# FARRER MEMORIAL TRUST

## ANNUAL REPORT 2019

FARRER MEMORIAL RESEARCH SCHOLARSHIP FUND

THE 2019 FARRER MEMORIAL ORATION

# FARRER MEMORIAL RESEARCH SCHOLARSHIP FUND

The Farrer Memorial Trust was established in 1911 to perpetuate the memory of William James Farrer and to encourage and inspire agricultural scientists. Initially it awarded scholarships for 'study or research in agricultural problems'. Later it included the delivery of an annual oration and the presentation of the Farrer Memorial Medal to a distinguished agricultural scientist for service rendered in the fields of research, education or administration.

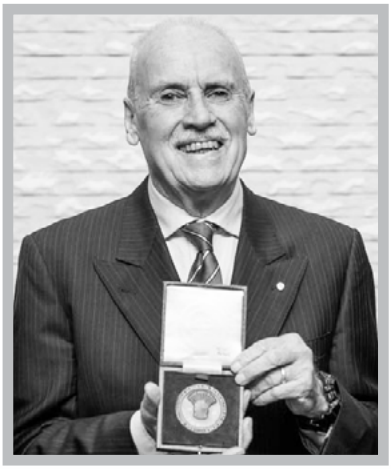
The Director General of the Department of Primary Industries, Mr Scott A Hansen, is the Chairman of the Trust. The other official Trustees are Ms Kate Lorimer-Ward, Deputy Director General, Agriculture NSW of the Department of Primary Industries; Prof. Alex McBratney, Professor and Dean of the Faculty of Agriculture, University of Sydney; and Dr J C Radcliffe AM, CSIRO, Unley Park, South Australia. The non-official Trustees, representing industry, are: Mr M J R Arnott AM, Boorowa (until 30 April 2019), Ms R Clubb AM, Araluen (until 23 June 2019), and Mr G Mason AM, Boorowa.

The Farrer Memorial Travelling Scholarships are designed to support overseas travel by post-graduates enrolled for a PhD on any aspect of field crop research. The 2019 Farrer Memorial Travelling Scholarships were awarded to:

- Mr Brenton Leske, University of Western Australia
- Ms Rachel Wood, Charles Sturt University
- Ms Jessica Hyles, University of Sydney
- Ms Michelle Demers, University of Sydney
- Mr Jakob Schulz, University of Adelaide

The 2019 Farrer Memorial Medal was awarded to Professor Tim Reeves, FTSE at the Australian Grains Industry Conference in Melbourne on Thursday 1 August 2019. Professor Reeves delivered the Farrer Oration entitled 'Sustainable Intensification of Agriculture – For Food and Nutritional Security'

The text of the 2019 Farrer Memorial Oration is reproduced on page 3 of this report



The 2019 Farrer Memorial Oration

# Sustainable Intensification of Agriculture – for Food and Nutritional Security

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**Summary**

I have spent over 50 years of my working life pursuing 'agricultural sustainability' and have witnessed many changes, challenges and successes – both nationally and globally. The successes have resulted from the combined efforts of scientists and farmers working together to identify, develop and adapt new technologies and systems to both address continuing challenges to productivity and profitability, and to also seize the new opportunities that continually arise. The clear message for me is that agricultural sustainability is a 'moving target' and that no single system has remained sustainable for one reason or another, and nor will it in the future.

It is equally clear to me that a new 'revolution' of diversified farming based on the effective integration of crops, pastures, livestock, shrubs and trees together with diverse practices, is urgently required to make farms more resilient financially, and to the increasing challenges of climate change and climate extremes. To achieve this resilience, it is also an imperative to build soil carbon content and soil health generally. The new 'sustainability mantra' worldwide is based on the 'sustainable intensification' of farming systems and more recently on 'regenerative agriculture' for the whole agri-food value chain. In this Farrer Memorial Oration, I consider the challenges and opportunities of sustainable intensification as a pathway to continue William Farrer's ideals of 'aiming high and making an impact'.

**The Farrer Legacy¶**

There have been many interesting and insightful accounts of William Farrer's substantial impacts on Australian agriculture and thanks to the great work of the Farrer Memorial Trust, many of these are recorded in the previous orations delivered by illustrious colleagues who have preceded me in achieving this prestigious award (www.dpi.nsw.gov.au/about-us/who-we-are/interacting/farrer-memorial-trust). I particularly enjoyed Dr John Kirkegaard's account in his Farrer Memorial Oration (2017) of his family and personal connections to Farrer's work and in a way, they are also a salutary reminder that good people underpin both the achievements and their effective adaptation for beneficial impacts.

My connections with William Farrer are much more tenuous, but nevertheless I am thankful to find some commonalities. We were both born in England, almost 100 years apart, and we both emigrated to Australia in our early twenties to seek a better life and to work in agriculture in this great land. In the first Farrer Memorial Oration (beautifully preserved on the website as a typewritten document), Prime Minister the Hon. Joseph Lyons stated:

*"Farrer had a high ideal and adhered to it. He had Charles Darwin's objective that unless you aim high you make no mark worthwhile. He said he only wanted to be able to think, when the end comes that my life has not been wasted"*

I think that we all aspire to this and it has certainly been an inner force that has driven me throughout my career and in my ongoing endeavours to improve the livelihoods of both Australian farmers and of resource-poor farmers in the developing world. In Australia, William Farrer was able 'to see the light on the distant hill' and when I was Director General of CIMMYT in Mexico I had the guidance and vision of the late, great Dr Norman Borlaug to light my way to the distant hill of global food and nutritional security. We should all be eternally grateful that pioneers such as Farrer and Borlaug showed us the way forward and it is fitting to remember them both here as they would surely have been mates, if they had ever been able to meet.

I am immensely honoured to be awarded the Farrer Memorial Medal and am most grateful to the Farrer Trustees for recognising me in this way, and in so doing also honouring the invaluable contributions of family, friends, colleagues and mentors who have enriched my life and my career.

**The 'Grand Challenges for Agriculture'**

In my Donald Oration (Reeves 2017b) I described the five 'grand challenges' that agriculture faces as it seeks to satisfy the needs of future food and nutritional security. Those challenges have not changed – nor would one expect them to in such a short period of time – but I have refined them to reflect further thinking and recent developments in knowledge and events.

In addition, it is now vitally important to view these challenges in the stark context of 'nutritional security' as well as food security. Malnutrition in its wider definition is rampant and negatively impacting livelihoods in the vast majority of countries, including Australia. See figure 1. Much needs to be done if we are to sustainably produce not just more food, but more, more nutritious food to meet humankind's needs.

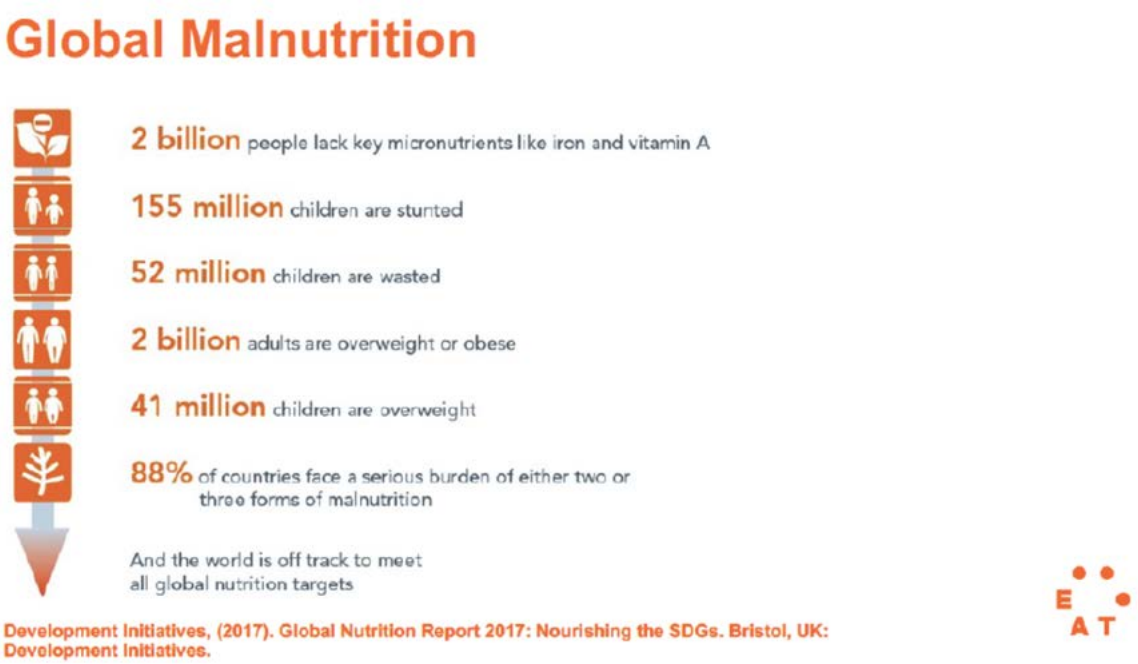



Figure 1 – The different types and incidences of global malnutrition

These are the 'grand challenges' I have developed, based on my own experiences and in consultation with learned colleagues.

***1. GRAND CHALLENGE (GC) – LOSS AND DEGRADATION OF NATURAL RESOURCES (Land, Water, Air)***

Prime agricultural land is being lost at an alarming rate around the world. Depending on which source of data one uses, the range of losses is from around 1 to 7 million hectares/year (various sources). As a result of population increase and land losses, the area of arable land per capita has decreased from almost 0.35ha/person when I started my career as an agronomist, to less than 0.2 ha/person now (World Development Indicators and World Population Statistics). In addition, of the land remaining in agriculture, much is degraded, some severely, resulting in lowered productivity (FAO 2015). More people, more food and more nutritious food required, but less land on which to produce it. This is a major challenge in its own right. Giving much greater emphasis to enhanced soil health and better soil fertility in the lands remaining, is therefore of paramount importance.

At least 70% of global freshwater withdrawals are used for agriculture (OECD 2017), with around 45% of global cereal crop production coming from irrigated systems. However, the irrigation efficiency of some of these systems is less than 50%. There has also been a rapid increase in competition for water resources between agriculture and other uses including for urban, industrial and environmental purposes and this competition will only be exacerbated in coming years. On current trends, global blue water withdrawals would approximately double by 2050 compared to 2000 levels. With 'business as usual' this additional water would simply not be available. Water stress will increase in many agricultural areas by 2025 due to growing water use and higher temperatures (IPCC Scenario A1B). Agriculture must not only increase water-use efficiency but also reduce overall water consumption – a major challenge.

Lastly, in relation to natural resources, greenhouse gas (GHG) emissions from agriculture are a major issue. It is estimated that around 14.5% of current global GHG emissions come directly from agriculture (Gerber et al 2013), with a further 10% arising from land-use changes including deforestation. If food production is to be doubled by around 2060 and current production methods are used, then it is estimated that this figure could rise to over 50% of global GHG emissions, a clearly unsustainable scenario. GHG emissions from agriculture must therefore be mitigated and reduced if the social license to farm is to be maintained.

