Are the outcomes that are vital for the survival of mankind achievable in an era of global warming?

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According to the United Nations, unless soil decline is addressed the world has less than 60 growing seasons left.[1] Additionally, it is estimated that the global population will reach almost 10 billion by 2050.[2] Given this perfect storm, the United Nations Decade for Deserts (2010–2020) and the fight against desertification[3] is especially relevant as more and more land around the world faces increasing deterioration and degradation.

The intensive nature of agriculture in today's world has degraded the vegetative cover and biodiversity of vast areas of the Earth's surface. This, coupled with soil surface temperature rises, is resulting in a major reduction of above- and below-ground carbon, and therefore soil biological resources, leading to erosion together with chemical, nutrient and pesticide run-off into river systems, estuaries and oceans.

These and other natural factors have damaged the capacity of the land and oceans to absorb (excess) carbon dioxide (CO_2) via the natural process of photosynthesis, reducing agricultural productivity. This is accompanied by increased salination, soil erosion, desertification and, in some important marginal irrigation areas, the production of huge amounts of saline water, depressing the effect of usually productive plants.

Micro-climates are increasingly unable to perform the function of keeping farmers' fields moist, cool and healthy, resulting in diminishing food quality, and giving rise to new evidence of rising public physical and emotional health issues and costs.[4] Prof. Robin Batterham, former Chief Scientist for Australia (1999–2006), states that current intensive land practices are not sustainable and will lead to losses in farmland productivity and profitability. He says a move towards regenerative farming can stem this undesirable trend without any long-term loss in farming outcomes, issuing instead an increase in productivity, profitability and sustainability.[5]

Does the world have sufficient land to grow food to feed 10 billion people?

From 2005 to 2050 the food requirement for rising populations is estimated to increase by between 70 and 110 per cent[6] as income from emerging middle classes drives a demand for farm-based produce, such as grains and meat for largely urban populations which already exceed 50 per cent of the total, and are expected to exceed 75 per cent by 2050.[7]

However, the area of land considered even marginally suitable for agriculture is predicted to rise from only 33.2 million km^2 today to just 34.1 million km^2 by the end of this century.[8] As some 50 per cent of grain production today is fed to livestock, substituting some of this grain by new livestock feeds grown in degraded areas is commonly suggested as a practical solution, utilizing proven techniques that also reverse soil degradation and allow for climate variability.[9]

Much of this degraded land exists in mixed farming zones fringing the deserts on each continent. These areas are mostly inhabited by poor, often marginalized people, who would be able to participate in this solution if they could be shown how their livelihoods might be improved as a result of their efforts in these farming proposals.[10]

The question: "Will the world have sufficient capacity to feed 10 billion people by 2050?" should be rephrased as: "Does the world have the necessary land resources to meet its future requirements for food?" A further question would be: "How can we equip the people who live in these degraded areas to become part of a solution that benefits all?"

Turning straw into gold: a new paradigm of regenerative agriculture

There is a solution to these questions but it requires international collaboration, global and local partnerships, widespread education and ways to involve the people who live in degraded areas to participate every step of the way.

Image: PZC

Greening the Earth trials in Australia demonstrating the development of a saltbush plantation grown in hedgerows suitable for the dual purpose of harvesting and livestock cell grazing between the rows

Image: PZC

Greening the Earth plantations trialled at Gayathi in western Abu Dhabi on land owned by the UAE Environmental Agency to test maximum moisture capabilities necessary for positive plant establishment purposes. Saltbush and local companionship species were successfully grown from encased seed pellets and irrigated using saline ground water for five minutes overnight

Most importantly, a solution requires the ability to foresee and appreciate events over the long term, the development and maintenance of a narrative for change that can inspire the range of stakeholders required for the period of time needed to achieve sustained, beneficial change. This change requires local leaders to be mobilized in each area, the action of key opinion and policymakers and leaders at both national and international levels, and appropriate partnerships across many levels.[11]

The solution would deliver a range of profitable and socially beneficial outcomes that address economic, environmental and agricultural concerns, public health and social and emotional issues, to increase many fold the scale of land area available for productive agriculture while addressing land degradation. This solution is regenerative agriculture[12] which is a production system that will long outlast the investment phase.

