2020 SALISBURY CASE STUDY NARRATIVE REPORT

Prepared by Mark Parsons and Matthew Bolton

In the 1980s, portions of Salisbury were fit for one thing and one thing only: landing an aeroplane. Since then, the MacAlpine family has rehabilitated much of this scalded land and developed a number of strategies to make their property ready for both the droughts and flooding rains that this part of the country is prone to.

The Property

The Salisbury property is located on the floodplain and associated relict red duplex terraces of the Marra Creek, to the west of the Macquarie Marshes about 160 km north-west of Warren in north-central New South Wales. The Queensland border is about 160 km further north. Carinda – the nearest town – is about 60 km north-east. Marra Creek runs through the region. It adjoins Salisbury on the property's western side and potentially flows north into the Barwon River, a tributary of the Darling River.

Salisbury is about 20,000 hectares. The MacAlpines consider that area can support a self-replacing merino flock totalling about 10,000 dry sheep equivalents, typically comprising 5000 breeding ewes (1.5 DSE each) and 2500 ewe lambs, on average in the long term (and allowing for the kangaroos!). The property is subdivided into 22 main paddocks and a few holding yards and transport routes (Figure 8).

Salisbury was previously part of the Womboin Station, which was owned by the Dalgety company. Womboin was subdivided in 1972. The MacAlpine family purchased the Salisbury part in 1977 and added two adjoining blocks soon after. Half of Salisbury is on dark heavy clay soil that is relatively impervious to erosion. This rest is red soil that has a better natural potential for grazing has been degraded by wind and water erosion.

Ready for drought, ready for rain

Salisbury is typical of Dorothea McKellar's '*land of droughts and flooding rains*'. There are no permanent watercourses on Salisbury. Water supply is rain and bores that tap the Great Artesian Basin. Average annual rainfall is about 450 mm on the property or 405 mm as measured at the nearest meteorological station, perhaps indicating high local variability. The average and median monthly rainfall sometimes falls in a single day, sometimes causing regional flooding. Conversely, very little rain falls for substantial periods.

Will MacAlpine is clear that for the grazing business to cope, obtaining maximum benefit from rainfall events and minimum damage during dry periods, '*we must be ready for drought, and we must be ready for rain*'. The strategy to achieve that comprises a number of tactics:

- Increase the area of productive grazing land by rehabilitating scalded land.

- Cap the artesian bores to control water supply.
- Control kangaroo grazing pressure.
- Manage sheep grazing pressure in dry periods by moving sheep to holding pens and hand feeding them, and by deferring joining young ewes.

In practice, these tactics are interlinked or interdependent.

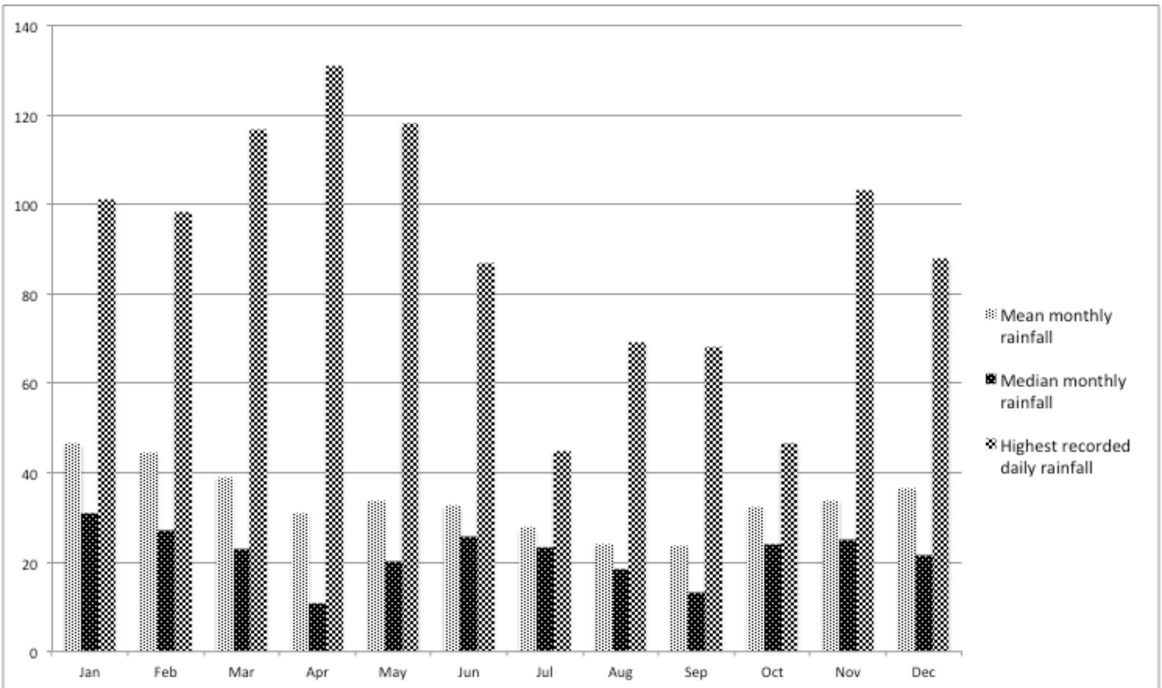

Figure 1: Monthly mean, median and daily maximum rainfall (mm). [1]

[1] Data for Bureau of Meteorology Marra Creek (Womboin) station; records from 1886 to 2018. http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=&p_c=&p_stn_num=051057

Rehabilitating the scalds

Figure 2: A scald on Salisbury, still remaining in 2020, showing the hard-packed surface soil and elevated root systems of dead plants, indicating the depth of topsoil lost to wind and water erosion.

Although rehabilitation work was begun on Salisbury in the 1970s by the previous owners, when the MacAlpines took over the property Grant MacAlpine could land his light plane almost anywhere on the property. After seeing promising results on properties nearby, the MacAlpine family continued rehabilitation in the 1980s and 1990s. Works ramped up in 2009 and 2012 when government grants were available.

The methods that have been used successfully for several years on Salisbury involve using a grader to build low ponding banks to hold rainwater to a depth of 10 cm or so. These are circular on flat ground and semi-circular (a 'horseshoe' shape) on scald with a mild slope. The opening of the horseshoe is to the up-slope side, so that run-off collects within the banks. Each pond covers about 0.4 hectares. The grader used to construct the banks is also used to disturb the soil surface within the ponds in strategic locations (Thompson 2008). Saltbush seed – some of it collected on the property – is sown over the disturbed surface. Running cattle over the ponded area after the surface had been softened by rain was used to disturb the soil surface in a previous Soils for Life case study of a property near Brewarrina.[2]

The effect of the ponding banks and disturbance is to hold water from the intermittent heavy falls. This then infiltrates – albeit slowly – to leach salts from the surface and provide moisture down the soil profile. The banks and disturbance within them provide a barrier to wind-blown sediments and plant material, which collects and starts to form an organic-rich surface layer. The saltbush seed, together with whatever seed is delivered by wind, sheep and birds, then has somewhere to germinate and moisture to tap in the soil profile. The natural processes of ecological succession have effectively been given a 'kick-start' and can take their course. To date, about half of the scalded areas on Salisbury have been treated in this way.

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[2] https://soilsforlife.org.au/bokhara-plains-reaching-the-real-potential-of-the-nsw-rangelands/

The results can be seen in Figures 3 to 5.

Figure 3: A horseshoe pond bank with water ponding in the trenches either side of the bank and across the surface. Regenerating vegetation is evident within the horseshoe.

Figure 4: Pond created in 2009. Note soil loss from parts of the bank.

Figure 5: Pond created in 2012. Note saltbushes growing in the rip line and posts used for monitoring.

Capping the bores

Four artesian bores that were installed early in the 20th century and have been flowing ever since supplement Salisbury's intermittent water supply from rainfall. The aggregate potential flow rate is 9 L/second (284 ML/year, or about 114 Olympic swimming pools). However, the volume required to support grazing stock is estimated at around 1 L/second, so the rest (around 250 ML/year) runs away to waste via bore drains (Figure 6). The wasted water supports a kangaroo population far in excess of what would be there naturally, whereas a tank and trough system can be managed to restrict water supply.

Figure 6: One of the four bore drains that together used to carry away around 250 Ml/year of surplus water.

Capping the bores maintained the pressure of the underground artesian aquifer and used only the amount of water needed for stock. A threat by governments to charge for water used in excess of stock requirements focused the MacAlpines' action. A subsidy from the NSW Government[3] helped too. Following the mandated specifications, each tank supplies two nearby troughs – the second being presumably for backup in case one failed (Figure 7). So far, two of the four bores on Salisbury have been capped.

Figure 7: Tank and troughs that have replaced free-flowing artesian bores.

Managing grazing pressure

This is the biggest concern for the viability of the Salisbury business is a seemingly endless supply of kangaroos willing to move on to the property. Generally, they come from the north and arguably in far higher numbers than would have been possible before graziers started providing water sources.

Managing the kangaroo population requires a massive investment in specifically designed fencing (Figure 9). Fences like that will also exclude wild dogs that be-devil sheep graziers elsewhere and that the MacAlpines expect in the Marra region before long.

Figure 8: Salisbury paddocks superimposed over a satellite image. Source: Google maps

The cost of kangaroo-proof fencing is around $4,000/km for materials and the property boundary is about 50 km, so a substantial investment is required. Fortunately, the NSW Government has provided a low-interest loan for this.

Sheep grazing pressure is managed in dry periods by moving sheep to holding pens and hand feeding them with grain and straw (Figure 10). This is especially useful for ensuring that ewes chosen for breeding have optimum nutrition.

Further tactics to reduce grazing pressure include:

- deferring joining young ewes so that their grazing requirements are minimised; and
- selling older ewes or passing them on to the farm run by Alex MacAlpine at Grenfell, NSW.

Will and Grant MacAlpine make these decisions from time to time[4], taking particular note of animal and pasture health.

[4] Especially over the summer period when a "feed gap" would develop if rain was inadequate.

Figure 9: Kangaroo-proof fence: extra height wire supported by fewer posts; mesh apron to prevent kangaroos pushing under the bottom wire; two electrified mid height wires powered by solar panels.

Adapted to a variable climate

In summary, the grazing enterprise at Salisbury is well adapted to the highly variable, semi-arid climate. Amongst their many benefits, the water ponds bring more areas into production and generally improve the appearance of the property. Capping the bore, erecting wildlife-proof fencing and managing stock numbers controls the total grazing pressure and ensures sustainability so that the MacAlpines are ready for drought and ready for rain.

Figure 10: Feeding enclosure

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Cunningham, G.M. 1987. Reclamation of scalded land in western New South Wales. Journal of Soil Conservation New South Wales, Vol. 3, number 2. Soil Conservation Service of NSW, Sydney.

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2020
SALISBURY CASE STUDY
SUMMARY ECOLOGICAL REPORT

Prepared by Mark Parsons and Matthew Bolton

Introduction

The Salisbury property is located on the floodplain and associated relict red duplex terraces of the Marra Creek, to the west of the Macquarie Marshes about 160 km north-west of Warren in north-central New South Wales. The Queensland border is about 160 km further north. Marra Creek runs through the region, adjoins Salisbury on the property's western side and potentially flows north into the Barwon River, a tributary of the Darling River.

The two general soil types on Salisbury are a dark heavy clay soil that is relatively impervious to erosion and red soils with a highly erodible sandy upper horizon over a finer red clay lower horizon. Large areas of the red soil are, or have been, degraded by wind and water erosion.

There are no permanent watercourses on Salisbury. Average annual rainfall is about 450 mm on the property or 405 mm as measured at the nearest meteorological station. The median annual rainfall is only 263 mm and records of highest daily falls show that rainfall tends to occur in infrequent large falls, commonly exceeding 50 mm/day in winter-spring months and exceeding 100 mm/day in summer-autumn months.

The native vegetation is sparse woodland with common tree species including poplar box (*Eucalyptus populneus*), leopardwood (*Flindersia maculosa*), wilga (*Geijera parviflora*), western rosewood (*Alectryon oleifolius*, also known as bullock bush), warrior bush (*Apophyllum anomalum*) and wild orange (*Capparis mitchelii*). The most widespread low ground cover is old man saltbush (*Atriplex nummularia*) and bladder saltbush (*A. vesicaria*). There is a wide range of herbaceous plants and grasses, including Mitchell grass (*Astrebla* spp.). The perennial saltbushes and Mitchell grass give the property a natural resilience to drought when managed well.

Key findings

The ecological values assessed include resilience to disturbance and soil nutrients, hydrology and biology. Because little empirical data was available to the authors at the time of writing, the assessment is necessarily based on observations and subjective judgement of likely effects of management.

