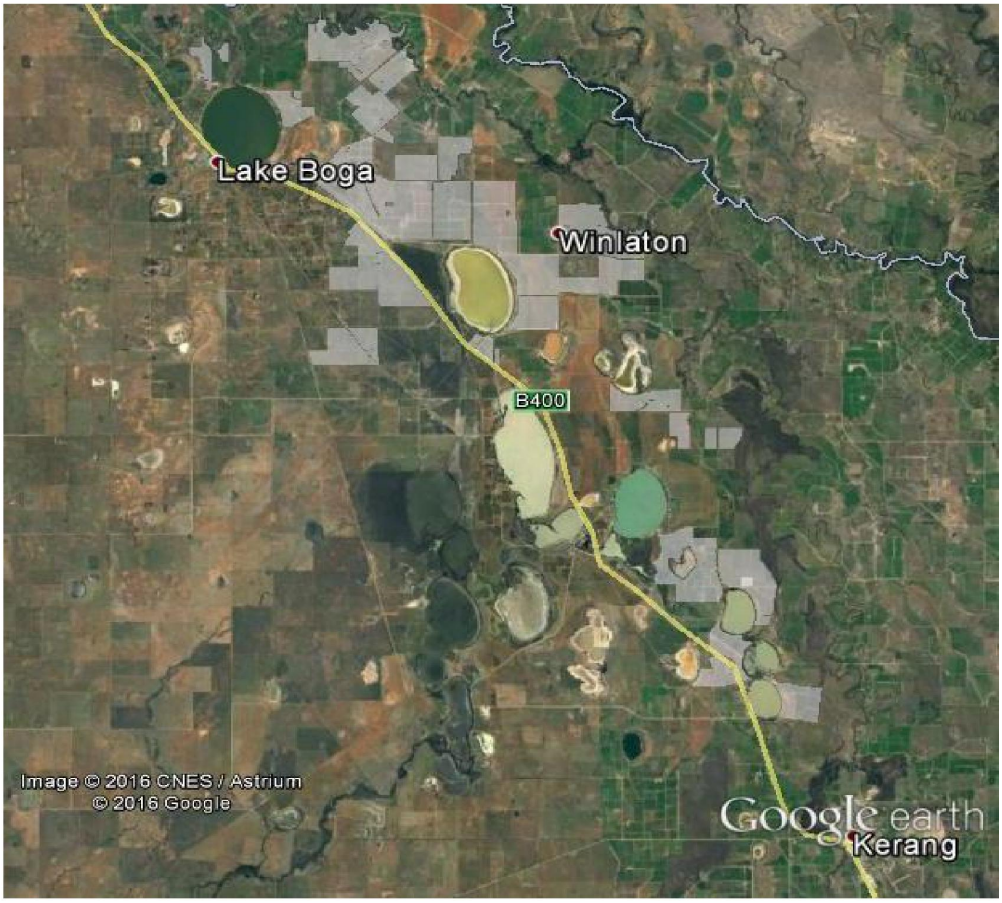
Case Study

2018

FFL WINLATON CASE STUDY: THE KILTER RURAL STORY

Profit with Impact in the Murray Darling Basin



FFL (Future Farming Landscapes) at Winlaton is an investment model - the brainchild of Kilter Rural founders. It involved turning agriculture into a mainstream investment for institutions and professional investors. The company, Kilter Rural, is succeeding where many have failed.

In the early 2000s, Kilter Rural had convinced VicSuper to commit more than $200 million into a "greenfields" farm investment. From 2007 onwards it selected 35 farms and had completed the bulk of these acquisitions by 2012. The vendors were tired of decades of dwindling production, falling milk prices and the Millennium Drought.

The Kilter Rural founders were trained in natural resource management (NRM) with a passion for the environment. Lake Boga is located near five RAMSAR Wetlands – the Barmah Forest, the Kerang Wetlands, the Gunbower Forest, the Hattah-Kulkyne Lakes and, just across the border, the NSW

Central Murray State Forests. In essence it is an ecological hotspot of international significance, making it ideal as a focus for environmental regeneration.
Kilter Rural saw the potential to aggregate many small holdings into a single corporately managed 'Lake Boga' enterprise (8,900 ha). It understood the intrinsic agricultural potential of the floodplain soils and the under capitalised farms, plus the valuable water entitlements that went with the land. Here was an opportunity to regenerate a degraded landscape from the ground up.

The Vision

From 2007 to 2013 it was time to put the 'FFL model' to the test. The effects of past land management regimes were recognised and understood. Decades of leaky flood irrigation had adversely affected the landscape's ecological function. There was a need to make the best land productive, while, at the same time, attending to soil and biodiversity imperatives to ensure a sustained commercial enterprise.
From the outset, Kilter Rural took the view that some of the land would be too expensive to develop and so should be turned back into a mixture of dryland sheep country and ecological "sanctuary". The least promising land - with poor, long-depleted soils - was to become habitat for vulnerable wildlife with the regrowth of chenopod (saltbush and bluebush) and woodland communities. This 'ecological estate' has been progressively fenced, protected and restored, and there are around 4000 hectares of native vegetation
Parts of the estate are selected for rotational grazing on the native forage for a flock of 3,000 merino ewes, then 'finished' on crop stubbles and lucerne.
The most arable land, as assessed by retained soil scientists Christian Bannan (South East Soil & Water) and Declan McDonald (SESL Australia), has been heavily infused with composts and organic matter. Sub-surface watering, centre pivots and levelled paddocks for gravity irrigation have been installed on the most productive areas – currently 3,150 hectares. Another 1,000 hectares are being readied for future irrigation.
"Nothing we do in that landscape, we do for free; key soil assets have to make money or contribute to creating long-term value," CEO Cullen Gunn told the SFL team. He believes there is a great deal of irrigation land in the Murray-Darling Basin which is underutilised or undercapitalised, and could be dealt with in a much more sustainable way. "We are about delivering profit, with impact, that's what we have been doing for 10 years". Cullen adds "We have a genuine drive to protect and restore Australian landscapes by marrying production, ecological and social outputs."

Income Streams

Kilter Rural manages the Lake Boga enterprise to achieve returns in excess of 8% on capital invested per year, through blending three income sources – agricultural produce, interacting with the water market and through available eco-markets in Victoria.
Such a project doesn't happen in isolation, and it required delivery input from the region. In the 2015 financial year, Kilter Rural spent $12 million with its suppliers alone, with almost $5 million spent locally. 30,000 tonnes of compost are currently applied to the cropping fields each year, mostly sourced from Melbourne's green waste. The development of cotton growing, tomatoes, lucerne, lamb, Queen Garnet plums and, more recently, organic winter cereals has not been without challenges. The early days saw the back end of the Millennium Drought that turned into the century flood of January 2011, when a significant proportion of the Boga farms were submerged under more than a metre of water for many months. The impact of those floods taught the Kilter Rural team to make sure water can drain away swiftly. On a number of properties two years' production was lost. On the other hand, the flood flushed out a great deal of salt and precipitated growth of clover.

Farming

Lake Boga is growing Australia's most southern cotton and it has proven its worth in rotation with lucerne and tomatoes for processing. Supply chains and forward contracts have been secured and,

with a reliable water supply, this rotation strategy is well established. The cotton is ginned at Hay in southern NSW in preparation for export, and the tomatoes are processed at Echuca.
The Queen Garnet plum – a hybrid variety developed by the Queensland Department of Agriculture Fisheries and Forestry – is said to contain five times the level of antioxidants than other plum varieties. The genetics of this crop are handled by the licensee, Nutrafruit, which has gained the worldwide marketing rights.
These high value products deliver directly to the bottom line and are underpinned by 13 tonnes per hectare of lucerne hay, which also has a critical role in regenerating the soil profile.
These crops also play a direct role in removing residual salt that has accumulated in the soil profile during a previous agricultural era.

Eco-Markets

Kilter Rural brings to 'Lake Boga' a strong regenerative policy to their practices for profit and as part of their corporate responsibility.
There is a small biodiversity team stationed at Lake Boga, with a role to service the 40% native vegetation cover across the aggregated farmland. This team does not work in isolation but partners with outside expertise and science based organisations. An example is its involvement with the Wentworth Group of Concerned Scientists in a project to generate a farm-based environmental asset account. The goal for the team is to turn environmental improvements into revenue in order to secure financial viability for the entire operation. In this manner Kilter Rural has developed two "securities" for the biodiversity market, which are activities under the BushTender program and covenants under the BushBroker biodiversity offset scheme.
Kilter Rural is optimistic that the rise of the eco-markets can underpin the cost of stewardship of environmental land. Eco-market opportunities can have a dual effect, providing revenue for cultivating ecological services but also providing a benchmark for valuing environmental assets.

The Future

Kilter Rural has established Wedgetail Food and Fibre as a marketing partnership, which was initially briefed to create markets and supply chains solely for Kilter Rural's produce but has now expanded to work with other growers to deliver quality, certainty and value.
Kilter Rural is also looking well beyond sustainable food and fibre. In partnership with The Nature Conservancy Australia and the Murray-Darling Wetlands Working Group, it manages the Murray Darling Basin Balanced Water Fund, the first water investment fund in Australia to address balanced environmental, agricultural, social and financial outcomes. This consortium won Australia's premier environment prize for 2017, the Banksia Award, in the natural capital category.
The team at Kilter Rural is keen to apply the Future Farming Landscapes model in another agro-climatic region of Australia. They have examined several locations in NSW and Queensland with a view to replicating what they have achieved at Lake Boga and were recently invited to Rockhampton by the Great Barrier Reef Trust to help explore how to best manage agricultural run-off and nutrients flowing onto the Reef.

Case Study

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FFL WINLATON CASE STUDY: ECOLOGICAL SUMMARY REPORT

Prepared by

ADJ.Assoc. Prof Richard Thackway BSc. NSc

Greg Hosking

This project enabled an opportunity to establish new enterprises and innovative land management regimes.

Key findings

Prior to 2007, and before to the purchase of the 35 properties that now comprise FFL Winlaton, each of the land parcels was independently managed freehold land. From 2007 the acquired land parcels have been progressively aggregated into one large farm, comprising a patchwork of multiple enterprises across multiple locations between Kerang and Lake Boga, northern Victoria.`

The pre-purchase landscape was highly degraded, largely a consequence of high salinity levels accumulating in the upper soil profile following a century of unsustainable flood irrigation practice on the Victorian riverine plain.

Knowledge of historic production systems and detailed soil analyses have been used to establish a four-class 'state and transition model' of soil condition (A-D).

Riverine flooding is arguably the greatest climatic-related risk to the region. Historical agricultural and irrigation development across the region has inevitably led to flood control infrastructure being laid over the landscape. Redevelopment and the location of new Infrastructure built by Kilter Rural is designed in the context of physical flood risk, but also from a perspective of potential future floodplain management opportunity (e.g. provision of flood mitigation services for community and ecological benefit).

Almost 50% of FFL Winlaton has been set aside for irrigated agricultural production. These areas are found across all soil-landscape types where soil is sufficiently arable.

40% of FFL Winlaton has been set aside for ecological protection i.e. minimal use conservation areas. Much of this area coincides with land deemed limiting for agricultural production, although there are readily identified ecological assets.

The balance of the land area of FFL Winlaton is either infrastructure or rural living related or is in transition to an end land use still in determination. It also includes small interstitial portions of land existing between active production areas that have some ecological value.

Riparian areas on FFL Winlaton are carefully managed and protected from agricultural utilisation.

Introduction

The FFL Winlaton property development model was based on renewal of an area of agricultural and social decline by investing expertise, time and capital to restore the land's agricultural productivity in part by activating local social capital. While agricultural productivity was a key focus, there was a realisation that this could only be sustainable if supported by improvements in the ecological health of the degraded land holdings (refer to the Supplementary Ecological Report).

Each of these land holdings on the previously privately owned farms has had a different history of land management regimes. There are three broad soil-landscape types on FFL Winlaton:

1) floodplains were primarily managed for dairy production using flood irrigation of pastures; 2) low sandier rises, and

3) lunette dunes which were variously dry cropped and grazed.

Historically, most of the native plant communities across the three soil-landscape types have been cleared, converted and managed to agricultural production. Small areas of remnant native vegetation remain as does a highly modified native and exotic groundcover mosaic within agricultural (cropping and grazing) paddocks. At the time of purchase of the holdings (2007-2011) their ecological health was in a significant degraded state with little prospect for improvement under the historic agricultural management regime. Inefficient irrigation practices within a sensitive hydrogeological environment contributed to a long declining eco-social state.

Much of the previous intensive agricultural activity had relied upon irrigated pastures and cropping, from channelled irrigation coming from the Murray via the Kerang Lakes system. An altered hydrological balance from early agriculture rapidly led to rising ground water levels and soil salinity in the district, which has been recognised for many decades. By the turn of the current century, the Millennium Drought had further set back the socio-economic state of the district and further challenged the prospect of rehabilitating and restoring a degraded landscape. A growing trend of selling of water out of the district would not help returning the land to a productive agricultural future. Through much of this time the remaining extent and condition of the native plant communities had become highly fragmented and transformed, relative to the original landscape.

Following the development of a new and visionary agricultural investment and rural rejuvenation concept plan, in 2007 Kilter Rural had begun implementing the FFL Winlaton project. This project enabled an opportunity to establish new enterprises and innovative land management regimes that were also designed to enable a reversal in the decline in the ecological health of the soil-landscape types. Kilter Rural's farming plan is continuously improved through the latest research relevant to each agricultural enterprise and forms of ecological rehabilitation. The farming plan is designed to:

- restore soil health through adopting improved irrigation and fertiliser delivery technologies;
- develop complementary crop - pasture rotations;
- retire low productive land from agricultural production; and,
- on this retired land employ revegetation strategies for ecological service production.

This plan, in combination with appropriate management regimes for the various enterprises, has led to improvements in productive (soil) capacity and the condition of native vegetation.

This report describes the ecological and biodiversity outcomes observed by Kilter Rural and its research associates for FFL Winlaton since 2005. Ecological and biodiversity outcomes are a response to implementing regenerative land management regimes.

FFL Winlaton has been managed over the four phases over the period 1900-2017:

Phase 1: 1900-2006	Conventional non-regenerative regimes and practices
Phase 2/3: 2007-2011	Phase 2: Conventional non-regenerative regimes and small-scale demonstrations. Phase 3: Transition to broader scale regenerative regimes
Phase 4: 2012-2017	Broad scale regenerative management regimes

Soil-landscape types, Land-use types and Soil condition

FFL Winlaton has three broad soil-landscape types:

1. Riverine floodplains with grey and black cracking clays;
2. Gentle low rises with lighter loamy clays
3. Lunette dunes on the eastern side of playa lakes.