Carbon sinks and organic carbon

A characteristic of most degraded soils is a loss of organic matter and a changed soil structure, often associated with heightened salinity of different types and reduced hydraulic conductivity (drainage). Such soils have potential as carbon sinks[13] whereby increased photosynthesis – possible with plants more adapted to such soils – transfers new carbon to soil as soil organic carbon (SOC) in the form of roots and soil flora and fauna that can become fixed with decomposition into more recalcitrant carbon materials that will last indefinitely.[14]

This activity gradually addresses structural and biological problems within soil, leading to improved drainage and productivity. Some plants that can do this also provide grazing as well as material for feed pellets and various valuable by-products.[15] It follows that the Earth's soils act not only as major storage systems for CO_2[16] but, in doing so,[17] can deliver the greatest opportunity for increasing productive land mass to address food security.

The solution becomes one of finding the means for the desert and under-productive marginal agricultural landscapes to be rehabilitated for the productive cultivation of food, thus addressing global food security while simultaneously creating the biggest and most efficient land-based carbon sink in the world for the capture of CO_2 to combat climate change.

An Australian solution

The land remediation/carbon credit initiative of the PundaZoie Company (PZC) and its Greening the Earth (GTE) programme commenced in Tasmania in 1989. The word PundaZoie, from Greek, means "always living."

The company began researching, trialling and developing agricultural species and systems to address the global issues of SOC as a solution for climate change and diminishing food security by engaging in a university research partnership in Tasmania (UTas) and conducting field trials in southern Europe, the UAE and across a number of states of Australia.

PZC has been researching the possibility of integrating drought and saline resistant species, including saltbush, into rotational grazing, harvesting, food processing and milling techniques, as well as the creation of bio-energy and flavonoids from halophytes to be used as anti-oxidants for the wellness and pharmaceutical industries. The company has also collaborated with the Institute for International Development (IID) in examining other halophyte plants important for inclusion in various degraded land areas in Australia and internationally. IID has also developed the capacity to engage remote communities under a wide range of biophysical and cultural circumstances in development activities.

Regenerative farming and carbon drawdown

Regenerative farming creates SOC whereby the soil's carbon content is increased using photosynthesis (a natural CO_2 pump), drawing down carbon dioxide from the atmosphere and converting it into carbon in the soil at the proportion of 3.75:1. The capture of 3.75 tonnes of atmospheric CO_2 thus converts to one tonne of SOC. This process not only revives and remediates marginal and depleted landscapes for agricultural use, but the resultant SOC can be measured and applied as accredited Australian Carbon Credit Units (ACCUs) for sale to Australia's Clean Energy Regulator (CER) by way of the reverse bidding mechanism of the Carbon Farming Initiative's (CFI) Emissions Reduction Fund (ERF).

Acceptance by CER and United Nations of the methodologies for SOC

In 2017 the CER accepted PZC's GTE regenerative farming carbon capture methodology using SOC whereby PZC aims

Image: PZC

Prime Minister of Australia, Hon. Malcolm Turnbull MP and Scotdesco CEO, Robert Larking, discuss the progress of the Scotdesco project, October 2017

Image: PZC

PZC's invitro tissue culture consultant and expert Dr. Jitendra Prakash of Invitro International, Bangalore, India, teaches Scotdesco community members the benefits of invitro tissue culture propagation techniques

to create around 20 tonnes of CO_2 equivalent/ha per annum[18] through the use of integrated saltbush planting, rotational grazing, and the harvesting and milling of high protein powder for both human consumption and the production of livestock feed pellets.

