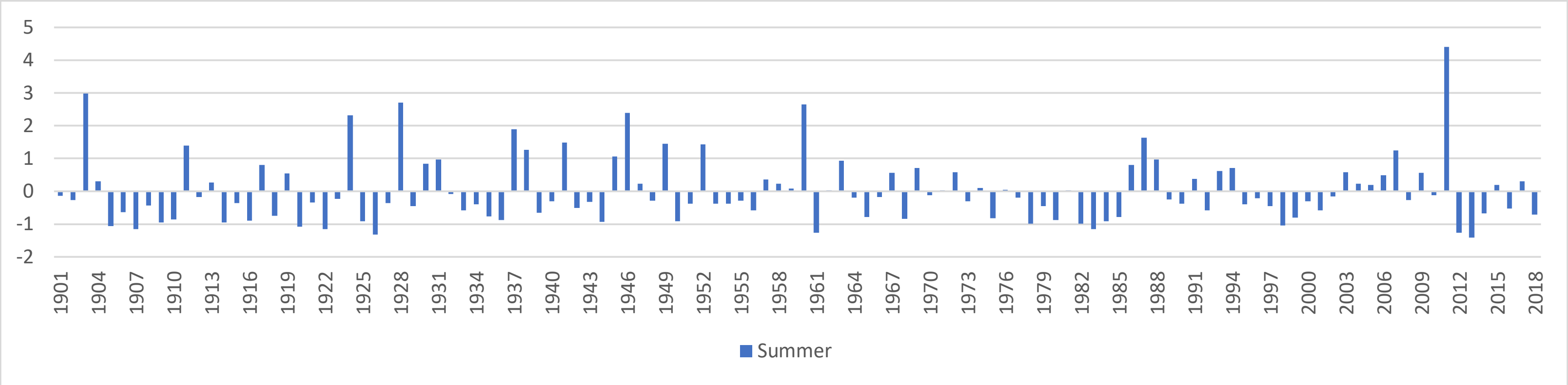
2001	Huge dam constructed (12 metres deep) which drought proofs half the farm. Commenced a concentrated effort of installing new electric fencing across the entire farm. This was very expensive, but you can't have cattle, especially angus, without having electric fencing! Decide that the facilities for both sheep and cattle are grossly inadequate and decide that I will sell the sheep and concentrate on getting the cattle facilities up to a proper standard and fix up the sheep stuff later. Currently we have two shearing sheds and no sheep – so that didn't happen!
2002	Purchased "superworm" mechanical aerator to help crack the hard pans created all over the farm, the result of using the mouldboard plough. Great purchase! Through the Landcare Group over three years, purchased three colonies of

	"Bubas Bison" dung beetles for release across the farm. Extremely successful. Also decide that I will become self sufficient with my own machinery rather than employing contractors or having a lend of gear. Again I purchased second hand machinery and this strategy has really paid off.
2003	All creeks fenced off and 6,000 indigenous trees planted with the assistance of the local CMA. Also over the next couple of years I decide to embark on a relentless campaign of removing two old houses, two former dairies, old sheds, heaps of old pine trees etc and generally get rid of three generations of rubbish! Continue to attend many interesting soil fertility seminars, read heaps of books and above all try different products!
2005	Two silt traps constructed across a very eroded creek to stop silt leaving the farm. Previously the silt would find its way into the local river system and I suppose out to sea. Shocking waste of good soil. I decide that foliar spraying is a great investment and I continue to do this on a semi regular basis today. Decide that my angus bull genetics are not good enough, so now purchase much more expensive "Banquet" genetics. I can see a very quick improvement to my breeding stock and weaners.
2006	Installed 120,000 litre capacity tanks on the highest part of the farm to store dam water and then reticulate to stock troughs. Purchased a "Ditch Witch" and trenched kilometres of poly pipe from these tanks to all paddocks. This cost a fortune, but is one of the best projects I have completed. Start using stock supplements medicated through the new watering system. I can now effectively get accurate amounts of major and trace elements etc for each cow over a three day period. I try to do this four times a year.
2007	Implemented a proper rotational grazing program now that I have water in every paddock. 21 paddocks will now make up my rotational grazing system. Calves are being weaned and sold at 10 months of age at higher weights than before as a result of improved genetics, pastures, water, stock supplements and better hay.
2008	Arrange to clean out and enlarge four dams. At the same time, small dams are filled in. We now have ten really good dams which are all fenced out, trees planted all around storing high quality water.
2009	Go crazy on solar! Install 1.7 kw PV system and a solar hot water system for the house. Replace a mains electric fence energizer with a solar unit and several solar battery chargers for equipment that is not used regularly. Solar pumps to replace windmills are too dear at this stage. See year 2014. One of the founding

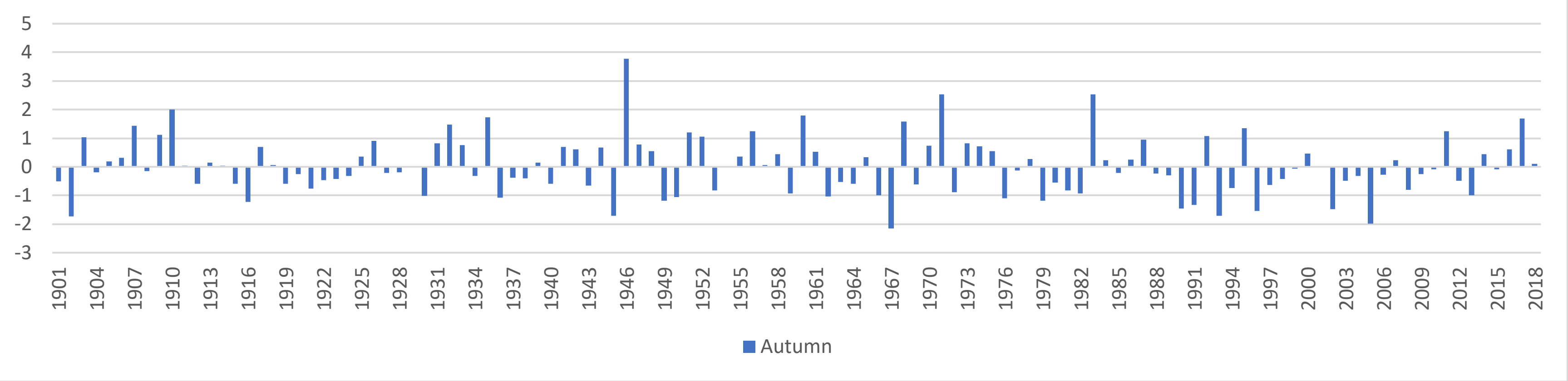
	members of the "Soil Health Group". We organise many seminars over the next 5 years and we have large numbers of people wanting to hear about alternative approaches to soil fertility.
2011	Major improvements to cattle yards.
2013	Following very heavy rains, the local CMA install a trickle pipe assembly leading into a major creek system. Soil erosion problems will always need attention in this region and the CMA have been excellent to partner with. Purchased another 90,000 litre capacity poly tanks to store stock water. I now have 210,000 litres of good quality stock water stored in tanks on the highest part of the farm to be gravity fed into concrete and poly troughs, with the float valves concealed.
2014	Purchased first solar pump to replace two old windmills. This unit has to pump to a head of 33 metres.
2015	Purchase two more solar pumps. All old windmills are retired after 100 years of faithful service!
2016	Coleraine township experiences one of the worst floods ever recorded. Does a lot of damage to the farm.
2018	CMA construct a long levee bank and fill in a huge hole due to the floods in 2016.

Attachment B

Patterns of seasonal rainfall derive from modelled monthly rainfall data for Collingwood[1] showing variants around the mean.



