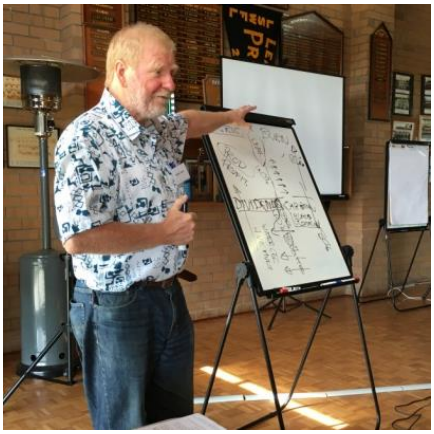

Regenerating the productivity and profitability of farming in the 21st century

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Agriculture in the 21st century; Key challenges confronting Australia's farmers.

The viability of farming in across Australia will most likely be governed by how effectively farmers can respond to a range of new and old challenges confronting key sectors markets. These include;

1. **Climate change**; specifically the increased variability, uncertainty and intensity of extremes within the overall context of warmer, dryer conditions and stresses impeding plant growth.
2. **Soil degradation**; due often to the collapse of soil structures with the oxidation of carbon and their resultant loss of water and nutrient availabilities, acidification and compaction.
3. **Input cost pressures** as crops become more vulnerable to stress and dependent on inputs and animals need more supplements as pastures and seasons become more marginal.
4. **Financial pressures** as the level and cost to service Australia's $75 billion farm debt becomes untenable for farmers from farm incomes or based on debt:equity ratios.
5. **Risk pressures** from these increased stresses now that conventional farmers may only be able to rely on viable returns 2 years out of 5 rather than the 4 out of 5 previously.

Structural stresses also arise due to the aging of Australian farmers, the lack of viable succession options, the loss of regional support infrastructure and from marketing structures that lock farmers into commodity sales at declining terms of trade, farmers often getting less than 10% of retail value.

While theoretically offset in part by increased global demand for quality food products, the ability to secure premiums for these requires; skills, coordination, capital and market relationships that are beyond most individual farmers, trapping them in the non viable mining of their natural soil capital.

By contrast, competitive interests along the food processing and value capture chain are often highly profitable and protected by subsidies and regulations with a vested interest to drive raw material prices and margins ever lower and transfer more costs, obligations and risks onto farmers.

Farms that collapse due to such exploitation are often appropriated at minimal cost by corporate or overseas market interests to be further 'mined' in the medium term via increased subsidised inputs.

These realities, not the capacity of farmers to produce food, are likely to increasingly underpin the non-viability and collapse of Australia's 120,000 farmers over the next decades. In response leading farmers have sought to break out of these pressures and demise by exploring innovative options to regenerate the resilience, productivity and profitability of their farms and futures.

These leading innovative farmers confirm that highly effective options are available to regenerate the; resilience, productivity, profitability and viability of farming in most regions and sectors.

While often not endorsed by the vested interests protecting the status quo, they provide blueprints for how such innovations can be extended, regionally by interested farmer groups, to achieve the critical mass and tipping point needed to revitalize key industries and regions.

The following outlines some of the issues, performance measures and strategies to revitalize the productivity, profitability and resilience of such lead farm ecologies, enterprises and industries.

The myth of the 'green revolution' in raising farm productivities and securing global food needs.

European agricultural science over several centuries has focused on increasing plant productivities to increase food yields. To do this by overcoming limiting factors; that in Europe's latitudes and young soils with adequate plant nutrients, often focused on aiding plants to fix sunlight to form sugar.

As a consequence plants were selected and cropping practices sought to, maximize green leaf areas that could intercept sunlight and by assuming plants had adequate water and nutrients to allow this. Over the past 50 years the green revolution went further to select and breed plants with shoots that grew bigger, faster under ideal conditions helped where needed by additions of water and fertilizer.

Contrary to natural selection this biased our industrial agriculture and food security to leafy plants with lower root:shoot ratios that were more vulnerable to stress and disease and more dependent on ongoing artificial inputs of fertilizer, irrigation and weed and pest control via toxic bio-cides.