The land area of FFL Winlaton has been classified into three land use types corresponding to the Australian Land Use and Management Classification (Version 7): intensive uses, extensive uses and minimal uses:

1) Intensive Uses:
   a) Intensive horticulture; Residential and farm infrastructure; and transport and communication
   b) Production from Irrigated Agriculture and Plantations
2) Extensive land uses:
   a) Production from Relatively Natural Environments
   b) Production from Dryland Agriculture and Plantations
3) Minimal uses: Conservation and Natural Environments

Across all three broad land use types a holistic assessment of the trajectory of the health of soils within FFL Winlaton has been developed to enable monitoring and reporting of both agricultural and native vegetation lands (Figure 1). Condition of soils is categorised within an A to D classification devised by soil scientists working for Kilter Rural.

Soils are classed for each of the 140 Land Management Units (LMUs) comprising FFL Winlaton, at 5yr intervals starting in 2007 (effectively pre-purchase condition). Land categorised as class A generally occurs on the lighter rises sitting on the floodplains, which has the highest soil condition and generally utilised for high value irrigated cropping (intensive use).

Figure 1 shows soil condition classes for four key reporting periods:

1 pre-purchase – before 2007;

2 pre-development – 2012;

3 aligned to this 1st report with ~75% of the landscape development completed - 2017;

4 projected 100% of the landscape redevelopment completed – 2022.

The 2012 assessment is assumed to be the same as 2007, as this was the date representing the beginning of FFL Winlaton's investment in large scale redevelopment. In-field soil assessment strongly underpins the 2017 condition assessment, and prudent assumptions are made to predict 2022 condition.

Soil condition is assumed to improve from active soil conditioning practices on cropping land, but as importantly also from the gradual rehabilitation of native vegetation on non-agricultural lands using both passive and active restoration methods.

Areas of intensive land use (irrigated cropping rotations and some perennial horticulture) currently comprise soil condition classes A, B and C. Areas of extensive land use - mostly rotational livestock (sheep) grazing - typically comprise classes C and D. Minimal use areas (managed ecological lands) are currently protected from both intensive and extensive agricultural production. Areas of minimal use currently mainly comprise soil condition classes C and D.

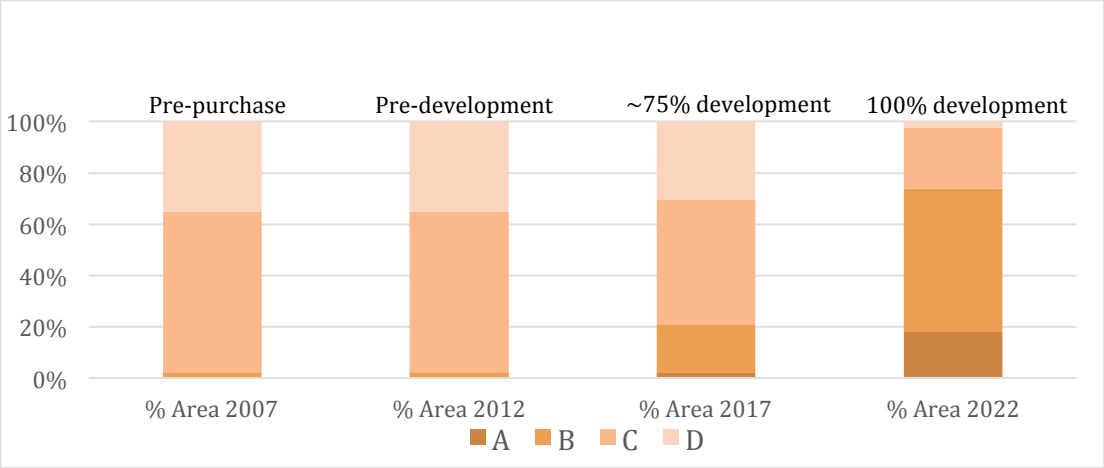

Figure 1. Relative areas of FFL Winlaton over time, 2007-2022 using four soil condition classes across all three-broad soil-landscape types, including agricultural and ecological lands

Assessment of ecological and biodiversity outcomes

Managing soil-landscape types to minimise effects of extreme climatic events

The most common extreme climate-related event in the region is riverine flooding associated with major rainfall events in the upper catchments of the central Victorian uplands. A major inundation event can leave the cropping land unsuitable for agricultural production for extended periods of time.

Since FFL Winlaton was established in 2007, Kilter Rural has worked on minimising the effects of flood inundation events. Much of the “intensive use” land use zone is situated upon lower lying soil-landscapes, where the risk of flooding is greatest. Paddocks have been laser levelled and drainage sumps installed to assist with shedding flood water particularly associated with flash flood storms. In addition, heavy-duty movable water pumps can be mobilised to reduce periods of inundation when flooding inevitably occurs. The need for this level of planning and design was demonstrated in January 2011 when a >1:100 yr flood event (refer to the Supplementary Ecological Report) impacted the region.

Despite these management strategies, major flood events and prolonged inundation remain a material risk to agricultural production in a floodplain environment. The consequences of flooding if it were to occur is obviously greater in a higher value agricultural (intensive) setting.

It is worth noting that during major flood and prolonged inundation events the “extensive use” and “minimal use” land use zones can still be adversely affected but the consequences are not as critical as the “intensive use” land use zones.

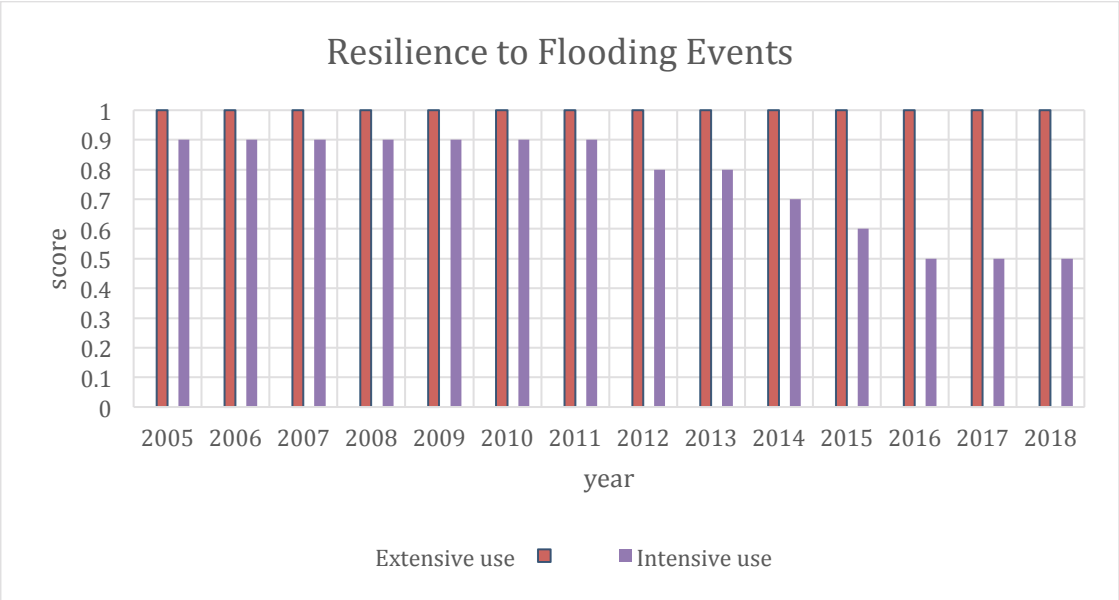

Figure 2. Depicts the ability of the “extensive use” and “intensive use” land management units within FFL Winlaton to recover from flooding events over time.

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

Kilter Rural has progressively introduced, tested and adopted a range of ‘active’ measures to improve key soil indicators (Figure 3.) across FFL Winlaton. The focus of these active measures has been on the intensively farmed land.

An initial step is to reduce high levels of salinity within the crop root zone, which also allows the status of other soil indicators to be more easily addressed. Large quantities of compost and gypsum have been applied throughout much of the redeveloped “intensive use” land, and soil conditioning crops such as lucerne chosen for their economic return in addition to their ability to improve soil capability.

Lucerne has a deep-root system, which has helped to mobilise salt deeper into the soil profile. Tomatoes have the ability to draw salt from the soil and hold it within the plant. In general, an orderly rotation between lucerne, tomatoes and cotton (and occasional fallow) has allowed the positive progression of soil condition, further enhanced by irrigation techniques that provide a level of match to natural soil behaviour (wetting and drying characteristics of floodplain clays). Soil indicators are also assumed to have also improved within the “minimal use” land (Figure 3.).

The removal of livestock from these areas has assisted the passive regeneration of groundcover as well as allowing active methods of revegetation with native grasses, shrubs and trees. Increased groundcover has also aided in the prevention of erosion.

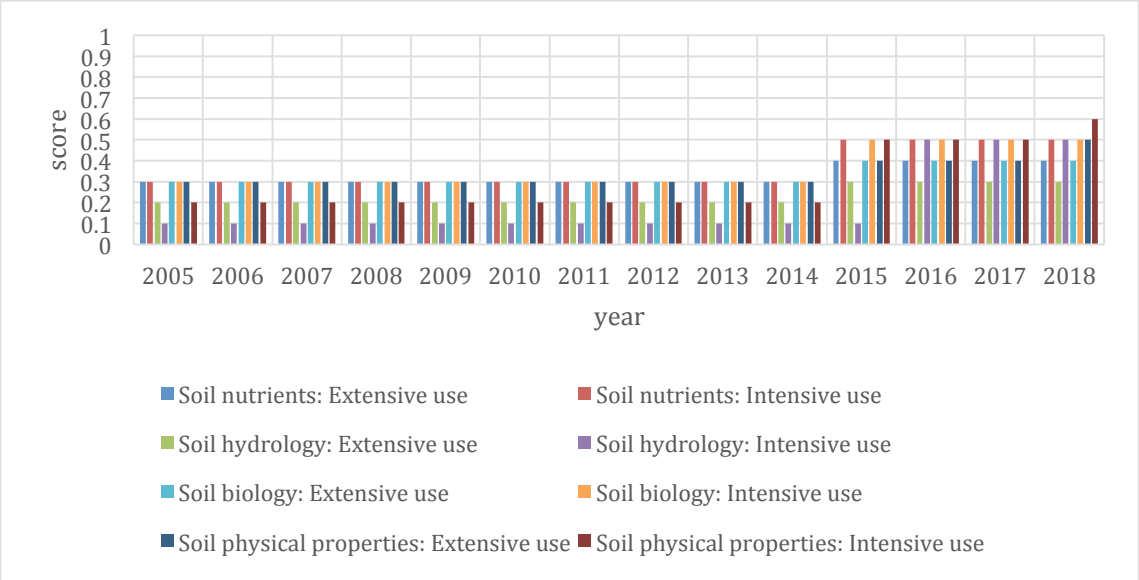

Figure 3. Status of soil indicators over time within the “minimal use” and “intensive use” land at FFL Winlaton.

Managing native groundcover for production and to maintain ecological health

Within FFL Winlaton, the “extensive use” land use zone is managed to allow light grazing (sheep) and the “minimal use” land use zone is managed to specifically improve and maintain ecological health. Within both these zones, grasses and herbs have been passively regenerated or actively planted to improve ground cover levels as well as structure and composition of these otherwise highly modified plant communities. Livestock (sheep) are rotationally grazed within the “extensive use” land to

minimise groundcover loss but also to attempt to promote the desired structure and composition of the grasses and herbs in the ground layer. (Figure 4).

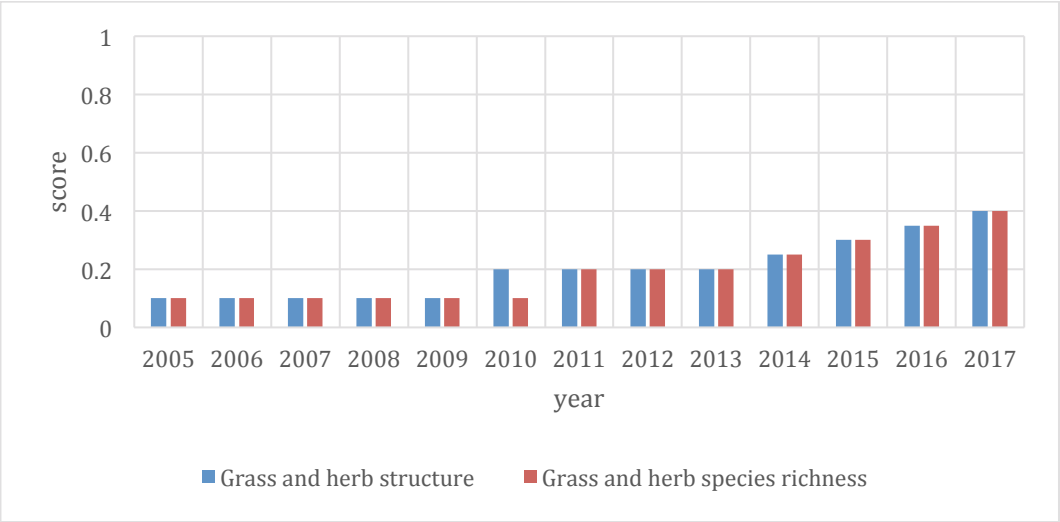

Figure 4. Status of grass and herb indicators overtime at FFL Winlaton.

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

The extent and condition status of trees and shrubs across FFL Winlaton at the time of purchase was relatively poor, with much of this subsumed by historical agricultural layout (irrigation). Over subsequent years, the status of trees and shrub indicators gradually improved due to slow natural regrowth following permanent abandonment of irrigation, but also by active planting/direct seeding of trees and shrubs throughout the “minimal use” and “extensive use” land.

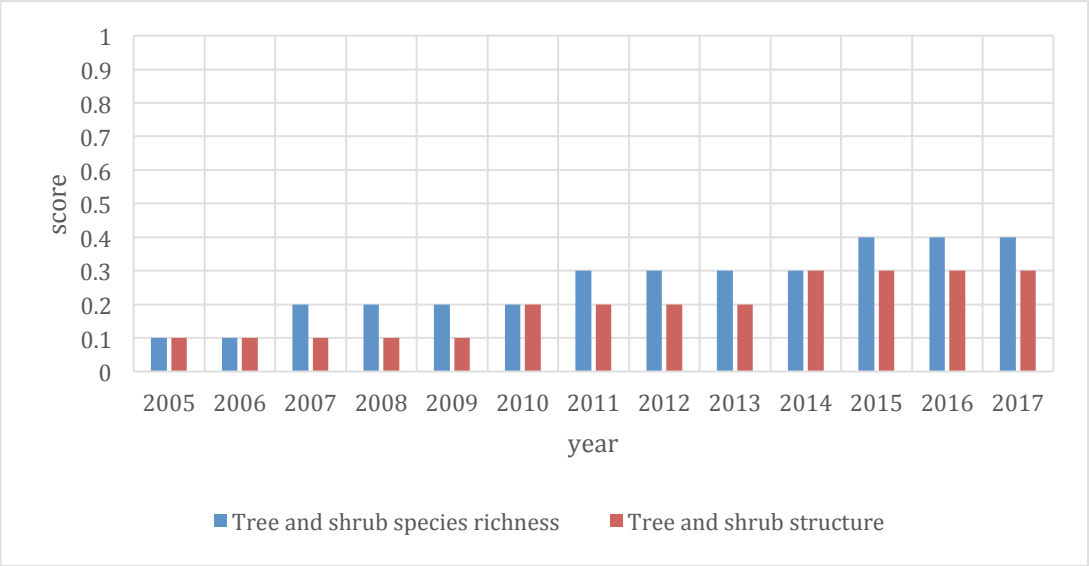

Figure 5. Status of tree and shrub indicators overtime at FFL Winlaton

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

Kilter Rural has fenced off livestock access to watercourses throughout FFL Winlaton.

