Climate Change Authority (CCA) Submission

A submission for reducing emissions, conserving natural capital and optimising farm productivity

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Cooling the planet to feed the World

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1. The recommendation – the thirty year plan

This submission to the Climate Change Authority is in response to the issues paper dated 9 March 2017 dealing with action on the land, reducing emissions, conserving natural capital and improving farm profitability.

This submission is made by the PundaZoie Company Pty Ltd (PZC) which is the originator and owner of the Greening the Desert Program (GTD) the word "PundaZoie" meaning everlasting life in the Greek language.

GTD is a modular business for the cultivation and processing of productive crops on predominantly marginal and under-productive land, conducted in partnership with rural and Indigenous Communities of Australia and around the world, as explained in the attached Executive Summary taken from the PZC Business Plan[1].

The crops have been selected by PZC after significant university-based research and extensive trial plots in Australia and the Middle East for the production of high-value protein powder, nutritional animal pellets and accredited carbon offset from the capture of carbon storage in the soil by applying methodologies that produce carbon offset using species recognized by the United Nations (UN) as among the most efficient sequestration species in the world[2]. These species improve farm productivity by optimising cropping and grazing capabilities for the soil by increasing the content of soil organic carbon (SOC).

The UN report concludes the soil is the largest terrestrial carbon pool in the world whereby the top two metres of soil holds four times the amount of carbon that is stored in plant biomass.

The submission deals with one unique feature for addressing global warming – SOC storage is the only known methodology for *reversing the build-up of tCO_2e within a time frame of thirty years* [3].

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[1] The PZC Business Plan dated 4 April, 2017 can be provided on request to qualified applicants.
[2] https://en.wikipedia.org/wiki/C4_carbon_fixation
[3] http://www.drawdown.org/solutions/food/regenerative-agriculture

The recommendation therefore is for Australia to develop strategies and policies for it to become the global leader in the field of regenerative agriculture whereby SOC storage turns back the clock not just for the purpose of reducing or halting greenhouse gas (GHG) emissions, but also for the purpose of recovering lost ground by storing tCO_2e in the soil to undo the damage caused to the world within a time frame of 30 years.

2. Regenerative Agriculture

Soils have the potential to store carbon for a very long time by various protective mechanisms[4] whereby there is enormous opportunity for tackling the twin challenges of landscape degradation and emissions reduction or drawdown by:

- Building landscape function through increased carbon sequestration both above and below ground (biomass and soil carbon);
- Improving soil biology and soil health;
- Increasing the ability of the soil sponge to retain water;
- Creating economic prosperity through increased farmland production and creating a monetary value from soil carbon for regional communities; and
- Creating jobs and business opportunities in a manner that improves the economic, social and cultural fabric of life on the land for rural and Aboriginal Australians in a manner that is empowering and reduces the reliance on government welfare for those locations where usually opportunities are scant.

Importantly, reducing atmospheric CO_2 while boosting soil productivity and increasing the resilience of the land to extreme climatic conditions by planting perennial crops for harvesting many times annually for more than 50-60 years, will deliver both direct and indirect benefits for maintaining healthy soils systems, measurable in economic, environmental and food security terms[5] whereby the benefit of simultaneously capturing carbon in the soil becomes the additional benefit delivered for nil or little extra cost.

[4] 4 per 1000: Soil Carbon to mitigate Climate Change, 2015, Sydney University, Faculty of Agriculture and Environment, http://sydney.edu.au/news/agriculture/1272.html?newsstoryid=15532

[5] http://www.fao.org/docrep/017/i1688e/i1688e06.pdf P. 144

While the issues paper suggests a number of specific questions, this submission by the PundaZoie Company Pty. Ltd. addresses the fundamental statements posed by the issues paper which are:

1. Understanding the key barriers to realising multiple benefits from the land, and
2. Discovering way to deliver more "win-win" outcomes for farmers and other landholders – improving their profitability while reducing GHG emissions and enhancing our natural resources.

3. Greening the Desert

This submission uses GTD projects to demonstrate PZC solutions as examples of regenerative farming as the key to addressing these questions by exemplifying the Company's 15 years of experience in this field as the blueprint for adopting methodologies to deliver an approach based on science and research supported by rigorous and independently conducted field trials and underpinned by the global leadership of the UN Food and Agriculture Organization (FAO) 4/1000 initiative (to which Australia is a signatory).

Readers are invited to consider the attached Executive Summary taken from the PZC Business Plan which explains the nature of our modular business for the cultivation and processing of productive crops on predominantly marginal and under-productive land, conducted in partnership with rural and Indigenous communities of Australia and ultimately, around the world.

Regenerative agriculture engages soil organic carbon (SOC) as the medium for enhancing and sustaining the health of the soil by restoring its carbon content, resulting in biological diversity which in turn improves productivity.

The crops selected for this purpose have been identified as a result of significant university-based research and extensive trial plots in Australia and the Middle East for the production of high-value protein powder, nutritional animal pellets and accredited carbon offset from the capture of carbon in the soil by applying methodologies that produce carbon offset using species recognised by the UN as among the most efficient sequestration methodologies in the world.

The vision entrenched in this research is for solutions that not only halt anthropogenic impacts on the land and atmosphere - but claw back lost ground by applying the SOC methodology, which if conducted at scale, can reverse the build-up of global tCO_2e within 30 years.

The direct and indirect benefits of maintaining healthy soils systems can be assessed in economic, environmental and food security terms[6] whereby the benefit of simultaneously capturing carbon in the soil becomes an additional benefit delivered for nil or negligible extra cost.

Our research reveals the world needs to reverse anthropogenic impact on the land[7] and atmosphere by the process of regenerative agriculture, achievable by the year 2050 by applying a commercial approach to improve land productivity that achieves improved food security and biological soil carbon sequestration for reducing the atmospheric carbon dioxide equivalent[8].

Conventional wisdom has long held a view that the world cannot be fed without chemicals and synthetic fertilisers but today, the evidence points towards a new wisdom: the world cannot be fed unless the soil is fed. Regenerative agriculture enhances and sustains the health of the soil by restoring its carbon content that results in biological diversity which in turn, improves productivity — the opposite of conventional agriculture[9].

The direct and indirect benefits from maintaining healthy soils systems can be assessed in economic, environmental and food security terms[10] whereby the benefit of the simultaneous capture of carbon in the soil, becomes an additional benefit delivered for nil or minimal additional cost as an agricultural solution.

[6] http://www.fao.org/docrep/017/i1688e/i1688e06.pdf P. 144
[7] http:www.drawdown.or/solutions/food/regenerative_agriculture
[8] http://www.ase.tufts.edu/gdae/Pubs/climate/ClimatePolicyBrief4.pdf
[9] http://www.drawdown.org/solutions/food/regenerative-agriculture
[10] http://www.fao.org/docrep/017/i1688e/i1688e06.pdf P. 144

3.1 Soil – the carbon storehouse

This submission has been formulated as a result of 15 years of research and field trials conducted by PZC for the purpose of implementing GTD projects to demonstrate many of the economic and related social and cultural benefits resulting from measures from improved soil management - from reduced establishment and input costs; by enhancing resource-use efficiency; decomposition and nutrient cycling; nitrogen fixation; water storage and nil-synthetic fertiliser and pesticides.

It highlights how PZC's regenerative agriculture methodologies for its GTD Program are consistent with the approach for soil to be the carbon storehouse for a climate change solution[11] for estimates that reveal nutrient cycling provides the largest contribution (51 percent) of the total value (US$33 trillion) of all ecosystem services (Costanza et al., 1997).

3.2 Soil carbon (SOC) a substantive solution

The recently released book *Drawdown*[12] maps, measures, models and describes the 100 most substantive solutions for combating global warming. This research reveals the goal for determining if the build-up of atmospheric carbon can be reversed within thirty years.

Drawdown's research identifies an estimated 44 million hectares (ha) of regenerative farming activity, which will increase to a total of 400 million ha by 2050 whereby from its research, regenerative agriculture currently ranks no. 11 in the top 100 solutions delivering 23.15 gigatonnes from 2020-2050 (where 1 GT is equal to 1,000,000,000 metric tons).

Regenerative agriculture according to *Drawdown,* is thus one of the foremost solutions backed by scientific and commercial market validation for biological soil carbon sequestration and the multiple benefits it provides, highlighted by the facts below, whereby:

- For every US$2.5 billion of investment in regenerative agriculture, the total atmospheric carbon dioxide is reduced by one gigatonne;

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[11] Soil as Carbon Storehouse: New Weapon in Climate Fight? – Yale E360
[12] Ibid

- This fact ranks regenerative agriculture as the fourth most cost-effective solution for climate change whereby the total cost of $57.22b is representative of only 3% of the value outcome in savings delivered as a result, making it the most cost-efficient solution of all;

- *Drawdown* identifies that farms are experiencing soil carbon levels rising from a baseline of 1 to 2 per cent to between 5 and 8 per cent over ten or more years; and

- This percentage increase can add as much as 10 to 24 tons of carbon per hectare to the soil.

Drawdown estimates that at least 50 per cent of the carbon in the earth's soils has been released into the atmosphere and oceans over centuries so returning carbon back into the soil using regenerative agriculture, represents one of the greatest opportunities for addressing human and climatic health for reviving the financial wellbeing of farmers, communities, industry and government.

3.3 Soil, the largest terrestrial carbon pool

At ~2400 billion tonnes (2400×10^{15} g) of C, *Drawdown* claims the soil is the largest terrestrial carbon pool on the planet.

The top two metres of soil holds four times the amount of carbon that is stored in plant biomass. Soil has the capability for storing carbon for a very long time by various protective mechanisms[13] so there is enormous opportunity for GTD that simultaneously tackles the twin challenges of landscape degradation and carbon dioxide drawdown.

The necessary components for implementing changes necessary for this purpose are readily available and well-proven - combining planned grazing with perennial plants and symbiotic use of livestock as well as researching and investigating inexpensive and practical methodologies for measurement and record-keeping that comply with requirements for continuous and accurate measurement capabilities.

[13] Sydney University, Faculty of Agriculture and Environment

Otherwise the propositions referred to herein are an economic, flexible and multi-faceted approach to clawing back on emissions, conserving natural capital and optimising farm productivity for the enhancement of food security and increased resilience of the land and the population dependent on the land. The potential and value of SOC and regenerative farming practices for the benefit and welfare of mankind are impossible to overstate.

3.4 Reversing the build-up of tCO_2e within 30 years

The *Drawdown* publication is supportive of our recommendation that Australia, with its ability to develop policies, becomes the global leader by doing more than just halting the progress of climate change, but also reducing atmospheric tCO_2e by boosting soil productivity and increasing the resilience of the land to extreme climatic conditions by planting perennial crops for harvesting many times annually for more than 50/60 years. These practices have the potential to reverse the build-up of tCO_2e within a time frame of thirty years.

The direct and indirect benefits for maintaining healthy soils systems can be assessed in permanent economic, environmental and food security terms[14] whereby the benefits from conserving natural capital and increasing farm productivity by simultaneously capturing carbon in the soil which becomes the additional value delivered contemporaneously for nil or little additional cost.

This submission features many of the economic benefits that apply from measures by improving soil management practices using regenerative farming techniques and by identifying many of the barriers restraining progress and suggesting policies for the use of soil as a carbon storehouse as a new, practical and inexpensive weapon in the climate fight[15].

Nutrient cycling is estimated to provide the largest contribution of all ecosystem services (including cultural, services waste treatment, disturbance regulation, water supply, food production, gas regulation and water regulation) provided each year (Costanza et al., 1997) being an amazing 51 per cent of a total monetary value of US$33 trillion.

