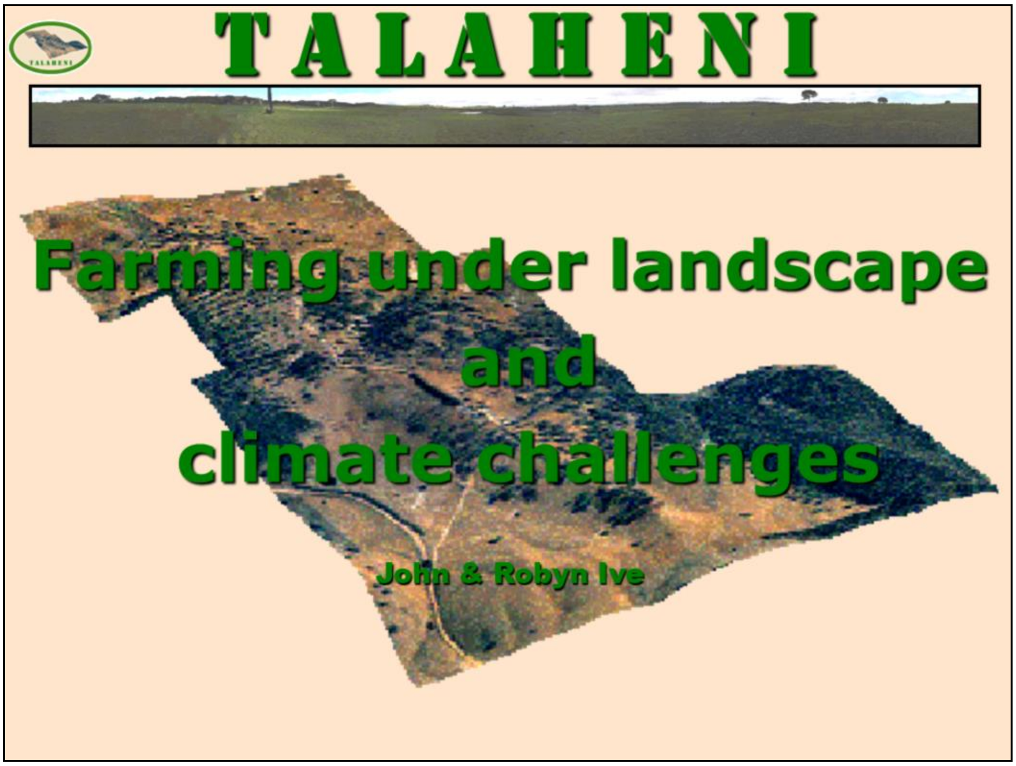
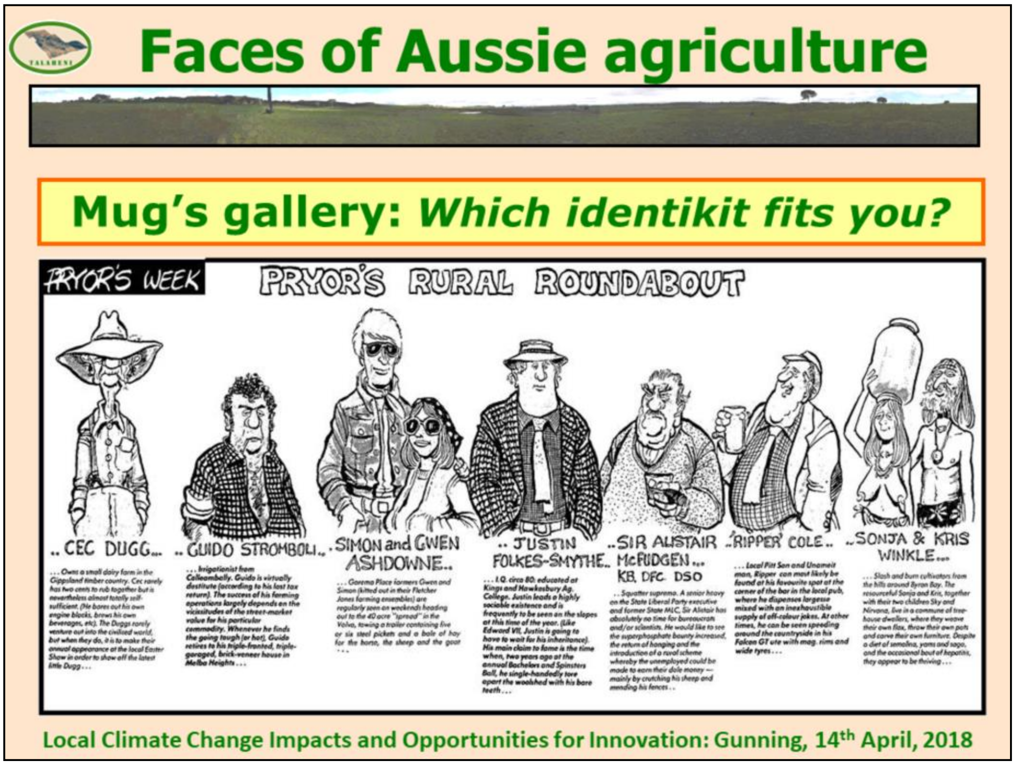


Talaheni was selected as an appropriate name nearly 40-years ago when we bought a run-down property in the Yass Valley. The word is Arabic for '*wait-a-while*' in recognition that things were not going to change overnight- one would have to *'wait-a-while'* or *'talaheni'*.

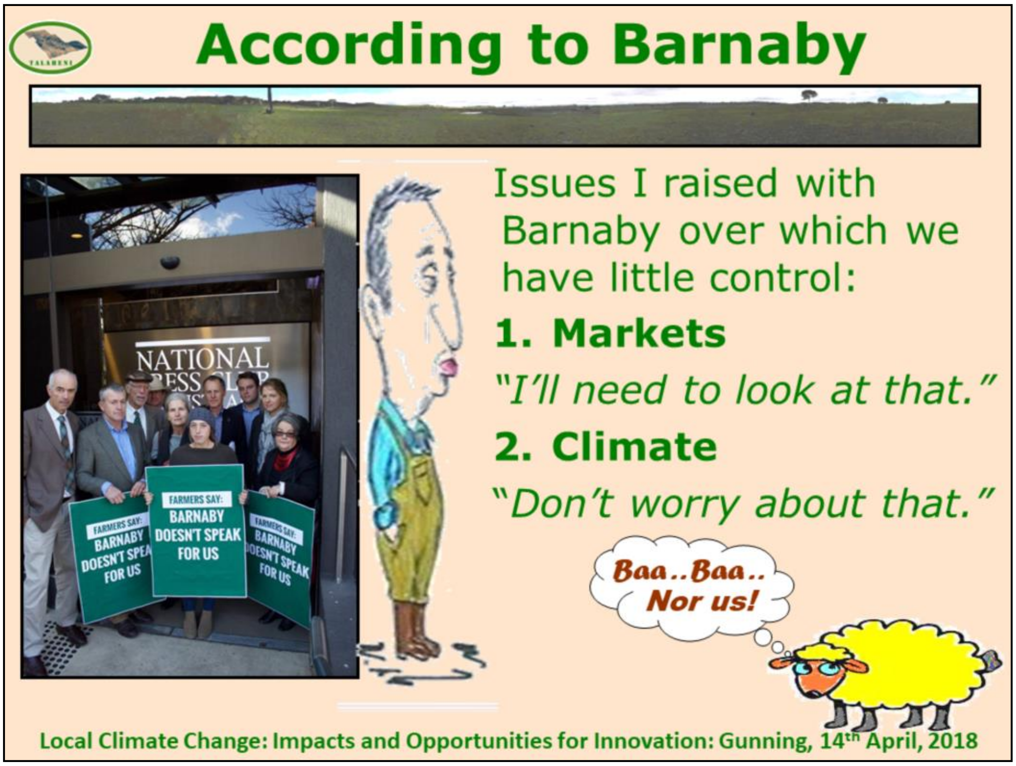
Realistically of course *'waiting-a-while'* was never going to fix anything. However, the sentiments of *wait-a-while* were directed to the response, not the commitment to addressing the issues.

Now all but four decades later we are confronted with a further emerging challenge: climate change. Reacting to climate change must be taken in the context of the overall farming operation- hence *landscape and climate challenges*.



It is often claimed that farming is a mug's game and Australian agriculture is made up of many and varied people with equally many and varied attitudes, aspirations and values.

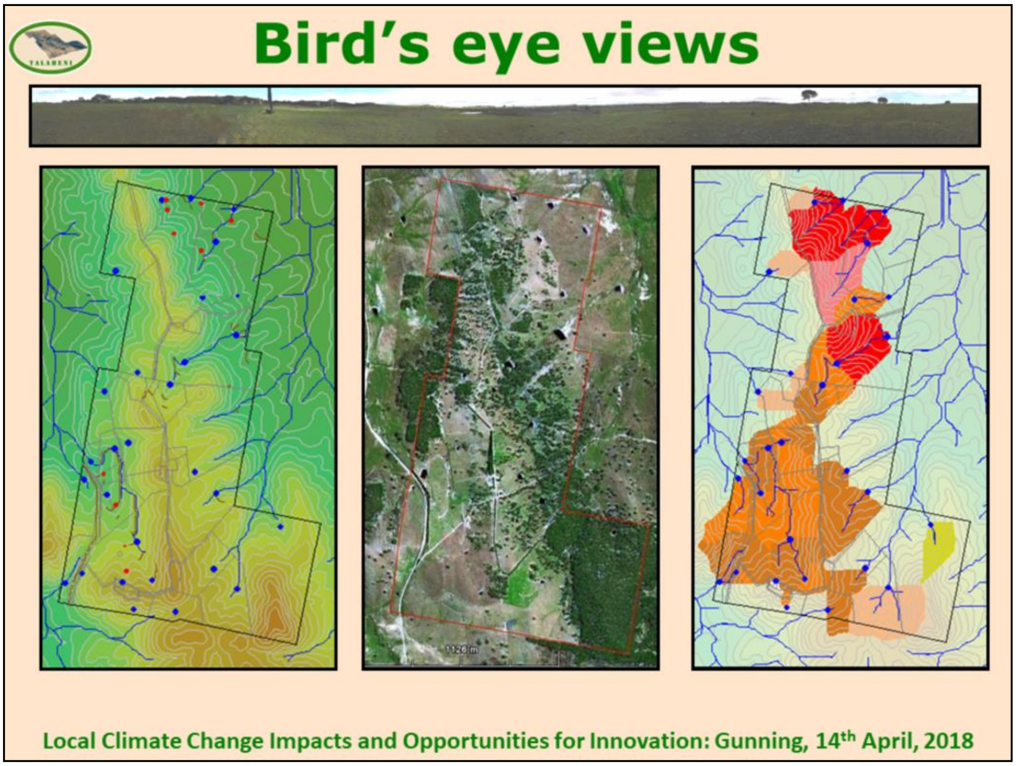
As a result, landholders have a range of views to land management and climate change. Consequently, I will leave it to you to see if it ignites any thoughts as to how to better manage one's *silent partner*- the natural resource base upon which one's agricultural future depends.



In the lead up to Federal election in 2016, we were invited to the National Press Club address by Barnaby Joyce as part of a delegation of farmers from across Australia who are concerned at the current direction of agricultural policy. I raised two issues with Barnaby over which we have minimal control but impact greatly on our farming operation.

Firstly, Barnaby took great credit for the bouyant beef market (that's fine), no attention was given to but the depressed state of ultra- superfine wool market- response: *I need to look at that*.

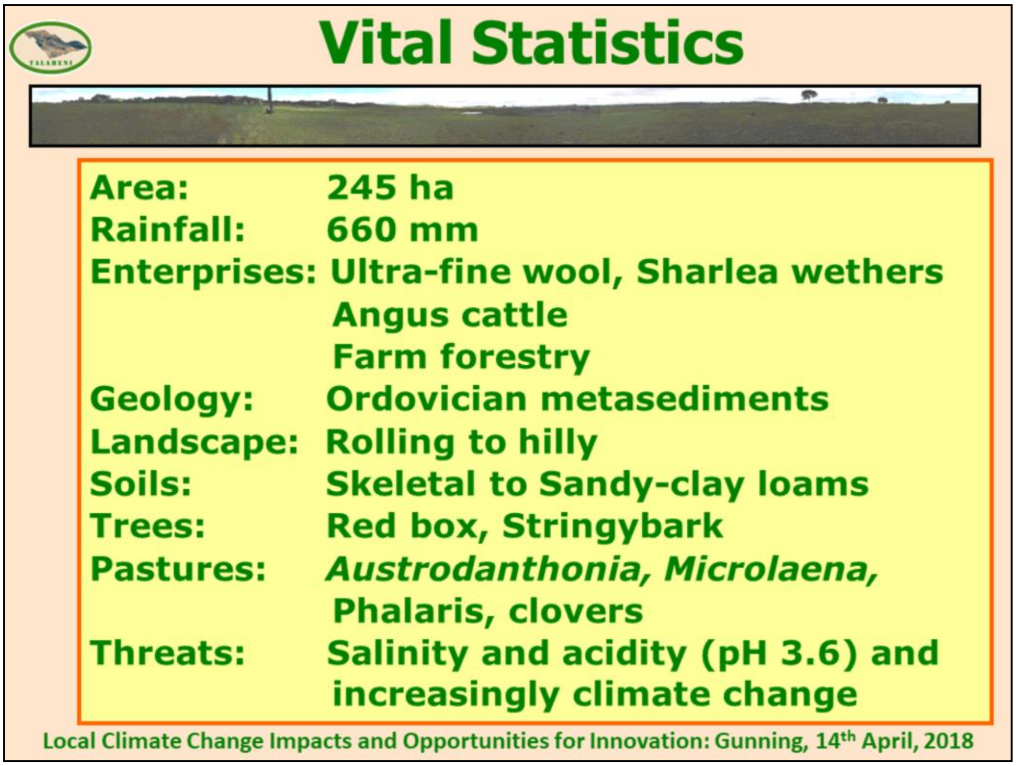
Secondly, in 45 minute address no mention was made of climate variability or change- response: *Don't worry about that*.



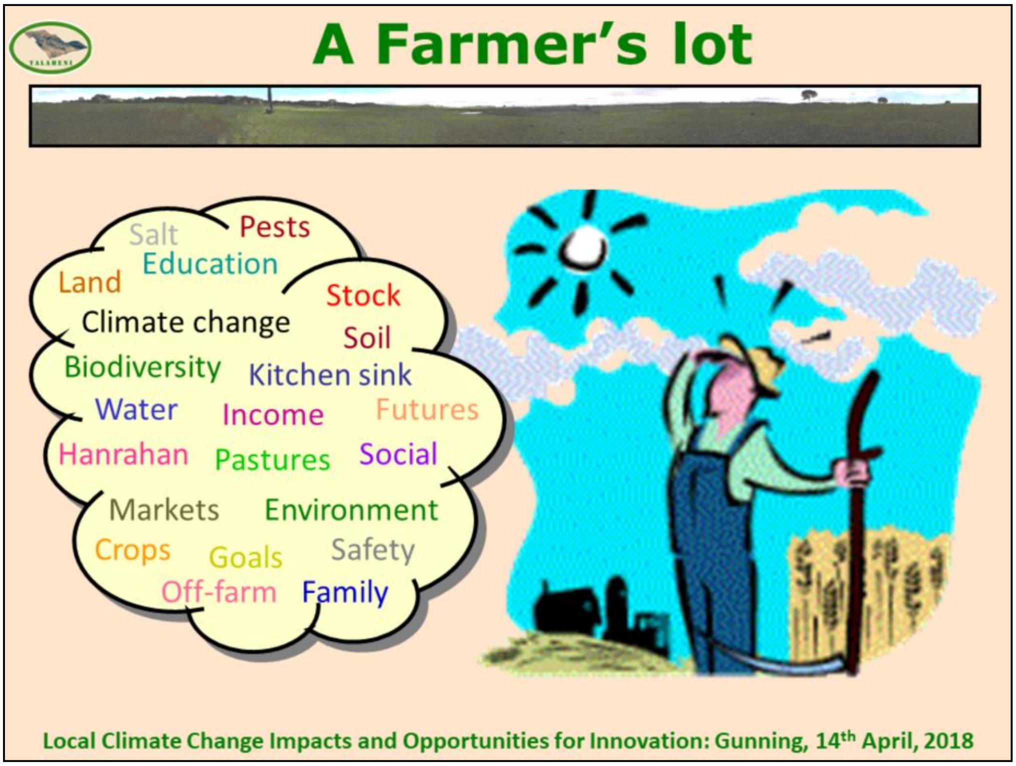
Giving a background to Talaheni before addressing the climate change challenge and response. Taking a look from above: we have a prominent ridge on a near north-south axis running the length of Talaheni. We have 38 dams (blue dots) and 40-odd paddocks. Groundwater is monitored weekly via a network of 12 piezometers (red dots).

SPOT satellite imagery shows variation in vegetation cover in 2005.

The third image indicates the spatial variation in severity of salinity risk as indicated by salinity levels measured in farm dams and attributed to the catchment of each dam. More on that later.



By way of background to Talaheni.



Like all farmers, we are faced daily with an on-going task of integrating across a large number of issues- aided by little more than what we have on our shoulders and driven by the desire to survive and hopefully succeed. These issues provide an ever-changing management kaleidoscope for today's farmers.

Our approach has attempted to integrate as many issues as possible rather than adopting single dimension approaches under a challenging landscape and climate. As will be seen this approach has delivered a rewarding quintet- with a environmental quartet (salinity, biodiversity, carbon and soil moisture), topping off the quintet- increased production in both quantity and quality.

We are involved in a number of activities.

<u>Ultra-fine wool:</u> our last clip averaged 13.8 micron and fibre diameter has been declining steadily for nearly three decades. Our objective is 13 micron.

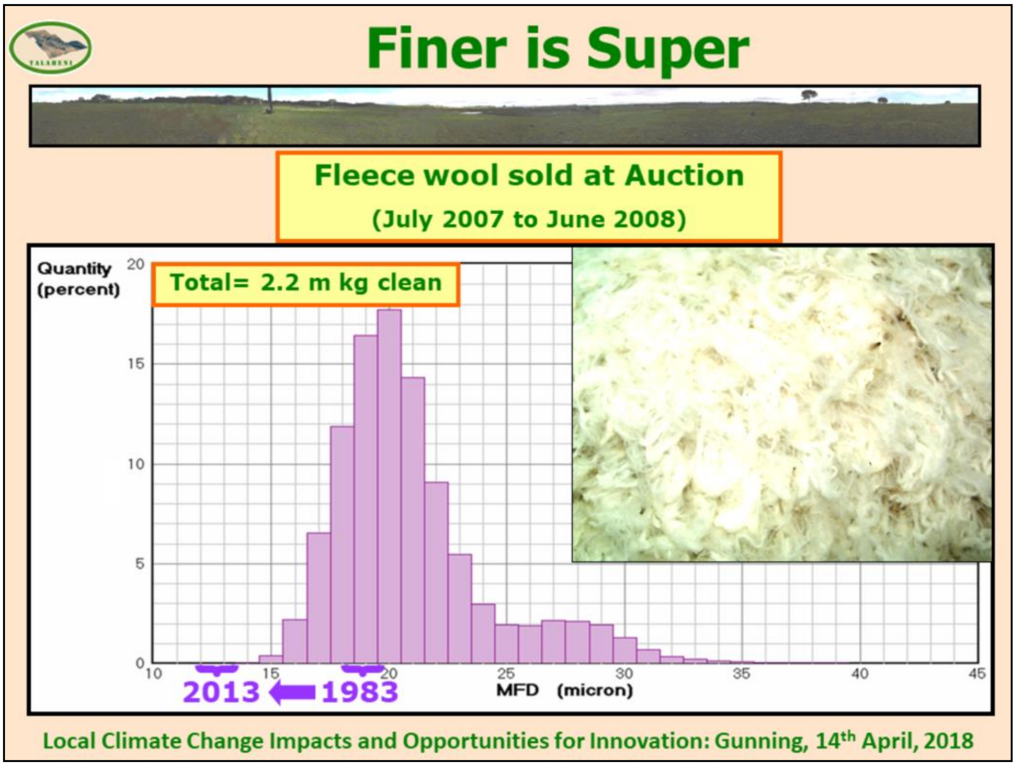
<u>Cattle:</u> Angus herd producing steers for feedlot on contract.

<u>Farm forestry:</u> apart from planting about 25 000 trees over the past 25 years, we mill mature Redbox trees when they die. This one yielded 72 furniture grade planks.

<u>Flora and fauna protection:</u> we have excluded grazing from a number of remnant areas and undertake flora and fauna surveys of these areas from time to time to establish the recovery response after removing grazing.

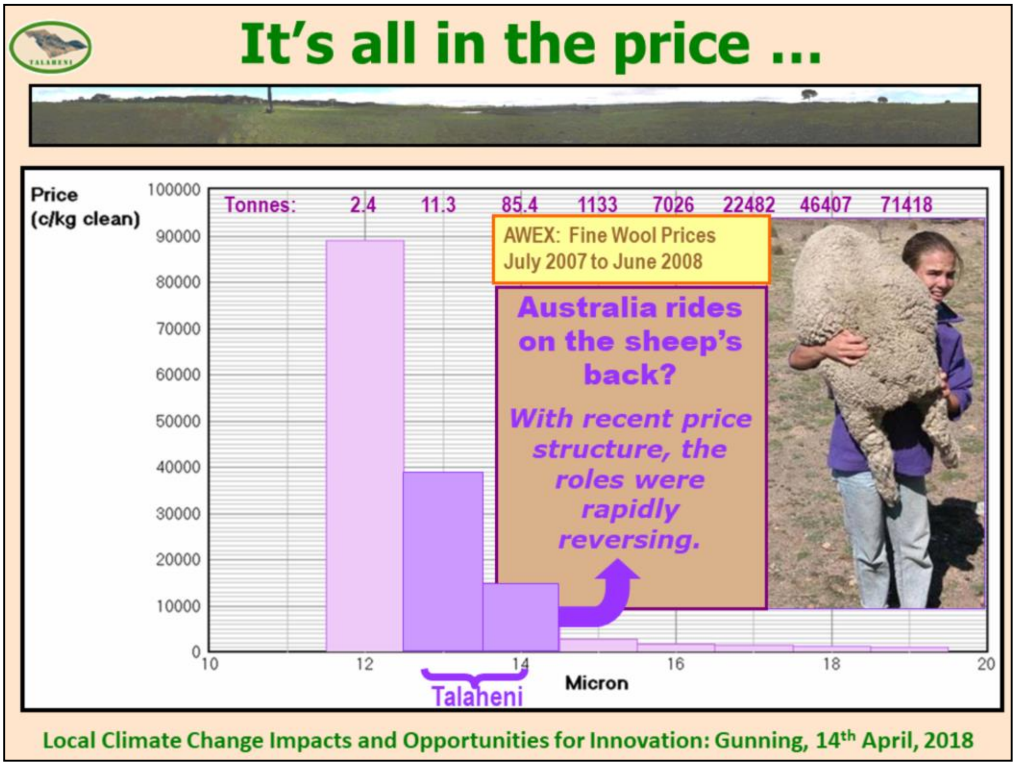
<u>Monitoring:</u> apart from groundwater, we measure salinity of surface and groundwater, landscape temperatures, soil and water pH, soil nutrients and soil biota activity.

