Pasture Cropping

A Regenerative Idea from Down Under

Australian farmer Colin Seis stands in a field on his 2,000-acre farm, Winona, where he employs pasture cropping — growing cereal plants in perennial pasture.

by Courtney White

As Colin Seis tells the story, the idea for pasture cropping came to him during a conversation with his friend while drinking beer.

It was 1993. Colin, a sheep farmer in western New South Wales, Australia, and his friend Daryl Cluff, also a farmer, were drinking beer one night, contemplating paradigms. Why, they asked, were crops and pastures farmed separately? Their answer: tradition. They had been taught that pasture and crop systems operated by different ecological processes and were thus incompatible. Crops needed tilling and pastures needed animals. The systems could be alternated over the years, but never integrated. Right? Or wrong?

Seis raised the question because he had been watching the native grasses on his farm and began to wonder if nature didn't intend for annuals and perennials to coexist. Nature certainly wanted weeds in his pasture — so why not a different type of annual instead, such as oats? He knew why: weeds liked to run a 100-yard dash while perennial grasses like to a run a marathon. Two different races, two different types of athletes. Right? Or wrong?

What if it were just one race? What if grasses acted as a kind of cover crop for the annuals, keeping down the weeds but allowing the middle-distance runners, such as oats or barley or canola, to grow while the perennials waited for their turn on the racetrack? More to the point: what if you no-till drilled the perennial pasture during its dormant period with a cereal crop? What would happen?

That was crazy talk, had to be. It was time for more beer.

Why couldn't a cereal plant be cropped in a perennial pasture? As farmers, couldn't they figure out a way to make them all get along symbiotically? If nature could do it, why couldn't they? That's when the light went on, Seis said, thanks to the beer.

"You had to be drunk to think of something like pasture cropping," Seis told me. "But once we sobered up the next day, we decided to give it a go."

And give it a go they did.

So have many others. Today, pasture cropping is practiced by over 2,000

farms across Australia, and many more overseas. The idea continues to spread as well. Here are some reasons why:

- High crop yields
- Sustained high pasture and animal production from cropped land
- Increased fodder for livestock
- High rates of carbon biosequestration
- Marked improvement in the water-holding capacity of the soils
- Improved nutrient cycling
- Improvements in biodiversity and resilience even under drought stress
- Significantly reduced input costs and risks
- Improved economic return from the "vertical stacking" of enterprises
- Improved "happiness" quotient on the farm

It is this last point that is perhaps most important, Seis said. As a practice, pasture cropping is pretty straightforward: by growing an annual plant in the competitive niches in the root ecology of a perennial pasture, it avoids the need to kill pasture grasses prior to sowing a crop, thereby maintaining a living plant cover, which improves biological health of the soil and protects from wind and rain erosion.

Plus, a farmer gets two products — crops and animals — from one piece of land. Three, actually, if you harvest the grass seeds as a potential food source, as Seis has done, mimicking the Aboriginals who historically lived in the area.

But it is the social and emotional value of farming regeneratively, as Seis calls it, that matters most to him. To tell the story properly, we need to back up in time.

A NEW FARM

When Seis gives a lecture or conducts a workshop, he invariably starts with the story of what went wrong with Australian agriculture. It's his way of putting pasture cropping in context, as well as explaining why he calls it regenerative agriculture — because so much of what happened on the continent's farms and pasturelands historically was unregenerative (by the way, they don't call anything a ranch Down Under, everything is a farm, unless it's a huge spread Outback, which are called stations).

The destruction of Australia's grasslands began 150 years ago, said Seis, with inappropriate grazing management, and later by plowing, mostly to grow wheat for the nation's burgeoning population. Overgrazing, tilling, and the introduction of exotic animals in colonial times, including foxes, rabbits, toads, and a variety of aggressive plant species all combined to devastate the continent's naturally nutrient-poor soils and largely defenseless indigenous wildlife. Topsoil began to wash away, along with its precious carbon and other organic matter, causing a general decline in overall soil health and crop productivity. Everything sped up with the introduction of the mechanized tractor in the 1920s, and not in a good way. This was followed by widespread application of herbicides, pesticides, and chemical fertilizer in a desperate attempt to salvage what remained of the soil's fertility.