[1] Source: Bureau of Meteorology (nd). Modelled 5-kilometre resolution rainfall data. Seasons are defined as the standard 3 monthly intervals e.g. summer comprising December, January and February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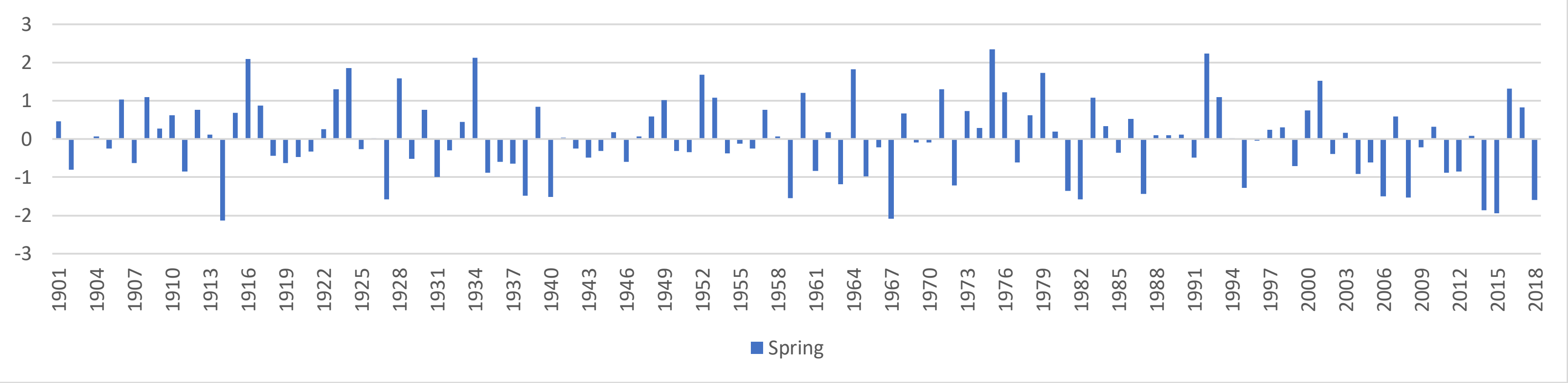
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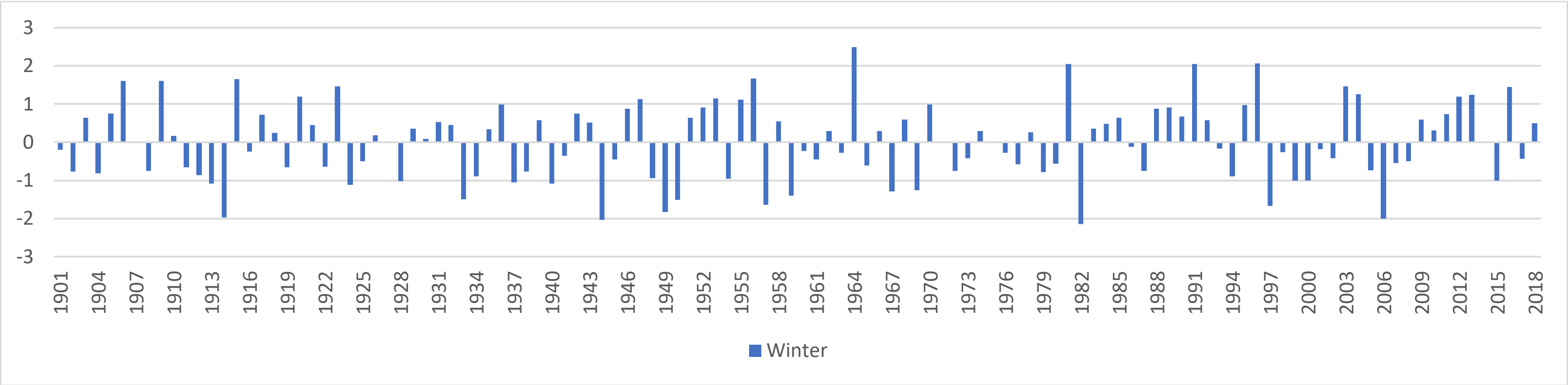
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Acknowledgements

2019 COLLINGWOOD CASE STUDY: ECONOMIC REPORT

Prepared by

RSM

Introduction

Collingwood is located southwest of the Grampians in the western district of Victoria. The farm is a 242-hectare grazing property with primary income derived from the breeding of Black Angus cattle. John Kane took over the management of Collingwood from his uncle in 1996.

Since then, John has implemented a number of regenerative practices in order to improve the productivity and sustainability of the property. In particular, improving the consistency of cattle breeding, introducing rotational grazing, and improving soil nutrients, hydration and structure. In this report it can be found that John has significantly higher investments towards particular expenses which reflects John's investment in modernisation. This has resulted in a 36% average annual increase in income for Collingwood.

John's higher expenses illustrates the reality of farming, implying that regenerative practices are not always necessarily low in cost. Nonetheless, the outcome in both the financial and productivity aspects imply that these investments allow him to receive a higher return in income.

This economic report will illustrate the positive effects that regenerative practices has on the profitability, productivity, and natural capital of Collingwood. To do this, we will compare current financial and production figures to historical figures and industry benchmarks.

Please note – for the sake of privacy the data throughout this economic report has been 'de-identified'. That is, the data has been reported so that it does not represent the owner's actual financial position, rather it proportionally highlights the changes of incorporating regenerative farming practices. In particular, we have used an index to proportionally represent the financial figures. Where two datasets are compared, we index both sets of data to the benchmark data.

All data in this analysis is presented on the basis of the financial year.

Report Data Sources:

Industry Benchmarks – MLA Farm Survey Data (http://apps.agriculture.gov.au/mla/)

Financial Data – John Kane Financial Accounts

Beef Prices – Index Mundi

Seasonal Conditions and Rainfall Data – Australian Government Bureau of Meteorology

Industry Insights – Published Industry Reports by:

- Meat and Livestock Australia
- Australian Bureau of Agricultural and Resource Economics
- Department of Agriculture
- Department of Primary Industries
- Rural Bank Australia
- Future Beef

Benchmarking

In order to illustrate the success of John's enterprise, we have compared his financials and productivity data to relevant industry benchmarks. In particular, we refer to the 'average farm' as the main indicator for our analysis.

The average farm is a specialist beef producer with a herd size of 100 to 200 and a high rainfall. This benchmark has been sourced from MLA Farm Surveys.

Where appropriate, we have used other industry benchmarks to indicate Collingwood's performance.

Collingwood's Timeline

The Story of Collingwood Property Improvements

Phase 1 1996 – 1997	**Phase 2** 1998 – 2000	**Phase 3** 2001 – 2008	**Phase 4** 2009 - 2018
John commenced managing 300 acres of conventional grazing with cross bread sheep and angus cattle. When he first began managing, the property was in poor condition. In 1996 John attended the Neil Kinsey seminar. This influenced him to change his approach to farming. In 1997, John commenced regular soil testing.	John started his journey towards understanding and implementing biological farming. A regular program to establish deep rooted perennial grasses using a direct drill was commenced in 1998. John also started courses in beef breeding, pasture management, and water management. He also aggregated the two family farms to create one 600 acre farm. Further, John began initiating trials of rotational grazing.	In 2006 John installed 120,000 litre capacity tanks on the highest part of the farm to store dam water and then reticulate to stock troughs. With water in every paddock, John was able to implement a comprehensive rotational grazing program.	The farm is now managed as fully regenerative. John's experience has enabled him to become a founding member of the district's 'Soil Health Group'. He has continued to replace and improve infrastructure that is associated mainly with handling stock, watering stock, and electric fencing.

John continues to improve his property in respect to regenerative farming practices so that Collingwood can continue to perform financially, productively, and sustainably in the future.

As exemplified in the Profitability and Productivity sections of this report, John's improvement of the natural capital of Collingwood has provided significant benefits to his cattle enterprise. In particular, the following improvements are key to John's success:

- Resilience – improvement of pastures allows John to be more resilient in difficult seasons, leading to a greater consistency in business performance and reduced risk
- Fencing – in order to implement a successful rotational grazing program, John has fenced the stock water and improved the fencing along the creek line, which in turn has enabled revegetation and allowed water to rehydrate the landscape.
- Stock Medication – supplements that are added to water troughs ensures that each animal gets the required amount of trace elements and food supplements.
- Soil Nutrients – having a high nutrient density in the soil has shown John that the cattle are healthy and unstressed, as a result grazing on well conditioned pastures.
- Weed Management – by addressing annual weeds with a targeted program of spraying with a broad leaf herbicide mixed with fulvic acid.

Figures 1, 2, 3, and 4 below outline a timeline of major events seen in each ‘phase’ that have occurred at Collingwood over the period analysed throughout this report. The events outlined below are those that have major impact on Collingwood’s financial performance and productivity. The consequences of these events will be explained further in our analysis.

