Evidence-based science is the key to regenerative practices

By
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'Regenerative agriculture', to me, is to 'regenerate' and not just 'sustain'. It is a movement, but describes farming and grazing practices that, among other benefits, rebuild soil organic matter and degraded soil biodiversity – resulting in both carbon drawdown and improving the water cycle. It also incorporates holistic management practices that utilise photosynthesis in plants to build soil health, crop resilience and nutrient density (O'Donoghue et al. 2022). Growing biomass achieves this with active growing plants sacrificing up to 40% of their sugars to feed microbes in the rhizosphere through root exudates in exchange for other nutrients. I have spent some time in the regenerative agricultural landscape, and I am neither conventional, nor biodynamic or organic. Rather, I like to consider my clients as landing somewhere on a spectrum from conventional to biodynamic. I like to look at the clients' operation, farming system, values, and beliefs to find solutions to issues. However, growing biomass is not the sole preserve of biodynamics! It is achieved through both synthetic and non-synthetic (fertiliser) approaches.

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In my line of work, unfortunately, and to its detriment, broadacre agriculture is not always an evidence-based industry at producer level. Yes, there are areas where evidence drives what is done, but it is far from being widespread. Too much attention is placed on current fashions and folks searching for the metaphoric holy grail in agricultural production. I am into measurable scientific evidence above anecdotes.

I adhere to two rules: one, we need to maintain and build soil carbon as this increases cation exchange capacity, moisture-holding capacity and provides a home and food-source for soil biology; and two, when using fertilisers, opt for sources that are softer on soil biology.

We know many synthetic fertilisers are, in fact, stimulatory to soil biology if used in correct amounts. Personally, I get tired of hearing some in the regenerative community say, 'synthetic fertilisers are bad'. Both synthetic and non-synthetic sources have their place, especially where source and cost are considered. The micronutrient elements known to be essential for both grass and legume pasture plants are boron (B), chlorine (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni) and zinc (Zn) (Bell and Dell 2008). On pasture soils here in Queensland, phosphorus (P) is widely deficient, and deficiencies of sulphur (S) are common (Peck 2018). Yet many of these nutrients cannot be applied in a cost-effective way, without the use of synthetic fertilisers.

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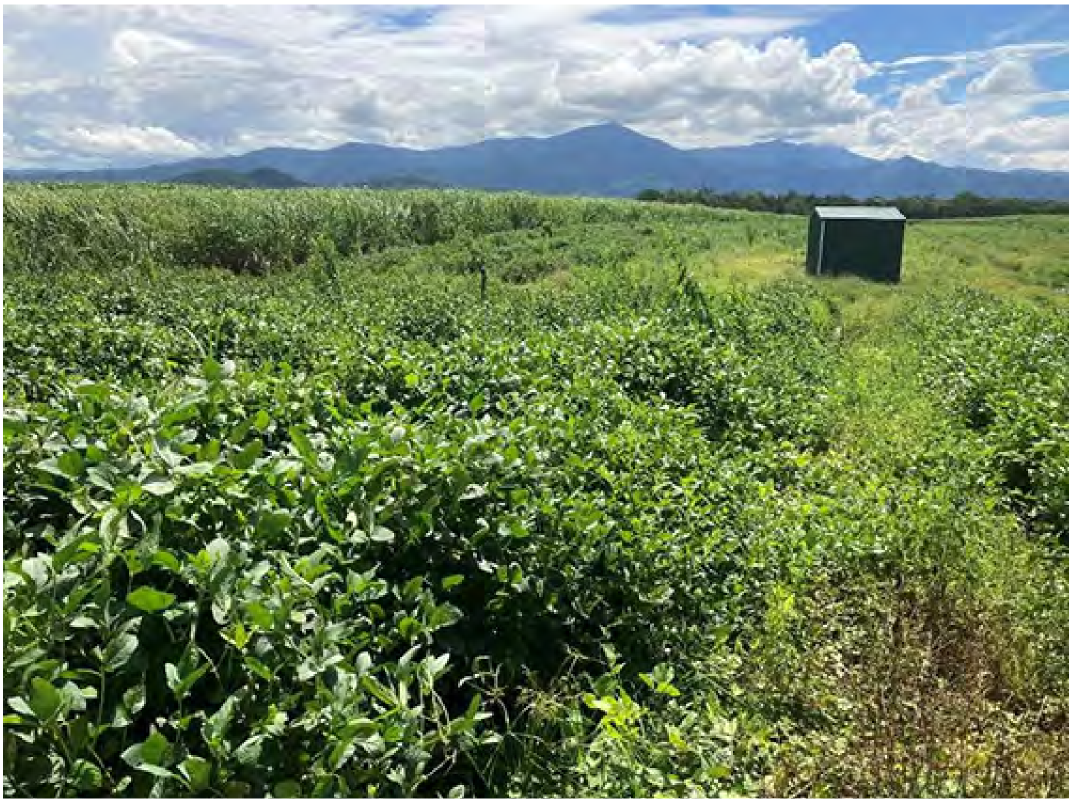