***Natural Resources – what needs to be done?***

» Development of integrated policy frameworks across the water-agriculture- food-energy-environment-population nexus

» Increased WUE and reduced water consumption

» Clear policies and strategies for peri-urban and urban agri-food production and associated land use planning

» Increased emphasis on soil health and fertility including 'tipping points'

» Conservation agriculture and sustainable intensification essential

» Farm enterprise choices based on input-use efficiencies

» Mitigation of GHG emissions by use of Best Management Practices (BMP) to avoid future 'right to farm' challenges

***2. GRAND CHALLENGE – ADAPTATION TO CLIMATE CHANGE***

In February 2015, the Director General of FAO made the following headline statement "The impacts of climate change are no longer an anticipated threat." This seemed to be a pretty bold statement if one did not read on. His full statement was: "The impacts of climate change are no longer an anticipated threat. They are now a crystal-clear reality right before our eyes. Climate change will not only affect food production but also the availability of food and the stability of supplies. And in a global, interdependent economy, climate change makes the global market for agricultural products less predictable and more volatile."

There is no doubt that if the world is to achieve global food and nutritional security, adaptation of our farming systems to climate change is absolutely critical. Climate-smart agriculture is required, and sustainable intensification can help us deliver more adaptive and more resilient production systems.

Most studies project net adverse impacts on crop yields due to climate change, and many of those adverse effects will be felt in regions that are at the forefront of both food production and food consumption, including South Asia; West Asia and North Africa; parts of East Asia; major areas of Sub-Saharan Africa; and large areas of South America (World Bank 2010).

These impacts have been confirmed from some of my own experiences working in these regions over the past couple of decades. For example, in a review that I chaired for FAO and the Government of India in 2009, on the impacts of climate change on Indian wheat production, farmers in NW India told us that the water level in their tube wells was falling by from 1 to 2 m per year, well above the overall NASA monitoring assessments of around 0.4 m per year – substantial in itself. These unsustainable water reductions were considered to have resulted from over-use of water as a consequence of two factors, the first was perverse policy settings that provided substantial subsidies for the costs of pumping water. The second factor was the changing climate whereby some aquifers were no longer being adequately replenished during the annual monsoon season (FAO 2009).

Most of the indicators for climate change in Australia paint an equally concerning scenario (Alexander et al. 2017). These include the following - annual average temperature increases, with 2018 being Australia's warmest winter on record, an occurrence that the Climate Council reports was 60 times more likely to have been caused by climate change; greater climate variability – although a recent article disputes this (Freebairn 2017); a higher incidence of extreme events – more likely to have occurred due to climate change (Graham and Eckard 2017); and reduced run-off in many regions (BOM 2016). The paper published by Dr Zvi Hochman and colleagues "Climate trends account for stalled wheat yields in Australia since 1990" (Hochman et al.2017), is perhaps a clarion call for more emphasis on adaptation to climate change and that 'business as usual' will not be viable. On the positive side, the authors pointed out that whilst wheat yield potential had decreased by 26% over the study period, actual yields had generally not fallen so markedly, as technology gains – read 'adaptation' – had been able to offset the potential losses. The question remains as to whether the future rate of technology gains can keep pace with the impacts of a changing climate, where much of the Australian cropping regions are likely to get warmer and dryer. Greater, longer-term and patient research investment is urgently needed to maintain and hopefully increase, the rates of adaptation in all major crop and forage farming systems.

***Adaptation to climate change – what needs to be done?***

» National adaptation strategies for agriculture where all innovation is evaluated through the 'lens' of climate change

» Substantial, long-term, patient co-investment in adaptation and mitigation by public and private sectors

» Farming systems that are more diverse, more resilient and adaptable and less emissive, based on sustainable intensification

» Infrastructure that both helps adaptation and is itself adapted to climate change

### *3. GRAND CHALLENGE – NITROGEN USE (IN) EFFICIENCY*

Nitrogen fertilisers account for over 50% of the protein in human diets and are therefore critical to global food and nutritional security. However, the 'elephant in the room' for these fertilisers is that nitrogen-use efficiency (NUE) only averages around 50% and the economic and environmental costs of low NUE are substantial and unsustainable (The Conversation 2016). Already, some countries and regions are basing 'right to farm' challenges on environmental damage caused by losses of nitrogen from farming systems (e.g. Dairy NZ 2014).

Global nitrogen fertiliser use has increased at a rate much greater than population growth and this dependence on N fertilisers has often been accompanied by less use of biologically fixed nitrogen from legumes. Legume-based cropping systems have been shown to reduce carbon and nitrogen losses in many situations (e.g. Drinkwater et al. 1998; Migliorati et al. 2015). I believe that we need to urgently review our investments in legumes, here in Australia and globally, in order to re-invigorate their usage on farms. Here in Australia, we have conclusive evidence around the importance of pulses and forage legumes in our farming systems (e.g. Peoples et al. 2013; Seymour et al. 2012) but their uptake remains static. This also needs to be addressed and the reasons – particularly the factors influencing farmer decision-making – investigated, so that new and effective strategies can be implemented. Legumes in global and local farming systems can have major beneficial impacts on food and nutritional security; on more diverse and resilient farming systems; and on reducing nitrogen losses and environmental impacts.

Of particular concern globally, is that nitrogen-use efficiency has reduced substantially since the 1960s (Tilman et al. 2002). As a result, these increasing losses have not only resulted in economic losses on farms but have also contributed to the "Nitrogen Cascade" and resultant environmental damage described by Professor Galloway during his visit to Melbourne in 2016 (Galloway et al. 2016). In Australia, due to our high consumption of animal products, we have one of the world's largest per capita 'nitrogen footprints' – around 47 kg N /person (c.f. 28 kg N/person in the US) another indicator that 'business as usual' is not sustainable (The Conversation 2016).

A lesser concern expressed around nitrogen fertilisers, but still of significance, is that urea the most widely used form globally, is a product that requires the use of 'fossil fuel' – natural gas – in its manufacture. Given the needs to reduce GHG emissions from the sector this could be seen as counter-productive and raises the question as to the development of other forms of N fertilisers that are not based on 'fossil fuels' (IAASTD 2016). We know that there is plenty of work on reducing dependency on fossil fuels in the energy, automobile and housing industries but is there any progress with regards to alternative processes for N fertiliser production?

#### *Nitrogen efficiency - what needs to be done?*

- Greater investment in energy-efficient fertilisers and better technologies
- Re-invigoration and re-investment in legumes RDE emphasising sustainability
- Real-time testing for mineralised soil nitrogen
- Enhanced Best Management Practices (BMP) for N use
- Regulatory framework for N use based on BMP
- Community education around our 'N footprint'

### *4. GRAND CHALLENGE – FOOD LOSS AND WASTE*

FAO has estimated that of the food produced globally, 32% by weight and 24% by calories, is lost or wasted! (FAO 2011b). This does not make economic or environmental sense – in fact, the complete opposite - and if we could reduce the rate of food loss and waste it would not only have substantial beneficial impacts on global food and nutritional security, but also on important sustainability issues. This is an area that provides both huge challenges and huge opportunities for improvement. For this paper, food losses are considered to be pre-farm gate and food waste, post-farm gate including consumption.

Unsurprisingly, the extent and the sources of food loss and waste vary around the world and Figure 2 below illustrates this well. Of significant concern is the high proportion of food losses at the farm level in Sub-Saharan Africa, arising from problems with production and storage and handling. There must be even greater investment by the international community in overcoming these problems. However, levels of per capita food loss and waste are higher in Europe and Industrialised Asia, whilst North America and Oceania have the highest per capita food loss and waste by a significant margin, with around 60% of that occurring at the consumption level, an alarming and disturbing fact.

There are a number of factors that I believe are influencing and exacerbating the profligate and unsustainable levels of wastage in Oceania and North America. Taking Australia as an example, conservative use-by dates and 'over–the-top' specifications for products in supermarkets are both significant contributors. Both result in unnecessary rejection of products and resultant wastage. However, my main hypothesis is that a major underlying cause of our extreme levels of wastage, arises because many of us in the Western

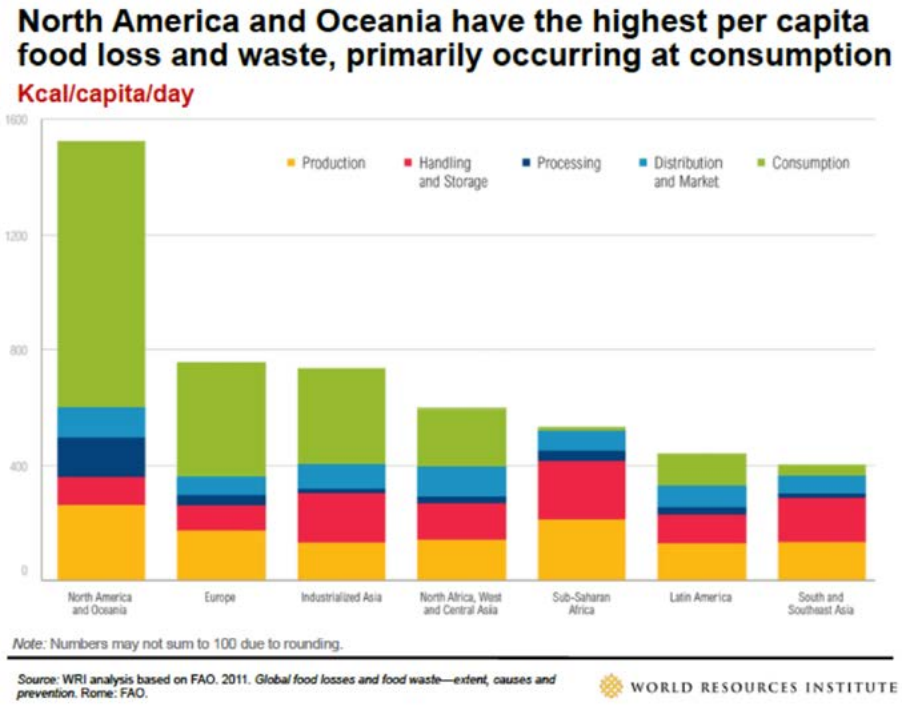



Figure 2. Variation in food loss and waste from various stages of food production and consumption around the world.

world have lost our respect for food, treating it as a commodity that will always be there and that we can take as much of as we wish, regardless of cost or real needs (Reeves 2017a). Such an attitude – which is in sharp contrast to the great respect for food in most developing countries – results in over-purchasing, excessive portion sizes for meals and in many cases over-consumption. When we phone up the pizza shop with our order and they say 'We can give you two for the price of one', there are many of us who should say 'Why?' rather than 'Why not?'…

Dietary choice can also have an important part to play in food loss and waste and the sustainability of farming systems. The following are some examples drawn from the literature:

» If the rate of food wastage is reduced by 50% by 2050 – the 'food gap' would be reduced by 22% (Lipinski et al. 2013)

» If all consumers were vegetarians and ate to nutritional guidelines it would reduce global nitrogen usage by 50% (Galloway et al.2016)

» The average daily (embedded) water consumption of a meat-eating person is twice that of a vegetarian (www.angelamorelli.com/water)

***Food loss and waste – what needs to be done?***

» Value-chain nexus approaches to reducing loss and waste

» Setting food loss and waste reduction targets to drive strategy

» Investment in RDE to reduce pre- and post-harvest losses for smallholder farmers

» Increased food re-cycling/'second harvest' approaches and less conservative use-by dates (industrialised countries)

» Respect for food – education around purchasing, portion sizes and consumption (industrialised countries)

### *5. GRAND CHALLENGE – (Benign) NEGLECT AND EROSION OF RURAL COMMUNITIES*

This is a major global issue that is already having significant implications for food and

nutritional security. It is estimated that 70% of the world's population will be urbanised by 2050 and that figure already stands around 50%, including in some developing countries. This rapid urbanisation of communities poses some key policy dilemmas for government decision-makers. Not the least of these is the ongoing tension between affordable food costs for city-dwellers and high enough prices for farm products, that allow farmers to make a profit and stay in the business of food production. It is common to hear politicians refer

to their determination to keep food affordable, but it is much less common to hear them espouse similar determination to keep farms profitable. The achievement of both is absolutely critical to future food and nutritional security.

