Agriculture is part of the solution

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Abstract

“Agriculture is the only industry in Australia to have meaningfully reduced its emissions footprint to date” (Guerin, 2021). Modern agricultural practices have supported widespread sustainable and regenerative agriculture over the past 70 years in northern Australia. Landholders have long strived to increase their Social Capital, and have used their Financial Capital to increase their Natural Capital, including biodiversity and ecosystem services, through applying regenerative management practices. In response to early degradation events in Australia’s rangelands the adoption of research findings has built the health of their unique landholdings. This has resulted in a widespread increase in their stock of Natural Capital including an increase in carbon sequestration in vegetation and soil and healthier ecosystems with reduced emissions, as measured by the Greenhouse Gas Inventory (Australian Government, 2021). The Vegetation Management Act, 1999 (VMA) in Queensland enabled Australia to reach emission targets under the Kyoto Protocol through reducing clearing and minimising Land Use, Land Use Change and Forestry (LULUCF) activities (UN, 2021). However, this “public good” was achieved at a “private cost” to Queensland landholders. With the global population projected to rise to 9.7 billion by 2050, the produce from the Northern Australian rangelands will be a vital source of nutrition. Agriculture is part of the solution and northern Australia is making a significant contribution to reducing global emissions through continuing investment in Natural Capital.

Keywords

natural capital, regeneration, sequestration

Introduction

This paper uses three types of capital to describe how Northern Australian land managers have invested in their Social Capital (experience, intelligence, education, labour, time) and Financial Capital (property equity, savings, borrowed money, built infrastructure and investment in their enterprise) to steadily enhance their Natural Capital (the soils and rock, grasses, pastures and herbage, trees and shrubs, natural cycles, biodiversity, underground microbiological life, rainfall and water movement, underground water, wildlife, ecosystems, and the surrounding air). There are two types of Natural Resources, renewable and non-renewable. Agriculture can improve renewable Natural Resources which builds the stock of Natural Capital.

Social, Financial and Natural Capital

The concept of Natural Resources being formally recognised as a form of Capital had its birth in Malthusian Economics whose initial concern was about exponential population increase depleting resources. A number of influential books were written such as “The Population Bomb” (Ehrlich, P.R. 1968) and “Limits to Growth” (Club of Rome, 1972) which sparked growing awareness of the degradation of renewable resources and the depletion of

non-renewable resources and the need for intergenerational equity through sustainable development as described in the Brundtland Report “Our Common Future” (1987).

The term Natural Capital was first used by E.F. Schumacher in “Small is Beautiful: A study of Economics as if People Mattered” (1973). Environmental Economists Herman Daly and Robert Costanza (1992) further developed the concept in “Natural Capital and Sustainable Development” before “Natural Capitalism: Creating the Next Industrial Revolution” Paul Hawken, Amory Lovins and Hunter Lovins (1999) developed a global economic model dependent on natural resources and ecosystem services essential to life. They described four types of Capital, human capital, financial capital, manufactured capital and natural capital. They identified renewable and non-renewable classes of Natural Capital, and reasoned that renewable natural capital can be degraded or improved by human activity.

At the individual producer level Natural Capital comprises the soils and rock, grasses, pastures and herbage, trees and shrubs, natural cycles, underground microbiological life, rainfall and water movement, underground water, wildlife, ecosystems, and the air of the parcel of land that producer is using to produce food and fibre. In addition to this, Natural Capital provides healthy ecosystems, improved biodiversity, clean air and water and sequesters carbon in the vegetation and soils, in a long term sustainable and profitable state for the benefit of the wider population.

The concept of three types of Capital aligns with the accounting concept of the Triple Bottom Line, accounting for the profit/loss socially, environmentally and economically (Elphington, 1997). Another closely aligned concept is that of the Ecological Footprint first developed in Canada by William Rees (1992) and further developed in collaboration with his PhD student, Mathis Wackernagel (1996) into a calculation method which compares lifestyle consumption with the impact on the environment, or simply the area of natural capital required to provide clean water, clean air, waste assimilation, food and fibre to individual humans living a certain lifestyle.