Seis knows this story firsthand — he saw it happen on his family's 2,000-acre farm, called Winona, located 180 miles northwest of Sydney.

Seis' grandfather resisted the industrial changes being pushed on Australian wheat farmers by agricultural companies and government agencies. He was doing fine, Seis said. His son, Harry, however decided to give something called "New Manure" a go, which turned out to be an early version of superphosphate, in an attempt to boost declining yields. His father objected, asking "What's wrong with the old manure?" Trouble slowly escalated after Seis' father bought a tractor. He didn't know it, but his increased plowing was depleting the soil, carbon especially. A vicious cycle ensued: less fertility in the soil meant more chemical inputs were needed to compensate, round and round. Then the farm began to fail. Costs kept rising, fertility kept falling, salinity rose, trees began to die — and they were going broke.

"Still, the 'moron' principle prevailed in my family," said Seis, his voice rising slightly, "you know, more fertilizer on and more on."

The farm ended up becoming dysfunctional and unprofitable. The granite soil on Winona had become compacted and acidic, and organic carbon levels had dropped to below 1.5 percent. The topsoil had declined to less than 100 mm (4 inches) deep and the subsoil had become sodic. Areas of salinity were also breaking out around the property as well.

Then in 1979, a wildfire burned almost all of Winona. Three thousand sheep died, all of the buildings were destroyed, 20 miles of fencing burned up, trees exploded, grass died, and Seis ended up in the hospital with burns on his body.

"Worst of all, there was no money to recover things with, which means we had hit rock bottom" he explained. "My grandfather had the last laugh, I'm afraid."

When Seis had recovered from his burns, he decided to rethink the way

he had been practicing agriculture. It wasn't a criticism of Seis' father, who had followed the rules of farming for the time, rather a realization that the rules themselves needed to change. The fire suddenly created an opportunity to do just that. Out of the ashes, Seis vowed, a new farm would emerge.

The first step was to physically rebuild the farm, which took two years, with lots of help from neighbors. The second step was to go cold turkey on fertilizer, herbicides and pesticides, because they couldn't afford them. The pastures collapsed as a consequence — they were addicted to phosphorus, Seis said. The third step was to research native grasses. Could they come back? Would they be an acceptable alternative? His father had battled against native grasses all his life, Seis told me, and they kept returning despite his efforts at eradication. This raised a question in Seis' mind: if they keep wanting to come back, why not let them? Apparently, they want to be on the farm.

This led to the fourth step: study the holistic management ideas of Allan Savory, who had developed a way of managing animals on pasture that mimics the graze-and-go behavior of wild herbivores. Seis resisted initially, but again felt that he had no choice. He quickly learned that it worked, especially when he sicced his sheep on the non-natives (with his father's reluctant blessing). However, this new approach created a long transitional period of low productivity, which reinforced his neighbors' belief that native grasses were not as productive as introduced ones. But Seis persisted with his plan.

"I'm stubborn like my dad and his dad," Seis said. "I wasn't sure if that was a good thing or not for a while, but in the end it paid off."

By 1990, things had improved substantially, and Seis was seeing benefits both on the land and in his bank account. But he knew it wasn't enough to completely repair all the damage that Winona has endured over the years. He needed a new idea.

That's where the beer came in.

"Before industrialized agriculture was developed, the world's grasslands and farms contained hundreds of plant species of all sorts," Seis said. "And they functioned with very few problems like disease, insect attack and weeds because it was a balanced ecosystem. Pasture cropping returns that balance. It also creates good, rich soil with high carbon levels and good water-holding capacity."

Today, thanks to holistic management, pasture cropping, and other regenerative practices, Seis can catalogue Winona's recovery in detail:

- Winona is now native grassland with over 50 species of grass, forbs and herbs.
- The farm saves around $60,000 annually in decreased inputs.
- It has increased profits by improving sheep carrying capacity, wool quality and wool quantity.
- Crop yields from pasture cropping remain about the same when compared to conventional cropping with 20-year oat yields averaging 2.5 ton/ha.
- No insect attacks or fungal diseases in crops or pasture.
- Increases in bird and native animal numbers and species diversity.
- Big improvement in soil health, soil structure and water holding capacity.
- Soil microbial counts show that the Winona soil has significantly higher counts of fungi and bacteria.
- All soil nutrients have increased by an average of 150 percent.
- Soil organic carbon has increased by 203 percent.

