Regenerative Agriculture

Ag2030 Challenge

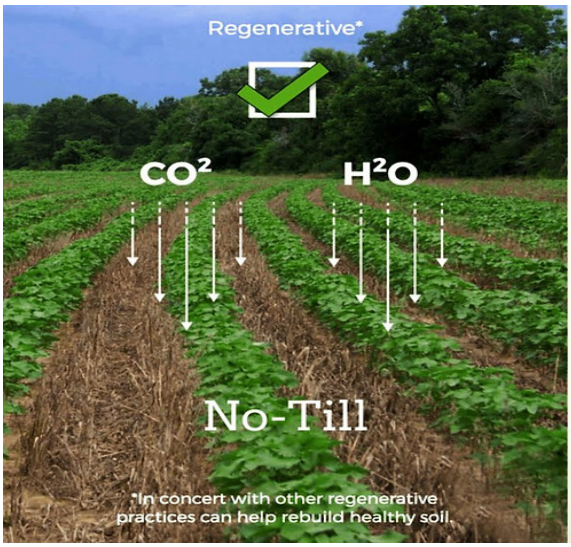
The Big Problem:

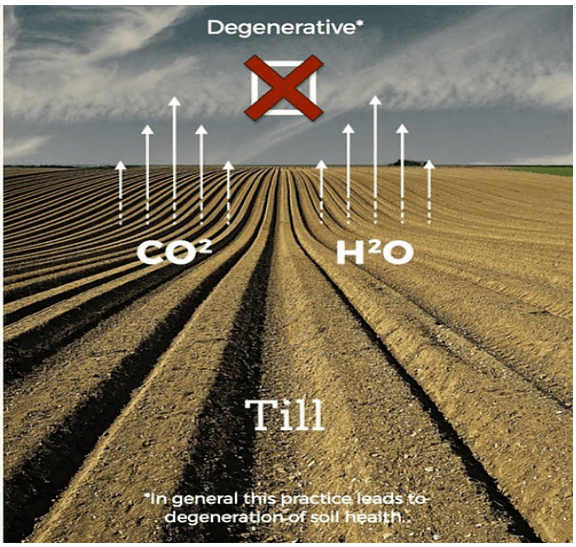
Industrial Agriculture is one of the leading causes of the global environmental crisis, climate change through environmental pollution, soil erosion and more. Industrial agriculture practice's large scale and intensive production of crops and animals. Industrial agriculture is mostly practiced in a monocultured format with the use of synthetic fertilisers, pesticides and more. Industrial farming not only is bad for the soil health it is also bad for the health of workers, consumers and downstream neighbours through pesticide toxicity, which has been associated with acute poisoning.

An effective solution for this is regenerative agriculture an alternative to traditional agricultural practices which focusses on improving soil health by encouraging biodiversity through a polyculture system, for the purpose of sustainability. This is undertaken by focussing on understanding the context of the farm's operation, minimising soil disturbance to encourage root growth, maximise crop diversity (by moving away from monocultured farming practices), maintaining living root year-round, integrating livestock and carbon sequestration.

How to Transition from Industrial to Regenerative Agriculture:

- Use cover crops: in conjunction with livestock to form a natural compost which encourages biodiversity and natural pest management
- Reduce tilling
- Rotating crops
- Spreading compost (can use super compost such as inoculants)
- Move away from synthetic fertilisers, pesticides, herbicides & factory farming
- Use livestock in conjunction with crops to create and maintain these natural ecosystems which encourage biodiversity





Benefits of Regenerative Agriculture:

Improves soil health, crop yields
More fibrous and nutrient dense crops
Provide food security
Builds topsoil
Recharges water cycle & restores water quality
+ more

Encourages biodiversity which is a natural pest management – money saved through not needing artificial pest managements.
Overall eliminates cost of machinery, synthetic fertilisers & artificial pest management

Aquaponics to Aid the Expansion of Australian Agriculture

Aquaculture is a fairly new technology, which can be summarised as using water as the growing medium for plants instead of soil. Aquaponics overcomes limitations with aquaculture including high levels of water toxicity from plant waste by incorporating fish to recycle nutrients, and is more environmentally friendly than many forms of aquaculture. The complexity of the ecosystem in aquaponics is why it is so successful, and can be more successful with research into optimising relationships in the ecosystems.

Benefits to aquaponics include:

- This method is less water-intensive than traditional farming methods
- All parts of the aquaponics system can be harvested including the fish and water
- Water is naturally filtered, detoxified and oxygenated by the plants and is suitable for other uses – in addition, studies have shown that higher water quality increases cattle weight, and thus profits
- Combined with climate control, aquaponic systems can grow food year round
- It is not limited by soil quality and climate factors, and thus can be installed anywhere

Research into this area focuses on maximising water use efficiency and interactions between plants, fish and the microbiome. A notable example is from the Latin American Journal of Aquatic Research on the study of tomatoes in aquaponics, it showed that fingerling and juvenile Tilapia improved fungal diversity and thus boosted tomato growth. As Tilapia is an invasive species in Australia, the potential to utilise them is great, in that aquaculture farms in significantly affected areas could take advantage of their presence while containing them so they don't continue to spread and harvesting them to keep the population under control whilst also providing food.