[14] http://www.fao.org/docrep/017/i1688e/i1688e06.pdf P. 144
[15] Soil as Carbon Storehouse: New Weapon in Climate Fight? – Yale E360

Drawdown refers to its publication as *The Most Comprehensive Plan Ever Proposed to Reverse Global Warming*, making the following points:

- There have been agreements and proposals on how to slow, cap and arrest emissions and there are international commitments to prevent global temperature increases from exceeding two degrees centigrade over pre-industrial levels - however to date there has been no detailed plan proposed for the reversal of global warming, notwithstanding that:

    - 195 nations have made extraordinary progress by coming together to acknowledge that we have a momentous civilisational crisis on our earthly doorstep and have created national plans of action;

    - The UN's Intergovernmental Panel on Climate Change (IPCC) has accomplished the most significant scientific study in the history of humankind and continues to refine the science, expand the research and extend our grasp of one of the most complex systems imaginable - climate; but

    - There is as yet no roadmap that goes beyond slowing or stopping emissions.

The regenerative farming approach proposed in this document is not new but is based on rock-solid science supported by rigorous and independently conducted field trials conducted by PZC in Australia and in the deserts of the UAE with research underpinned by the global leadership of the UN FAO 4/1000 initiative to which Australia is a signatory.

4. The blueprint for regenerative farming

Drawdown points out that regenerative agriculture ranks no. 11 in the top 100 solutions researched - being the foremost solution delivered by any agricultural process (backed by scientific and commercial market validation for biological soil carbon sequestration and the multiple benefits it provides). The full summary of the *Drawdown* rankings can be found online[16] which includes the following regenerative agricultural practices for:

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[16] http://www.drawdown.org/solutions-summary-by-rank.

- Nil tillage,
- Diverse cover crops,
- In-farm fertility (no external nutrients),
- No pesticides or synthetic fertilisers, and
- Multiple crop rotations.

The publication confirms PZC's practices for increasing carbon-rich soil organic matter resulting in the proliferation of vital microbes; deeper roots; better nutrient uptake; increased water retention; better pest resistance and compounded soil fertility.

It states farms are seeing soil carbon levels rise from a baseline of 1 to 2 percent up to 5 to 8 percent over ten or more years, which can add up to 25 to 60 tons of carbon per acre. It is estimated that at least 50 percent of the carbon in the earth's soils has been released into the atmosphere and oceans over the past centuries. Bringing carbon back into the soil using regenerative agriculture is one of the greatest opportunities to address human and climate health, along with the financial wellbeing of farmers of the world.

Our submission outlines the GTD Program as a blueprint for a process for the investigation of soils as a major collection reservoir for the capture of carbon on a large scale that is greater than the capability of the atmosphere and terrestrial vegetation combined [17].

It deals specifically with the opportunity for establishing policy for reducing and clawing back emissions - not just as a goal in its own right for Australia - but by researching and coordinating a global program for policies that deliver multiple additional benefits from the land by conserving natural capital and optimising farm productivity to enhance global food security, increase resilience of the land and the population dependent on the land all over the world.

This GTD blueprint includes an extensive array of measures already impacting from our actions for conserving natural capital and improving farm profitability in addition to positive climate impact by delivering intrinsic additional benefits for communities and economies.

[17] FOA 2017. Soil Organic Carbon: the hidden potential. Food and Agriculture Organisation of the United Nations, Rome Italy.

These initiatives improve lives, create jobs, restore the environment, enhance security, generate resilience, improve cultural values, reduce welfare reliance and advance human health by:

- Building landscape function through increased carbon sequestration both above and below ground (biomass and soil carbon);
- Improving soil biology and soil health;
- Increasing the ability of the soil sponge to retain water;
- Creating economic prosperity and cultural enhancement by improving farming profitability; creating jobs and business opportunities from the land for rural and Indigenous communities of the world; and
- Reducing the national reliance on the public welfare purse.

At about 2400 billion tonnes (2400×10^{15} g) of C, the soil is the largest terrestrial carbon pool. The top two metres of soil holds four times the amount of carbon that is stored in plant biomass. Soil has the potential to store carbon for a very long time by various protective mechanisms[18] so there is enormous opportunity for tackling the twin challenges of landscape degradation and emission reduction or drawdown, and this solution offers a “win-win” outcome.

The necessary components for implementing the changes necessary for this purpose are readily available and well proven as demonstrated by GTD activity which combines planned grazing with perennial plants and symbiotic use of livestock as well as researching and investigating inexpensive and practical methodologies for measurement and record-keeping that comply with all requirements for continuous and accurate measurement practices.

Thus the propositions referred to in this document comprise an economic, flexible and multi-faceted approach for clawing back on emissions, conserving natural capital and optimising farm productivity for the enhancement of food security and increased resilience of the land and the population dependent on the land.

[18] Sydney University, Faculty of Agriculture and Environment

5. Multiple benefits

The practical benefits are multiple and immediately visible to the farmer, comprising:

- The creation of accredited carbon offset from the capture of carbon in the soil that can be sold for additional income value;
- The use of a broad range of farming landscapes – inclusive of marginal and generally limited and poor quality and under-productive land - for a variety of productive and/or improved crop outcomes by;
    - Growing high-quality feedstock crops for high-protein, non-genetically modified food for processing for human consumption;
    - Processing low-cost livestock pellets for improved growth and juicy, tender and tasty meat outcomes;
    - Reducing the incidence of bushfire; and
    - Establishing sustainable agricultural farming processes that optimise dryland farming practices for improved land values by growing long-lived perennial crops that can be harvested many times a year for more than 50 years for both human food security and livestock feed, using negligible quantities of water and nil-synthetic fertiliser.

On a global scale, the additional benefits can be summarised as follows:

- Overcoming desertification in this the UN Decade of Desertification (2010 – 2020);
- Remediating drought and salinity affected landscape, and desert and dryland degradation for productive cropping outcomes;
- The phytoremediation of under-productive, marginal or degraded landscape using specifically researched and selected plant species to overcome rising water tables, poor water quality and dryland salinity;
- Restoring ecosystem functions: reviving habitat loss, combating soil erosion and creating soil stability;
- Creating enhanced community employment and regional business opportunities including economic, social, cultural, sporting development and related net gains from improved farming conditions and related downstream processing for enhanced economic opportunity;

- Creating empowerment and social self-sufficiency for Indigenous and rural Communities with less reliance on Government welfare and Encouraging people to remain on or return to the land.

6. The dollar value

Drawdown has modelled each solution to determine its carbon impact to the year 2050 for assessing the total net cost to society measured against total lifetime savings (or cost). Each solution reduces GHG by avoiding emissions and/or by sequestering carbon dioxide already in the atmosphere.
The calculated financial outcomes and benefits of *Drawdown* are staggering in terms of dollar values:

- *From an estimated 108 million acres of current adoption, it is estimated regenerative agricultural practices can increase to a total of 1 billion acres by 2050.*
- *This rapid adoption is based in part on the historic growth rate of organic agriculture, as well as the projected conversion of conservation agriculture to regenerative agriculture over time.*
- *This increase could result in a total reduction of 23.2 gigatons of carbon dioxide, from both sequestration and reduced emissions.*
- *Regenerative agriculture could provide a $1.9 trillion financial return by 2050 on an investment of $57 billion.*

7. The global value

If adopted on a global scale, *Drawdown* research summarises:

- An estimated 44 million ha of current adoptive practices for regenerative farming, would increase to 400 million ha by 2050;
- Regenerative Agriculture ranks no. 11 in the top 100 solutions researched by *Drawdown*;
- This would deliver 23.15 gigatonnes of tCO_2e between 2020-2050 (1 GT is equal to 1,000,000,000 metric tons);

- Regenerative Agriculture is one of the foremost solutions backed by scientific and commercial market validation for SOC and the multiple benefits it provides;
- *Drawdown* identifies that for every US$2.5 billion of investment in regenerative agriculture total atmospheric carbon dioxide is reduced by one gigatonne; and
- This ranks regenerative agriculture as the fourth most cost effective solution whereby the total cost of $57.22b comprises only 3% of the savings that are delivered as a result.

8. Practical examples

With so much to gain, it follows that policy research should be directed at overcoming barriers prevailing against the availability of Halophytes, being the subject of significant university-based research as appropriate species for regenerative agricultural purposes due their inherent abilities to tolerate salt and resist drought.

In February 2015, PZC formed an alliance with the Royal Group of Abu Dhabi in the UAE and established two 2 hectare trial plots at Ghayathi in the Western Districts of the UAE on land managed by the Abu Dhabi Environmental Agency.

No fertiliser was used in these trials for these species which were grown from PZC designed seed capsules (not seedlings) and which shows growth after just two years.

Saltbush trial plot conducted by PZC in the UAE (Feb 2015 – April 2017)

For the purpose of testing the rigour and technical capability for establishing GTD cropping programs capable of delivering global change for sustainable agriculture on marginal, desertified and degraded landscapes, initial trials of Saltbush plantations were undertaken in the United Arab Emirates under some of the hottest, driest and most demanding environmental conditions in the world.

In this regard, PZC species did not just "survive" but flourished (see pictures above) beyond expectations in temperatures that surpassed 50 degrees Celsius for two to three months under saline (12,000ppm or 19 dS/m) groundwater slow drip irrigation limited to 10 minutes daily applied overnight, bearing out the facts presented below.

We also acknowledge the valuable input and research conducted by Alan Lauder and his treatise on *"Carbon Grazing – The Missing Link: Improving plant & landscape resilience; re-carbonise the soil for profit; de-carbonise the atmosphere and reduce methane emissions"* [19] in which he identifies the following beneficial outcomes from Saltbush:

"Fodder provision: Most graziers in the southern rangelands of Australia are familiar with the value of Saltbushes for cattle and sheep. In particularly they provide a perennial source of plant protein needed for efficient digestion of roughages like dried grass. Saltbushes are generally low in energy and high in salt as their name implies. Hence livestock need a lot of water to flush out the excess salt, but the benefit of this salt is that it protects the shrubs from being browsed by kangaroos.

On their own, saltbushes are not a perfect source of fodder. Not even Lucerne, phalaris or rye grass are perfect forages (bloat and staggers can be a fatal result often much of these plants when they are green and lush). Saltbushes are simply one part of a balanced diet that livestock seek to consume from diverse native pastures.

"Salinity mitigation: Most Saltbushes have some deep roots that can access and use fairly saline water at depth. Saltbushes are evergreen and it is only green leaves that can 'pump' (respire) water. These shrubs can be useful in protecting against rising water tables and can contribute to lowering water tables. These natural pumps are far cheaper than having to install the massive electric pumps required to keep saline water tables from seeping to the surface in some irrigation systems (e.g. salt interception schemes).

"Nutrient capture: Saltbushes are great at slowing down and capturing wind-blown soil and organic matter (eg leaf litter). Some amazing hummocks (mounds) of sandy soil up to a metre in height can build up under and around large old bushes. Their low-lying branches and leaves are effective at gathering scarce soil resources.

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[19] www.carbongrazing.com.au

"Soil protection: Saltbushes reduce the erosive power of the searing winds of droughts. These low-lying shrubs are all that holds ancient soils from being blown across to Sydney and beyond. A good cover of perennial Saltbushes also protects the soil when the rains return. Their leaves and branches reduce raindrop impact and the healthy soil hummocks underneath the bushes can rapidly absorb water, rather than shedding water that can lead to erosion down slope.