While this resulted in more consistent plants and increased yields in optimal non-stress conditions, such plants were often less productive in stressed and marginal sites unless provided with ever more expensive inputs. Their growth often relied on inputs of embodied oil based energy 10 times greater than the food energy their yields produced. As input costs increase they are often non-viable.

More seriously the reduced root production and high levels of cultivation, fertilizer and bio-cides needed by such industrial crops rapidly starved and oxidised organic matter from these soils. This has led to their structural collapse and lower ability to infiltrate and retain rain, retain nutrients in available forms or enable roots to proliferate to depth and sustain plant growth under stress.

While 12-16 million hectares of finite crop land is lost annually, most of the Earth's residual 6 billion hectares of managed crop and pasture land has and is degrading rapidly due to such practices. Soil organic matter levels have often declined from over 8 to often less than 1-2% in the past decades. This has intensified water, nutrient, pest and disease stresses and impeded yields; even with inputs.

As sunshine is not limiting, but soil water and nutrients are, in most regions globally, these crop plants often fail to produce adequate yields to cover their very high expensive input dependencies. In turn the high oxidative inputs often result in the rapid further degradation of marginal soils. Rather than aiding productivities their yield to inputs and return on investment are often non-viable.

This is further accentuated where farmers are forced to grow excess crops to service their debt. As these excess crops often depress market prices they intensify both soil degradation and debt crises.

It follows that these oxidative industrial agricultural practices can not meet the food needs of the projected 10 billion by mid century. They can not reverse our serious degradation of our soils, their hydrology, productivity or of our bio-systems, climate and future. Indeed unless addressed their ongoing exploitation of social and soil values risks the collapse of communities and food security.

How nature generated and sustains high sustained plant productivities with minimal inputs.

As late as 420 million years ago the Earth was covered by just oceans, and bare eroding rocky land. Over the next 100 million years, fungi and plants transformed this bare land into deep organic soils supporting verdant forests of immense bio-diversity and productivity and efficient nutrient cycles.

Even now these natural pedogenesis and regeneration processes can rapidly transform dead mineral rocky detritus into highly productive sustainable bio-systems; such as in the US Prairies following the last ice age or the formation of tropical rainforests on sand dunes in Queensland within decades.

What governs the evolution and extension of our terrestrial bio-system, or their rapid regeneration, is not the abundance of plant growth factors but on the health of the key microbial processes that govern their available to negate limitations, drive pedogenesis and sustain productive plant growth. On the health of the key microbial processes that drive pedogenesis and thereby plant productivity.

No where were these processes more important or more highly refined naturally than in Australia, the driest continent with the most variable extreme climate and oldest leached low nutrient soils. These processes enabled Australia to evolve and sustain some of the most bio-diverse, efficient and productive floras and terrestrial bio-systems on Earth in some of the most extreme limited habitats.

The regeneration of these cyclic processes is now fundamental if we are to regenerate soils globally, rebuild productive sustainable agro-ecosystems and hope to feed 10 billion people by mid century.

Just as nature does in creating productive bio-systems on bare wastes; we need to understand and use these microbial processes and ecologies to accelerate pedogenesis and rebuild an ecological agriculture able to similarly sustain highly efficient and productive food plants, yields and cycles.

All plant growth requirements; abundant sunshine, CO2 and nitrogen are either free from above or in the case of water and nutrients available adequately from most soils if they are managed wisely. Farming seeks to aid their availability so plants can bio-convert them into sugar and then biomass.

As it is the availability of water and nutrients, not sunshine and CO2, that most limits plant growth we need to focus on how nature overcomes such water and nutrient limits so we can do this as well.

As plants obtain their water and nutrients from or via soils, we must understand the soil processes that govern the availability of water and nutrient so we can restore them and become less reliant on the continued input of expensive fertilizers and irrigation and their soil degradation in growing food.

Leading innovative farmers across Australia are doing this, sustaining equal or higher yields with 20% of the inputs much more reliably and at lower risk now that climate uncertainties are increasing. In so doing they are also regenerating the carbon content and health, productivity, resilience and natural capital value of their soils and key land assets.