<u>Landcare:</u> in addition to tree planting, has involved farm planning, re-fencing to land class types, constructing contour and interception banks, remnant exclusion and enhancement, linking corridors etc.



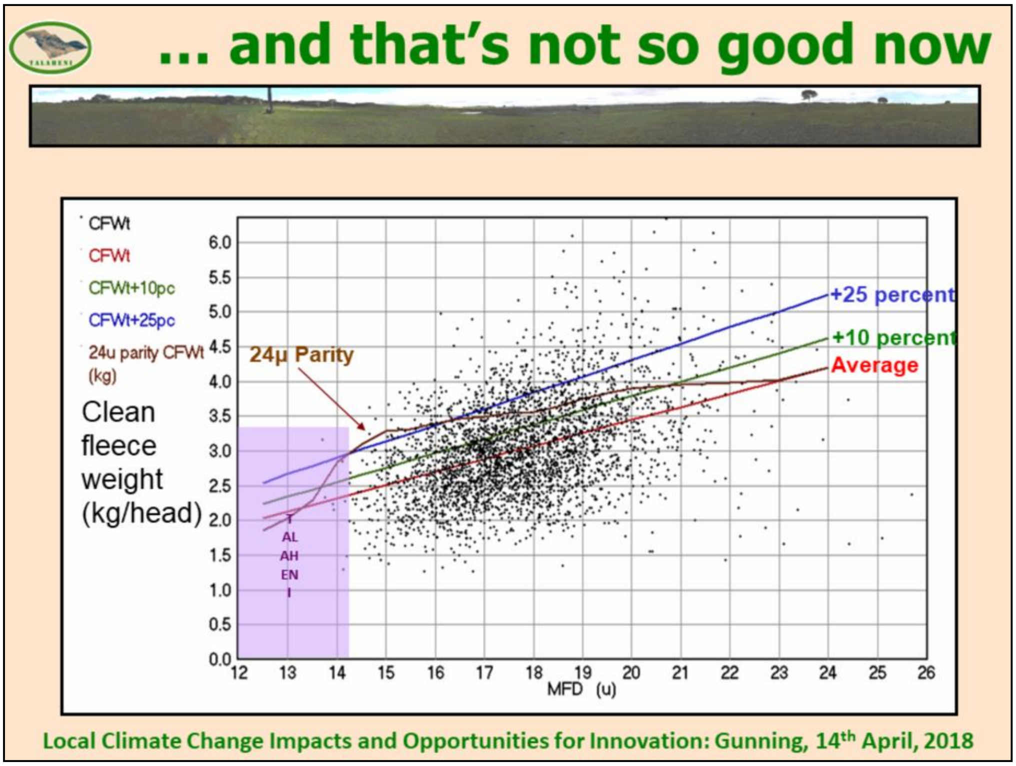
Thirty-eight years ago we started out with a clip average of over 19 micron and actively embarked upon a program to reduce fibre diameter while increasing staple strength and clip quality with the objective of achieving an ultra-fine flock.

Over recent years our entire clip has been below 14 micron and no sheep is over 15.5 micron on a mid-side sample and down to 10.4 micron. In wool terms, we now have an ultra-fine flock.



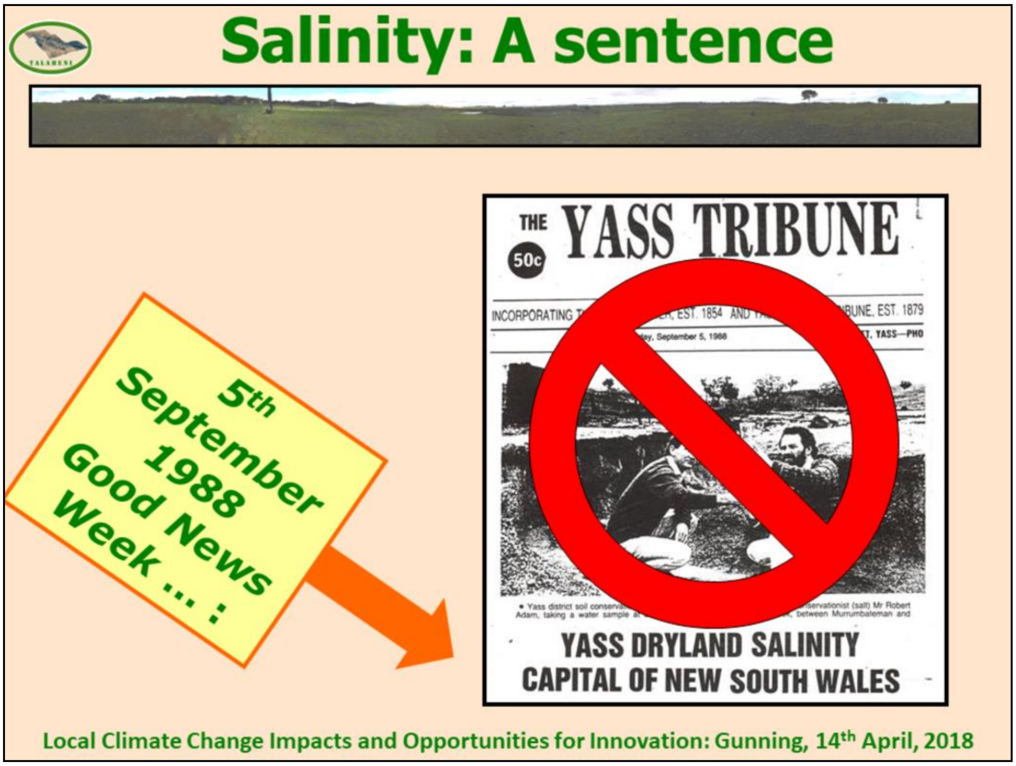
Focusing upon reducing micron was undertaken recognizing the long history of declining commodity prices in real terms for traditional agricultural commodities and recognition that we were running a small enterprise and had to focus upon the highest and finest quality and target very specific premium markets to give some hope of a future. While times have been tough for fine wool in general for over a decade, the above graph gives supportive evidence for the strategy we embarked upon more than 30-years ago.

Not only are we positioned to take advantage of future premiums for fineness and quality in the wool market, but we are now also a sought after provider of sharlea wethers by shedded sheep operators.



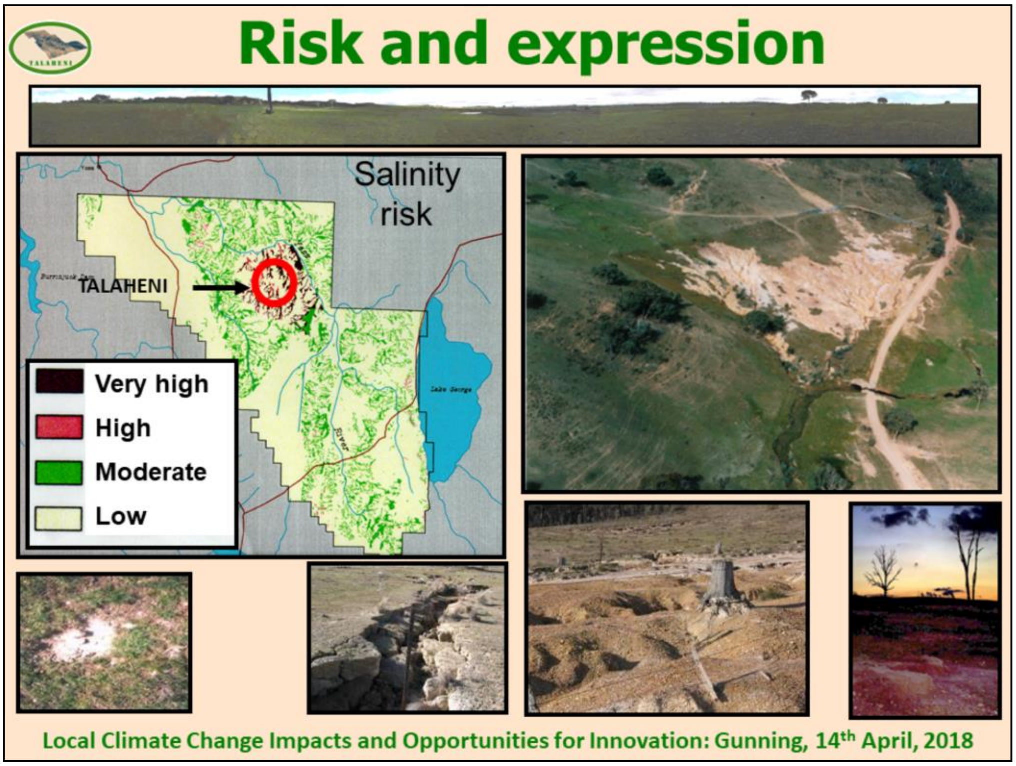
Taking results from recent wether trials across NSW we can get the overall relationship between micron and clean fleece weight (red line), the green line represents achieving 10 percent better and blue line 25 percent better.

The brown line shows the wool cut required across the micron range to achieve a similar return as that from 24 micron flock, indicating that at 15 micron one has to achieve more than 25 percent more than average to have parity with an average 24 micron clip- a big ask. Talaheni's clip is in a better position- but given costs of production are much higher, it is not a great position.



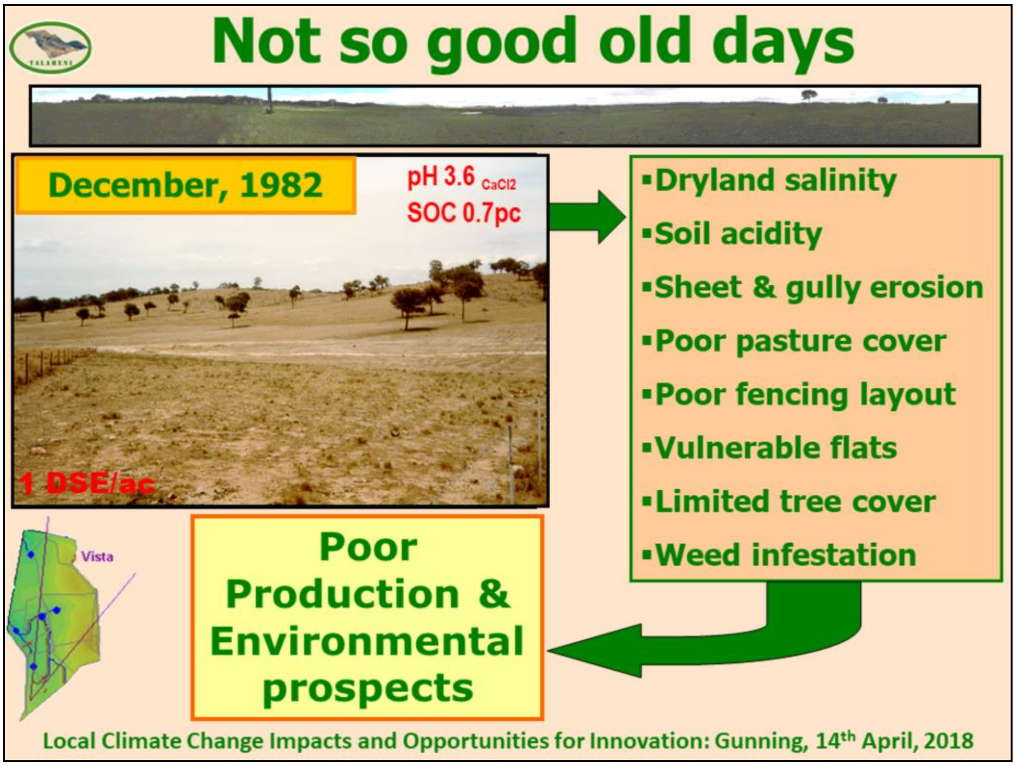
Dryland salinity was the most serious environmental issue we faced initially. Yass Valley is infamous for the incidence of dryland salinity and the salinity of Yass River has increased at 7 per cent per year or doubling every 10 years.

Dryland salinity reflects an imbalance between incoming rainfall and the water used by vegetation after allowing for runoff. This is largely due to the replacement of deep-rooting native vegetation with poorly producing annual and perennial pastures particularly on areas with high recharge rates. This represents the dominant process contributing to dryland salinity in the Yass Valley.



Bullseye!! Talaheni sits in the middle of some of the most saline areas in the Yass Valley and therefore New South Wales, leaving a pock-marked landscape with on and off-farm consequences.

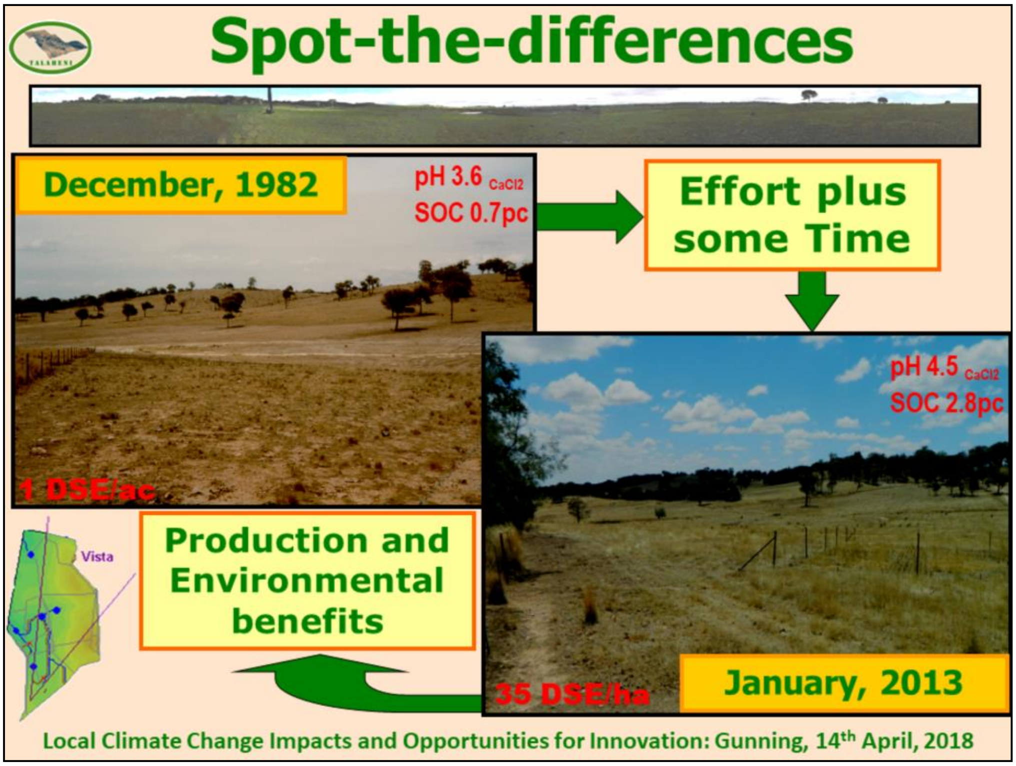
Salinity effects all vegetation, whether the pastures which support our grazing operation or the remaining native tree vegetation with consequences upon environmental and production values.



This scene from Talaheni in the not so good old days, shows a number of the degrading challenges we were confronted with:

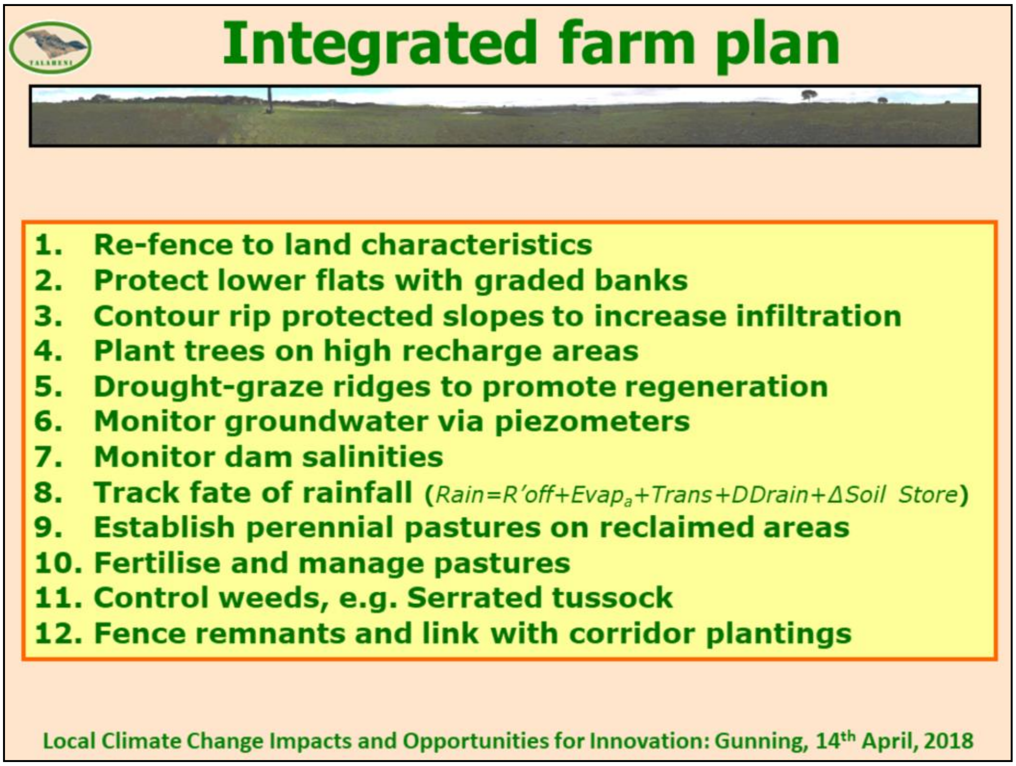
- **Flats badly affected by salinity and acidity,**
- **Flats vulnerable to high overland flow from adjoining near-treeless ridges,**
- **Sheet and gully erosion,**
- **Poor pasture cover,**
- **Poor and inadequate fencing layout,**
- **Limited tree cover, particularly on high recharge ridges,**
- **Infestation of noxious weeds, e.g. serrated tussock.**

All of which were having an increasing detrimental effect upon production opportunities and environment- both on- and off farm.



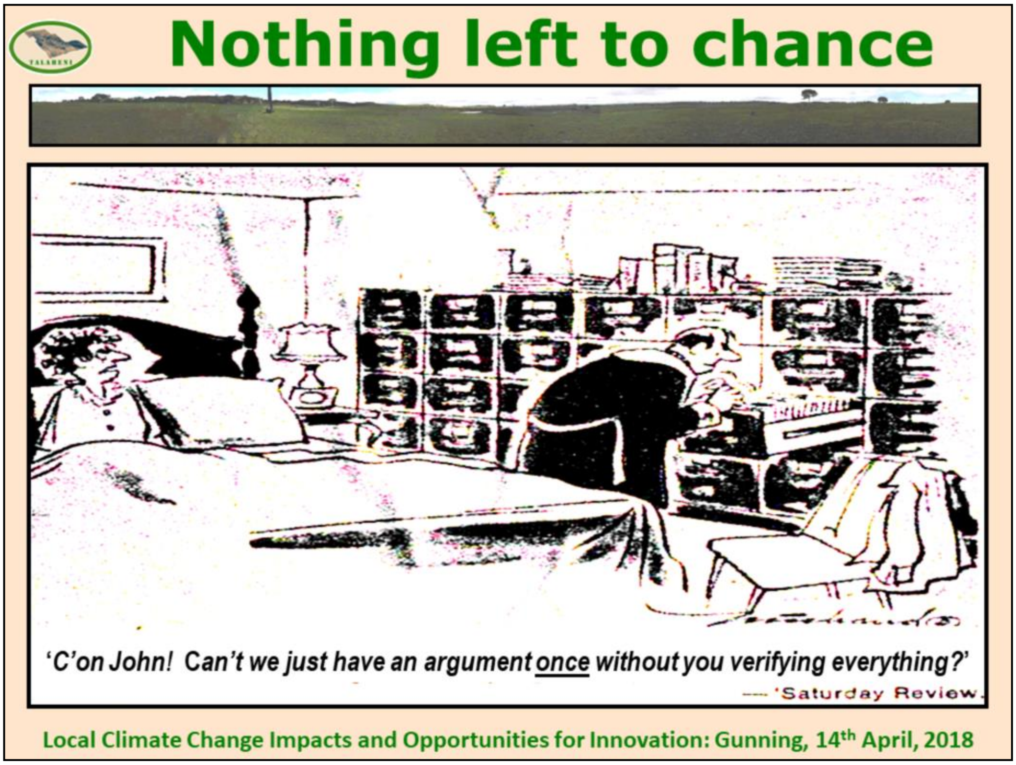
A scene from the same point over thirty years on.

This area carried just over 35 DSE/ha for the financial year 2011-2012 on a rotational basis where any one paddock (there are now 6 paddocks in the vista) was grazed for only about two months in the year in a number of rotations- although we had back-to-back above average rainfall years.

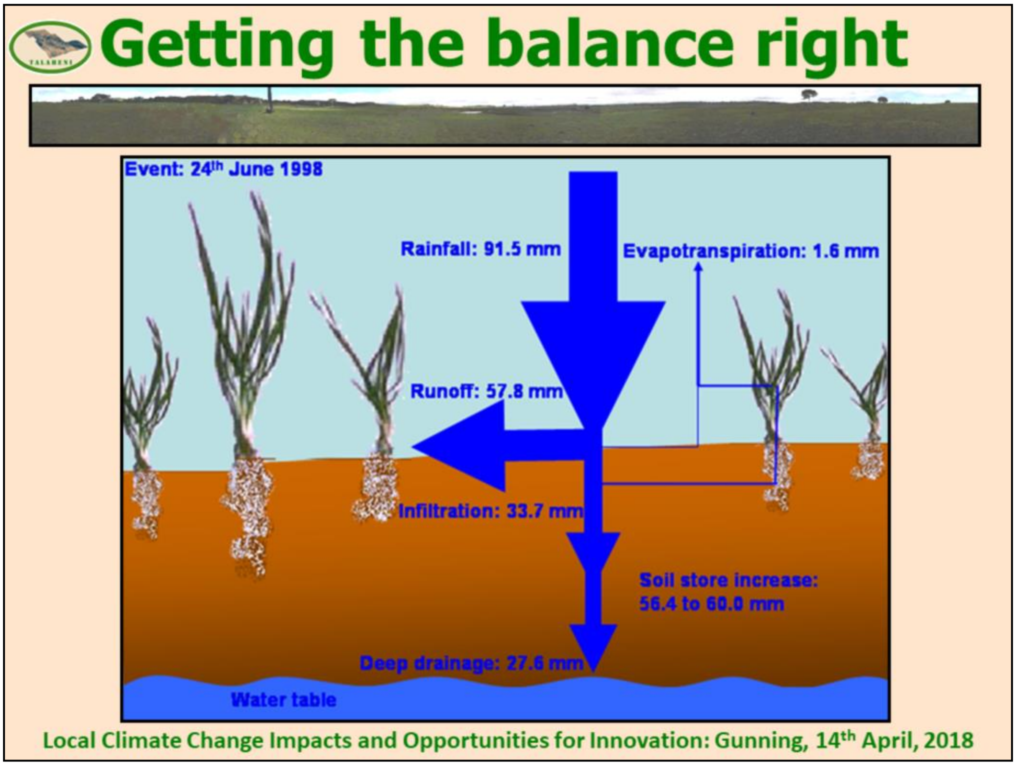


Taking the conditions we purchased and the prevailing climatic and landscape conditions we developed a rolling farm plan which included twelve integrated steps with the purpose of addressing the environmental challenges we faced to achieve our production objectives.