"Shade and shelter: Likewise, this wind protection provides shelter for grazing livestock, particularly for vulnerable animals like new-born lambs and recently shorn sheep. It is difficult to see sheep in well-managed shrub lands as they head for cover under larger shrubs during the midday heat. Increasing temperatures with climate change will increase the importance of shade.

"Firebreak: Shrub lands and plantations of saltbushes can burn, but not as readily as tinder-dry annual grasses during a howling north-westerly gale. These shrubs maintain a higher moisture content, have fewer flammable compounds than eucalypts, and the shrubs themselves break the wind and can reduce spreading rate of fire.

"Wildlife habitat: There is an amazing variety of ants, termites, beetles, lizards and shrub loving birds that have called saltbushes home for many millions of years. All these creatures are a part of a complex system that maintains productivity.

"Resilience: Saltbushes are tough plants. They have deep roots, woody stems and small leaves. This can detract from their forage value. They are not soft and sweet like clovers and medics; however, this toughness allows Saltbushes to survive drought and rapidly respond to the inevitable post-drought rains. These shrubs bounce back. They have endured climate changes over millions of years. Some shrubs like Old Man Saltbush can also cope with massive floods that can inundate thousands of hectares for months. There are not many agricultural plants that can withstand decades of drought and months of flood; so many of our imported agricultural plants have to be planted over and over again.

"Carbon sequestration: Many species such as Old Man Saltbush are long lived (over a hundred years in some cases), have deep roots and woody stems. All this long-lived material is atmospheric carbon structured into carbohydrates by the amazing process of photosynthesis.

Large saltbush species have the potential to contribute to carbon markets; it is just a matter of scientists doing the research to quantify how much carbon is fixed per millimetre of rainfall constrained by various types of soil.

"Aesthetics: The amazing diversity of Saltbushes includes strikingly beautiful plants with great names like 'Pearl Bluebush'. The shrublands of the Nullarbor Plain would be desolate places without such a patina of greys and pale greens across this vast land. Saltbushes give character to country and have given many people an important sense of place for thousands of years.

"Green insurance: Most of us are willing to pay hard-earned cash for life, fire, health and car insurance to reduce risks to ourselves and our families. We sleep better at night knowing that our insurance buffers us from potential devastating events like an untimely death or accident. Likewise, farmers and graziers with native or planted saltbush sleep better at night.

Their Saltbushes are providing a protein haystack for their drought-stricken livestock, protection for their lambing ewes during a bitter southerly, and cover for their fragile soils."

As part of a project supported by funding from the Australian Government Department of Agriculture as part of the Carbon Farming Future Action on the Ground program, author David Heislers stated:

"Grazing: both carbon credits and liabilities - Grazing to maintain greater levels of biomass throughout the year and creates the potential to re-sequester carbon back into the soil. Rebuilding soil carbon is a patient process…there is a catch though – sheep emit methane that is an important GHG. To generate credits from a soil carbon grazing operation these emissions will first need to be deducted. An important aspect of this project is to quantify this liability. Grazing records resolved to the grazing cell (how many sheep, when and for how long) being maintained by Bright Futures will be critical in this evaluation".

"Influence of SOC on water holding and porosity": Organic matter improves soil aggregate and structural stability which, together with porosity are important for soil aeration and the infiltration of water into soil. While plant growth and surface mulches can help protect the soil surface, a stable, well-aggregated soil structure that resists surface sealing and continues to infiltrate water during intense rainfall events will decrease the potential for downstream flooding.

Porosity determines the capacity of the soil to retain water and controls transmission of water through the soil. In addition to total porosity, the continuity and structure of the pore network are important to these functions and also to the further function of filtering out contaminants in flow (FAO and ITPS, 2015). [20]

The water stored in soil serves as the source for 90 percent of the world's agricultural production and represents about 65 percent of global fresh water (Amundson *et al*., 2015).

9. Smart policy - overcoming barriers

For the purpose of identifying policy design, it is first appropriate to enunciate the barriers preventing widespread adoption of regenerative farming practices for implementing the SOC solution for reducing emissions, conserving natural capital and improving farm productivity.

The approach taken by GTD is to first identify the issues then recommend a suite of opportunities as the vital precursor for creating policies to achieve solutions. The challenges confronting SOC sequestration and preservation are manifold - some are caused by human-induced factors such as low adoption rates for sustainable soil management practices for reasons that are complex and diverse (FAO and ITPS, 2015). Others are factors are beyond human control.

9.1 Financial barriers

Financial barriers are one of the key barriers that restrict implementing adaptation strategies (Antwi-Agyei, 2012; Antwi-Agyei *et al*., 2015; Takahashi *et al*., 2016; Azhoni *et al*., 2017). Most forms of climate change adaption and mitigation practices entail some form of direct and/or indirect financial cost (Takahashi *et al*., 2016). Examples of direct climate change adaptation costs might be the use of expensive and improved crop varieties that offer tolerance towards unfavourable growing conditions or the application of off-farm, carbon-rich inputs. Other costs could involve the imposition of a carbon tax or a direct charge to major emitters creating costs passed on to the consumer.

[20] FAO and ITPS. 2015. *Status of the World's Soil Resources*, Rome

Indirect costs, on the other hand, include practices with high opportunity costs which require an investment of time that might otherwise be directed towards income producing activities (Boon, 2013); e.g. incorporating crop residues into soil versus tending to crops or selling them as biomass.

Financial barriers tending to discourage farmers from implementing SOC-building practices can be found in the form of budget deficits, limited finances or lack of access to capital at farm, provincial, or national level (UN-HABITAT, 2010; Takahashi *et al.*, 2016).

Other factors could include high currency risks due to fluctuating foreign exchange rates; upfront investment costs for equipment, machinery and labour; opportunity costs; costs associated with time and travel to access technical advice or inputs; and potentially low returns given by the uncertainty of the likely benefits (FAO, 2015).

In a study by Takahashi *et al.* (2016) on the barriers that farmers experience in undertaking climate change adaptive measures, the most frequent response pertained to economic consideration, particularly the relative economic risk of implementing new practices or the unpredictability of changing market conditions (as it relates to climate change). Finance therefore is considered the main driver of farmers' practices (Takahashi *et al.*, 2016).

9.2 Overcoming financial barriers

In the case of PZC for example, planting the five projects described in the attached Executive Summary comprises a total of 50,000 ha of otherwise under-performing land the costs for which could be facilitated by a process of forward payment for carbon offset to be delivered at a future date once crops have matured and the carbon offset accreditation process has commenced.

Policies that encourage a precedent whereby farmers might be forward paid for crops in the ground that will deliver accredited carbon offset grown on their land (but delivered at a future date) could be a practical consideration. Such forward payments (in whole or in part) might require support by way of performance criteria to safeguard prepayments made in the form of performance bonds and/or guarantees and safeguards. Nonetheless the prospect for arranging for forms of practical instruments for overcome barriers in this manner is worthy of serious policy dialogue.

In the case of PZC the five projects are taking eight years to establish for both cropping and manufacturing purposes however, GTD activities will make a significant contribution to the local rural economies as even from commencement during the development period, significant capital is being expended with the local community in set up costs for the enterprises, after which there will be continuing local business activity and jobs for at least the next 50/60 years for the relevant districts from GTD activity in their local area.

For every GTD project the key economic indicators from 50,000 ha of plantations and land regeneration activities will result in:

- The development of 15 x 6t/hr and two 1.5t/hr manufacturing plants;
- The creation of 375 new permanent jobs;
- The accreditation of 10 million carbon credits;
- The processing of 130,000 t/yr of High-Protein Powder;
- The processing of 187,500 t/yr of Saltbush Livestock Pellets; and
- The harvesting of 250,000 t/yr of Saltbush Plantation harvested feedstock.

Given the financial opportunities that undoubtedly will arise from engineering practices such as these from GTD projects, adopting similar regenerative farming programs can comprise subject material for policy research for similar solutions for other parts of Australia and the world.

The role of government in this instance might be inclusive of providing the appropriate enabling legislative framework to facilitate a system for ensuring farmers' planting activities were conducted properly and satisfactorily in a manner consistent with best practice requirements with fall-back safeguard mechanisms possibility provided in the form of assistance from local municipal councils.

The suggestion however, obviates any need for the introduction of alternative politically sensitive solutions such as the need for a carbon tax or similar impost on the public purse - being a future payment for farm-related productivity benefits for additional value arising from a transition from basic farming activities towards new and better regenerative farming practices.

Consideration could be given for policy development whereby criteria for ATO tax rebates for funds expended by complying organisations for research and development activities might similarly be transitioned to include an identical tax rebate system for funds expended by farmers for converting their farming practices towards regenerative farming methodologies specifically for the purpose of creating carbon offset in addition to improving regular farming practices such as cropping and grazing outcomes.

Such ATO rebated sums for example, might be held in escrow as a form of performance bond or as a sinking fund to guarantee protection of an emitter's prepayment risk from unsatisfactory performance against any forward payments made to a farmer in respect obligations to deliver carbon credits at a future date.

Additionally, a similar forward payment system might be appropriate with respect to the supply by the farmer (from their improved regenerative farming techniques) of other productive crop outcomes such as the HPP and SLP products referred to in the PZC Business Plan, whereby a forward payer might receive a form of tax concession rebate for producing additional accredited carbon offset in the form of SOC derived ACCUs with additional commercial benefits, such as consideration of tax exemption from the obligation to pay GST on sales, for example.

9.3 Socio-economic barriers

Farmers may fail to achieve agricultural resilience and enhanced food security through mitigation and adaptation practices that foster SOC sequestration (Antwi-Agyei, 2012). Notwithstanding that technological developments such as new crop varieties, soil conserving machinery and irrigation systems are considered to be key agricultural climate change adaptation and mitigation pathways, (Smit and Skinner, 2002) lack of suitable technology is often a barrier to adoption of mitigating and adaptive measures (FAO, 2015).

These barriers are especially pronounced in least developed regions such as in Sub-Saharan Africa for example (Kithiia, 2011; Antwi-Agyei, 2012) where farmers have little to no access to such tools (Kolikow *et al.*, 2013).

The same may be said of some Australian Aboriginal and rural communities hard pressed by lack of financial means due to prolonged periods of drought and increasing levels of salinity. As such, these limitations may constrain opportunities for farmers to achieve agricultural resilience and enhanced food security outcomes through mitigation and adaptation practices that foster SOC sequestration (Antwi-Agyei, 2102).

Technical barriers can occur in many forms including non-availability of appropriate technologies, lack of technical capacity and/or equipment and low detectability of short-term changes such as those encountered during periodic measurements of SOC dynamics (FAO, 2015). Thus logistical barriers are reported as a difficult and complex to adapt to long-term climate trends due to high year-to-year variability, especially given the high risk of short-term failures and the unviability of adaptive practices from one year to another (Takahashi *et al*., 2016), which should also be a topic of research into SOC.

9.4 Political barriers

The encouragement by governments to remove political barriers by acting as agents for change should be included as part of any worthwhile policy research agenda. This should involve avenues for the research of holistic alternatives for policy measures that overlap competing departmental priorities and in many cases, prejudices.

The case in point is there have been many examples whereby competing priorities by different government departments in examining the prospects for reducing emissions, conserving natural capital and optimising farm productivity, have demonstrated a number of different – and very competitive – purposes and priorities between themselves whereby competing interests of separate and individual government ministries and departments become intent on brokering policy action that affect only their own realms of responsibility.