European Settlement and the Mistakes Made

When the first fleet arrived in Port Jackson in 1788 the soldiers and convicts had little knowledge of any form of agriculture and no knowledge of Australia’s agricultural conditions. Descriptions of the countryside often quoted from the Journals of the early Explorers described park-like land with abundant grasses. Recent authors such as Historian Bill Gammage (2012) and W. Burrows(2013), have suggested that prior to European settlement the Aboriginal people had significantly shaped the landscape through the use of “cool burning”.

It soon became abundantly clear to the early settlers that they had settled in a country so succinctly described by Dorothea McKeller (1911) as “… a land of drought and flooding rain…”. Any agricultural knowledge they possessed was based on English farming methods practiced in a country of predictable rainfall and generally fertile soils. Australia is an old and very eroded landscape with a notoriously variable climate (Wentworth Group of Concerned Scientists, 2002), so for many years the new settlers struggled to understand the conditions. After such a short time they did not know what “average” or “mean” rainfall, or “normal” seasons were. Despite this lack of knowledge some managed to succeed, particularly some of the free settlers who “squatted” on large tracts of land, but many endured great hardship.

Due to their lack of knowledge significant degradation of the land took place as they struggled to make a living. The relationship with the local indigenous groups was often hostile and, where there was some rapport, communication was difficult so the early settlers

could not fully benefit from the indigenous knowledge, though the early explorers had detailed descriptions of the practice of mosaic burning in their Journals (Gammage,2012) (Burrows, 2013).

Not only did the landholders misunderstand the country, the authorities developing and legislating land policies did not understand the extremely diverse landscapes of Australia. Various State Governments introduced well-meaning legislation which often had unintended and perverse outcomes which also led to land degradation. After Federation in 1902, the responsibility for land ownership and management remained with the States.

The Soldier Settlement Schemes (Queensland Government 2021) introduced after the first World War were intended to thank and reward our returning soldiers, but too often the authorities were still thinking of the size of a European “living area” which was too small to be a “living area” in Australia. Having learnt from the mistakes made, the settlement schemes after the Second World War were more successful.

State and Federal Governments have continued to make mistakes with legislation to the present time.

Agricultural land tenure in northern Australia is predominantly held as leasehold or Native freehold title in the Northern Territory (Northern Territory Government of Australia, 2021) and Western Australia (Government of Western Australia, 2018), while in Queensland (Queensland Government, 2021) there are approximately 1,000 pastoral leases covering 40% of the State. This State has had a policy of converting leasehold to freehold for a fee, this has happened in some pockets of the Queensland Rangelands.

The Terms of many pastoral leases required lessees to use the land to graze stock and to “develop” so much of the land per year, the “Development” was mainly to take the form of fencing and clearing. Other clauses stipulated the type of activity to be carried out on the leased property. In Western Australia, pastoral leases were to be for the purpose of “grazing” which ruled out destocking as one step in land rehabilitation (Pollock,2019)

Since 2000 the Murray Darling Management Plan prevents any unlicensed diversion or interruption to overland flow. So many of the regenerative techniques used by land managers are prohibited under the plan. Ponding, rakes and bunds to stabilise scalds, erosion areas and stabilizing active gullies, slowing surface water flow to spread across the landscape to enhance infiltration, are all prohibited. (Murray Darling Basin Authority – Floodplain harvesting and overland flows, 2020)

In 1999 the Queensland Government introduced the Vegetation Management Act (VMA) which set strict guidelines for the management of vegetation on freehold and leasehold land in the State. Regrowth, clearing, fodder harvesting and thinning were all restricted, but this legislation ensured that emissions from its Land Use, Land Use Change and Forestry (LULUCF) activities would be reduced over time and would enable Australia to meet its obligations under the Kyoto Protocol (UNFCCC, 2021).