One of the main reasons for the migration from rural areas to the cities in many countries – both developing and industrialised – is the steady erosion of infrastructure and essential services in rural areas, leading to continual rural restructuring and demographic changes. This is not a new phenomenon and the outstanding social researcher Neil Barr, has stated that in the average lifetime of an Australian farmer s/he can expect the number of local farms to halve in number (Barr 2009).

In addition, there is a range of other socio-economic issues that disproportionately affect rural communities. Alston (2011) lists some of these:

» High levels of rural poverty

» Out-migration

» Masculinisation of remote communities

» Higher unemployment

» Poorer health

» Lower levels of education

» Higher levels of ageing

» Poorer service infrastructure

I have talked to some long-standing friends who still live in rural areas in Australia and their thoughts reflect many of the points made by Professor Alston. They add additional concerns around health and safety – particularly around increased illicit drug usage; the demise of social and sporting clubs due to population decreases; and the ICT 'divide' between connectivity in metropolitan and rural areas. I have other friends who run a large farming business, but who cannot get mobile phone reception or internet access at their home. Their home is not 'beyond the black stump' but less than 300 km from Melbourne! Would a business in Melbourne tolerate such poor services? We all know the answer – a resounding 'NO!'. But if you live in the country, all too often this is the type of issue that is commonplace. Technological changes and climate change have added to the uncertainties facing rural communities.

These principles and deficiencies are common to both developing countries – where some of these problems can be even more severe – and industrialised countries. Future food and nutritional security will only be achieved if farmers can access the services and infrastructure that they require to remain productive, profitable and sustainable. Governments and other key decision-makers must address these issues with urgency!

***Rural communities – what needs to be done?***

» Development of a clear vision, strategy and investment plan for rural regions

» Cohesive and supportive policy framework

» Greater rural community participation in policy advice

» Immediate attention to assessing the impacts of technological changes and climate change

» Further decentralisation of government services to rural areas

**Addressing the 'Grand Challenges' through Sustainable Intensification of Agri-Food Systems**

What does 'sustainable intensification' mean? In simple terms it is about 'doing more with less' (Pretty 1997; Reeves 1998; Pretty and Bharucha 2014). Some have simplified it further to 'more crop per drop' but the two underlying principles are **increased productivity/profitability, simultaneously achieved with enhanced ecosystem health**. But firstly, I wish to put this important development into the context of where we have come from, as it's important to understand this to successfully develop the 'road map' for where sustainable intensification can take us.

When I commenced my career at the Rutherglen Research Institute in NE Victoria in 1967, ley farming was at its peak and considered to be the 'holy grail' of sustainability. Soil fertility was built up under subterranean clover/annual grass pastures that were grazed by sheep and sometimes cattle, and after 3 to 5 years these were then ploughed up, cultivated several times and planted to wheat. The soil fertility built up under those pastures was often sufficient for the production of 3 or 4 successive cereal crops, with the final crop – often oats – under sown with sub-clover to commence the next pasture/grazing phase (see Ellington et al 1979, later in this paper). This 'holy grail' initially teetered for economic reasons – market returns from both sheep and beef cattle were extremely poor in the 1970s and simultaneously bio-physical problems as soil acidification, compaction and cereal root diseases all took their toll. This demise of ley farming was for many, one of the most significant and shocking examples of the 'moving target' of sustainability. There are lessons and principles arising from that demise that need to be taken into account when evaluating what is happening with our farming systems today.

Since those times, I have been a part of and/or witnessed three subsequent major changes in farming systems. Firstly, the move after ley farming to more intensive cropping - using cereals, oilseeds and pulses - in both higher rainfall zones and in traditional grain producing regions, but still within

a framework of mixed farming (perhaps the most sustainable system that I have seen, but more on that later). This then progressed to even more intensive cropping based on zero till, dominated by canola-wheat rotations, with a very heavy reliance on fertilizer nitrogen applications and often the total removal of livestock from farms. It is these intensive cropping systems that are now, in my opinion, moving steadily towards being unsustainable, with new climatic risks exacerbating the abiotic and biotic risk factors, and the resultant economic risks associated with such narrowly based farming systems. Globally, and increasingly nationally, sustainable intensification is seen as the way forward to achieve the 'win-wins' of productivity, profitability and environmental sustainability.

The Oxford Martin Programme on the Future of Food, at the UK's prestigious Oxford University defined it as follows:

*The goal of sustainable intensification is to increase food production from existing farmland while minimising pressure on the environment. It is a response to the challenges of increasing demand for food from a growing global population, in a world where land, water, energy and other inputs are in short supply, overexploited and used unsustainably. Any efforts to 'intensify' food production must be matched by a concerted focus on making it 'sustainable.' Failing to do so will undermine our capacity to continue producing food in the future.*

This a challenge, but one that it is essential to overcome, as we must produce more to meet ever-growing global demand – world population is still growing at around 140 people per minute, all of whom need access to sufficient nutritious and safe food to live healthy and productive lives. In so doing, we have to ensure that key environmental factors – soils, water, air and other key attributes - are enhanced, so that our children, grandchildren and their successors can continue to meet the future demands for food and nutritional security, as they will have to achieve it from less land, with less water, less energy-rich inputs, less greenhouse gas emissions and under the potential 'multiplier effects' of climate change and greater climate variability. Many of our current farming systems do not satisfy these sustainability criteria.

The essential foundations are, as previously noted, the simultaneous achievement of increased productivity/profitability AND enhanced ecosystem health. In considering this, my friend and distinguished colleague Professor Amir Kassam (http://www.ecaf.org/about- us/members-of-ecaf/item/55-honorary-member-dr-amir-kassam) a global leader in conservation agriculture, illustrated how sustainable intensification farming system practices can contribute to important ecosystem services (Friedrich et al 2009). Their findings are shown in table 1 and one can see the major commonalities with other forms of regenerative agriculture (for example, WA Landcare 2019).

**Contribution of sustainable intensification farming system practices to important ecosystem services**

| | System component | | | |
|---|---|---|---|---|
| Objective | Mulch cover | Minimized or zero tillage | Legumes to supply plant nutrients | Crop rotation |
| Simulate optimum "forest-floor" conditions | ✱ | ✱ | | |
| Reduce evaporative loss of moisture from soil surface | ✱ | | | |
| Reduce evaporative loss from upper soil layers | ✱ | ✱ | | |
| Minimize oxidation of soil organic matter and loss of $CO_2$ | | ✱ | | |
| Minimize soil compaction | ✱ | ✱ | | |
| Minimize temperature fluctuations at soil surface | ✱ | | | |
| Provide regular supply of organic matter as substrate for soil organism activity | ✱ | | | |
| Increase, maintain nitrogen levels in root zone | ✱ | ✱ | ✱ | ✱ |
| Increase cation exchange capacity of root zone | ✱ | ✱ | ✱ | ✱ |
| Maximize rain infiltration, minimize runoff | ✱ | ✱ | | |
| Minimize soil loss in runoff and wind | ✱ | ✱ | | |
| Permit, maintain natural layering of soil horizons through action of soil biota | ✱ | ✱ | | |
| Minimize weeds | ✱ | ✱ | | ✱ |
| Increase rate of biomass production | ✱ | ✱ | ✱ | ✱ |
| Speed recuperation of soil porosity by soil biota | ✱ | ✱ | ✱ | ✱ |
| Reduce labour input | | ✱ | | |
| Reduce fuel/energy inputs | | ✱ | ✱ | ✱ |
| Recycle nutrients | ✱ | ✱ | ✱ | ✱ |
| Reduce pest-pressure of pathogens | | | | ✱ |
| Rebuild damaged soil conditions and dynamics | ✱ | ✱ | ✱ | ✱ |
| Pollination services | ✱ | ✱ | ✱ | ✱ |

Friedrich, T., Kassam, A.H. & Shaxson, F. 2009. Conservation agriculture. In: *Agriculture for developing countries. Science and technology options assessment (STOA) project.* European Parliament. Karlsruhe, Germany, European Technology Assessment Group.

Table 1 Sustainable intensification and ecosystem services (FAO 2011)

In order to implement sustainable intensification at the farm level, there are five key building blocks (adapted from Reeves et al 2016). Each is important in its own right, but the greatest impacts arise from their effective combination and integration. These building blocks are:

» **Conservation agriculture** (CA), through minimal soil disturbance (zero tillage), the use of surface mulches and crop rotation and the integrated production of crops, forages, livestock, trees and shrubs

» **Healthy soils** with greater levels of soil organic matter, through integrated soil nutrition management including more legumes, to enhance crop growth, bolster stress tolerance and promote higher input use-efficiency of water and nutrients

» **Improved crops/varieties/livestock** that are well adapted, with high yield potential, resistance to biotic and abiotic stresses, more input-use efficient and with higher nutritional quality

» **Efficient water management** (after ensuring environmental flows are met) that improves productivity, labour and energy efficiency, helps reduce agricultural water pollution and ultimately uses less water

» **Integrated pest management** based on good farming practices, more resistant varieties, natural enemies and judicious use of pesticides when necessary

Some would argue that Australian farmers are already well invested in these five practices, and certainly in terms of some elements of component one – CA - this is true, as we are a leader in the adoption and adaptation of conservation agriculture. However, there are still some very important areas where changes and improvements have to be made and these are addressed in the sections that follow.

**Enhancing Sustainable Intensification Practices – in Australia and Globally**

***Conservation Agriculture***

Australia has been and remains a leader in the development, adaptation and adoption of CA systems (NLA Trove 2016; D'Emden et al 2008). These achievements have been the result of a number of effective partnerships – between scientists and farmers; between the public and private sectors; and between farmers, through grower groups including the No-Till Farmers Associations. However, there are clear signs that new and different directions need to be taken if CA is going to continue effectively contributing to sustainable intensification, both nationally and globally.

In Australia, greater system diversification is required. Canola-wheat rotations, which now dominate southern cropping farms are not a diverse system.

In addition, nitrogen use- efficiency still averages around 50% with the application of nitrogen fertilizers, and some of these losses are contributing to emissions of the potent greenhouse gas, nitrous oxide.

Recent research has shown that these losses can be reduced by the utilization of more biologically fixed N from legumes - both pastures and pulses - as legume-fixed N is generally a less emissive form of N input than fertilizer N (NANORP 2012-2015). Pasture rotations which help to re-build soil carbon levels and in so doing sequester carbon dioxide are absent from many farms and yet without them there is clear evidence that soil carbon/OM levels are steadily declining in our farming systems (see later under 'Soil Health').