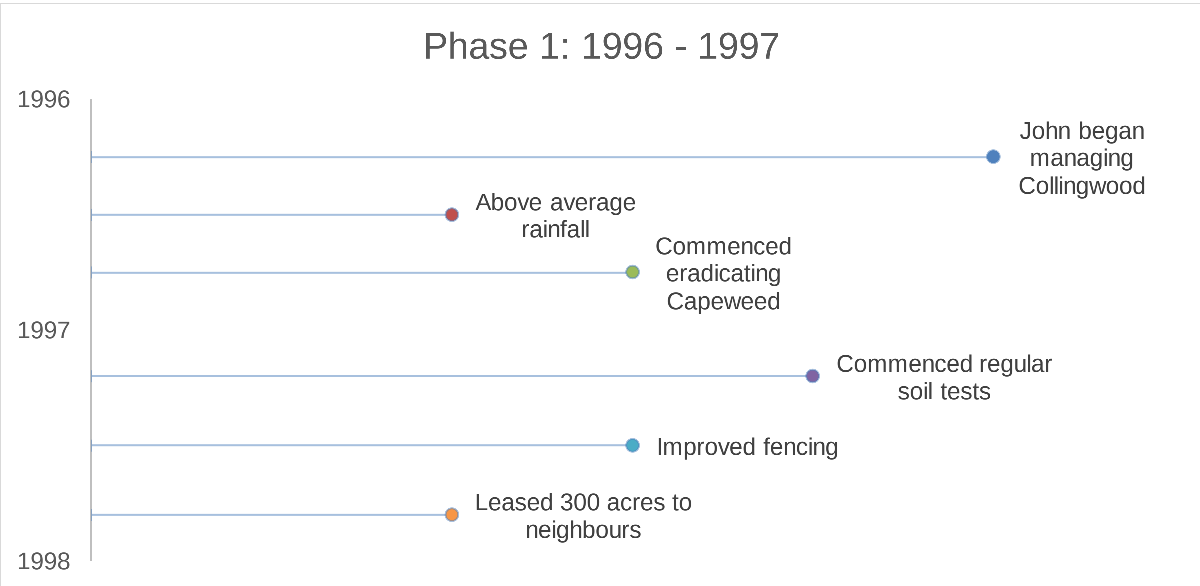

Figure 1: Collingwood’s Major Events Timeline Phase 1

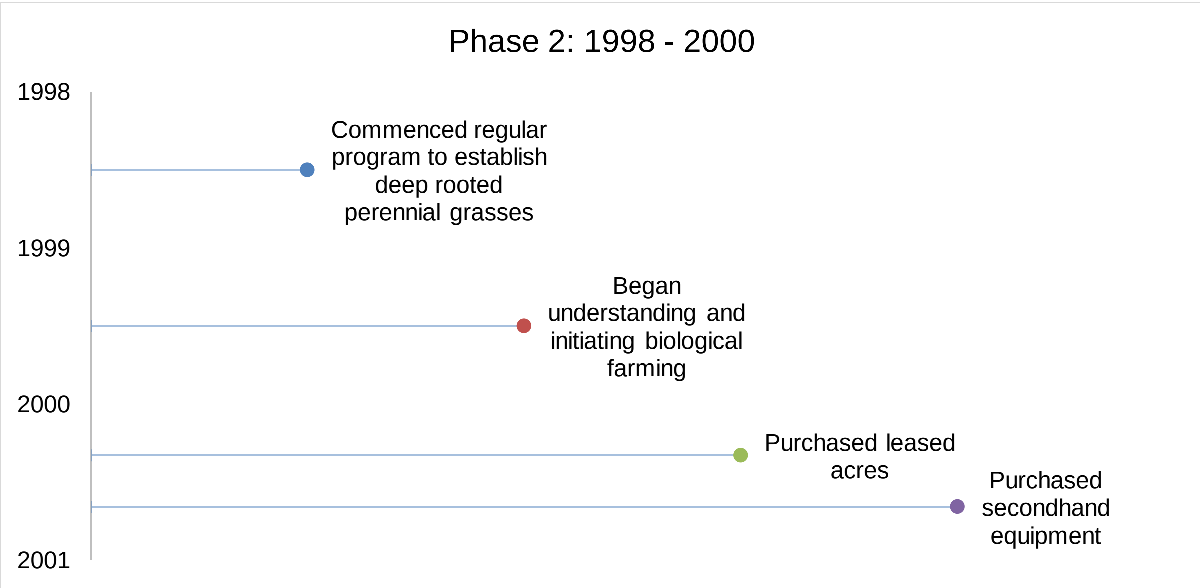

Figure 2: Collingwood's Major Events Timeline Phase 2

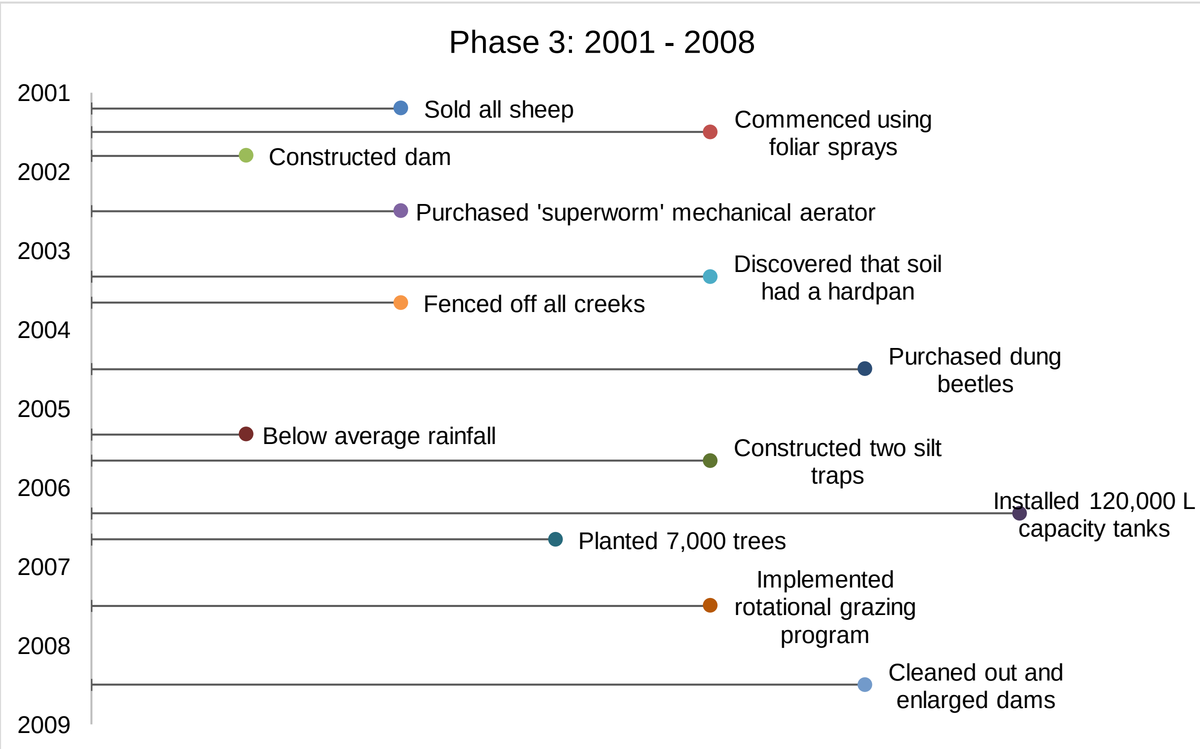

Figure 3: Collingwood's Major Events Timeline Phase 3

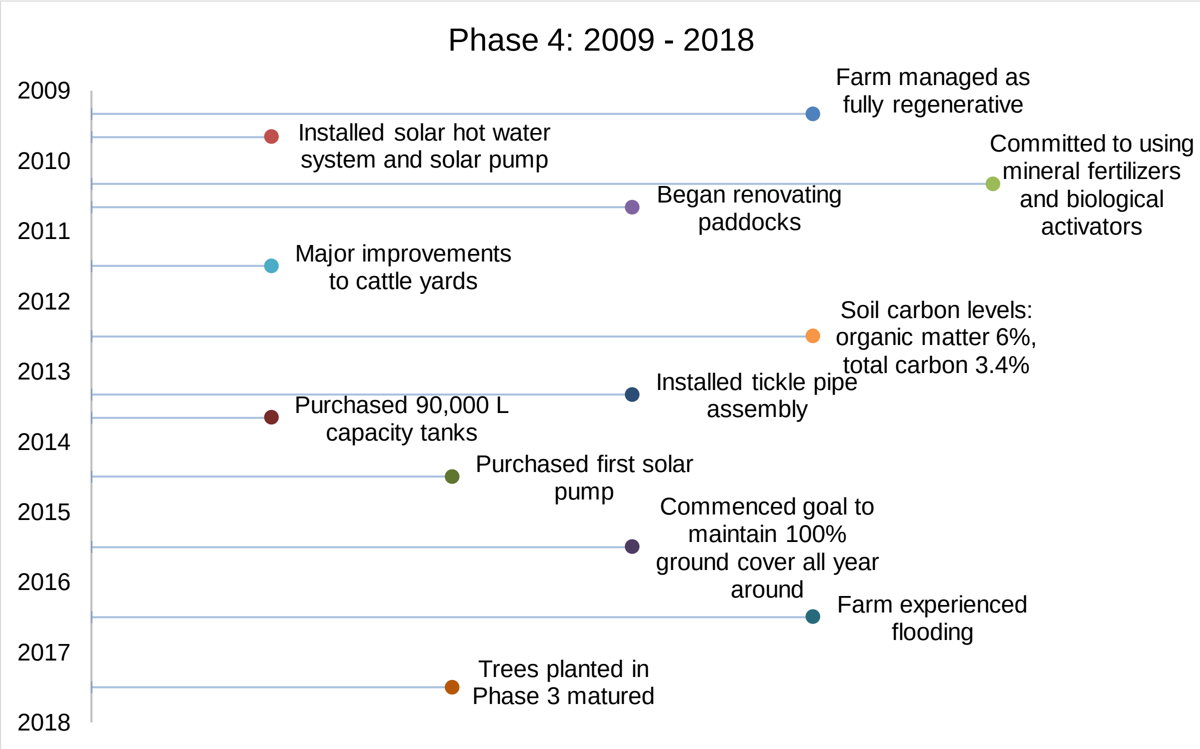

Figure 4: Collingwood's Major Events Timeline Phase

Profitability

Business Profit

Figure 5 below illustrates the business profit for Collingwood and the average farm.

- Generally, Collingwood has performed well above the average farm.
- Collingwood experiences peaks in business profit, as seen in 2005 and in 2016 despite having a below average rainfall or flooding.
- In 1997, 2001, 2011, and 2014 Collingwood experiences losses, but performed above the average farm benchmark.
- The average farm generally has losses.