In implementing the plan we have monitored a range of elements to keep track of how we were travelling.

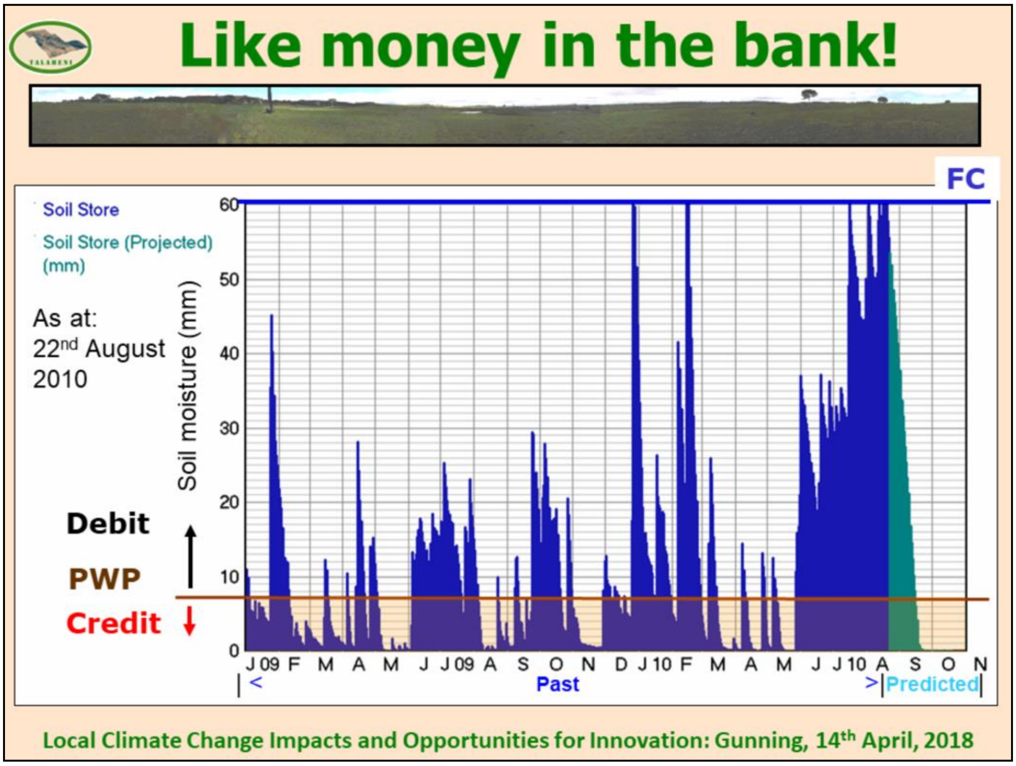


To do this, one has to be committed and a *bit different* from the norm I suspect, to keep the records necessary to enable a comprehensive understanding and reporting of progress. In fact, if you do not monitor you cannot manage.



Soil moisture management is our greatest challenge, whether it is too little (all too common, euphemistically called drought) or too much (although rare, a significant contributor to high recharge and consequently dryland salinity). A daily soil water balance model(WaterBank) has been developed to assist with soil moisture management.

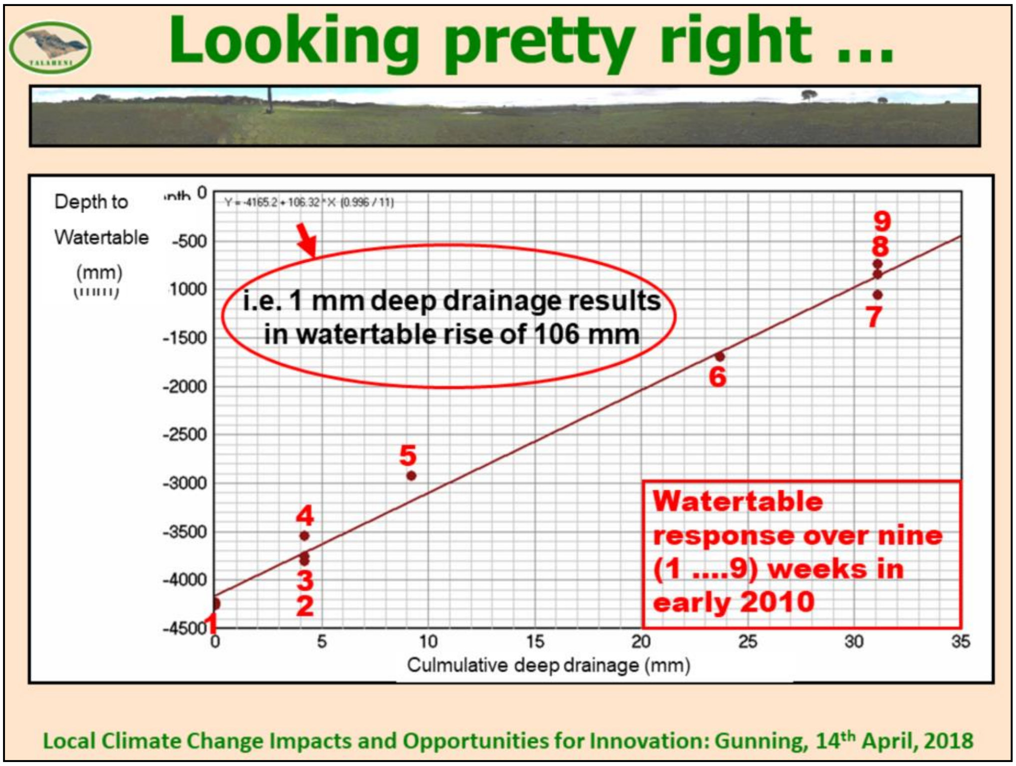
The graphic provides an indicative example of the partitioning of a rainfall event- an example from times when it rained. The model does this partitioning routinely using rainfall and evaporation data and models current conditions and predicts soil moisture into the future.



Just for the record this was the situation to 22nd August 2010, with the potential for the season receiving a setback by poor follow-up rain in the critical autumn period (March, April and May).

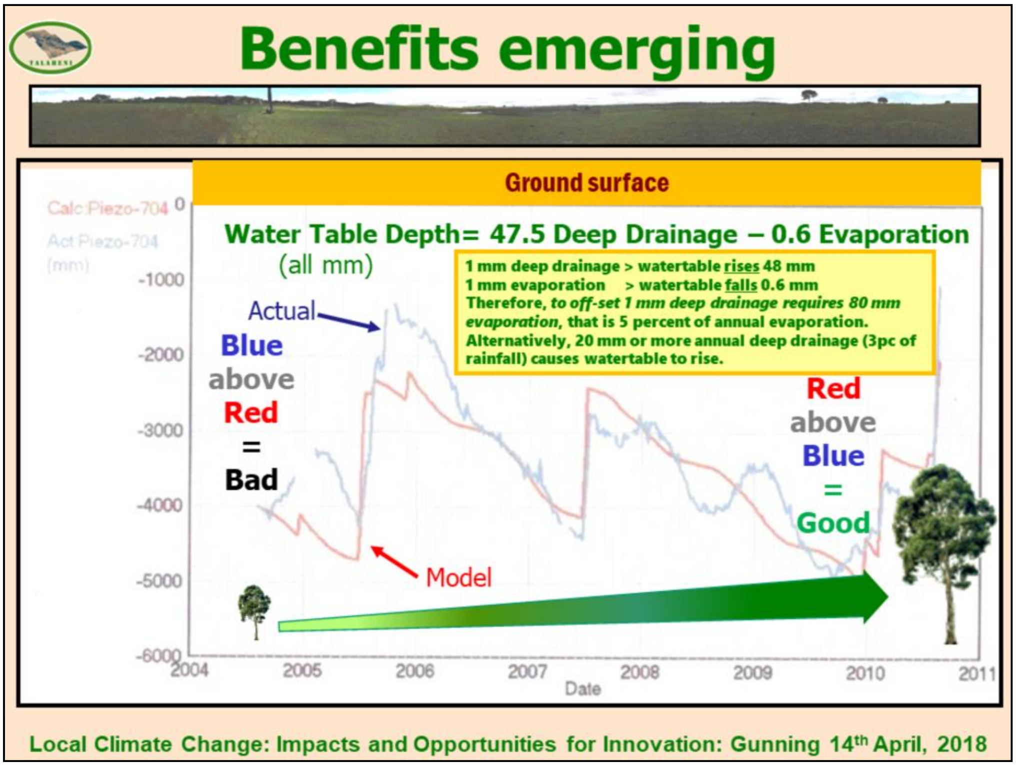
The graph also highlights the episodic nature of soil moisture variation over the past two years with many false starts at critical times.

However soil moisture conditions are not uniform across Talaheni.

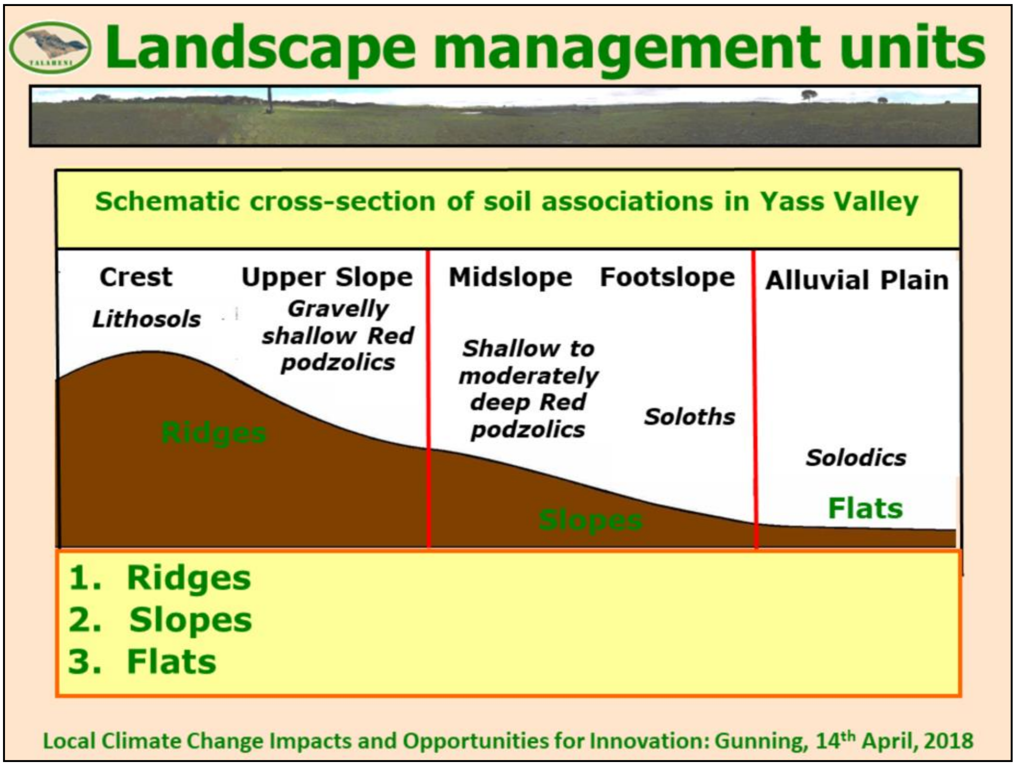


In early 2010 we had our first serious period of deep drainage events since the development of WaterBank (our daily soil moisture model)- and the first opportunity to evaluate the relationship between deep drainage calculated by WaterBank and the water table response on the flats. Given that deep drainage had always been the unmeasured component of the water balance equation it was reassuring to get such a good fit between deep drainage and water table response.

The response suggests that the depth to water table is a function of local events and that there is little time between rainfall events and water table response. The relationship suggests that for each mm of deep drainage the water table on the flats rises just over 100 mm.

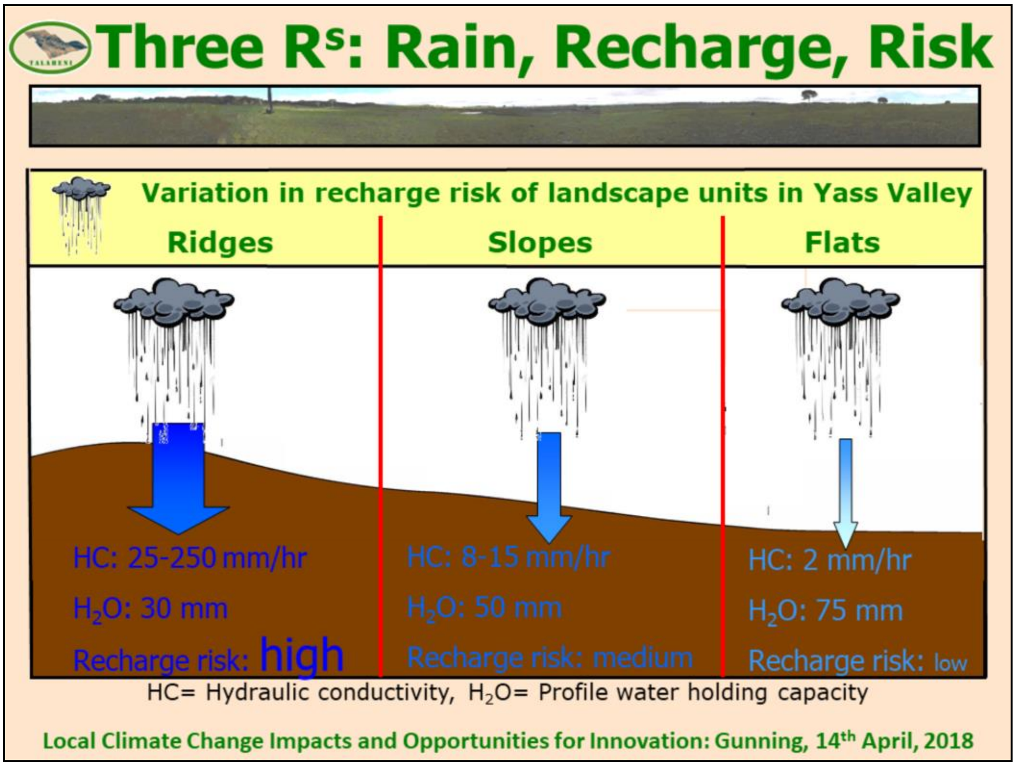


Delving a little deeper, a further model has been developed to reflect water table change over time. The inputs: *deep drainage* leads to a rise in water table, alternatively *evaporation* leads to a fall in the water table. In the early days the model consistently predicted lower water table than measurements indicated; as time went on the situation reversed. This change is due to the effects of the growing trees established on the high recharge areas reducing deep drainage with the consequence that water table is now have the opportunity to decline more.



Looking at the impact of climate change we need to look at the implications of landscape variation across Talaheni. A stylised cross-section of our landscape shows the variation in soil types as one progresses from the upper ridges to the flats, this was in part the stimulus to re-fence to soil and landscape characteristics.

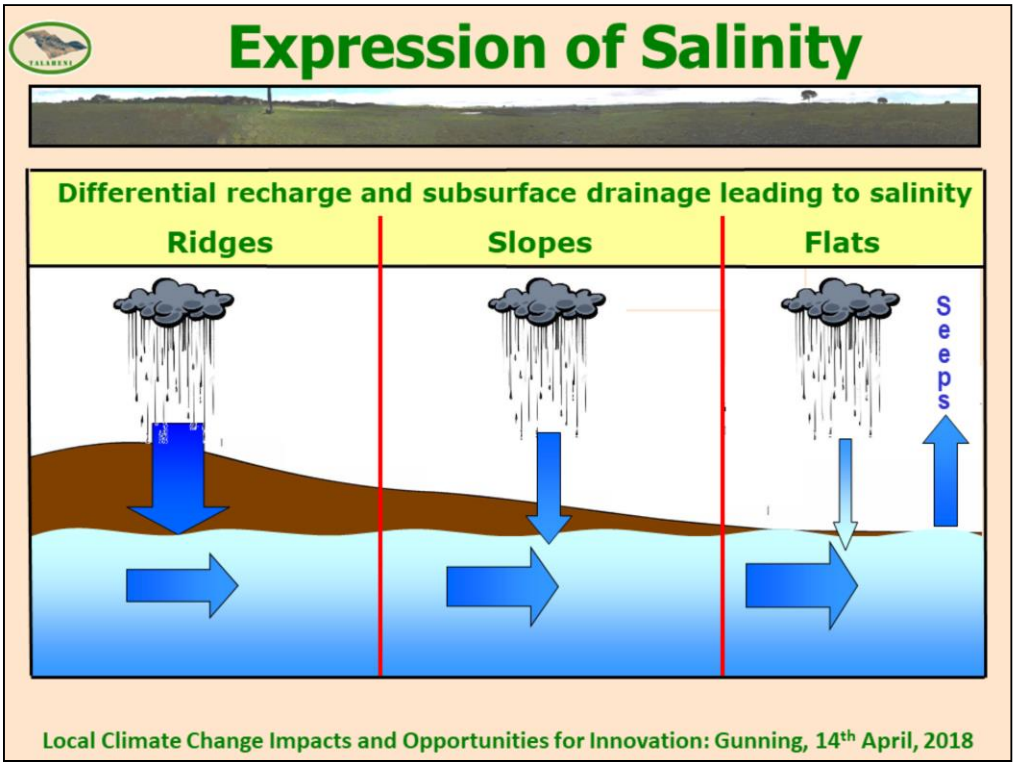
These landscape units have different hydrological characteristics.



Ridges: <u>high</u> *hydraulic conductivity* or infiltration, <u>low</u> *soil moisture holding capacity* in profile and therefore <u>high</u> *recharge risk*.

Slopes: <u>medium</u> *hydraulic conductivity* or infiltration, <u>medium</u> *soil moisture holding capacity* in profile and therefore <u>medium</u> *recharge risk*.

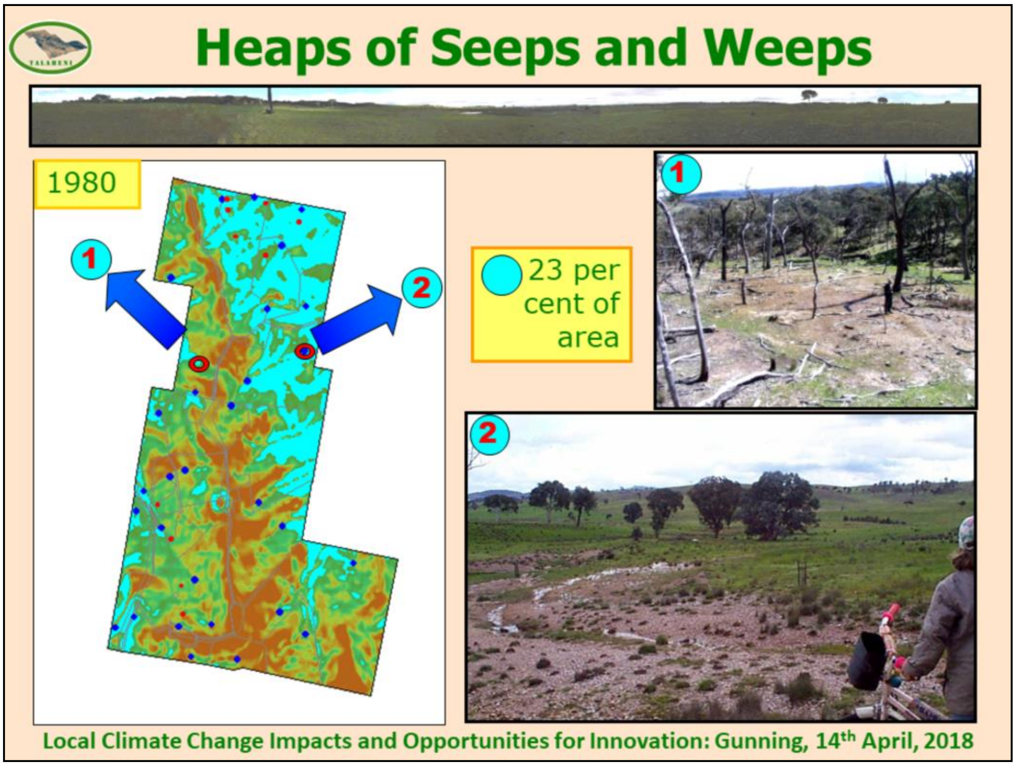
Flats: <u>low</u> *hydraulic conductivity* or infiltration, <u>high</u> *soil moisture holding capacity* in profile and therefore <u>low</u> *recharge risk*.



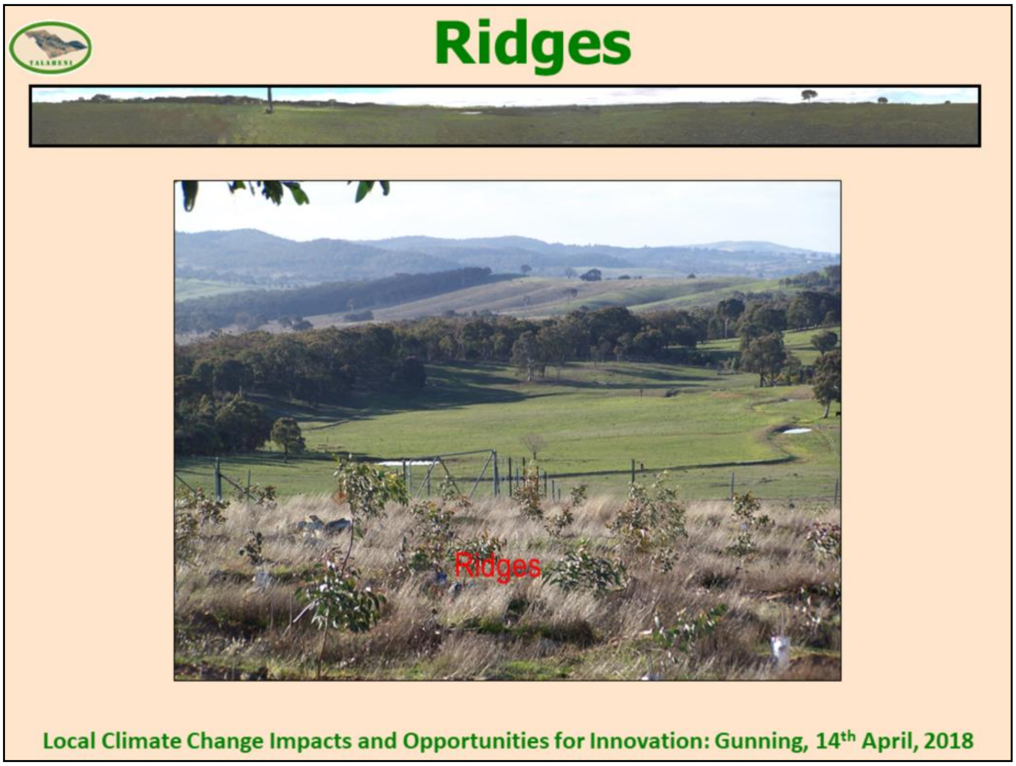
These differences and the interactions between the landscape units leads to the expression of dryland salinity.