Using the Three Types of Capital Land Managers have increased their Natural Capital

Australian land managers are renowned for their hard work and innovation (The Wentworth Group of Concerned Scientists, 2002) For many years they continued to think in terms of European management paradigms but through keen observation they learned to “read” their own particular land and pastures (Forsyth, 2021), noting that no two properties are exactly the same, this was the beginning of the increase in land manager Social Capital.

Land Managers have gradually improved their social capital through education. In the 1950s few land managers had tertiary qualifications, now the majority have some form of formal qualification This has helped them to take the ideas from science and other innovators and adapt them to best suit their land.

The steady improvement of land managers Social Capital enabled them to improve their Financial Capital. They improved their knowledge of accounting methods, cash flow management and general business analysis. They invested in manmade capital like technology, machinery, yards fit for purpose and cropping techniques such as zero till. More sophisticated management has enabled more efficient and effective use of external finance and better control of cash flow and record keeping. The successful land managers have gathered around them a highly skilled set of advisors who have helped to build more robust and resilient agricultural enterprises.

Using their improved Social and Financial Capital land managers were on a mission to increase the health and abundance of their Natural Capital. State Government Departments of Agriculture or Primary Industries carried out extensive research and extension particularly after the second world war which was taken up by the “innovators” and “early adopters”, many of whom were concerned at the loss of topsoil occurring through wind and rain erosion. “Our Common Future” (Brundtland Report, 1987) highlighted the need for world agriculture to become sustainable.

The Commonwealth Scientific Industrial Research Organization (CSIRO) made significant contributions in the fields of sheep and cattle research as did Meat and Livestock Australia (MLA). The latter is a producer owned company providing marketing and research and development to the red meat industries. They carry out extensive extension through their “Beef Up Forums” and EDGE Network (MLA, 2021). A benchmarking tool, the Beef Sustainability Framework (ARMAC, 2017), was introduced to track how the beef industry is performing over a series of indicators. The indicators can be used by individual beef enterprises to track their sustainability performance.

A number of methods have been put forward as a means of achieving sustainability and regeneration. “Holistic Management” was first devised as a systems approach to resource management in Zimbabwe (Savory and Butterfield, 1999), in Australia it has evolved into a whole of farm and decision-making system to help land managers become sustainable (Australian Food & Farming, 2021) and meet their Triple Bottom Line (Elphington, 1997). Peter Andrews from the Upper Hunter Valley developed Natural Sequence Farming based on the principle of reintroducing natural landscape patterns and processes as they would have existed prior to European settlement (Natural Sequencing Farming,1975).

The term “regenerative agriculture” was first used by the Rodale Institute of the USA in 1987 to describe a conservation and rehabilitation method to enhance sustainability. In Australia it has become synonymous with a variety of adaptations of methods devised to restore Australian agricultural landscapes while concurrently increasing productivity.

A dedicated group of agricultural and rangeland scientists have provided invaluable work through grazing experiments carried out at places such as “Wambiana” near Charters Towers, and “Pidgeon House” near Victoria River Downs in the Northern Territory. The North Australia Beef Research Council (NABRC, 2021) is a group who aims to ensure innovation and learning in the northern beef industry. Rural Consulting Services (RCS, 2021) is a private provider of holistically-integrated education, training and advisory services to the agriculture sector. Versions of all these methods have been widely adapted and adopted in the rangeland agricultural industries of northern Australia.

This has resulted in a widespread increase in the stock of Natural Capital across Northern Australia, an increase in carbon sequestration in vegetation and soil and healthier ecosystems with reduced emissions, as measured by the Greenhouse Gas Inventory 1(Australian Government, 2021). By using the three types of Capital land managers have been able to reduce agricultural annual greenhouse gas emission from 91.6 Mt of CO2e in the year to December 1990 to 72.9 Mt for the year to December 2020 as measured by the Greenhouse Gas Inventory (Fig. 1) (Australian Government, 2021).