Management options for greater, 'modernized' system diversification include:

» Improved soil management with minimal or no disturbance, surface and subsoil amendments where appropriate, with lime, gypsum, organic materials and major and macro-nutrients to stimulate soil biological activity and overall soil health

» Greater range of crop options – wheat, barley, oats, triticale, millets, sorghums, maize, canola and various pulses and other legume options

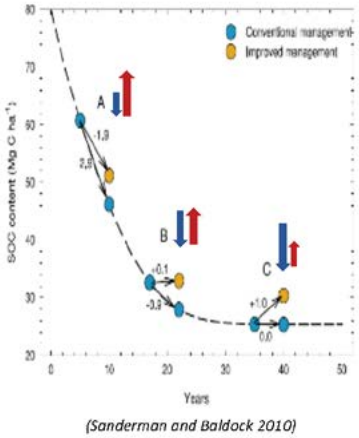
» More diverse crop varieties/species – range of planting times, flowering times and crop maturities, and with greater resistance to biotic stresses and tolerance of abiotic stresses (dryness, heat, frost)

» More diverse crop management – differential grazing/defoliation regimes, N timing and forms including more biologically fixed N, cover crops/ mulches, differing stubble heights and spreading

» Livestock integration for enhanced crop, residue, weed and pasture management and N cycling and for diversification of farm income streams

» Incorporation of trees and shrubs to provide a range of ecosystem services, including shade and shelter for livestock, as the incidence and magnitude of heat stress for animals is likely to increase as our temperatures rise and more 'high heat' days are experienced. Re-invigoration of 'adaptive agroforestry'

» More innovative ideas that will require more research and evaluation, could include; sowing 'shandies' of crop varieties; strip cropping – alternate strips, of say a cereal and a pulse, side by side across the paddock; inter-cropping – different crops in different rows; 'fan' drones to aid frost protection; biopolymers for soils to reduce evaporation (and perhaps one day, to protect crops). Too futuristic? So were smart phones around 15 years ago…




(Sanderman and Baldock 2010)

- Red Soil, GSR 300mm, 4t/ha @ 10.5% protein

| Year | Soil N | Fert N | N Cost (% of GM) |
|---|---|---|---|
| 2017 | 108 | 80 | 9.1 |
| 2037 | 54 | 134 | 14.6 |
| 2067 | 27 | 161 | 17.7 |

Declining N fertility – need for legumes….

(Sanderman and Baldock 2010)

Figure 3 Soil C and N changes under current farming systems (Courtesy of Dr John Kirkegaard CSIRO)

Angus et al (2015) have provided an excellent review of the impacts of break crops on wheat yields based on more than 900 comparisons conducted across Australia and elsewhere and it is well worth reading.

***Healthy Soils***

Soil health is defined as *'the capacity of the soil to function as a living system that sustains plant and animal productivity, maintains or enhances water and air quality, and promotes plant and animal health'* (Doran and Zeiss 2000).

Soil health and fertility are the 'engine room' of productivity, profitability and sustainability on farms and yet there are some disturbing signs that our current intensive cropping systems are steadily depleting both soil N and soil carbon levels (figure 3) here in Australia (Sanderman et al, 2010; Sanderman and Baldock, 2010; Lake 2012b). These are critical indicators of sustainability for our farming systems as the benefits arising from fertile, healthy soils are well recorded and include – increased water infiltration; increased microbial activity and nutrient availability; enhanced root growth; less dependence on energy-rich inputs, particularly nitrogen fertilizers; and more resilient farming systems.

In relation to soil carbon levels under intensive cropping, Dr Geoff Baldock, CSIRO (Baldock 2019) made the following salient points:

» Stocks of soil organic matter (SOM) and nitrogen (N) are limited resources and current trends across Australian agricultural soils indicate that these are declining (Luo et al. 2010).

» Soil derived N can contribute to the amount of N available to a crop. As the capacity of a soil to deliver N declines, increased rates of fertiliser N will be required and optimising profit (where marginal benefit=marginal cost) may move to lower yields.

» N balance calculations are essential to define how management is altering the stock of soil N. A range of indices exist that can be monitored over time to provide an indication of how management is affecting N stocks.

» Altering management practices to maintain SOM and N status are likely to be associated with increased costs (either increased expenditure or opportunity costs). Mechanisms for offsetting increased costs associated with applying management practices to accumulate organic matter and N exist, and more are under development.

» Taking a long term (decadal) view on the economic implications is critical to ensure future productivity will not be compromised in an effort to maximise short term (annual) profits.

In addressing the steady and relentless declines in soil N (see figure 4) across our farming systems (Lake 2012b), (Peoples et al (2017) and Lake (2012a) have both described the importance of including more legumes in these intensified systems, with the greatest impacts on soil N accretion resulting from pasture legume phases or 'brown manuring' of grain legumes (see table 2).

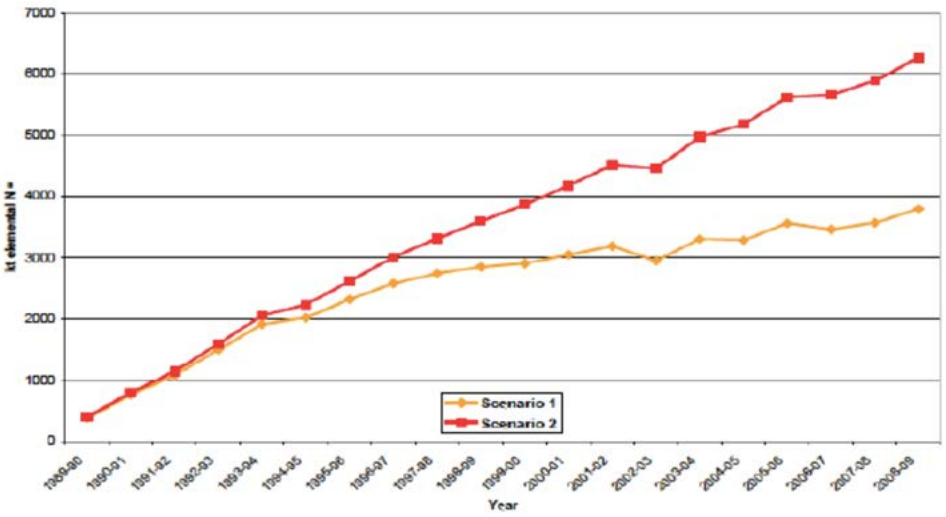



Figure 4 – Accumulated N deficits expressed as elemental N fertilizer equivalent in Australian temperate crop soils as estimated by two scenarios, Scenario 1 being the best possible case of N fertiliser usage on those crops and Scenario 2 being a more realistic assessment of likely N usage levels.

Australia's declining crop yield trends II: The role of nitrogen nutrition – A.W.H. Lake

## Declining N fertility – need for legumes....

- 19 kg/ha/N per tonne biomass produced
- All variable so all have room for improvement
- Pasture=Brown manure > Grain legume

| System | N fixed (kg/ha) | Net input (kg/ha) |
|---|---|---|
| Grain legumes | **134** *(65 – 310)* | 45 (-40 – 96) |
| Grain legume BM | **144** *(86 – 246)* | 144 *(86 – 246)* |
| Pastures | **174** *(102 – 256)* | 132 *(70 – 199)* |

*Courtesy Mark Peoples CSIRO: GRDC Crop Sequence Initiative*


Table 2 – Impacts of legumes on soil N levels

In honouring the memory and work of William Farrer and his emphasis on soil fertility as well as crop breeding, it has stimulated me to look back at lessons from the past and in so doing to reflect on the outstanding work on soil fertility of my long-time, now sadly passed colleague, Tony Ellington. His work at Rutherglen in the 1960s and 1970s, on soil N and OM accretion under clover pasture leys and its subsequent use by successive cereal crops reminds us that we have a number of well proven options to increase soil N, as Baldock (2019) re-affirms. I have reproduced here one of the original figures (see figure 5) from Tony's work (Ellington et al 1979) and it is interesting to note that the clover-ley system that he used actually resulted in a 'spiralling up' of soil N levels despite the growing of four successive wheat crops after the 5 year pasture phase. This is in contrast to the 'spiralling down' trend that we are now experiencing on many farms and one could argue that these steady losses of soil nitrogen and carbon levels could be interpreted as a slow path to financial demise where the largest impacts are likely to be endured by the next generation. Of course, as previously outlined, we know that the ley system broke down due to a number of biophysical and economic reasons. However, we now have ready solutions to these bio- physical problems and the returns from livestock have well and truly risen. There is evidence that in many regions, crop-livestock producers have fared better than crop-only producers during the tough seasons experienced in recent years, as livestock have been a source of economic diversity and have helped to offset climatic and market risks, as well as helping to enhance soil health.

Sustainable intensification and the future of farming is highly dependent on fertile, healthy soils and if we are to achieve the dual imperatives of enhanced productivity and ecosystem health then greater attention to our key resource, the soil, is urgently required. Many ancient civilisations declined as soil fertility declined - "Civilisations rise and fall on the quality of their soil" (Scholes and Scholes 2013) - let us not join them.

**Improved crops and livestock**

Improved crop varieties are invariably used in our current systems and are an important component of sustainable intensification, now and in the future. It is however critical thatgreater emphasis is given to those genetic attributes that will boost the success of sustainable intensification systems. These include the continuing development of durable resistance to biotic stresses, where good progress continues to be made (eg McIntosh and Pretorius 2011). For other important crop traits, the development and adoption of early sown winter wheats (Hunt et al 2019) has been an exciting development and highly beneficial in helping many crop producers to adapt to changing climatic conditions, particularly the changed rainfall patterns of the past 25 years or so, where autumn and winter rainfall has declined and summer rainfall increased, in many parts of southern Australia (Karoly 2014).

However, the excellent work of Flohr et al (2018) is a reminder that constant attention is required to meet the changing needs of our evolving farming systems as she and her colleagues found that the rates of wheat yield increases in NSW had plateaued since the 1980s; that flowering time was less stable

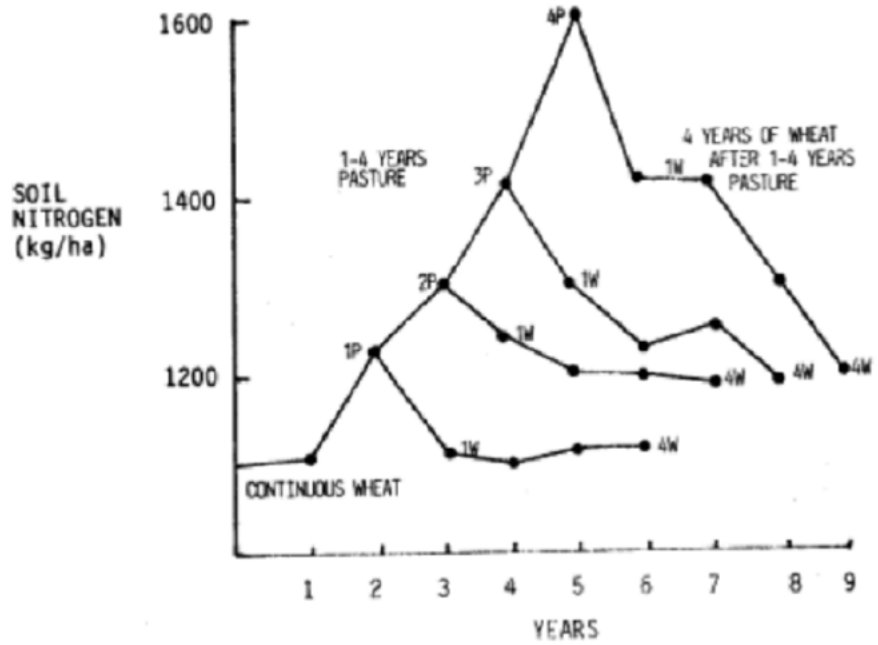



Figure 5 Soil N accretion under legume pastures (Ellington et al 1979)

in the modern varieties; and that vernalisation could become a more important trait in our wheat breeding programs.