With the hydraulic head produced from high recharge on the ridges, sub-surface movement of water downhill causes water tables to rise with consequential expression of salinity on the flats.

The presentation will focus upon the three landscape management units identified, while recognising that there are strong interactions between the three landscape units.

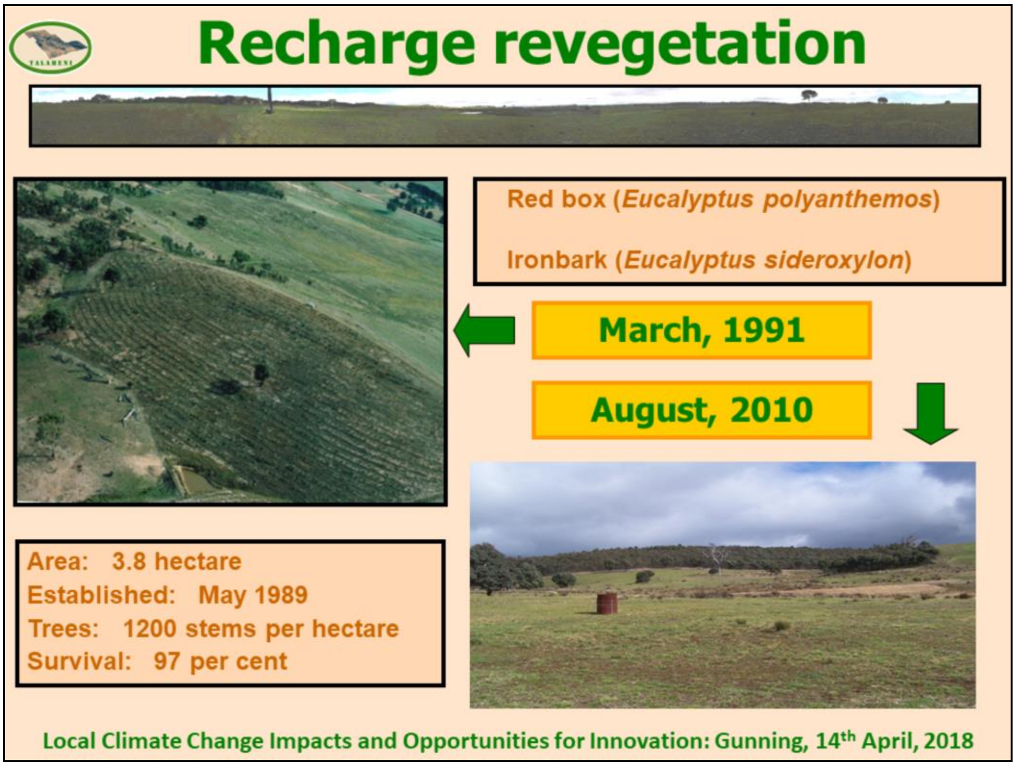


In 1980, twenty-three percent of Talaheni was affected by saline seeps, some for all intent and purpose, were permanent, others ephemeral but nevertheless with detrimental effects.



Firstly the ridges.

The ridges have skeletal soils (with high infiltration rates up to 3000 mm per hour and risk of deep drainage) which are incapable of supporting the vigorous perennial pastures required to avoid deep drainage. Therefore we have chosen to re-tree the ridges.



For areas lacking seed trees, we have had to resort to planting tube stock.

This ridge top was previously near treeless, hosting a capeweed and barley grass covered sheep camp with panoramic views for more than 5 km in all directions. The lower slopes and flats were water-logged, salinity affected, eroding and production declining.

This area was planted to trees in 1989 at about 1200 stems per ha. Red box and Ironbark were used with over 97 per cent survival rate.

Regeneration

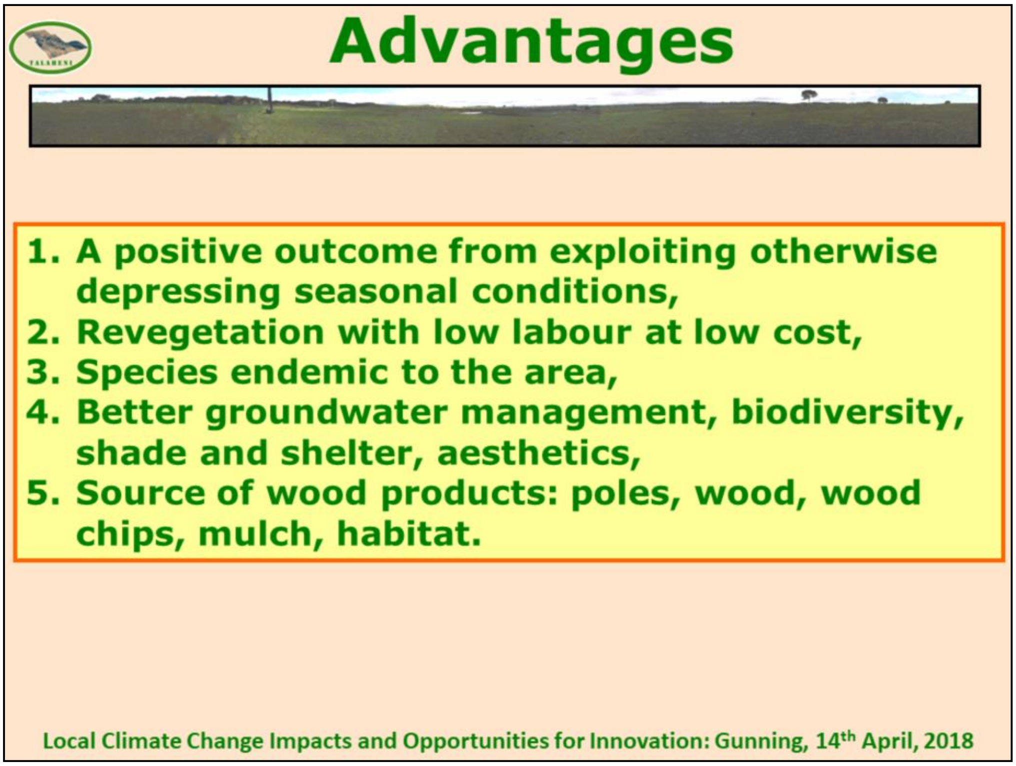
From:

To:

- **Drought conditions imminent- *El nino* predicted**
- **Reduce stock numbers to core breeding stock**
- **Move remaining stock to ridge-top paddocks**
- **Feed stock and protect quality pastures on flats**
- **Keep feeding stock …**
- **Drought breaking rains- *La nina,* hooray ….**
- **Move stock to flats when pastures recovered**
- **Spell ridge-top paddocks to allow regeneration**
- **Pulse graze as and if required until trees established**
- **Manage as required recognising: a) species b) density c) location d) objectives**

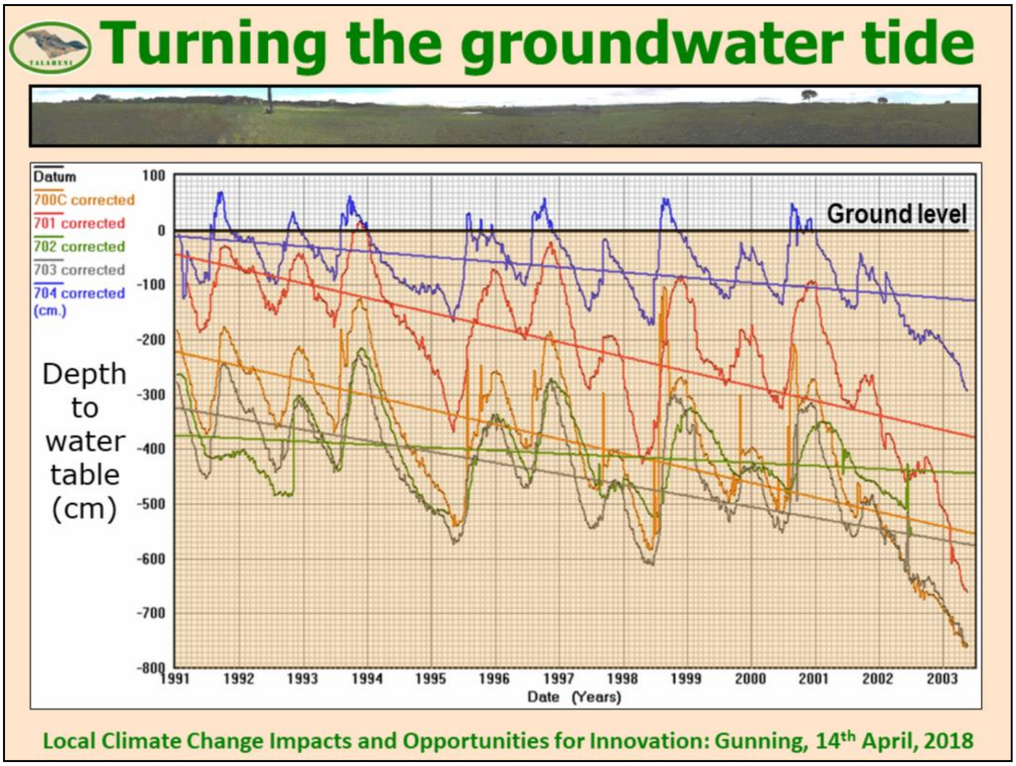
Local Climate Change Impacts and Opportunities for Innovation: Gunning, 14th April, 2018

Where seed-trees remain, natural regeneration has been actively induced by exploiting the contrasting conditions of *El nino* and *La Nina* cycles. This has resulted in establishment of an estimated 200 000 trees by substituting a bit of timely innovatory thought for significant effort and resources or simply brains for brawn.



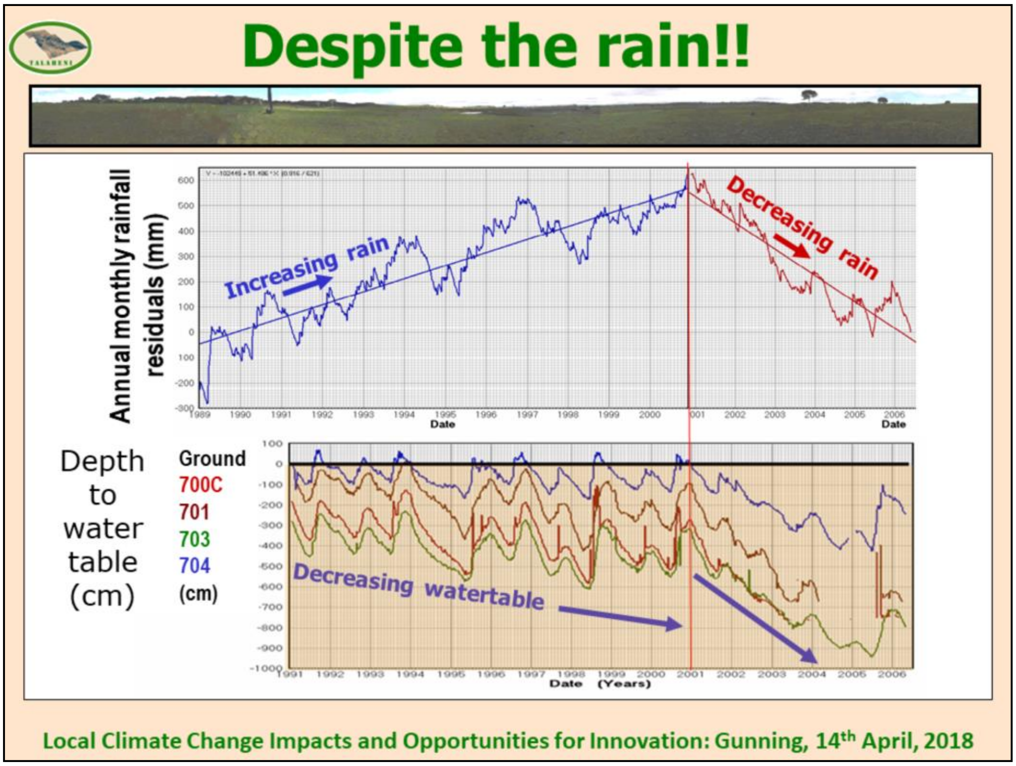
This approach has a number of advantages, not least of which is being able to turn adversity into a benefit, namely drought into a significant re-treeing event involving very little physical effort or resources.

I hasten to add that I would however prefer to do without the droughts in the first place!

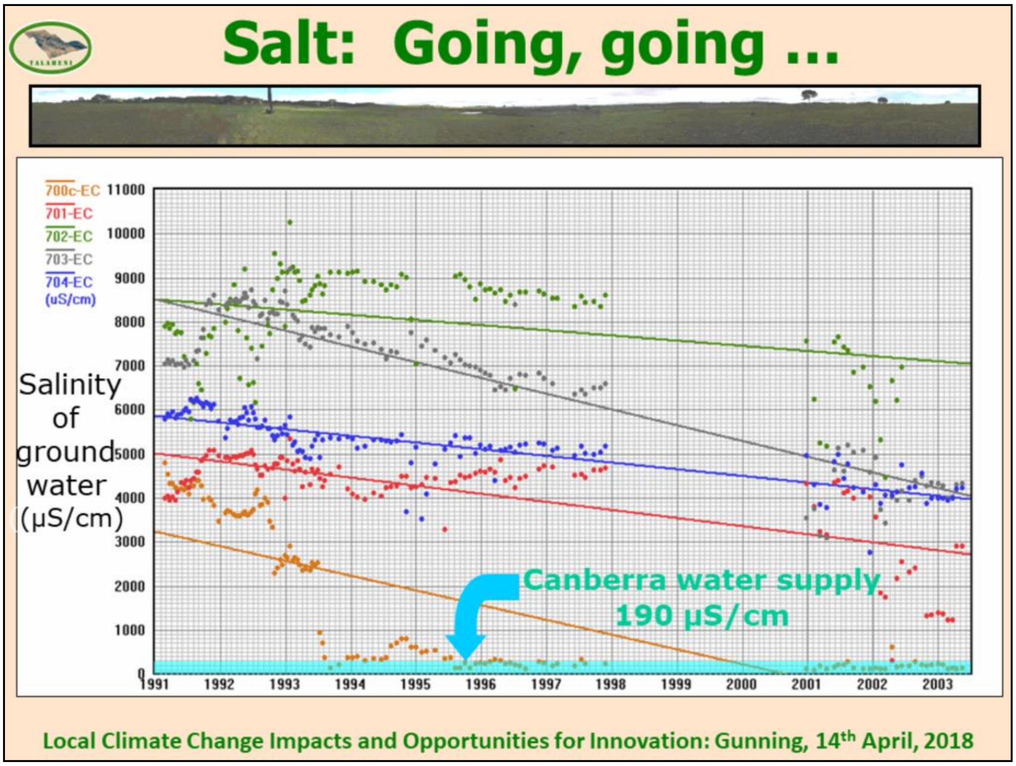


Since tree establishment, the water tables have gradually declined at varying rates depending upon distance from the ridge top. It took 5-years (1994) before there were signs that the decline was anymore than just the seasonal cycle. Erosion has stopped, pastures are reinvigorated, animal production is increasing and the trees continue to grow.

But is this just reflecting drier conditions?

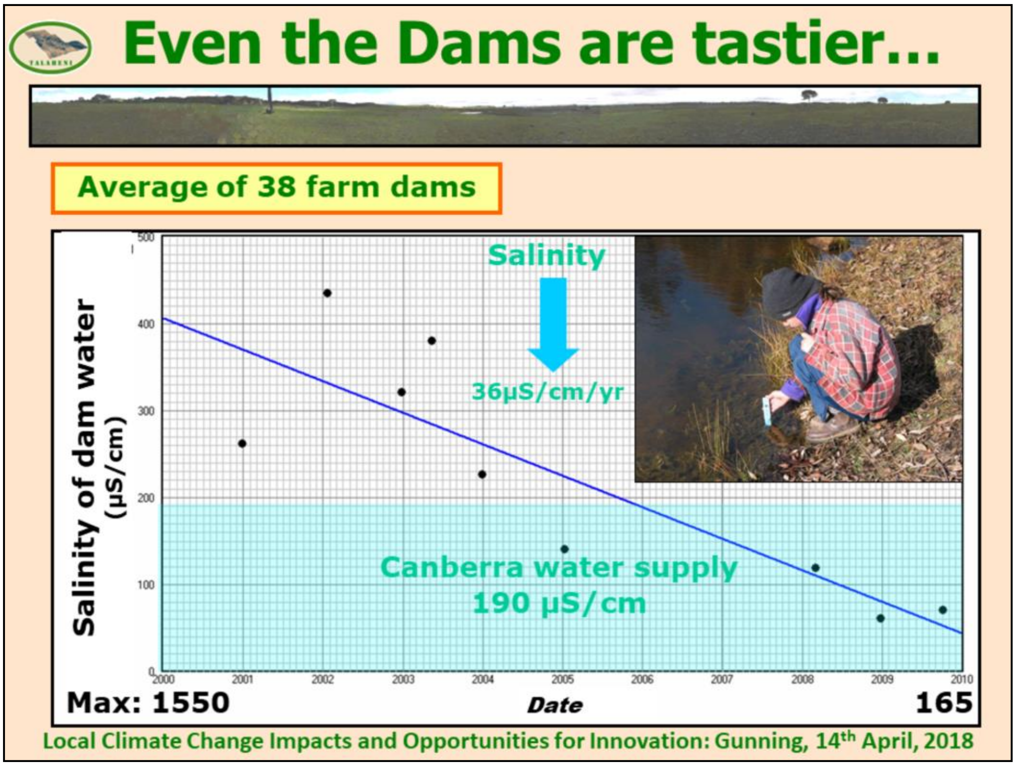


The persistent decline in groundwater levels as measured by the network of piezometers, commenced and continued under a period of largely above average rainfall conditions up to the end of 2000. The following prolonged dry period saw- not surprisingly- accelerated the rate of decline in the groundwater levels- an acceleration that we could have done without.



Not only have the water tables declined, but the quality of the groundwater has improved markedly, in one case it is already better than Canberra's water supply, with other sites showing similar trends. Canberra's drinking water is currently around 200 EC units.

We have gone from a situation where groundwater was a liability (too high, too saline), to it now being an asset. Pretty valuable asset given that for most of the year, available water of suitable quality limits production.



What does this mean for surface dam water supplies. Annual measurement of the 38 dams on Talaheni have shown a steady decline in the salinity levels of the dams. Although individual dams vary, the average salinity level is now lower than Canberra's drinking water- and I suspect somewhat lower than Yass's. Along with a decline in average salinity level the maximum salinity levels have shown the greatest decline.

Rainfall partitioning

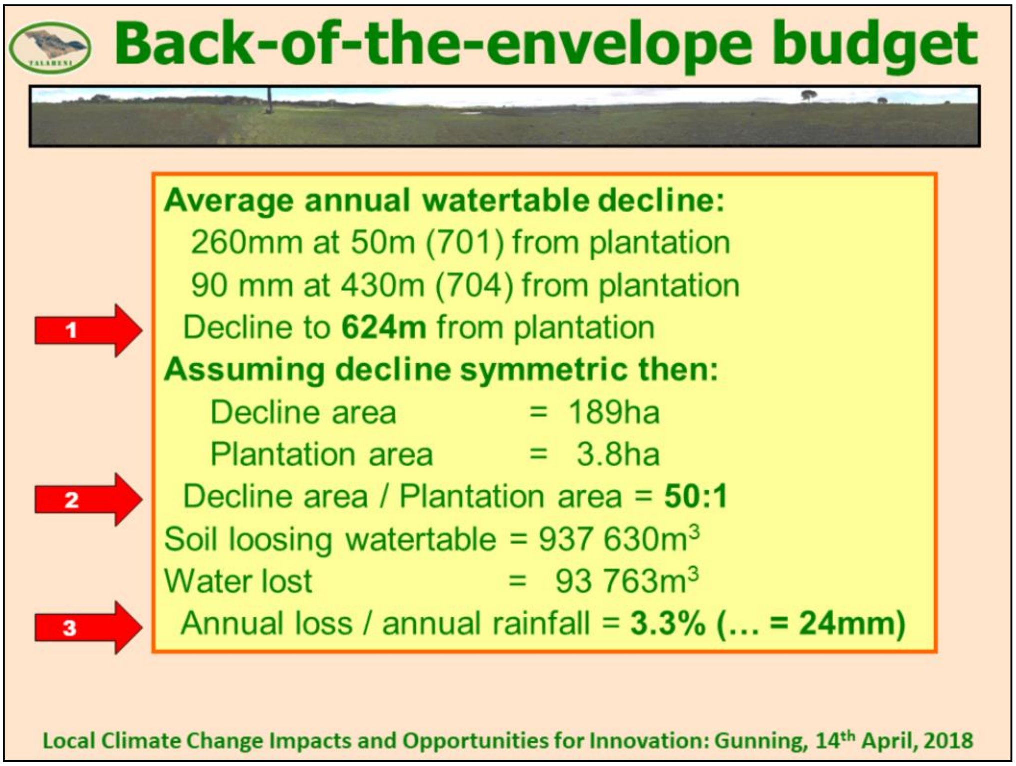
Component (mm)	Tree	Pasture
Rain	414	414
Interception	50	5
Runoff	3	30
Infiltration	361	379
Evaporation	184	184
Transpiration	394	257
Deep drainage	0	7
Total water use	631	414

Local Climate Change Impacts and Opportunities for Innovation: Gunning, 14th April, 2018

What does this mean in terms of partitioning of rainfall between the different components of the water balance equation?

Taking the twelve months to June 2003, the trees transpired an amazing 95 per cent of the rainfall; after allowing for interception, runoff and evaporation, the total water use by the trees was 631 mm or 217 mm more than rainfall received indicating the trees were using the historical groundwater resource- the catalyst for dryland salinity on the flats. This is consistent with the accelerated lowering of the water table measured by the piezometer network.

If the original poor native pasture had been retained on the area, not only would groundwater not have been accessed, but, even in a year of below average rainfall, another 7 mm would have been added by deep drainage, exacerbating the saline water table issue. Seven mm might not sound much but such small quantities add up over time with detrimental consequences- recall that 1 mm of deep drainage results in over 100 mm rise of the water table on the flats- or in this case, nearly 750 mm rise on the flats.