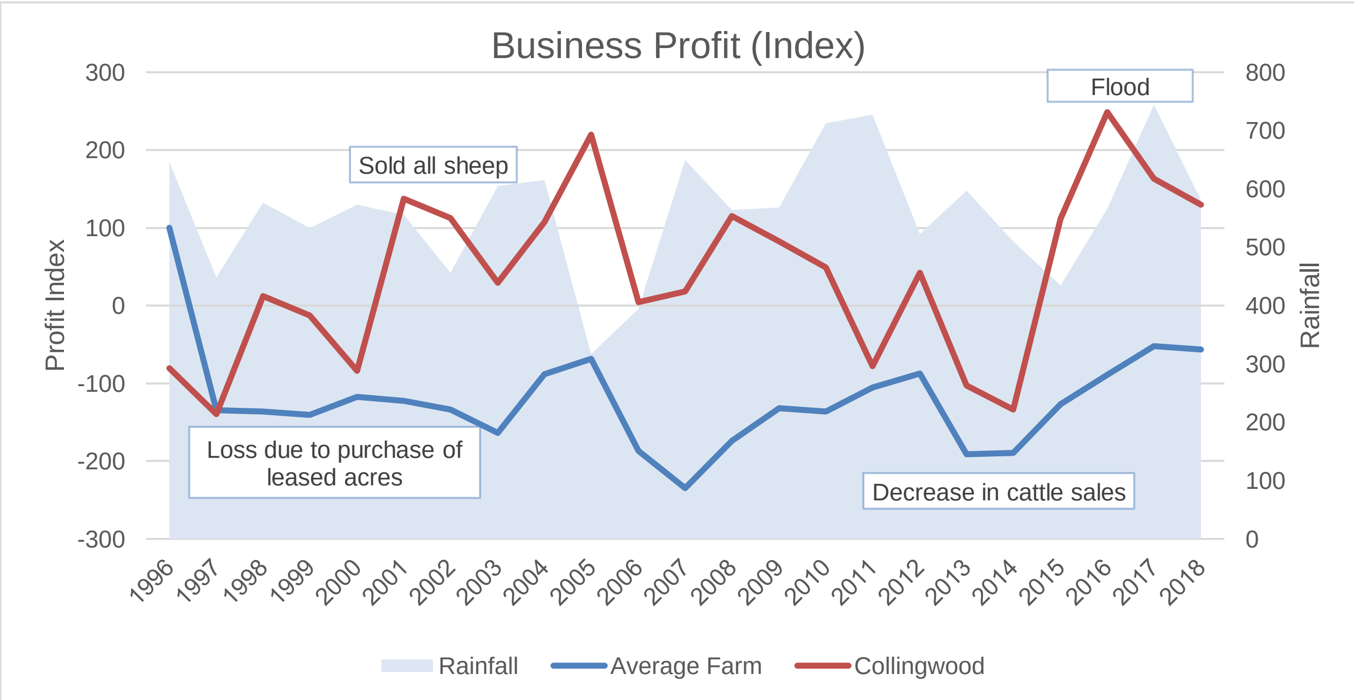

Figure 5: Business Profit (Index)

Data Insights:

- In 2000, four years after John began implementing regenerative practices, Collingwood experiences a loss in business profit.
- In 2001, there is a significant increase of business profitability as a result of John selling all his sheep to concentrate of breeding Black Angus cattle.
- There is a peak in Collingwood's profit in 2005 due to a random sell-off of sheep.
- There is a fall in profit in 2013 and 2014 due to a decrease in cattle sales resulting from a large sale of cattle in 2011 and 2012.
- In 2016 Collingwood experiences a peak in business profit.

Total Income

Figure 6 below illustrates the total income for Collingwood and the average farm.

- Collingwood performs well above the average farm on income.
- In 2014 there is a drop in total income due to less cattle being sold.
- There is a peak in 2015 due to an increase of cattle being sold.
- Collingwood's growth income consistently increases compared that of the average farm which does not show any significant growth.

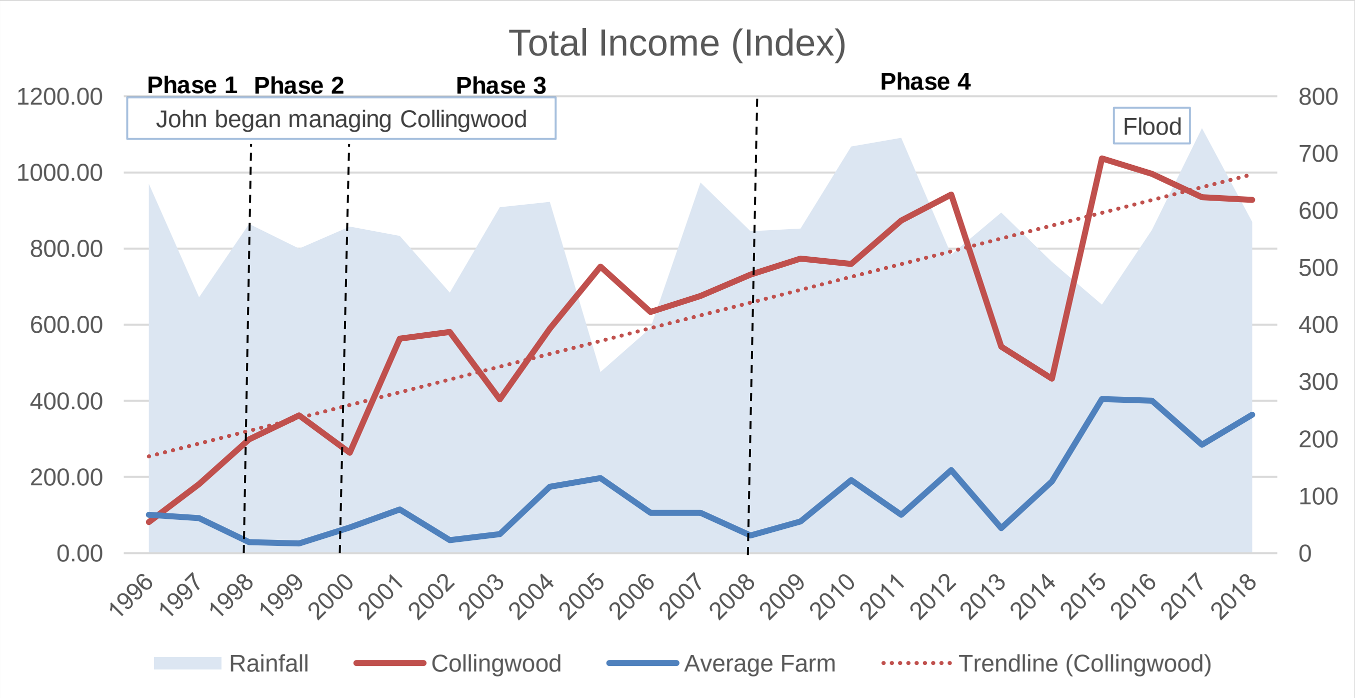

Figure 6: Total Income (Index)

Data Insights:

- Collingwood consistently achieves a significantly higher income each year than other farms in the industry.
- The only year in which Collingwood has a similar income to that of the average farm is in 1996, which is the year that John took over managing the farm. This is when the farm was in poor condition and had not adopted any regenerative regimes.

Expenses

Collingwood's key expense items since 1996 have been compared to the average farm benchmark. It was found that Collingwood's expenditure rate for each item varies in each year.

As seen in 2005-06, Collingwood's total expenses remain consistent – John did not need to increase his investment as per other farms, indicating that he is resilient when it comes to his expenditure.

Overall, the growth in expenses correlates with John's production but remains lower than that of the average farm.

