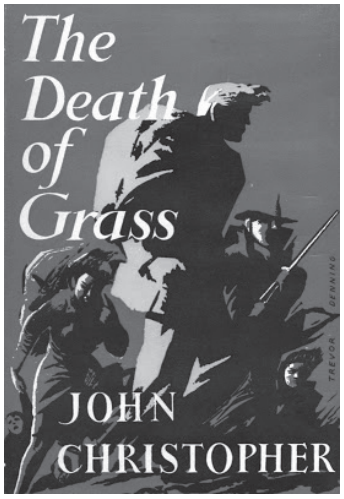
The Dearth of Grass

Chris Smaje connects Cereals, Civilisation and Colonialism.

In his 1956 novel *The Death of Grass*, John Christopher describes the emergence of a virus that destroys the world's grass species. With wheat, rice and other cereal harvests failing, civilisation breaks down in short order, and Christopher's once blamelessly peaceable middle class protagonists find themselves shooting and pillaging their way across a ravaged English countryside, making for the somewhat unlikely destination of a relative's fortified potato farm.



If that scenario belongs in the realm of science fiction, the fact remains that humanity is hugely reliant on the plant family *Poaceae*, which provides the majority of the carbohydrates and proteins fuelling our bodies, and a good proportion of the forage for our livestock. Just three grass family plants – wheat, rice and maize – furnish about half the energy we eat worldwide.[1] Christopher's wider point is surely valid: humanity has built its civilisations on a narrow base, and the rule of law will not long survive if that base should crumble. Though it's probably unlikely that a pathogen of such broad virulence will emerge to cause the 'death of grass', nevertheless there are reasons to think that a slower burning degradation is underway in the capacity of global agriculture to keep churning out the cereals. If not 'the death of grass', then perhaps the 'dearth of grass'. There are good grounds for building more diversity and resilience into our agricultural systems.

In fact, the opposite seems to be happening. Between 1961 and 2011, global population increased by a factor of 2.3, while production of the three key grass staples increased by a factor of 3.6. By contrast, over the same period production of other major non-grass staples (potatoes, cassava, yams, taro, plantain) increased by a factor of just under 2, failing to match population increase. The amount of grains traded between countries has rocketed too, with grain exports nearly five times higher in 2011 than in 1961. As countries urbanise, so they become reliant on this international cereal trade: there is a statistically significant association between grain import dependence and degree of urbanisation. And urbanisation is the biggest contemporary story of all. In 1961, 1 billion of the world's 3 billion people lived in urban areas. By 2011, more than 3.5 billion of the world's 7 billion did so.[2]

Pragmatism or Peasantry?

Two main stories contend today over interpreting these trends. One, associated with self-styled 'eco-pragmatists' like Stewart Brand, welcomes urbanisation and the associated transformation of the rural poor from small-scale farmers to a landless urban reserve army of labour. "Subsistence farming", says Brand, is a "poverty trap and an environmental disaster".[3] Better to let more efficient large-scale export agriculture – based mostly on heavily mechanised farming in wealthier temperate countries – to take care of the world's subsistence needs, allowing newly proletarianised ex-peasants to seek greater fortunes through wage work in the city. However, the 'eco-pragmatists' rarely consider whether the poverty associated with peasant farming results from systemic inequalities of wealth and power rather than being an intrinsic feature of small-scale rural production as such, and whether similar inequalities in the city may stymie the chances of slum dwellers to escape an urban poverty scarcely less crushing.

The other story takes those inequalities as its starting point. From the brief high-water mark of pro-peasant populism in the earlier part of the twentieth century, the possibility of founding self-reliant national prosperities upon independent small proprietors has slowly been eroded through land grabs, global trade agreements and agrarian policies favouring capital intensive staple commodity production over local self-provision, regardless of the consequences for small-scale farmers. Contemporary populists, peasant groups and the food sovereignty movement now seek to reclaim these possibilities from the clutches of 'eco-pragmatists' and neoliberals.