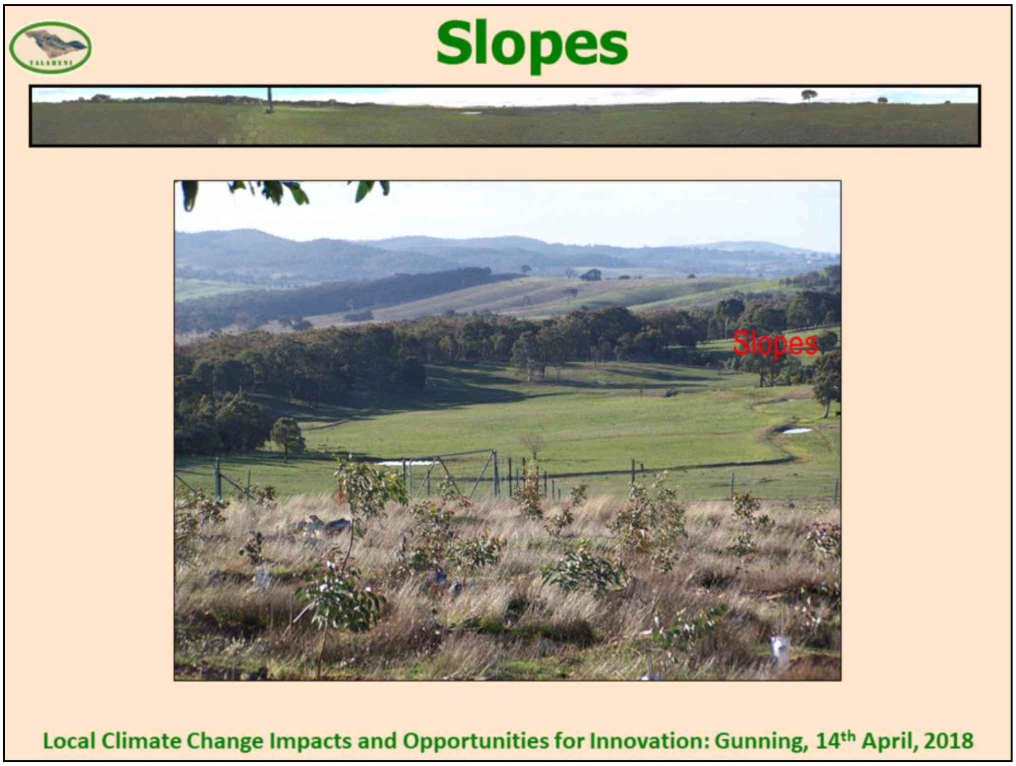


Some simple back-of-the-envelope calculations show some interesting results.

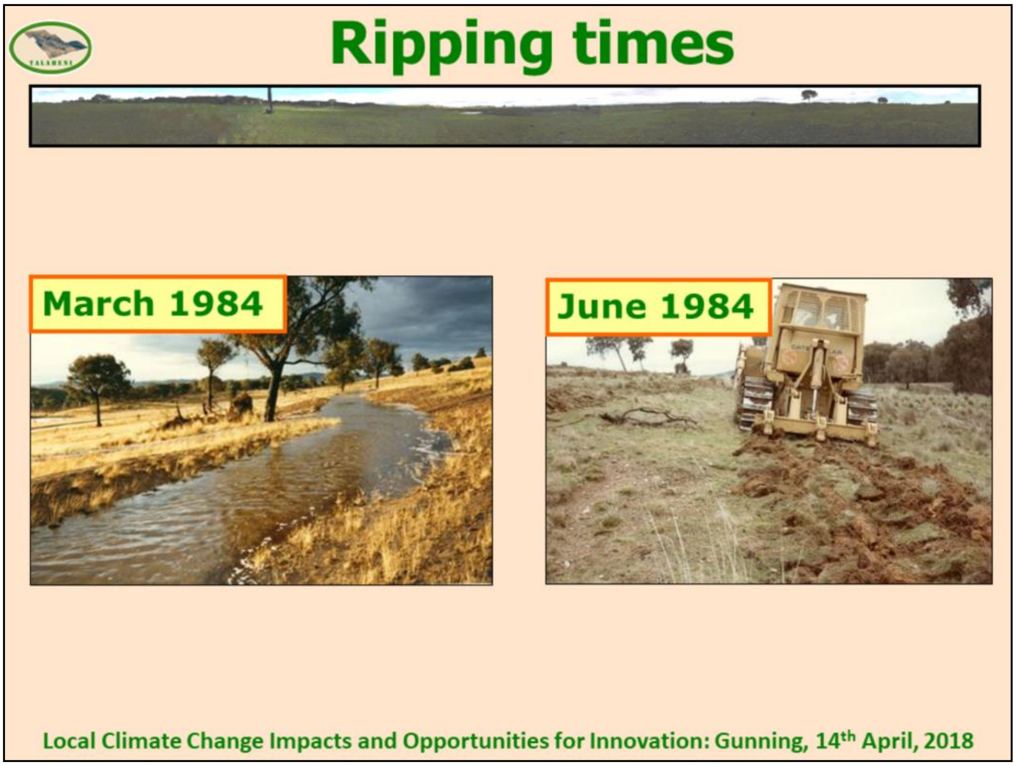
Distance of influence of the ridge top trees- over 600m across slopes and flats and still increasing.

The ratio of trees to responding pastured area- pretty good payback when treed area was no big sacrifice in terms of foregone production. I do not think even the sheep have really missed their elevated camp site.

The trees have had to use only a relatively small additional amount of the rainfall to that used by the previous vegetation to kick start the recovery (c.f. 7 mm deep drainage under pasture even with below average rainfall of 414 mm, zero for trees).

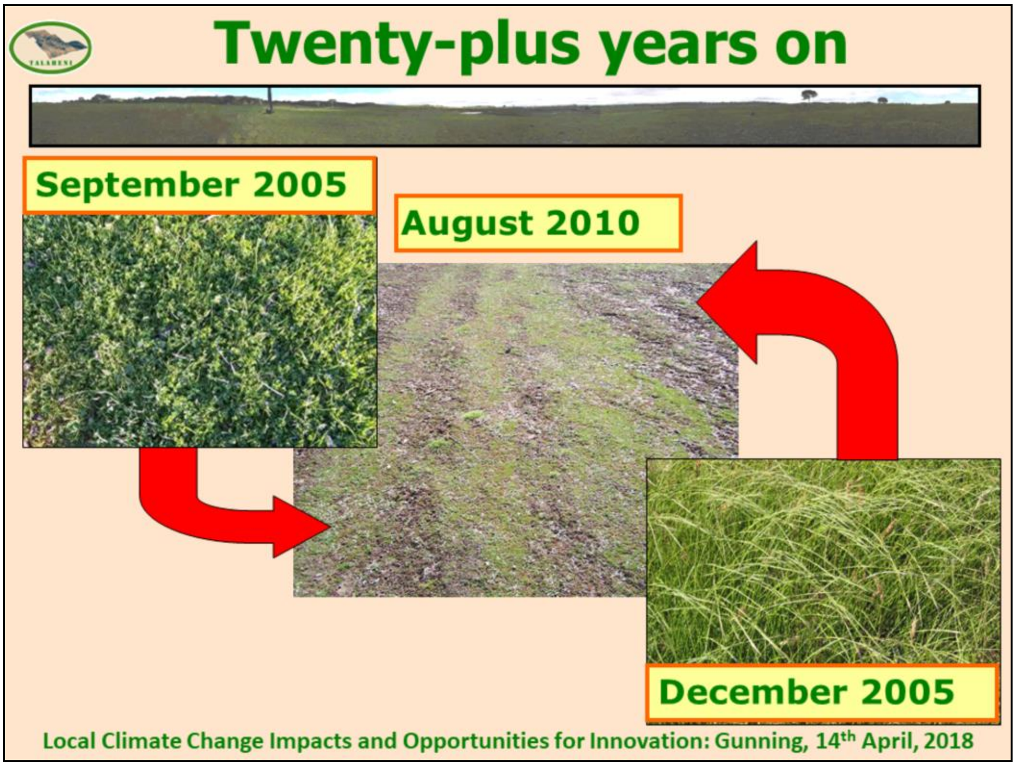


With the ridges now under control, we turned attention to management of the slopes.



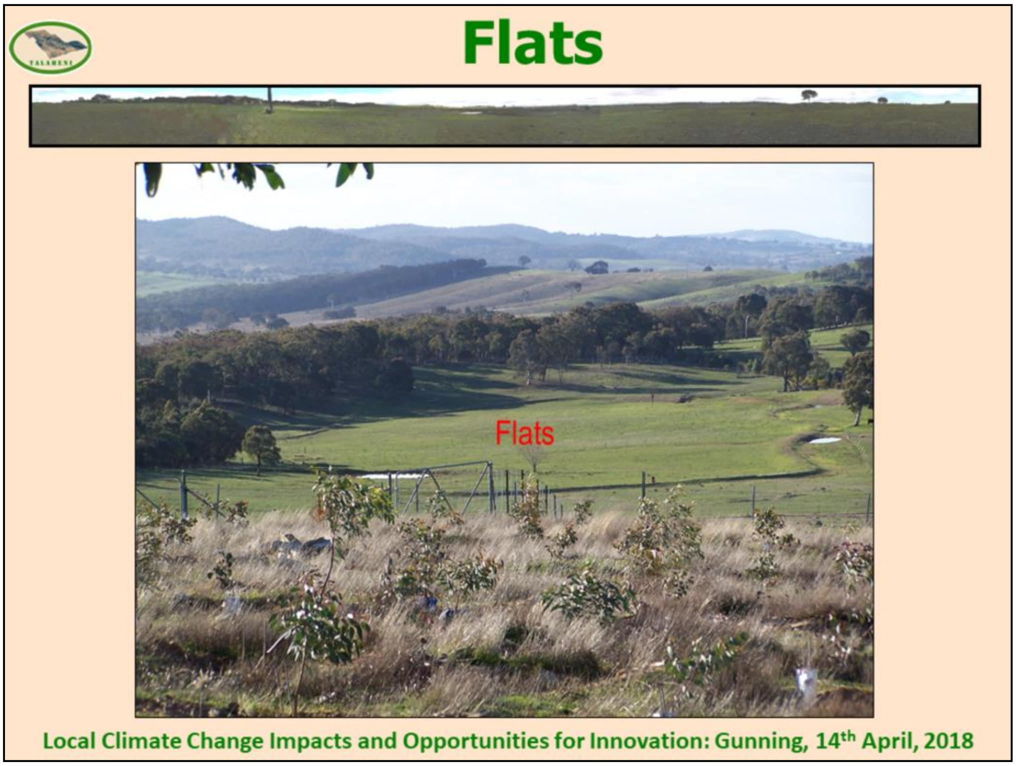
In contrast to the ridges, the slopes have high runoff rates from rainfall events even under good ground cover. With runoff representing a loss of potential pasture production, the challenge is to keep and use rainfall where it falls.

To assist this, slopes were ripped to depth to increase infiltration. This was only undertaken where treed vegetation upslope (limits deep drainage) and down slope (uses deep drainage) protected the area and its surrounds.



The legacy of ripping remains more than 20 years on. The slopes carry good pasture bulk predominantly of perennial native pastures of *Austrodanthonia and Microlaena spp.* when rainfall conditions permit.

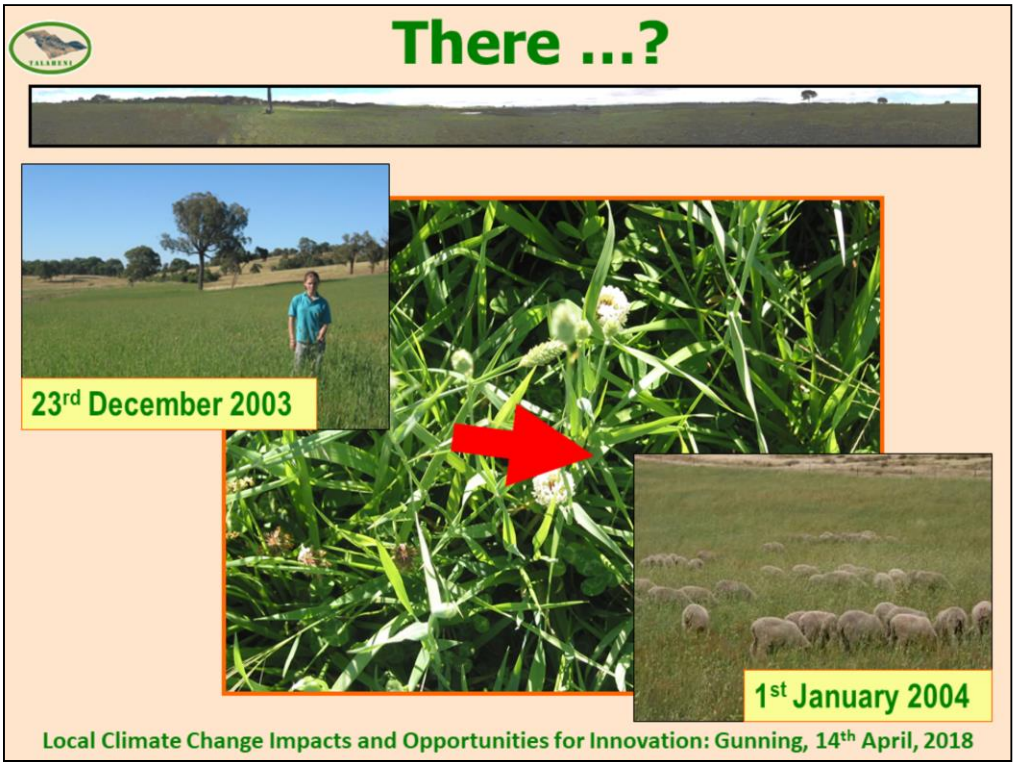
Clover tends to dominate the ripped areas and native pasture the inter-ripped areas, although the balance changes throughout the growing season.



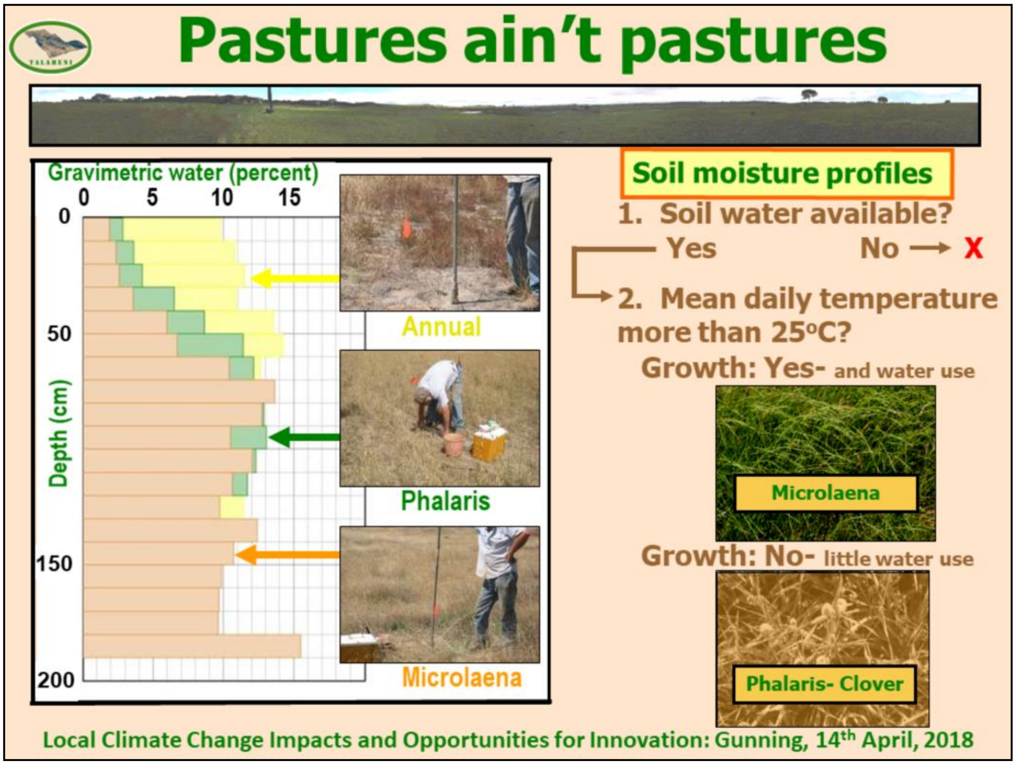
With ridges under control, slopes producing and the flats recovering as saline water tables declined, attention turned to realising the production potential of the flats.

The flats have been previously protected by a series of contour and graded banks to limit overland flow from adjoining areas.

Reclaimed areas which supported poor cover of sorrel and couch grass along with some annuals were sprayed out with glyphosate and seeded with phalaris and clovers.



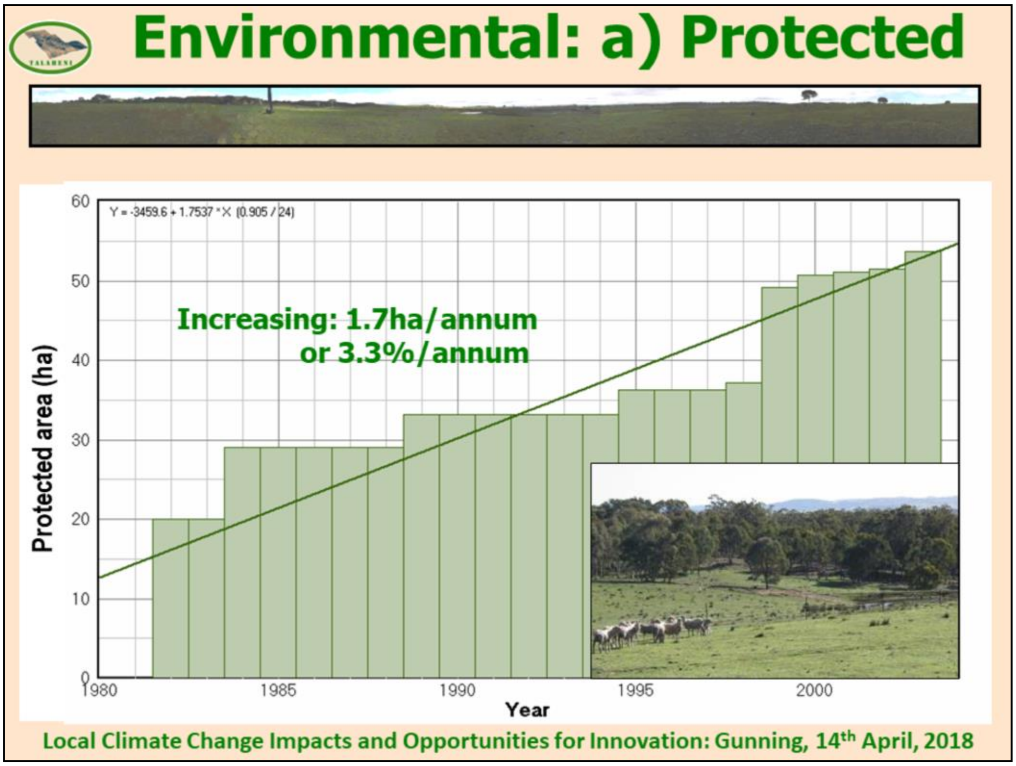
Four months later there was a good bulk of feed consisting of phalaris with a good clover sole and a dramatic increase in production potential.



Given the significance of managing soil moisture, it is important to appreciate the difference in ability of different pasture species to use available soil moisture.

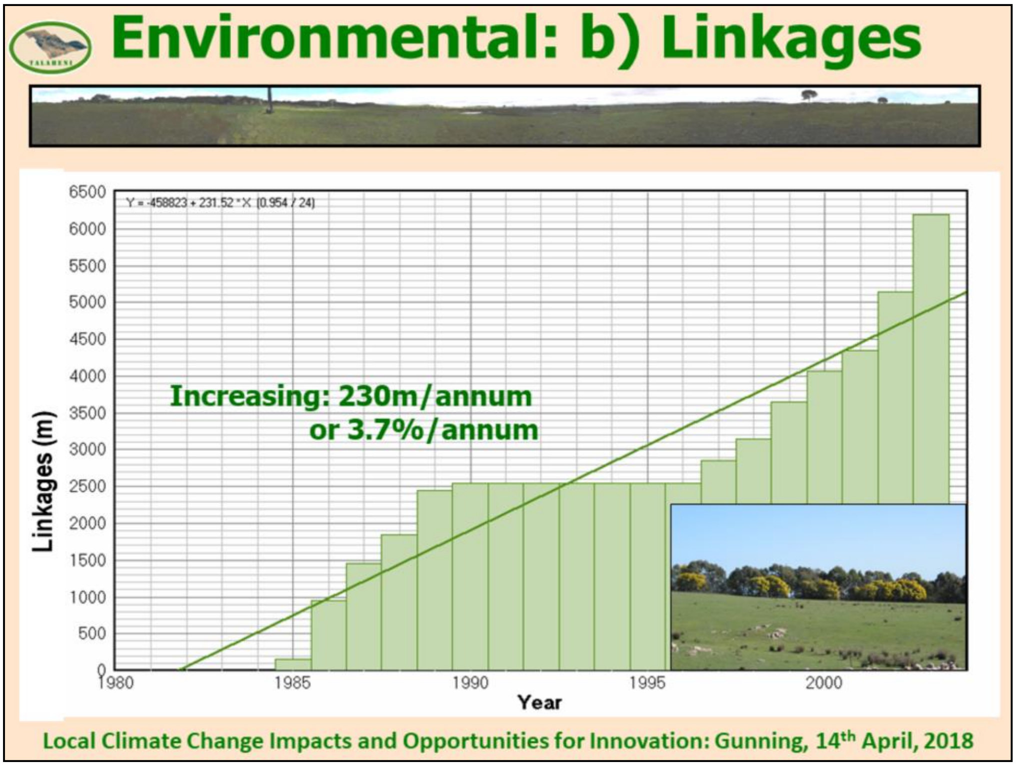
Soil samples are taken annually at the driest time of the year and indicate that native perennial pasture, *Microlaena* is at least as good if not better than Phalaris- Strawberry clover pasture in using soil moisture and drying out the profile in summer and therefore providing greater storage opportunity for winter rains when falling temperatures restrict pasture growth and further use of in-coming rainfall.

Having hayed-off early, Annual pasture is unable to utilise subsequent summer rain which risks replenishing the profile so that further rain entering the profile risks adding to deep drainage recharge.

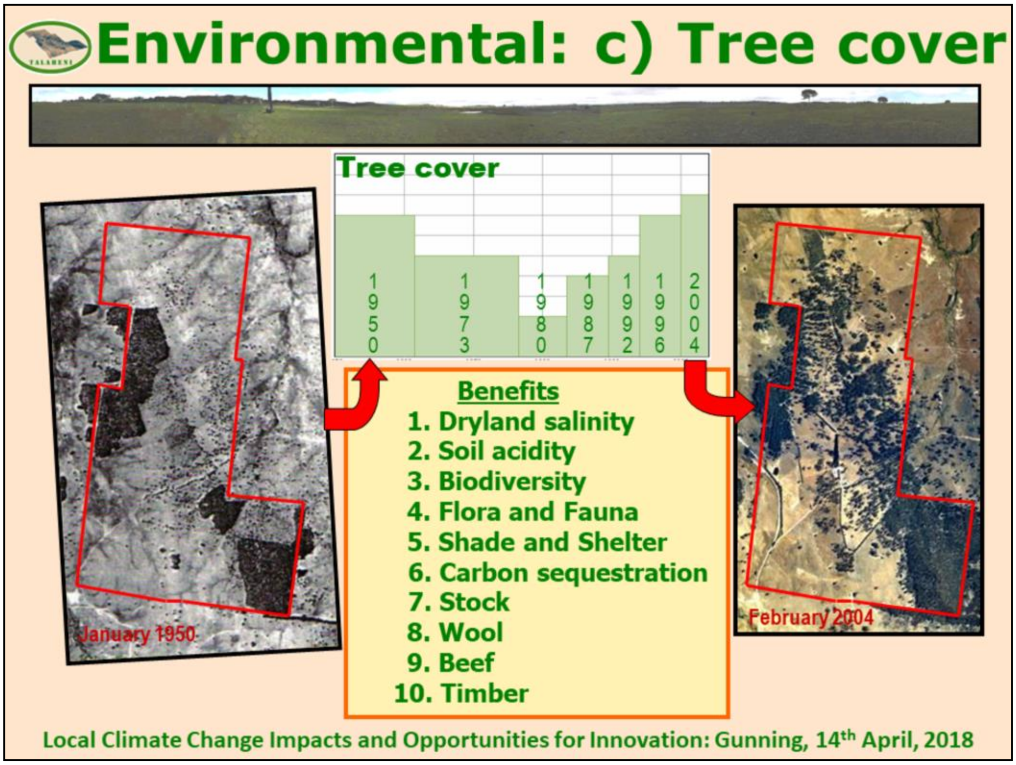


With woodlot, shelterbelt and remnant management we have over time taken a number of areas out of conventional production as we seek to reverse environmental decline.