As perhaps a support to their conclusions that the rate of wheat yield increase had declined possibly due to an emphasis on quality related traits rather than yield per se, the performance of several imported feed quality wheats e.g. RGT Accroc (N. Poole, Hyper Yielding Cereal Project GRDC Updates 2018) has been quite remarkable in some regions. In a field comparison conducted at the University of Melbourne's Dookie Campus in 2018, RGT Accroc yielded around 30% more than Australian bred grazing wheats, despite a very dry and hot growing season. RGT Accroc is of French origin and this reminds us once more of the vision of William Farrer who had close collaboration with the French wheat breeder Henri Vilmorin, all of those years ago. France has proven to be an excellent source of high- yielding wheats for many decades and it seems that the Farrer partnership with Vilmoren contributed to the foundations of this, as Vilmoren's varieties featured strongly in Europe for a more than two decades – including some resulting from crosses with Farrer's material (Belderok et al 2000)

Another important aspect of the use of a range of crop varieties for sustainable intensification and as a source of genetic diversity on farm, is the diversity between farms in a district or region. The genetic diversity between farms is often limited – for example a single canola variety dominated around 70 to 80% of the planted area in NE Victoria in 2018. From an industry perspective this is undesirable in terms of risk management particularly for diseases, and adds complexity to the decision making by growers and their agronomists when selecting varieties. For sustainable intensification, decision making must move from paddock productivity, to system productivity, to farm productivity and the latter also needs to take into account the landscapes and ecosystems in which the farm is located.

Crop varieties/species with enhanced resistance/ tolerance to abiotic and biotic stresses; with greater input-use efficiency – water, nutrients and elevated carbon dioxide; with greater adaptability to mixed farming systems – for example graze and grain crops; and with greater nutritional value, are all required as a key component of sustainable intensification.

Improved livestock are also a key part of sustainable intensification systems both globally and here in Australia, eg Herrero et al (2010) and McDermott et al (2010). In the Australian context we have long concentrated on successfully breeding and selecting for productivity gains – meat, wool, milk – for key management attributes – durable conformation, easy calving/lambing, temperament – and for quality aspects. Whilst all of these remain important, there are now other traits to be considered that are critical to sustainable intensification systems and these include:

» Enhanced stress tolerance – especially, to heat

» Enhanced input-use efficiency – particularly feed conversion efficiency

» Enhanced pest and disease resistance – particularly to pathogens more likely to be important in a changing climate

» Adaptation to a range of 'new' farming systems – including housed and zero grazing options

Genomic selection is helping to make all of these a reality and significant progress has been made in several of these areas. In the dairy industry (e.g. Pryce et al 2018; Nguyen et al 2017) provide good examples of this progress.

**Efficient water management**

Water use-efficiency on many Australian farms is high, but nationally crop yield gaps – between potential water limited yields and actual yields - average around 30 to 40% (Kirkegaard et al 2014) and so there is still significant scope for improvement, albeit with the need to take risk management into account. In his 2017 Farrer Oration (now also published as Kirkegaard 2019), John Kirkegaard emphasised the need for an integrated approach to enhancing water-use efficiency, citing that the combined impacts of better varieties adapted to earlier sowing and improved agronomy are necessary to achieve these greater efficiencies (Kirkegaard and Hunt 2010). These are also the principles of sustainable intensification where system productivity and sustainability are the aims, rather than maximizing the performance of one crop or livestock unit.

An excellent example of system adaptation to achieve efficient water management is the widespread adoption of summer weed control in the rainfed cropping regions of southern Australia. As rainfall patterns have changed (Karoly 2014) with resultant reductions in autumn and winter rainfall, but in many cases also with marked increases in summer rainfall, the practices of conservation agriculture and summer weed control have helped to reduce the dependency on 'growing season' rainfall – which in some regions has had little relief from the 'Millennium drought' – and taken advantage of significant rain whenever it falls. This remarkable adaptation, that sometimes 'flies under the radar' is another great example of scientists and farmers working together to achieve a significant breakthrough (Hunt and Kirkegaard 2011).

Another even more recent example of system adaptation to rainfall changes is the re- introduction of long fallows into intensive cropping systems in a number of regions in southern Australia. The early adopters – mainly large-scale operators – believe

that the benefits of more timely seeding and management of the paddocks to be planted with crops and the 'income smoothing' effects resulting from fallowing are more than enough to offset 'lost production' incurred during the fallow period (D. Cann and J. Hunt, GRDC Research Updates 2018). Fallows are based on CA with no tillage and mulch retention and either commence around July, or September, through 'brown manuring', and for the shorter fallows this could be after several months' growth of vetch, for example.

There is still further scope to improve water-use efficiency on farms through efficient combination of all of the components of sustainable intensification and this applies to both crop and livestock systems. Whilst, as described above, many cropping farmers have effectively utilised the increased falls of summer rainfall, there is less evidence of such adoption in some of the livestock industries. Matching pasture forage species and varieties to seasonal rainfall has been a major feature of past recommendations and this needs to be re-visited to re-assess the values of Lucerne, Phalaris and other perennial forages under the changed rainfall scenarios (Cheng et al 2019). New opportunities for pasture-cropping (www.pasturecropping.com) and other forms of regenerative agriculture may also arise in some regions.

**Integrated pest, disease and weed management**

The ever-increasing problems of herbicide resistant weeds are indicative of the need to further improve our integrated weed/pest management strategies and practices if sustainable intensification is to be successful. A weakness of our CA systems in Australia that underpin sustainable intensification, is the extensive reliance on herbicides to manage weeds, which has not only caused resistance problems (Manalil et al, 2011) but also raises concerns over soil residues (Holloway et al 2006 a and b), environmental impacts and in some cases, the health of the operators involved. In other regions of the world much more attention has been given to other ways of controlling weeds through the use of cover crops (GRDC Cover Crops for No-Till Farming Systems report, 2009) and other techniques such as relay-cropping (Rodriguez et al 2013). We continually need to look at other options for weed management that involve more judicious use of herbicides.

Innovative research on microwave (MW) treatment of weed seed banks by my colleagues at the Dookie Campus of the University of Melbourne, may add to future options for resistant weed/weed seedbank management and for non-chemical weed control in mixed farming systems (e.g. Khan et al 2018). This work is led by Dr Graham Brodie (Brodie et al 2017) who has been investigating the role of MW weed and soil treatments in agricultural systems for over a decade. Results have been very positive with significant reductions in weed seeds and weed numbers; beneficial impacts on soil fertility, and resultant wheat yield increases of around 25% after MW treatments. This technology has now become much more energy- efficient and is now being commercialised, and likely to be available in the next couple of years. Perhaps one of the lessons to be learned from this development with microwaves is that new technologies for agriculture may well come from other sectors and industries – materials technology/minerals/aeronautics/nanotechnologies and more.

**The Way Forward for Sustainable Intensification of our agri-food systems**

Sustainable intensification provides a sensible and practical way forward as the world meets the need to 'produce more with less' or as one colleague recently put it to 'produce enough with less' (Professor John Porter, personal communication, 2018). More people, more food, changing diets, less land, less water, less energy-rich inputs and less greenhouse gas emissions from agriculture is hardly the scenario for 'business as usual'. In many parts of the world including Australia, significant progress has been made with sustainable intensification of our agricultural systems, but much more needs to be done, and done efficiently, effectively and with urgency. In this Oration, I have outlined what I believe to be are some of the improvements required. One that has become very clear to me is that sustainable intensification cannot stop at the farm level and is essential throughout the whole agri-food value chain. Hard won efficiencies at the farm level cannot be squandered at the landscape, processing or consumption levels and vice versa.

Drawing on my 50 years of sustainable agriculture research and development I am firstly, strongly of the belief that **greater diversification must be urgently re-introduced into our farming landscapes** to build stronger farm business resilience. The dictionary definition of resilience is "the capacity to recover quickly from difficulties; toughness" and better preparedness to face future farming difficulties is of paramount importance, as both our climate and operating environments are changing markedly. Secondly, I am also strongly of the belief that the **declining soil carbon and nitrogen levels** in many of our farming soils are a further reminder that 'sustainability is a moving target' and are a **strident call to action** for immediate attention.

Resilience needs to be the cornerstone of any future drought policies by governments, giving attention to diversification of farm income, greater off-farm reserves, and other on- farm diversification of income sources that are not so dependent on annual rainfall. At the paddock level, the same practices and systems that build greater farm business resilience – less disturbance, greater diversification,

enhanced input use-efficiency, and healthy soils with higher soil carbon levels – are the same as those that will also result in greater productivity, profitability and sustainability – a 'win-win' outcome. To achieve these 'win- wins' will require ongoing and patient support for good, multidisciplinary, on-farm research and the training of young scientists who are effective 'integrators' rather than specialists, as a new generation of scientists is required to take on this challenge of working with farmers to develop 'more diverse farms and more diverse but integrated practices'.

Sustainable intensification is the best way forward to food and nutritional security for the foreseeable future and we should further develop and implement the improvements to it that are described above, with urgency. What else is on the 'horizon of hope' for feeding humankind? The answer is that there are many new products and ideas in the 'production line' of new foods and new solutions to food and nutritional security and these include:

- Burgers without meat – the hamburger chain Burger KingR are already selling them in the USA https://protect-au.mimecast.com/s/jBL-CQnzDmsQB35WUx_Fvl?domain=theguardian.com
- Black Soldier Fly larvae – the potential for these to efficiently utilize waste products and convert it into usable protein-rich feed/foodstuffs is exciting many
- Vertical farming - is taking off around the world and more recently in Australia
- Seaweed farming for protein, fertilizers, energy and more – https://agfundernews.com/quest-sustainable-seaweed.html
- Printing 3D food
- What the supermarkets think
- Who knows, a future Farrer Memorial Oration may well cover the lifetime achievements of an eminent scientist who has worked in one or more of these fields and it will serve to remind the audience that sustainability in our food production systems will remain as a 'moving target'.

**Acknowledgements**

I am deeply honoured to receive this prestigious award and wish to thank the Farrer Memorial Trustees for recognising my work in this way. Farrer was an inspiration for us all with his pioneering work for the betterment of agriculture and humankind and we all stand 'on his shoulders'. I have always believed that little can be achieved without the work of great teams and throughout my career I have been a team member with some outstanding colleagues and later I have focused on helping to bring great teams together - at the Rutherglen Research Institute, at the Roseworthy Campus of the University of Adelaide, at CIMMYT and in the past year, at the Dookie Campus of the University of Melbourne. I am indebted to all who I have had the honour and privilege of working with, thank you everyone! Good bosses have also been very important in my career and I acknowledge them all, particularly Arthur Mann, the late Les Hore, Dr Des Hore, the late Paul McGowan, the late Dr Jim McLaughlin, Dr Jack Meagher, the late Professor Harold Woolhouse, Professor Wally Falcon and Professor John Fazakerley, each one of whom entrusted me to get the job done.

Lastly, but most importantly I thank my wonderful family whose love and unrelenting support have been major contributors to my life and my career. My first wife Pat, sadly passed, was a soul mate when we first sailed to Australia - almost 100 years after Farrer took a similar journey – and for another 33 years at Rutherglen and beyond. RIP Pat. Since 2003, my wife Patricia has been and remains a pillar of my family and working life, thank you Patti! To my children, you are the best kids a father could have and are indeed my greatest achievement. Thank you!