The condition of all values assessed is assumed to be poorer than when sheep grazing commenced in the 1800s. This assumption is based on the set stocking strategy used over a long period, leading to loss of soil structure, hydrological function and biological values, combined with negligible fertiliser inputs and limited pasture improvements. Severe scalding of the red duplex soils resulted from overgrazing under previous management. This assessment places special emphasis on the reclamation of these scalded areas by a technique known as waterponding.

The ecological assessment identified four phases of land management.

- Phase one: The pre-European phase that ended when the first pastoral settlers arrived some time from about 1830 to 1850.
- Phase two: Conventional management was used until about 1972, by which time there was widespread degradation from overgrazing, leading to the formation of hard-packed “scalds” with negligible vegetation cover.
- Phase three: In 1972 efforts to reclaim scalded areas and to control grazing pressure began.
- Phase four: The final phase is in the future when results of waterponding, capping artesian bores and controlling grazing pressure are expected to become increasingly evident.

Summary of improvement

All functional criteria are considered to have improved since 1972. For example, since the widespread adoption of regenerative practices in 2009:

- the property is becoming more resilient to drought (Criterion A). A similar conclusion is likely for flood proofing
- soil health and function has gradually improved
- vegetation biodiversity has stayed much the same during the waterponding operations
- pasture status has gradually improved (from zero) in the ponded areas, due to increased ground cover and herb species richness.

The reproductive potential of the plant species and plant community has similarly improved.

More improvement in these values is expected in future, particularly when drought conditions ease. Further rainfall will serve to leach salts from surface layers of the scalds as well as provide an essential input for plant growth.

2020 SALISBURY CASE STUDY DETAILED ECOLOGICAL REPORT

Prepared by Mark Parsons and Matthew Bolton

Summary

This report on the ecological values of Salisbury is based on the known history of management of the property since 1972. The earlier history of the Marra Creek district has been inferred from a number of published and unpublished sources on nearby properties with the same land types, including Ditchfield (1996) and R. Thackway, pers. comm. (January 2020).

The ecological values assessed include resilience to disturbance and soil nutrients, hydrology and biology. Because little empirical data was available to the authors at the time of writing, the assessment is necessarily based on observations and a subjective judgement of likely effects of management.

The condition of all values assessed is assumed to be poorer than they were originally in the mid-1880s having declined steeply around the time of the Federation drought when scalds developed on duplex soils in the Marra Creek district. Also assumed is a slow, steady decline during the 20th Century until Salisbury was split off from Womboin in 1972. These assumptions are based on the set stocking strategy used over a long period, leading to loss of soil structure, hydrological function and biological values, combined with negligible fertiliser inputs and limited pasture improvements. This assessment places special emphasis on the reclamation of these scalded areas by a technique known as waterponding.

Information presented in this assessment has been compiled by interviewing the land manager, Will MacAlpine, to document the response of the red duplex land type[1] to these land management regimes over time. Measured data such as soil tests and biodiversity survey data have been referred to where available to the assessors. The ecological responses have been assessed using 10 ecological criteria. However, a time-series of the fractional ground cover of Salisbury was not available at the time of writing this report.

Key findings

This assessment identified four phases of land management on Salisbury (Table 1), which includes production regimes and biodiversity enhancements.

The pre-European Phase 0 (zero) lasted until about 1830 to 1850, when the first pastoral settlers came to the Marra Creek district (Ditchfield 1996). Conventional management (phase one) occurred until about 1972 and included widespread degradation from overgrazing, leading to the formation of

[1] The areas of grey/black clays on Salisbury were not assessed formally, but may be mentioned at times though this report.

hard-packed “scalds”, with zero to minimal vegetation cover, on the relict floodplains of Marra Creek and associated tributaries.

After 1972, phase two commenced when Salisbury was split off from Womboin Station, the first owners and then the MacAlpine family (after 1977) began to experiment with reclaiming scalded areas. Some improvements to the scalded areas were apparent, but failures were common and large areas of scalds remained, enabling Grant MacAlpine to land his light aeroplane most places on the property.

After 1999, waterponding work on Salisbury was ramped up. It accelerated even further in 2009 and 2012 using the expertise of Ray Thompson (Thompson 2008), then at the Catchment Management Authority in Nyngan. This comprises phase three and includes additional practices to manage water use, stock health and total grazing pressure.

Phase four is in the future. Further results are expected from completing regenerative projects, such as the wildlife-proof fence to control total grazing pressure, capping the artesian bores and increased areas of improved pasture.

This assessment shows that all functional criteria are considered to have improved, but that there is room for further improvement (i.e. scores between 0.8 – 1.0). For example, since the widespread adoption of regenerative practices in 2009:

- The property is becoming more resilient to drought (Criterion A). A similar conclusion is likely for flood proofing.
- Soil health and function has gradually improved. This summary applies to the following ecological changes: soil nutrients and soil carbon (Criterion B); soil hydrology (Criterion C); soil biology (Criterion D); and soil physical properties i.e. soil as a medium for plant growth (Criterion E).
- Vegetation biodiversity has stayed much the same during the waterponding operations. This summary applies to the following ecological changes: tree and shrub structure (Criterion G) and tree and shrub species richness and functional traits (criterion I).
- Pasture status has gradually improved (from zero) in the ponded areas. This summary applies to the following ecological changes: ground cover/ground layer/grass and herb structure (criterion H) and ground layer/grass and herb species richness and functional traits (criterion J).
- The reproductive potential of the plant species and plant community (Criterion F) was applied to both the tree/shrub and pasture layers and a similar conclusion to the above criteria was found.

More improvement in these values is expected in future, particularly when drought conditions ease. Further rainfall will serve to leach salts from surface layers of the scalds as well as provide an essential input for plant growth.

Table 1. The four management phases at Salisbury

	Production Regimes	General Observations
Phase one: 1850- 1972	Conventional management practices were undertaken throughout this phase.	• Large numbers of stock were present in the late 19th century.
Phase two: 1972-1998	During this phase the manager implemented small-scale experiments and interventions with a view to expanding some or most of them in future.	Small scale interventions include: • ponding of scalds in red country • managing stock numbers to prevent overgrazing, especially after the wool crash of 1991.
Phase three: 1999-2019	The manager implemented certain regenerative and sustainability practices.	The land manager has: • capped artesian bores and provided water to each paddock via pipes, tanks and troughs • expanded the area of ponds on red soil scalds • observed "triggers" for stock management • established infrastructure for containment feeding • sown improved pastures on the intact red country • begun erecting a wildlife-proof fence.
Phase four: 2020 and beyond	Further implementation of regenerative practices is expected in the near future.	• Plans to add pasture seeds to both the red and black country, with particular emphasis on the ponds on red soil. • Completion of recent, current and planned work under phase three is expected to pay dividends for the ecology, production and finances, after the current drought breaks.

Salisbury in ecological context

Salisbury is situated on the Marra Creek district approximately 60 km west of Carinda. It was split off from the large Womboin Station in 1972. Present day Salisbury comprises 20,000 ha and supports a self-replacing merino flock totalling about 10,000 dry sheep equivalents of grazing pressure, typically comprising 5000 breeding ewes (1.5 DSE each) and 2500 ewe lambs, on average in the long term (and allowing for the kangaroos!). The property is subdivided into 22 main paddocks and a number of smaller holding yards and transport routes (Figure 8).

Figure 1: Salisbury paddocks superimposed over a satellite image. The dark circles in the central areas are naturally vegetated areas.

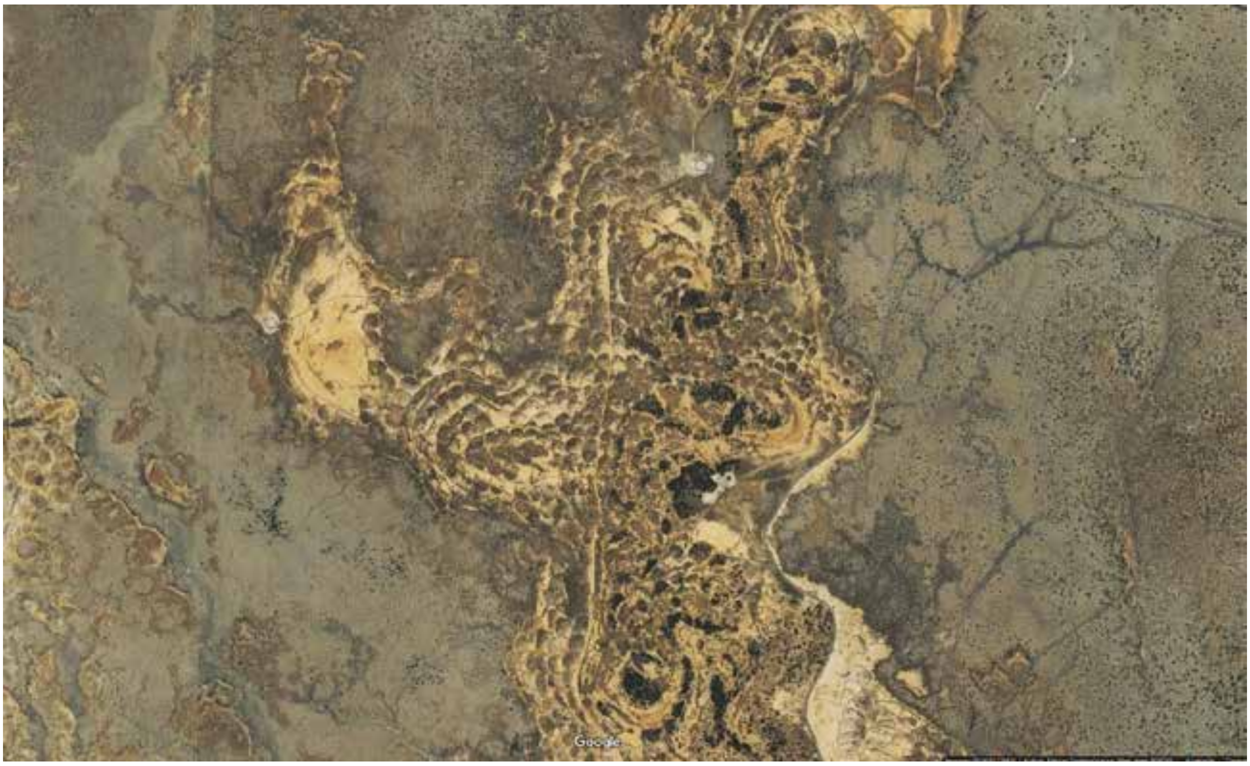

Figure 2: Satellite image zoomed in to show some of the water ponds.

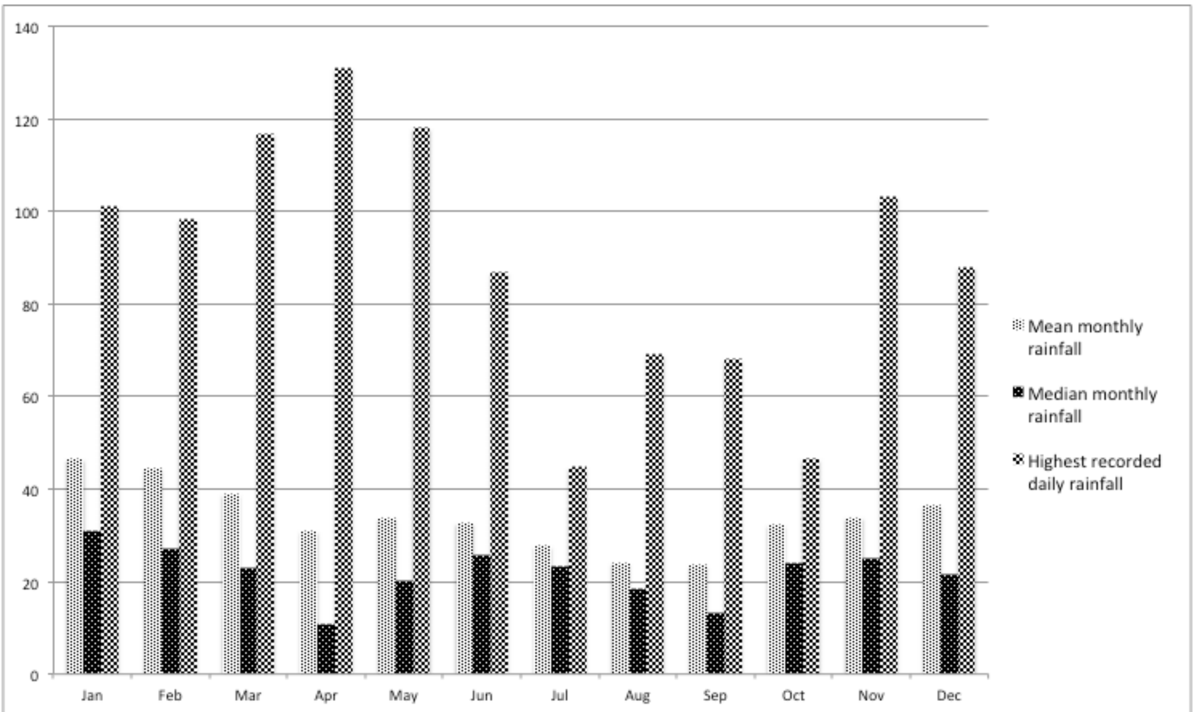

Figure 3: Monthly mean, median and daily maximum rainfall (mm).[2]

[2] Data for Bureau of Meteorology Marra Creek (Wamboin) station; records from 1886 to 2018. http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=&p_c=&p_stn_num=051057

There are no permanent watercourses on Salisbury. Water supply is rain and bores that tap the Great Artesian Basin. Average annual rainfall is about 450 mm on the property or 405 mm as measured at the nearest meteorological station, perhaps indicating high local variability. The median annual rainfall is only 263 mm and records of highest daily falls show that rainfall tends to occur in infrequent large falls, commonly exceeding 50 mm/day in winter-spring months and exceeding 100 mm/day in summer-autumn months (Figure 3). In other words, the average and median monthly rainfall sometimes falls in a single day, and conversely very little falls for substantial periods. Levee banks have been constructed around towns in the region, such as Warren, to protect them from floods. As is the case across large areas of Australia livestock production is challenged by the low average rainfall, high rainfall variability and infrequent but intense falls interspersed with extensive dry periods.