Rather than stimulating rapid shoot growth via inputs, the productivity of plants is also governed by their soil-microbial- root interface and soil microbial ecology that enables plants to access adequate natural water and nutrients to maximize crop yields, their nutritional integrity and quality. Extended globally the use of such strategies can fully meet the food needs of the 10 billion while regenerating soils and landscapes; despite and to buffer our locked in more extreme uncertain climate.

Agricultural productivity and competitiveness in the 21st century.

Given these inescapable realities, for agriculture and its dependent communities to be sustained it needs to rapidly and fundamentally refocus on regenerating the health, resilience and productivity of its soils. As in nature farmers need to refocus on optimizing their soil-microbial-root interfaces to maximize the availability of soil water and nutrients for the sustained growth of the desired plants.

As forthe lead innovators, this should enable them to achieve equivalent yields using only 20% of more strategic inputs and with higher reliability as well as the rise in soil and natural capital values. In addition to improving returns on investment and risk/return ratios, such strategies enable farmers to operate far more flexibly and opportunistically, without debt and as seasons and markets dictate.

A wide range of simple practical management approaches can help farmers achieve these outcomes. All revolve around regenerating the health and structure of their soil so that it can infiltrate, retain and make available every raindrop to sustain desired plant growth and the nutrients from that soil.

To do this we have to regenerate the former organic matter or stable carbon content of our soils. As in nature we can do this by aiding plant production and then by limiting the oxidation of that plant biomass, instead bio-converting it microbially into stable humus and glomalin to restore their soils. Every gram of carbon bio-sequestered aids the retention and availability of water and nutrients and direct aids the productivity and regeneration of that soil in a series of positive feedback processes.

Our current industrial agricultural practices don't do this, often oxidizing all the carbon fixed by their plants and some of the carbon fixed previously to create that soil; leading to the degradation of the structure and productivity of that soil and collapse of their dependent communities and economies. By contrast regenerative agricultural practices that build soil carbon can reverse and prevent this.

These regenerative agricultural practices limit this oxidation of carbon by limiting excessive, soil cultivation, exposures, desiccation, fertilization and irrigation. They also limit the use of toxic bio-cides so as to sustain the quantity and longevity of green growth and plant covers and the microbial conversion of roots, root exudates and litter biomass into stable soil carbon. The integration of herbivores can also aid these microbial processes and cycles and enhance soil and plant productivity.

Just as innovative leaders have done, all farmers can tailor make such strategies to regenerate their soils, productivities and landscapes via combinations of these practical management changes. Such strategies can help farmers by specifying objectives, where individuals are now, their limiting factors and how to overcome them via mentored local regeneration action to deliver specific outcomes.

Collectively such strategies help form regional and sectoral breakout groups with the critical mass and range of specialist skills to drive viable commercial innovations at grass roots and market levels. For example Regenerate Australia is focused on the regeneration and rehydration of 300 million hectares across northern and inland Australia via innovative ecological grazing strategies to convert fire risks into soil carbon to restore the soil, productivity, flexibility and profitability of these farmers.

Relevant local strategies, based on innovative, soil, rehydration, bio-fertilizer, grazing, cropping, cover cropping, shelterwood, bio-conversion and value capture options, are being refined by groups of innovators across Australia. They can serve as the foundation for a productive viable 21st century agriculture for Australia and to meet the food, and thus social stability needs, of a future 10 billion.

Australia's agricultural profitability and viability in the 21st century.

Australian agriculture and 120,000 remaining farmers has a collective debt of some $75 billion, or over 50% of their recent asset valuations. This needs to be serviced from an uncertain variable gross farm GDP of some $60 b/an, up to half of which is for the increasing cost of inputs from suppliers.

At the same time the price of agricultural commodities and thus net income to farmers has declined greatly over the past century relative to average earnings and inflation. Whereas farmers used to get some 30% of the retail price of food, they now often get less than 10% despite their higher costs.

It follows that farming has become non-viable for many traditional operators and sectors, some only surviving by progressively 'mining' the natural capital of their land assets or outside incomes. This has impeded succession transfers and innovation so that residual farmers are often 60 or older.

In contrast, industrial farming has expanded and intensified with ever more capital and inputs and investments from overseas to produce larger volumes and yields more cheaply. While this results in the faster mining and degradation of soils, new areas can be exploited to sustain outputs and profit. As soil degradation and climate extremes intensify, even these inputs and risks may be non-viable.