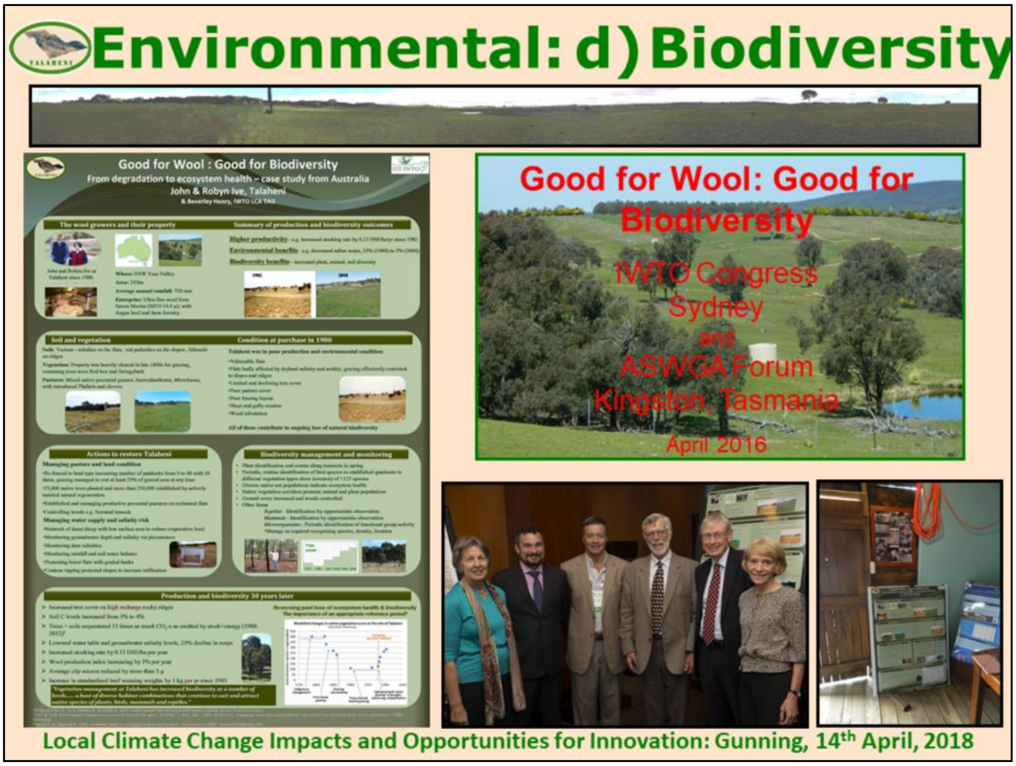
Now more than 30 per cent of Talaheni has been taken out of conventional production. However, these areas provide beneficial ecosystem services to the remaining area.



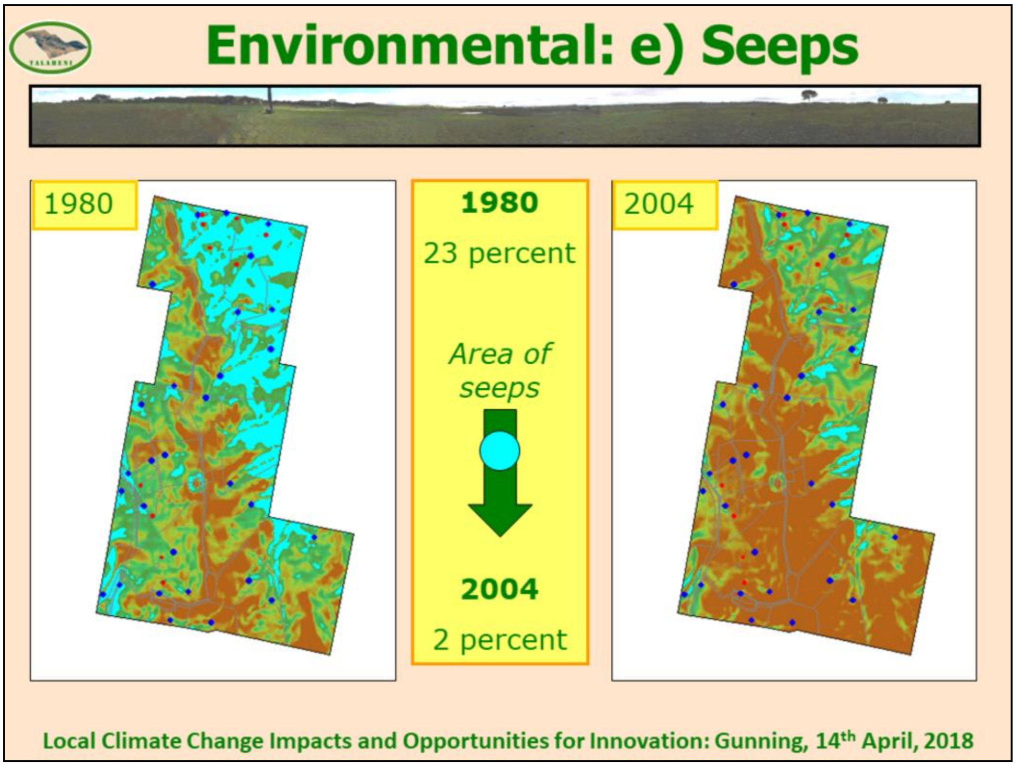
Not only has the area of protected remnants increased but the native vegetation linkage between the remnants has increased by more than 200 metres a year, providing shade and shelter for livestock, wildlife corridors and a more aesthetically appealing landscape.



Aerial photographs over more than fifty-years provide a historical log of the changing tree cover on Talaheni over time. After pre-purchase decline (due to further clearing), there has been a steady increase in tree cover particularly along the central ridge.

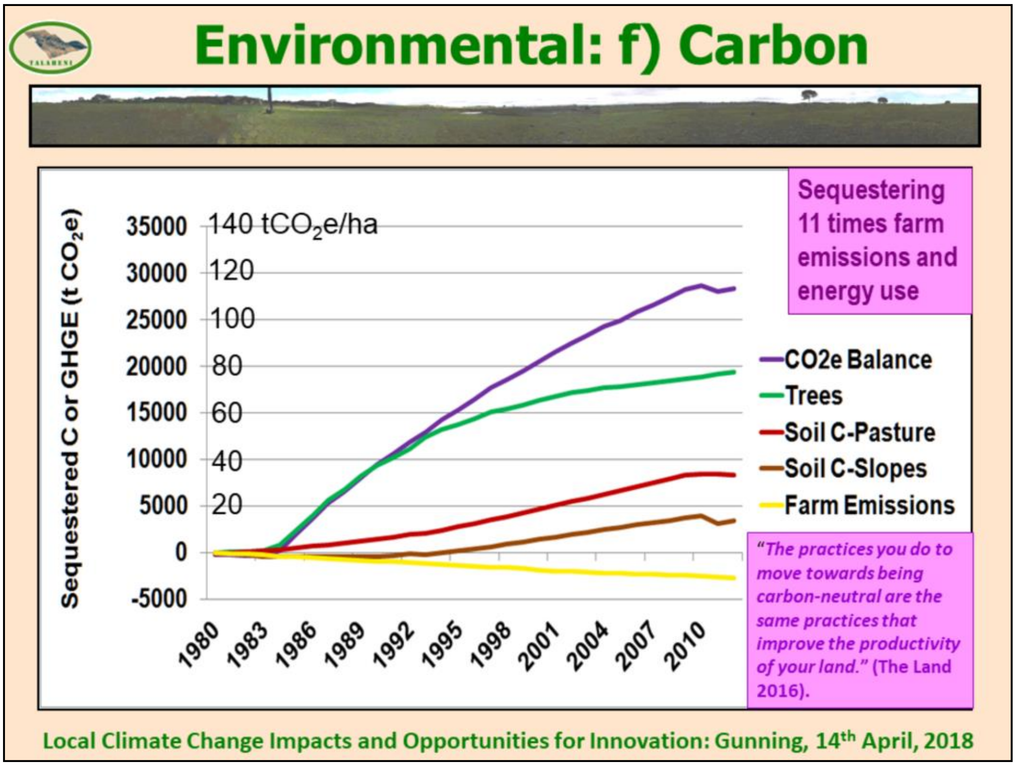


Our biodiversity achievements were recognised at International Wool Textile Organisation congress in Sydney in 2016 where the Talaheni case study highlighted the gains in biodiversity over four decades. This was quickly followed by a second exposure in Tasmania at ASWGA forum- albeit in a more subdued setting.



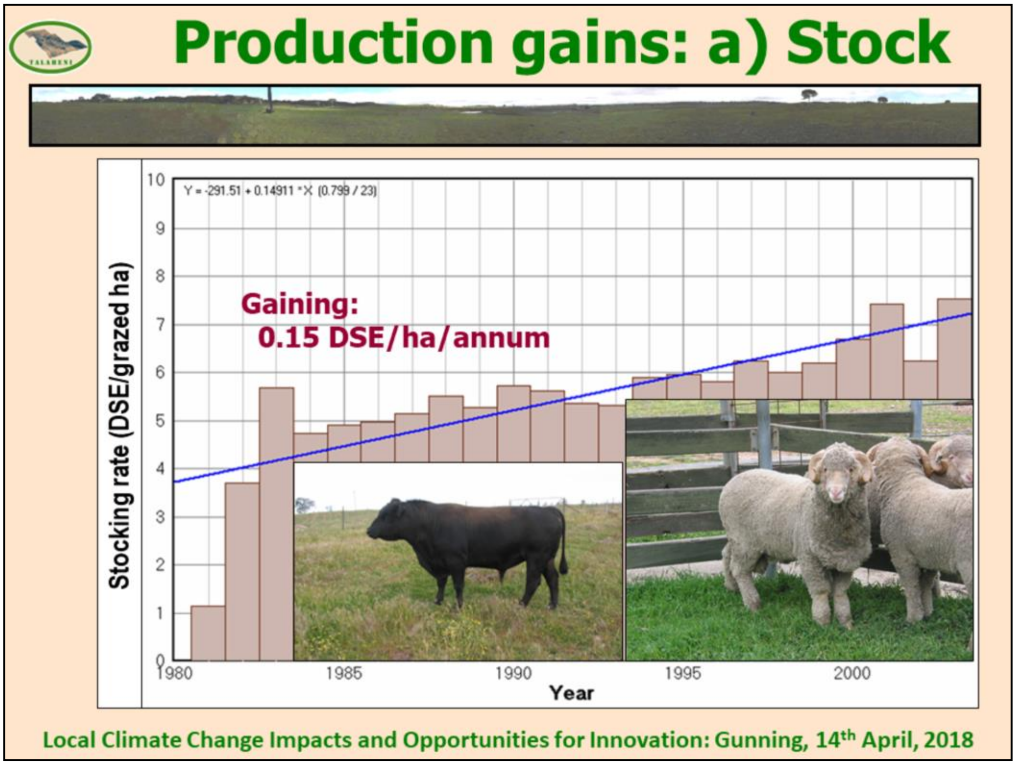
Now looking at the extent of saline seeps.

These have declined from 23 percent in 1980 to 2 percent in 2004 in keeping with the decline in the water table as recorded in piezometer readings.

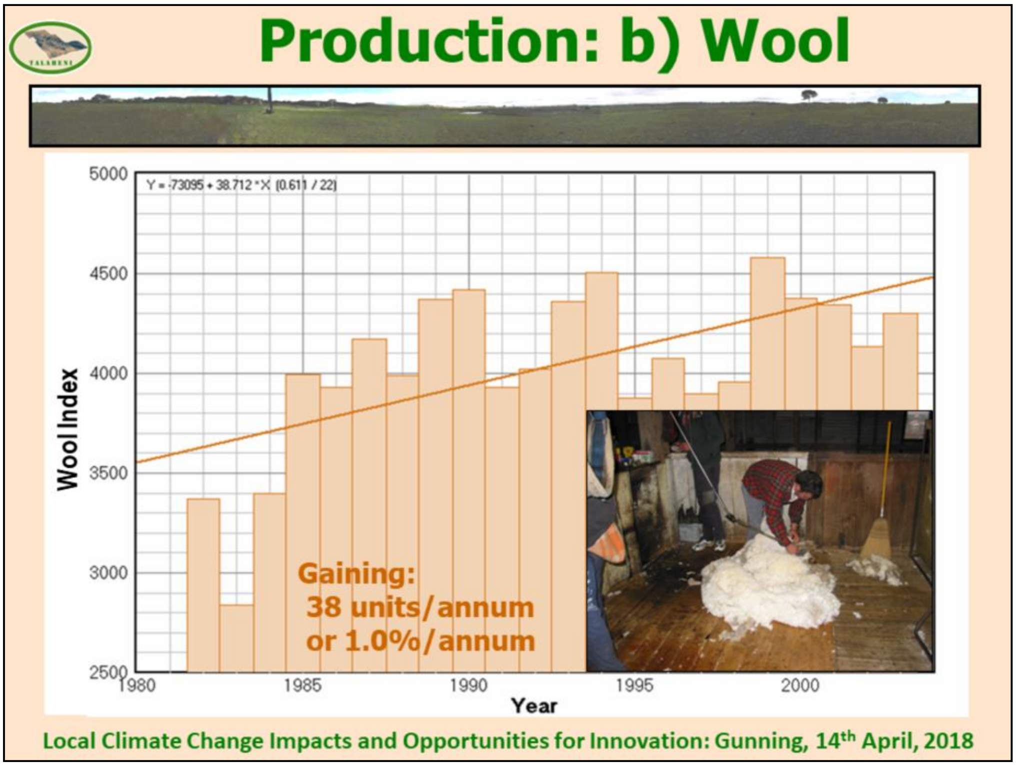


In terms of carbon sequestration, Talaheni is sequestering more than eleven times as much carbon as emitted (by animals and on and off farm energy use). Increase in soil carbon more than offsets total emissions and trees are sequestering about twice the increase in soil carbon.

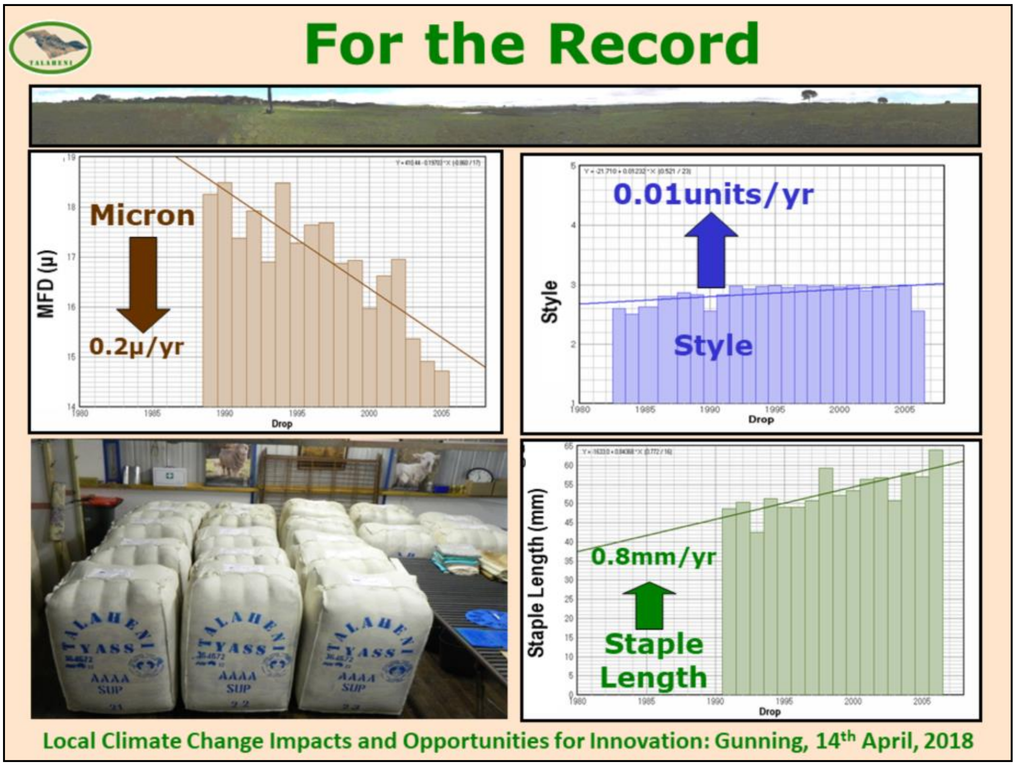
All this might may give a warm and comforting feeling but it counts for little in the real world if there are not also production gains.



Firstly, in terms of overall carrying capacity or Dry sheep equivalents, this has been gaining at about 0.15 DSE per ha per annum or an extra DSE about every seven years. Although stock reduction with continuing dry periods during the first decade of the century saw a drop in stocking rate and again more recently unfortunately.



Secondly, a combined quality and quantity index for our wool enterprise. This has been increasing at around 1 per cent per year; with average clip micron falling by more than 5 micron with limited loss of clean fleece weight.

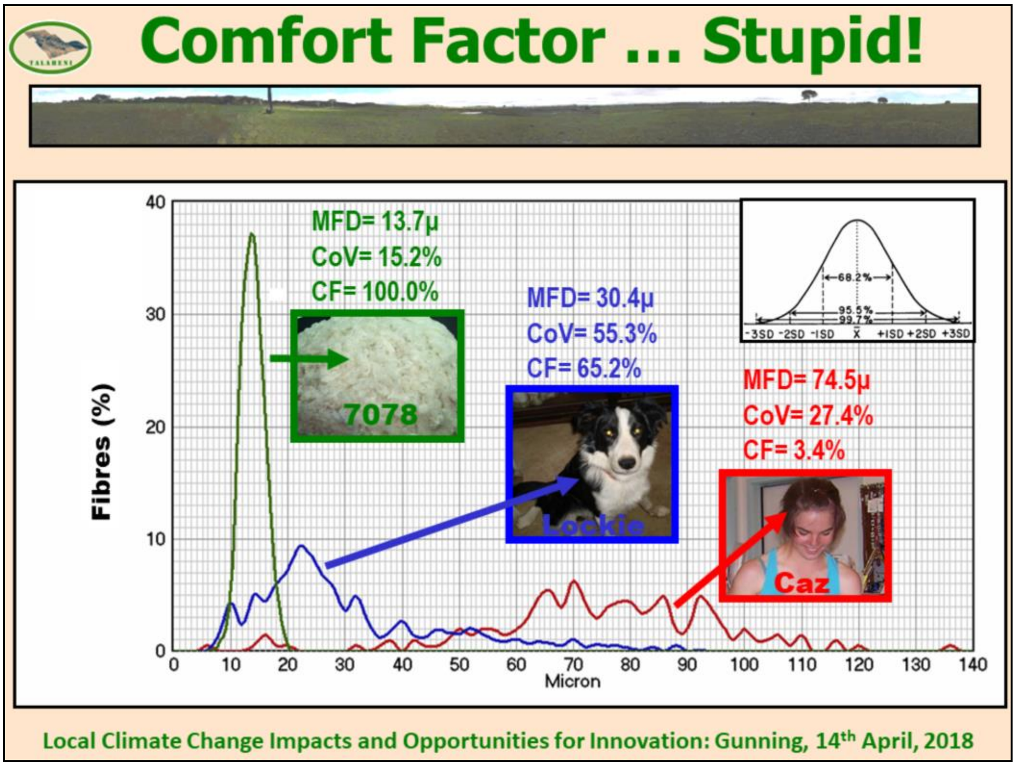


Where our clip is now positioned, has been the result of nearly forty years effort of commitment to improvement. Since the introduction of mid-side sampling the evidence is one of continual lowering of micron and increase in staple length. In addition, visually assessed 'style' has improved. Nevertheless, still more to do.

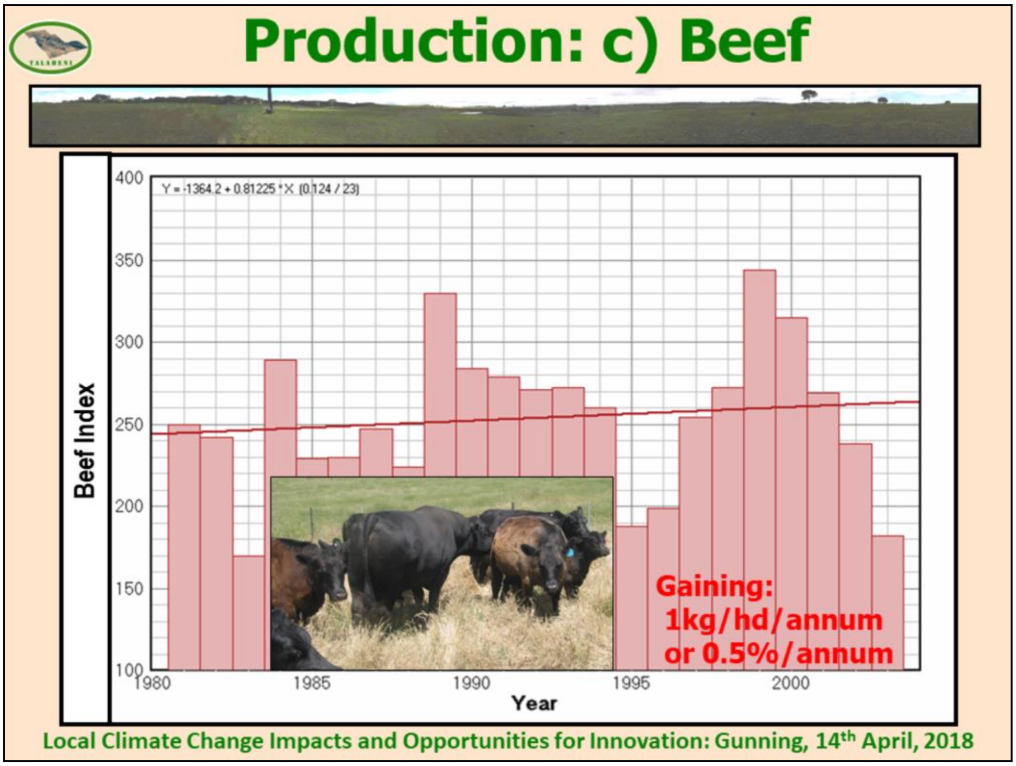
Our sheep have been recognised of the highest quality by the Highlander Group on the competitive international stage.