These contemporary positions mirror the debate in eighteenth century England between the agricultural 'improvers' who argued for enclosure and the extinction of common rights in order to improve the efficiency of agriculture and end the poverty of commoners, and the opponents of enclosure who perceived a dangerous world emerging of yet greater inequality, rural dereliction and a loss of freedom among labouring people that would threaten the social fabric of the nation.[4] What was not at stake in the eighteenth century debate, but is now, is the long-term environmental sustainability of the choices made over who grows staple foods, and how and where they grow it. Looking at this issue more closely can help illuminate the larger politics of cereals and civilisations.

Steppe Changes

Wheat is the most important of the cereals in international trade. It's widely grown throughout the world, but its biome par excellence is semi-arid continental grassland – otherwise known as steppe or prairie, which exists in vast tracts globally. The Eurasian steppe stretches from Eastern Europe to China, and into southwest Asia where wheat and most of the other temperate cereal crops were originally domesticated. In North America, the prairies run down the middle of the continent, from the central provinces of Canada, through the American Midwest and into northern Mexico. There are other large areas of steppe in Argentina and Australia. Nine of these wheat-growing steppe countries – Ukraine, Russia, Kazakhstan, Uzbekistan, Canada, USA, Mexico, Argentina and Australia – grow about a third of the world's wheat, and are responsible for two-thirds of global wheat exports. Corresponding figures for maize production are similar.

Eurasian steppe landscape with yurt-dwelling pastoralists, Mongolia

The biogeography and ecology of the steppe regions is an important part of the story. Rainfall is low and erratic, but when it occurs it can be torrential and erosive. Summers are hot, with periodic droughts that are likely to intensify with climate change. Winds are strong and also potentially erosive. Soils are often excellent, but endangered by erosion through the interaction of rain, wind and tillage farming. Wild floras are dominated by perennial grasses. The rarer annual grasses, among which the wild ancestors of wheat are counted, evolved where the trampling or burrowing of animals created rich, disturbed soil that could be colonised by seeds – and because of the aridity, the seeds came with a big package of energy in the endosperm, to feed the early growth of roots that could find scarce water. This energy package is of course what makes wheat and the other cereals so useful for humans, and the ecology of these annual steppe grasses explains both the characteristic structure of human agriculture historically, and its frequent destructiveness in the need to disturb (plough) and enrich (fertilise) the soil.[5]

Neither human agriculture nor humans themselves were abundant on the steppes in earlier history, however. Steppe resources weren't easy to tap, and the dominant land uses were low density hunting and gathering, pastoralism and localised horticulture in favourable microclimates. But more recent times have brought an acceleration in resource exploitation.

On the American prairies the introduction of horses from Europe enabled a brief flowering of the bison-hunting plains Indian cultures, before they (and the bison) were violently supplanted by European colonisation, with homesteaders using horses for the more intensive business of cereal production. While the first European prairie settlers were primarily subsistence farmers and only secondarily commercial ones, nevertheless they constituted the frontline of an expanding commercial world system, and a large-scale wheat export agriculture was therefore able to arise with astonishing rapidity on the prairies.

In 1832 Chicago was still an Indian fur trading post. By 1865 the Chicago Board of Trade had formalised the world's first futures market in order to support its wheat trading, and this transformation of wheat (and later meat) into a uniform, transportable 'liquid' commodity prefigured the invention of modern agribusiness on the great plains, which crashed over the heads of small-time prairie farmers, engrossing their farms into the giant export enterprises we see today.[6]

Other steppe regions followed a similar trajectory. On the Eurasian steppes, for example, the nomadic pastoralists who had long contended for political supremacy with settled agrarian peoples ultimately lost that battle, as Russian colonialism from the north peopled the steppe with grain farmers. The abolition of the English Corn Laws in 1846 and the abolition of serfdom in Russia in 1861 are two signal dates for the emergence of an international wheat economy in Eurasia paralleling American developments.[7]

Perennial Improvement?

The narrative of agricultural improvement typically woven around these events is one of progress in human technology – from hoe to horse to combine harvester – enabling more effective exploitation of the steppe's resources, however regrettable the associated extirpation of its former peoples, so that it now furnishes a cereal agriculture capable of nourishing the world.