This is especially the case where there is competition for funding which is often sought without regard to the requirements of other ministries or government departments, whose contribution can often impact positively on achieving holistic solutions. Consequently, in many instances, there has been scant regard for overlapping practical and efficient policy adaptation practices due to the inefficiencies of competing bureaucratic priorities which in many cases constrain strategies within federal, state and local government enclaves on many levels (Sietz *et al*., 2011; Antwi-Agyei, 2012).

These interdepartmental barriers can result in shallow and adverse national policy regulations and become responsible for insecure land tenure; imperfect markets and low risk-taking capacities as well as imposing limitations on research and extended services; weak inter-institutional coordination; gender-related cultural conventions and more often, an emphasis only on obvious mitigation benefits without regard to holistic solutions not related to other relevant issues (FAO, 2015).

There have been many examples of confusion and conflicting party attitudes prevalent on the Australian political landscape over the past 20 years commencing with Australia's reluctance to ratify the Kyoto protocol and political point scoring relating to a carbon tax and an emissions trading scheme whereby rules have been changing in an ad hoc manner causing extreme levels of scepticism, doubt and contradiction whereby solutions become based on political issues rather than on practicality.

Some states of Australia such as South Australia for example, have embraced innovation by way of the "New Horizons Program" by growing the capability of its dryland farmers to significantly increase crop and pasture production on poor performing soils[21]. Policy should address such barriers.

9.5 The barrier of lack of vision

On-farm decision making and farming practices are driven by the nature of available markets and the business models of local operators (Antwi-Agyei *et al.*, 2015) as farmers perceive that due to long term pre-established links to specific markets, finding new markets for new or diverse crops or for new hybrids or varieties that sequester more carbon in the soil is a difficult task.

This fact makes it unlikely that farmers will switch crops from monocultures to perennials or engage in controlled cell grazing practices unless there is a foreseeable destination in the form of a (usually) guaranteed market or outcome position (Takahashi *et al.*, 2016).

Market insecurity and fear of the unknown can thus be a driving force resulting in poor physical infrastructure for certain crops. Flawed attitudes can discourage innovative adoption practices as a bargaining chip for many small-scale farmers who cannot store their harvest on their farms when there is a glut and market prices are low (Antwi-Agyei *et al.*, 2015).

[21] http://www.pir.sa.gov.au/__data/assets/pdf_file/0008/218357/PIRSA.1402.08.06_nh-factsheets_general_2pager.pdf

Consequently, researching policy to create government initiatives for the establishment and support for relevant market opportunities becomes a vital requirement within this submission whereby in the case of smaller holdings, farming communities have extension services only as their link to knowledge-based assets and technological innovations whereby sustainable soil management advice is limited often by the field officers involved who can be overwhelmed by the number of communities within their circle of responsibility.

This factor can impede the progress of those responsible for attending to address the needs of the farming communities involved and hamper the adoption of soil conserving practices, weaken the institutional will to invest and lead to the unreliability of climate adaptation information which, combined with extreme variables (drought, flood, pestilence, salinity etc.) can be a major deterrent for many farmers in a number of countries under extreme levels of stress. (Antwi-Agyei, 2012).

9.6 The barrier of lack of knowledge

Lack of knowledge is a vital barrier that requires to be addressed by policy research to overcome the impact of lack of information and/or awareness for factors for reducing land degradation, improving agricultural productivity and facilitating the adoption of sustainable land management measures among smallholder farmers (Liniger *et al*., 2011).

For example, in developing countries and in remote areas of Australia, the lack of state-of-the art equipment at meteorological departments translates into poor information about weather conditions that result in the low adoption of management strategies that might mitigate and adapt a farmer towards climate change (Antwi-Agyei, 2012).

It is important to note that reliable climate information such as annual forecasts is equally important for food security, given that many global farming systems depend on rain-fed agriculture whereby seasonal forecasts are the best option for long-term planning for agricultural resources and activities (Ziervogel et al., 2010).

Sufficient knowledge of different available weather options is crucial for farmers to make informed decisions about the best management strategies (Lee, 2007).

Significant aspects in relation to knowledge barriers are that in many cases it's not so much the knowledge transmitted to the farmer, but the identity of those who are transmitting it. In a survey conducted by Takahashi *et al.* (2016) many surveyed farmers expressed scepticism about the accuracy of information from certain sources, namely those that are politically affiliated, whereby he highlighted the need for access to information from reliable, consistent, objective and apolitical sources.

It is generally desirable and even expected that farmers should comprise an important part of such panels or commissions for sustainable soil management and for policy formation, since farmers themselves, along with cooperative extension agents, are deemed the most reliable sources for local information (Takahashi *et al.*, 2016).

9.7 The barrier of lack of resources

Another impediment worthy or policy research is the (often perceived) absence of sufficient quality land, labour inputs, water and/or availability of sufficient plant species and the means to adapt to apply them in sufficient numbers to mitigate climate change (Takahashi *et al.,* 2016).

In one study, the greatest obstacle to improving soil functions and other ecosystem services was identified as the lack of plant residues due to the low productivity levels of the soils (Palm *et al.*, 2014).

In terms of labour for example, many farmers, especially in developing countries rely on off-farm work as an additional source of income, which in turn limits the amount of time that can be spent working on farms to implement innovative and sustainable soil management practices (Takahashi *et al.*, 2016).

This submission opines therefore that any policy extension of an R&D-type tax rebate payment system should include an ability to claim the costs involved for farmers to address such resource deficiencies, particularly relating to the provision of the most important resource of all – the labour involved.

9.8 The socio-cultural barrier

These are key barriers that influence actions for dealing with climate change mitigation and adaptation Antwi-Agyei *et al.*, (2015, p. 19) state that the belief systems of a particular group of people can constitute one of the greatest barriers to the implementation of climate adaptation strategies.

The voluntary implementation of sustainable soil management practices largely depends on the way farmers perceive climate change and the identification of risk which is fundamentally influenced by personal beliefs, cultural norms, value systems and world views (Jones and Boyd, 2011; Smith *et al.*, 2011; Antwi-Agyei, 2012; Adger *et al.*, 2013).

As such, different cultural groups with distinct pre-existing belief systems within the same geographical region may respond differently to risks generated by climate change (Moser, 2010; Adger *et al.*, 2013).

9.9 The barrier of interconnectivity

The different barriers to climate change adaptation and mitigation practices are highly intertwined, amplifying the challenges of fostering SOC sequestration. For example, technical and logistical barriers are highly connected and related to financial, socio-economic, and institutional constraints (Klein *et al.*, 2001).

This is exemplified by the lack of sufficient funds for government agencies or the absence of a proper structure to enable efficient reporting which will most likely translate into technical, logistical and knowledge constraints. Furthermore, financial barriers are highly correlated with institutional barriers - in particular, insufficient finance or credit facilities which are considered to be one of the most limiting factors and relevant important obstacles hindering the implementation of appropriate management strategies by farmers (Bryan *et al.*, 2009).

It is clear that the lack of readily accessible markets as an institutional barrier impacts negatively on financial barriers. The absence of ready and available markets fuels the vicious cycle that links low prices for agricultural products to the inability to repay loans, preventing the negotiation of future loans and resulting in low adoption rates for sustainable land practices (Antwi-Agyei *et al.*, 2015).

9.10 Non-human-induced barriers

In addition to human-induced barriers, uncontrolled abiotic factors such as climatic conditions and soil texture can limit the potential of soil to sequester carbon, particularly by influencing carbon cycling processes mediated by soil biota (FAO and ITPS, 2015).

Warmer temperatures in northern latitudes accelerate SOC decomposition which is observed by the high CO_2 fluxes occurring during the summer when biological processes are promoted. Consequently, maintaining SOC stocks may be more challenging under such conditions whereby SOC sequestration rates in agricultural and restored ecosystem soils, are estimated to range from 0 to 150 kgC/ ha/year in warm and dry climates, compared to 100 to 1000 kgC ha-1/year in humid and cool climates (Lal, 2001).

This can be explained by the fact that, during the winter months or in cold climates, low CO_2 fluxes are observed since low temperatures suppress decomposition processes (Ward *et al*., 2007; Clark *et al*., 2009; Armstrong *et al*., 2015).

During extreme events such as drought, soil organic matter (SOM) decomposition may initially decrease, but may subsequently increase after rewetting (Borken and Matzner, 2008). Although it is well-established in soil C cycle models that temperature is a major control of SOM storage, the temperature sensitivity of decomposition of different SOM fractions remains an area of uncertainty (Conant *et al*., 2011) and require policy research as a consequence.

The availability of water influences SOC storage through several processes. Since well-aerated, moist soils are optimal for microbial activity, decomposition rates decrease as soils become drier.
In contrast, organic matter decay rates are decreased in flooded soils due to restricted aeration, often yielding soils with very high amounts of SOC (e.g. peat and muck soils) (FAO and ITPS, 2015).

In these water-saturated soils, other abiotic properties, namely physical properties such as peat depth and bulk density also influence the biological processing of C cycling. These properties control for example, substrate availability and the diffusion rates of water, compounds, and gas through the peat profile, ultimately influencing the SOC in the soils (Dorrepaal *et al*., 2009; Levy *et al*., 2012).

Such flooded conditions may cause a surge in CH_4 (methane) emissions (Blodau *et al.,* 2004). In terms of CH_4, whereby Armstrong *et al.* (2015) showed that there is a peak in CH_4 emissions from peat soils, especially in autumn (characterized by relatively high water tables and temperatures) which promote greater methanogenesis (CH_4 production) while limiting methanotrophy (CH_4 oxidation).

In mineral soils, the quantity and composition of SOC is strongly dependent on soil type which can differ at the field-scale. In clay-rich soils, higher organic matter content and a higher concentration of O-alkyl C derived from polysaccharides may be expected.

To the contrary, sandy soils are often characterized by lower C contents and high concentrations of alkyl C (Rumpel and Kögel-Knabner, 2011) thereby decreasing its potential for increasing SOC stocks. Other abiotic barriers to SOC sequestration may include soil erosion and fires which may initially decrease soil C storage (Knicker, 2007).

10. Measurement and reporting

The authors consider this factor to be of extreme importance with respect to this submission whereby baselining, measurement and reporting requirements for SOC are contained in extremely complex and expensive legislation. By any measure these requirements can only be described as onerous and well beyond the capability of ready understanding by farmers on whom the outcome of reducing emissions, conserving natural capital and improving farm productivity will rely [22].

There is an urgent need to undertake a comprehensive research and development project to establish new monitoring and measurement methodologies for the efficient quantification of soil carbon sequestration over large areas to measure the carbon abatement that meets the requirements to qualify as accredited carbon credits (ACCUs).

This work should include the use of remote sensing technology as well as advanced on-farm soil data analytical programs to collate and interpret data from new farm field sensor devices and signals. All of the relevant scientific experts and research organisations in industry and government should be invited to collaborate and share resources for this work which should be scoped to address the following points:

- Problem Outline: problem description assessing current measurement and monitoring methodology flaws and developing and scoping new project for hypothesis, goals and funding strategies;

[22] https://www.legislation.gov.au/Details/F2015C00582/Download.

- Literature review and issues analysis: review of existing soil carbon measurement and monitoring methods used by industry, government and farmers in order to build on the knowledge and experience in the field; including case studies to illustrate relevant issues to be considered in the development of a new methodology; and
- Sustainable Agriculture:
    - The technical components needed for establishing soil carbon measurement and monitoring instruments to enhance management of large-scale commercial farming operations as well as carbon sequestration issues;

    - Technologies to utilise soil sensors for soil carbon ground-truthing and the use of satellite remote sensing capabilities to estimate sequestration rates achieved and accumulated over time in order to qualify as ACCUs;

    - Regenerative farming practices: Capitalising on the opportunity to optimise productivity by regenerating the landscape for food security / land degradation neutrality.