Connected remnant and regrowth vegetation that is superfluous to the agricultural footprint (previously intensive use) has, in many instances been added to, and therefore expanded the area of “minimal use” land. Fencing demarcates the agricultural from non-agricultural zones, so that riparian and related waterway frontage is protected from agricultural activity.

For more detail, see the Ecological Supplementary Report

Case Study

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FFL WINLATON CASE STUDY: ECOLOGICAL SUPPLEMENTARY REPORT

Prepared by

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Greg Hosking

Planting native shrubs such as salt bush may have helped reduce salinity levels in the soil, resulting in an improvement in the level of soil nutrients

Key findings

Prior to 2007, and before to the purchase of the 35 properties, each of the land parcels were independently managed freehold land parcels.

Riverine flooding is arguably the greatest climatic-related risk to the region. New Infrastructure built by Kilter Rural is designed and located in the context of physical flood risk, but also from a perspective of future floodplain management opportunity (e.g. flood mitigation services).

The floodplains were primarily managed for dairy production using flood irrigation of lucerne pastures. The gently rolling low sandy hills and the lunette sand dunes were managed for relatively intensive grazing of cattle and sheep. Most of the native plant communities across the three land types have been cleared, converted and managed to agricultural vegetation. Small areas of remnant native vegetation remain, as does a native and exotic mosaic within minimally used paddocks, where grazing has been totally removed or intermittently rested from grazing for long periods.

Knowledge of historic production systems and detailed soil analyses have been used to establish a four-class 'state and transition model' of soil condition and function across all FFL Winlaton's land types. Where soil was identified as not adversely affected by prior land management regimes, these land management units are delimited and managed as prime agricultural land. Varying degrees of impairment for agricultural production have been delimited into the remining three classes depending on the degree of impediments.

Assessing responses to land management regimes according to the ecological criteria

A field visit to FFL Winlaton was made on 28-29 November 2017. Kilter Rural was asked to document the production system's history and land management regimes leading up to the current regenerative land management regimes (Attachment A). This included a collation of all available published and unpublished relevant ecological data and information about the farm and how it was managed. Information available in that interview included whole of farm aerial photographs, fertiliser history, and paddock-based management histories.

This section describes how the property has been managed over the four phases over the period 1900-2017:

Phase 1: 1900-2006	Conventional non-regenerative regimes and practices
Phase 2/3: 2007-2011	Phase 2: Conventional non-regenerative regimes and small-scale demonstrations. Phase 3: Transition to broader scale regenerative regimes
Phase 4: 2012-2017	Broad scale regenerative management regimes

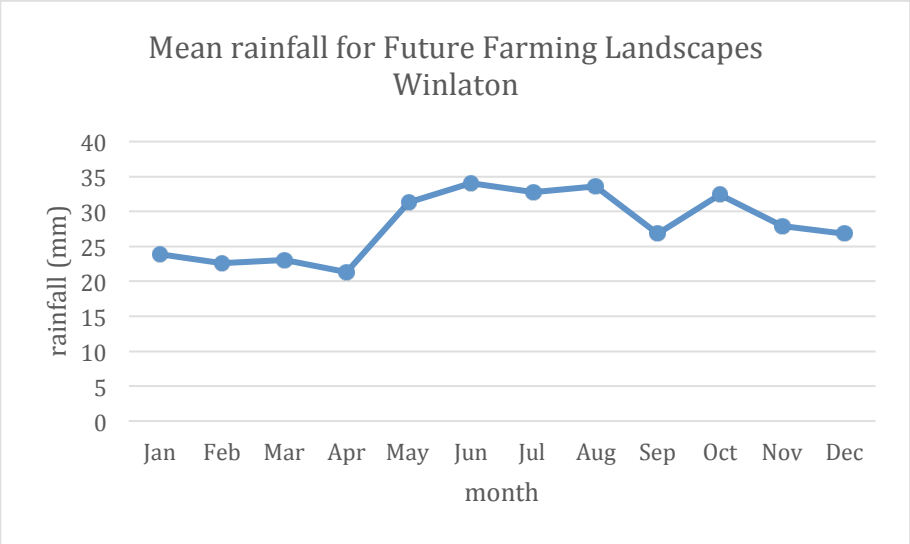
Where quantitative data had been collected over time by the land manager, these were used to populate the respective ecological response. Expert elicitation was used to assist the land manager to assess the ecological responses of implementing the production systems on ecological criteria associated with ecosystem function, structure and composition over time.

The land manager was asked to self-assess how his goals or lifestyle intentions affected his landscape management regimes (i.e. production systems) and what effects he observed on a scale of 0-1 for each ecological response criteria. Change was assessed graphically, relative to the baseline, which was defined by the land manager as conventional non-regenerative land management.

In the following section, the ten ecological response criteria are assessed and shown graphically over four phases (i.e. Landscape Management Regimes). Each phase is described by an aggregate of land management practices, which correspond to the goals or ideals of the land manager (Attachment A).

This Ecological Assessment acknowledges that climate variability plays a major role in influencing the land manager's decision-making process and his capacity to implement his plans for production. In turn, the effects of climate variability have major impacts on ecological, economic and social wellbeing. The highest rainfall months at FFL Winlaton are between May and August, (Figure 1) which corresponds to a Mediterranean climate (Thackway and Freudenberger 2016, Figure 1). It should noted, that within this winter season, the rainfall at FFL Winlaton is highly variable (Appendix 2).

FFL Winlaton, like most agricultural land managers use rainfall to as a gauge of climate variability. A summary of the modelled seasonal rainfall from 1900 to 2015 for the property is presented in Attachment B.



Source: Bureau of Meteorology (BOM n.d)

Figure 1. Mean monthly rainfall for FFL Winlaton

The following 10 ecological response criteria are assessed[1] below:

A. Resilience to natural major disturbance/s (e.g. drought, fire, flood);
B. Status of soil nutrients including soil carbon, major and minor elements;
C. Status of soil hydrology including infiltration, percolation and water availability to plants;
D. Status of soil biology including bioturbators i.e. nutrient recyclers, fungi and bacteria ratios and soil organic matter;
E. Status of soil physical properties including bulk density and soil as a medium for plant development and growth;
F. Status of the reproductive potential of the plant species and plant community;
G. Status of tree and shrub structure;
H. Status of ground layer/ground cover/grass and herb structure;
I. Status of tree and shrub species richness and functional traits; and
J. Status of the ground layer/grass and herb species' richness and functional traits

[1] Ecological change and trend information presented in this report has been scored by the land manager relative to a baseline. This process involved considering relevant qualitative and quantitative data and information and expert elicitation and workshopping. The graphical summaries are scored using the VAST assessment framework.

To evaluate and validate the land manager's self-assessment, Soils For Life has engaged Farmmap4D, in a partnership agreement, whereby Farmmap4D will provide a satellite-based validation of two measures:

1. the observed responses of paddocks within FFL Winlaton over time
2. the observed responses of FFL Winlaton compared with the surrounding properties within a 2 kilometre radius over the study period.

These two measures are expected to show varying levels of correlation within FFL Winlaton to several response criteria including:

D. Status of soil biology - Soil surface condition

E. Status of soil physical properties – Landscape function

G. Status of tree and shrub structure - Extent of tree cover

H. Status of grass and herb structure – Year-round ground cover

J Status of grass and herb functional diversity - Grass and herb species richness

Assessment of Response Criteria

A. Resilience to extreme climate events

Wildfire (Intensive and Extensive land use zones)

Phase 1. (1900-2006)

Before 2007, prior to the purchase of the 35 properties (i.e. private land parcels) that now comprise FFL Winlaton, each of the land parcels was resilient to wildfire because:

- Many of the floodplain paddocks were cleared of native vegetation, cropped and periodically inundated using flood irrigation. Only small areas of remnant native woody overstorey have been retained;
- There was ready access to large quantities of water;
- Other non-floodplain sand plain and lunette paddocks were conventionally grazed resulting in a native and exotic pasture mosaic, which was minimally flammable.

Even if the land were to be burnt by wildfire it would have returned to productivity quickly due to the abundance of water, and the utilisation of the landscape through livestock or crops.

Phase 2/3. (2007-2011)

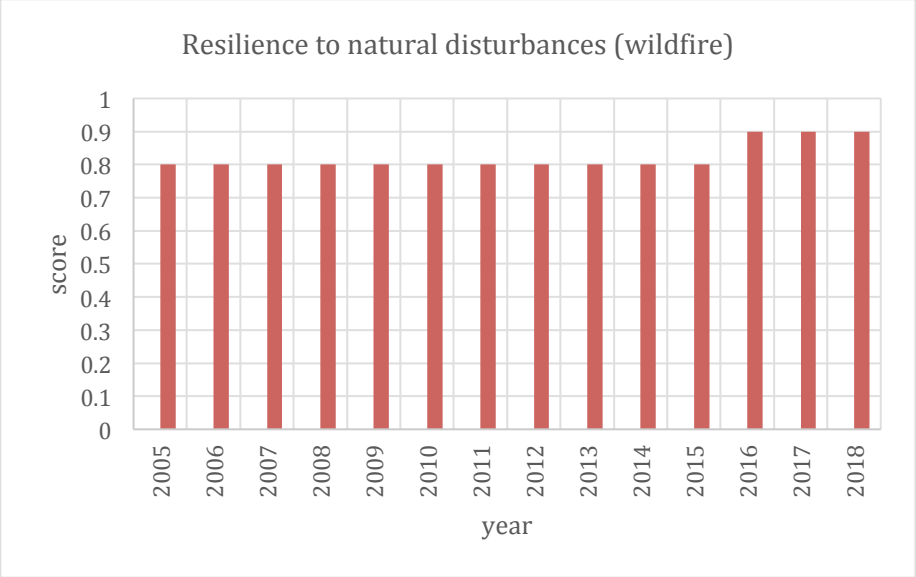
The resilience of the land parcels found on the floodplains, sand sheets and lunettes to wildfire did not alter during this phase. Improvements were not made across the land and the continued use of irrigation kept the risk of wildfire low, while recovery to productivity following fire would have been quick.

Phase 4. (2012-2017)

The resilience of FFL Winlaton to wildfire increased during this phase. The improvements provided by Kilter Rural throughout the landscape, particularly with water wastage, resulted in the increase in resilience to wildfire. The infrastructure added to the properties also helped increase their resilience to wildfire.

Other infrastructure, including formed all-weather road access contribute to the resilience of the landscape to wildfire.

40% of FFL Winlaton is deemed as native vegetation and managed accordingly.



Flood (Intensive land use zone)

Phase 1. (1900-2006)

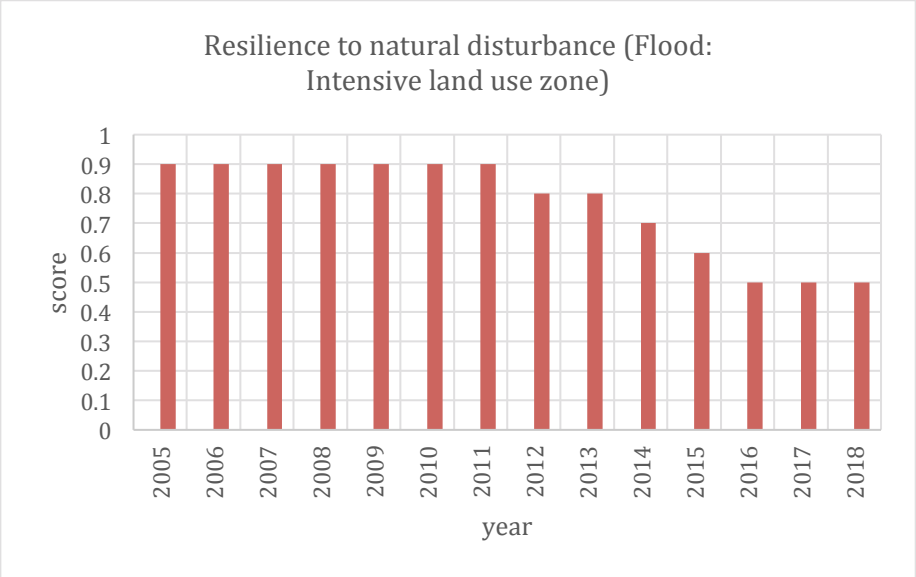
The resilience of individual properties to flood on the intensive land use zone would have changed throughout this phase. At times of higher production, the land's resilience to flood would have been low and, at times of low production, the resilience would have been higher.

Phase 2/3. (2007-2011)

The resilience of individual properties to flood on the intensive land use zone would have been quite high due to the land management practices. The majority of the land was not in heavy production and a flood would not have dramatically affected the production occurring.

Phase 4. (2012-2017)

The Lake Boga region is highly susceptible to major flood events associated with the Murray River and can suffer from prolonged periods of inundation, impacting heavily on the land and knock it out of production for an extended period of time. Recently, as the agricultural activity increased across the intensive land use zone, its resilience to cope with a flood event declined until plateauing in 2016. Increased cropping and horticulture has resulted in attention to drainage to avoid loss of production from major floods. Nevertheless floods are considered the highest risk to productivity on the floodplain intensive land use zone.



Flood (Extensive land use zone)

Phase 1. (1900-2006)

The extensive land use zone on the individual properties surrounding Lake Boga is generally not susceptible to major floods associated with the Murray River. The elevation of the land is somewhat higher and the production rates on the land are low due to the poor quality of the land. These factors combined to reduce its susceptibility to inundation and give it a high resilience to major flood events associated with the Murray River.