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Washington, DC © World Bank

# INDEPENDENT AUDITOR'S REPORT

**The Trustee for Farrer Memorial Research Scholarship Fund**

To Members of the New South Wales Parliament

## Opinion

I have audited the accompanying financial statements of The Trustee for Farrer Memorial Research Scholarship Fund (the Trust), which comprise the Statement of Comprehensive Income for the year ended 31 December 2019, the Statement of Financial Position as at 31 December 2019, the Statement of Changes in Equity and the Statement of Cash Flows for the year then ended, notes comprising a Statement of Significant Accounting Policies and other explanatory information.
In my opinion, the financial statements:

- give a true and fair view of the financial position of the Trust as at 31 December 2019, and of its financial performance and its cash flows for the year then ended in accordance with Australian Accounting Standards
- are in accordance with section 41B of the *Public Finance and Audit Act 1983* (PF&A Act) and the Public Finance and Audit Regulation 2015

My opinion should be read in conjunction with the rest of this report.

## Basis for Opinion

I conducted my audit in accordance with Australian Auditing Standards. My responsibilities under the standards are described in the 'Auditor's Responsibilities for the Audit of the Financial Statements' section of my report.

I am independent of the Trust in accordance with the requirements of the:

- Australian Auditing Standards
- Accounting Professional and Ethical Standards Board's APES 110 'Code of Ethics for Professional Accountants (including Independence Standards)' (APES 110).

I have fulfilled my other ethical responsibilities in accordance with APES 110.

Parliament promotes independence by ensuring the Auditor-General and the Audit Office of New South Wales are not compromised in their roles by:

- providing that only Parliament, and not the executive government, can remove an Auditor-General
- mandating the Auditor-General as auditor of public sector agencies
- precluding the Auditor-General from providing non-audit services.

I believe the audit evidence I have obtained is sufficient and appropriate to provide a basis for my audit opinion.

**Level 19, Darling Park Tower 2, 201 Sussex Street, Sydney NSW 2000**
GPO Box 12, Sydney NSW 2001 | **t** 02 9275 7101 | **f** 02 9275 7179 | mail@audit.nsw.gov.au | audit.nsw.gov.au

## Other Information

The Trust's annual report for the year ended 31 December 2019 includes other information in addition to the financial statements and my Independent Auditor's Report thereon. The Trustees are responsible for the other information. At the date of this Independent Auditor's Report, the other information I have received comprise the Statement in accordance with Section 41C(1B) of *Public and Finance and Audit Act 1983*.

My opinion on the financial statements does not cover the other information. Accordingly, I do not express any form of assurance conclusion on the other information.

In connection with my audit of the financial statements, my responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the financial statements or my knowledge obtained in the audit, or otherwise appears to be materially misstated.

If, based on the work I have performed, I conclude there is a material misstatement of the other information, I must report that fact.

I have nothing to report in this regard.

## The Trustees' Responsibilities for the Financial Statements

The Trustees are responsible for the preparation and fair presentation of the financial statements in accordance with Australian Accounting Standards and the PF&A Act, and for such internal control as the Trustees determine is necessary to enable the preparation and fair presentation of the financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, the Trustees are responsible for assessing the Trust's ability to continue as a going concern, disclosing as applicable, matters related to going concern and using the going concern basis of accounting.

## Auditor's Responsibilities for the Audit of the Financial Statements

My objectives are to:

- obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error
- issue an Independent Auditor's Report including my opinion.

Reasonable assurance is a high level of assurance, but does not guarantee an audit conducted in accordance with Australian Auditing Standards will always detect material misstatements. Misstatements can arise from fraud or error. Misstatements are considered material if, individually or in aggregate, they could reasonably be expected to influence the economic decisions users take based on the financial statements.

A description of my responsibilities for the audit of the financial statements is located at the Auditing and Assurance Standards Board website at: www.auasb.gov.au/auditors_responsibilities/ar4.pdf. The description forms part of my auditor's report.

My opinion does *not* provide assurance:

- that the Trust carried out its activities effectively, efficiently and economically
- about the security and controls over the electronic publication of the audited financial statements on any website where they may be presented
- about any other information which may have been hyperlinked to/from the financial statements.

Min Lee
Director, Financial Audit Services

Delegate of the Auditor-General for New South Wales

8 May 2020
SYDNEY


# The Trustee for Farrer Memorial Research Scholarship Fund

## Financial Statements
## Year ended 31 December 2019

**THE TRUSTEE FOR FARRER MEMORIAL RESEARCH SCHOLARSHIP FUND**

**STATEMENT IN ACCORDANCE WITH SECTION 41C(1B)**
**OF PUBLIC FINANCE AND AUDIT ACT 1983**

Pursuant to Section 41C (1B) of the *Public Finance and Audit Act 1983* and in accordance with a resolution of the Trustees of the Farrer Memorial Research Scholarship Fund, we declare on behalf of the Trust that, in our opinion:

(a) the accompanying financial statements have been prepared in accordance with applicable Australian Accounting Standards (which include Australian Accounting Interpretations), the provisions of the *Public Finance and Audit Act 1983,* and the applicable clauses of the *Public Finance and Audit Regulation 2015.*

(b) the accompanying financial statements exhibit a true and fair view of the financial position and the financial performance of Farrer Memorial Research Scholarship Fund for the year ended 31 December 2019.

(c) at the date of signing we are not aware of any circumstances that would render the financial statements misleading or inaccurate.

Scott Hansen - Chair
Dated 5 May 2020

Kate Lorimer-Ward - Trustee
Dated 5 May 2020

Beginning of the Financial Statements

THE TRUSTEE FOR FARRER MEMORIAL RESEARCH SCHOLARSHIP FUND

STATEMENT OF COMPREHENSIVE INCOME
FOR THE YEAR ENDED 31 DECEMBER 2019

| | Notes | 2019 $ | 2018 $ |
|---|---|---|---|
| **Expenses excluding losses** | | | |
| Operating expenses | | | |
| Personnel services | 2a | 34,922 | 9,349 |
| Other operating expenses | 2b | 33,394 | 8,655 |
| **Total expenses excluding losses** | | **68,316** | **18,004** |
| **Revenue** | | | |
| Investment revenue | 3a | 30,240 | 31,088 |
| In kind contribution - Department of Planning, Industry and Environment | 3b | 42,622 | 16,849 |
| **Total revenue** | | **72,862** | **47,937** |
| Other Gains / (losses) | 4 | 37,367 | (37,223) |
| **Net Result** | | **41,913** | **(7,290)** |
| **Total Comprehensive Income** | | **41,913** | **(7,290)** |

The accompanying notes form part of these financial statements

THE TRUSTEE FOR FARRER MEMORIAL RESEARCH SCHOLARSHIP FUND

STATEMENT OF FINANCIAL POSITION
AS AT 31 DECEMBER 2019

| | Notes | 2019 $ | 2018 $ |
|---|---|---|---|
| **ASSETS** | | | |
| **Current Assets** | | | |
| Cash and cash equivalents | 5 | 152,099 | 154,540 |
| Receivables | 6 | 13,905 | 8,308 |
| Inventories | 7 | 523 | 787 |
| Other financial assets | 8 | 70,357 | 68,703 |
| **Total Current Assets** | | **236,884** | **232,338** |
| **Non-Current Assets** | | | |
| Financial assets at fair value | 9 | 481,648 | 444,281 |
| **Total Non-Current Assets** | | **481,648** | **444,281** |
| **Total Assets** | | **718,532** | **676,619** |
| **Net Assets** | | **718,532** | **676,619** |
| **EQUITY** | | | |
| Accumulated funds | | 718,532 | 676,619 |
| **Total Equity** | | **718,532** | **676,619** |

The accompanying notes form part of these financial statements

THE TRUSTEE FOR FARRER MEMORIAL RESEARCH SCHOLARSHIP FUND

STATEMENT OF CHANGES IN EQUITY
FOR THE YEAR ENDED 31 DECEMBER 2019

| | Accumulated Funds<br>$ | Total<br>$ |
|---|---|---|
| **BALANCE AT 1 January 2019** | **676,619** | **676,619** |
| Net result for the year | 41,913 | 41,913 |
| **BALANCE AT 31 December 2019** | **718,532** | **718,532** |
| | | |
| **BALANCE AT 1 January 2018** | **683,909** | **683,909** |
| Net result for the year | (7,290) | (7,290) |
| **BALANCE AT 31 December 2018** | **676,619** | **676,619** |

The accompanying notes form part of these financial statements

THE TRUSTEE FOR FARRER MEMORIAL RESEARCH SCHOLARSHIP FUND

STATEMENT OF CASH FLOWS
FOR THE YEAR ENDED 31 DECEMBER 2019

| | Notes | 2019 $ | 2018 $ |
|---|---|---|---|
| **CASH FLOWS FROM OPERATING ACTIVITIES** | | | |
| **Payments** | | | |
| Grants and subsidies | | (24,375) | - |
| Other | | (1,056) | (891) |
| **Total Payments** | | **(25,431)** | **(891)** |
| | | | |
| **Receipts** | | | |
| Interest received | | 1,258 | 1,356 |
| Dividends received | | 21,732 | 21,479 |
| Capital returns | | - | 7 |
| Franking Credits | | - | 19,813 |
| **Total Receipts** | | **22,990** | **42,655** |
| **NET CASH FLOWS FROM OPERATING ACTIVITIES** | 11 | **(2,441)** | **41,764** |
| | | | |
| **NET INCREASE / (DECREASE) IN CASH AND CASH EQUIVALENTS** | | **(2,441)** | **41,764** |
| Opening Cash and Cash Equivalents | | 154,540 | 112,776 |
| **CLOSING CASH AND CASH EQUIVALENTS** | 5 | **152,099** | **154,540** |

The accompanying notes form part of these financial statements

## 1. Summary of Significant Accounting Policies

### (a) Reporting Entity

The *Farrer Memorial Research Scholarship Fund Act 1930* permits the Trustees (the Trust) to use its earnings to assist study and research into agricultural problems, meet costs of the Farrer Memorial Oration and may provide an honorarium to the recipient of the Farrer Memorial Medal. The Trust is a not-for-profit entity as profit is not its principal objective and it has no cash generating units.

These financial statements for the year ended 31 December 2019 have been authorised for issue by the Chair of the Trust on the date the accompanying statement by the Chair of the Trust was signed.

### (b) Basis of Preparation

The Trust's financial statements are general purpose financial statements which have been prepared on an accrual basis and in accordance with:

- applicable Australian Accounting Standards (which include Australian Accounting Interpretations)
- the requirements of the *Public Finance and Audit Act 1983* and *Public Finance and Audit Regulation 2015.*

Financial assets at 'fair value through profit or loss' are measured at fair value. Other financial statement items are prepared in accordance with the historical cost convention.

Judgements, key assumptions and estimations management has made are disclosed in the relevant notes to the financial statements.

All amounts are rounded to the nearest dollar and are expressed in Australian currency which is the entity's presentation and function currency.

### (c) Statement of Compliance

The financial statements and notes comply with Australian Accounting Standards which include Australian Accounting Interpretations.

### (d) Accounting for the Goods and Services Tax (GST)

Income, expenses and assets are recognised net of the amount of GST, except that the:

- amount of GST incurred by the Trust as a purchaser that is not recoverable from the Australian Taxation Office is recognised as part of the cost of acquisition of an asset or as part of an item of expense and
- receivables and payables are stated with the amount of GST included.