There are two general soil types on Salisbury: a dark heavy clay soil that is relatively impervious to erosion and red soils with a highly erodible sandy upper horizon over a finer red clay lower horizon – so-called texture contrast or "duplex" soils[3]. These land types each cover approximately 50% of the area of Salisbury (Figure 1).

The red soil has better natural potential for grazing than the heavy clay, but large areas of it have been degraded by wind and water erosion in the Marra Creek district (Figure 3 and Ditchfield 1996). Texture contrast soils cover about 20% of Australia and may have been formed from one or more of four possible processes (McKenzie *et al*. 2004):

- Formation of a "biomantle" A-horizon by the action of earthworms, ants and/or termites with the loss of fine particles in arid regions by erosion;
- Supplementation of clay in the B-horizon by downward clay movement;
- Differential weathering; and/or
- Sedimentary layering.

The native vegetation is sparse woodland with common tree species including poplar box (*Eucalyptus populneus*), leopardwood (*Flindersia maculosa*), wilga (*Geijera parviflora*), rosewood (Heterodendrum oleifolium, also known as bullock bush), warrior bush (*Apophyllum anomalum*) and wild orange (*Capparis mitchellii*). The most widespread low ground cover is old man saltbush (*Atriplex nummularia*) and bladder saltbush (*A. vesicaria*).

The following vegetation types on Salisbury were identified from Keith (2006):

- North-west Floodplain Woodlands;
- Inland Floodplain Woodlands; and
- Western Peneplain Woodlands.

There is a wide range of herbaceous plants and grasses, including Mitchell grass (*Astrebla* spp.). The perennial saltbushes and Mitchell grass give the property a natural resilience to drought when managed well.

Scald rehabilitation by waterponding

The early period of sheep grazing in the arid and semi-arid rangelands of western New South Wales was a disaster for topsoil. Overgrazing encouraged by high wool prices destroyed ground cover, which in dry periods led to widespread wind and water erosion that created 'scalds' where the coarser textured surface material has been completely lost, leaving the finer textured and less permeable subsoil (Figure 4). This was reported as being an extensive problem as long ago as 1901

[3] Now called texture differentiated soils (McKenzie *et al*. 2004)

(Cunningham 1987). By the 1960s, tens of thousands of square kilometres of rangeland sites in western NSW were moderately bare or 'scalded' (Thompson 2008).

Figure 4: Scald at Salisbury showing the hard-packed surface soil and elevated root systems of dead plants, indicating the depth of topsoil lost to wind and water erosion

The natural rate of vegetation re-establishment on these scalds is nil or negligible, largely because the surface seals up to prevent water infiltration and root development. Also, air temperatures are exceedingly high for too long. Lack of seed and abrasion of germinating plants by wind-blown sand also contribute to the problem (ibid). Intervention is required to get re-vegetation started.

Methods for reclaiming scalded soils in Western NSW have been researched since the late 1940s (Cunningham 1987). Rehabilitation work was begun on Salisbury in the 1970s by the previous owners, continued by the MacAlpine family in the 1980s and 1990s, and ramped up in 2009 and 2012 when government grants were available. The previous owners used a 'checkerboard' pattern, dividing the scald into squares by ploughing two sets of furrows, one set perpendicular to the other. However, that method was found to be an ineffective way to enable vegetation to establish and persist (Cunningham 1987).

Surveying and construction methods developed over several decades have made rehabilitation of scalds more and more cost-effective (Rhodes 1987). The methods that have been used for several years on Salisbury involve using a grader to build low ponding banks to hold rainwater to a depth of 10 cm or so. These are circular on flat ground and semi-circular (a 'horseshoe' shape) on scald with a mild slope. The opening of the horseshoe is to the up-slope side, so that run-off collects within the banks. Each pond covers about 0.4 hectares. The grader used to construct the banks is also used to disturb the soil surface within the ponds in strategic locations (Thompson 2008). Saltbush seed – some of it collected on the property – is sown over the disturbed surface. Running cattle over the ponded area after the surface had been softened by rain was used to disturb the soil surface in a previous Soils for Life case study of a property near Brewarrina.[4]

The effect of the ponding banks and disturbance is to hold water from the intermittent heavy falls. This then infiltrates – albeit slowly – to leach salts from the surface and provide moisture down the soil profile. The banks and disturbance within them provide a barrier to wind-blown sediments and plant material, which collects and starts to form an organic-rich surface layer. The saltbush seed, together with whatever other wind-blown or sheep- or bird-delivered seed arrives, then has somewhere to germinate and moisture to tap in the soil profile. The natural processes of ecological succession have effectively been given a 'kick-start' and can take their course.

On Salisbury, several tranches of waterponding works (Figure 2 and Attachment A) cover approximately half of the red country – i.e. about a quarter of the property. Some of the results can be seen in Figures 5 to 7.

Figure 5: A horseshoe pond bank with water ponding in the trenches either side of the bank and across the surface. Regenerating vegetation is evident within the horseshoe.

[4] https://soilsforlife.org.au/bokhara-plains-reaching-the-real-potential-of-the-nsw-rangelands/

Figure 6: Pond created in 2009. Note soil loss from parts of the bank.

Figure 7: Pond created in 2012. Note saltbushes growing in the rip line and posts used for monitoring.

Figure 8: Waterpond established in 2012. From the foreground: scalded area, external borrow trench, pond wall, inner borrow trench, reclaimed area. The water is from 30 mm of rainfall in an overnight storm.

Managing grazing pressure

The accompanying Narrative Report has a discussion of wildlife proof fencing and 'trigger points' in stock management to control total grazing pressure. The authors were unable to detect the presence of rabbits on Salisbury – perhaps because of the absence of deep sandy substrates in the district.

Assessing responses to land management regimes according to the ecological criteria

This detailed ecological report is underpinned by the Soils For Life *Conceptual Model* and *Assessment Framework* that documents the responses of 10 criteria corresponding to ecosystem function, composition and structure.

During the visit to Salisbury in February 2020, Will MacAlpine was asked to represent the responses of all 10 criteria graphically. This ecological assessment[5] commences in 1989, which is an arbitrary date before the "Ginghet" blocks were added in 1999. Will also expects an improved response for most criteria after the drought breaks.

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[5] Further context on management regimes is provided in the Chronology at Attachment A.

The graphs for several criteria were considered identical to others at interview and were not hand-drawn separately. However, they are presented in this report. Despite the two major land types, only one land type was considered for the majority of the graphs[6]. The most productive country on Salisbury was considered to be the "lighter, red country" with duplex soils. This responds well to lighter showers of rain compared with the floodplain country with black clay soils. The reclamation of scalded areas back into productive usefulness has been a long-term goal of Grant MacAlpine and his son Will.

Assessment of response criteria

A. Resilience of landscape to natural disturbances – flood, drought and frost

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

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

Assumptions and definitions

Since the purchase of the property by the MacAlpine family in 1977, several important interventions have been conducted (Table 1). This includes waterponding of the scalded red duplex soils, the success of which has contributed to the overall resilience of the property. Unlike the majority of the criteria, this assessment is of the whole property and enterprise, rather than the red country.

Results and interpretation

In phase one, the current land manager regards the previous resilience to be generally good, where perennial pasture components (saltbushes and/or Mitchell grass) remained intact. However, the scalded country did not contribute to drought resilience at all.

In phase two, the land manager implemented a series of trials and experiments to reclaim the scalded areas of red country, but only small areas had beneficial effects.

In phase three, after ramping up the area of waterponding in 2009 and 2012, the MacAlpines noticed an improvement in drought resilience.

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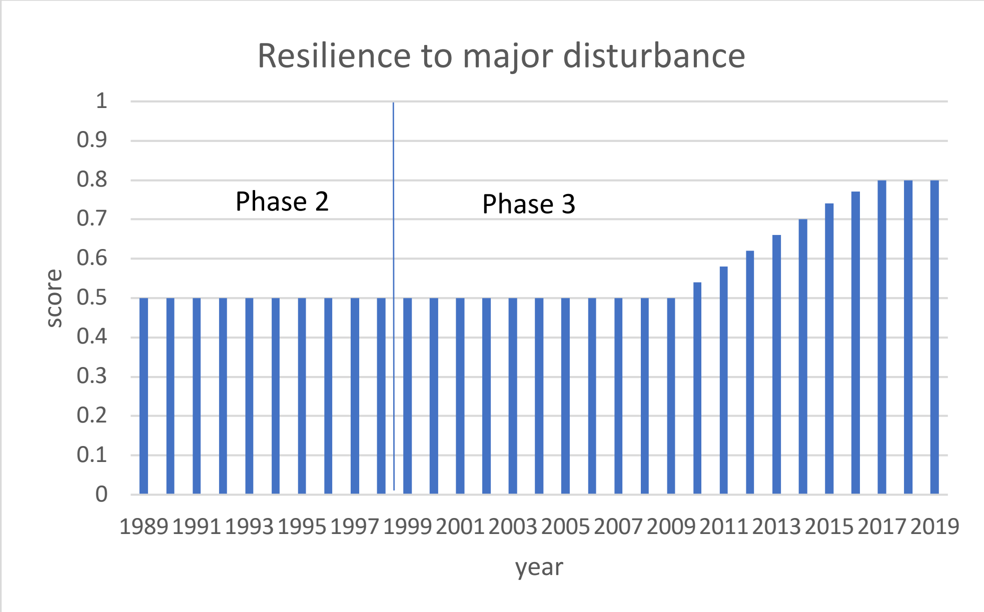
[6] Except Criterion A, below.



B. Status of soil nutrients – including soil carbon

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

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

Assumptions and definitions

The following figure is an aggregate score of soil nutrient status for the red country on Salisbury. It represents the observed and inferred changes in status with changes in land management practices.

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

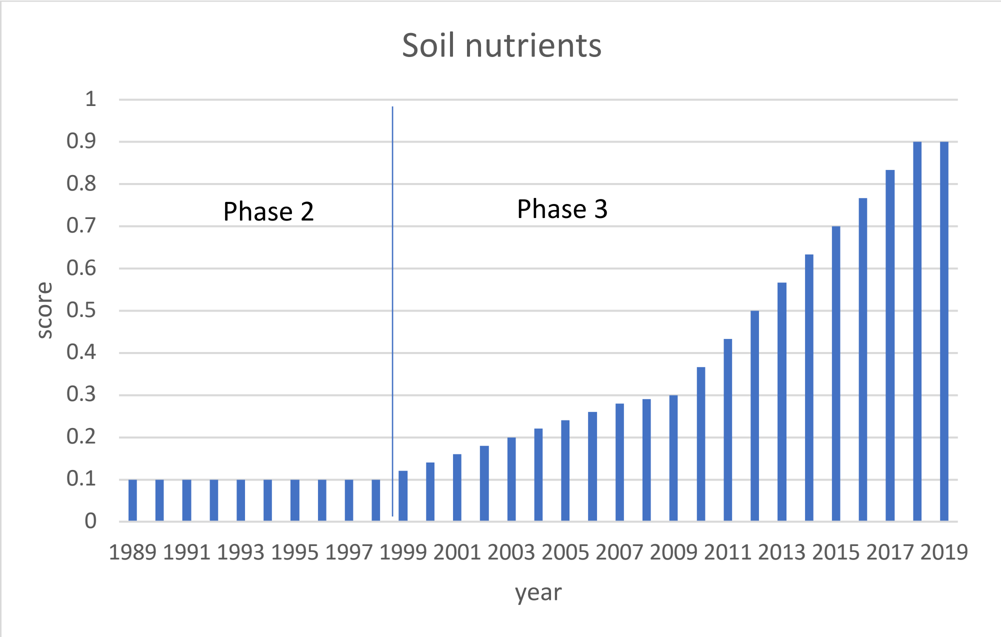
Results and interpretation

In phase two, the following graph shows a very low status of soil nutrients on the red country because of the large scalded areas compared with intact pastures.