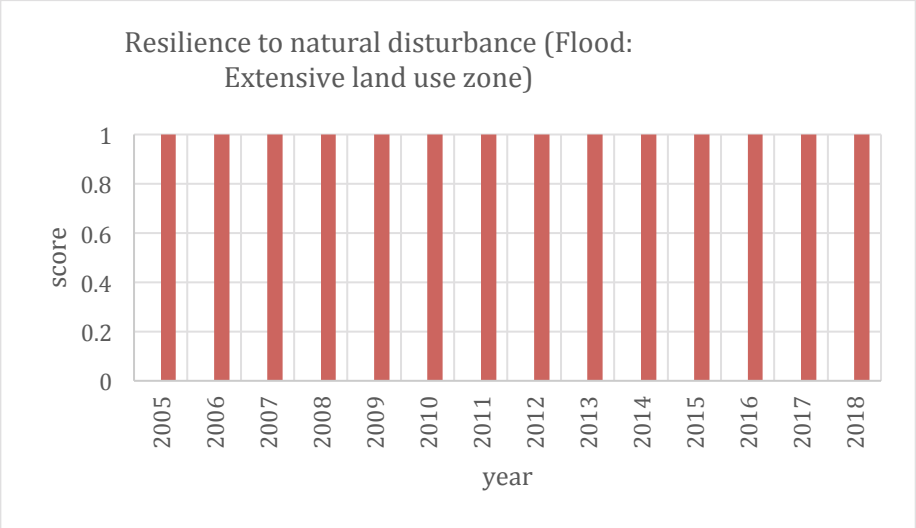
Phase 2/3. (2007-2011)

The ability of the extensive land use zone within the properties at Lake Boga to respond to major floods associated with the Murray River was excellent. The extensive land use zone was not heavily utilised for agriculture and floods had little effect on the land. Much of the native vegetation present in the region responds well to major flood events associated with the Murray River and is not adversely affected.

Phase 4. (2012-2017)

There has been little change in the capacity of the extensive land use zone to withstand major flood events associated with the Murray River during Kilter Rural's ownership. Engineering works associated

with laser levelling means the irrigated area now freely floods and the native vegetation responds well to occasional floods.



B. Status of soil nutrients

Soil carbon, major and minor elements (Extensive land use zone)

Phase 1. (1900-2006)

The status of soil nutrients is expected to have been quite low within the extensive land use zone throughout this phase. This area of land was not heavily utilised for agriculture except for opportunistic livestock grazing throughout this phase due to its low quality. While there was no testing of soil nutrients during this phase, it can be inferred that the status of soil nutrients would have been poor due to natural causes.

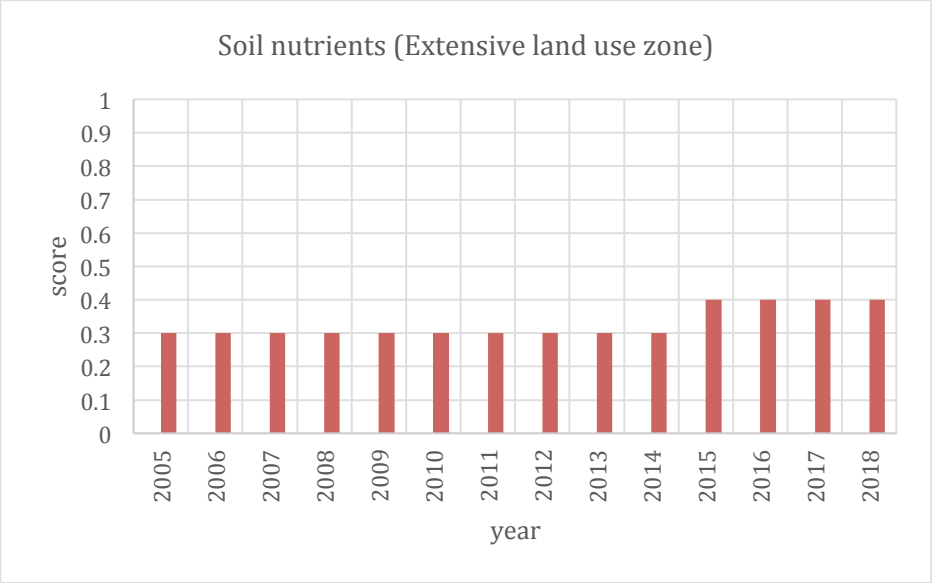
Phase 2/3. (2007-2011)

Land parcels that were deemed unsuitable for agriculture were set side for ecological purposes. Some of the extensive land use zone was deemed suitable for livestock grazing and utilised for sheep grazing in the summer of 2009. Direct seeding of old man saltbush occurred in certain paddocks in March 2010. The actions taken by the land manager during this phase did not improve the soil nutrient status within the

extensive land use zone in this phase. However, it is possible that the soil was nutrient deficient due to natural causes.

Phase 4. (2012-2017)

The soil nutrient levels increased slightly within the extensive land use zone. This may have occurred due to the planting of native vegetation throughout the extensive land use zone and excluding the majority of it from agricultural practices. Planting native shrubs such as salt bush may have helped reduce salinity levels in the soil, resulting in an improvement in the level of soil nutrients. Where direct seeding or tube-stock planting was unsuccessful, it is now realised that natural regrowth was possibly more effective.



Soil carbon, major and minor elements (Intensive land use zone)

Phase 1. (1900-2006)

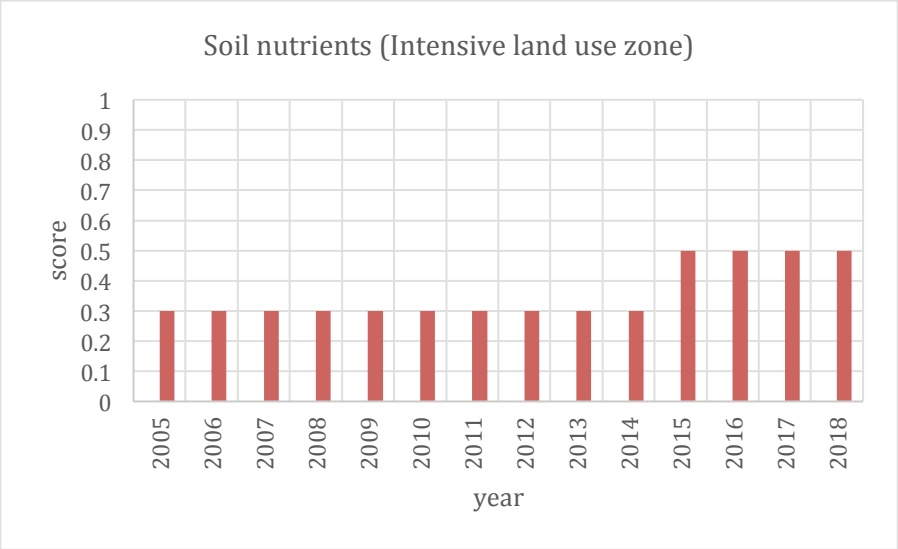
Extensive dairy farming occurred throughout the region for the majority of this phase. Opportunistic grazing for fat lamb, wool and vealer enterprises was also prevalent. Flood irrigation was utilised heavily throughout much of the land holding. Summer and winter cropping was conducted in non-drought years. By the turn of the century many paddocks were effectively abandoned from agricultural use due to the salt and soil impacts of past cultivation and inappropriate irrigation practices.

Phase 2. (2007-2011)

The land manager's focus during this phase was on improving the soil nutrient levels to enable the land to be utilised for agricultural production in the future. The actions the land manager took to achieve this included applying compost across the intensive land use zone as well as gypsum and other (unknown) fertilisers. Minimum till cropping was practiced as well as leaving the cereal stubble and root ball to stand and naturally mulch back into the soil. Some paddocks were sown with the deep-rooted crop lucerne in April 2010. Whilst the management actions of the land holder during this phase did not result in an improvement in soil nutrient levels, the management focus of the land holder changed to incorporate sustainable farming practices.

Phase 4. (2012-2017)

The effect of earlier top-dressing and continued applications gave rise to increased soil nutrient levels within the intensive land use zone areas during this phase.



C. Status of soil hydrology

Infiltration, percolation and water availability to plants; (Intensive land use zone)

Phase 1. (1900-2006)

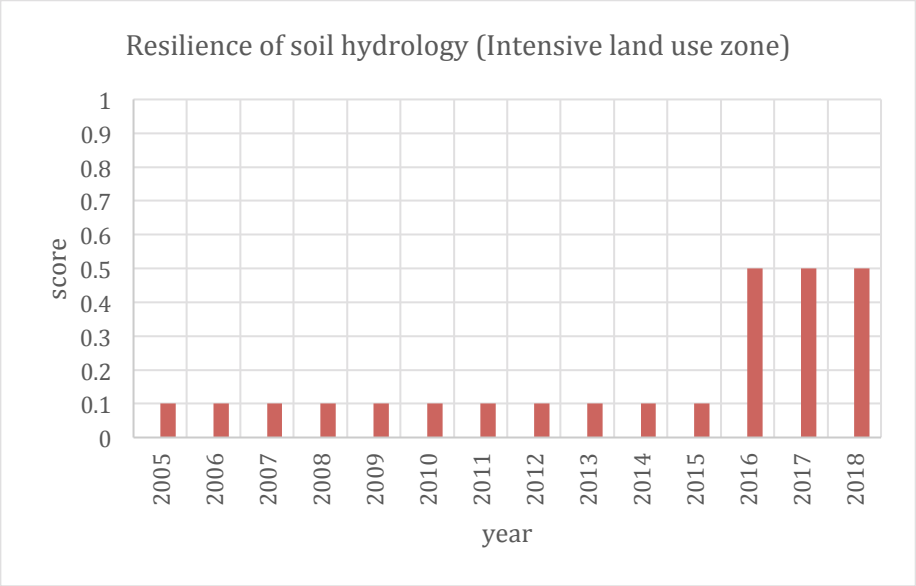
Throughout this phase the land was subjected to irrigation practices which would have raised the salinity of the soil and affected its physical structure reducing the soil's ability to retain and hold water. These factors may have kept the soil hydrology at the level that was found after Kilter Rural begun purchasing properties from 2007.

Phase 2/3. (2007-2011)

At the time of purchasing the land parcels, the status of soil hydrology was poor due to the management actions undertaken in the previous phase. The land holder undertook specific actions to improve the status of soil hydrology within the intensive land use zone of the land parcels. Crops such as lucerne were sown in 2010 in certain paddocks to improve root depth and infiltration capability of water. The land holder also improved the irrigation infrastructure on the land holdings installing high gradient gravity subsurface drip and centre pivot irrigation systems.

Phase 4. (2012-2017)

The status of soil hydrology within the intensive land use zone increased during this phase. , The improvement in the physical structure of the soil caused by specific cropping regimes was a major factor in improving the soil's ability to retain water.



Infiltration, percolation and water availability to plants; (Extensive land use zone)

Phase 1. (1900-2006)

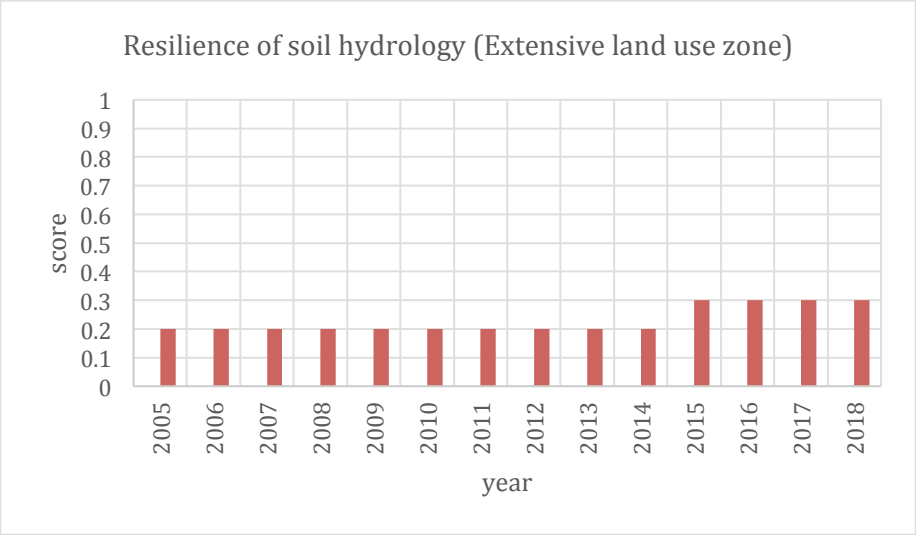
The status of soil hydrology within the extensive land use zone for this phase may have been relatively similar to the status seen post 2007. The extensive land use zone was left largely untouched by agriculture except for opportunistic livestock grazing due to its poor soils. This factor indicates that the soil hydrology level pre-2005 would have been similar to that of post-2007.

Phase 2/3. (2007-2011)

When the land was purchased by Kilter Rural, it was decided that certain areas were unsuited to agriculture and they were set aside for ecological purposes. Other areas within the extensive land use zone were lightly grazed with sheep in the summer of 2009. Much of the extensive land use zone was planted with native trees and shrubs throughout the phase, but many of the plantings failed. The management actions undertaken in the phase did not immediately improve the status of soil hydrology within the extensive land use zone but may have paved the way for future improvements.

Phase 4. (2012-2017)

Tree and shrub planting continued throughout the extensive land use zone. Much of the extensive land use zone was also locked away from agricultural use under legal covenant (BushTender). Although the plantings continued to fail in this phase, natural regrowth occurred in areas of the extensive land use zone and the growth of deep rooted plants helped improve the status of soil hydrology.



D. Status of soil biology

Nutrient recyclers, fungi and bacteria ratios and soil organic matter; (Extensive land use zone)

Phase 1. (1900-2006)

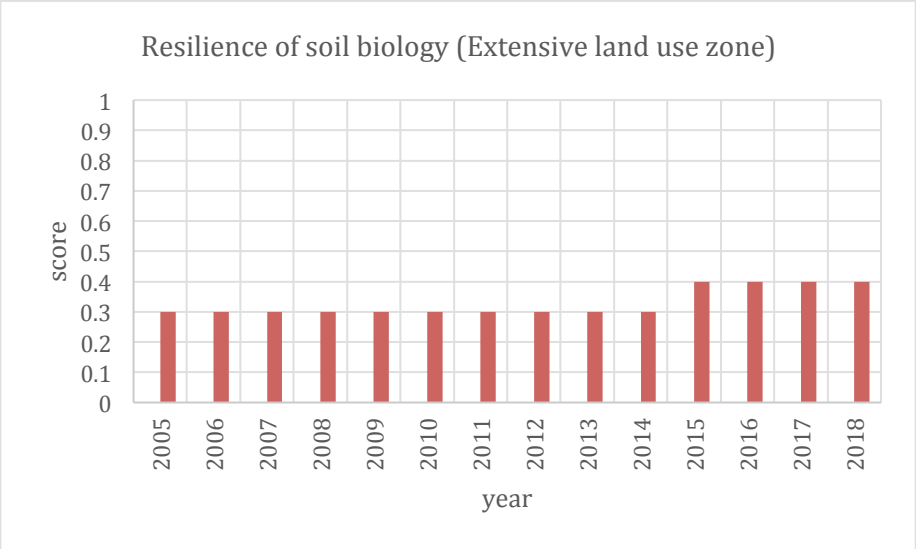
Throughout this phase the extensive land use zone within the land holdings was utilised for opportunistic livestock grazing. The land was not suitable for cropping or intensive farming due to its poor soils, and there were areas of surviving native vegetation. The areas where native vegetation was present would have had a better status of soil biology due to fungi and bacteria requiring a 'host' to provide sugars. Likewise, vegetation couldn't survive without the nutrients provided by the fungi and bacteria. The clearing of native vegetation which may have occurred throughout this phase would have reduced the status of soil biology within the extensive land use zone.