The net amount of GST recoverable from or payable to the Australian Taxation Office is included as part of receivables or payables respectively.

Cash flows are included in the statement of cash flows on a gross basis. However, the GST components of cash flows arising from investing and financing activities which are recoverable from, or payable to, the Australian Taxation Office are classified as operating cash flows.

### (e) Comparative Information

Except when Australian Accounting Standard permits or requires otherwise, comparative information is presented in respect of the previous period for all amounts reported in the financial statements.

## 1. Summary of Significant Accounting Policies (continued)

### (f) New Australian Accounting Standards issued and effective for the first time at 31 December 2019

The accounting policies applied in the preparation of these financial statements are consistent with those of the previous financial year unless otherwise stated. The following new and revised Accounting Standards were applicable for the first time for the 2019 financial year.

The Trust applied AASB 15 *Revenue from Contracts with Customers*, AASB 1058 *Income of Not-for-Profit Entities*, and AASB 16 *Leases* for the first time. These new accounting standards do not have an impact on the financial statements of the Trust.

In addition to AASB 15, AASB16 and AASB 1058, several other amendments and interpretations apply for the first time, and have no impact on the financial statements.

- AASB 2018-8 *Amendments to Australian Accounting Standards – Right-of-Use Assets of Not-for-Profit Entities*
- AASB 2016-7 *Amendments to Australian Accounting Standards – Deferral of AASB 15 for Not-for-Profit Entities*

### (g) Changes in accounting policy, including new or revised Australian Accounting Standards

NSW Public sector entities are not permitted to early adopt new Australian Accounting Standards, unless Treasury determines otherwise.

The following new Australian Accounting Standards have been issued but are not yet effective. The Trust has not early adopted any of these new standards or amendments. When applied in future periods, they are not expected to have a material impact on the financial position or performance of the Trust.

- AASB 1059 *Service Concession Arrangements: Grantors*
- AASB 2018-5 *Amendments to Australian Accounting Standards - Deferral of AASB 1059*

## 2. Expenses Excluding Losses

| | | 2019 $ | 2018 $ |
|---|---|---|---|
| (a) | **Employee related expenses** | | |
| | Personnel expenses | 34,922 | 9,349 |
| | | **34,922** | **9,349** |

**Recognition and Measurement**
The Trust does not have any employees and receives administrative, secretarial support and operational assistance from Department of Planning, Industry and Environment. The Trust is not required to reimburse Department of Planning, Industry and Environment for personnel services.

| | | | |
|---|---|---|---|
| (b) | **Other operating expenses include the following:** | | |
| | Auditor's remuneration | 7,700 | 7,500 |
| | Scholarships | 24,375 | - |
| | Other operating expenses | 1,319 | 1,155 |
| | | **33,394** | **8,655** |

**Recognition and Measurement**
***Insurance***
The Trust's insurance activities are covered by Department of Planning, Industry and Environment insurance with the NSW Treasury Managed Fund Scheme of self-insurance for Government agencies.

## 3. Revenue

### Recognition and Measurement

Until 31 December 2018, income is recognised in accordance with AASB 111 *Construction Contracts*, AASB 118 *Revenue* and AASB 1004 *Contributions*.
From 1 January 2019, income is recognised in accordance with the requirements of AASB 15 *Revenue from Contracts with Customers* or AASB 1058 *Income of Not-for-Profit Entities*, dependent on whether there is a contract with a customer defined by AASB 15 *Revenue from Contracts with Customers*. Comments regarding the accounting policies for the recognition of income are discussed below.

| | 2019<br>$ | 2018<br>$ |
|---|---|---|
| **(a) Investment revenue** | | |
| Interest income from financial assets at amortised cost | 2,857 | 3,098 |
| Dividends | 21,680 | 21,691 |
| Franking Credits | 5,703 | 6,292 |
| Gain on sale of investment | - | 7 |
| | **30,240** | **31,088** |

**Recognition and Measurement**
***Interest Income***
Interest income is calculated by applying the effective interest rate to the gross carrying amount of a financial asset.

***Dividend Income***
Dividend income is recognised when the Trust's right to receive payment has been established.

| | | |
|---|---|---|
| **(b) In kind contribution - NSW Department of Planning, Industry and Environment** | | |
| Personnel services contribution | 34,922 | 9,349 |
| Audit fee contribution | 7,700 | 7,500 |
| | **42,622** | **16,849** |

Department of Planning, Industry and Environment pays for audit remuneration and personnel service on behalf of the Trust. Department of Planning, Industry and Environment provides financial statement preparation services free of charge to the Trust.

**Recognition and Measurement**

**Until 31 December 2018**

Contributions (including grants and donations) are generally recognised as income when the Trust obtains control over the assets comprising the contributions. Control over the contributions is normally obtained upon receipt of the cash.

Contributions are recognised at their fair value. Contributions of services are recognised when and only when a fair value of those services can be reliably determined and the services would be purchased if not donated.

**From 1 January 2019**

Contributions (including grants and donations), without sufficiently specific performance obligations are recognised as income when the Trust obtains control over the assets comprising the contributions.

Contributions are recognised at their fair value. Contributions of services are recognised when and only when a fair value of those services can be reliably determined and the services would be purchased if not donated.

## 4. Other Gains / (Losses)

| | 2019 $ | 2018 $ |
|---|---|---|
| Gains / (losses) on financial assets at fair value through profit or loss | 37,367 | (37,223) |
| | **37,367** | **(37,223)** |

## 5. Current Assets - Cash and Cash Equivalents

| | | |
|---|---|---|
| Cash at bank and on hand | 152,099 | 138,488 |
| At call deposits | - | 16,052 |
| | **152,099** | **154,540** |

For the purposes of the financial statement of cash flows, cash and cash equivalents include cash at bank, cash on hand, short-term deposits, at call deposits and bank overdraft.

Cash and cash equivalent assets recognised in the statement of financial position, are reconciled at the end of the financial year to the statement of cash flows as follows:

| | | |
|---|---|---|
| Cash and cash equivalents (per statement of financial position) | 152,099 | 154,540 |
| Closing cash and cash equivalents (per statement of cash flows) | **152,099** | **154,540** |

Refer Note 12 for details regarding credit risk, liquidity risk and market risk arising from financial instruments.

## 6. Current Assets - Receivables

| | | |
|---|---|---|
| Receivables from investing activities | 13,905 | 8,308 |
| | **13,905** | **8,308** |

Details regarding credit risk, liquidity risk and market risk, including financial assets that are either past due or impaired, are disclosed in Note 12.

**Recognition and Measurement**

Receivables are recognised initially at fair value plus any transaction costs. The Trust holds receivables with the objective to collect the contractual cash flows and therefore measures them at amortised cost using the effective interest method, less any impairment. Changes are recognised in the net result for the year when impaired, derecognised or through the amortisation process.

Short term receivables with no stated interest rate are measured at the original invoice amount where the effect of discounting is immaterial.

## 7. Current Assets - Inventories

| | | |
|---|---|---|
| Medals held for distribution - at cost | 523 | 787 |
| | **523** | **787** |

Inventories consist of Farrer Memorial Medals. Medals are valued at cost which approximates fair value.

**Recognition and Measurement**

Inventories held for distribution are stated at cost, adjusted when applicable, for loss of service potential. A loss of service potential is identified and measured based on the existence of a current replacement cost that is lower than the carrying amount.

## 8. Current Assets - Other Financial Assets

| | 2019 $ | 2018 $ |
|---|---|---|
| Macquarie bank term deposit | 70,357 | 68,703 |
| | 70,357 | 68,703 |

**Recognition and Measurement**

All 'regular way' purchases or sales of other financial assets are recognised and derecognised on a trade date basis. Regular way purchases or sales are purchases or sales of other financial assets that require delivery of assets within the time frame established by regulation or convention in the marketplace.

Other financial assets are initially measured at fair value plus any transaction costs.

Refer to Note 12 for further information regarding credit risk, liquidity risk and market risk arising from financial instruments.

## 9. Non-Current Assets - Financial Assets at Fair Value

The following summary shows the market values (Fair value) of all shareholdings as at 31 December 2019.

| Company | Market Value 2019 $ | Market Value 2018 $ |
|---|---|---|
| **Fixed Income Securities** | | |
| National Australia Bank (NABHA) | 34,040 | 30,895 |
| Macquarie Bank (MBLHB) | 33,372 | 30,780 |
| Suncorp Group (SBKHB) | 33,050 | 32,230 |
| | 100,462 | 93,905 |
| **Listed Trusts** | | |
| Dexus Property Group (DXS) | 23,576 | 21,399 |
| Goodman Group (GMG) | 18,919 | 15,041 |
| Sydney Airport (SYD) | 88,434 | 68,646 |
| SP AusNet (AST) | 24,650 | 22,548 |
| | 155,579 | 127,634 |
| **Growth Securities (Shares)** | | |
| National Australia Bank (NAB) | 28,325 | 27,681 |
| Clydesdale Bank (CYB) | - | 956 |
| Virgin Money (VUK) | 1,002 | - |
| Westpac Banking Corporation (WBC) | 38,704 | 40,064 |
| Coles Group (COL) | 17,036 | 13,478 |
| Cimic Group (CIM) | 56,835 | 74,448 |
| Wesfarmers (WES) | 47,526 | 36,988 |
| Telstra (TLS) | 36,179 | 29,127 |
| | 225,607 | 222,742 |
| **Portfolio Total** | 481,648 | 444,281 |

The movement in the market value of the financial assets at fair value through the income statement in 2019 was a gain of $37,367 (2018: loss of $37,223).

Refer to Note 12 for further information regarding fair value measurement, credit risk, liquidity risk and market risk arising from financial instruments.

## 9. Non-Current Assets - Financial Assets at Fair Value (continued)

**Recognition and Measurement**

All 'regular way' purchases or sales of financial assets are recognised and derecognised on a trade date basis. Regular way purchases or sales are purchases or sales of financial assets that require delivery of assets within the time frame established by regulation or convention in the marketplace.

**Classification and measurement**

The entity's financial assets at fair value are classified, at initial recognition, as subsequently measured at fair value through profit and loss.

**Financial assets at fair value through profit or loss**

Financial assets at fair value through profit or loss include financial assets held for trading, financial assets designated upon initial recognition at fair value through profit or loss, or financial assets mandatorily required to be measured at fair value under AASB 9. Financial assets at fair value through profit or loss are initially and subsequently measured at fair value.

A gain or loss on a financial asset that is subsequently measured at dair value through profit or loss is recognised in net results and presented net within other gains/(losses).

Purchases or sales of investments under contract that require delivery of the asset within a timeframe established by convention or regulation are recognised on the trade date; i.e. the date the Trust commits to the purchase or sale of the asset.

The fair value of investments that are traded at fair value in an active market is determined by reference to quoted current bid prices at the close of business on the statement of financial position date.

## 10. Equity

**Recognition and Measurement**

***Accumulated Funds***

The category accumulated funds includes all current and prior period retained funds.