- Digital Data platform
    - Managing and recording copious volumes of information as it becomes available in real time; and

    - Security for carbon trading transactions;

- Other Applications for measuring and monitoring; and
- Stakeholders: three tiers of government; industry and public and private interests.

A comprehensive system for measuring and reporting on outcomes therefore is integral to any policy with regard to this topic whereby formal performance measurement and reporting standards must be established by implementing systems consistent with the Global Reporting Initiative (GRI) which is the international independent standards organisation that helps businesses, governments and other organisations understand and communicate their impacts on issues such as climate change, human rights and corruption.

GRI provides the world's most widely used standard for sustainability reporting and disclosure; enabling business, government, civil societies and citizens to make informed decisions based on relevant and contemporary information (n.b., 92% of the world's largest 250 corporations self-report on their own sustainability performance).

Sustainability reporting enables continual review of the impact and contributions for a wide range of sustainability solutions for total transparency with regard to the outcomes, risks, opportunities, corporate governance and social factors and policies developed as a result of implementing the regenerative farming techniques suggested in this document.

Policy measures must be considered to simply and effectively reduce the costs involved in any process for reporting to a multi-layered network of stakeholders and relevant parties for recording both techniques and outcomes from activity for reducing emissions, conserving natural capital and optimising farm productivity.

Thus any reviewed policy factors should address matters relating to UN Framework Convention on Climate Change (UNFCCC) requirements whereby countries are required to have a national system of institutional and legal arrangements in place to ensure the proper and timely management of and reporting on GHG emissions to the atmosphere (e.g. through mineralisation of SOM) and removals from the atmosphere (e.g. SOC sequestration). Such reporting systems are referred to as measuring, reporting and verification (MRV) systems that are transparent; complete: consistent, comparable and accurate.

Because every country has to report regularly to the UNFCCC/Paris Agreement regarding its level of GHG emissions (e.g. CO_2, CH_4 and N_2O) even if the form for such regular reports vary according to the country's status (Annex 1, Non-Annex 1 or Least Developed Country (LDCs) each country will still be required to provide quality information on its level of GHG emissions and evolutions in order to demonstrate its willingness and efforts to meet the international requirements to limit global warming (UNFCCC, 2016).

To estimate SOC changes and associated anthropogenic GHG emissions and removals from the SOM pool, countries will have to follow the methodology provided by the IPCC in its Guidelines for National GHG Inventories. Default methodologies and default factors for reporting on SOM stocks are given in volume 4 ("Agriculture, Forestry and Other Land Use" - AFOLU) of the 2006 IPCC Guidelines for National GHG Inventories and its Wetlands Supplement which focuses on inland organic soils, coastland soils and inland wetlands mineral soils).

The other five C pools for which GHG estimates have to be reported are the above-ground biomass, below-ground biomass, dead wood and litter and the harvested wood products (IPCC, 2006) – all of which will require accommodation within any measurement and recording policies review.

10.1 Measurements and soil depths

Current estimates of SOC are based largely on surface measurements to depths of 0.3 to 1 m. Many of the world's soils greatly exceed 1 m depth and there are numerous reports of biological activity to depths of many metres. Although SOC storage to depths of up to 8 m has been previously reported, the extent to which SOC is stored at deeper depths in soil profiles is currently unknown. Our submission suggests research therefore to provide the first detailed analysis of these previously unreported stores of SOC.

Soils from five sites in the deeply weathered regolith in the Yilgarn Craton of south-western Australia were sampled and analysed for total organic carbon by combustion chromatography. These soils ranged between 5 and 38 m (mean 21 m) depth to bedrock and had been either recently reforested with *Pinus pinaster* or were under agriculture[23]. These sites experienced mean annual rainfall factors of between 399 and 583 mm/yr.

The data obtained may be indicative of SOC mass densities for each of the five locations varying from 21.8–37.5 kg C m^{-2} which between two and five times greater than data reported to a sampling level depth 0.5 m. Thus it follows that a finding such as this may have major implications for estimates of global carbon storage and modelling for the potential beneficial global impact of climate change and land-use change on carbon cycles as the paper demonstrates a need to reassess the current arbitrary shallow soil sampling depths for assessing carbon stocks.

[23] http://www.sciencedirect.com/science/article/pii/S0378112702001214

Thus the revision of global SOC estimates and elucidation of the composition and fate of deep carbon in response to land use and climate change should be accommodated within any research parameters.

The IPCC guidelines stratify the reporting on SOM (and consequently on SOC) in six different land use (LU) categories and thirty land use change (LUC) categories. Because the calculation of SOC stocks differ according to the type of soil (organic soil or mineral soil - IPCC, 2006) whereby organic soils are identified on the basis of criteria 1 and 2, or 1 and 3 as listed below (FAO, 1998) this also should be a requirement as a topic for accommodation within any research brief.

10.2 GSi technology

Moving from a codified model to software based applications - inclusive of remote sensing and global intelligence systems – to simply and significantly reduce the costs involved for landowners is a policy consideration that must be addressed in considerable detail.

The obvious solution around which policies require development is to take into account the scientific advance made in measuring and reporting SOC whereby in support of this approach and future assessments, country-specific reference to SOC stock inventories will be needed for baselining purposes inclusive of land representation, specifically for identifying and tracking land use and management systems and associated changes over time (IPCC, 2015).

This will overcome a significant range of problems whereby existing measurement methodologies under the ERF are designed to accommodate small land areas for measurement purposes only and are not cost-effective for deployment at scale (see - https://www.environment.gov.au/climate-change/emissions-reduction-fund/methods/sequestering-carbon-in-soils) which heralds methodology requirements that put simply, are far beyond the financial resources of landowners and provide an impenetrable barrier towards improving farm productivity in concert with emissions reductions requirements.

In addition, current methodologies focus on integrated pasture grazing and fail to accommodate the additional sequestration factors such as those delivered by our GTD projects for measuring abatement values delivered by perennial cropping plants, particularly C4 Halophyte species.

Consequently global intelligence systems methodologies will prove superior over time in terms of economic efficiencies due to a capability for quick, efficient and consistent deployment over large areas in real time to validate the level of abatement required to satisfy the generation and money value for tradeable carbon credits at significantly higher levels across significantly vast tracts of land.

This form of policy research has been commenced by PZC in conjunction with its affiliate Regenerative Australian Farmers Pty. Ltd (RAF)[24] using a UK based company's (GSi) satellite-based platform and world-leading technology to apply powerful satellite capabilities for a machine learning platform and online computing system that accumulates data from existing or historical farming, meteorological bureaux and related scientific data for forecasting soil carbon from any number of different locations and/or grown under different soil and climatic conditions.

This approach can deliver validated scientific evidence from soil measurement conducted in accordance with planting and species methodologies with the ability to reduce transaction costs for validating the carbon abatement achieved by more than 80%.

Research regarding the introduction of this systemic approach has been commenced by RAF with respect to GTD projects with the intention – on fulfilment – of contracting it to the marketplace as a solution for addressing costs and efficiencies that provide the volumes and values necessary from commercially and environmentally integrated satellite and ground-based digital soil carbon sequestration platforms, scalable over time for outcomes approved by the ERF/CFI rules for real time measurement within short term time frames (hourly) whereas current requirements are for measurement intervals of ten (10) years.

[24] www.raf.com.au

Currently, continuous monitoring of SOC measurement intervals every 10 years is recommended as a compromise between detectability of changes and temporal shifts in trends. However, this is longer than the duration of many land use and management projects that involve the measurement of SOC stock changes (i.e. between baselining and at the end of the project).

Some countries for example, use an interval of five years (Batjes and Van Wesemael, 2014).

10.3 Remote sensing

Temporal changes in SOC stocks can be assessed by repeated soil inventories in real time or by monitoring remote sensing monitoring programs on representative sites before and after land use and/or management changes or by repeated soil sampling over regular time intervals when no such changes occur (Laurenz and Lal, 2016).

Soil properties that are responsive to management intervention can be monitored rather easily. This means SOC changes affected by new factors (such as climate change for example) can be readily measured if subjected to inter-annual variability due to the rotation of planting or grazing practices, as well as regularity in the disturbance regime and the cycles in the climate variables. Hence, SOC stocks can be monitored at minimal intervals over longer periods of time.

Moreover, SOC stock changes, being relatively small in relation to very large stocks of SOC - as well as their inherent variability across space and time - require sensitive measurement techniques and due consideration for the minimum detectable differences as well as representative sampling design and size.

A monitoring protocol therefore, must be designed to detect changes in soil properties over relevant spatial and temporal scales, with adequate precision and statistical power. For example, the effect of climate change on SOC is observed more readily at a broad scale than at a smaller spatial scale (Batjes and Van Wesemael, 2014).

Soil monitoring networks (SMNs) encompassing global monitoring systems will deliver immediate information on direct changes of SOC stocks, provided through repeated measurements at a given site, as well as data to parameterise and test biophysical models at plot scale.

Policy must include SMNs designed to detect changes in soil properties over relevant spatial and temporal scales, with adequate precision and statistical power. Most SMNs, however, being in planning and/or early stages of implementation have only a few networks located in developing countries where most deforestation and land use change is occurring.

Within these monitoring networks, sites may be organised according to different sampling schemes, for example regular grid, stratified approach or randomised sampling, Adequate statistical methods should be associated with each of these sampling designs (Batjes and Van Wesemael, 2014).

10.4 Monitoring and measuring

Firstly, annual changes in SOC are small compared to the SOC stocks and these stocks are highly variable throughout the landscape whereby changes in the carbon balance attributable to projects can only be detected after 5–10 years (FAO, 2015).

Secondly, the suitability of existing data for monitoring changes in SOC stocks is uncertain so there is currently need for revised methodologies including those for soil sampling and updated remote sensing and field information to enhance the credibility of the overall data (Laurenz and Lal, 2016). To enable a SOC monitoring program to represent the main types of ecosystems globally and allow both the SOC stocks and the stock changes to be estimated, several challenges remain to be addressed by the CRP which are:

- Harmonisation: As the information on SOC is geographically unbalanced, an immediate challenge is the harmonisation of existing regional soil monitoring programs and soil databases (Batjes and Van Wesemael, 2014; Jandl *et al.*, 2014; GSP Secretariat and ITPS, 2016). Harmonisation refers to the minimisation of systematic differences between different sources of environmental measures (Batjes and Van Wesemael, 2014).
- Universal metric: The identification of a universal metric for SOC monitoring is needed. Typically, information is available for the total C content which is then converted to the total SOC pool (Jandl *et al.*, 2014).

- Universal spatial and temporal resolution: Adoption of a scientifically and politically (e.g. for UNFCCC) appropriate spatial and temporal resolution for the measurement of SOC as well as consistent global protocols are eventually needed (Batjes and Van Wesemael, 2014).
- Soil depth measurement: A standardised approach to the reported soil depth for SOC pool estimations is required, since SOC can be unevenly distributed over varying soil depths (Jandl *et al.*, 2014; Laurenz and Lal, 2016).
- Field protocols and sampling: Specific fieldwork protocols and efficient sampling systems for the assessment of SOC dynamics are needed. The large spatial heterogeneity of SOC in comparison to its moderate temporal change calls for cost-effective sampling protocols in order to properly capture SOC dynamics on a landscape scale and to identify small SOC changes in a highly variable pool (Batjes and Van Wesemael, 2014; Jandl *et al.*, 2014; Laurenz and Lal, 2016).
- The need to include SOC in soil experiments: SOC monitoring programs need to liaise with long-term soil experiments that offer a baseline for the SOC pool and can comprise a set of sites where targeted research on soil processes and their impacts on SOC can be performed (Jandl *et al.*, 2014).
- Improved understanding: The understanding of SOC stabilisation processes is incomplete. There is no general agreement on SOC fractionation methods to estimate the degree of stabilisation achieved (Jandl *et al.*, 2014).