Phase 2/3. (2007-2011)

The status of soil biology is directly linked with the presence of vegetation. The land holders during this phase attempted to increase vegetation density across the extensive land use zone. They aimed to achieve this by planting trees and shrubs and setting aside paddocks from agricultural use. The trees and shrubs planted during this time largely failed and did not survive.

Phase 4. (2012-2017)

Native regrowth of vegetation occurred in this phase in the paddocks set aside from agricultural production. The increase in vegetation density caused by the native regrowth and partially due to the tree and shrub plantings undertaken by the land holder caused an improvement in the status of soil biology. The status of soil biology improved due to the increase in 'host' plants providing sugars for the fungi and bacteria to survive off.



Nutrient recyclers, fungi and bacteria ratios and soil organic matter; (Intensive land use zone)

Phase 1. (1900-2006)

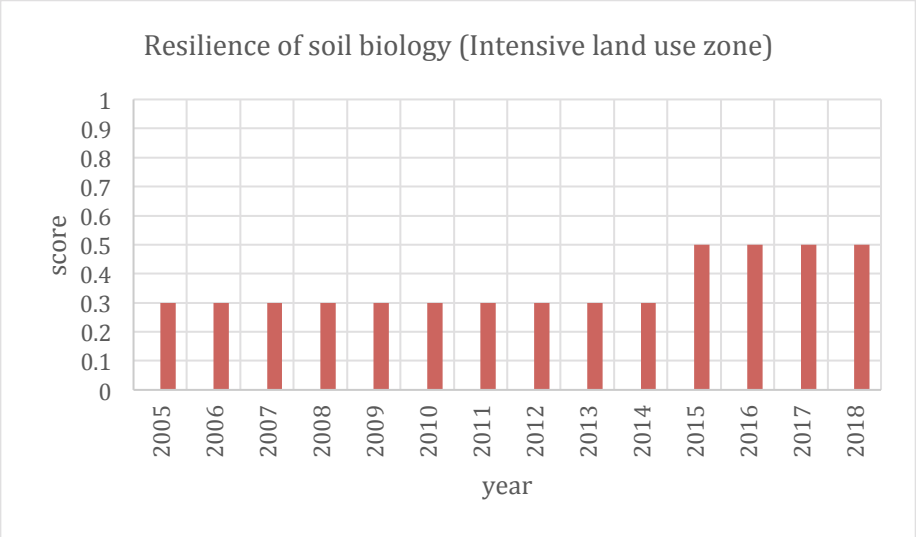
The management actions undertaken by the land holder during this phase would have caused a reduction in the status of soil biology. Much of the landscape was intensively farmed for dairy production for long periods of time. Cropping, fat lamb, wool and vealer enterprises were also conducted when weather conditions allowed. The management ideal of producing as much as possible with little regard for the environment led to soil degradation across the land holdings. By the turn of the century much of the land holding was denuded of vegetation with bare ground throughout. This resulted in the poor status of soil biology due to fungi and bacteria requiring 'host' vegetation to provide the necessary sugars for survival.

Phase 2/3. (2007-2011)

Throughout this phase the land manager focused on reducing the salinity levels of the soil and improving the status of soil biology. A major focus was placed on ensuring bare ground on the land holdings was reduced as much as possible. Wallaby grass, lucerne, chenopods and other native grasses were planted throughout 2010. The aim of the plantings was to ensure paddock coverage within the intensive land use zone. Large quantities of compost were applied strategically across the land holdings to increase biological activity within the soil. Gypsum and other fertilisers were also applied across the land holding to improve soil health. While the status of soil biology did not improve during this phase, the management ideals of protecting and caring for the soil would lead to future improvements.

Phase 4. (2012-2017)

The status of soil biology within the intensive land use zone increased during this phase. The management practices begun in the previous phase were continued, leading to improvement. Crop rotations were conducted across much of the intensive land use zone with the aim of reducing the time a paddock lay 'fallow'. By reducing the 'fallow' time, fungi and bacteria within the soil would have a greater chance of surviving between cropping rotations. Large quantities of compost continued to be applied strategically throughout this phase. The result of the management actions was an increase in the status of soil biology within the intensive land use zone during this phase.



E. Status of soil physical properties

Bulk density and soil as a medium for plant development and growth: (Intensive land use zone)

Phase 1. (1900-2006)

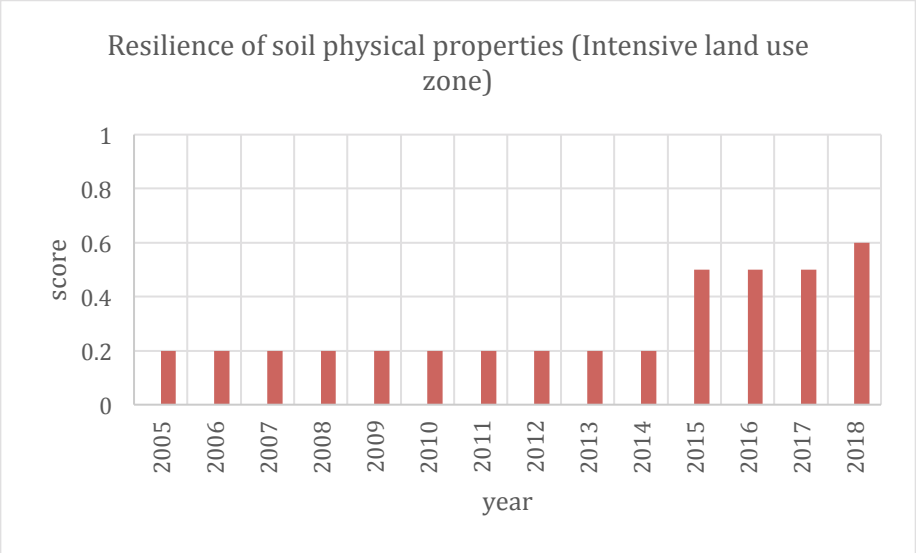
The production systems utilised throughout this phase such as dairy farming, fat lamb, wool and vealers, with the occasional crop, would have lowered the physical structure of the soil due to their intensity and the focus of land holder on 'production'. The widespread prevalence of bare ground and salt affected soil across the land holdings seen at the end of the phase suggest that the physical structure of the soil was relatively poor. The low amount of vegetation within the intensive land use zone would also have adversely affected the structure of the soil due to poor root depth.

Phase 2/3. (2007-2011)

The management actions undertaken by the landholder during this phase were focused on improving the productivity of the intensive land use zone by improving the health of the soil. Crops such as lucerne were sown due to their deep root structure. An aim of the land holder was to ensure a vegetation layer existed over the soil, reducing the amount of bare ground. Minimum till cropping was practised as well as leaving cereal stubbles and the root ball in place to naturally mulch back into the soil. The changes in production systems did not improve the physical structure of the soil during this phase but they paved the way for future improvements.

Phase 4. (2012-2017)

The landholder continued to implement the production systems utilised in the previous phase throughout the current phase. Crop rotations were planned for each paddock to minimise the amount of time each paddock lay 'fallow'. Crops such as lucerne continued to be planted to improve the root depth within the soil. Tomato crops were utilised heavily for their ability to remove salt from the soil and their high production value. The management action undertaken by the land holder throughout the current and previous phase successfully improved the physical structure of the soil within the intensive land use zone.



Bulk density and soil as a medium for plant development and growth; (Extensive land use zone)

Phase 1. (1900-2006)

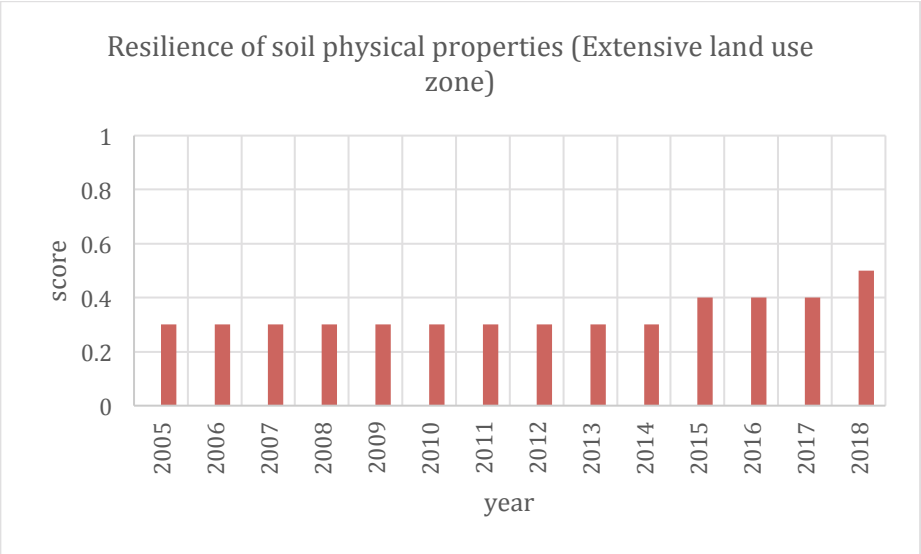
The physical structure of the soil within the extensive land use zone may not have been as degraded as the soil in the intensive land use zone during phase 1, due to it not having been subjected to intensive farming over many years. The poor, low nutrient soil found in the extensive land use zone would not have been as productive as the soil found in the intensive land use zone. This would have contributed to it not being utilised as heavily for agriculture as the intensive land use zone. These factors may potentially have aided in keeping the physical status of the soil in a better condition within the extensive land use zone than the intensive land use zone towards the end of phase 1. The increased density of vegetation within the extensive land use zone would also have aided in improving the structure of the soil due to the deeper root depths.

Phase 2/3. (2007-2011)

Land parcels deemed unsuitable for intensive agriculture were set aside as the extensive land use zone, and were managed for ecological purposes. Trees and shrubs were planted or, where possible, regrowth protected. While this did not immediately improve the soil biology of the extensive land use zone, the presence of more vegetation with increasing root depths would lead to future improvements.

Phase 4. (2012-2017)

The physical structure of the soil improved in the extensive land use zone, as a result of ecological management during this and the previous phase. The increased presence of vegetation in the form of plantings and natural regrowth provided a deeper root base which improved the physical structure of the soil within the extensive land use zone.



F. Status of the reproductive potential

Plant species and plant community; (Intensive and Extensive land use zones)

Phase 1. (1900-2006)

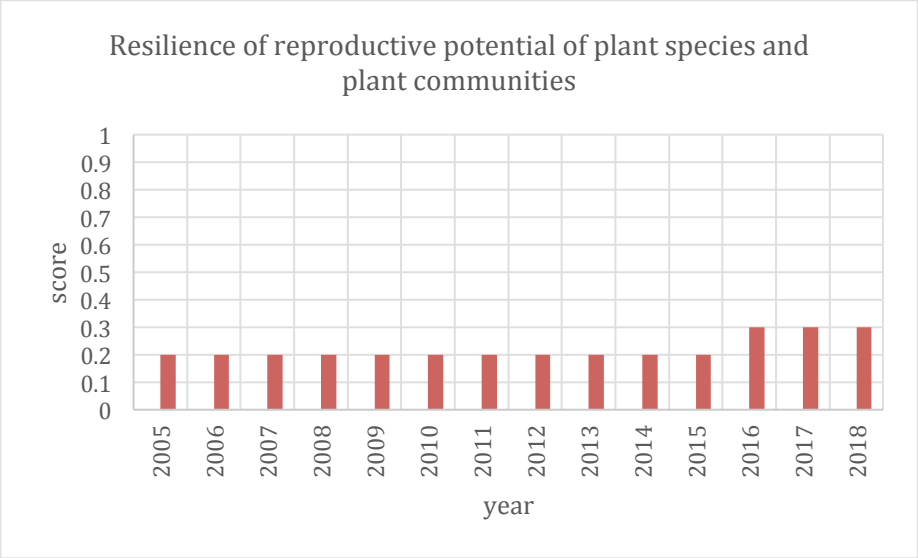
The reproductive potential of plant species and communities across the property may have been limited during this phase. Clearing of native vegetation for agriculture would also have reduced the ability of the plant species to reproduce. Opportunistic livestock grazing was also conducted throughout this phase by the landholders, and this would have impacted on vegetation due to livestock browsing. The production systems utilised throughout this period reduced the reproductive potential of plant species and communities across the land holdings.

Phase 2/3. (2007-2011)

The land holder altered production systems in this phase, including locking away up to 30% of the entire land holding from agricultural use under BushTender status and planting native trees and shrubs in paddocks to return vegetation to the landscape. The actions taken by the land holder enabled areas of the land holding to rest and begin to recover from agricultural use during this phase.

Phase 4. (2012-2017)

The management actions taken in the previous phase to improve the reproductive potential of plant species and communities began to take effect in this phase. Within areas locked away from agricultural use, native regrowth of vegetation began to occur. While tree and shrub plantings still continued into this phase, they had limited success. The reproductive potential of plant species and communities improved during this phase due to the land holder resting areas of the landholding from agricultural use.



G. Status of tree and shrub cover and structure (Intensive and Extensive land use zones)

Phase 1. (1900-2006)

Throughout much of this phase the landholders managed the land with a mindset focused on 'production'. Areas of the land holding were subjected to opportunistic livestock grazing which would have reduced the amount of regrowth produced naturally by trees and shrubs. Paddocks would also have been cleared of vegetation to make space for crops and dairy cows. The impact of the production systems utilised throughout this period was to severely reduce the status of the tree and shrub structure across the land holdings.