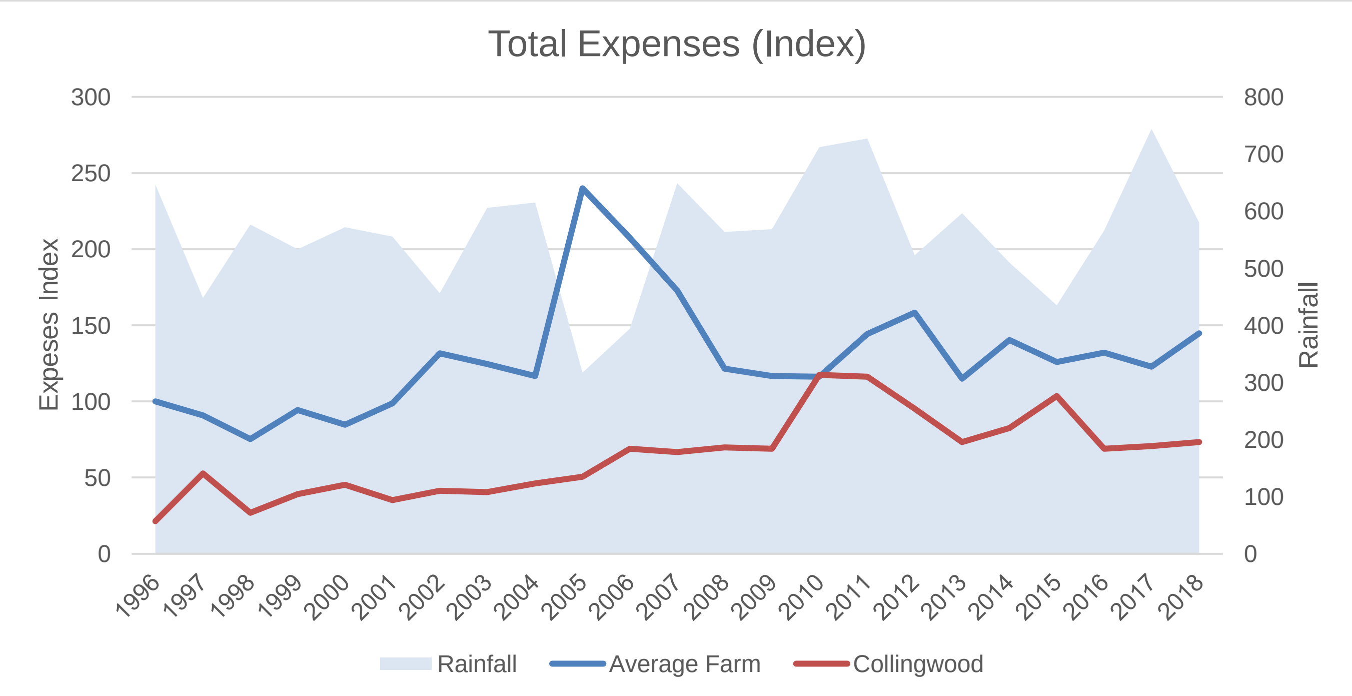

Figure 7: Total Expenses (Index)

The graphs below outline detailed expenditure, year-on-year since 1996. The following are the key relevant expense categories assessed in this report:

- Fertilizer
- Fuel, Oil and Lubricants
- Repairs and Maintenance
- Seed
- Fodder

A key point to keep in mind in this analysis is that John intentionally has a high expenditure on many of the above expenses in order to modernise the farm. To accomplish this, John has focused his investment towards expenses such as fertiliser and machinery. So while some of his expense categories often exceed the average farm to a considerable extent, it is important to note that Collingwood generates a significantly higher return in income and overall total expenses remain lower than that of the average farm.

Fertilizer

Figure 8 below outlines the comparison between Collingwood's fertilizer expense and that of the average farm.

- Over the period of 1996 to 2017, the fertilizer expense for Collingwood is relatively inconsistent to that of the average farm.
  For example, in 2005, Collingwood's expense is significantly lower than the average farm, however in 2011 Collingwood's expenses exceeds the average farm's by over 50%.
- The rolling average calculated shows the average amount spent on fertilizer over four-year interval.

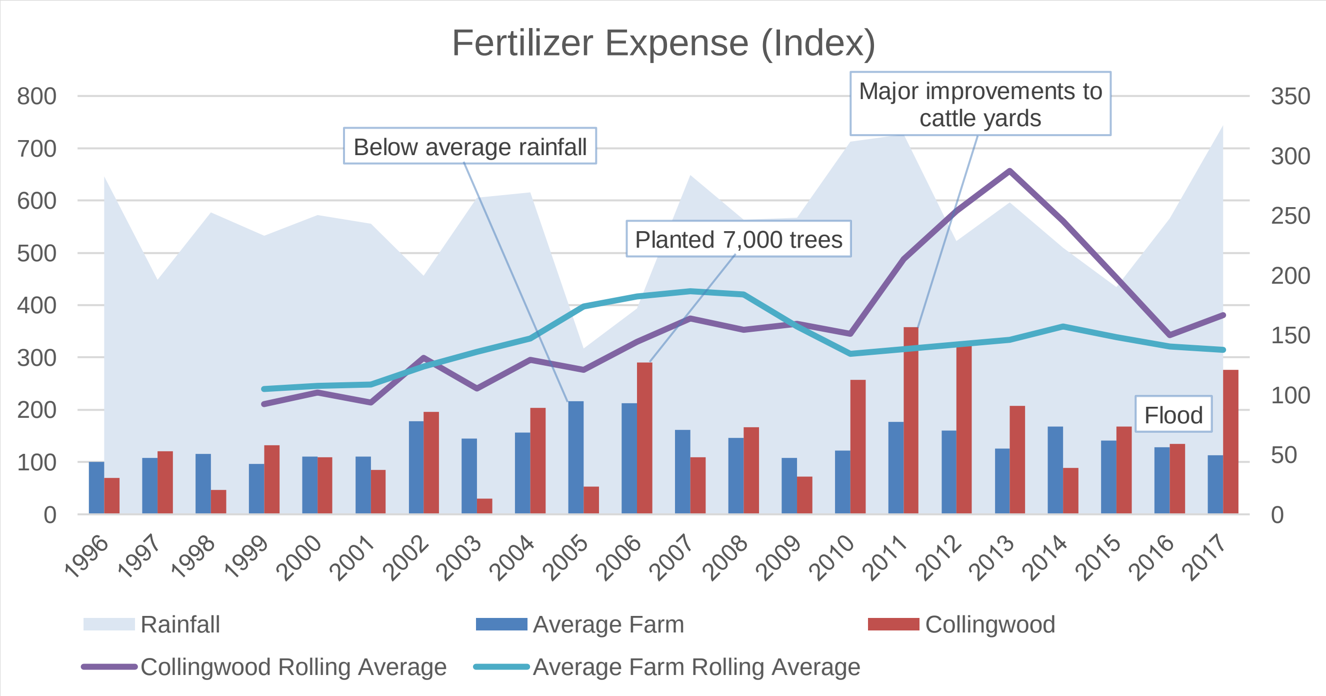

Figure 8: Fertilizer Expense (Index)

Data Insights:

- In 2005, Collingwood's fertilizer expense is considerably lower to that of the average farm. This is due to the farm experiencing a below average rainfall for that year.
- In 2006, Collingwood's fertilizer is noticeably higher to that of the average farm.
- From 2010 to 2017, Collingwood's fertilizer expense continually exceeds the average farm's. This is due to John's commitment to using mineral fertilizers and biological activators, and to not using insecticides at all.

Fuel, Oil and Lubricants

Figure 9 below compares Collingwood's fuel, oil and lubricants expense to that of the average farm.

- Over the period of 1996 to 2017, the fuel, oil and lubricants expense for Collingwood remain similar to that of the average farm.
- Inflation is cause of the increase in cost of fuel.

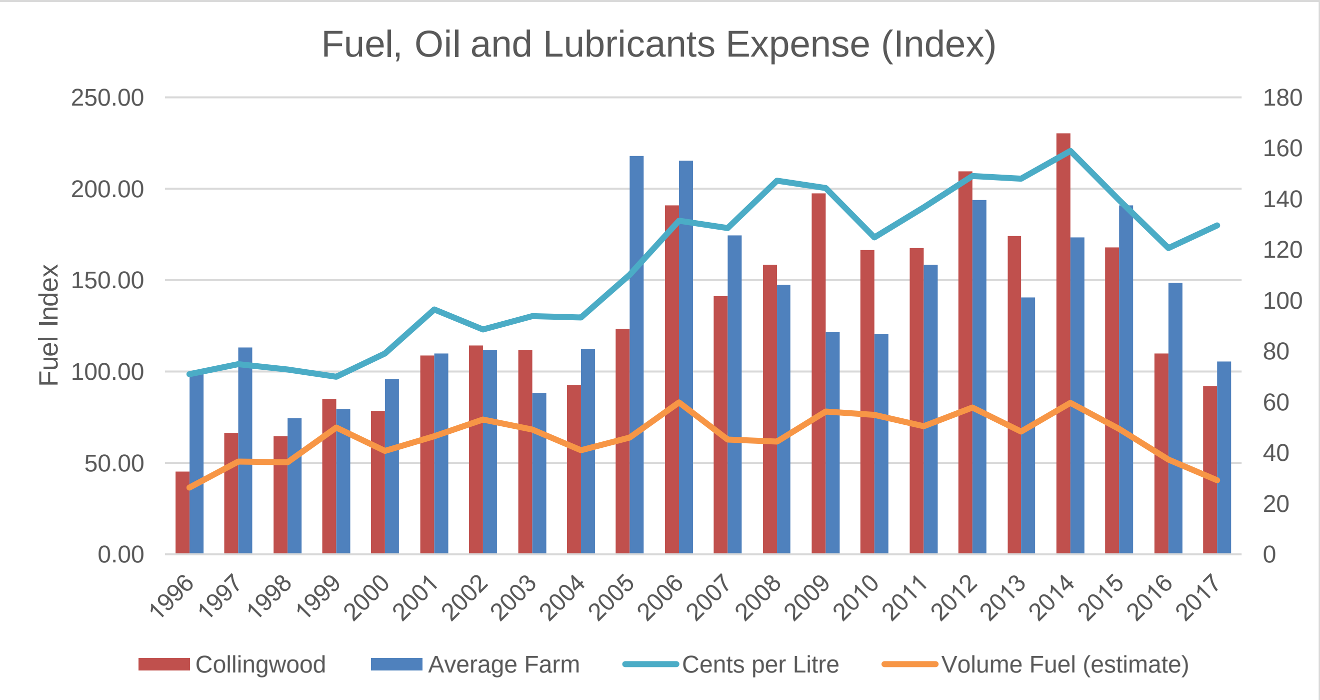

Figure 9: Fuel, Oil and Lubricants Expense (Index)

Data Insights:

- Please note – the increase/decrease in the expense correlates to the rise/fall in the price of fuel for that year. Further, the volume of fuel used has remained fairly consistent year-on-year.
  For example, in 2006 there is an increase in both Collingwood and the average farm's fuel, oil and lubricants expense due to a rise in the price of fuel.
- In 2009 there is an increase in Collingwood's fuel, oil and lubricants expense due to John cleaning out and enlarging his dams.