Saltbush – one of the many halophytes that grow wild in diverse parts of Australia that are suitable as a C4 species for the capture of SOC – was not only accepted by the CER for this purpose but has been identified by the United Nations Carbon Emission Trading Scheme as a species that assists the fight against global greenhouse warming by the sequestration of atmospheric carbon back into the soil.

The United Nations estimates that the Australian native, *old man saltbush*, once it has reached three years of age, converts approximately 15–20 tonnes of carbon annually per ha.

Different plants are important to various parts of the landscape and for differing climatic conditions and soil types. For example, *Distichlis spicata* Var. Yensen 4a PbR (NyPa Forage™) is adapted for waterlogged saline lands to enhance both the grazing and harvesting values of saltbush while restoring soils and fixing carbon in a similar way.[20]

Reversing the impact of climate change

It is predicted that sequestering new SOC on a year-to-year basis and on a sufficient scale will not only halt the continuing effects of climate change but can put the concentration of atmospheric greenhouse gases into decline.[21]

The financial returns

The benefit of GTE is that it turns the obligation of emissions reduction from that of being a cost to one of creating profits.

Financial modelling conducted by PZC is based on establishing field plantations of 10,000 ha sites for both cropping and grazing, each with its own in vitro tissue culture propagation nursery and feedstock processing plant. Appropriate sites are secured by way of partnership, lease and/or purchase. These can be adapted for smallholder and patchy situations that exist in many degraded areas associated with ongoing food production.

The cost, calculated for each plantation area of 10,000 ha, inclusive of the cost for providing an in vitro tissue culture propagation nursery and processing plant, is approximately AU$39 million (once only). The pre-tax profit generated from the activities described above for the life of the project – which is estimated to be a minimum period of 60 years – is approximately AU$21 million (annually).

The financial modelling outcomes are impacted in a positive manner in cases where GTE plantations are conducted over much larger areas due to savings afforded by economies of scale caused by centralizing assets.

Profit is also derived from the broad base of flow-on effects and the beneficial consequences derived from the plethora of downstream jobs and business opportunities that arise in addition to a range of social, emotional and environmental benefits of GTE. This is especially relevant for rural and indigenous communities where employment opportunities are scarce and the consequential reliance on government welfare systems is intense.

Increased farmland productivity and land values

GTE plantations not only capture carbon dioxide in the soil to reduce greenhouse gas emissions, they can also increase the carrying capacity of farmland by as much as twenty-fold; reduce the mortality rate of newborn lambs as the plants offer shelter from cold winds and adverse climatic conditions; improve productivity in terms of yield and quality; increase land values and consequentially encourage a return to the land.[22, 23]

Both the direct and indirect benefits from maintaining healthy soil systems are highly visible and measurable in terms of positive economic, environmental, social and food security outcomes[24] whereby regenerative farming practices,[25] restoring the carbon content of the soil, result in preserving the natural capital of the land; biological diversity; increased farmland productivity and improved land values. This is in contrast to common land practices in conventional agriculture.[26]

Social and humanitarian outcomes

The many compelling public health and social welfare reasons for change in these landscapes has made it possible to attract prominent spokespersons at national and international levels to develop and maintain the narrative for change. This is reflected in a high level, forward-thinking report by Australia's national advocate for soil health, Major General Michael Jeffery, a former governor general of Australia, who has made 10 strategic recommendations on how to preserve farming practices sustainably and profitably. Major General Jeffery is an enthusiastic supporter of global collaboration.

The Scotdesco experience – turning words into action

In the tiny Aboriginal township of Bookabie on the edge of Australia's Nullarbor Plain, the members of the Scotdesco Aboriginal community are demonstrating their vision as a solution for the rest of the world. Australia is the driest inhabited continent in the world with 70 per cent of its land either arid or semi-arid, receiving 250mm to 350mm of rainfall a year, or less. Approximately 81 per cent of Australia is broadly defined as rangelands, known to most Australians as 'the outback' which is the natural home to many of Australia's indigenous peoples and culturally very important for most Australians.