Image 1 - Multi-species cover crop, breaking a sugar-cane cycle near Gordonvale, North Queensland

Continuous grazing practices have resulted in depletion of soil organic carbon levels, with substantial loss of soil fertility. Multi-species cover-cropping, over-sowing deep-rooted perennial legumes, and application of catalytic fertiliser and biological inputs have been identified as potential practices for improving soil health, lifting fertility and soil carbon levels. However, the economic effect of interactions between fertiliser application on soil biology, plant diversity and soil health, and their subsequent effect on economics is poorly understood.

Organic carbon levels can be maintained or improved by maximising living plant production, maximising the thickness and availability of groundcover, introducing biodiversity. Livestock are nature's recyclers, the addition of manures or the growing of cover crops or permanent swards. It is true that we have, in general, mined/lost carbon from our soils and it needs to be treated like other inputs – N, P, K, S, Ca, Mg, etc.

There are, what I consider, many 'snake oil' biological products on the market, particularly 'P-solubilising' products with low evidence. There are some field proven products also for effectiveness. 'Field proven' being replicated, randomised high quality trials comparing fertiliser alone with fertiliser and the biological product and the biological product alone.

However, my intrigue leads me to try new products, especially given cost of fertilisers. On my own operation, breeding bulls on the Atherton Tablelands, I utilise a combination of approaches. This includes:

- Applied biology – rhizobium, *Azobacter* (a free-living nitrogen fixer), and *Bacillus subtilis*;
- Incorporating legumes, and soil ameliorants to obtain high weight gains;
- On the red basalt soils of the Tablelands the use of lime to correct pH is important;
- As the soils have high iron, and a high PBI (Phosphorus buffer index), P-solubilising bacteria – *Bacillus subtilis* – offers promise;
- Nitrogen fixing bacteria and endophytic Trichoderma to improve growth and vigour of grasses, root development and disease resistance. This has not been quantified by way of replicated trial work, but by way of paddock comparison looks to offer promise visually;
- Molasses to stimulate soil biology through protozoa;
- Catalyst micronutrient inputs (that spark better growth and utilisation of macronutrients) such as silicon molybdenum and zinc.

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Within regenerative agriculture (and to an extent cell grazing) approaches, there are principles being taught that are not new or 'magic' but have been extended and encouraged for decades by agricultural extension staff in 'conventional agriculture'. For instance, matching stocking rates to carrying capacity, maintaining high levels of ground cover and residual biomass in the soil (O'Reagain et al. 2011). There is nothing 'mysterious' or new about these approaches, and they are not the preserve of regenerative agriculture.

You do not need complicated grazing systems that run animals around in circles to achieve better grazing land management, livestock performance and business performance – and you do not need to pay thousands on courses to teach you this. The key in both extensive and intensive pastures is rest. You need grass to produce grass, not tax the plant to draw down on its root reserves. One does not need to cell or intensively rotationally graze with high animal numbers. Once paddocks are fully watered, the addition of further waters and fencing does not lead to further increases in carrying capacity and results in reduced economic returns (Cowley 2016). Proponents of intensive rotational grazing (IRG) suggest it will increase the productivity and profitability of northern grazing systems. This has garnered considerable interest at a time where there are declining productivity gains and high debt levels. Several reviews of studies have found no conclusive experimental evidence of pasture or livestock production advantages from IRG compared with continuous grazing (Hall et al. 2014). Despite this, IRG has many strong advocates and several producers have reported benefits in financial performance and sustainability from adopting IRG (McCosker 2000).