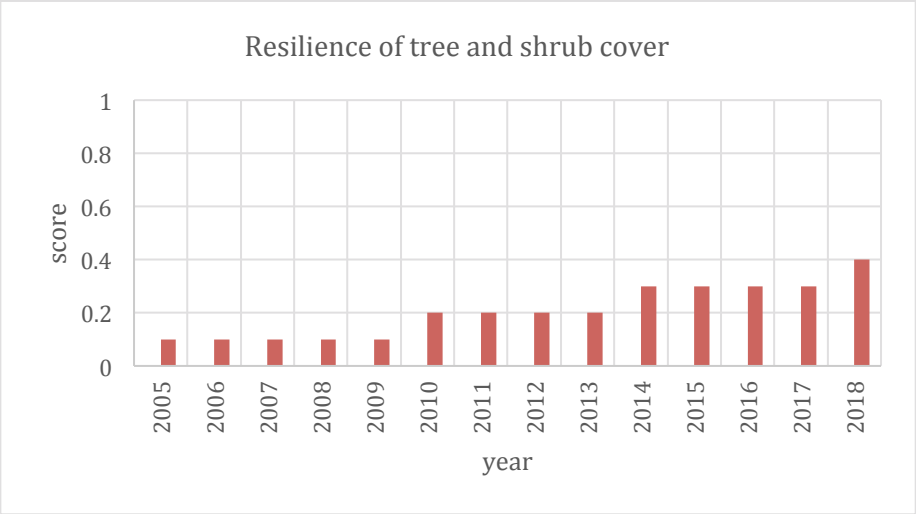
Phase 2/3. (2007-2011)

During this phase the production systems utilised by the land managers changed. Land was locked way from agricultural use under legal covenant (BushTender), trees and shrubs were also planted across the land holdings. Whilst the tree and shrub plantings had limited success, within the areas locked away from agricultural use natural regrowth of vegetation occurred. The status of the tree and shrub structure improved marginally due to the regrowth of vegetation.

Phase 4. (2012-2017)

The landholder continued to plant trees and shrubs throughout this period and monitored the progress of the natural regrowth occurring across the land holdings. The aim of the land managers during this phase was to enhance vegetation complexity in certain areas of the property. To assess if this was being achieved, vegetation assessments were conducted during 2013 and 2014 within trial paddocks across the property. The results of the study found that the status of the tree and shrub structure improved between 2013 and 2014. The results of the study can be found here:

http://www.nccma.vic.gov.au/sites/default/files/publications/sequesting_soil_carbon_in_irrigated_landscape_turned_dry_ecological_grazing_2014.pdf



H. Status of ground layer/ground cover/grass and herb cover and structure (Intensive and Extensive land use zones)

Phase 1. (1900-2006)

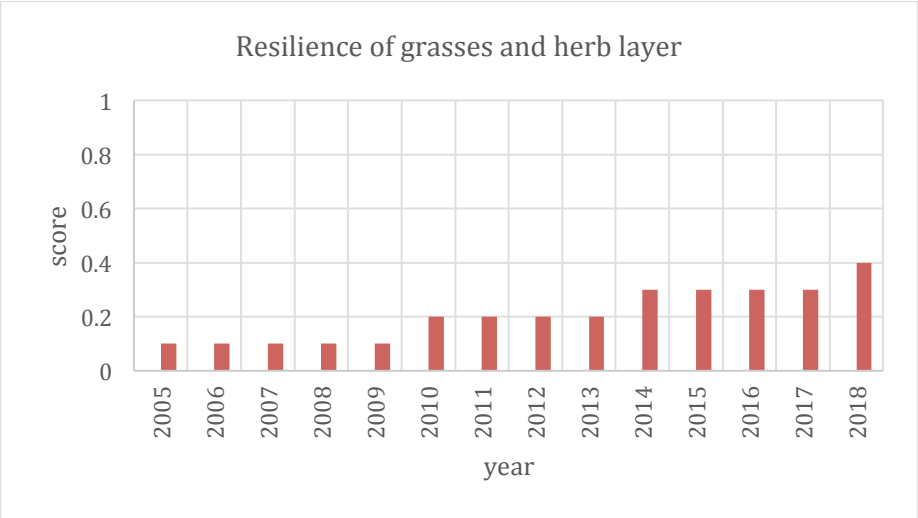
Landholders farmed the area intensively from the beginning of the phase up till the end of the century. The main enterprises consisted of dairy farms, cropping when weather conditions allowed and opportunistic grazing of livestock. Dairying was focussed on the floodplains. Intensive production systems would have dramatically affected the grass and herb cover and structure due to the land rarely being rested from agricultural use. Decreasing soil health over time (saline water tables) would have been evident on the floodplain soils, which would have reduced the capacity of the grass and herb cover to grow and produce healthy grasses and herbs.

Phase 2/3. (2007-2011)

The management ideals of the landholder changed during this phase. Much of the land was managed with the aim of repairing the health of the soil and bringing it back into production. Areas of the land holding were sown with perennial lucerne in 2010 in place of annual grass species. Wallaby grass, chenopods and other native grasses were also sown throughout 2010. This reduced the amount of bare ground across the land holding and improved the status of the grass and herb layer.

Phase 4. (2012-2017)

The status of the grass and herb layer improved due to actions taken by the land managers. Much of the property was locked away from agricultural use under legal covenant (BushTender) and strategic cell grazing of livestock was conducted. Vegetation surveys were conducted in 2013 and 2017 which found that the grass and herb layer was improving within certain paddocks. The results of the 2013 study can be found here:
http://www.nccma.vic.gov.au/sites/default/files/publications/sequesting_soil_carbon_in_irrigated_landscape_turned_dry_ecological_grazing_2014.pdf



I. Status of tree and shrub species richness and functional traits; (Intensive and Extensive land use zones)

Phase 1. (1900-2006)

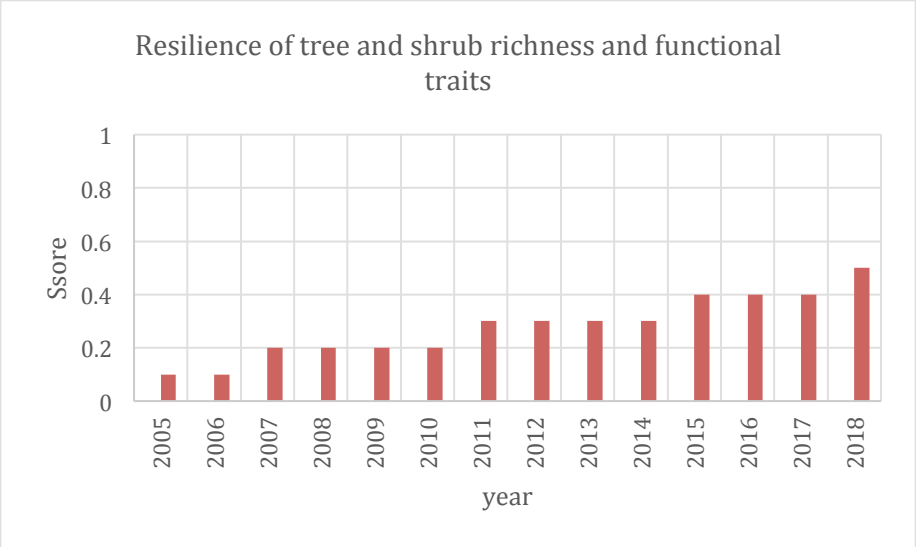
Like most land in the intensive land use zone i.e. non-rangelands, each of the former land holdings now part of FFL Winlaton were managed for asset intensification during this period. Early in this phase, large, mature paddock trees were harvested and used for strainer posts, building materials or firewood. Only the poor specimens or immature trees were retained. This would have caused a reduction in tree species richness across the individual properties. Shrubs would have been removed to make way for pastures and crops, again negatively affecting species richness.

Phase 2/3. (2007-2011)

Tree and shrub species richness began to increase during this phase. This was due to the land managers planting varying species of trees and shrubs in appropriate areas across the properties.

Phase 4. (2012-2017)

Tree and shrub species richness increased further due to increases in tree and shrub plantings, introducing more species to the property. 30% of the property was also set aside from agricultural use for ecological purposes under legal covenant. This allowed tree and shrub species to grow unhindered by livestock and feral animal grazing. Site-based vegetation surveys were conducted in 2013 and 2014 which indicated that tree and shrub species richness was improving. The results of the study can be found here:
http://www.nccma.vic.gov.au/sites/default/files/publications/sequesting_soil_carbon_in_irrigated_landscape_turned_dry_ecological_grazing_2014.pdf



J. Status of the ground layer/grass and herb species richness and functional traits (Intensive land use zone)

Phase 1. (1900-2006)

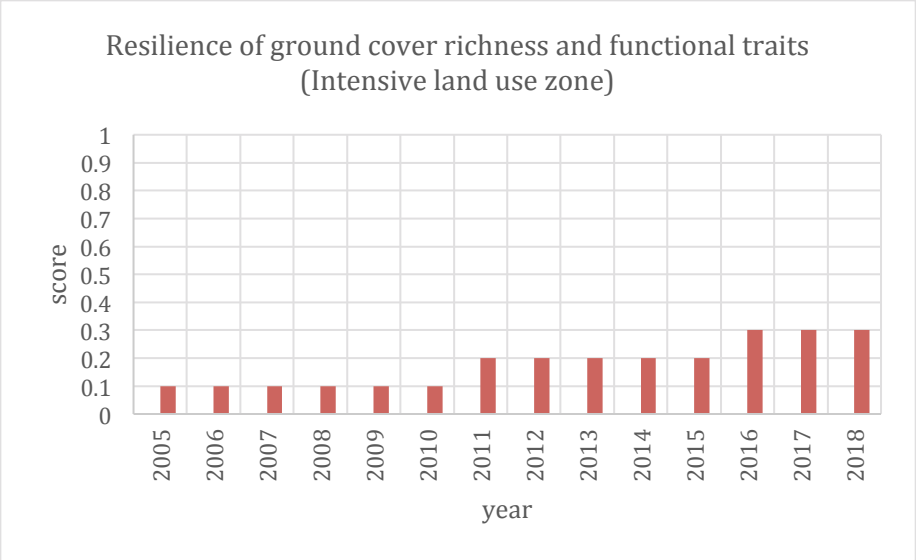
Ground cover species richness would have suffered during this phase due to the 'traditional' farming techniques utilised within the intensive land use zone. Overgrazing from livestock and planting monocultural winter fodder crops would have occurred throughout much of the phase.

Phase 2/3. (2007-2011)

The ground cover species richness within the intensive land use zone may not have improved pre-2010, partly because of the Millennium Drought and partly because it required time to recover from the decades of conventional farming. However, ground cover species richness improved in 2011 after plantings of lucerne, wallaby grass, chenopods and other native grasses occurred throughout 2010.

Phase 4. (2012-2017)

Ground cover species richness improved within the intensive land use zone during this phase. The improvement is due to the changes in farming techniques applied across the intensive land use zone. The land managers focused on growing diverse, healthy pastures during this stage as well as trialling new species of forage within the pastures. These methods, combined with managing livestock through rotational movements across grazing cells, helped to improve the ground cover species richness during this phase. Site-based vegetation surveys was conducted in 2013 and 2014, and repeated in 2017,found ground cover species richness was improving. The results of the study can be found here: http://www.nccma.vic.gov.au/sites/default/files/publications/sequesting_soil_carbon_in_irrigated_landscape_turned_dry_ecological_grazing_2014.pdf



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Attachment A: Production Systems – Land management regimes over time

The following chronology was established as a partnership with the land manager for each of the phases 1-4:

Phase 1 (1900-2006)

Years:

- 1900-2006

Land area:

- 8900 acres

Management ideals:

- The land was managed from an economic perspective with little regard for the environment during this phase. (Kilter_PaddockHistories)

Animal management and production:

- Fat lamb and wool. (Kilter_PaddockHistories)
- Vealer enterprises. (Kilter_PaddockHistories)
- Extensive dairy farming across the land holding for the early part of the 1900's, continued in some areas till the 1990's. (SFL_EOI)
- Opportunistic grazing with little attention provided to strategic (sustainable) grazing management. (SFL_EOI)

Crop and pasture management:

- Flood irrigation occurred throughout much of the land holding. (Kilter_PaddockHistories)

- Summer cropping occurred in non-drought years. (Kilter_PaddockHistories)
- Winter cropping believed to be wheat during drought years (2000's). (Kilter_PaddockHistories)
- Some paddocks consisted of 'sub & rye' annual pasture – predominantly Trefoil and Ryegrass boosted by Barley Grass. (Kilter_PaddockHistories)
- Annual pastures were prevalent in conjunction with dairy operations. (SFL_EOI)

Monitoring and observations:

- Generally denuded soils. Nutrient deficient and salt affected land widespread. (SFL_EOI)
- Many paddocks effectively abandoned due to salt and soil impacts of past cultivation, and inappropriate irrigation practices. (SFL_EOI)
- Generally poor attention to weed management in line with loss of land production value. (SFL_EOI)
- Much of the landscape was in a highly modified state from land clearing activities, with natural regrowth on stranded irrigation land typically of low quality (dominated by halophytes on salt affected ground). (SFL_EOI)

Evaluation:

- Substantial soil structure damage with bare ground and salt scalds throughout the land holding. (SFL_EOI)

Improvements:

- None recorded

Phase 2/3 (2007-2011)

Years:

- 2007-2011

Land area:

- 8900 acres

Management ideals:

- The Land holder's focus was on preparing for and implementing their desired management regime of environmentally sustainable farming.

Animal management and production:

- Sheep grazed lightly over the summer period (2009). (Kilter_PaddockHistories)

Crop and pasture management:

- Export quality oaten hay crop grown in some paddocks in 2009 utilising Autumn watering, produced 3 tonnes/ acre. (Kilter_PaddockHistories)
- During this phase minimum till was practiced as well as leaving the oat stubble and root ball to stand and naturally mulch back into the soil. (Kilter_PaddockHistories)

- Some paddocks were ‘air seeded’ with Wallaby grass in April 2010. (Kilter_PaddockHistories)
- Paddocks were sown with native grasses and chenopods by ‘air seeding’ in June 2010. (Kilter_PaddockHistories)
- A few paddocks were sown with lucerne and then oversown with a barley crop in April 2010. (Kilter_PaddockHistories)
- Direct seeding of native species including Old Man Saltbush was utilized in certain paddocks in March 2010. (Kilter_PaddockHistories)
- Gypsum and fertilisers applied throughout this phase. (SFL_EOI)
- Large quantities of compost sourced from Melbourne and applied strategically to support improvement in soil structure and biological activity. (SFL_EOI)
- Utilised irrigation to exploit the natural cracking property of the soils to assist with flushing of salts deeper into the soil profile. (SFL_EOI)

Monitoring and observations:

- Large areas of the land holding were inundated for extended periods of time due to the flooding of the Lower Loddon in January 2011. (Kilter_PaddockHistories)
- BushBroker status was granted to certain trees on the Land holding in 2011. (Kilter_PaddockHistories)
- Detailed soil surveys were carried out to quantify soil constraints to production. (SFL_EOI)

Evaluation:

- The management regimes utilised during this phase have assisted in bringing the soil back into a productive state.