Repairs and Maintenance

Figure 10 below outlines the difference between the repairs and maintenance expense for Collingwood and the average farm. This is the total expenditure on repairs to motor vehicles, plant and equipment, structures, etc.

- From 1997 to 2017, Collingwood's repair and maintenance expense exceeds the average farm's expense. This is due to ongoing investment in improvements and modernisation of equipment.
- Notable peaks in repairs and maintenance expense is in 1997, 2006, 2009, 2011, and 2015.

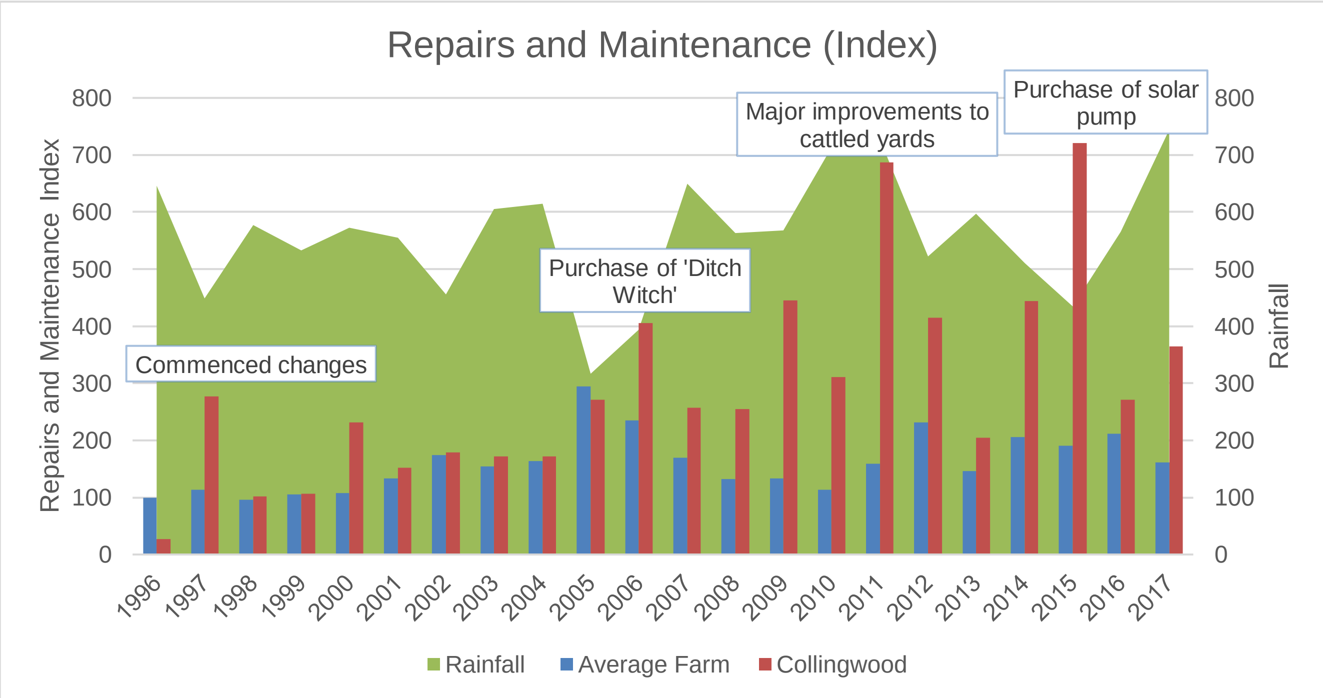

Figure 10: Repairs and Maintenance Expense (Index)

Data Insights:

- In 1997 there is a significant increase in Collingwood's repairs and maintenance expense. Prior to John taking over the management of Collingwood, the property was in an inadequate condition. This increase is due to John implementing changes such as eradicating weeds and improving fencing in order to modernize the farm.
- In 2006 Collingwood's repairs and maintenance has increased as a result of John purchasing a 'Ditch Witch' – one of his most effective and worthwhile expenses, despite being quite costly.
- In 2009 Collingwood's repairs and maintenance expenses are considerably high when compared to that of the average farm. This is due to John's installation of a 1.7 kw PV system and solar hot water system, the replacement of an electric fence energiser, and the replacement of solar battery chargers for equipment.
- In 2011 Collingwood's expenditure significantly exceeds the expenditure of the average farm due to John making major improvements to the cattle yards.
- Again, in 2015, Collingwood's repairs and maintenance expense is significantly higher to that of the average farm due to John's purchase of solar pump to replaces the windmills.

Seed

Figure 11 below illustrates the difference between the seed expense for Collingwood and the average farm.

Collingwood's seed expense does in fact significantly exceed the average farm in some years. Nonetheless, for the most part, it is similar or lower than the average farm.

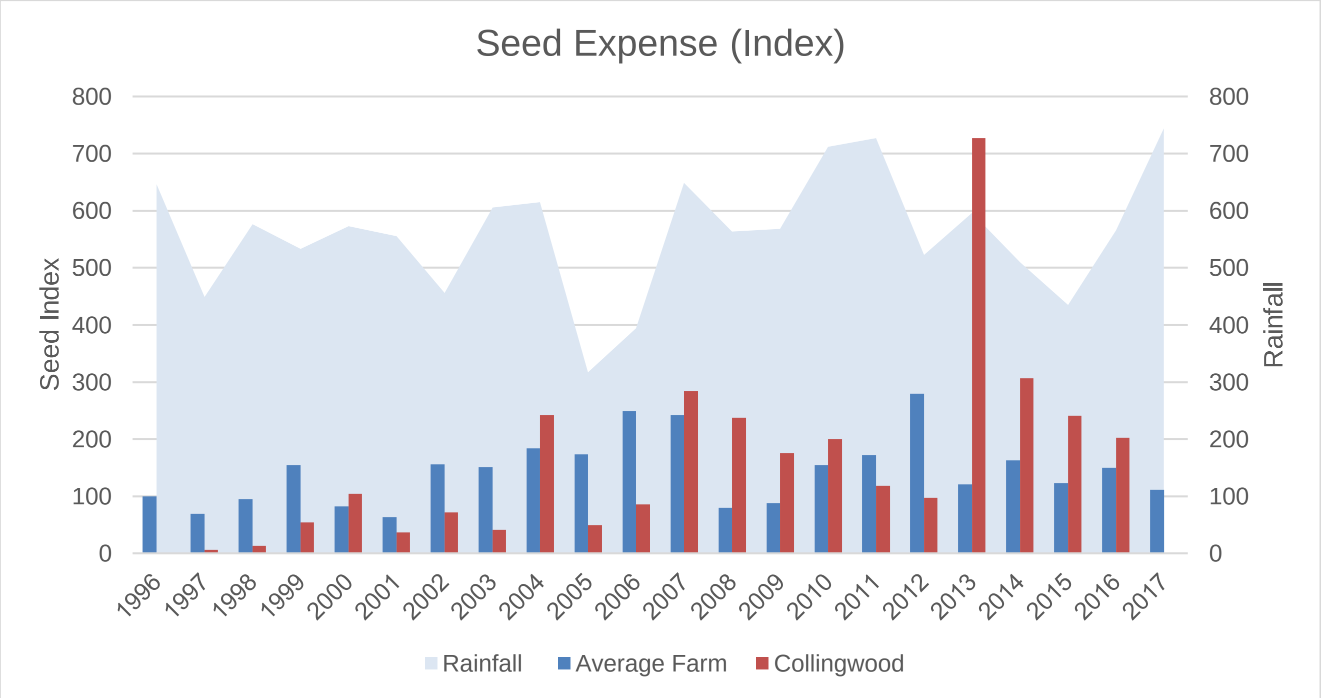

Figure 11: Seed Expense (Index)

Average Seed Expense (Index)	Average Farm	Collingwood
Phase 1: 1996-1997	85	3
Phase 2: 1998-2000	110	57
Phase 3: 2001-2008	162	131
Phase 4: 2009-2018	151	230

Data Insights:

- In 2013, Collingwood experiences a significant increase in seed expense.

Fodder

Figure 12 compares Collingwood's fodder expense to that of the average farm.

- From 1996 to 2017, Collingwood's fodder expense remains significantly low to that of the average farm, apart from in 2007 when John made a shift to rotational grazing that required a one-off investment.