10.5 Quality control and assessment

The quality control and quality assessment (QA/QC) process contributes to improve the transparency, consistency, completeness, accuracy and therefore comparability of GHG inventories. The QA/QC process is part of the internal verification process whereby QA is a planned system of review procedures conducted by third parties not directly involved in the monitoring/reporting process.

Reviews are performed on a completed inventory using QC procedures to verify that measurable objectives are met; that the inventory represents the best possible estimates of emissions and removals - given the current state of scientific knowledge and data availability support the effectiveness of the QC program.

QC activities include general methods such as accuracy checks on data acquisition and calculations and the use of approved standardised procedures for data collection, emission and removal calculations, including associated uncertainties, data archiving and reporting.- IPCC, 2006).

Regarding data collection (i.e. measurements) SMNs should be included in a broader cross-method validation program to ultimately enable spatially and temporally validated comparisons both within and between countries (Batjes and Van Wesemael, 2014).

Finally, verification according to the IPCC involves the comparison of National GHG Inventory estimates with alternative estimates as a means for ensuring the quality of the estimates prepared (IPCC, 2006).

11. The agricultural sector and its challenges

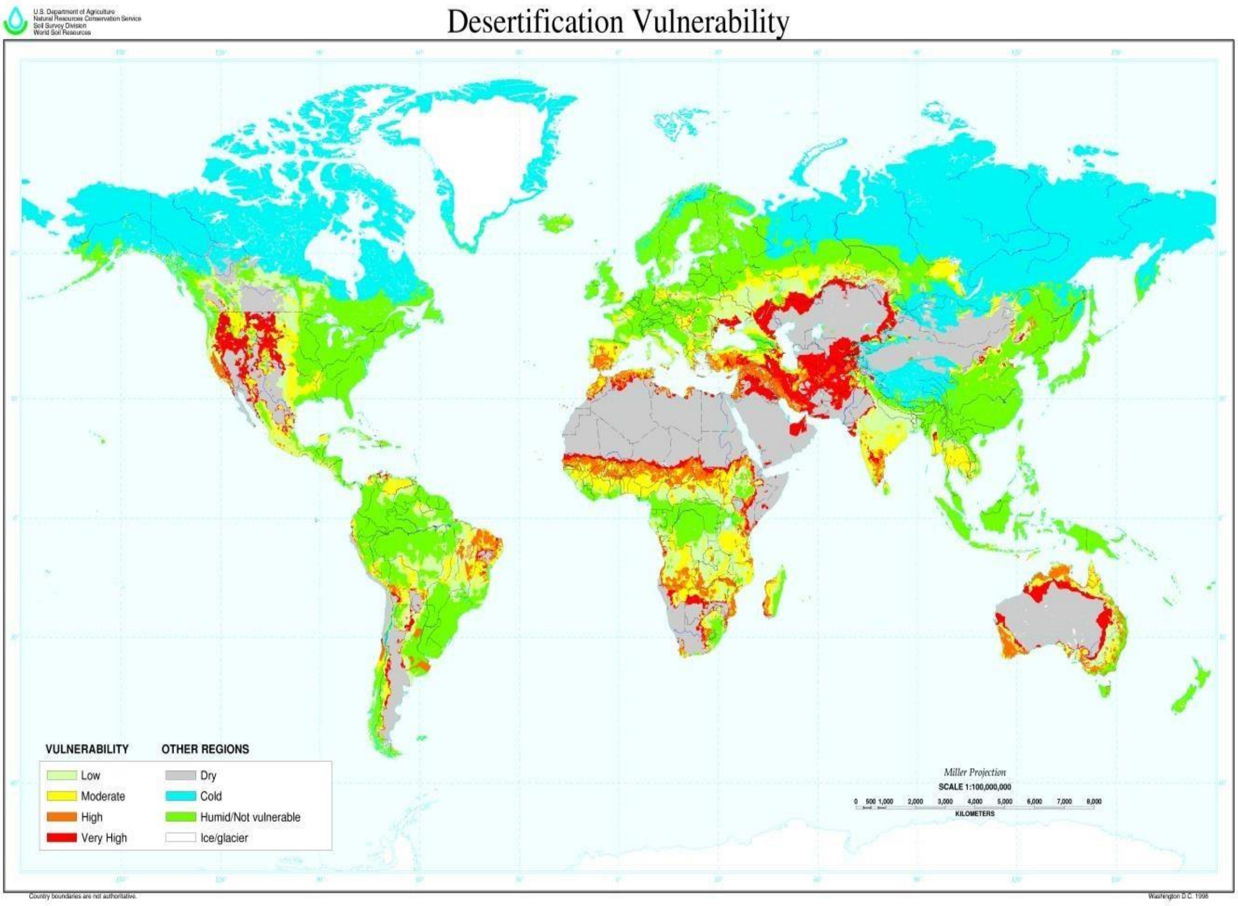
Prolonged periods of drought and desertification are among the issues faced by many countries, especially in Australia and in Africa and Asia, where the rural poor and smallholders are most heavily affected.

This submission is based primarily on recommending research for the application of SOC and how its anthropogenic impact can turn soil from being a net source for greenhouse gas emissions (GHG) into net carbon sinks for carbon to enter into the soil in the form of organic material caused by soil fauna and flora persisting in the soil for decades, centuries or even, millennia.

The submission deals with research to quantify global carbon fluxes to ensure SOC is used productively for reducing emissions, conserving natural capital as a range of economic, environmental, social and cultural net gains and by optimising and building on a range of farming productivity measures and initiatives emanating from the capture of carbon in the soil.

In addition, there is a global problem of degraded and marginal farm land and desertification whereby in an era of natural disasters, global famine, homeless and stateless refugees and climatic extremes - food along with water and shelter, is becoming one of the most valuable commodities in the world evidenced by refugee crises in Africa and the Middle East.

About 1/3rd of the land surface of the World is desert[25] and by the year 2050, the global population will be about 9.5 billion people[26]. To match this burgeoning growth, food production will need to increase by 44 million tonnes every year for 40 years. About 5.7 million hectares of Australian land is affected by dryland salinity – about 80% of which is required for agriculture and this figure will triple to 17 million hectares by 2050, unless something practical is done[27].

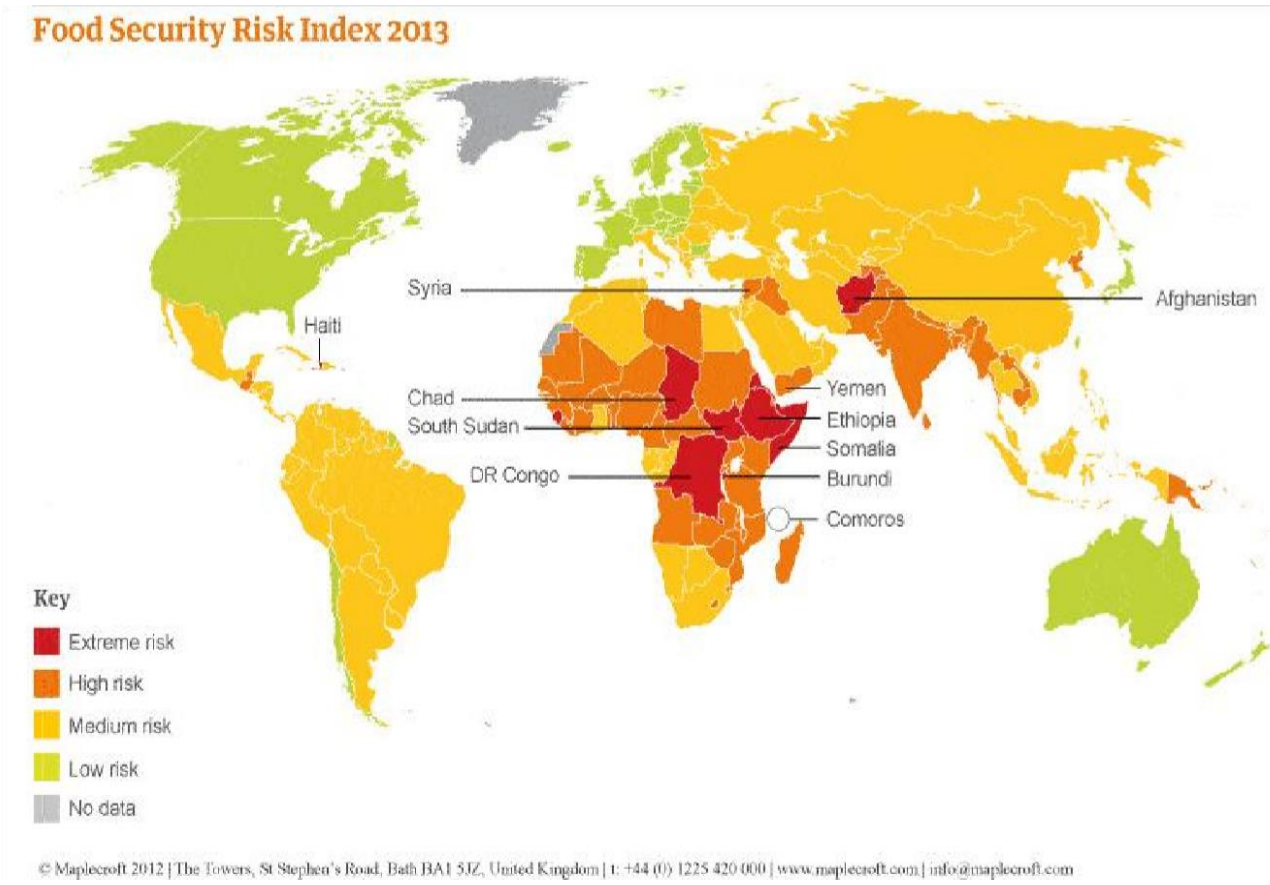


In the UN Decade of Desertification, the vulnerability of the World to desertification is extreme.

Drylands are home to 2.1 billion people, meeting the basic needs for a significant proportion of the world and harbouring some of the world's most valuable and rare biodiversity whereby one crop in every three crops under cultivation has its origins in drylands – supporting 50% of the world's livestock and wildlife and accounting for nearly half of all cultivated land systems.

[25] Fraser Cain – Universe Today June 1 2010
[26] Tester and Langridge 2012 and FOI 2011
[27] National Land & Water Resource Audit, Dryland Salinity in Australia 2000.

Government programs alone cannot address the issues of land remediation by capturing carbon in the soil to consequentially improve farming capabilities and land values; conserve natural capital and create additional downstream manufacturing, business, social and lifestyle opportunities for communities that are in decline.



Thus the cropping methodologies suggested herein include the capability for integrated grazing as an integral component for carbon offset accreditation as ACCUs under the ERF in combination with planting and harvesting activities conducted over a long period of time (more than 50/60 years) at scale across vast tracts of land, resulting in the cumulative build-up of considerable quantities of SOC as well as increasing the productive capabilities and value of the subject farmland.

11.1 The role of government and the private sector

From the small starting point of reducing emissions, conserving natural capital and improving farm productivity on a grand scale, the benefits that have been enumerated herein can only be described as breathtaking.

It is evident, even from the paucity of the information and material presented herein, that regenerative farming practices and the wholesale capture of SOC have the ability to make a huge difference from a plethora of different beneficial outcomes available for changing the world for the better.