Improvements:

- Efficient forms of irrigation being implemented include, high gradient gravity with reuse, sub-surface drip (SDI) and centre pivot. (SFL_EOI)
- Approximately 40% of the landscape protected (voluntarily and under legal covenant) and enhanced for its native vegetation value to provide ecological services, physical buffering and offsetting of agricultural impacts. (SFL_EOI)
- Pest and weed management programs conducted on both agricultural and ecological lands. (SFL_EOI)

Phase 4 (2012-2017)

Years:

- 2012-2017

Land area:

- 8900 acres

Management ideals:

- To strategically manage the landscape using an environmentally sustainable land management

regime. Low input dryland cell grazing is the dominant land use planned for the Kilter landscape where irrigation is being removed.

Animal management and production:

- 4000 strong flock of merino cross ewes (wool and fat lambs) cell grazed on native vegetation and seasonally on Lucerne and cropping residues. (SFL_EOI)

Crop and pasture management:

- Currently 30% (building to 50%) of landscape developed for summer cropping (cotton, tomatoes, Lucerne), horticulture (stone fruit, plums) and winter cereals. (SFL_EOI)
- Rotations of trial crops conducted intermittently across the irrigated section of the land holding. (SFL_EOI)
- An experimental crop of cotton grown in 2014? (Gray 2014)

Monitoring and observations:

- Soil surveys conducted by hired scientists monitoring and planning for changes in soil health and structure. (SFL_EOI)
- Soil carbon surveys conducted in October 2012. (FACT SHEET NO. 2)
- Post purchase and redevelopment Kilter Rural seeks to deliver total return of 8% p.a. (SFL_EOI)

Evaluation:

- Nil recorded

Improvements:

- Investment to date of approximately $40M for purchase and redevelopment of 35 Soldier Settlement scaled farms. (SFL_EOI)
- Kilter invests heavily in the training of staff (farmer managers). (SFL_EOI)
- Areas of the land holding were fenced and protected from stock incursion in Autumn 2012. (Kilter_PaddockHistories)

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Case Study

2018

FFL WINLATON CASE STUDY: ECONOMIC REPORT

Prepared by Mark Gardner

Kilter Rural has quickly become an international leader in processing tomato production with its large operational scale, and focus on yields and quality. A strong focus on water use efficiency and soils will continue to drive productivity and soil improvement.

Background:

Kilter Rural's returns in excess of 8% on capital invested a year is achieved by returns generated from the blending of multiple business units – agricultural produce, irrigation water services and environmental markets (to the extent that they are available), and the operational returns generated as capital appreciation of the land. This is regularly assessed by independent valuation.

When both Operational Returns and Capital Valuations are added, Kilter Rural is aiming to *exceed* a target of 8% a year.

This report focuses on the agricultural produce enterprise.

Production Focus: Soil and Water

Since 2014 Kilter Rural has transformed its agricultural production systems by focussing on both water use efficiency and soil health. This dual focus underpins the improving levels of production that have been measured over the last four years.

In order to create a more regenerative production system, the most suitable irrigation soil types are identified through detailed soil tests for nutrient status and chemical properties. Soil pits are used to examine physical soil structure and applications of organic matter at rates up to 10 t/ha are commonly applied as compost in order to assist the soil biological processes in the first years of production. Compost is currently transported from other parts of Victoria. Agricultural production is focussed on the black and grey cracking clays (Vertosols) on the lower floodplain as well as loamier clays (Sodosols) on the gentle rises where these meet irrigation suitability criteria.

Sub-surface irrigation, centre pivots and laser levelled paddocks for gravity irrigation have been installed on the most productive soils, currently nearing 3,000 ha. A further 1,300 ha is in the process of being developed for irrigated production.

Over time various summer and winter irrigated crops have been trialled. These include dryland cereals where there is the ability to irrigate at key growth stages to supplement increasingly unreliable rainfall. The business is currently operating on two distinct streams of cropping rotations:

1. Irrigated summer crops rotating around lucerne, processing tomatoes and cotton; and
2. Winter organic cereals in combination with a short rotation organic summer crop (e.g. soybean)

A sheep enterprise is run on the dryland areas and opportunistically on crop feed/residue, and small areas of new crops are actively trialled to determine future viability.

The summer irrigated cropping provides the bulk of the net income from the enterprise. A focus on lucerne, processing tomatoes and cotton creates a balanced cropping rotation as well as strong predictability in market prices through the ability to sell forward. However this is now being increasingly supported by the elevated margins associated with a broadacre organic enterprise. All cropping enterprises have well developed agronomic programs with linkages to leading industry partners and R&D organisations.

Regenerative practices:

When purchased by the company, much of the original aggregation consisted of low nutrient status soils with a long history of past cultivation and unsustainable irrigation practices. Soils were also significantly affected by salt, brought about by a century of inadequate irrigation and drainage management.

Farm productivity was low, and the farms had effectively become a stranded asset at the turn of the 21st century. Natural regrowth on stranded irrigation land was typically of low quality and dominated by a few early colonisers (often by halophytes on salt affected ground).

A number of innovations have brought soils back into production. These include:

- The strategic use of compost, gypsum and fertilisers.
- The introduction of (deep rooted) lucerne and careful management of irrigation
- Irrigation combined with the natural cracking properties of the soils, assists with flushing of accumulated surface salts deeper into the profile.
- Large quantities of compost are used to support improvement in soil structure, organic matter levels and biological activity.
- Compost is a key element of a broader strategy to regenerate these soils.
- Over 1000 ha of managed lands are under organic certification.

Kilter Rural is particularly innovative in developing production efficiencies in its cropping enterprise including;

1. Soil management: integration of crop residue; introducing organic matter through composting; strategic crop rotations; irrigation to mimic natural wet-dry cycles to develop soil structure and permeability in cracking clays,
2. Water use efficiency: optimising water applications to the plant in the right amount at the right times; and

3. Fertiliser management: improving soil biological processes; crop rotation; targeting applied nutrients to meet plant requirements; enhancing soil nutrient availability through improvements in soil structure; sub-surface delivery of nutrients in-crop.

The Kilter management team is able to access a strong technical team within and outside the business and has taken a detailed measurement based style to their management. This provides a good platform for their innovation.

Kilter is building a strong data driven learning style to managing its land, which will allow them to refine a locally adapted management approach.

Cropping Rotation:

After re-development of land for irrigation (either through subsurface, spray or laser levelling for gravity irrigation), lucerne typically starts the rotation and plays an important role in soil conditioning. Its deep roots open pathways for air and water to permeate through the soil profile. As a legume, the ability to add nitrogen to assist subsequent crops that have high nitrogen requirements, is important. Processing tomatoes are currently the highest value cropping enterprise and follow lucerne in the rotation. Generally, after two harvests, tomatoes are rotated with cotton for up to two years. The actual sequencing of crops within a rotation is dependent upon the needs and capability (soil and irrigation) of the particular paddock.

Allowing crop residues to be returned to the soil and minimising soil disturbance are important processes to ensure soil structure is maintained. Compost is embedded in the management cycle and is applied at rates up to 10 t/ha.

This crop combination is designed for sustained long-term returns. Over a four year period *gross margins* are currently averaging between $1000-$1500/ha/year.

Measurable soil structural and health improvements over time demonstrate the success of the summer crop rotation strategy. Through the use of regular and detailed soil testing, and use of an experienced Soils Consultant, soil improvement is planned and then monitored on a paddock by paddock basis.

Crop yields and quality are also closely monitored on a paddock by paddock basis and, together with soil data, inform future management decisions.

The future:

Kilter Rural has quickly become an international leader in processing tomato production with its large operational scale, and focus on yields and quality. A continuing focus on water use efficiency and soils will continue to drive productivity and soil improvement.

Detailed paddock, soil and crop records allow for a yearly cycle of review and adaptive learning. This creates a continuous improvement culture within the organisation.

Within the irrigation enterprise, the cotton rotation is an evolving area of knowledge. Growing cotton in a southern (short season) climate on a sub-surface irrigation zone is innovative, but increasingly possible given a changing northern Victorian climate.

A continual focus on agronomics, water use efficiency and soil profile improvements will help drive further growth in yields and Gross Margins, and lift average Gross Margins to the top of the target range.

While continually improving year on year production from each individual crop is important, Kilter Rural remains focused on the overall Gross Margin return over the full rotation cycle. This philosophy also somewhat removes the distraction of year to year commodity pricing that can be managed but not controlled.

Crop yield and efficiency information:

Crop type: Processing Tomato

The following table shows the area, average yield (t/ha and t/ha/100mm rain) and water use (ML/ha) for the tomato crop from 2014-17 financial year's crop. Note this crop has been grown on Sub Surface Drip Irrigation

TABLE 1: CROP YIELD AND EFFICIENCY MEASURES: KILTER TOMATO CROP

Sub surface Drip Irrigation

Financial Year End:	Area grown (ha)	Yield (t/ha)	Irrigation Water Use (ML/ha)	Water use efficiency for irrigation and rainfall (t/ha/100mm)
FY14	65	92	7.7	11.2
FY15	165	135	7.4	16.9
FY16	275	152	8.5	16.7
FY17	268	119	6.3	16.3

Note: Rainfall contribution to total crop water is that accumulated over Oct-Jan growing season

The Kilter management team focuses on water use efficiency as a driver of both production and Gross Margin. Their target is to exceed 16 t/ha/100mm and this is considered a high benchmark in the industry.

Individual seasonal influences such as within crop temperature variations (particularly cold temperatures early in the season) and changing crop paddocks (new irrigation fields) have led to the small fluctuations in water use efficiency around the target.

After the first cropping year, the internal benchmark has been exceeded in all years. The management team believes that with further experience and learning there is an opportunity for additional improvement in both overall yield and efficiency.

We were unable to locate published benchmark water use efficiency figures for processing tomatoes in Northern Victoria. However, the SFL team has verified in discussions with independent industry experts that the water use efficiencies measured at the Kilter farms are very high by industry standards.

Crop type: Lucerne

Sub surface drip irrigated lucerne:

The following table shows the area, average yield (t/ha and t/ha/100mm rain) and water use (ML/ha) for the lucerne crop from 2014-17 financial year's crop. Note the crop characterised here has been grown on Sub Surface Drip Irrigation.

TABLE 2: CROP YIELD AND EFFICIENCY MEASURES: LUCERNE CROP

Sub surface Drip Irrigation

Financial Year End:	**Area grown (ha)**	**Hay Yield (t/ha)**	**Irrigation Water Use (ML/ha)**	**Water use efficiency for irrigation and rainfall (t/ha/100mm)**
FY15	100	10.7	8.3	0.99
FY16	212	12.5	8.7	1.19
FY17	312	11.9	7.1	1.16
3 yr AVERAGE				**1.13**
COMPARATIVE				*1.10*

Notes:

1. Lucerne yields are for the season following establishment
2. Rainfall contribution to total crop water was accumulated over Jul-Mar growing season
3. Comparative: see footnote for reference citation

As for tomatoes, seasonal variations in temperatures, the pattern of rainfall (particularly after hay is cut) and the length of growing season all impact on the numbers of hay cuts possible in a season and yield. In some years grazing with sheep has been preferred to an inferior final cut.

The Comparative line is taken from a paper published in the Journal of Crop and Pasture Science examining lucerne yield, water productivity and persistence under a range of irrigation strategies. The research was undertaken over a five year period in Northern Victoria.[1] The water use efficiencies

[1] *Lucerne yields, water productivity and persistence under variable and restricted irrigation strategies. ME Rogers, AR Lawson and KB Kelly. Crop and Pasture Science, 2016, 67 563-573.*

being achieved using Sub Surface Irrigation are comparable with those found in the research trial, which suggests a good level of water use efficiency is being achieved.

Gravity irrigated lucerne (flood irrigation):

Lucerne had been opportunistically grown for some years. However it was 2014 when Kilter saw a strategic role for lucerne as a genuine long term rotation crop with tomatoes and cotton. The soil conditioning properties of lucerne were able to be closely monitored in the subsequent high value crops and were reflected in improvements in yield and quality.

This has created a focus on the overall Gross Margin *of the rotation*, rather than on an individual crop.

TABLE 3: CROP YIELD AND EFFICIENCY MEASURES: LUCERNE CROP

Gravity Irrigation (Efficient Flood)

Financial Year End:	**Area grown (ha)**	**Hay Yield (t/ha)**	**Irrigation Water Use (ML/ha)**	**Water use efficiency for irrigation and rainfall (t/ha/100mm)**
FY16	140	9.5	8.5	0.92
FY17	320	9.4	6.7	0.95
AVERAGE:				*0.94*
COMPARATIVE TRIAL				*1.02*[2]
COMPARATIVE LUCERNE HANDBOOK				*0.73*[3]

Notes:

1. Lucerne yields are for the season following establishment
2. Rainfall contribution to total crop water was accumulated over the Jul-Mar growing season
3. Comparative: see footnote for reference citations

[2] *Lucerne yields, water productivity and persistence under variable and restricted irrigation strategies. ME Rogers, AR Lawson and KB Kelly. Crop and Pasture Science, 2016, 67 563-573.*
[3] *Bullen, K 2002 Lucerne Management Handbook 4th edition DPI Publishing*

The water use efficiency for the laser levelled gravity irrigated paddocks is below that achieved through sub surface drip irrigation, which is to be expected. The yields achieved are slightly lower than those achieved in the five year comparative research trials, however they are greater than those achieved under commercial conditions as cited in the Lucerne Management Handbook.

Water use efficiency: Overall Lucerne crop

Water use efficiency is a key management focus at Kilter. Table 4 below shows the irrigation efficiency comparisons between gravity irrigation and sub surface Irrigation for the lucerne rotation over a three year period.

While the capital costs of sub surface irrigation are substantially more than laser levelled gravity irrigation, the irrigation efficiency gains range from 22% to 29%.

TABLE 4: IRRIGATION EFFICIENCY MEASURES: LUCERNE CROP

Gravity Irrigation (Flood) compared to Sub Surface irrigation

Financial Year End:	Gravity (Flood irrigation) Water use efficiency for irrigation and rainfall (t/ha/100mm)	Sub surface irrigation Water use efficiency for irrigation and rainfall (t/ha/100mm)	Efficiency difference (sub surface over gravity) %
FY16	0.92	1.19	29
FY17	0.95	1.16	22

Water use efficiency: Paddock example

Below is an example of the yields achieved from Paddock DBRA3 which was sown in spring 2014. This crop was rotated out of lucerne into tomatoes in 2017, and the yields cut short by the need to prepare the soil for the subsequent summer crop.