In phase three, interventions to reclaim the scalds by waterponding after 2000 (and certainly after 2009) showed marked improvement in soil nutrient status. Read *et al.* (2014)[7] show an approximate 29% increase in carbon density to 30cm within five years of establishment when compared with the scalded soils.

Further improvement is likely in the future. However, achieving a status of “1” on the graph does not necessarily imply that the reclaimed land will be as productive as undisturbed red country.

[7] Including sample sites apparently on Salisbury.



C. Status of soil hydrology - Soil surface water infiltration

Why track changes and trends in soil surface water infiltration?

Soil physical properties have a direct relationship to soil moisture. Soil texture and structure greatly influence water infiltration, permeability and water-holding capacity. Of the water entering a soil profile, some will be stored within the root zone for plant use, some will evaporate, and some will drain away. In agro-ecological settings, by increasing water infiltration, permeability and water-holding capacity this will usually act as a stimulus to improve ecological function.

Assumptions and definitions

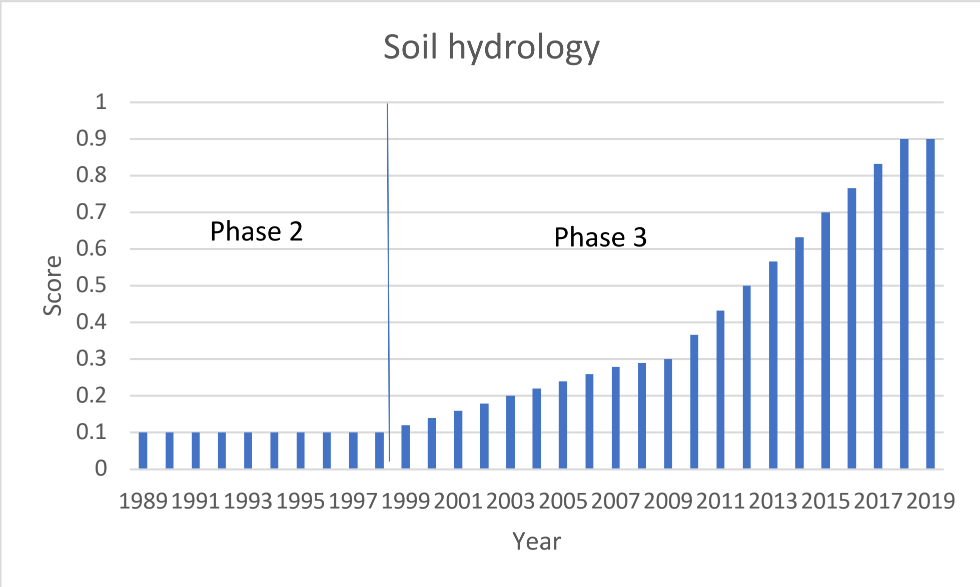
The following figure is an aggregate score of soil hydrology for the red soil country on Salisbury. It is identical in shape to the soil nutrient status outlined above in that it represents the observed and inferred changes in status occurring with changes in land management practices.

Results and interpretation

In phase two, the following graph shows a very low status of soil hydrology on the red country because of the extremely poor infiltration on large scalded areas compared with intact pastures.

In phase three, the waterponding (and other interventions listed in Table 1) have begun to improve the soil hydrology, including a dramatically improved infiltration rate (Ringrose-Voase et al. 19898).

[8] Working on a nearby property



D. Status of soil biology - Soil biology

Why track changes and trends in soil biological activity?

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

- natural processes (litter transformation, micro-food web participation and soil engineering)
- the decomposition of organic material resulting from compost applications and disturbance from cattle grazing
- enhancing nutrient distribution for plant health and productivity.

In healthy soils, there is a good balance between fungi and bacteria, and invertebrates including arthropods and worms are usually present. Collectively these form a vital part of a plant nutrient supply web.

Assumptions and definitions

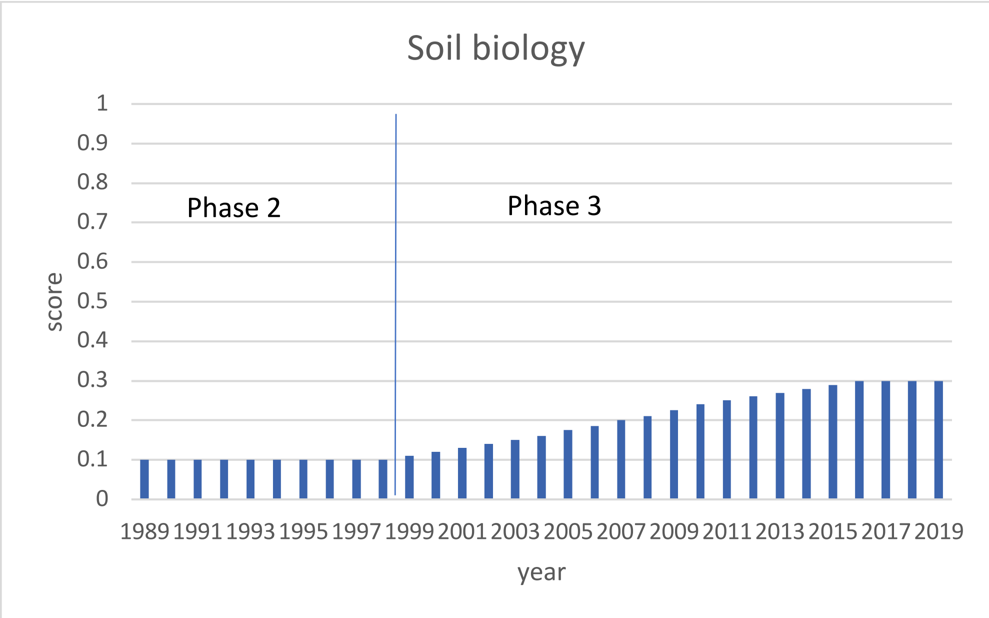
Decomposition of plant and animal residues is a dynamic process involving trophic levels. While some of the residues are being broken down for the first time by the litter transformers called detritivores, other residues have already been sequestered by soil microflora, which are in turn consumed by microfauna predators.

The following figure is an aggregate score of soil biology for the red country paddocks on Salisbury. It was considered by the land manager to be identical in shape to the soil physical properties (below) in that it represents the inferred changes in status in relation to changes from the waterponding work.

Results and interpretation

In phase two, the following graph shows a very low status of soil hydrology on the red country because of the extremely poor infiltration on large scalded areas compared with intact pastures.

In phase three, the waterponding (and other interventions listed in Table 1) have begun to improve the soil biology in line with increases in soil organic carbon (Read et al. 2014).



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

Why track changes and trends in soil physical properties?

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

Assumptions and definitions

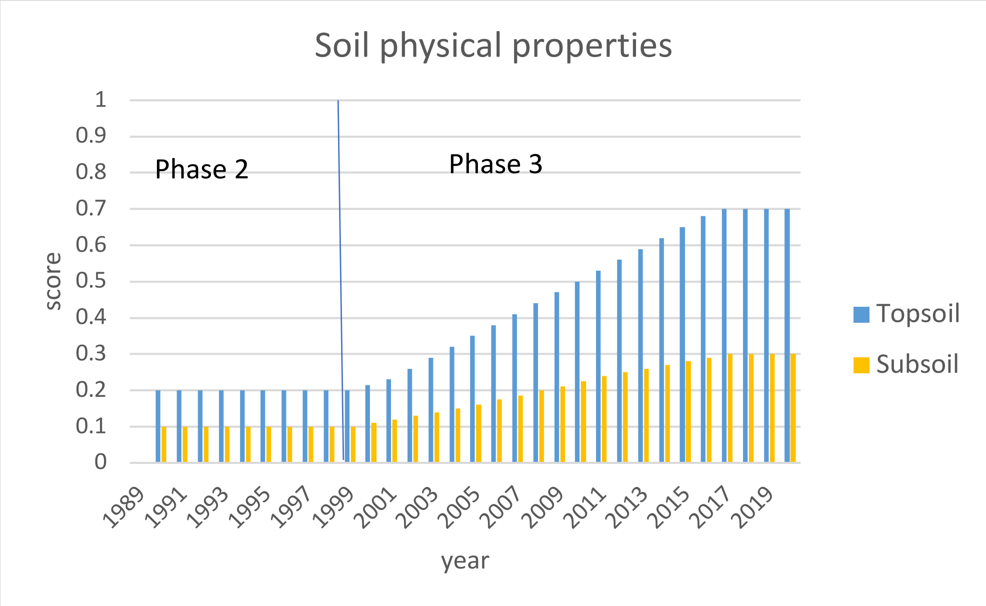
Indicators of improving landscape function over time include soil surface rain-splash protection, cryptogam cover; reduction in soil surface erosion type and severity, reduction in washed/deposited materials, presence of biological structures, e.g., perennial tussocks to intercept and retain resources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

The following figure is an aggregate score of soil physical properties for the red country on Salisbury. It represents the inferred changes in status in each of topsoil and subsoil with changes in relation to changes from the waterponding work.

Results and interpretation

In phase two, the following graph shows a very low status of soil physical properties on the red country because of the extremely poor infiltration on large scalded areas compared with intact pastures.

In phase three, the waterponding (and other interventions listed in Table 1) have begun to improve the soil physical properties. Work by Ringrose-Voase et al. (1989), including sites on Salisbury, showed that highly beneficial, deep cracks in the soil resulted from the ponding.



F. Status of plant reproductive potential

Why track changes and trends in reproductive potential of plants?

An understanding of plant reproductive potential leads to managing plant reproduction, germination, establishment and development of plants.

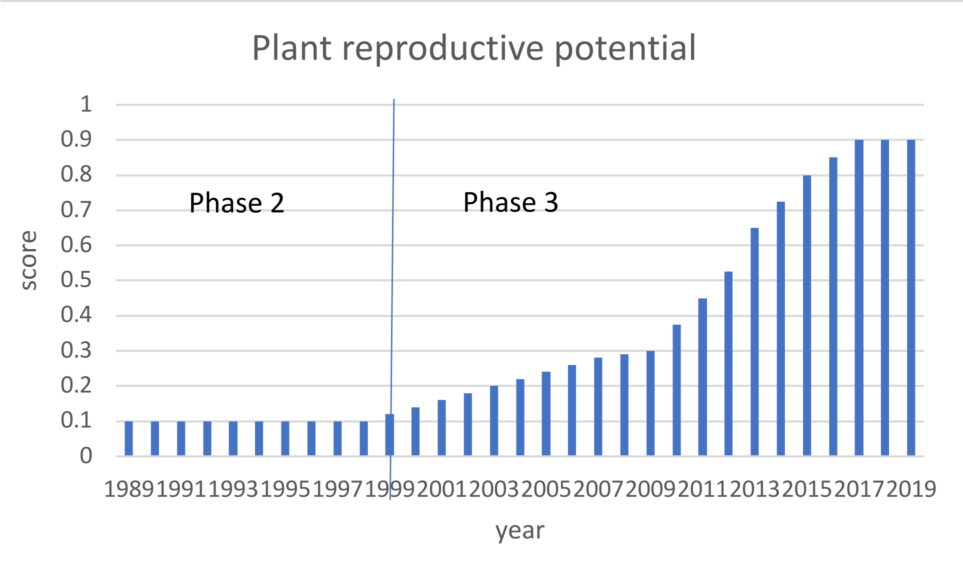
Assumptions and definitions

Development of regenerative land management regimes leads to lower costs of production over time.

Results and Interpretation

In phase two, the following graph shows a very low status of plant reproductive potential on the red country because of the extremely poor regeneration on large scalded areas compared with intact pastures.

In phase three, the waterponding (and other interventions listed in Table 1) have progressively improved the plant reproductive potential. The pond ecosystems are now less reliant on seeds from external sources for regeneration, although further seeding with improved pastures is envisaged. Monitoring ponding works on nearby properties demonstrate improved conditions for plant growth over nine years (Thompson 2008, 2012).



G. Status of tree and shrub structural diversity and health

Why track changes and trends in extent of tree cover?