But the question must be asked: Can the story of soil carbon be satisfactorily communicated by government or the private and non-government sectors individually or alone? The answer is clearly in the negative.

Regenerative farming practices and the capture of SOC are of themselves relatively inexpensive in nature and are seriously income producing as well – so implementing the product is not the problem – it's spreading the word that demands the solution.

No research program worth its salt can thus ignore the factor of marketing the SOC solution so what is required is a comprehensive policy for communicating the message of SOC and the value for regenerative farming practices.

What is compulsory is a policy to formulate a comprehensive marketing strategy based on simple value demonstrations and examples of just how effective and beneficial regenerative farming and SOC programs can be – with special emphasis on extolling its virtues as a solution for food security; combating global warming; increasing income and land values for farmers – even as an investment destination for mutual funds and superannuation as the world seeks investments in companies and factors that make the world a better place in which to live.

The authors opine that demonstrating the practical nature of GTD projects delivers a significant opportunity for steering public attitudes and perceptions towards a positive understanding of the global benefits that can be delivered by promoting Aboriginal and rural commerce for harnessing beneficial social impact values independently of any dependence on government support.

11.2 Marketing barriers and policy solutions

Regenerative farming may be seen as complex due to:

- Relatively low general community knowledge of the plant types used;
- Limited understanding of rehabilitation requirements, processes and effects;
- The large cash flow potentially associated (inter alia) with the carbon credits arising from the core business activity (performing as a financial distraction from core operations);
- Limited understanding of how carbon benefits arise and potential for a perception that the "core" business is a front for "carbon credit farms;"
- Processing operations that apparently combine livestock fodder production with pseudo-pharmaceutical products of a nature that are marketed by potential customers (such as Swisse and Blackmores);
- The involvement of Indigenous communities in large scale enterprise; and
- Remoteness of locations that might limit any ability for the general public to learn more about the regenerative farming business activity;

This situation is exacerbated by the individual priorities and mandates of potential stakeholders, including but not limited to:

Government (both Australian and State) at the following levels:

- Prime Minister and State Premiers;
- Federal and State Ministers and Ministerial Advisors;
- Environment and climate change;
- Employment;
- Mining and resources;
- Taxation; and
- Indigenous community programs

Investors, including:

- Professional investors;
- Altruistic and/or semi-commercial investors;
- Private lenders; and
- Commercial financiers

Operational partners, including:

- Staff;
- Contractors;
- Partners in modules:
- Indigenous communities;
- JV financier partners;
- Suppliers;
- Customers; and
- The general public, as taxpayers and observers.

For these reasons, it is extremely important and necessary for policies to be developed for the SOC message to be professionally managed and disseminated to appropriate targeted audiences in a manner that can be easily and readily understood.

12. Global sales opportunities

This submission suggests that due to the strong commercial nature of GTD, there is a self-evident policy opportunity for the encouragement globally of practices that are instrumental in accelerating a transition towards a new, low-carbon economy in a manner that is scalable, commercial and sustainable and conducted in a way that least taxes the public purse and/or imposes a financial cost on industry and business.

Many of the views put forward here have as their foundation the experience based on land management practices, research, field trials and projects conducted by PundaZoie Company (PZC) in the origination of its GTD which has as its core:

- Perennial crop plantations with integrated grazing and regenerative farming techniques across a range of landscapes that optimise farmland productivity;
- Consequential downstream manufacturing capabilities for high-quality commercial commodity food products for human and livestock consumption, and
- The sequestration of carbon in the soil for supply of tradeable carbon credits.

12.1 Market opportunities

The opportunities for creating and establishing new markets to exploit the commercial attributes related to the environmental and socio-economic benefits from regenerative agriculture abound. For example, in 2016, 13 million metric tonnes of livestock feed was required to meet Australia's demand[28].

12.2 Demand for HPP

The protein supplement market is booming among the young and healthy, with retail sales of sports nutrition protein powders and other products in the United States alone projected to reach $9 billion by 2020 (up from about $6.6 billion last year) according to the research firm Euromonitor International, which advises in Australia, the figure is upwards of $850 million a year.

PZC management conducted a number of interviews with potential customers (users and/or distributors of HPP) whereby key outcomes indicated strong interest in HPP derived from GTD species and from locally grown pulses and grains as well, which can also be processed on a contract basis for the local farming communities, thus increasing employment and business activity opportunities.

It should be noted that HPP from whey commands a price of between $6,000 and $15,000 p/tonne[29] however PZC suggests that price calculations using a sale price as low as $2,500 p/tonne as a safeguard against seasonal price fluctuations, would still deliver significant profits against costs because dairy-free, soy-free, gluten-free, and allergen-free characteristics of HPP are identified as the key characteristics/benefits.

Positive comment was made frequently about the increasing importance of higher levels of protein in many fast-moving consumer goods offered in the national supermarkets for food manufacturers looking for a replacement for whey protein isolate and soy protein isolate because of negatives associated with each.

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[28] http://www.sfmca.com.au/common/programs/MiddlePageItem.asp?type=15&id=1093&keyrequest=False.

[29] https://www.google.com.au/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=alibaba+wholesale+prices+for+high+protein+powder.

GTD's HPP is the first and only Australian product to deliver such market opportunities both in Australia and world-wide which is a relevant factor due to the Truth in Advertising legal requirements due to commence in Australia on 1 July 2018, compelling mostly all products on supermarket shelves to display bar codes relating to the origin of their products and ingredients.

A report by MarketsandMarkets Analysis into the soy protein ingredients market estimates that the market had a world-wide value of US$6.4 billion in 2012 and is expected to reach US$9.2 billion by 2018, growing at a compound annual growth rate (CAGR) of 6.3%. The Frost & Sullivan and MarketsandMarkets Analysis reports are supported by a further report prepared by Grand View Research Inc. Market Research and Consulting, San Francisco and published in April 2014.

The report is titled: "Soy & Dairy Protein Ingredients Market Analysis by Product (Isolates, Concentrates, Hydrolysates, Casein) and Segment Forecasts to 2020" and states that the global protein ingredient market revenues are expected to reach USD $28.90 billion by 2020, growing at a CAGR of 6.5% from 2014 to 2020.

Increasing market acceptance, especially in functional foods and dietary supplements is expected to drive protein ingredient demand over the next six years. Additionally, consumer attitudes towards these products have undergone a transition over the last five years – a trend expected to remain strong in the near future as consumers look for healthier and sustainable options.

Further key findings from the study suggest:

- The global demand for protein ingredients was 3,186.7 kilotonnes in 2013 and is expected to increase to 4,583.1 kilotonnes by 2020, growing at a CAGR of 5.4% from 2014 to 2020;
- Plant proteins accounted for over 56% of global volumes in 2013, and are expected to continue dominating the market over the next six years, growing at an estimated CAGR of 6.3% from 2014 to 2020;
- Plant protein ingredients were dominated by soy-based products, accounting for over 70% of global volumes in 2013. Global demand for soy protein concentrates is expected to reach 967.6 kilo tons in 2020, growing at an estimated CAGR of 6.3% from 2014 to 2020;

- Europe was the largest market for protein ingredients in 2013, accounting for 45% of the global consumption. Asia Pacific is expected to be the fastest growing regional market, with revenues is expected to reach USD 5.53 billion in 2020; and
- The global market is highly concentrated with top four participants catering to over 70% of global demand. The market is dominated by integrated participants such as DuPont Solae, Bunge, ADM and Cargill.

It is estimated that the Australian market represents 0.5% of the world market which would value the vegetable and plant whey and soy protein isolate segments in 2014 at an estimated A$80 million – with whey protein isolate at A$43 million and soy protein isolate at A$37 million which is in line with the estimated market size presented in the Stage 1 Report with data sourced from the Department of Primary Industries.

HPP requirements are common for the snacks, cereal and energy bars category with new products positioned as high protein having nearly tripled from 12% of the category in 2010 to 35% last year. In 2014, key trends put protein food and beverages in the top three trends to take off this year; however weight wellness, free-from, seniors' and children's nutrition will all be focusing on the protein levels in food, with scientists finding a link between high protein breakfast/diet and weight control and health.

The new demand for non-allergen proteins is anywhere between 2-8% of the population considered to be at risk for anaphylaxis, with up to 25% having non-life threatening intolerance. Eight foods account for 90 per cent of all reactions: milk, eggs, peanuts, tree nuts, soy, wheat, fish and shellfish whereby there is an increasing demand for non-allergenic HPP from vegetables especially for non-allergenic protein replacements in everyday products as well as the nutraceutical/functional foods market which has traditionally relied on dairy, soy and wheat proteins.

The rise in the aging population of the world is increasing the need for protein in a healthy diet and is leading to the development of high protein specific foods, which give above average protein in a smaller portion size. This has led to companies trying to find ways of adding protein to those parts of a meal that normally would not have a high level of protein (such as sauces or pasta).

A September 2014 article in FoodNavigator USA reported on research conducted by DuPont Nutrition & Health has revealed that as people age, they believe they should up their intake of protein - though most prefer to get it from food and beverage sources as opposed to taking protein supplements.

A DuPont spokesperson commented: "What we found is that aging consumers—like many—are really looking for sustained energy and they believe protein helps give them increased, better energy. They also do have some key areas of concerns like heart health and immunity. If you can build and position a product that supports more energy and supports one of the health concerns they have, then it could be a big hit."

13.Conclusion

Our suggestion is for the CCA to adopt the role as Australian leader for the development of a 30 year global initiative for the reversal of global warming by seizing control of the debate based on irrefutable evidence provided by way of sound research and comprehensive investigative activity to demonstrate globally the commercial, social and cultural benefits that result.

There is no doubt that regenerative farming practices represent a practical and inexpensive means for securing carbon in the soil, resulting in the conservation of natural capital and improving land values and farm profitability in a manner that does not tax the public purse or impose undue and costly measures on business.

The regenerative farming approach suggested herein is based on science and research supported by rigorous and independently conducted university-based research and field trials and further underpinned by the global leadership of the United Nations (FAO) 4/1000 initiative to which Australia is a signatory.

At about 2400 billion tonnes (2400×10^{15} g) of C, the soil is the largest terrestrial carbon pool whereby the top two metres of soil holds four times the amount of carbon that is stored in plant biomass.

Soils also have the potential to store carbon for a very long time by various protective mechanisms[30] so there is enormous opportunity for tackling the twin challenges of landscape degradation and emission reduction or drawdown whereby there is the perfect confluence of:

- Building landscape function through increased carbon sequestration both above and below ground (biomass and soil carbon);
- Improving soil biology and soil health;
- Overcoming desertification; restoring habitat and valuable ecosystems;
- Increasing the ability of the soil sponge to retain water;
- Economic prosperity through increased production and monetising soil carbon for regional and Indigenous communities;
- Creating employment and business opportunities;
- Addressing the issue of global famine through improved food security measures, and
- Reducing the incidence of reliance on the public welfare purse.

The opportunity exists now to investigate the only possible resource that can deliver the desired outcome on a scale that is necessary for meaningful impact. The measures necessary is to implement the changes that are readily available and well proven, combining planned grazing with perennial plants and symbiotic use of livestock as well as researching and investigating inexpensive and practical methodologies for measurement and record-keeping that comply with all requirements for continuous and accurate measurement capabilities.

Otherwise the propositions referred to herein reveal an economic, flexible and multi-faceted approach for clawing back on emissions, conserving natural capital and optimising farm productivity for the enhancement of food security and increased resilience of the land and the population dependent on the land - whereby, the potential value of SOC and regenerative farming practices cannot be overstated for the future of mankind.