	Table 5: Sub Surface irrigation Lucerne Water-Yield Efficiency: DBRA3				
Financial Year end	**Ha grown**	**Ave. t/ha** **Crop Yield**	**Ave. ML/ha** **Irrigation water applied**	**Ave t/ha/100mm** **Water use efficiency for irrigation and rainfall (t/ha/100mm)**	**Comment**
FY14	100	5.2	6.4	0.5	Establishment: Lucerne sown in spring
FY15	100	10.5	8.3	1.1	
FY16	100	13.5	8.6	1.3	
FY17	100	11.4	7.4	1.1	Consistently wet winter/spring , crop rotated out in autumn

The case study above shows the above lucerne paddock DBRA3 consistently achieving in excess of 1.1 t/ha/100mm of applied water (rain and irrigation).

Lucerne is currently harvested with a combination of small and large bales and marketing is targeting the higher value racehorse industry.

Gross Margins:

Kilter has a strong financial management focus to its activities. A key financial metric with a strong focus is Gross Margin/Megalitre of water applied ($GM/ML.) for each of their crops. This helps ensure that the most profitable use of their irrigation water is made.

Below is a Gross Margin range that has been achieved for the current range of crops, some being fully established and some for newer crops.

Table 6: Gross Margin per ha ($GM/ha) and Gross Margin per ML applied water ($GM/ML) for a range of crops.

Crop	$GM/ha range	GM $/ML range	Comment
Tomatoes	1500-2500	175-300	Demonstrated
*Cotton	800-1200	95-140	Work in progress
Lucerne	300-500	35-60	Demonstrated
Organic Cereals	500-700	200-280	Demonstrated
Organic Stone fruit	8000-12000	650-950	Demonstrated

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Case Study

2018

FFL WINLATON CASE STUDY: SOCIAL REPORT

Prepared by

Mark Gardner

Vanguard Business Services

Background:

This report looks at some of the people related or social aspects of the Kilter Rural business and, with the ecological and economic analyses which have also been undertaken, will give a report on the overall accomplishments of this farming enterprise.

Following are three graphs that present the farm Operations Management Team's averaged response to the questions completed on the social (people) aspects of the business, using the On Track Farm Family Business Indicators. This particular case study involved a corporate farming operation, therefore the questions related to Family Time, Family closeness and Time to do Fun things are perhaps not quite as applicable as for a Family Business Operation.

An overview to the On Track Indicators:

The indicators show the management team's response to the survey questions at a given point of time. Each individual decision maker has the opportunity to complete the survey questions in a confidential manner and submit them to the consultant for processing. Results are averaged and reported back.

The On Track Farm Family Business Indicators have been developed for Farm Family use with the aim to give people in management, an insight as to the level of satisfaction in the enterprises, and also an understanding of the family's or owner's goals across a range of criteria. These indicators can also be used to trigger useful discussions of the aspects of the enterprises which are going well, and may help gain an insight into aspects which may need improvement.

In addition, monitoring changes over time can help track variations in satisfaction levels, movement towards a unified future and changing goals and motivations over time. In this project, we have also asked kilter Rural to identify barriers they have experienced in their enterprises over the last three years.

Results:

The On Track Indicators have two aspects; Family Satisfaction and Goals.

Satisfaction:

Individual decision makers are asked to complete the survey questions by ranking their level of satisfaction on a scale from very pleased to very unhappy, with five choices in between. The questions are presented below:

	Satisfaction Scale:
1	I feel accepted by friends
2	My family/team is close
3	I have freedom to spend time alone
4	There's flexibility
5	I'm able to try new things on the farm
6	Clear expectations
7	time we spend together
8	We are able to make decisions as a family/team
9	We work well to solve problems
10	common sense of purpose
11	fun things together

The results, as scored by the three main business decision makers, are presented in Graph 1 below:

The results from this case study show a good level of satisfaction is evident, scoring an average of 75% across all indicators. A benchmark figure of 85% is considered a high average score.

Comments on the results: Including observations from interviews

Kilter Rural has an inclusive leadership and management style, which has led to a positive team based culture.

It was evident throughout the interview and subsequent follow up that management value and respect the opinions of their staff, and that staff feel valued.

The management team trusts staff and give them the discretion to make decisions independently, and provide oversight to ensure accountability and responsibility. The staff understand what is expected of them and perform to this expectation.

In discussions, the leadership team mentioned the importance of recruiting people who fit the organisation's culture and values and have strong teamwork skills.

There is low turnover in the organisation, and staff are committed to the organisation as management has created the conditions to flourish.

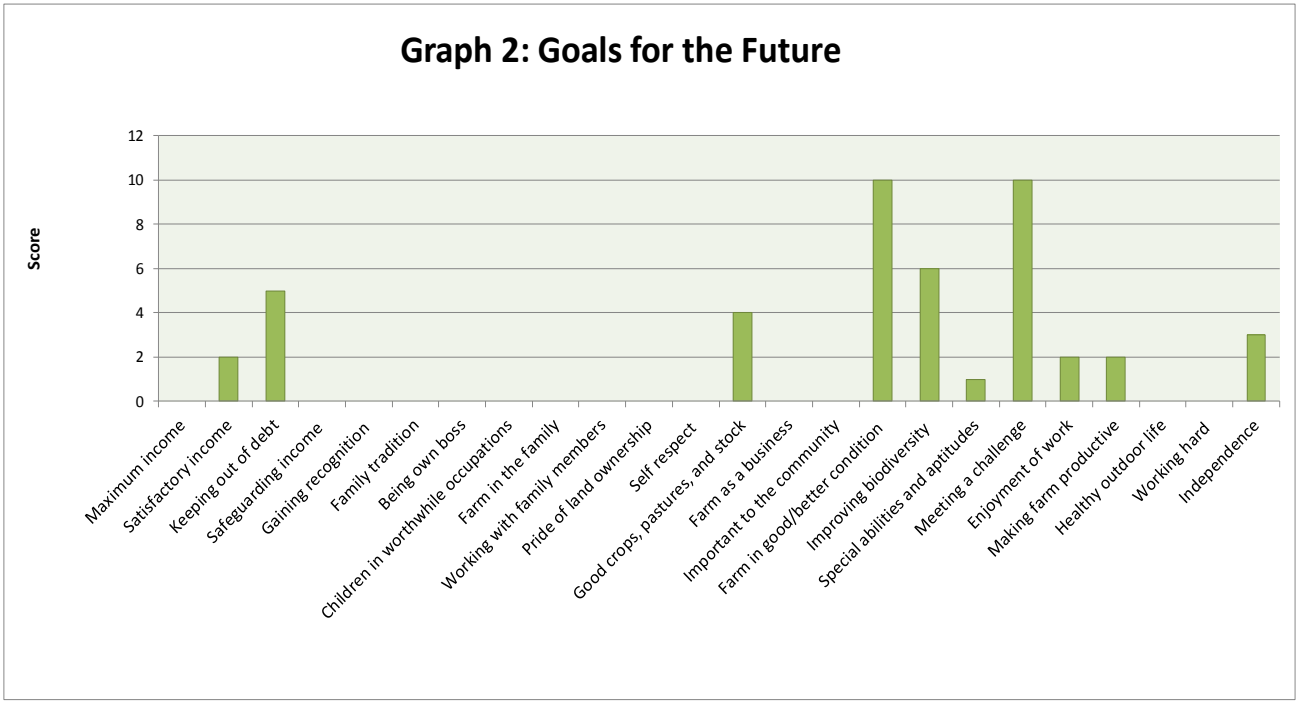
Goals for the future:

Individual decision makers are asked to complete the survey questions by choosing their five most important goals from a list of 24 choices. The choices cover a range of financial, risk, personal, family, lifestyle and ecological statements. The five most important goal statements are then ranked by each individual in descending level of importance from 5 to 1. Only 5 "votes" per person are allowed, giving an effective prioritisation process.

These goal statements and selection give an indication as to the motivations of the business decision makers as well as prioritising their goals. The goal questions are presented below:

Goal statements:
1. Making maximum income
2. Making a satisfactory net income
3. Keeping out of debt
4. Safeguarding income for the future
5. Gaining recognition as a good farmer/grazier
6. Continuing the family tradition
7. Being my own boss
8. Seeing my children in worthwhile occupations
9. Keeping the farm in the family
10. Working with other family members
11. Feeling pride of land ownership
12. Gaining self-respect for doing a worthwhile job
13. Having really good crops, pastures, and stock
14. Running the farm as a business
15. Feeling important to the community
16. Leaving the farm in as good/better condition as you received it
17. Improving biodiversity on the farm
18. Exercising special abilities and aptitudes
19. Meeting a challenge, achieving an objective
20. Enjoyment of work tasks
21. Making farm land fully productive
22. Living a healthy outdoor life
23. Working hard
24. Independence, freedom from supervision

The results as scored by the three main business decision makers is presented in Graph 2 below:



In the graph above The Kilter Management Team exhibits a strong motivation to meet the challenge of creating a regenerative business and the qualitative discussions have reinforced this motivation. The desire to Leave the Farm in Good/Better Condition and improving Biodiversity also came through in discussions and language used.

To the management team, keeping out of debt (in this case corporate debt) was the primary financial motivator.

Comments on the results: Including observations from interviews

The leadership and management of Kilter Rural enjoy a challenge and it is evident in their language. Meeting the challenge of creating a successful business which has strong ecological credentials, flows through the organisation to the operations staff who clearly articulate this as an important motivator.

One of the most impressive aspect of Kilter Rural is their focus on the organisational Charter, which not just describes *what* they are setting out to do and *how* they plan to do it, but explains *the type of organisation they wish to be and why*.

A number of staff made reference to the Charter.

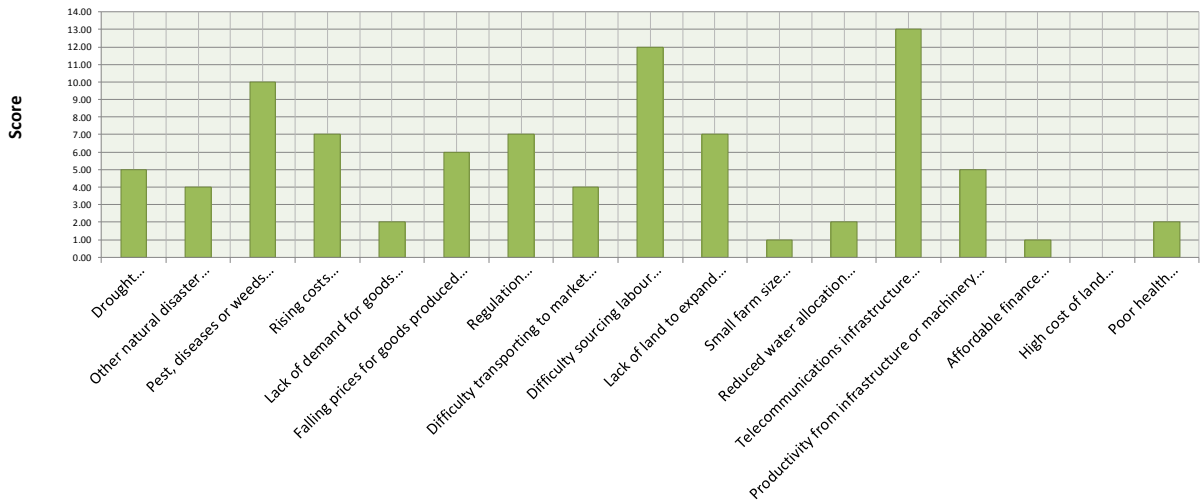
Barriers to change:

Through the data collection process, survey participants were also asked about the barriers to running their farm business they had experienced in the last three years. Seventeen questions were asked and participants asked to score each on a scale of 1 to 7, where 7 is a large Barrier. These questions are below:

Have any of the following been a barrier to you running your farm business the way you would like to in the last 3 years?
1. Drought
2. Other natural disasters e.g. flood, bushfire, storm damage
3. Pest, disease or weed invasion causing substantial damage
4. Rising input costs e.g. fertiliser, fuel
5. Lack of demand for the goods you produce
6. Falling prices for the goods you produce
7. Too many regulations
8. Difficulty transporting produce to market
9. Difficulty obtaining labour
10. Lack of land available to purchase or lease for farm expansion
11. Small size of my farm
12. Reduced water allocation for one or more seasons
13. Poor telecommunications infrastructure e.g. phone or internet coverage
14. Inability to fully use farm infrastructure, e.g. not getting full productivity from infrastructure or machinery
15. Difficulty accessing affordable finance
16. High cost of agricultural land
17. Poor health (of you or other people in your household)

The results as scored by the business decision makers is presented in Graph 3 below:

Graph 3: Barriers



It can be seen that poor Telecommunications is seen as a blockage (mobile phone coverage is patchy on the farms), followed by difficulty in obtaining labour and pest, disease and weed issues.

Comments on the results: Including observations from interviews

While the barriers to change that have been identified through this report are not unique to Kilter Rural, and will resonate with many in the rural sector, the way they have gone about overcoming them is quite unique.

- Their willingness to seek out and engage technical expertise, particularly in the area of soils, is most impressive and the solutions being applied to remediate saline, low fertility, sodic and poorly structures soils is outstanding

- Kilter has a range of partnerships with likeminded organisations that creates a win:win outcome, for example, the sheep (wool-lamb) joint venture .This partnership is also an example of the organisation's ability to involve outside expertise where required

- The openess to trial a range of new crops, well suited to their soils and climate, has provided potential for a stable long term earnings platform for the business. Kilter is prepared to innovate, or create new solutions, in order to overcome barriers. Developing the organics market, and a specialist marketing company to maximise returns is an example

- While Kilter is prepared to bring in expertise when necessary, it is also prepared to invest locally into skills development for its own workforce. A number of team members have been up skilled and engaged to overcome a particular problem or manage an agreed solution. They are hard at work examining and trialling options and solutions as part of Kilter's drive to improve production, land management and profitability

- Management has a strong commitment to data capture and storage, and is using this data to learn about its soils and production agronomy. This means their management of crops and soils improves, each year based on the learning of previous years

In agriculture, it is unusual to see an organisation that is as strong in all areas of the business (Ecological, Economic and Social) as Kilter Rural and it provides an example of the strength of an approach that is well balanced and more holistic.

Conclusion:

The results from this case study show a high level of satisfaction evident amongst the key day to day decision makers in the farm operations of the business (three of which were surveyed).

The results from this case study also show a high motivation towards meeting a challenge and leaving the farm in good/better condition particularly taking into account biodiversity. The two resource management questions scored highly; Improving Biodiversity and Farm in Better Condition . Of the four profit questions available, keeping out of debt was chosen the primary profit motivator.

This case study identified a technical barrier (telecommunications) a production barrier (pest, diseases or weeds) and a people barrier (sourcing labour) as key challenges to the business.

These results give an insight into the motivations of the business decision makers. The profit motivation in this business ranked lower than meeting a challenge and resource condition goals.