Missing from this narrative is a sense of how the story of wheat on the steppes is not just one of technological improvement, but of colonisation – of bringing different groups of people into new relationships with one another to create economic value, usually on disadvantageous terms to at least one of them. Also missing is a sense of tradeoffs or ecological limits. Typically, steppe farming draws down fossil fuel and sometimes fossil water, fosters rapid soil erosion and creates polluting fertiliser runoff, in order to produce food for people in other parts of the world no longer able to produce it for themselves. Sometimes it's upended by the vagaries of human and natural cycles: droughts and dustbowls, recessions and price volatility. Some of these problems arguably are remediable, but it's hard to construct a plausible narrative of simple technological or human progress from them.

At this point in the story, Wes Jackson and the Land Institute make their entrance. A plant geneticist from the premier wheat-growing US state of Kansas, Jackson developed a critique of agricultural civilisation in general and annual cereal agriculture

in the steppe biome in particular on a number of fronts, but mostly in relation to the unsustainable soil loss occasioned by tillage farming in the fragile steppe environment, and the leakage of nutrients and toxins out of conventional farming systems.

The solution Jackson identified was to create perennial rather than annual crops of high seed yield, but requiring little or no tillage, and with primarily 'endogenous inputs', meaning able to take care of their own fertility and pest control. In 1976 he founded the Land Institute, which has pursued a research programme along these lines ever since. Jackson has also been a prolific essayist on the issue of agricultural civilisation. Persistent themes are elegy for the agricultural destruction of steppe grasslands, and the need for human adaptation and readjustment to the wider ecologies we inhabit – of 'becoming native to our places', to use one of his essay titles – rather than importing the means to overcome them through colonial connections.[8]

Given the increasing global dependence on steppe grain agriculture described earlier, such doubts over its long-term sustainability are troubling. But Jackson is bullish about the promise of his perennial-based approach. "For the first time in 10,000 years", he writes, "humans can now build an agriculture based on nature's ecosystems".[9] Other Land Institute authors have continued this theme, arguing that the domestication of annual cereals by the first farmers was a "well-intentioned wrong turn", now remediable by a perennial grain agriculture that will end "10,000 years of conflict between agriculture and nature".[10] In this vision, perennial grains will be no less productive than their existing annual counterparts.[11]

Never Seen in Nature

This big idea, that a just and sustainable global food system can be achieved through perennial cereal cultivation on the steppes, faces at least three big questions.

- Is a high yielding perennial grain agriculture possible?
- Will it deliver the claimed ecosystem benefits?
- Will it bring social benefits across the global food system?

My own answer to each of these is a qualified 'no'.[12] A brief look at the issues will help illuminate the larger theme.

Although perennial grain agriculture mimics natural ecosystems inasmuch as wild grasslands are mostly perennial, the fact is that perennial grasses producing lots of starchy seeds every year are not found in nature. Traditional mixed farming systems adapt to this by juggling (perennial) pasture and (annual) arable in an attempt to balance fertility, productivity and soil management. By contrast, the Land Institute's programme requires, in their words, "a never seen in nature environment".[13] That it is therefore less mimetic of nature than traditional mixed farming doesn't necessarily matter if it can better meet agricultural and environmental aims, but the fact that nature has never come up with prolifically starchy-seeded perennial grasses hints at the strong ecological limits which artificial selection for perennial grain crops must overcome. Essentially these limits reflect the contrast between the 'live fast, die young' strategy of annual plants, and the cautious self-preservation of perennials.[5]

The Land Institute programme is based on the view that there

Gertrude Hermes (detail)

Fat starchy seeds are the hallmark of the family *Poacea*.

is great malleability in plant genes, available for manipulation by breeders to produce crops of virtually any desired character. But both ecological theory and practical results suggest that all plants, including artificially bred ones, are subject to strong evolutionary, ecological and biogeographical constraints, that perennial grain programmes will not easily overcome. The bottom line, as grain breeder Peggy Wagoner concluded some years ago, is that "the resources available for seed production in a perennial appear to be less than in an annual".[14] Breeding perennial grains to match the productivity of annual ones using primarily endogenous resources seems ambitious at best, and probably fanciful.