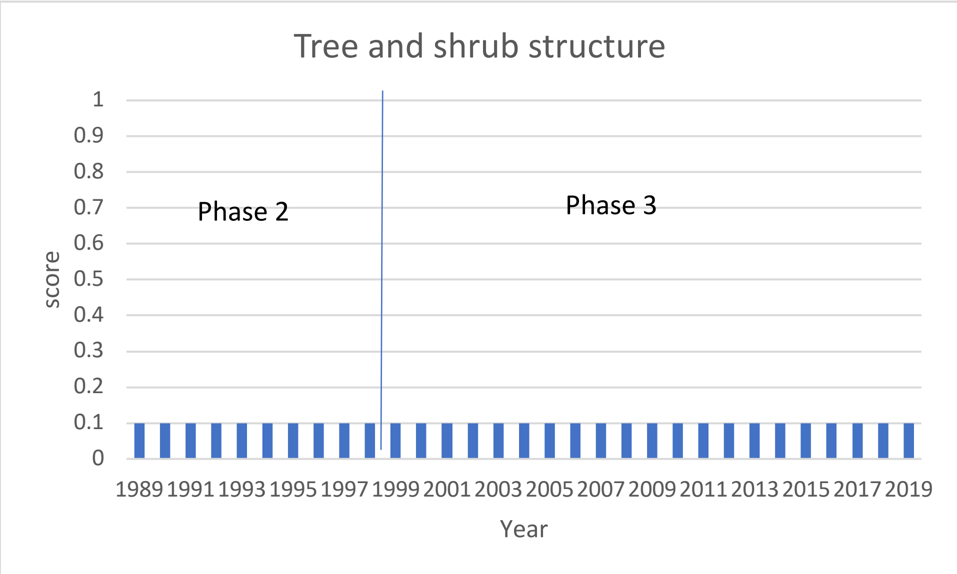
Tree cover in agricultural landscapes provides important ecosystem benefits, including mitigation of soil erosion; shelter for pastures; improved animal welfare; enabling added revenue from stacked enterprises; habitat and breeding sites for pollinators and predatory insects birds and animals; improved salinity management; improved interception of rainfall; and improved aquifer recharge management.

Assumptions and definitions

Trees and shrubs are largely intact as open woodlands on some of the unscalded red and black country on Salisbury. However, the graph below is focused on the scalds. For the purposes of the assessment, chenopod (saltbush) shrubs are considered separately as part of the ground layer in Criteria H and J, below, because they generally grow below the browse line.

Results and interpretation

There are few trees and shrubs on scalded areas before or after reclamation, so no changes have been recorded in the graph below.



H. Status of grass and herb structure - ground cover

Why track changes and trends in ground cover?

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

Assumptions and definitions

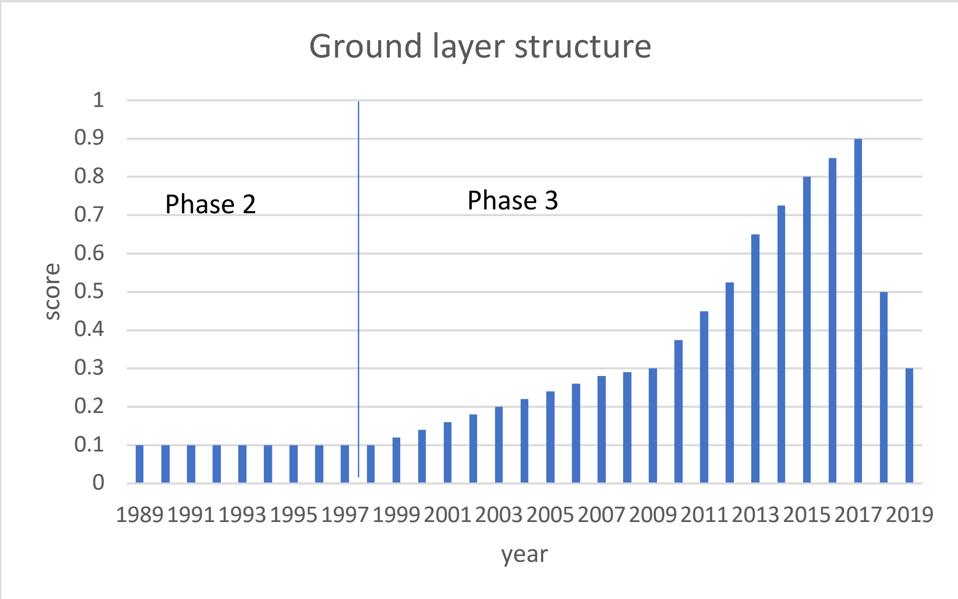
For the purposes of this criterion, chenopod (saltbush) shrubs are considered part of the ground layer.

Results and interpretation

The following graph shows a very low status of grass and herb structure on the red country in phase two because of the extremely poor natural vegetation regeneration on large scalded areas compared with intact pastures.

In phase three, the waterponding (and other interventions listed in table 1) have progressively improved the ground layer structure over many years. Monitoring of the 2009 ponds on Salisbury show an increase in vegetation cover from zero to 60% (plus 7% litter cover) in five years[9]. Monitoring ponding works on nearby properties demonstrate improved pasture cover over nine years (Thompson 2008, 2012). The recent drop in ground layer structure is attributable to severe drought.

[9] Extract from Project Monitoring Annual Survey (2014) Central West Catchment Management Authority, Nyngan, NSW.



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

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

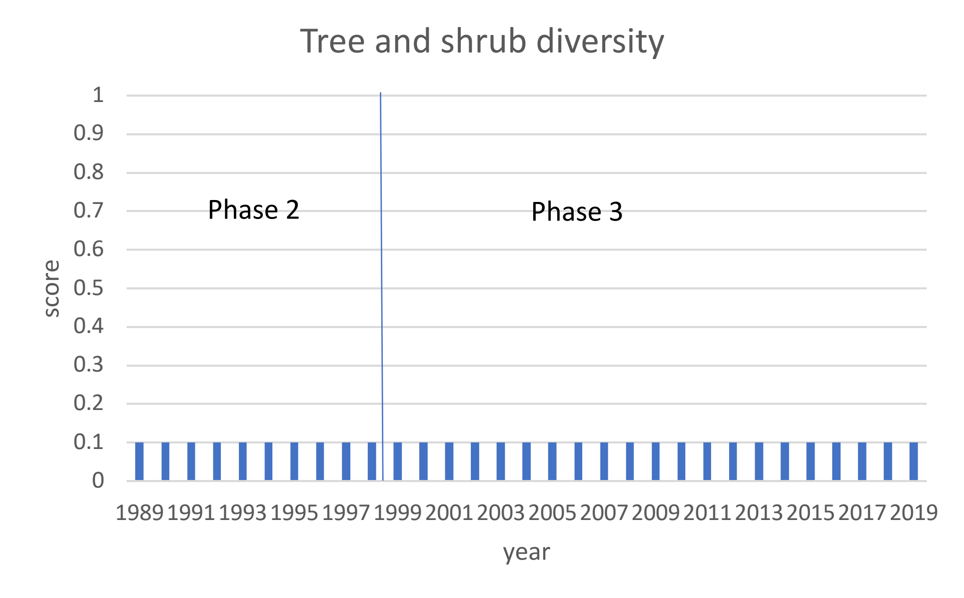
Grazing land management regimes typically result in a reduction in the numbers of species of trees and shrub species as the landscape is modified for pasture production. Grazing animals can inhibit the regeneration of trees and shrubs species.

Definitions and assumptions

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

Results and interpretation

As per Criterion G (above) trees and shrubs are not a feature of the regenerated vegetation of the water ponds. Thompson (2012) makes some suggestions for regenerating trees for conservation purposes.



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

Why track changes and trends in grass species diversity?

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

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

Assumptions and definitions

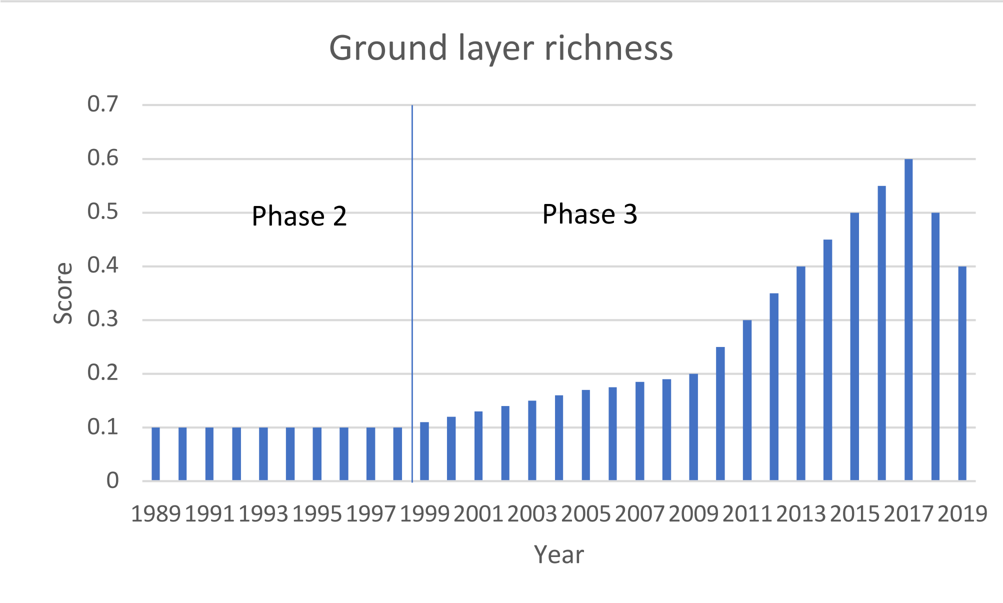
Functional traits refer to the types of species inhabiting a place and what is/are their roles in that place. Functional diversity reveals how evenly the species are distributed in an area. A decrease in functional richness and evenness decreases an ecosystem's productivity and stability. As a general rule, the more functional traits of plants found in an area indicates an area is less intensively managed.

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

Results and interpretation

The following graph shows a very low status of grass and herb species richness on the red country in phase two because of the almost complete absence of plants on large scalded areas compared with intact pastures.

In phase three, the waterponding (and other interventions listed in Table 1) have progressively improved the ground layer species richness over many years. Monitoring ponding works on Salisbury and nearby properties demonstrate improved species richness after five to seven years (Thompson 2012). The recent drop in ground layer species richness is attributable the temporary loss of annuals in the severe drought.


Ground layer richness
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Score
Phase 2
Phase 3
1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017 2019
Year

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Attachment A

Chronology, Salisbury, NSW

The following chronology was established by discussion with the land manager and from unpublished sources for nearby properties on Marra Creek.

1830s to 1850s	First European settlers in the Marra Creek district
Mid to late 1800s	High stocking rates over much of NSW rangelands
Late 1890s -1902	Federation drought
1923	Map of the area shows "Booka", "Ginghet" and "Trialgara" blocks. Womboin station is further South.
1972	Salisbury block split off from Womboin station.
Mid 1970s	Chequerboard ploughing trials
1977	Salisbury purchased by the MacAlpine family. Added the "Booka" block. Apart from the scalds, the country was described by the MacAlpines as 'pristine'.
1984	Ponding first trialled on "Booka" block. Marra Creek waterponding demonstration: Four year program (Thompson 2008)
1991	Australia's wool crash caused the family to 'batten the hatches' including: • flock reduction (paid to shoot the sheep - never restocked to the same levels) • let go staff that were employed.
1994	Rest of family bought out by Grant and Cathy MacAlpine
1999	"Ginghet" blocks (NE of main property) purchased
2009 & 2012	Significant waterponding areas established on Salisbury
2020	Well below average rainfall for the previous three years[10]

[10] Monthly rainfall for Marra Creek (Womboin), Bureau of Meteorology (http://www.bom.gov.au/climate/data/) station number 51057.

2020
SALISBURY CASE STUDY
SOCIAL REPORT

Prepared by Mark Parsons and Matthew Bolton

Introduction

This Social Report for this Salisbury Case Study will look at the transition process undertaken by the MacAlpine family in their adoption and implementation of the principles and practices of regenerative agriculture. It looks at the journey of the decision makers undertaking the transition.

Background

This is the story of the MacAlpine family in north west NSW, focussing on Will MacAlpine and his parents Grant and Cathy. The family's first experience of farming and grazing began when Will MacAlpine's grandfather married into a family farming on a small block near Coolabah, on the Nyngan to Bourke road. This was a sheep farming operation and the family has continued with that industry ever since.

In 1977, when Salisbury came onto the market, Grant and Cathy identified an opportunity to buy a bigger property with drought resistant pastures (saltbush and Mitchell grass). Apart from the scalds on the relict, red creek terraces, the country was 'pristine'. It had been underutilised for grazing until split off from the large Womboin Station in 1972. Another tract of land to the west, "Booka", was added to Salisbury later in 1977. To the north-east, the "Ginghet" blocks were added in 1999. Although early grazing practice comprised heavy stocking rates on the saltbush and Mitchell grass pastures, the former remain largely intact.

Salisbury is about two hours' drive from Warren, the nearest town with substantial commercial and medical services. Going to the supermarket, to the dentist or to play football with the local club takes the best part of a day, which takes a substantial chunk out of the working week. As is the case for many farming families, Will, his two brothers and one sister all went to boarding school in their secondary years as there was no other practical option. But for Will's family (who as of early 2020 have a toddler and another baby on the way) there are challenges getting child-minding and, in the not so distant future, getting children to the nearest primary school 60 km away.