Today Seis and his son Nicholas run around 4,000 Merino sheep on Winona and pasture crop around 200 ha (500 acres) annually in oats, wheat and cereal rye.

Winona has left rock bottom far behind. So have Seis and his family.

HOW IT WORKS

The key to how pasture cropping works is the relationship between C3 (cool season) plants and C4 (warm season) plants — the difference being the number of carbon molecules and how they affect the process by which

glucose is produced in a plant. C3 plants, such as wheat, rice, oats and barley, grow early in the season and then become less active or go dormant as temperatures rise and light intensity increases. In contrast, C4 plants, such as corn, sorghum, sugarcane, and millet, remain dormant until temperatures become warm enough to switch on and begin growing.

Pasture cropping utilizes the niche created by C3 and C4 plants. When a C4 is dormant (during winter), a C3 plant seed is sown by no-till drilling into the C4 pasture. With the onset of spring, the C3 plants begin to grow. If managed properly, with the right amount of rain, the C3 crop can be harvested before the C4 plants begin the vigorous part of their growth cycle. The removal of the C3 crop will then stimulate C4 plant growth (due to reduced competition). Also, the mix of shallow and deep rooted plants access water resources in the soil differently, which can reduce competition and increase overall productivity.

A key is what's happening in the soil. C3 cereal crops provide sugars to soil microbes, such as fungi, nematodes, and protozoa, during the time when the C4 plants are dormant, which can improve soil fertility faster than a C4 pasture alone might. This also speeds up nutrient cycling, promotes an improved water cycle, increases nitrogen content, and adds organic matter to the soil, which can build humus. Additionally, the no-till drill lightly aerates the soil, allowing oxygen and water to infiltrate.

Another key is using grazing animals to prepare the C4 field before drilling. Grazing animals hit the perennial pasture hard, which gives the C4 plants a "headache," according to Seis, so that the C4 plants come up slowly, giving the C3 plants a chance to grow. By hitting the pasture hard with a large mob of sheep in a time-controlled manner, Seis can keep the C4 plants from growing too tall, too early and thus prevent them from shading the C3 plants. Animals can also control weeds; create litter on the soil surface; supply a pulse of organic nutrients for the crops; and remove dry plant residue from the pasture.

Seis says his use of sheep mobs has been controversial in some quarters due to a concern about soil compaction. This is only a problem where there are low levels of ground cover and litter, he says, or when the ground is very wet. "Where there are good perennial pastures and ground cover," says Seis, "pasture cropped paddocks show very little compaction and soil structure problems."

Proper sowing is another key. An assessment of a pasture's potential before a farmer tries to crop it. Seis has some advice before sowing: graze the paddock to 3-4 inches, create as much litter as possible, use an herbicide to control weeds only if absolutely necessary, use no-till equipment to sow at the correct depth and row spacing, sow the correct crop for your soil type, conduct a soil test if possible, because crops sown by pasture cropping are slower to develop, the crops can be sown up to two weeks earlier than usual. Avoid fertilizer use as much as possible — it shouldn't be necessary. In Seis' case, he started with normal rates of fertilizer, but reduced use by 70 percent over time and today only uses organic fertilizer at very low rates.

One more: never, never, never, use a plow.

Seis also cautions that crop yields are usually lower than with conventional, industrial agriculture in the beginning. He says this is more than offset by the ability to produce two (or three) products from the same bit of land, plus all the fertility that is being built up in the soil.

In 2010, the University of Sydney conducted a research project on Winona and an adjoining farm, under the direction of Dr. Peter Ampt, to evaluate the effects of pasture cropping versus conventional management on soil health and ecosystem function. The project compared paddocks of comparable size on each farm. Some findings of that research include:

- Winona's paddock was 83 percent native perennial grass species.
- The neighbor's paddock was 88 percent annual weed species.
- There was greater ecosystem function on Winona.
- The sheep stocking rate was double on Winona.
- Crop yields were the same.
- Soil microbial counts showed that Winona had significantly higher amounts of fungi and bacteria over the neighboring farm.