There's little doubt, nonetheless, that perennial grain cropping would be less damaging to the fragile steppe environment than annual cropping. But whether it would end the '10,000 years of conflict between agriculture and nature' is debatable. According to historian Geoff Cunfer's detailed analysis of US agricultural census data, the devastation wrought by the Dustbowl on American prairie farming in the 1930s did not result primarily from the inappropriate cultivation of annual grains, but was part of a natural climatic cycle of drought, heatwave and wind which stripped soil from native perennial groundcover as well as from annual grain fields. From this point of view, steppe agriculture's unsustainability appears generic, related to climatic patterns and variability, and not necessarily remediable by a turn to perennial cropping. As Cunfer writes:

> "People are not the masters of nature, nor are they utterly subservient to it. People negotiate a compromise with nature, but one that shifts through time, through sequential stages of adjustment, temporary equilibrium, disturbance, and readjustment. . . . The ultimate goal of an agricultural system that, once set in motion, will continue to be evenly productive without damaging any other species or natural system, is unrealistic".[15]

Ending Riotous Farming

So, to address my second question, a perennial grain agriculture on the steppes would probably deliver environmental benefits. But it would not 'end 10,000 years of conflict between agriculture and nature'. It would not free humanity from the endless dance of adjustment, disturbance, and readjustment to the challenging steppe environment that Cunfer describes. Therefore, it seems wise for humanity not to put too many eggs in the basket of steppe grain agriculture, be it annual or perennial.

An experimental plot of perennial intermediate wheatgrass (*thinopyrum intermedium*), at the Land Institute in Kansas. The resulting grain is now trademarked as "Kernza".

Wheat and maize production on the US plains halved in the Dustbowl. If the same happened today across the major steppe regions – not inconceivable in the context of growing soil erosion, warming climates, water drawdown, and increasing frequency of severe weather events – then on present figures global production would be reduced by around 20%, exports by over 30%. If such a 'dearth of grass' occurred, it would be a major shock to the global food system. But to come back to the larger theme, and to my third question, it could also prompt system adjustments favouring ecological resilience and social justice.

A perceptive nineteenth century Kansan farmer proclaimed "let us not spend Nature's accumulated fortune in riotous farming".[16] But a good deal of contemporary agronomic effort is devoted to continuing 'riotous farming' on the steppes, in the face of negative ecological feedback. This is true both of glyphosate-dependent 'no-till' conventional farming, and of perennial grain breeding efforts like the Land Institute's, which aim to maintain present levels of productivity beyond local subsistence needs, presumably in order to maintain existing levels of grain export. 'Riotous farming' has also engulfed small-scale farmers, on the prairies and steppes from the 1930s, and in the urbanising, export-promoting imperatives against peasant farmers in the contemporary world. Here, 'eco-pragmatism' functions as a latterday argument of agricultural 'improvement', cheerleading the demise of local small-scale farming on the grounds of its alleged poverty, inefficiency and environmental destructiveness, while replacing it with greater dependency on a precarious steppe export agriculture.

All this seems a long way from Wes Jackson's 'becoming native to our places'. The agricultural improvers of eighteenth century England failed to notice or at least to care much for the independence of the cottagers and commoners, or for the subtle productivity of the subsistence strategies they wove around private and common rights, in the absence of a colonial agriculture furnishing their needs from elsewhere. Contemporary 'eco-pragmatists' make the same mistake, and 'riotous farming' of various kinds on the steppes feeds directly into their agenda.

Both environmental prudence and social justice point in a different direction – towards Jackson's 'becoming native' project and thus, ironically, away from the unlikely dream of producing perennial crops to match annual productivity, as pursued by his Land Institute. Why not focus upon less riotous and more diverse land- and people-intensive local agricultures that are fitted to their native places, instead of undermining them with a short-term flood of grain from the steppes? On the steppes themselves, that could involve a lower-yielding perennial grain agriculture. Productivity of perennial intermediate wheatgrass, though much lower than wheat, is already more than enough to support the people of the North American prairies. Elsewhere, it could involve annual cereals, non-cereal staple crops, and a whole range of other smaller scale agricultural and horticultural strategies.

The present zeitgeist vaunts the genetic reform of the crop system as a solution to our agricultural problems, whether 'conventional' and transgenic, or 'alternative' and perennialised. But social and political reform of the food system may turn out to be more important. How to do so, how to create flourishing local peasant agricultures, and how to undo the harm of breakneck urbanisation and proletarianisation is by no means straightforward. But a focus on those problems may bring greater benefits than an unholy alliance of city, steppe and cereal.

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