The family has also recently invested in a property near Grenfell, operated by Will's brother Alex. It is largely independent from Salisbury, but sometimes receives excess older ewes from Salisbury.

The family is receiving professional advice on succession management for a harmonious transition to the next generation(s). This is to avoid common pitfalls such as family conflict or splitting the assets into unviable units. Will's other brother and sister are occupied in off-farm jobs.

The MacAlpine's Vision

The MacAlpine vision for regenerative agriculture developed and evolved over many years of experience to meet perceived needs of the family and their country. Their broad aim is to remain profitable while not degrading (or, where possible, improving) their asset base and its resilience to drought. Their early grazing practices noticeably degraded the country and its resilience, so they were always on the lookout for better ways of managing their stock and country.

Grant made all management decisions in the early days. Will is now joint manager with a focus on the stock. Strategic decisions for Salisbury are made by Grant, Cathy and Will at weekly meetings. Rather than a formal risk management framework, the family makes judgements based on the accumulated wisdom gained from years of experience on the property and the experience of neighbours.

From Vision to Reality

In rough chronological order, improved practices include:

- scald reclamation
- reduced stocking rates after the wool crash
- bore capping and piping
- wildlife-proof fencing
- "triggers" for stock management and
- confinement feeding of breeding ewes.

In the early 1980s, Grant noticed reclamation work on the scalds elsewhere in the Nyngan district and began experimenting with various ponding and ripping methods. He considered it an obvious thing to do because it would bring "useless" land back into production. At the time, the only use of scalds was for landing Grant's light plane anywhere on the property. Small areas provided runoff water for local dams, but the vast majority was indeed "useless".

Improved water management began at the initiative of government, with a subsidised bore capping and piping program. With water piped to tanks, each with two troughs, grazing was reliably spread more evenly over the property.

With the ponding and improved grazing management showing promising results, the family began investing in wildlife-proof fencing to manage total grazing pressure (from kangaroos) and wild dog predation.

Will MacAlpine is keen on reading the health of his stock and pastures and uses several "trigger" points in the annual calendar as to whether to join stock, how many, etc. and whether to feed breeders in containment pens to ensure optimum nutrition and give the pasture a rest.

The future vision shared by the whole family includes the restoration of Mitchell grass in the black soil paddocks and the introduction of exotic and native grasses to the red country – both within and outside the ponds. This is expected to increase the productivity and drought resilience of the enterprise.

Changes and Challenges

Many of the improvements on Salisbury have been subsidised by one or other level of government. Irreversible decisions were made to align with government timetables to qualify for subsidies or go it alone, with the main consideration being the availability of labour and flexibility of its deployment. For example, work on the wildlife proof fencing is labour-intensive for the MacAlpines over several years, so contractors were engaged to do some of the stock work.

The pond work is open-ended and useful from the first rainfall with little need for further input. The first green shoots of 'new normal' were evident within one year of construction of the ponds on the scalds[1]. Everyone was very positive about the results; all felt excited that the effort had brought previously unproductive land into production and made their enterprise more resilient to drought. The country looks better compared with overgrazed land. It was certainly a validation of their vision.

The purchase of fencing materials is a major cost item and only returns benefits if erected around the property and between certain paddocks. The same is true of the capping and piping of bores. Grant initially resisted installing the infrastructure for containment feeding, but eventually deferred to Will's judgement – illustrating a passing of the management baton. Grant now recognises that it provides a very useful (non-mandatory) option for use in particular circumstances.

Now that much of the physical infrastructure is in place, or soon will be, focus will be on stock and pasture management. The annual cycle of triggers articulated by Will[2] is remarkably simple and effective. The enterprise is in a flexible position to adjust to adverse climatic circumstances, such as the current drought.

The main disappointments are the lack of pasture grasses[3] in the ponds and the current severe drought. The MacAlpines plan to distribute seeds of promising pasture grasses in the ponds (and on the red and black drylands.) The enterprise is operating at reduced profitability in the drought due to the ponds, fencing and management, but is still going forwards. Because of the land's inherent characteristics and subsequent improvements, they regard Salisbury as more drought resilient than their new Grenfell property.

Over all, the family feel that Salisbury has provided a good living and they would do it all again.

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[1] Called "claypans" by the family.
[2] From his own observations and discussions with his father.
[3] Saltbushes, forbs and some grasses grow well, but the grass bulk is disappointing.

2020
SALISBURY CASE STUDY
ECONOMICS REPORT

Prepared by RSM

Introduction

Salisbury is located in the Marra region of New South Wales, to the west of the Macquarie Marshes and about 160 kilometres north-west of Warren. The farm is a self-replacing merino flock enterprise. On average, the farm stocks 5000 ewes and 2500 ewe lambs a year. The property was purchased in 1977 by Grant and Cathy MacAlpine. The farm is currently managed by Grant, Cathy and their son Will.

Since the purchase of Salisbury, the MacAlpine family have strived to ensure regenerative farming practices are effectively implemented for the benefit of their property and enterprise. These regenerative practices include:

- Water ponding to maintain productive soils
- Management of stock numbers by adjusting grazing management according to the seasonal conditions. The property is stocked below capacity to ensure a sustainable enterprise.
- The construction of an exclusion fence to improve control of total grazing pressure

Intermittent heavy rainfalls and prolonged periods of drought have created challenges for farms in the Marra region. The regenerative improvements the MacAlpines have made has increased water infiltration and reduced grazing pressure. This reduces the climate difficulties of the region and allows for more pasture growth and sustainability resulting in healthier sheep.

Report Data Sources:

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

Financial Data – MacAlpine Financial Accounts

Seasonal Conditions and Rainfall Data – Australian Government Bureau of Meteorology

Loans – Rural Assistance Authority NSW

Industry Insights – Published Industry Reports by:

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

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

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

Due to data availability, some years may be missing throughout our analysis.

Benchmarking

Throughout the analysis, we have compared the financial and production data to relevant industry benchmarks. This illustrates the success of Salisbury and the MacAlpine's management practices. The benchmark data in this report is referred to as the 'Average Farm'.

The primary benchmark used in this report for the Average Farm is a Specialist Sheep Enterprise in the Pastoral Zone (as per the Australian Broadacre Zones & Regions). The data for the Average Farm is published in MLA Farm Survey reports.

Production and Income

The regenerative farming practices that the MacAlpines have implemented on Salisbury have led to significantly increased production levels when compared to the Average Farm. With increased productivity, the income generated on Salisbury is also significantly higher than that of the Average Farm.

The MacAlpines focus on two primary sources of income – Livestock Sales and Wool Production.

The sale of sheep is the primary source of revenue on Salisbury, closely followed by the significant revenue from merino wool.

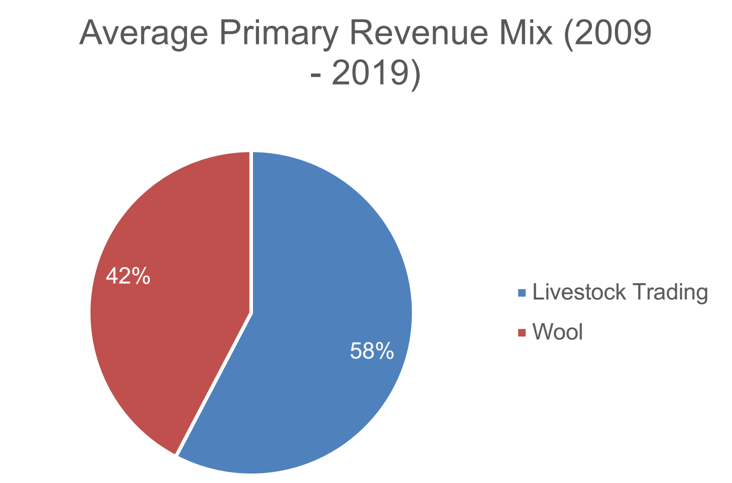

Figure 1: Average revenue Mix (2009-2019)

For the MacAlpines, understanding and learning about the landscape has helped them to continually improve their regenerative farming practices, allowing them to excel in production. Over time, the MacAlpines have come to focus on managing ground cover and protecting their pastures. Their main priority is the health and wellbeing of their sheep, and the condition of the landscape significantly influences this.

The MacAlpines have chosen to significantly invest in infrastructure such as water ponding and constructing an exclusion fence. This has enabled them to turn unproductive soils into productive soils, which, in turn, has allowed for much more pasture growth and control of the grazing pressure.

"By ponding our scalded country, we have turned unproductive soils into productive soils allowing more pasture growth on country that previously yielded very little."

"Our main priority is the health and condition of our sheep. The biggest influence of this is the condition of our country, the more productive we can get our soils the better our pastures the better the health and condition of our sheep."

Further, by improving the land on Salisbury, the McAlpine's have been able to keep their flock healthier for longer in dry times, providing them with a more reliable business model.

Grants and Low Interest Loan Support to Fund Infrastructure

The water infrastructure and exclusion fencing have been heavy investments. In order to purchase the required material for these projects, the MacAlpines have received grants and a low interest loan support from the Rural Assistance Authority NSW for funding.

"We have been utilising a low interest loan from the rural assistance authority (RAA) to purchase the fencing material need for our exclusion fence."

"Our most recent project is to construct an exclusion fence around our property, by doing this we hope to better protect the benefits of water ponding by managing grazing pressure to maintain ground cover therefore soil health. This is a big project with 55km of fencing to construct at a cost of close to $500,000."

"The ponding has been done over many years with the help from grants, our exclusion fencing is currently underway with help from the RAA low interest loan we have been able to purchase most of the materials needed."

The Farm Innovation Fund is available to farmers in New South Wales to meet the cost of carrying out permanent capital works that will have a significant beneficial impact on the land and long-term profitability of the business, and further helping farmers to:

- Improve farm productivity
- Manage adverse seasonal conditions
- Ensure long term sustainability.

Gross Margin

Gross Margin is a measure used to show the profitability of farming activities – such as, livestock trading. Gross Margin shows the net sales less the direct costs and is commonly referred to as 'Trading Profit'. Gross Margin is calculated as; Sales minus Cost of Goods Sold.

Gross Margin per Hectare per 100mm of Rainfall (GM($)/Ha/100mm) is a common measure used to show how well a farming enterprise utilizes its available land and rainfall.

Figure 2 illustrates the Sheep GM($)/Ha/100mm for Salisbury and the Average Farm. As can be seen, Salisbury significantly outperforms the Average Farm.

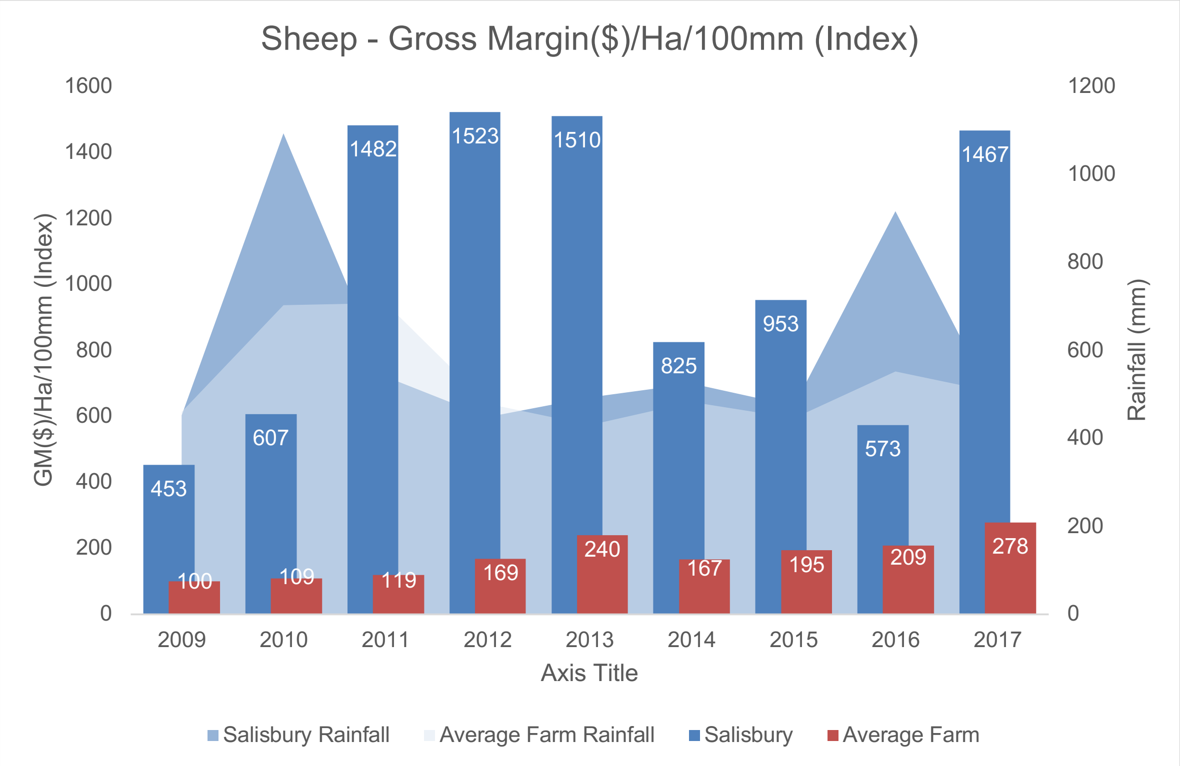

Figure 2: Sheep – Gross Margin Per Hectare Per 100mm of Rainfall

Data insights:

- Salisbury's GM($)/Ha/100mm is generally higher than the benchmark due to little (or no) livestock purchases made each year. The sheep flock is predominately self-replacing.