Claims of higher weight gains being achieved under cell or IRG systems are not proven and anecdotal at best. It is well-known that forcing

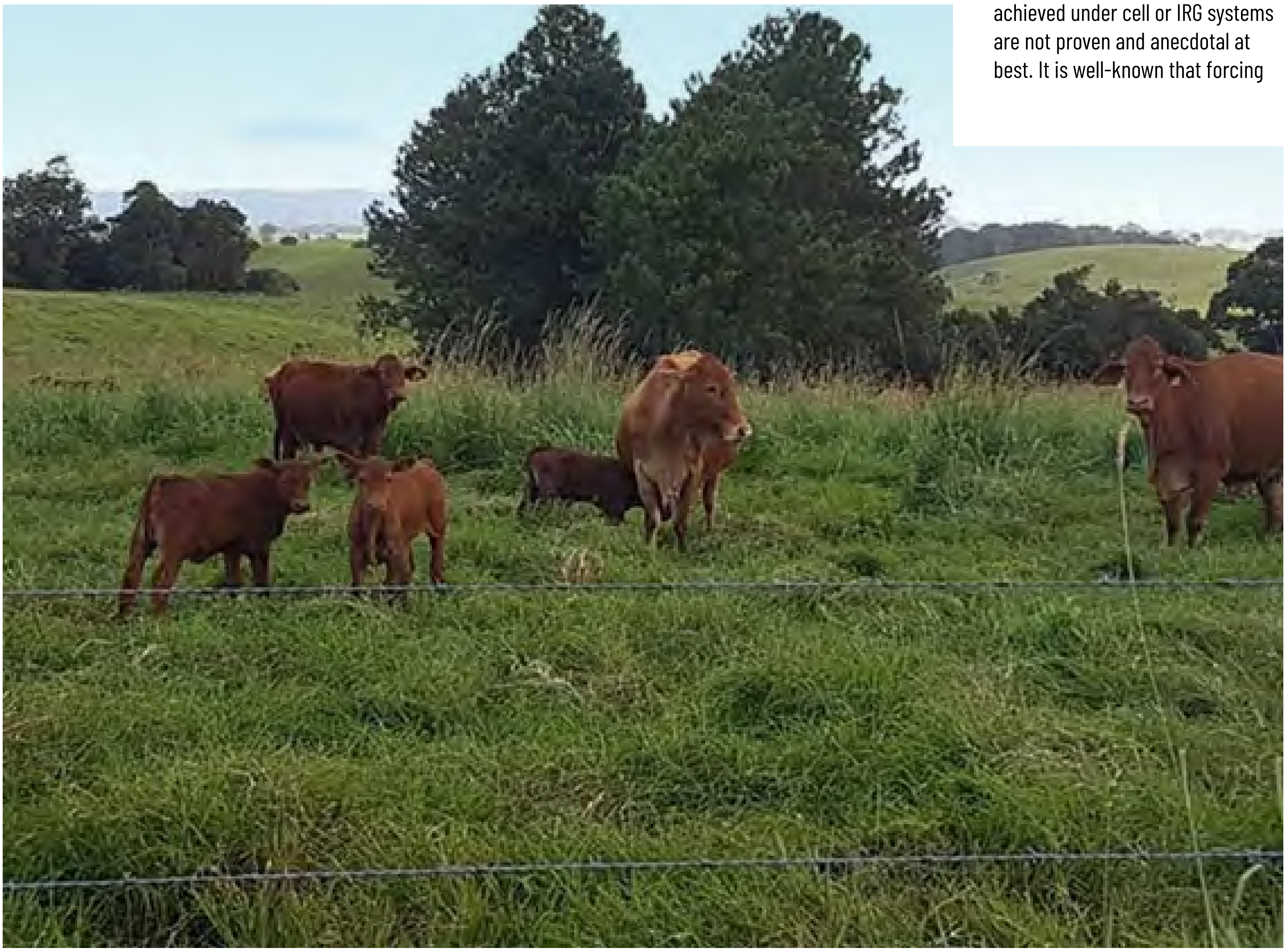

Image 2 - High levels of groundcover are important for soil health

cattle onto a patch under cell grazing may lift the ratio of kilograms of beef per hectare, but it does reduce individual liveweight gains through forcing cattle to consume less palatable species, and less selectivity of desirable plant species. A nine-year study, conducted by the Northern Territory Department of Primary Industry and Resources at the Douglas Daly Research Farm, 220km south of Darwin, studied the impacts of intensive rotational grazing (IRG) compared to continuously grazed paddocks. The study was designed with advice from a leading cell grazing consultant. The study found better cattle performance on set stocked areas than intensively rotationally grazed areas. Schatz (2016) found liveweight gain per head, generally, was highest in the continuous grazing treatment with the lowest stocking rate, and liveweight gain per ha was highest in the continuous grazed treatment with the highest stocking rate, as in different years the stocking rate in the continuously grazed (variable stocking rate) was higher or lower than the other continuously grazed treatments. In each of the nine years of the study, growth of cattle was greater both per head and per hectare under continuous grazing compared to intensive rotational grazing (Schatz 2021).