As an indication of the commercial value of our flock, we achieved the highest valued paddock-grown commercial ewe or wether fleece in the Australian Sheep & Wool Show in 2010 for a 13.7 micron fleece from a two-tooth lamb-raising ewe sired by Rock-Bank ram. And this was at a time when there was very little price premium for quality fine wools with Italians buyers effectively inactive.

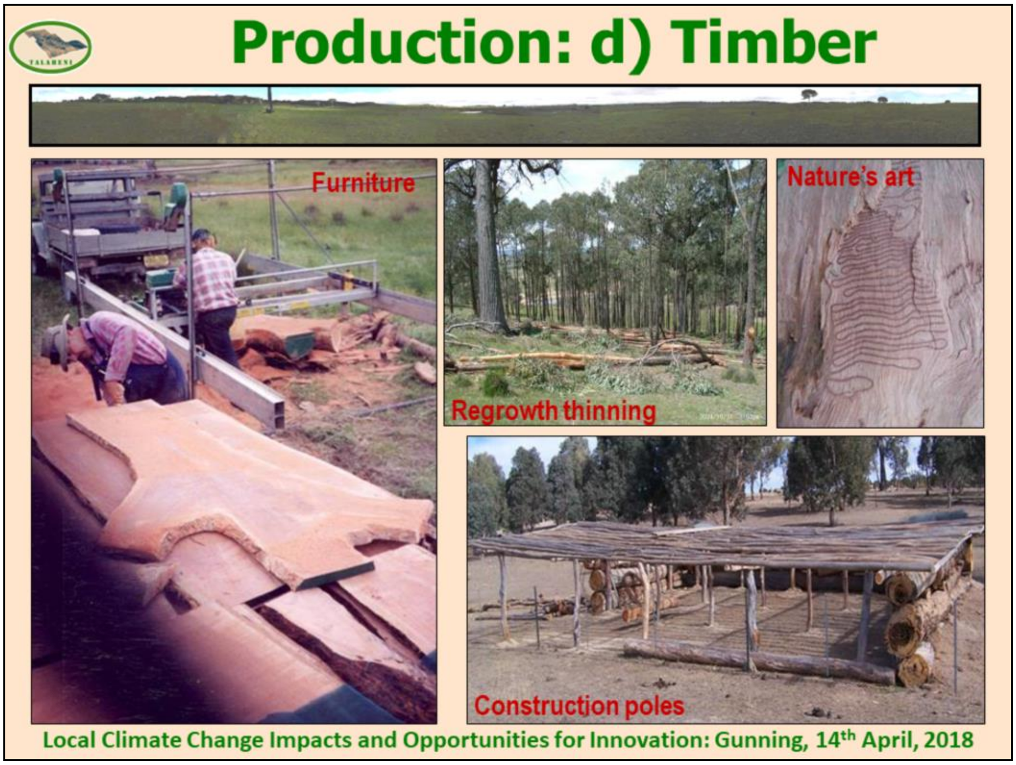
More recently, last year we won the ultrafine fleece competition at National Merino Sheep Show in Dubbo, as the only commercial entry we beat all the stud entries.



Although a bit of a self indulgence, this gives an indication of the quality of our wool, we compare the uniformity in fibre diameter profile of ewe (Australian Sheep & Wool Show winner 2010), with the fibre profile of our sheep dog and daughter. The contrast in fibre uniformity is extreme.



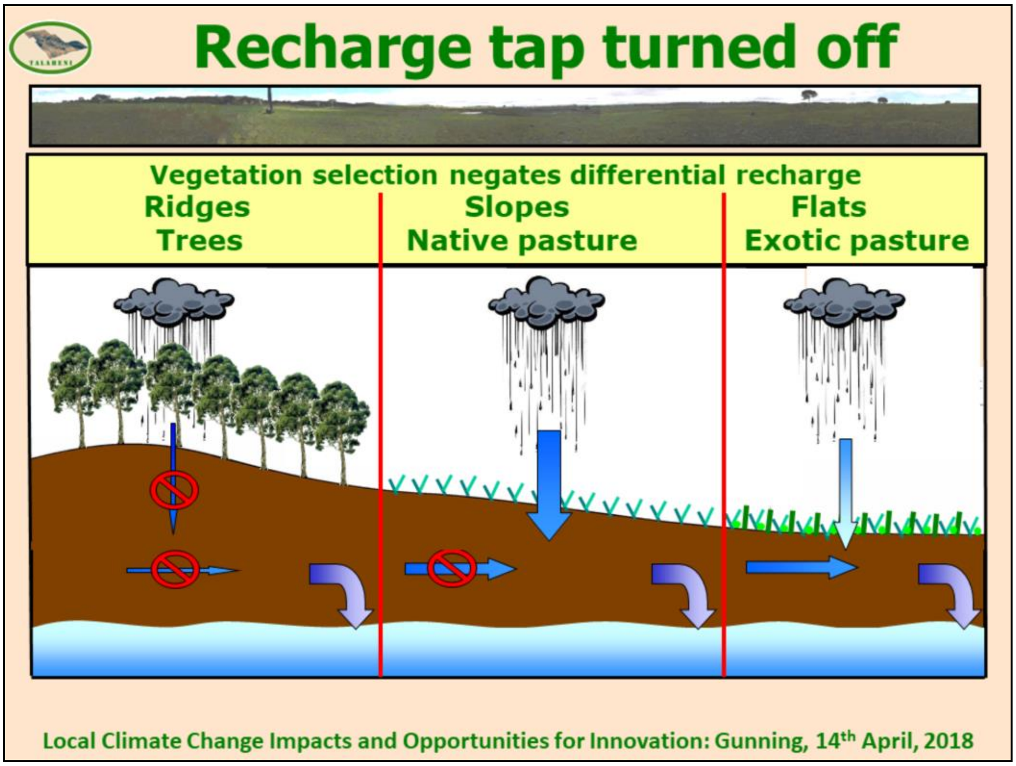
Thirdly, beef production performance tends to be highly variable in response to seasonal conditions, nevertheless we continue to gain both in fertility and standardised weaning weights.



Managing native vegetation yields a number of products. Milling of sound but dying Red box trees have yielded high quality furniture timber, this particular tree yielded 72 planks of furniture quality.

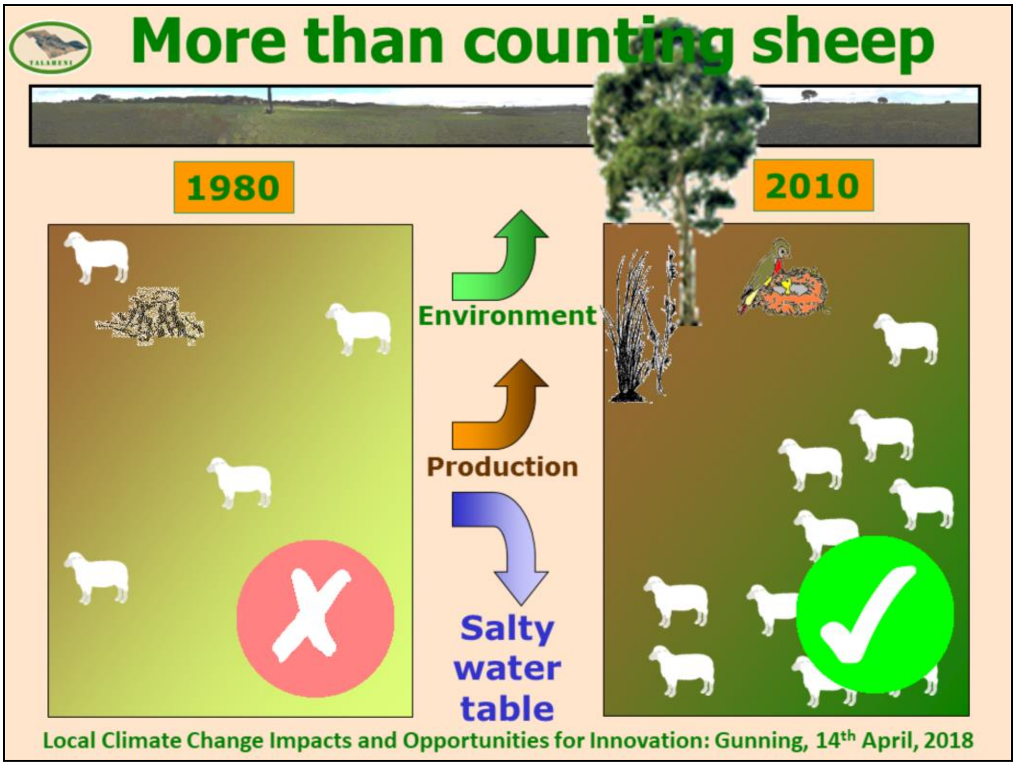
Poles from management thinning of dense regeneration provide material for on- and off farm construction.

Then there is the unexpected appearance of examples of Nature's art.



With trees established on the ridges, the recharge tap has been turned off with very little rainfall infiltrating beyond the rooting depth of the trees. As a consequence the water table across the slopes and flats has gradually declined reinvigorating the pastures.

Establishment of deep-rooting perennial pastures on the reclaimed flats utilised further groundwater and accelerated water table decline.



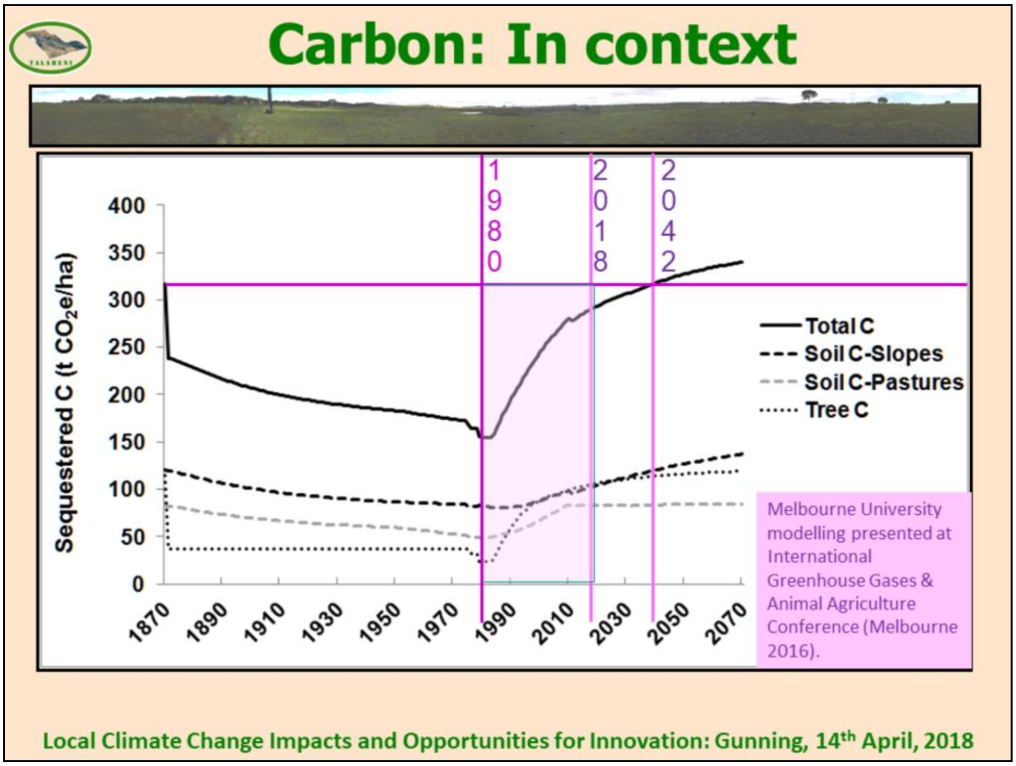
Diagrammatically the changes over nearly 40-years can be summarised as follows.

The area had been heavily cleared in the late 1800s igniting a slow burning dryland salinity fuse. Initially our grazing was predominantly restricted to the slopes and ridges. Re-establishing trees on the low productivity ridges turned off the recharge tap leading to a reclamation of the flats.

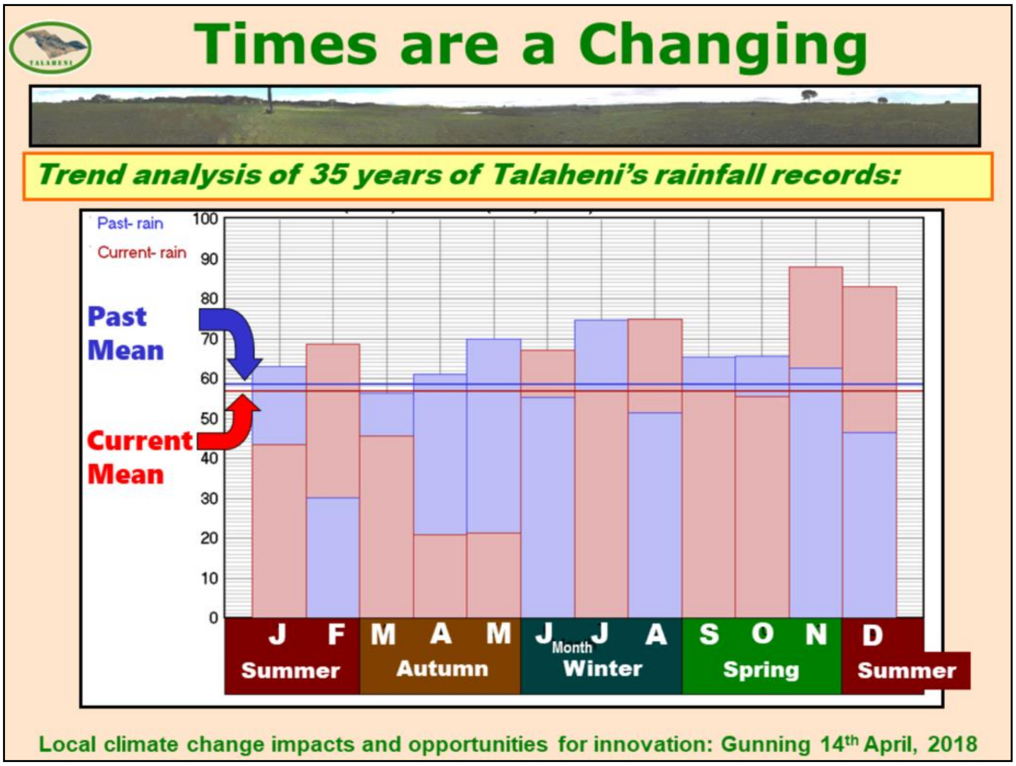
Thirty years later and the flats are now the most productive areas carrying more stock producing better commercial products and water tables continue to decline.

In essence, by substituting trees for the low grazing capacity of the ridges, the grazing potential of the more highly productive flats has been regained. As a result of strategic and comprehensive vegetation management, production overall has increased along with a range of environmental values all made possible by lowering depth to and quality of water table. Attending to the environmental issues has lead to production gains.

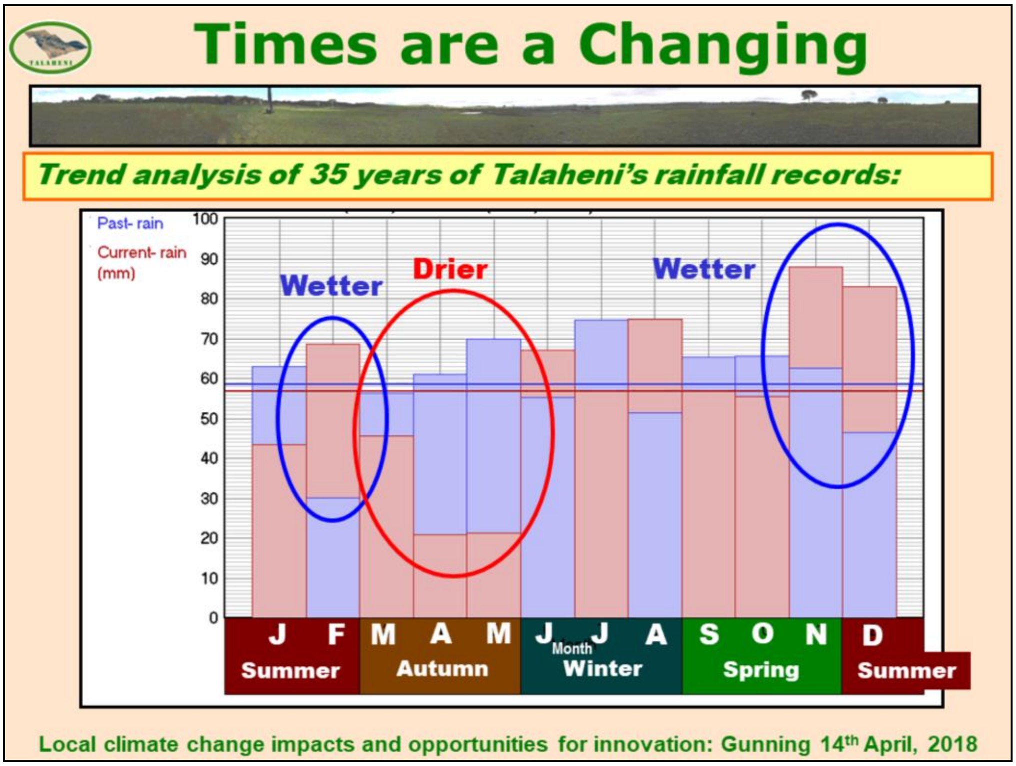
A win-win outcome, essential although not necessarily sufficient for a sustainable future.



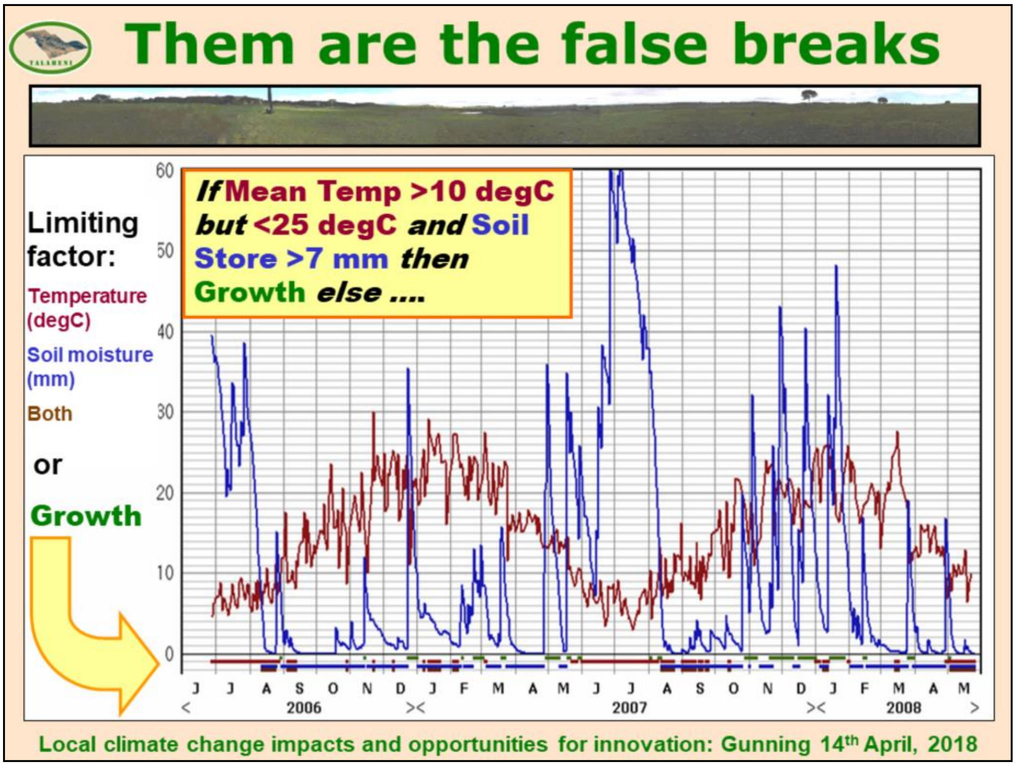
The carbon audit by Melbourne University not only established that Talaheni is sequestering more than eleven times as much carbon as our farm emissions and energy use, they also established the long term carbon trend from the time of initial white settlement out to 2070 (assuming appropriate management continues). This indicates by 2042 the carbon situation will be back to that at the time of initial clearing nearly 150 years ago.



Looking now at our changing weather and climate conditions. We have undertaken trend analysis of 35 years of Talaheni's rainfall records which indicates the mean rainfall has declined by a tolerable 3mm per year, but this represents a less tolerable 120 mm per year after 40 years.

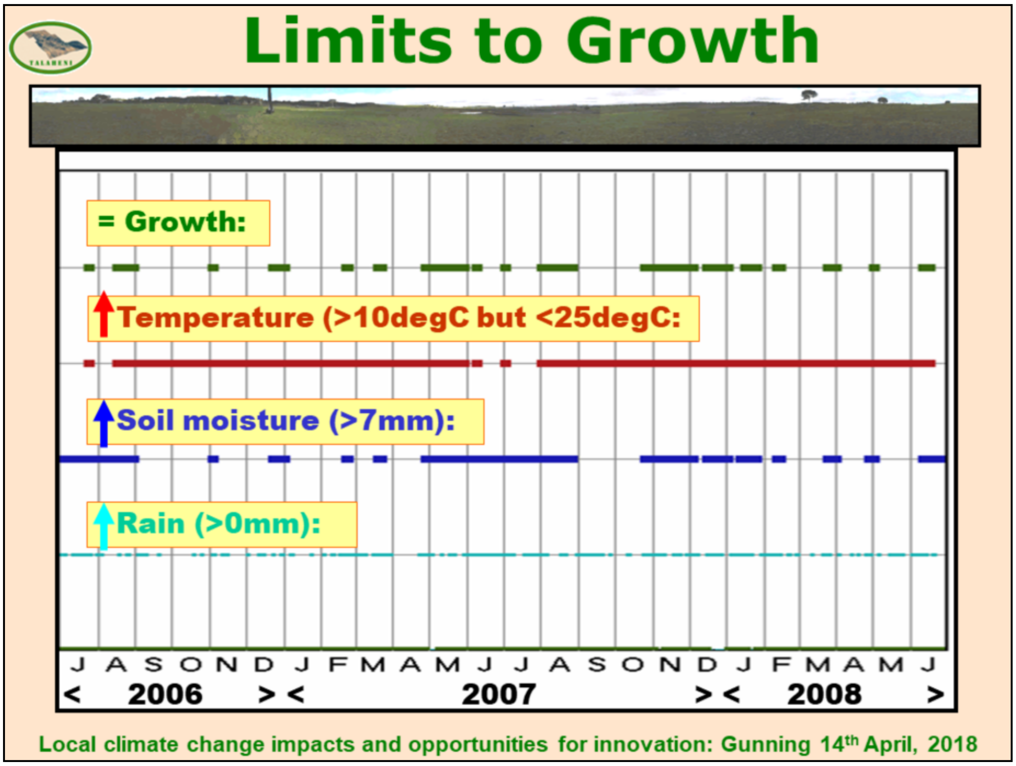


More importantly the seasonal rainfall pattern has changed significantly. We have lost 100mm in the all important autumn period and regained this rainfall in late spring and summer. Consequently, we now have a far inferior seasonal rainfall pattern for the traditional pasture systems for the area.