Theory becomes practice –
Scotdesco, the Aboriginal gateway for a global solution

The Scotdesco initiative, run in partnership with PZC, is implementing the GTE programme to establish a new business paradigm whereby the Scotdesco/PZC relationship is incorporated into a vital and equal corporate partnership conducted in the name Bunyuru Pty Ltd (Bunyuru being the local Aboriginal word for saltbush).

Scotdesco CEO, Robert Larking, says: "The Greening the Earth partnership between PZC and the Scotdesco Aboriginal community is a vision of health and prosperity for the future well-being of our country and its people. It draws from spiritual, physical, social and cultural connections and the natural affinity and knowledge that Aboriginal Australians have of the land going back some 60,000 years, as the world's oldest living culture. The cropping and manufacturing programmes foster new employment, business, mentoring and training opportunities for Scotdesco and for the regional community which, over time, will deliver improved skills, profitable returns and economic self-sufficiency in a manner that is dignified and respectful of Aboriginal history, culture and traditions".[27]

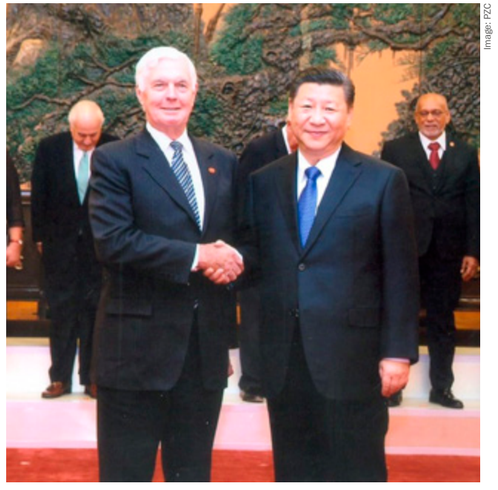

Image: PZC

Major General Jeffery emphasises the need for international collaboration by exchanging views with President Xi Jinping of China on mutual opportunities for Australia and China in regenerative agriculture, linked to China's climate change policy

Image: NyPa Australia Limited

Commercial application of halophyte *Distichlis spicate* Var. 4a (NyPa Forage™) growing on saline aquaculture effluent in the central wheat belt of Western Australia. This sets an example for the valuable use of a resource common in many degraded areas of the world

The big picture for Australia and the world

Foreseeing and accepting the enormous potential of sequestering SOC is fundamental to universal success whereby international cooperation and widespread teaching and training action are vital.

Given that GTE plantations can sequester approximately 20t CO_2/ha, it follows that, if a country such as Australia was to create 500 plantations comprising 10,000 ha each (5 million ha) across its vast rangelands and Aboriginal holdings, the drawdown would be 200 million tonnes of atmospheric CO_2 per annum or more than one third of Australia's total greenhouse gas emissions.

This process would reverse salination and desertification trends, create beneficial micro-climates with increased biological diversity (both in the soil and above-ground), and reduce run-off and erosion – all without the need for intensive irrigation and chemical applications – resulting in regional job and business opportunities, healthier food, healthier animals, and healthier farmers and communities

Should this claim seem fanciful, it should be remembered that this land size is equal to just 13 per cent of the 10 largest landholdings in Australia[28] while 14.22 per cent of the country's 7.7 million km^2 (1,094,00 km^2) is held under Aboriginal Torres Strait Islander organizations as freehold, leasehold and reserve.[29]

Applied in collaboration over several continents, the GTE programme would catalyse many other regenerative agriculture techniques that could collectively draw down up to 20 billion tonnes of carbon worldwide per annum and make a major contribution to removing excess atmospheric CO_2 to help avoid the predicted devastating effects of climate change as well as providing healthy food and satisfying jobs for the increasing population of the world.[30]

3703 ENDNOTES
These will appear at the back of the book

Are the outcomes that are vital for the survival of mankind achievable in an era of global warming?

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3703