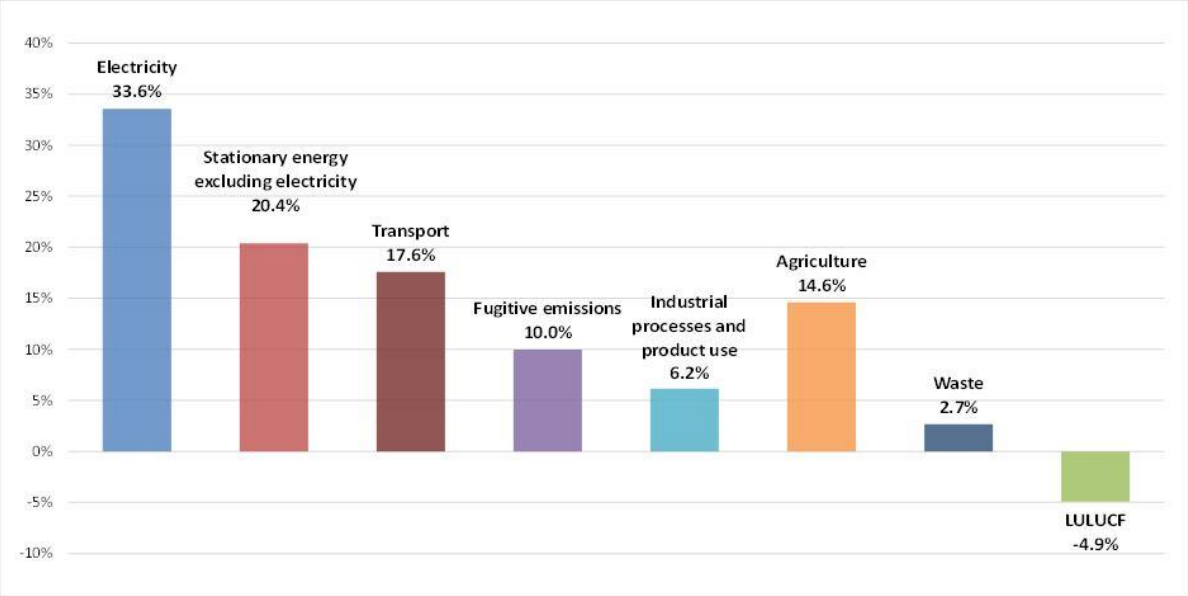

Fig. 1. Share of total emissions, by sector, for the year to December 2020 Greenhouse Gas Inventory. *Source: Australian Government, Department of Industry, Science, Energy and Resources (permission for use received under license* https://creativecommons.org/licenses/by/4.0/)

The introduction of the VMA, 1999 in Queensland, through reducing clearing and minimising LULUCF activities on between 50-60 M ha of woodland and open forest on designated agricultural land (Burrows, 2013), heavily and negatively impacted land managers in that State. The lost opportunity cost through restricted future planned development, vegetation thickening negatively impacting productivity and, in some cases, thickening causing environmental harm through increased erosion, is considerable (Burrows, 2013).

The VMA, 1999 enabled Australia to reach its emission target commitments under the Kyoto Protocol by significantly reducing LULUCF activities (UN 2021). A great outcome for the Nation, however, this “public good” was achieved at a “private cost” to Queensland landholders. No compensation has ever been paid by either the Queensland State Government or the Federal Government (Nason, 2018)(Burrows, 2013).

Due largely to the effect of this legislation there has been a significant decrease in LULUCF emissions in Australia, where this category has changed from being an emitter of 186.1 Mt (29.9% of annual greenhouse gases) in 1990 to providing a net Carbon Sink of -24.5 Mt or (-4.9% of emissions) in 2020 (Fig. 1 & 2)(Greenhouse Gas Inventory, 2021). Due to the significant contribution made by agriculture in Queensland to the dramatic change in LULUCF, it is appropriate to consider the LULUCF contribution to the National Greenhouse Inventory when looking at the net effect of agriculture (Fig 2).