Readers of this submission are invited to read the attached Executive Summary taken from the PZC Business Plan for implementing GTD projects in Australia. On request, a full copy of the Business Plan may be provided to suitably qualified parties, inclusive of detailed financial projections (conditions apply).

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[30] Sydney University, Faculty of Agriculture and Environment

greening the desert™

ATTACHMENT

Business Plan

(Executive Summary only)

4th April 2017

Prepared by:

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the pundazoie company

greening the desert™

Cooling the Planet to Feed the World

Agricultural partnerships delivering a

commercial solution for sustainable agriculture,

climate change and food security

1. Executive Summary

The PundaZoie Company Pty Ltd (PZC)

PZC is the originator and owner of the intellectual property (IP) for the Greening the Desert Program (GTD) – a world-first sustainable agricultural solution that simultaneously addresses the global problems of land degradation, climate change and food security.

The name PundaZoie is a combination of two Greek words which in translation mean "everlasting life".

GTD involves three core business areas:

1. Perennial crop plantations with integrated grazing and regenerative farming techniques across a range of landscapes that optimise productivity;
2. Manufacturing high-quality commercial commodity food products for human and livestock consumption; and
3. The sequestration of carbon in the soil for supply of tradeable carbon credits.

Current GTD projects are for:

- Establishing Saltbush crop plantations for five Project Modules (PMs) each on 10,000 hectares (ha) of degraded, marginal or under-performing Australian agricultural landscape, in partnerships with Aboriginal and rural landowners;
- Constructing five manufacturing and food production plants in five regional communities across Australia; and
- Generating biological soil carbon sequestration from the PMs to achieve atmospheric abatement of around 10 million tradeable carbon credits over ten years.

PZC has an esteemed Board of Directors, an experienced management group and includes an exceptional team of specialists and experts, comprising acknowledged world leaders in their respective fields.

Gabriel Haros, Managing Director, and Jeffrey Castellas, Chief Operating Officer, are the major shareholders and Directors of PZC. Together their interests own more than 90% of the shares in the Company whereby they have been driving the development and growth of PZC since its incorporation in 2002.

GTD accelerates the transition towards a new, global, low-carbon economy that is scalable, commercial and sustainable without taxing the public purse or imposing a financial burden on industry and business by delivering jobs, economic opportunities and social and cultural advantages - particularly for Australian Aboriginal and mainstream rural farming communities, as well as delivering significant environmental benefits and generating profitable returns for PZC shareholders and its landowner and industry partners.

GTD's plantations comprising Halophytes[31] (mainly Saltbush species) and other selected species used for integrated grazing purposes are the centrepiece for PZC's regenerative farming program, designed for delivery as Project Modules (PMs) in partnership with one or any number of multiple landowners for clearly defined regional geographical areas of 10,000 ha each.

The cropping program for each PM supplies feedstock to a centrally located PZC manufacturing plant that utilises PZC's exclusive Alligator milling technology for production of high quality and value food products.

GTD crop species have one single immutable value – they are amongst the best in the world for removing carbon from the atmosphere photosynthetically and permanently sequestering it into the soil through the superior carbon cycle biological processes and the deep root structures of the GTD plant species (C4 plants)[32].

The soil carbon sequestration generates valuable carbon credits accredited under the Australian Government Emission Reduction Fund (ERF) for which PZC is approved to be contracted by the Clean Energy Regulator (CER) to supply at a fixed price over 10 years. The GTD carbon credits serve to economically offset carbon emissions on a large scale in order to meet government and industry emissions reduction targets.

[31] https://en.wikipedia.org/wiki/Halophyte
[32] https://en.wikipedia.org/wiki/C4_carbon_fixation

GTD plantations provide permanent groundcover preventing most of the heat reflectance of the sun back into the atmosphere, thus reducing the albedo[33] effect. By sequestering carbon in the soil - as well as reducing warming of the atmosphere over very large areas - GTD crops permanently and quickly reverse the impact of anthropogenic climate change.

GTD crops have deep root structures that provide advantages for stabilising soils to reduce erosion and by increasing the amount of water in the soil, enabling carbon to be permanently stored in the soil to address the global issue of climate change. In addition, farm land owners benefit from increased productivity and land values from biological soil carbon sequestration.

Thus, GTD perennial crop plantations and products:

- Deliver an integrated mix of commercial outcomes for both livestock grazing and harvesting for a valuable range of food products for both human and livestock consumption.
- The harvested feedstock is used to manufacture products in the form of High-Protein Powder (HPP) for people, and Saltbush livestock pellets (SLP) for animals.
- The plants in the field, together with other grasses and crops grown between the Saltbush rows, provide improved livestock grazing opportunities as well as sequestering carbon in the soil that generates tradeable carbon credits;
- GTD enables the development of new localised manufacturing industry in the form of harvesting, transporting, drying, milling, and packaging for new commodity products for the domestic and international markets – thus creating a range of related commercial activities, new job opportunities and business growth.
- The resultant economic, social and cultural net gains for communities can reduce the reliance on government welfare requirements and payments - particularly those for rural and regional Australians;
- GTD increases retention of water in the soil that improves soil microbial/mycorrhizal activity which regenerates the land, improves productivity, reduces risks and increases land values;

[33] https://en.wikipedia.org/wiki/Albedo

- GTD increases the organic matter in soils from permanent groundcover, with a mix of perennial vegetation and selected pasture and grasses that do not require the use of fertiliser, irrigation systems or annual replanting like annual broadacre crops;
- GTD increases biodiversity;
- GTD reduces the risk of fire as the shrubs are fire resistant; and
- GTD species reduce the risks of extreme climatic conditions such as drought, wind, soil erosion, and salinity.

GTD projects deliver commercial net gains for landowners and communities from its sustainable agricultural, commercial and environmental land use methodologies.

Project Modules (PMs)

To implement GTD on a broad scale, PZC engages in Project Partnerships called Project Modules (PMs).

GTD can be delivered by setting up PMs on marginal, degraded or under-performing agricultural land that may have depleted nutritional/microbial/mycorrhizal functions and/or drought conditions or exhibit soil and climatic stresses such as poor productivity and or dryland salinity, etc.

Each PM comprises 10,000 ha of crop plantations to supply harvested feedstock to a local manufacturing plant developed centrally using PZC's innovative and exclusive processing technology known as Alligrator which is a compact modular system with a processing capability for milling feedstock in excess of 6 tonnes per hour (t/hr).

The manufacturing plant includes drying, milling, packaging and research facilities. PZC undertakes Project Partnerships with landowners and industry for its operation and sharing of the costs and returns.

PMs are established for both the cropping and manufacturing components of PZC's business activity. In the case of cropping, landowners are invited to become the Project Partner with PZC whereby capital costs and returns from the sale of crop harvested feedstock is shared between PZC and landowners on an equal basis. In both cases, PZC retains ownership of at least 50% of each Project Partnership business.

Since the subject land is usually marginal, degraded or subject to under-performing farm management practices; drought and/or salinity, or is classifiable as desertified land – PZC's cropping partnerships do not displace viable agricultural land required to support the global food chain.

Thus landowners bring to their partnerships with PZC, land that otherwise would not be as productive, for a new wave of vigorous fresh commercial outcomes and opportunity from GTD. Similarly, Project Partnerships established with PZC for manufacturing activity, may comprise Project Partners who are landowners or any other interested parties wishing to participate with PZC in the manufacturing business.

As with Project Partnerships for cropping, PZC retains at least 50% of the manufacturing enterprise whereby costs are contributed by both PZC and the Project Partners and returns shared fairly on an agreed basis. In the event that Project Partners require loan funds for capital to meet the cost for their participation in a PM, they may receive support from PZC.

The initial five PMs are being undertaken by PZC with Project Partners at:

1. Ceduna, on the edge of the Nullarbor Plain in South Australia (two PM with Scotdesco Aboriginal Community and related Aboriginal partners for a total of 20,000 ha);

2. Wimmera and Gippsland, Victoria (two Project Modules; one as part of the Wimmera Carbon Ready Plan (10,000 ha) and the other with EnergyAustralia and Gippsland Water (10,000 ha) as part of the Gippsland Sustainable Agriculture Project); and

3. Carnarvon, on the west coast of West Australia (one Project Module (10,000 ha) with the Baiyungu Aboriginal Corporation at Cardabia Station).

The timing and area of the Saltbush plantations to be established for each of the PMs are shown in the following table.

Table 1: Saltbush plantations established for each of the PMs

Crop Plantation Establishment (ha/year)					
GTD Project Modules	2017-18	2018-19	2019-20	2020-21	2021-22
Ceduna Module A	1,000	4,000	5,000		
Gippsland	1,000	4,000	5,000		
Wimmera	500	1,500	2,000	6,000	
Carnarvon		500	1,500	2,000	6,000
Ceduna Module B		500	1,500	2,000	6,000
Planting Program: area planted	2,500	10,500	15,000	10,000	12,000

PZC has offtake and purchase agreements in train with a range of large and successful Australian companies including Blackmores for HPP and the stockfeed companies, Frews, CopRice and Ridleys for SLP, guaranteeing long term contract conti8nuity and price stability.

PZC has an agreement to contract with the Australian Government under the ERF for the sale of 7.5 million accredited Australian carbon credits units (ACCUs) for a gross value of $75 million over 10 years generated from five GTD PMs.

PZC is in the process of obtaining qualification of GTD as a project program for the State Government of South Australia's *New Horizons* policy inclusive of advanced payments to PZC for the annual supply of a large number ACCUs to offset 100% of the balance of the State's commitment for Adelaide to become the first carbon-neutral city in the world, offsetting the State's total Greenhouse Gas (GHG) emissions to near net-zero by 2050.

GTD in South Australia involves implementing two PMs initially to generate the carbon credits and increase farm production across 50,000 ha with immediate economic benefits from development of the manufacturing plants in the Ceduna region.

Jeffrey Castellas, COO PZC, and Robert Larking, CEO Scotdesco Aboriginal Community, sign the partnership agreement to implement the Greening the Desert Flagship Project at Scotdesco, Bookabie, South Australia.

The Scotdesco and PundaZoie team prepare for a day in the fields

Economic Benefits from the Five PMs

PZC's establishment is for five PMs staged over eight years for full operation, including farm crop plantations and manufacturing processing. The associated economic benefits for each location however are commencing immediately because of the need to set up and establish crop and manufacturing plants require local expenditure and generate business activity.

Commercial scale revenues commence three years after planting the crops, whereby harvesting coincides with the construction of the manufacturing plants. After this development period, PZC consistently delivers the following key economic benefits and commercial outputs:

- 50,000 ha of GTD Saltbush crop plantations and increased farmland productivity;
- 15 X 6t/hr and 2 X 1.5t/hr manufacturing plants in full operation;
- 120 new FTE manufacturing jobs;
- 240 new cropping jobs;
- 10.17 million accredited carbon credits (ACCUs) over 10 years;
- 56,250 t/yr of High-Protein Powder (HPP);
- 193,500 t/yr of Saltbush Livestock Pellets (SLP); and
- 250,000 t/yr of Saltbush plantation harvested feedstock.

The financial modelling reveals a staged development approach over eight years will generate significant annual profit forecasts for which may be provided by PZC to appropriate persons or organisations for considerable income continuing for more than 50-60 years which is the longevity of GTD perennial crop species.

These outcomes are in addition to the delivery of the environmental, economic, social and cultural net gains and the beneficial impact on social welfare programs referred to in the Business Plan.

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