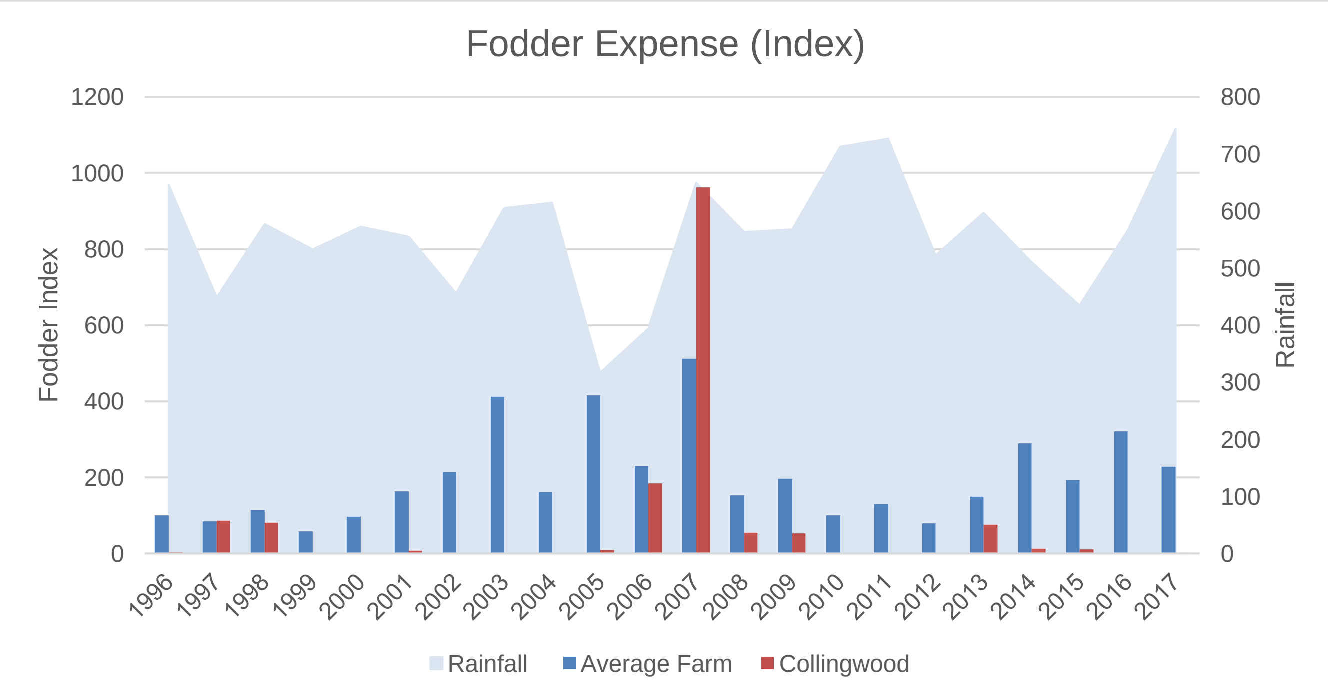

Figure 12: Fodder Expense (Index)

Data Insights:

- In 2007 Collingwood's fodder expense is significantly higher when compared to the average farm.

Productivity

Land Productivity

As noted in the Introduction section of this Economic Report, Collingwood is a 242 Ha cattle farm. The average farm that is used for comparison purposes has been chosen based on a comparable herd size – that is, 100 to 200 cattle – in a high rainfall zone.

The average size of a farm that supports a herd of 100-200 cattle, based on MLA Farm Surveys, is 567 Ha (in 2018). When comparing Collingwood's 242 Ha to the size of the average farm, it is clear that John's beef cattle enterprise is more productive.

The below graph compares the kilograms of beef sold per Ha per 100mm of rainfall for Collingwood to that of the average farm.

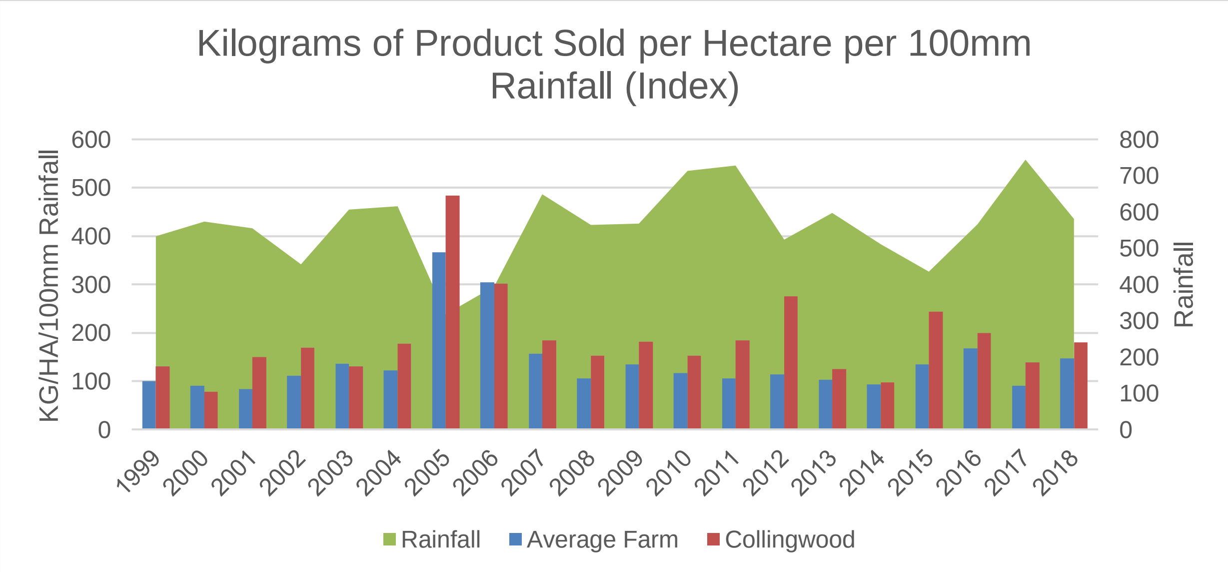

Figure 13: Kilograms of Product Sold per Hectare per 100mm Rainfall (Index)

Data Insights:

- This graph shows that John's productivity per Ha per 100 mm rainfall is consistently higher than the average farm. For example, in 2012 Collingwood's productivity is 141.5% greater than the average farm.
- In 2000, Collingwood's productivity is marginally less than that of the average farm. This is simply due to John focusing on his expenses in Phase 2 to modernise his farm which in turn allows him to receive a higher productivity.
- It can be observed that the years subsequent to high rainfall results in a significant increase in John's productivity.

As can be seen, John's farm is more productive than that of the average farm. This allows John to maintain a much higher stocking rate per hectare than average beef cattle farming enterprises.

John's productivity correlates to his focus on increasing his fertilizers and maintenance expenses. Due to his higher productivity, he is able to invest more on particular expenditures. Nonetheless, John's total expenses remain lower. Thus, John is producing the same amount of cattle for less, resulting in greater profits.

Further, due to John's high expenditure on fertilizer, he has been able to improve the status of his soil nutrients and furthermore increase his levels of soil carbon. In particular, John is able to regularly achieve soil carbon levels of 9% organic matter and 5% total carbon. This allows John to maintain good soil health, fertility, and improve crop and pasture yields.

The below table and graph (sourced from Ecological report) summarise the soil organic nutrient including soil carbon levels for Collingwood over 2002 to 2018.

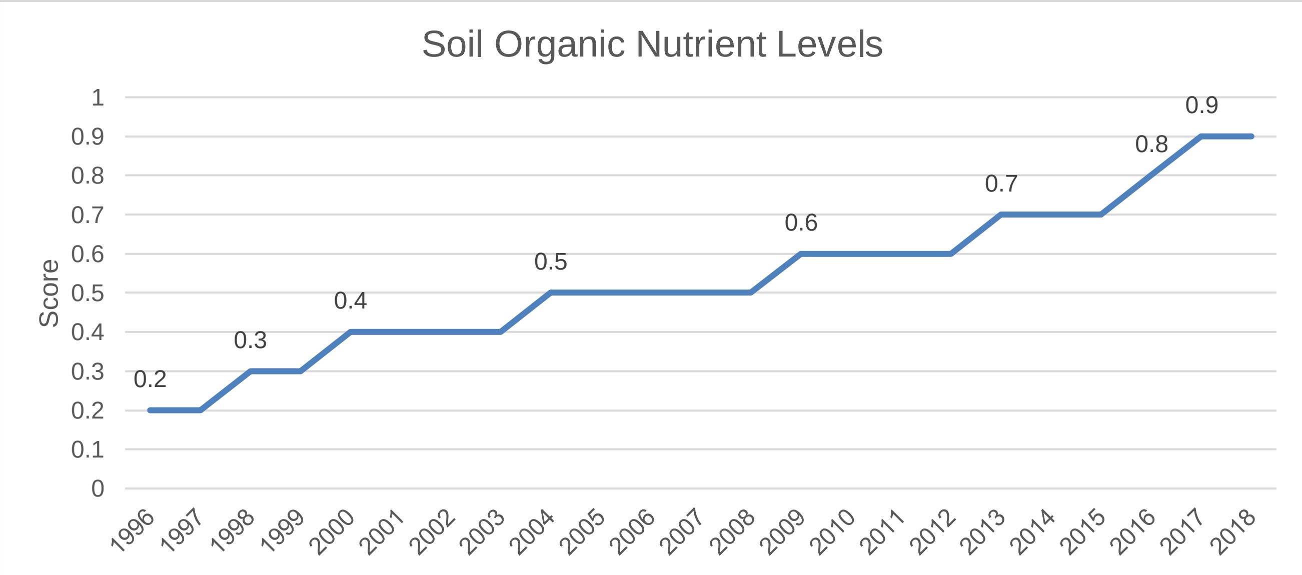

Figure 14: Soil Carbon Levels

Year	Score	*Year*	Score
1996	0.2	*2008*	0.5
1997	0.2	*2009*	0.6
1998	0.3	*2010*	0.6
1999	0.3	*2011*	0.6
2000	0.4	*2012*	0.6
2001	0.4	*2013*	0.7
2002	0.4	*2014*	0.7
2003	0.4	*2015*	0.7
2004	0.5	*2016*	0.8
2005	0.5	*2017*	0.9
2006	0.5	*2018*	0.9
2007	0.5		

Figure 15: Table of Soil Carbon Levels

In addition, as part of his feeding out strategy, John has increased his 36 Ha three paddocks to 100 Ha four paddocks. Further, John focuses on the fertility of the soil in the hay paddocks and to the nutrient density of the hay. The resulting hay production of some 600 large round bales is fundamental to the animal nutrition and soil biology strategy.