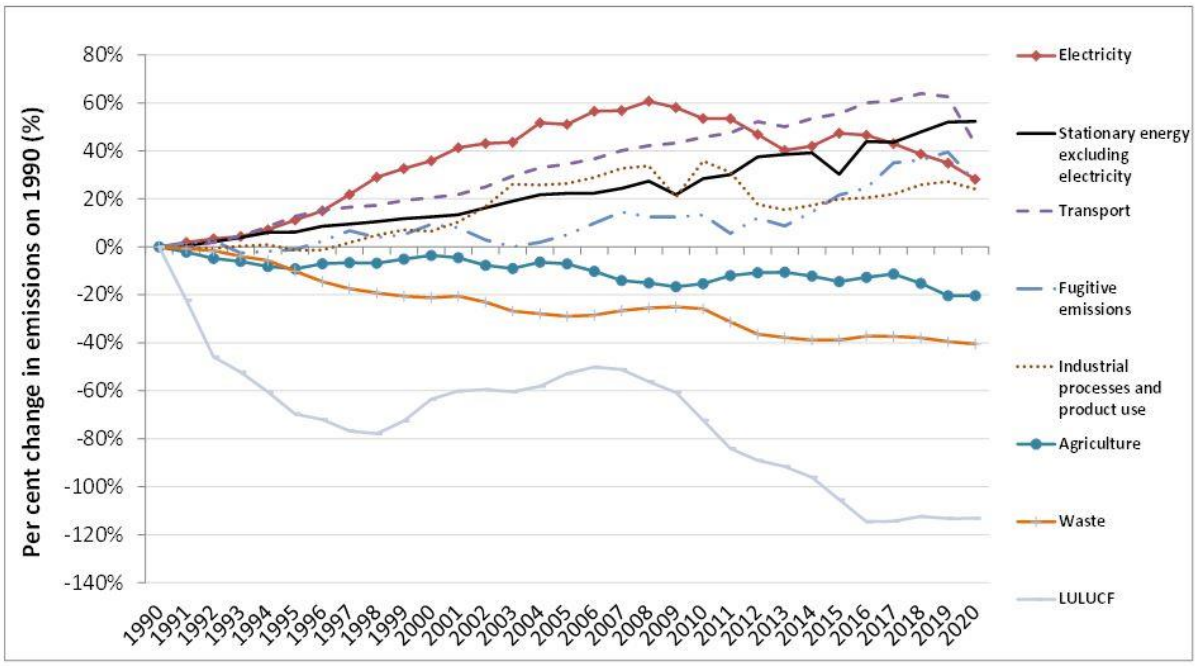

Fig. 2. Percentage change in emissions, by sector, since year to December 1990 Greenhouse Gas Inventory. *Source: Australian Government, Department of Industry, Science, Energy and Resources (permission to use received under license* https://creativecommons.org/licenses/by/4.0/)

Due to their belief that land managers are continually increasing their Natural Capital, the MLA have developed a set of core activities to achieve a target of Carbon neutrality for the Australian red meat industry by 2030 (MLA, 2021). Given the downward trend in agricultural emissions and the increasing carbon "sink" provided by the trend in LULUCF activity this target seems realistic. What is not being accounted for is the huge "sink" that vegetation in northern Australia represents through the forest country not being cleared for development (Fig. 3). A Carbon Emissions Audit such as that carried out by the University of Queensland on "Keytah" (Visser & McClymont, 2019), may be able to quantify this sink. Many agricultural landscapes are already carbon neutral or better (Guerin, 2021).

Work from the Oxford Martin School of the University of Oxford have devised a measure, GWP*, which they contend is a more accurate measure of the warming effect of methane in the atmosphere than the currently used GWP 100 or GWP 20, methane being a much shorter lived Greenhouse Gas than carbon dioxide (Allen, Fuglestvedt, Shine, Reisinger, Pierrehumbert & Foster, 2016) and (Lynch, Cain, Pierrehumbert & Allen, 2020) research from the University of California Davis supports the Oxford work (Mitloehner, Kebreab & Boccadoro, 2020). The Climate Council Australia (2021) also suggests the short-lived nature of methane should be taken into account (Climate Council, 2021).

Given acceptance of this new metric the methane effect on global warming of the world's ruminant herd and natural wetlands has been overstated.