In terms of integrating this technology in Australia's current agriculture, aquaponics would be best implemented in new developments, rather than making significant change in existing farming systems, which would take significant time and effort. Despite this, aquaponics have many benefits and new developments in the technology as listed above and should have a significant part in the future of Australian agriculture as we work towards a more efficient and sustainable economy.

Drip Irrigation as a Replacement for Traditional Watering Methods on Soil Farms

As it is not viable to make significant expensive change all at once such as the replacement and refurbishment of traditional farming methods and areas it is necessary to improve existing systems. One of these improvements is implementing drip irrigation.

Drip irrigation is particularly successful in China on cotton farms. The level of control that comes with administering results in maximum efficiency of water use. It is estimated that drip irrigation saves 30-50% water, and the uniformity in which it is distributed results in better growth outcomes.

As with any infrastructure, there is an associated initial cost with installation but will save money in the long run as there is less water use for the same product turnover.

Recycling Waste/Sewage Water

The process of pasteurising sewage sludge and the sewage sludge itself has potential to boost agriculture sustainably and is implemented in Israel. The pasteurisation process involves adding lime and fly ash (a by-product of burning coal), and is a better alternative to composting, which is costly and releases greenhouse gases.

After pasteurisation the final product can be used as fertiliser, which has benefits as follows:

- Improves soil structure
- Lessens the infectiousness of plant pathogens in sandy soils

Limitations include problems with the actual contents of the sludge and potential harmful chemical contamination.

In terms of economic benefits:

- Fly ash is a by-product and thus there is minimal cost to create it
- The cost is borne by the urban sector and so covering costs are not up to the farmer
- Conforms to the zero waste principles – using waste negates the need to buy or create more which costs money
- Reduces the need for pest controlling chemicals which also cost money

Energy

In general, what we want to accomplish is to minimize the non-renewable resources that go into agriculture, increase production, and repurpose waste. Whilst ensuring the whole process is sustainable.

Renewable energy in Agriculture is a crucial step towards sustainability. The use of Wind farms and wind turbines, to pump water (a practice that may complement hydroponics well), and generate electricity is a core part of this change. Crops and livestock can grow and graze right up to the base of wind farms, so this is an efficient use of space.
Likewise, large solar-farms/solar arrays can be used in agriculture, with livestock grazing around the base of them, both keeping the grass short and taking shelter in the shade of the solar panels. The use of both solar and wind is important, as diversifying power sources creates a more stable baseline.

Crop fertilizers are mostly ammonia, which is manufactured industrially using the Haber process, this process requires a mixture of nitrogen and hydrogen gas. The hydrogen is produced from methane, with CO_2 as a by-product of this reaction. This means that the production of such fertilizers is unsustainable. To remedy this, we can make green ammonia using green hydrogen. Green hydrogen is produced from electrolysis of water, and the nitrogen required to make green NH_4 can be split

from the air. Green hydrogen is a new fuel, and as such would be more expensive initially. However, if an industry such as the fertilizer industry provided a stable demand for green hydrogen it would help to commercialize and scale up its manufacture.
Along with solar and wind, this would create greater initial investments but result in a more sustainable long term investment.

The use of greenhouses is an efficient agricultural practice, and the greenhouses themselves can be used as a CO2 dump. Australia has a-lot of land, so in regards to efficiency, the main concern is efficiency of resources rather than efficiency of space. Large greenhouses with solar panels could be used to nurture a single layer of cropps (considering some of the problems that arise with vertical farming). These could then be constructed around other non-renewable industrial processes involved in agriculture that produce CO2 and have no current alternative, allowing for CO2 emissions to be piped directly into them.
Smaller greenhouses could also be built on rooftops in more urban areas. This would also reduce the cost of transporting food into these areas.

In regards to waste, the agricultural and food industry has much room for improvement . Because of the high standards of the modern day mass-market for food there is a lot of produce that goes to waste. This doesn't have to go to landfill, and could be used much more efficiently. used as a bio-fertilizer, which would further reduce the need for ammonia, as animal feed, or as biodiesel feedstock, to name a few. Additionally, if Hydroponics were to be more widely used (especially in greenhouses) it creates much less waste water as the water remains clean and can be reused, and if in a controlled environment like a greenhouse, the crops produced are much more consistent resulting in less “below standard” products.

Some other new technologies that are making a difference in this space are drones, soil moisture probes, water monitoring, and live-stock maintenance tech such as fenceless collars and chicken tractors.

Executive Summary

Our proposal aims to be comprehensive and address inefficiencies in the agricultural, water and energy sectors in order to reach the 100 Billion profit goal set by the Government. The main aspects of our proposal include regenerative agriculture as a replacement for traditional farming, aquaponic agriculture as an aid and extension of traditional agriculture, and transition to renewable and sustainable energies to fuel the technological advancements, among other solutions. We took care to make sure that our proposals meet the standards of the circular economy and a sustainable future, while also being economically beneficial and feasible for Australia. Our work and ideas are backed up by research, published studies, and case studies from countries successful in the agricultural sector.

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