It follows that we must find ways to make our regeneration of soils and agriculture not just feasible, technically but also viable. We need to consider values other than just yields and profits, such as;

- The increased value of the eco-system services produced from the regenerated land such as via its water, carbon, bio-diversity, air quality, climate buffering and human health benefits.
- The increased natural capital and equity value of the regenerated land asset to the farmer.
- The strategic and existential value of productive land to a nation facing extreme stress noting President Roosevelt's warming 'that a nation that destroys its soil, destroys itself'.

Our challenge is to translate these improved values into prices and new income that can justify the investment by farmers in creating them. The introduction of a commercial carbon price and market for verified stable carbon increments would help do this as would governments paying for the land outputs generated by farmers that are currently appropriated as 'free', 'natural' outputs or goods.

Similarly Government budgets currently subsidize and protect the status quo by externalizing its real costs and consequences to the taxpayers, environment and future. By enforcing its own laws against this, governments could ensure that the real costs were met on a polluter/user pays basis and that innovations for more efficient and equitable regeneration outcomes were not impeded.

For example Australia's $150 b/an disease industry is driven and protected largely by governments externalizing the known adverse health impacts from our industrial food onto public health budgets. In doing so it is impeding the production and supply of healthy food from regenerative farmers the higher nutritional integrity of which can deliver major preventative health outcomes and savings.

Alternatively regenerative farmers with higher quality products need to find and develop markets here and overseas that value these qualities and are willing to pay premiums for it. This may require further investment, but the rewards from moving 'up the value chain' often justify these. Syndicates of regional farmers can often share these extra initial costs to grow sales in such market niches.

While regenerative agriculture can deliver major benefits, these need to be realized by its farmers.

Conclusions

In the end, humanity needs to recognize that its communities and economics rely totally on the health of its bio-systems, on their sustained ecology, and their capacity to sustain our human health.

Degrade these bio-systems and we impair our communities, economies, self interest and our health.

Our development and survival for the past 10,000 years has been underpinned by our agriculture and its capacity to produce adequate nutritious food to sustain our numbers and health. Actually, on the health and ability of our agricultural soils, and those of others we can exploit, to sustain this.

The collapse of civilizations is a chronology of our sequential degradation of the soils of key regions, mostly within centuries, and of the suffering and warfare involved to avoid their inevitable demise.

Given our finite planet, our degradation of its soils, hydrology and climate and the food and health needs of our projected 10 billion by mid century; we must faced an existential reality this decade. Should we continue to accelerate our degradation of our soils, food production, health and future or regenerate the natural foundation of our sustainable health and future, our soils and bio-systems?

We have all the science, skills, resources, blueprints and imperatives we need to do the latter but need to be clear that we need to decide and change urgently. Business as usual will not get us there.

If we do decide to change our leading innovative farmers have demonstrated highly effective, safe, natural options with which we can transition to regenerate the health of our soils and landscape;

1. By restoring its former high soil carbon levels and structure.
2. So as to increase its ability to infiltrate retain and sustain the availability of rainwater.
3. And enhance the retention, availability and cycling of soil nutrients for plant growth.
4. So as to optimize the soil-microbial-root interface to aid the healthy growth of plants.
5. Thereby maximizing the productivity and resilience of these plants despite minimal inputs.

Extended regionally and globally such innovative soil regeneration practices could readily reinforce the productivity, resilience and viability of agro-ecosystems as outlined for example in Regenerate Australia, despite and to help buffer the now locked in increasing climate extremes.

Combined with innovative strategies to re-define, actualize and capture values these regeneration practices could similarly revitalize the profitability and viability of agriculture, farming and regions.

Australia, while being in the front line of pending climate extremes and impacts, also has unique natural and potential strategic competitive advantages to lead globally in this regeneration of our soils and landscape, food production and thereby the health and social stability of communities.

However to realize this potential, leadership will be needed to remove many current impediments.

Most pressing, Australia and humanity may have less than a decade to initiate this regeneration before climate extremes and social instability impairs our capacity to do so. Even if we don’t, we can be certain that nature will again use these same processes to regenerate its soils, bio-systems and stable climate; with or without us.