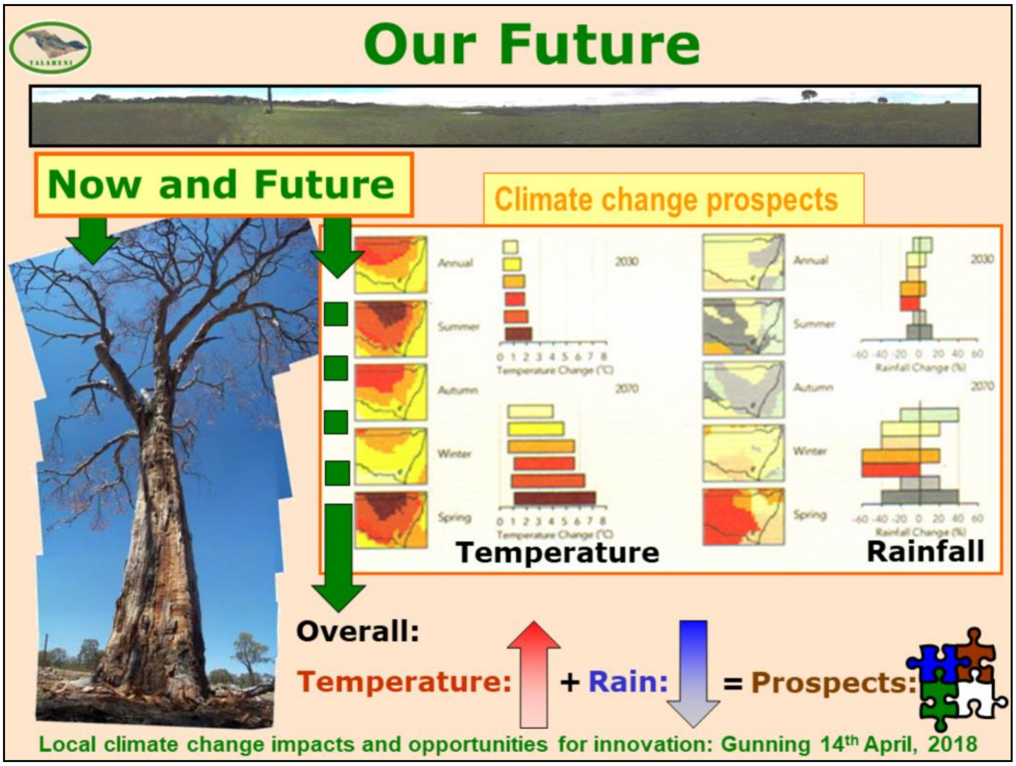
Looking now in more detail. An extended period of nearly a decade of drought took a toll upon our landscape as evidenced by death of hundred-plus mature trees across Talaheni (irrespective of whether paddock isolates or protected remnants) which may have downstream impacts upon production.

Looking at the combination of temperature and soil moisture it can be seen that conditions conducive to pasture growth have been limited and sporadic.



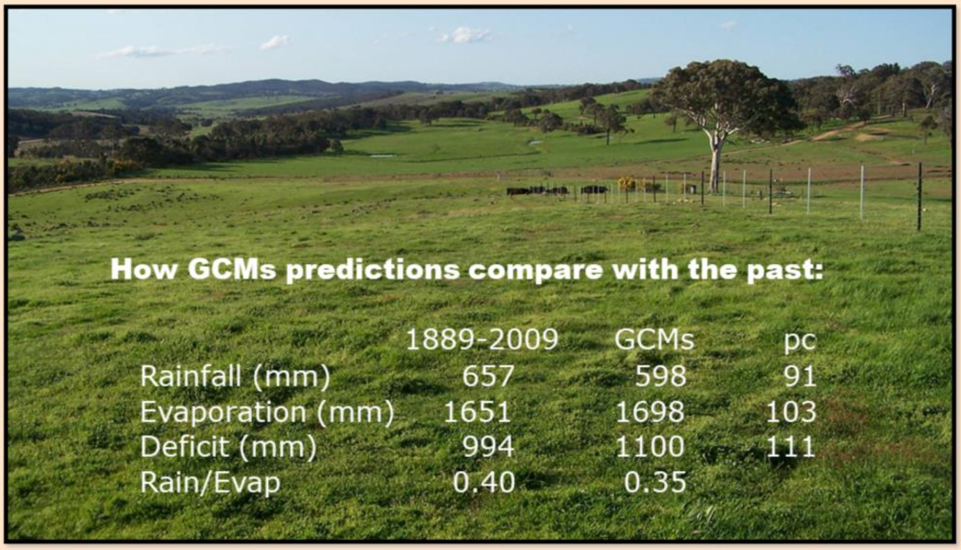
Looking more closely at the periods of growth and the periods when either temperature or soil moisture, or both limit growth over the particularly dry period 2006-08. The growth period is one of stop-start action and frequently both temperature and soil moisture are limiting growth.

False and late-breaking poor seasons have seen clover content of pastures decline significantly. Even the highly valued native perennial *Microlaena* has also declined even under minimal grazing.



With on-going death of trees due to exhaustion of soil moisture and with mounting evidence of climate change we face new and different challenges for the future of both our production and environmental objectives and their interaction. We will have to work differently to successfully put together the pieces of the new jig-saw.

Global Circulation Models



How GCMs predictions compare with the past:

	1889-2009	GCMs	pc
Rainfall (mm)	657	598	91
Evaporation (mm)	1651	1698	103
Deficit (mm)	994	1100	111
Rain/Evap	0.40	0.35	

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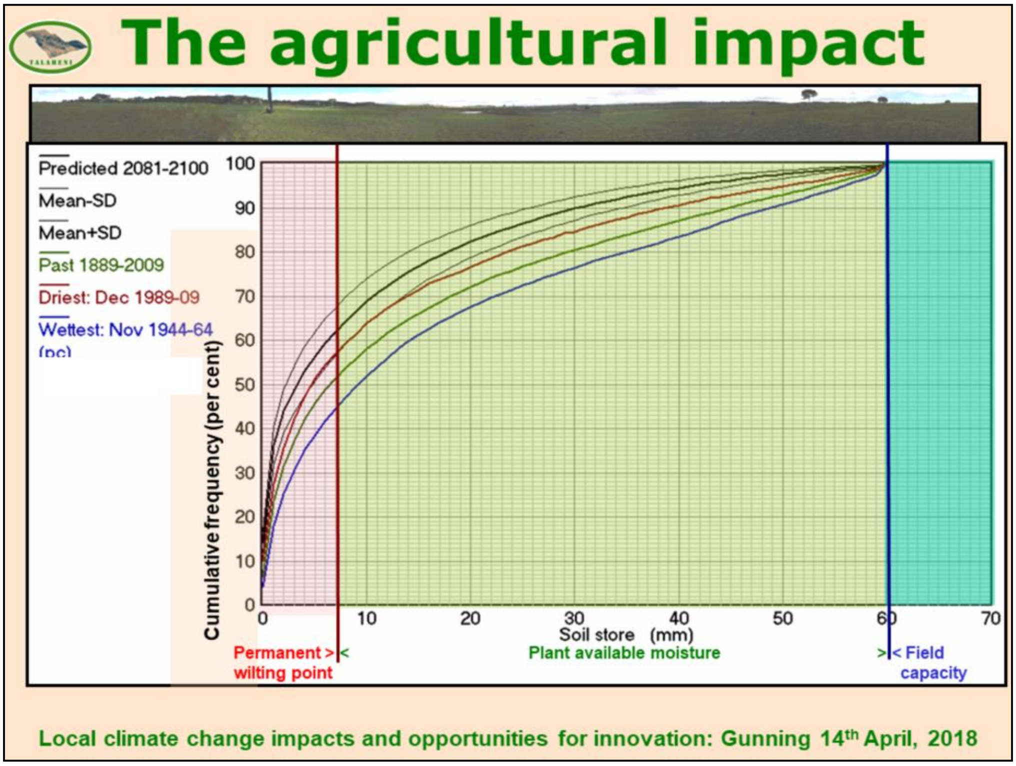
The Bureau of Meteorology have provide us with data from ten global circulation models downscaled for Talaheni. This data gives climate predictions out to 2100 and has been compared with historical data for Talaheni going back to 1889. Both these data sets have been put through WaterBank to establish the impact of climate change is expected to have upon the soil moisture situation for Talaheni.



Using data from ten Global Climate Models for Talaheni area a cumulative soil moisture distribution curve can be developed for the twenty-year period 2081-2100. This curve can be compared to that for the past (1889-2009) and also the wettest and driest twenty-year period during that time.

If one takes the time at or below permanent wilting point as the most important agricultural indicator, then climate change predictions for Talaheni suggest that the future is going to be as dry or drier than the historical driest 20-year period on record- 1989-2009.

Should the interval between the historical wettest and driest periods be repeated under climate change then the future's wettest will likely shadow the historical driest. If that is not enough, the uncertainty under climate change is expected to also increase with greater climate variability on top of the change. A sobering thought!

Time at or below PWP*

Curve	*Per cent of time*	*Weeks ... of year*	*Weeks ... over 20 years*
Climate change	**62.0**	**32**	**645**
1889 to present	**51.4**	**27**	**535**
Wettest	**44.6**	**23**	**464**
Driest	**57.0**	**30**	**593**

* **PWP** = Permanent wilting point: *the soil moisture value at which plants cannot obtain enough moisture to keep from wilting. Depending upon soil type, this moisture is usually around fifteen bars of pressure.*

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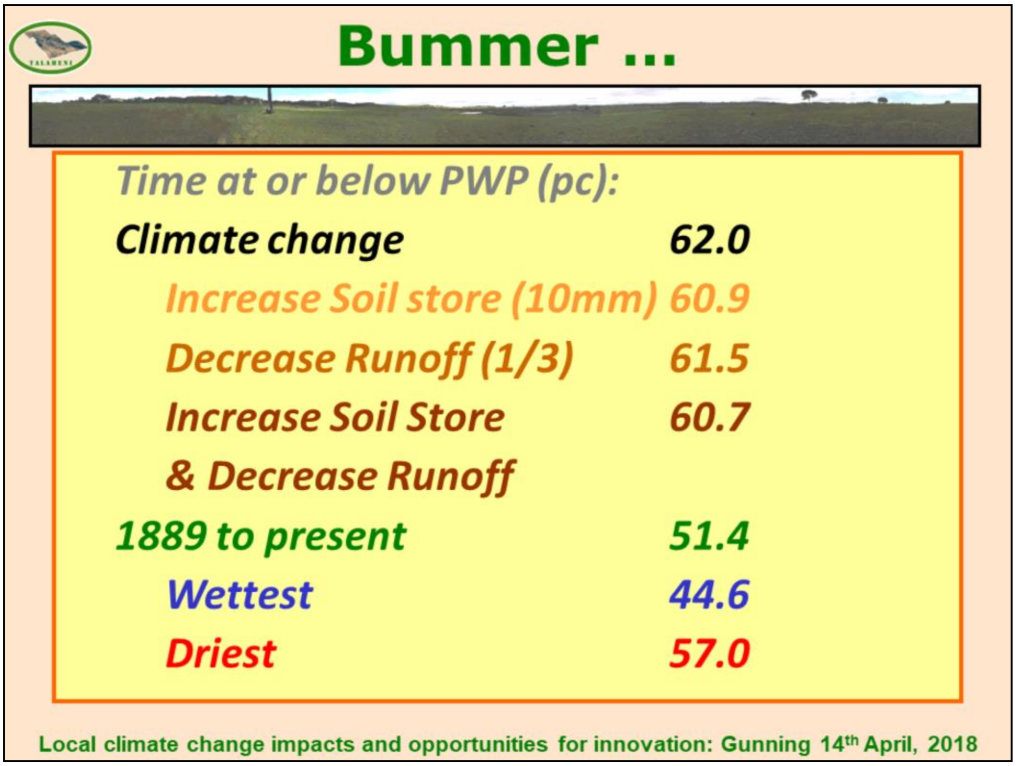
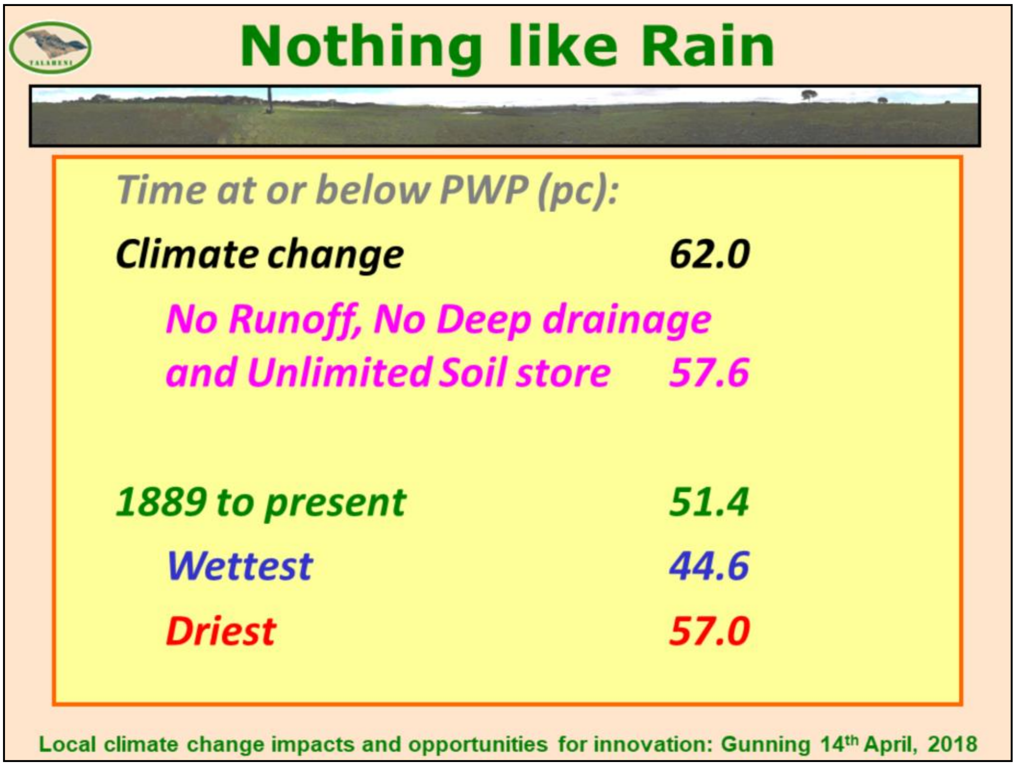
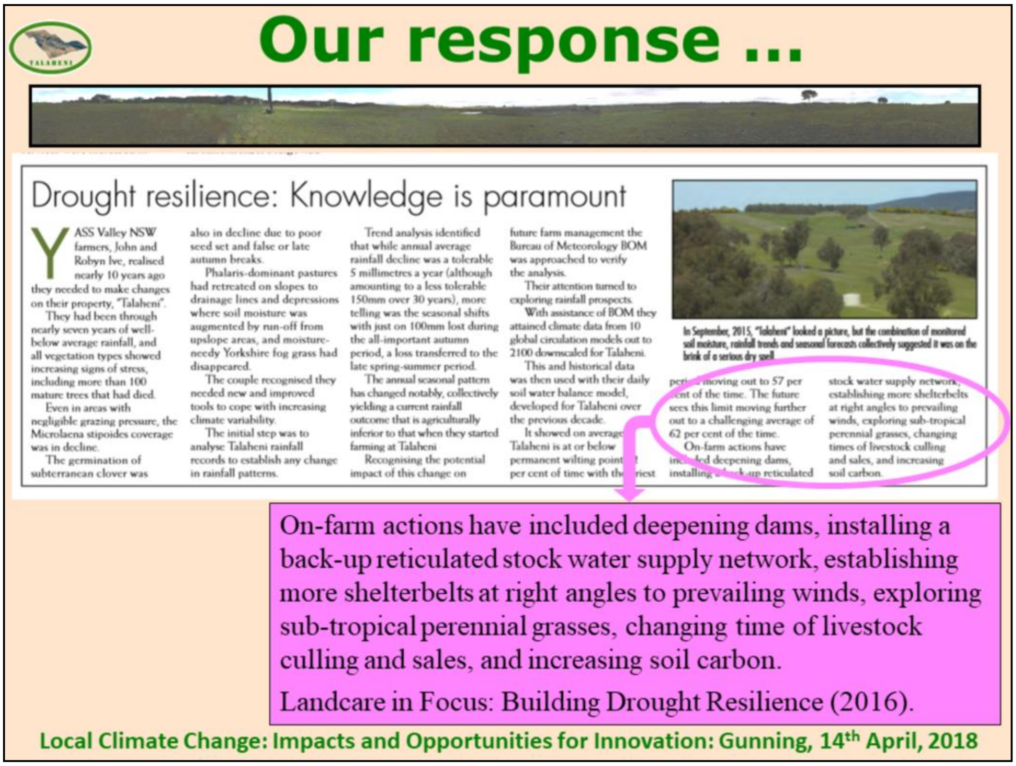
For agricultural production the time at or below permanent wilting point is critical as soil moisture is insufficient to maintain pasture or crop growth. This suggests that on average we are in for drier times.



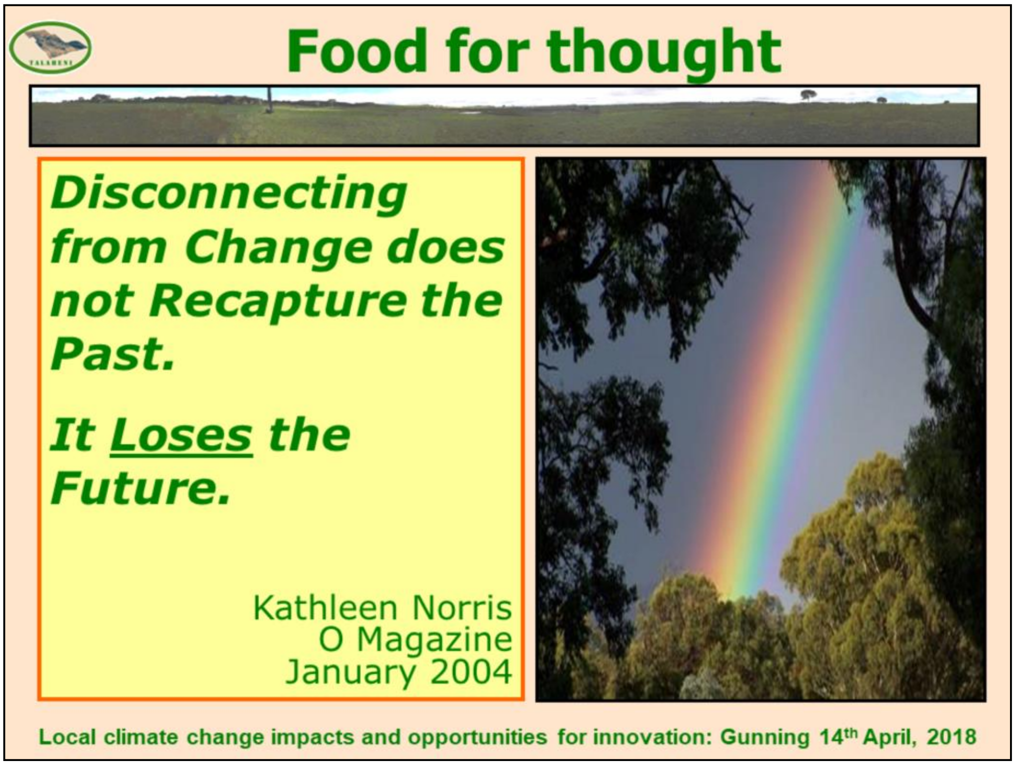
Faced with this we have given thought to minimize the effect off climate change. If we can increase the soil store for moisture by 10mm- the effect is minimal, likewise if we decrease runoff by a further third the change is even less. Putting the two management goals together still does not achieve an outcome better than the driest period ever. Pretty daunting outlook!



Now taking an unachievable extreme position with no runoff, no deep drainage and soil improvement allowing all rainfall to be held in the profile still delivers a result not even as good as the driest period we have ever experienced.



Given this position what have we been doing to try and minimize the evolving drier conditions. We have deepened farms dams, installing a back up reticulated water system feed from a spring fed dam, establishing more shelterbelts at right angles to prevailing drying winds to reduce evaporation, exploring the value of sub-tropical perennial grasses, changing time of livestock culling and sales while all the time seeking to continue increasing all important soil carbon.



However with these new and evolving challenges we need to keep in mind the above sentiment, otherwise our future will be as illusionary as the mythical *pot-of-gold* at the end of the rainbow.

Our message

1. Many environmental gains achieved on Talaheni.
2. Environmental enhancement, even under adversity.
3. Production gain (both quantity and quality) achieved concurrently with environmental gain.
4. Production and other environmental gains are a by-product of remedying dryland salinity and soil acidity.
5. Current systems are vulnerable under climate change and further rethink and adaptation is required.

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There are a number of messages you might care to ponder:

1. **Numerous environmental gains have been achieved on Talaheni over the past 30-years.**
2. **On-farm environmental gains can be enhanced even under adversity.**
3. **Production gains in both quantity and quality, have been achieved concurrently with improved environment.**
4. **Need to recognise the interactions between different elements of the landscape and manage accordingly.**
5. **Production and other environmental gains are a by-product of remedying dryland salinity and soil acidity.**
6. **Current systems are stressed and further rethink and adaptation is required with increasing threat of climate change.**

Our wish list

1. Impact of climate change predictions upon persistence and production of native pastures- particularly perennials.
2. More agronomic studies on native perennial pasture and browse species.
3. Pasture breeding and evaluation trials focusing more upon persistence (rather than spring production) under predicted climate change expectations.
4. Need to consider impact of climate change upon our natural resource base.

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Regionally-relevant synthetic climate data sets are required for use with our soil water balance model to identify the likely consequences of climate change upon our pastures and the resource base- this has been partially fulfilled.

Traditionally new pasture releases are promoted almost solely on the basis of dry matter production, with evidence of increasing climate variability more attention should be given to persistence under the range of conditions we might experience in the future.

I believe our native perennial species have much to offer and if the same amount of investment was put into them as exotic species our pastures might be in better shape after the severe drought for instance.

We need to consider what impact expected climate change will have upon our most important resource- *our land*. For instance under a drier and hotter climate will soil carbon be at greater risk?

Finally, an insightful and pertinent saying that keeps us focused for the future. As a consequence we regard today's best practice as but a step in tomorrow's journey and that new issues and better practices will undoubtedly arise.

Just as climate change has come to prominence in the past twenty-years, new challenges will arise as we attempt to continue meeting our production and environmental goals.

Hence the title of this presentation: Farming under landscape and climate challenges- which recognises that addressing climate change needs to take in account the landscape conditions under which one is farming.

I'll drink to that …

A timely sentiment to finish on

Questions **&** comments welcomed…

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