Sheep Sales

Sheep Sales are the primary source of income on Salisbury. For the MacAlpines, they have initiated selling off stock accordingly in dry periods. In doing so, the MacAlpines have consistently run stock below capacity and have been able to improve the management of their stock numbers in order to limit grazing pressure. This shows that the Salisbury enterprise is in a flexible position to adjust to adverse climatic circumstances.

"The current dry time we are experiencing has taught us a few lessons in managing our stock numbers, we try to implement a destocking strategy as early as possible to conserve our country the best we can."

"In early years when we first came here, we probably ran too many stock as we hadn't got a feel for the landscape. Over time we have learnt how important it is to properly manage ground cover and protect our pastures, resulting in us now running fewer stock but being able to run them better."

"By improving our country and not increasing our stocking rates it has helped us to keep our flock healthier for longer in dry times, proving us with a more reliable business."

Figure 3 compares Salisbury's number of sheep sales per Ha to that of the Average Farm. It is clear that Salisbury sells a significantly higher number of sheep per year.

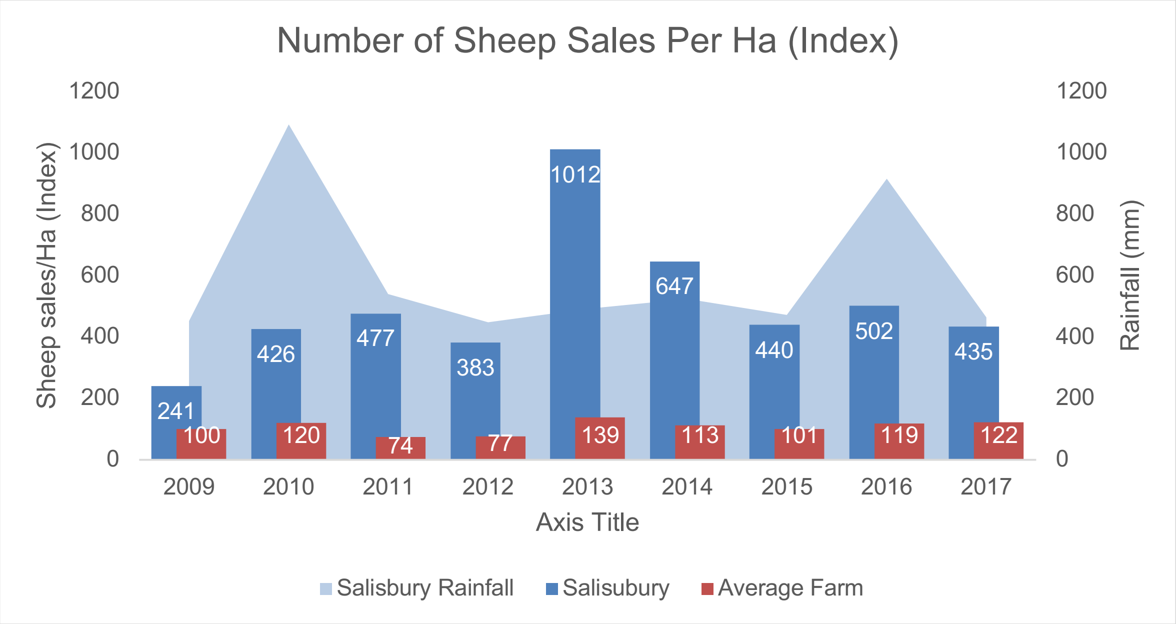

Figure 3: Number of Sheep Sales Per Ha (Index)

Data insights:

- In the years 2011 to 2015, Salisbury experienced low rainfall, therefore the MacAlpines sold more sheep in order to adjust to the dry times.
- In years of above average rainfall, such as 2010 and 2016, the MacAlpines have sold less sheep.

Wool Production

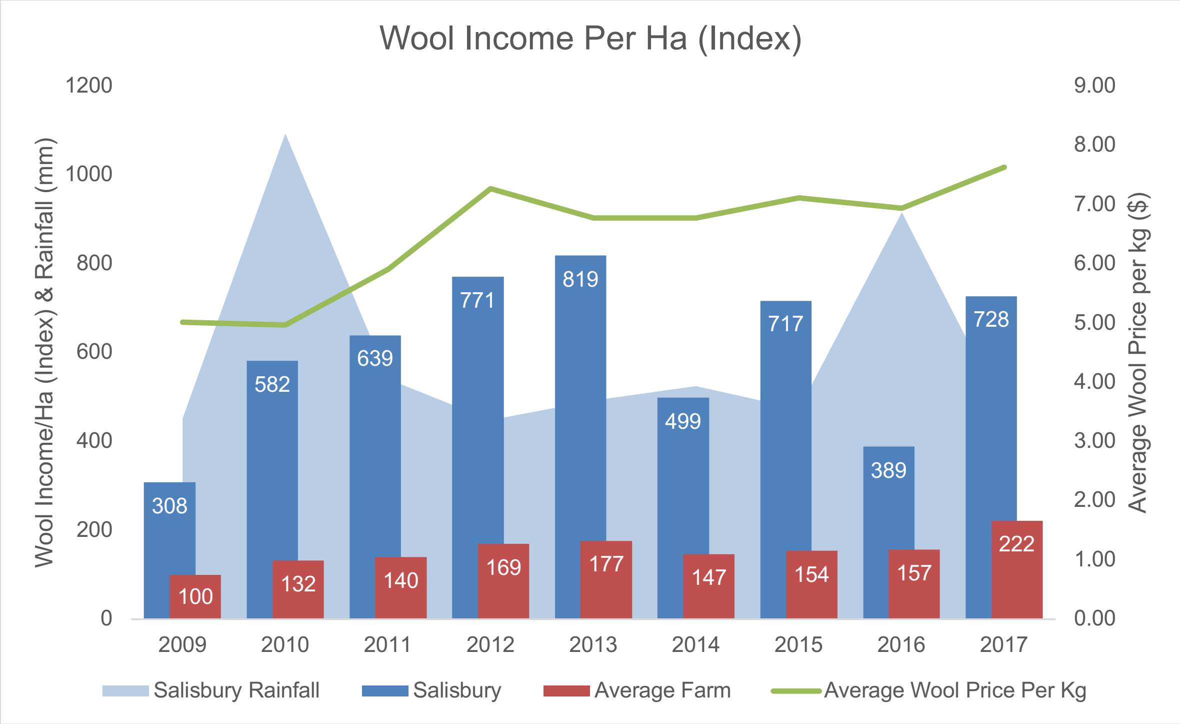

Figure 4: Wool Income Per Ha (Index)

Data insights:

- For Salisbury, the increase/decrease in wool income correlates to the rise/fall in the price of wool for that year. For example, in 2017 there was an increase in the average wool price and an increase in Salisbury's wool income.

Total Income

Figure 5 compares the total farm income per hectare of Salisbury to that of the Average Farm. Again, it is clear that Salisbury performs well above the Average Farm on income.

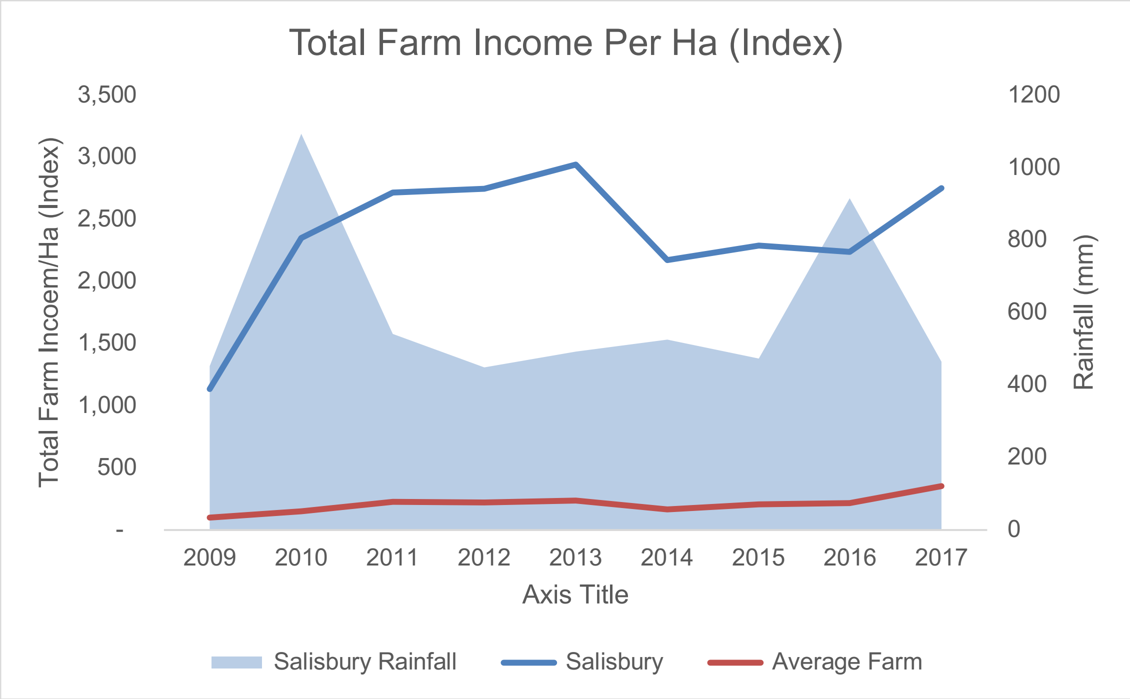

Figure 5: Total Farm Income Per Ha (Index)

Business Profit

Figure 6 compares Salisbury's farm business profit to that of the Average Farm. Salisbury usually performs significantly better than that of the Average Farm.

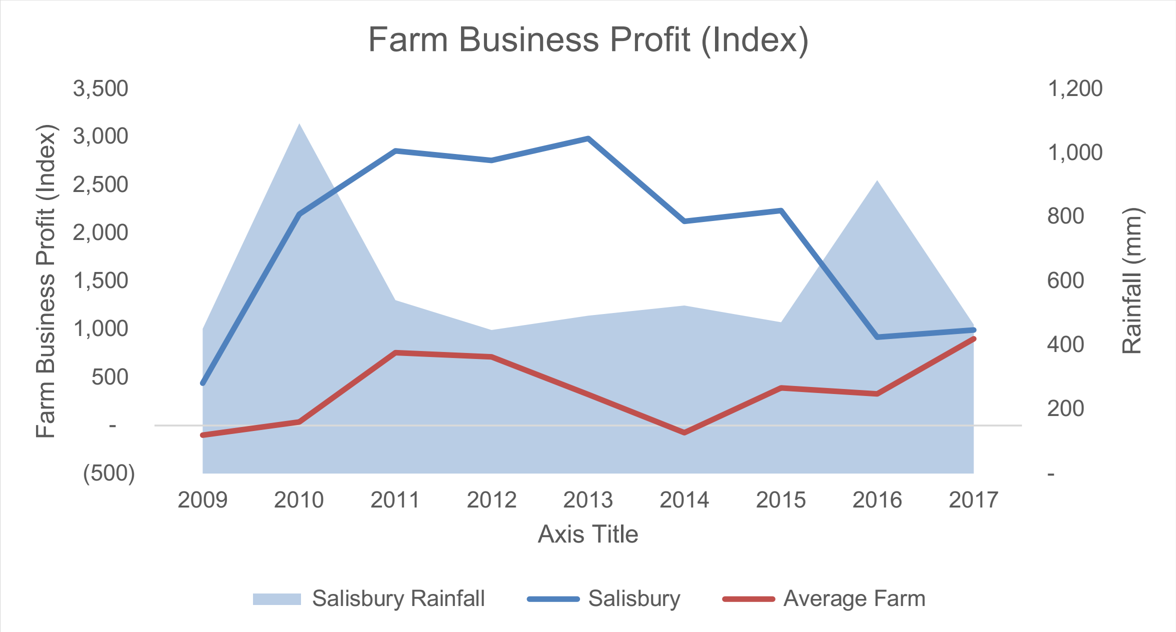

Figure 6: Farm Business Profit (Index)

Data insights:

- From 2011 to 2015, Salisbury experienced low rainfall. Despite this, the farm was been able to maintain a well above average business profit.
- Profitability fell in 2016 due to a significant decrease in wool sales.
- In 2017, there was a significant increase in depreciation expenses. This is due to increased property improvements (predominately fencing) in 2017.