In the study's conclusion, Dr. Ampt and Sarah Doornbos write:

"These results illustrate that the rotational grazing and pasture cropping practiced on the innovator site can increase perennial vegetative ground cover and litter inputs, compared to the continuous grazing system and conventional cropping practiced on the comparison site. Increased perenniality and ground cover lead to improved landscape function in the pasture through increased stability, water infiltration and nutrient cycling which in turn can lead to improved soil physical and chemical properties, more growth of plants and microorganisms and an ultimately more sustainable landscape. It also shows that rotational grazing and pasture cropping can improve landscape function while sustaining similar or higher stocking rates over the year compared to the conventional system."

This corroborated Seis' intuition about what was happening on Winona. It also proved that he hadn't been so drunk after all!

For a copy of this study see:
sydney.edu.au/agriculture/documents/2011/reports/ampt_reports.pdf

MORE GOOD NEWS

There are other good reasons to give pasture cropping a go.

It can be used as a land restoration strategy, for example. That's precisely how Seis used it on Winona — to convert a worn-out, weed-dominated, burned-over, failing patch of farmland into an ecologically healthy and economically profitable landscape. He did it by rotating pasture cropping around his farm over time, generally only cropping one-quarter of his farm at a time. Seis is convinced the same strategy can be used anywhere similar C3-C4 plant relationships exist. "It's a great way to rebuild grasslands and can happen almost anywhere there's enough rain to grow a crop," he says. In arid environments, he says, you must drill more carefully and expect yields to be lower — especially in the first few years. "It can also be done with horses or electric engines, I suppose," he says. "You're only limited by your imagination."

By the way, don't use fire to do this job, he insists. Don't burn anything. "Throw your matches away," he instructs. Use livestock instead.

Another benefit is increased carbon, which Seis calls "rocket fuel for plants." According to research conducted by Dr. Christine Jones, soil organic carbon has increased 203 percent over 10 years on

Winona compared to the same neighboring farm studied by Dr. Ampt (the farm is owned by Seis' brother, who, Seis says, has been a good sport and good conventional farmer). Dr. Jones calculates that 171 tons of CO_2/ha has been sequestered to a depth of half a meter (1.5 feet) on Winona. This has contributed to a dramatic increase in the water-holding capacity of the soil as well, which, according to Dr. Jones has increased by 200 percent in 10 years and can now store over 360,000 liters/ha (38,487 gallons/acre) with every rainfall event.

It's the same with other minerals. Winona has seen the following increases: 227% more calcium, 138% more magnesium, 146% more potassium, 157% more sulfur, 186% more zinc, 151% more phosphorus, 122% more iron, 202% more copper, 156% more boron, and 179% more cobalt. It has 277% more calcium than the neighboring farm, and 151% more phosphorus.

Another benefit is what some farmers call "vertical stacking" — the stacking of enterprises on a farm that fit together and thus make more profit per acre. Pasture cropping is a perfect example. It also lowers the cost of growing crops to a fraction of conventional cropping methods. The added benefit is that up to six months extra grazing is achieved compared with the loss of grazing due to ground preparation and weed control required in traditional cropping methods. Other benefits include the recruitment of perennial plant numbers and diversity of the pasture following the crop. This means that there is no need to re-sow pastures, which can cost from $100 to $150 per hectare.

"The best way to improve your profits is to improve your soil," Seis likes to say.

And there's no reason pasture cropping can't be done organically, thus adding value to both the cereal and animal products. Winona isn't certified organic, mostly because Colin likes to keep "every tool in the toolbox" when managing the land. But it would be very easy for someone else to give organic a go.

There's one last benefit — one that may be the most important of all in coming years: feeding people. A lot of people.

According to the United Nations, there will be 9 billion people on the planet by 2050, which raises a serious question: how are we going to feed them without destroying what's left of the natural world, especially under the stress of climate change?

The answer is to intensify food production sustainably by managing land in nature's image. Consider the alternative: more of what got us into trouble in the first place. With 2 billion more people to feed, intensifying food production will be crucial if we're going to have our natural world and eat it too, so to speak.

Pasture cropping is one answer. It produces a grain crop and an animal product plus a wild harvest crop (grass seeds) all from the same acre — while building topsoil, improving the water cycle, enhancing the nutrient quality of the plants, and restoring land health. All on one farm or ranch.

It's possible and profitable, as Colin Seis and his friend Daryl Cluff have demonstrated. We can feed 9 billion if we want. We know how.

I'll raise a beer to that!

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