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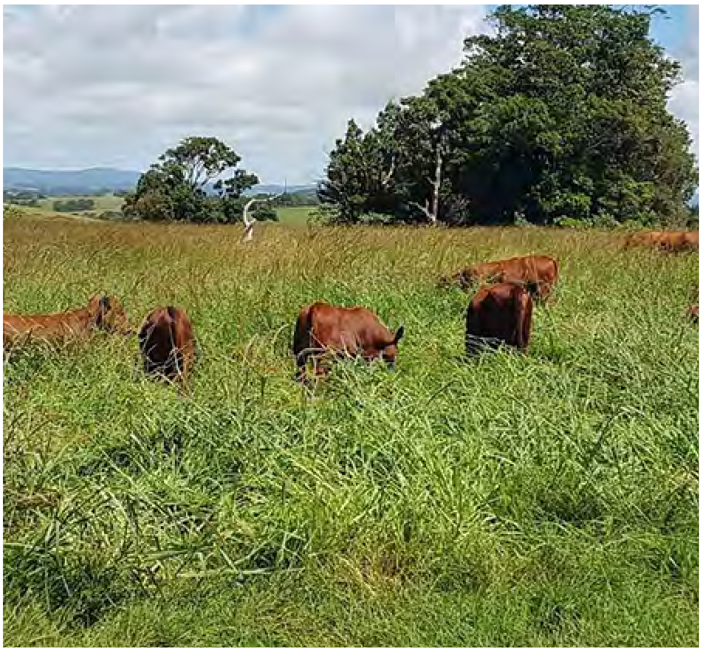

Image 3 - Cattle grazing Setaria pasture near Malanda, Far North Queensland

Fully watered continuously grazed paddocks with appropriate stocking rates performed as well or better than IRG systems. Northern Territory findings are consistent with others (Hall et al. 2014; Briske et al. 2008). The lower or similar production combined with higher operating and capital costs of IRG make them less profitable – at least in the short term. Unless IRG leads to higher carrying capacity, there is no potential for it to lead to higher profit given the higher costs (Cowley et al. 2016).

Cowley et al. (2016) found pastures did not stay in phase two growth during the dry season. IRG did not lead to improved pasture yield, composition, or soil carbon in the short term. Smaller paddock size of IRG paddocks was associated with more even grazing with distance from water, but carrying capacity was the same as fully watered (within 3km of water) continuously grazed paddocks. Diet quality and liveweight gains were never higher and were sometimes lower in IRG systems (Schatz 2016). The higher operating costs (1.5 to 1.8 times higher) and higher capital investment of IRG led to poorer economic performance compared to continuously grazed systems.

Walsh and Douglas (2016) found that stocking rate is the main driver of animal production. Regardless of the grazing system employed, it is important to match stocking rates to the long-term carrying capacity of the land type in its current land condition if animal performance and land condition outcomes are to be optimised (Walsh and Douglas 2016). It is important though to undertake regular feed budgeting and monitoring of land condition to ensure the natural resources are not declining. Through strategic grazing management, fencing paddocks according to land type, rotational grazing management, reduce grazing pressure on better land types and manage them (O'Reagain et al. 2011). Having enough watering points and strategically located to even out grazing pressure and so cattle do not need to walk more than 2 to 3km, depending on the country. Industry has been advocating this in extension since the early 1990s and it is not something 'new' of the regenerative ag movement.

Conventional agriculture is neither archaic and unsustainable, however new approaches must be supported by robust science and sound economics. Our libraries are full of peer-reviewed journal articles on agricultural research conducted since the 1960s that has seldom been successfully extended. There is a greater need for adoption of existing research, rather than more research when it comes to our funding bodies. The former DPI and CSIRO, through agricultural research conducted in the 1960s through to the 1990s, addressed some of the critical issues that constrained productivity. This material is a veritable goldmine for folks who are serious about undeniable evidence.