Expenses

For some expenses, we have observed that the MacAlpines invest significantly more than that of the Average Farm. However, by focussing their expenditure on specific projects such as water infrastructure and fencing, the MacAlpines have been able to lower their other expenses, whilst still maintaining higher productivity and profitability.

While the MacAlpines invest more in expenses such as water infrastructure and fencing, this is offset by lower expenses in other areas such as chemicals and fertilizers. Overall, production rates are significantly higher, and despite the higher expense, the profitability of the farming operation has been positive.

Repairs and Maintenance Expenses

Figure 7 below compares Salisbury's Repairs and Maintenance per hectare expenditure to that of the Average Farm. This is the total expenditure on repairs such as motor vehicles, plant and equipment and other structures.

For Salisbury, the MacAlpines have heavily invested in water infrastructure such as water ponding and taking artesian water out of open drains and into tanks and troughs. Hence, Salisbury has a higher average expenditure for Repairs and Maintenance compared to the Average Farm.

"We have heavily invested in water infrastructure this includes water ponding and taking our artesian water out of open drains and into tanks and troughs."

Additionally, the MacAlpines recently began a new project to construct an exclusion fence around the property. This project is aimed to improve the management and control of the grazing pressure, which will help maintain ground cover and therefore the soil health. The exclusion fence will also improve the management of pests on the property.

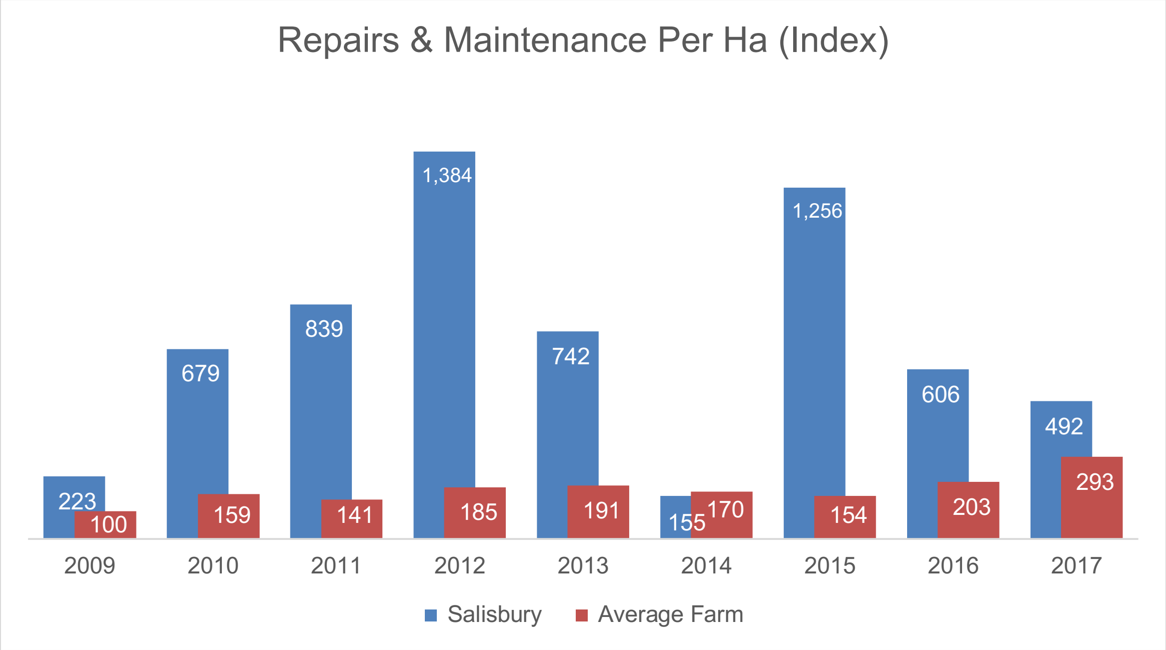

Figure 7: Repairs and Maintenance Expenses Per Ha (Index)

Despite having a higher expenditure to that of the Average Farm, the MacAlpines regenerative innovations have been successful and as a result there have been a number of improvements to the property:

- By water ponding, the MacAlpines have turned unproductive soils into productive soils. This has allowed more pasture growth on land that has previously yielded very little.
- Additionally, water ponding has allowed water to better penetrate the soil, resulting in a rise in vegetable matter and the amount of stored carbon levels.
- Again, the benefits and outcomes of the exclusion fence will allow for better control of the grazing pressure and the health of the soil, which is important for the overall health of the sheep.

Pasture Expenses

Pasture expenses are those that are necessary to maintain the soil and pasture health in a farming enterprise. In this analysis, we have considered the following expenses as Pasture expenditure and compared them to that of the Average Farm:

- Fertilisers
- Seed
- Fodder

As can be seen in Figure 8, 9, 10 and 11 the MacAlpines spend significantly less and often do not invest in Fertilizers, Seeds, Crop and Pasture Chemicals and Fodder. The MacAlpines heavy investment in water ponding has resulted in the improvement of the soil health and function and the overall pasture status. Hence, they have been able to reduce their expenditure on pasture maintaining expenses.

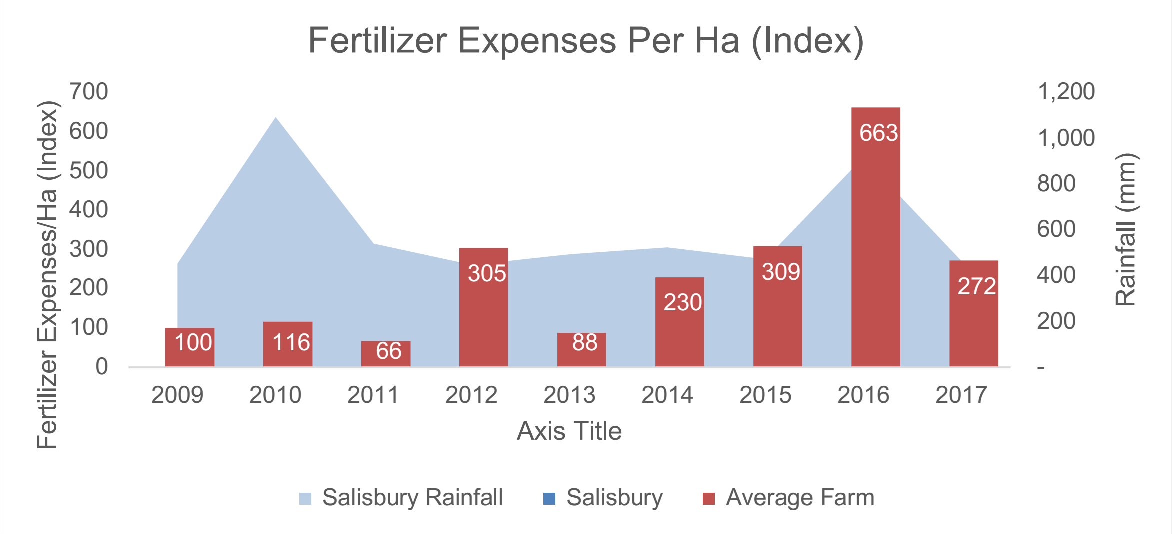

Figure 8: Fertilizer Expenses Per Ha (Index)

Data insights:

- For all years analysed in this report, Salisbury have made no expenditure on fertilizer as a result of the regenerative improvements the MacAlpines have made. The fertilizer expenditure for the Average Farm has still been included for comparison purposes.

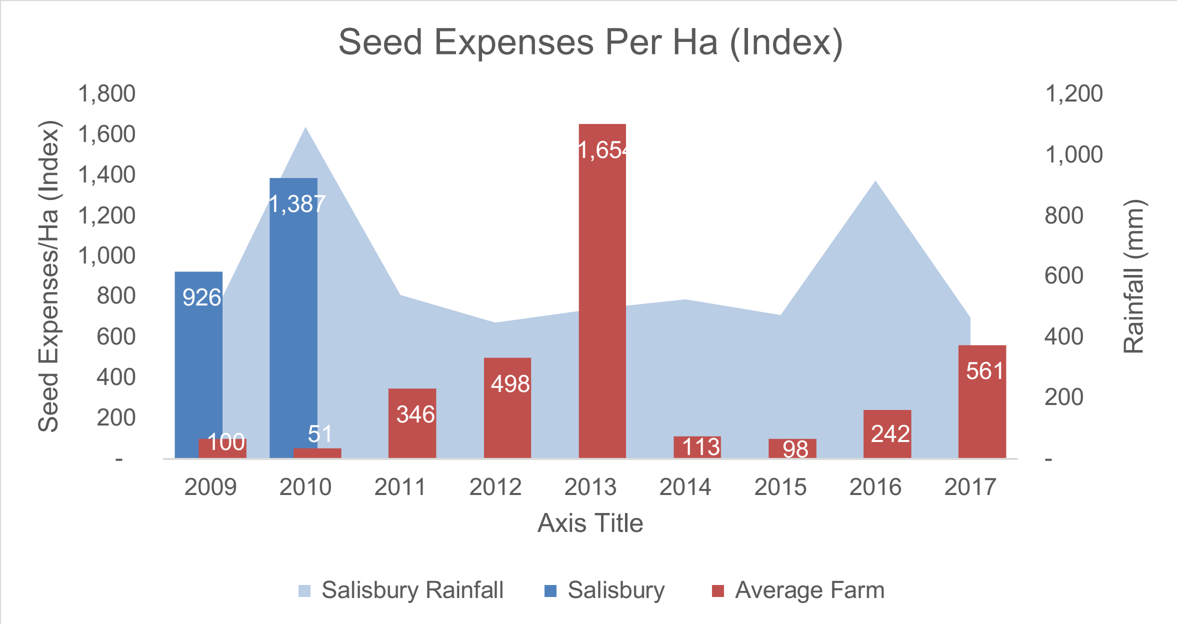

Figure 9: Seed Expenses Per Ha (Index)

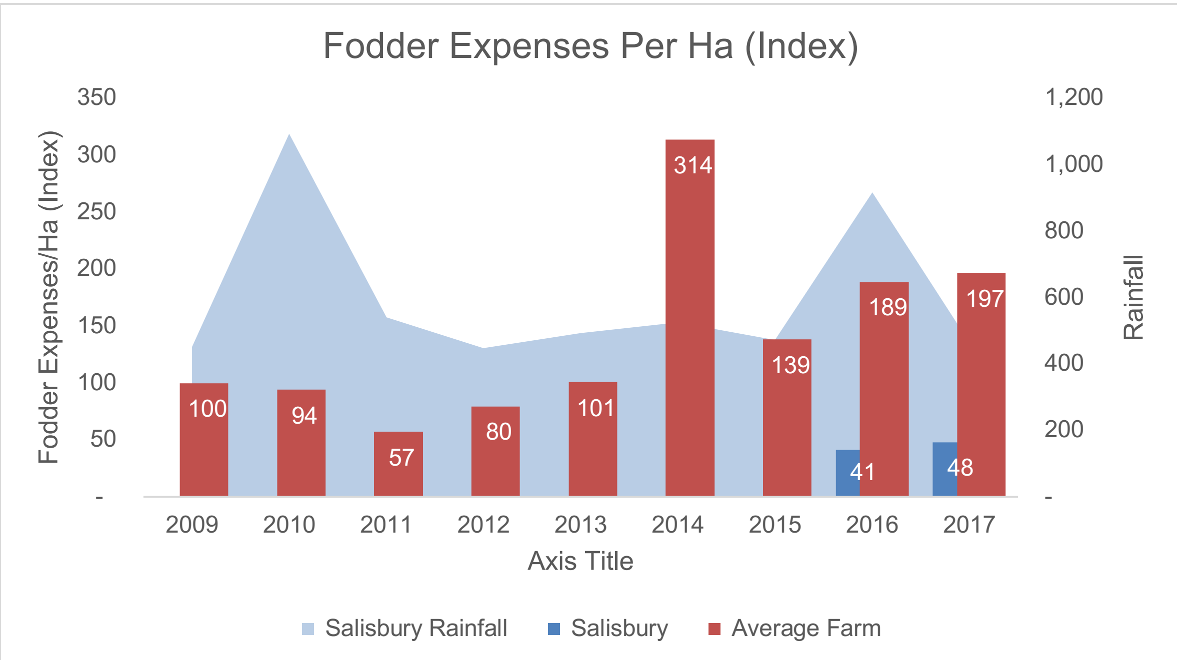

Figure 11: Fodder Expenses Per Ha (Index)