Case Studies of Natural Capital Improvement on Properties

The following are examples of "regenerative" practices that have improved Natural Capital.

"Keytah" near Moree in north-western New South Wales.

The University of Queensland carried out a comprehensive audit on the carbon benefits versus the carbon emissions on "Keytah" for the 2017-2018 season. The enterprise consisted of irrigated cotton, dry land cotton and winter crops, cattle and timber. The carbon footprint for the operation as a whole including cattle was -26,682 tonnes of CO2e, being negative emissions or a carbon sink. A separate audit was carried out on just the irrigated cotton and included the whole production chain from paddock to port being the point of export. This resulted in -185.0 kg of CO2e per bale, a small carbon sink. The emission from the cattle production was offset by another carbon sink, the native vegetation and the woodlot returning -1,635.5 tonnes of CO2e per annum (Visser & McClymont, 2019).

"Werrina Downs" – 18 km SE of Dalby and another property 7.5 SW of Dalby on Queensland's Darling Downs

Irrigated cotton on the Inner Darling Downs on some of the very best soils in Australia though naturally low in carbon. By changing from conventional tillage to zero-till management in the 1990's the soil carbon has been increased from a baseline of 0.05% in 1980s to 0.08% in 2000s, a 10 year period (Bremner, K., 2021)

The Late Major General the Honourable Michael Jeffery, AC, AO (mil), CVO, MC was appointed the National Soil Advocate in 2012 by then Prime Minister Julia Gillard and founded "Soils for Life" in 2013 with the vision to encourage Australians to focus on soil health and the urgent need to regenerate our urban and rural landscapes (Soils for Life, 2021).

Soils for Life examined a number of case studies where land managers had used regenerative practices. These were described in "Innovations for Regenerative Landscape Management Case Studies" (Outcomes Australia, Soils for life Programme, 2012)

A brief description of these Case Studies, relevant to the Northern Australian Rangelands, follows.

"Colodan" – 45 km east of Monto in Southern Inland Queensland.

Following the adoption of regenerative practices the owners now have three diverse and integrated enterprises. Using soils with moderate capacity to supply nutrients and low carbon levels and due to the introduction of rotational grazing, the use of urea and molasses and the undertaking of regular cool burning supported by regeneration of effective tree-grass balance, the enterprise now supports successful cattle, carbon and forestry enterprises in harmonious co-existence. (Soils for Life Program,2012)

"Glenelg" - near Mungallala in South Western Queensland.

A Sheep and cattle property where improvements over the years, combined with a conservative stocking rate, have developed productive pastures. Dense woody vegetation has been cleared, woody regrowth has been controlled, improved pasture has been established and total grazing pressure has been controlled through the construction of an exclusion fence. High functioning ground cover provides an ongoing resource for the grazing operation and has led to noticeable improvements in water infiltration, a reduction in soil erosion and increased habitat for grassland-dependent biodiversity. (Soils for Life Program, 2012)

"Bokhara Plains" – 35 km north of Brewarrina New South Wales.

Degradation had led to large areas of clay pans. A system using cattle in a “Cell grazing” configuration to break up the claypans by allowing water to penetrate and seeds to germinate, combined with holistic management techniques was introduced. The claypans are now being reverted to productive pastured rangelands with an increased carrying capacity. The business is using cattle trading to balance stocking rate with pasture availability, and further diversification into tourism is being introduced to ensure that the business remains viable regardless of the rainfall. (Soils for Life Program, 2012)

“Beetaloo Station"- 60 km east of Elliot, 800 km south of Darwin in the Barkly Tablelands of the Northern Territory.

The rehabilitation plan was designed to deliver a reliable water supply to support grazing across vast areas of previously unused native rangelands. Establishing smaller paddocks on a very large scale to concentrate grazing animals to ensure controlled use of pastures and continuing improvement of soils has led to a significant increase in carrying capacity. Delivering time controlled planned rotational grazing on a significant scale is an innovative vision for grazing Northern Australia (Soils for Life Program, 2012).