Expense per Kilogram of Beef Produced

Figure 14 outlines the total expenses per kilogram of beef produced by Collingwood and the average farm. As illustrated below, Collingwood consistently produces a lower expense per kilogram of beef than that of the average farm.

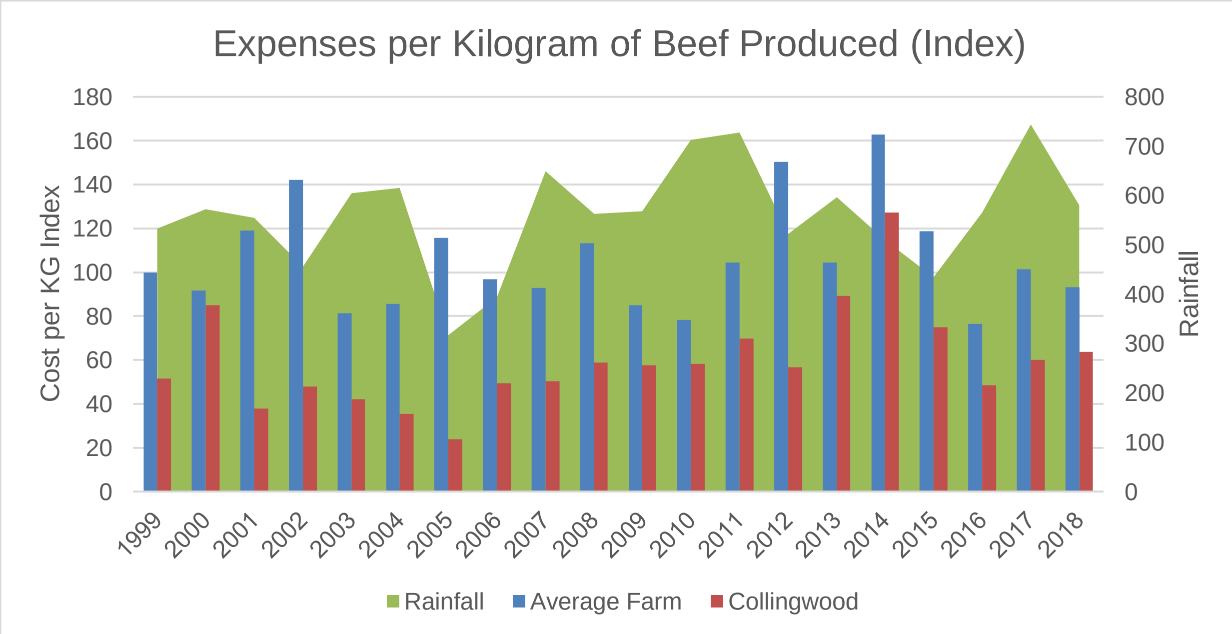

Figure 14: Expenses per Kilogram of Beef Produced (Index)

Data Insights

- In 2014 Collingwood experiences a significant increase in expenses per kilogram of beef produced. Again, this is due to John's increase in expenses, as discussed in the Productivity section of the report. Nonetheless, it remains less than the average farm.

2019 "COLLINGWOOD" CASE STUDY: SOCIAL REPORT

Prepared by

John Leggett and Richard Thackway

A Family Opportunity

John Kane had been a long-time career Victorian State public servant but at age 38 in 1996, it was time for a change. John's family had farmed in the Coleraine district in western Victoria for over a century. The traditional family farming operations were of cattle and sheep breeding. In 1996, the enterprise was being conducted on a conglomerate of property titles comprising 242 hectares. Management was in the hands of two bachelor uncles who were considering retirement and who offered John the opportunity to take over the running of the properties.

With little understanding of what the opportunity entailed, John's wife Jenny and their three children, Andrew, Christopher and Melissa, enthusiastically supported John in accepting the uncles' proposal and moved onto the farm.

Reality Bites

The property was not in good condition. Fences were in need of maintenance, water infrastructure was inadequate, herd genetics were poor and herd quality was low. Historically, tree clearing had been excessive but remediation was in train. The bed of Kanes Creek running through the property was really, in John's opinion, a twelve metre deep erosion gully that could only deteriorate further if not addressed. However, he felt that overall the enterprise had the potential for solid and continuing profit.

John wanted to change the way the business was managed but that was easier said than done. The uncles opted for the *status quo* which in John's opinion was ''subsistence farming''. The agreed compromise was that John leased and later purchased, half of the property and managed the uncles' remaining half as well.

A Matter of Choice

At the beginning of their tenure, John and Jenny could have opted to follow either a conventional farming methodology based on the farming practices on the property at that time, or adopt some more radical changes of practice.

Jenny was by profession a botanist and had a good understanding of organic farming, but also wanted to go bio-dynamic. This discussion was settled by a three day workshop conducted in 1998 at Naracoorte by the American agronomist and soil fertility expert, Neal Kinsey. John saw the common sense in Kinsey's propositions and convinced the family that they should opt for a program of regenerative agriculture.

After some setbacks John concentrated on improving soil fertility, tackling the weed problem and pasture shortcomings and undertaking the improvement of herd genetics. Jenny began an ambitious tree planting program and an extensive vegetable garden.

The Handover

In 1999, one uncle passed away and John raised enough capital to buy half the property. A little later, the remaining uncle handed over complete management of the enterprises to John. In 2006, the remaining uncle passed away and John inherited the other half of the farm.

The Vision

From the beginning of his tenure on the property, during the early management period, and as a result of the Kinsey workshop, John and his family had a clear vision of where they wanted to take the enterprise. With that focus, John and Jenny gradually implemented changes, initially with the reluctant agreement of the uncle. Soil fertility was top priority. John pressed on with weed control and pasture improvement and also with a heavy concentration on improving herd genetics.

The Kane family generational commitment to the highest standards of animal welfare have continued.

John feels a clear and compelling connection to country and a keen awareness that he has a responsibility to care for, and manage the land so that when it is handed on to the next generation, it is in better condition than when he took over.

Knowledge and Skills

John was conscious of his lack of a farming back ground, a point noted by his late uncles and some of the locals. But he had a vision. John attended field days and local conferences and founded a Community Soil Health Group to exchange ideas among like-minded individuals. Initially the Group attracted scepticism from some quarters but in the end, the Group received wide publicity and acceptance.

John undertook to improve his knowledge through self-education, including a four month pasture management course and a six month beef breeding and production course. He reads widely and continues to follow regenerative agriculture events, new ideas and trends. He does not employ agronomists, instead he researches ideas, issues and options and decides on the optimum course of action. That way, he owns both the decision and the outcomes. There is no one else to blame if the decision was the wrong one. As he says this is "an opportunity for a learning experience".

The New Normal

Some twenty two years after the Kane family tree-change, to what extent does the new normal reflect their Vision?

John believes the answer is "To a significant extent".

Although Jenny is no longer part of the team, she had been there for many years and shared in the vision, the decisions and the work. In the end, an amicable parting of the ways leaves John to contemplate the work of half a lifetime in the luxury of 20/20 hindsight. John and his family remain close and they share vicariously in the positive outcomes.

Satisfaction …. A Job Well Done

John says that he rises every morning at 7.00 am and looks out his kitchen window at what he has achieved. The green rolling paddocks barely showing any exposure of the rich grey and black soil, the belts of trees, the rehabilitation of the creek under way, the efficient water infrastructure, the animals in good condition, all put a smile on his face.

He is proud of what has been accomplished in twenty two years. All the heavy work has been completed. The farm is prosperous and runs smoothly. Stock are of a high quality and well cared for. He now plans to take time off from the daily routine of the farm, to travel more widely and do more community work, building on his many years in the Country Fire Authority and his involvement in the local cricket club.

If John had his time over, what would he change in his opting for the principles and practice of regenerative agriculture to underpin the family vision? His answer, an emphatic "Nothing"!