## 11. Reconciliation of Cash Flows from Operating Activities to Net Result

| | 2019<br>$ | 2018<br>$ |
|---|---|---|
| **Net cash used on operating activities** | **(2,441)** | **41,764** |
| Increase/(decrease) in inventories | (264) | (264) |
| Increase/(decrease) in receivables | 5,597 | (13,277) |
| Increase/(decrease) in fair value of financial assets | 37,367 | (37,223) |
| Increase/(decrease) in other financial assets | 1,654 | 1,710 |
| **Net result** | **41,913** | **(7,290)** |

## 12. Financial Instruments

The Trust's principal financial instruments are outlined below. These financial instruments arise directly from the Trust's operations or are required to finance the Trust's operations. The Trust does not enter into or trade financial instruments, including derivative financial instruments, for speculative purposes.

The Trust's main risks arising from financial instruments are outlined below, together with the Trust's objectives, policies and processes for measuring and managing risk. Further quantitative and qualitative disclosures are included throughout this financial statements.

The Trustees have overall responsibility for the establishment and oversight of risk management and reviews and agrees policies for managing each of these risks. Risk management policies are established to identify and analyse the risks faced by the Trust, to set risk limits and controls and to monitor risks.

The Trust's overall risk management program focuses on the risk versus return feature of financial markets and seeks to minimise adverse effects on the Trust's investment returns. The Trust currently does not use derivative instruments such as foreign exchange contracts and interest swaps to hedge its risk exposure. The Trust uses a variety of risk mitigation measures to manage the types of risk to which it is exposed. These methods include sensitivity analysis in the case of interest rates and other price risks.

The Trust maintains a number of investment portfolios to address a variety of objectives:

- A long term growth portfolio representing the Trust's asset reserves and endowments and has a long term investment horizon. This portfolio has an investment profile oriented towards growth assets and is managed by external fund managers.
- A long term debt portfolio used to generate a fixed income stream. This portfolio invests in short to medium term fixed and floating rate securities.

### (a) Financial Instrument Categories

| Financial Assets | Note | Category | Carrying Amount | Carrying Amount |
|---|---|---|---|---|
| Class: | | | 2019 $ | 2018 $ |
| Cash and cash equivalents | 5 | Amortised cost | 152,099 | 154,540 |
| Financial assets at fair value | 9 | At fair value through profit or loss - designated as such upon initial recognition | 481,648 | 444,281 |
| Receivables | 6 | Loans and receivables (at amortised cost) | 13,905 | 8,308 |
| Other financial assets | 8 | Fair value through profit or loss - designated as such upon initial recognition | 70,357 | 68,703 |

### (b) Credit Risk

Credit risk arises when there is the possibility that the counter party will default on their contractual obligations, resulting in a financial loss to the Trust. The maximum exposure to credit risk is generally represented by the carrying amount of the financial assets.

Credit risk arises from the financial assets of the Trust, including cash, receivables and other financial assets. No collateral is held by the Trust. The Trust has not granted any financial guarantees.

Credit risk associated with the Trust's financial assets, other than receivables, is managed through the selection of counterparties and establishment of minimum credit rating standards.

**12. Financial Instruments (continued)**

**(b) Credit Risk (continued)**

**Cash**

Cash comprises cash on hand and bank balances with St George Bank. St George interest is earned on the daily bank balance at market rates and Rabobank interest was earned at a flat 0.05% rate during 2019 (2018: 0.05%). The Rabobank account was closed during the year.

**Receivables - trade debtors**

All trade debtors are recognised as amounts receivable at balance date.

**Other financial assets**

The Trust has placed funds on deposit with Macquarie Bank Limited for a fixed term. The interest rate payable is fixed for the term of the deposit. The deposits at balance date were earning an average interest rate of 2.40% (2018: 2.75%).

**(c) Liquidity risk**

Liquidity risk is the risk that the Trust will be unable to meet its payment obligations when they fall due. The Trust continuously manages risk through monitoring future cash flows and maturities planning to ensure adequate holding of high quality liquid assets. The Trust has no loans payable and no assets have been pledged as collateral. The Trust's exposure to liquidity risk is deemed insignificant based on prior periods' data and current assessment of risk. The Trust has no material liabilities and the majority of the assets are cash, cash equivalents or tradable shares and securities.

**(d) Market risk**

Market risk is the risk that the fair value or future cash flows of a financial instrument will fluctuate because of changes in market prices. The Trust's exposure to market risk are primarily through price risk and cash flow and fair interest rate risk.

The effect on profit and equity due to a reasonably possible change in risk variable is outlined in the information below, for interest rate risk and other price risk.

**Interest rate risk**

The Trust's interest rate risk arises from the cash kept in the bank account subject to interest bearing at variable average rate of 0.05%. At 31 December 2019, if interest rates decreased/increased by 1.00% with all other variables held constant, equity would have been $1,521 lower/higher (2018: $1,545 lower/higher) as a result of an increase/decrease in fair value of debt security.

**Other price risk**

The Trust has exposure to equity securities price risk. This arises from investments held by the Trust and classified on the balance sheet as "Assets held at fair value" through the income statement, such that the impact of a change in value of the securities would be reflected as either an increase or decrease in fair value of the security through the income statement.

To manage its price risk from investments in equity securities, the Trust has contracted out the management of the portfolio to external fund managers, Macquarie Equities Limited. These fund managers are mandated to diversify the investments of the portfolio under their management. The quantum of funds under management per external fund manager and the investment objectives of each external fund manager are in accordance with policies set by the Trustees.

A majority of the Trust's equity investments managed by external fund managers are denominated in AUD, are publicly traded and included in the ASX 300 Index. The impact of increases/decreases on the ASX 300 Index on the Trust's equity would be increase/decrease of $48,164 (2018: $44,128). The analysis is based on the assumption that the ASX 300 Index increased/decreased by 10%, with all other variables held constant and the Trust's equity portfolio moves according to the historical correlation with the index.

## 12. Financial Instruments (continued)

### (d) Market risk (continued)

| | Carrying Amount | Interest rate risk | | | | Other price risk | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | -1.00% | | 1.00% | | -10.00% | | 10.00% | |
| | $ | Profit | Equity | Profit | Equity | Profit | Equity | Profit | Equity |
| **31 December 2019** | | | | | | | | | |
| **Financial Assets** | | | | | | | | | |
| Cash & cash equivalents | 152,099 | (1,521) | (1,521) | 1,521 | 1,521 | - | - | - | - |
| Financial Assets held to Maturity [1] | 70,357 | - | - | - | - | - | - | - | - |
| Receivables [2] | 13,905 | - | - | - | - | - | - | - | - |
| Fixed Income Securities [3] | 100,462 | - | - | - | - | (10,046) | (10,046) | 10,046 | 10,046 |
| Listed Trusts | 155,579 | - | - | - | - | (15,558) | (15,558) | 15,558 | 15,558 |
| Growth Securities | 225,607 | - | - | - | - | (22,561) | (22,561) | 22,561 | 22,561 |
| **Total increase/(decrease)** | | **(1,521)** | **(1,521)** | **1,521** | **1,521** | **(48,165)** | **(48,165)** | **48,165** | **48,165** |
| **31 December 2018** | | | | | | | | | |
| **Financial Assets** | | | | | | | | | |
| Cash & cash equivalents | 154,540 | (1,545) | (1,545) | 1,545 | 1,545 | - | - | - | - |
| Financial Assets held to Maturity [1] | 68,703 | - | - | - | - | - | - | - | - |
| Receivables [2] | 8,308 | - | - | - | - | - | - | - | - |
| Fixed Income Securities [3] | 93,905 | - | - | - | - | (9,391) | (9,391) | 9,391 | 9,391 |
| Listed Trusts | 127,634 | - | - | - | - | (12,763) | (12,763) | 12,763 | 12,763 |
| Growth Securities | 222,742 | - | - | - | - | (22,274) | (22,274) | 22,274 | 22,274 |
| **Total increase/(decrease)** | | **(1,545)** | **(1,545)** | **1,545** | **1,545** | **(44,428)** | **(44,428)** | **44,428** | **44,428** |

*Notes:*
*1. Held to Maturity Term Deposits are not traded and are not subject to interest rate variation during the term.*
*2. Receivables include interest due on Fixed Interest Securities and Term Deposits and dividends receivable. The value of these receivables will not change due to changes in market interest rates.*
*3. Fixed Income Securities are composed of Listed Fixed Interest Securities which are not subject to changes in market interest rates.*

### (e) Fair value measurement

#### (i) Fair value compared to carrying amount

Fair value is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date. The fair value measurement is based on the presumption that the transaction to sell the asset or transfer the liability takes place either in the principal market for the asset or liability or in the absence of a principal market, in the most advantageous market for the asset or liability.

#### (ii) Fair value recognised in the statement of financial position

When measuring fair value, the valuation technique used maximises the use of relevant observable inputs and minimises the use of unobservable inputs. Under AASB 13, the Trust categorises, for disclosure purposes, the valuation techniques based on the inputs used in the valuation techniques as follows:

- Level 1 - quoted prices in active markets for identical assets/liabilities that the Trust can access at the measurement date.
- Level 2 - inputs other than quoted prices included in Level 1 that are observable, either directly or indirectly.
- Level 3 - inputs that are not based on observable market data (unobservable inputs).

The Trust recognises transfers between levels of the fair value hierarchy at the end of the reporting period during which the change has occurred.

## 12. Financial Instruments (continued)

### (e) Fair value measurement (continued)

#### (ii) Fair value recognised in the statement of financial position (continued)

| | Level 1 $ | Level 2 $ | Level 3 $ | 2019 Total $ |
|---|---|---|---|---|
| **Financial assets at fair value** | | | | |
| Fixed Income Securities | 100,462 | - | - | 100,462 |
| Listed Trusts | 155,579 | - | - | 155,579 |
| Growth Securities | 225,607 | - | - | 225,607 |
| | **481,648** | **-** | **-** | **481,648** |

| | Level 1 $ | Level 2 $ | Level 3 $ | 2018 Total $ |
|---|---|---|---|---|
| **Financial assets at fair value** | | | | |
| Fixed Income Securities | 93,905 | - | - | 93,905 |
| Listed Trusts | 127,634 | - | - | 127,634 |
| Growth Securities | 222,742 | - | - | 222,742 |
| | **444,281** | **-** | **-** | **444,281** |

There were no transfers between Level 1 or 2 during the period.

## 13. Related Parties

During the year, the Trust incurred $5,323 (2018: $4,985) in respect of the key management personnel services that were provided by a separate management entity, Department of Planning, Industry and Environment. All other services received from the Department of Planning, Industry and Environment were free of charge.

During the year, the Trust did not enter into any transactions with key management personnel, their close family members and/or controlled and jointly controlled entities thereof.

During the year, the Trust entered into transactions with other entities that are controlled / jointly controlled / significantly influenced by NSW Government. These transactions (incurred in the normal course of business) in aggregate are a significant portion of the Trust's revenue and expenses, and the nature of these significant transactions are detailed below:

| Entity | Nature of Transactions |
|---|---|
| Audit Office of NSW | Provides independent audit services on the Trust's financial statements. |
| Department of Industry *(1 January 2019 - 30 June 2019)* | Provision of administrative, secretarial support and operational assistance. |
| Department of Planning, Industry and Environment *(1 July 2019 - 31 December 2019)* | Provision of administrative, secretarial support and operational assistance. |

## 14. Commitments for Expenditure

The Trust has no commitments for expenditure as at 31 December 2019.

## 15. Contingent Assets and Liabilities

The Trust has no contingent assets or liabilities as at 31 December 2019.

## 16. After Balance Date Events

The Trust is unaware of any significant events after balance date that would impact the financial statements and the notes to the financial statements.

**END OF FINANCIAL STATEMENTS**


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