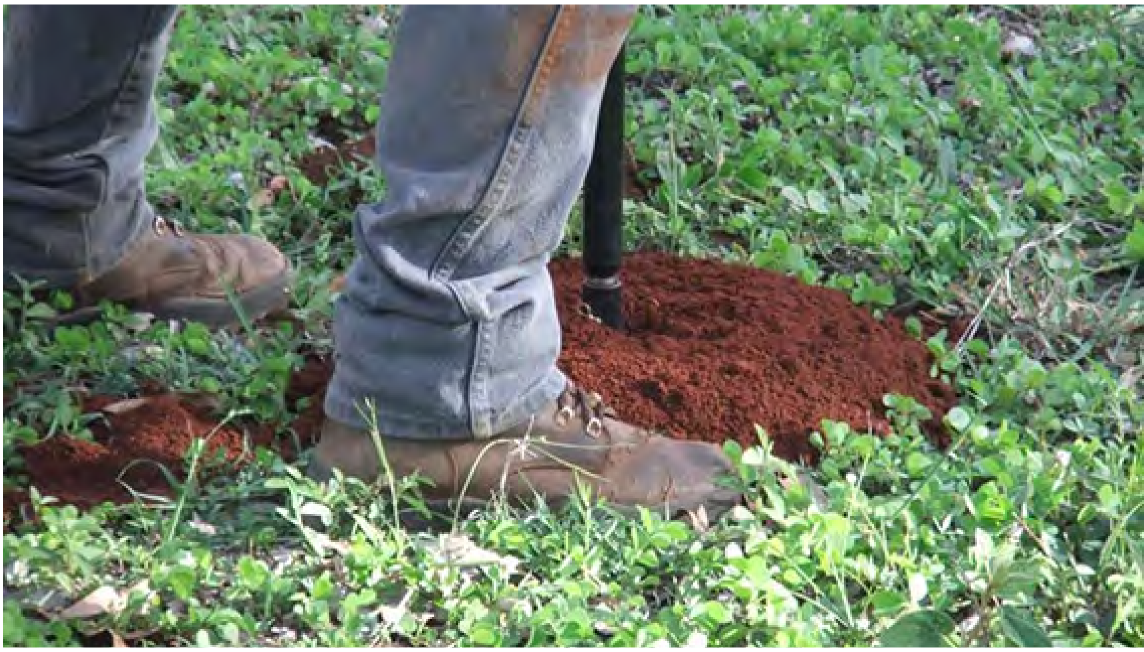

Image 4 -Red basalt soil (ferrosol) on the Atherton Tablelands

My observation is that producers seek evidence-based approaches. Good science starts with a null hypothesis that is either accepted or rejected. Trial work is randomised to avoid bias using a nil treatment and utilising industry standards, e.g., fertiliser at the correct rate. It is replicated and it is repeatable. Further, correct sites need to be chosen. For example, in fertiliser rate trials a P-responsive paddock with low P status needs to be found. Much of our cropping area has high background P status due to many years of repeated application of P fertiliser. Some of us may have heard that there is no effect on yields by reducing fertiliser rates and using products with P-solubilising bacteria. However, have paddocks that have high Colwell P, but low soluble P and high Phosphorus Buffer Index and good P totals in soil been chosen? For example, a high-iron basalt soil on the Atherton Tablelands? Lastly, good science is peer-reviewed. With livestock research it also incorporates a control group of animals.

When I look at several of the 'regenerative agriculture' or holistic management providers, I see a lot of broad statements that have no hard evidence and are just anecdotal. That is not to say regenerative agriculture is bad – to me it is great – but there are many that, in my opinion, are taking something that is good, is altruistic, and milking it for all it's worth, while much of this information is publicly-available.

Regenerative agriculture can be done through both synthetic and non-synthetic (fertiliser) approaches. Ag professionals and producers need to look for the hard, quantifiable evidence rather than anecdotes to ensure that any regeneratively focused system of crop and/or livestock production systems perform and deliver the quality of the product and the availability of the resources agriculture depends on (i.e., soil, water, biota) and are economically viable. Regenerative approaches should be based on science and leveraged with technology. Importantly, any bodies in charge of public or industry funds should ensure that an appropriate level of rigour is applied to their distribution of funding. They have an obligation to ensure that the public purse does not promote, or perpetuate, any fads. The most up-to-date, proven research findings, agronomic tools and diagnostic techniques are key ingredients in finding solutions for our clients' enterprises. The focus should always be on proactively working towards the long-term growth and productivity goals from a whole-farm system perspective balancing economic outcomes with the environment. That is truly sustainable.

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