“Three Rivers Station” – 230 km north of Meekatharra 1000 km north east of Perth Western Australia.

Increased mining operations and exploration on the station had interrupted pastoral operations and made large demands on water supplies in the aquifers. It was decided to de-stock and suspend pastoral operations while mining was taking place. This has enabled conditions to help restore the landscape by working with the mining companies to halt the decline and accelerate the regeneration of the rangelands. After building knowledge of local landscape and function, the managers have been experimenting with earth working techniques such as rakes and bunds to stabilise erosion areas. By nurturing perennial grass seed banks active gullies have been stabilised, surface water flow has been slowed and spread across the landscape and a dramatic increase in the abundance, diversity and vigour of perennial grasses has occurred (Soils for Life Program, 2012).

In December 2017 the Soil Advocate reported “Restore the Soil: Prosper the Nation” (Jeffery, M., 2017). He made ten recommendations in this report to the Prime Minister and the Minister for Agriculture.

Other Benefits of Improved Natural Capital

The declining trend in emissions from agriculture and the increasing offset from LULUCF practices (Australian Government, 2021) will give breathing space to other Greenhouse Gas emitters to find viable methods of reducing their emissions, while ensuring that Australia meets its commitments under the Kyoto Protocol and more recently the Paris Agreement (United Nations, 2015).

Work with regeneration of pastures and healthy ecosystems will assist Australia’s unique wildlife to prosper and at the same time improve our water quality by reducing erosion. With greater ground cover the stock of carbon sequestered in vegetation and soils will increase and the wind erosion in dry times will decrease providing improved air quality.

The vast Northern Australia Rangelands will provide an enormous amount of the ecosystem services the rest of the country requires for the clean water, clean air, waste assimilation, food and fibre necessary to sustain life (Reece, W., 1992).

The Future

The world population is projected to increase to 9.7 billion by 2050 (United Nations, 2019). To feed this population it will be necessary to increase the productivity of all forms of agriculture around the world. It will be a long time before food manufactured in a laboratory is accessible or acceptable to the world population at large. Nor will the limited supply of arable land in the world be sufficient to grow the vegetable and edible grain and pulse crops needed without further large areas of land being cleared, which in turn would likely increase the emissions from LULUCF activities.

In the eyes of our near neighbours the vast Northern Australian Rangelands represent a great under-utilised resource. It may be a case of “use it or lose it”. Already countries such as Indonesia and Vietnam, with growing populations and limited land resources, are sourcing live cattle from northern Australia, effectively using our resource as their “Breeder paddock”.

The inevitable pressure from these neighbours will result in the development of further reliable water supplies to support grazing across vast areas of previously unused native rangelands for red meat production. Water storage for development of the pockets of good soil that are suitable for intensive agriculture will be required. Existing intensive agriculture in the Ord River, around the Katherine district and in the Flinders River will face pressure for further expansion and largescale investment of foreign Financial Capital will inevitably be required.

Australians will have to accept this reality. In order to withstand the overwhelming international need for increased development, to protect the really wild and remote wilderness areas and to ensure sustainable development of the northern rangelands, continued wise use of the three types of capital will be required.

As a matter of some urgency Australians should have a conversation about setting the ground rules to ensure that the Australian nation reaps due reward from the development and that the wilderness areas are well managed. Grazing will be the dominant land use in the norther Australian rangelands.

Australian land managers have demonstrated their ability to regenerate our rangelands and to reduce agriculture’s carbon footprint. As the Late Major General Michael Jeffrey so eloquently said “Australia can play a leading role in showing the rest of the world how inherently infertile soils in a difficult climate can be managed to meet the world’s Sustainable Development Goals for land and soils” (Jeffrey, M 2012).

Conclusion

Agriculture is part of the solution and agriculture in northern Australia is making a significant contribution to reducing global emissions of greenhouse gases through continued investment in Natural Capital. The red meat protein produced from the Northern Australian Rangelands will be a vital source of nutrition for the ever-increasing World population.

Conflicts of Interest

The author declares no conflict of interest

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