Farming's Overlords

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Very few companies control the supply of the machines, fertilisers, seeds and pesticides that modern farmers require. Their names, thanks to a whole series of mergers and rebrandings, are no longer all that familiar. Corteva Agriscience for seeds and pesticides. AGCO, one of the four largest farm machine companies in the world. Nutrien Ltd, for fertilisers.

These giant companies are the subject of a new book called *Titans of Industrial Agriculture: how a few giant corporations came to dominate the farm sector and why it matters*. The author is Jennifer Clapp, a professor and Canada Research Chair at the University of Waterloo in Ontario.

So how concentrated is the farm inputs business?

Jennifer: It's a bit tricky because there's global levels of concentration in terms of the global market that's controlled by these firms, and there's also national level and even subnational levels of concentration that matter. But to give the global picture: Today, the top four pesticide companies, which are also the top seed companies, they control around 70% of the global pesticide market and around 60% of the global seed market. But that can be much more concentrated, as I said, at the national level. So, for example, in something like 15 countries, the concentration ratio for maize seeds alone is over 80% for the top four firms. So it's different in different markets. Similarly in the farm machinery industry, around half of the machineries, the farm machinery, sold in the world is controlled by the top four firms. And in fertilisers it's a little bit different. We actually don't have really good data because that market is a bit more fragmented. But at the national level, we know for in North America, for example, the top four firms control around 75% of the nitrogen fertiliser market.

Jeremy: Let's start with farm machinery, because the kind of standard mythology is that McCormick invented the reaper and it

was better than all the other reapers and that's why McCormick became a giant company. What's the real story?

Jennifer: It's a good question. The real story is a little bit more complicated. He was ... Cyrus H. Mccormick wasn't, in fact, the first to invent a reaper. There was one invented in Scotland, several years before Cyrus McCormick came up with his model. The story is complicated in the sense that there were multiple inventors of reapers, but the technology fit quite well in the North American context because of the relative scarcity of labour. And so because the reaper machinery saved labor, it sort of took off there a bit more. And there was in fact, another ... Obed Hussey had also developed a machine around the same time that Cyrus McCormick did, and he actually, he submitted his patent, got it, got a patent for that machinery before McCormick did.

What I talk about in the book is that Cyrus McCormick's firm, the McCormick Harvesting Machine Company, really was able to take off, not simply because it made better machines, it was more that it was in the right place at the right time. It had privileged access to finance and financiers. It had access to this expanding market westward because of the building of the railways. And because it had that capital, it could offer credit to its purchasers. And then after his death, and I should say as well, he was very aggressive in suing any other company that he thought was stealing his designs or his features. And this made him a wildly wealthy man. But after his death, his family actually went on a major campaign trying to create this public image of Cyrus H. McCormick as this very generous American who invented this, you know, game changing technology and benefited everybody. But it was it was more complicated because he was not a very well liked man at the time of his his great wealth and fame, and not unlike the big tech moguls we talk about today.

Jeremy: I'm trying hard to avoid the big tech moguls of today, though we may get to them later. But the whole business of farm machinery consolidation ... I was stunned to read in your book that in 1902, there was this mega-merger, I think you and others have called it, that resulted in 85% of all tractors in North America being sold by one company. How did that come about?

Jennifer: Yeah, it's a really fascinating story. And I was surprised when I was reading about this as well and that's why I felt really very

much like I had to convey this story, because it really reinforced for me that this kind of consolidation and mega-mergers we experience today is not new. It goes back well over a century. So that particular merger happened in the farm machinery industry. So McCormick invented his machinery in the 1830s. But by the 1860s and 70s, these had become really big companies. The patents, patents on his basic designs had expired, other companies had come into the mix. And there was these ... It's important to understand these companies were benefiting from the fact that America was expanding westward, taking lands of indigenous peoples. Expanding farming machinery also led to larger farms, but it maintained this kind of demand for farm machinery until about the 1870s. And around that time, a lot of the land had already been taken and the demand for farm machinery started to decline. And that led to what, you know, what they call, you know, these harvester wars, where there were this really intense competition between the firms and the sector.

And that was, you know, the panic of 1873. There was a great depression in that period and that really put pressure on these firms if they wanted to survive. They felt they had to merge. But of course, in the US, there was the passage of the Sherman Act, which outlawed monopoly. Basically, no one firm can control the entire market. And so, interestingly, you know, these firms had gone back and forth with these merger talks across the 1890s. And finally, in 1902, they agreed to this mega-merger of seven different farm machinery firms together, and they controlled 85% of the market. And their advisor from, I believe it was JP Morgan Bank, George Perkins, he said to them, "oh, don't worry, we won't, we won't be busted by the Sherman Act because it's not a complete monopoly. It doesn't contain all the firms in the market". But it gave the resulting firm, which was called International Harvester, a commanding lead over the market. And as you said, it controlled 85% of the farm machinery sales in the US at that moment. It was quite incredible and much more concentrated than what we see even today.

Jeremy: Let's move to fertilisers. fertilisers sort of come after farm machinery to some extent. So I think one of the things that's interesting about fertilisers is, to begin with it was all kind of mined. It wasn't being manufactured, it was things like, like bird guano and bat guano and things like that. Was there concentration in that market?

Jennifer: When it became clear that you could bring in these nitrogen resources from elsewhere, that's when the trade in guano really took off, because it was understood around that time, around the 1840s and 50s, that guano, bird guano, specifically from the Chincha Islands off the coast of Peru, was like specifically, very, very rich in the right kinds of nitrogen for plant growth. So that led to the mining of those islands within just a few short decades. They had basically taken hundreds of feet deep of guano and mined it out in horrible conditions. And workers died. And it was, you know, indentured labour from China. It was really awful conditions.

But yes, there were monopolies on that trade that the government of Peru actually had taken a cut. And then these international traders of the fertiliser, these merchant companies from Britain, for example. And so there was a degree of cartelisation in the fertiliser industry from really early on. And when the guano was depleted, then they started a similar process with nitrate mining in Chile, and that is responsible for tensions in the region. A war between various countries over the borders and, you know, access to resources. And again, very wealthy financial and trading interests from Britain in a cartel-like kind of setting.

Jeremy: But when you get chemists — Haber-Bosch process — being able to synthesise nitrogen using lots of energy, was it the same people who continued to control synthetic fertilisers?

Jennifer: Well, the synthetic fertiliser, the synthetic nitrogen was first ... The process for that was first developed by BASF, which is still one of the big chemical companies in the world, and that, it shifted the power dynamic within the fertiliser industry, especially with respect to nitrogen, to these chemical companies that were on the rise in the early 20th century when synthetic nitrogen came around, it was more about access to the methods to use it and access to energy. So it was quite constrained at the beginning because of patent protection over these techniques.

Jeremy: So how did it then stay concentrated, because patents expire?

Jennifer: Yeah. And in fact, at the end of the war, there was this — the First World War — there was this taking of of the technological know-how from Germany and making sure that it got into the hands of the companies in the US that were frantically trying to figure out

how to replicate this process. And the US wasn't very successful in doing that, though. In Canada, we had a big cyanamide factory in Niagara Falls that was using energy from the falls to develop this fertiliser process. What's interesting, obviously, is the synthesis of nitrogen was really important for bomb making. That's sort of ... It was this desire to get away from dependence on Chile for nitrates, where, you know, now you could produce it yourself to make bombs. So there was definitely government interest and involvement in the sector. And that kind of helped the firms in a way to gain some of that dominance in the sector.

Jeremy: Mhm. It's a bit sort of Four Horsemen of the Apocalypse, but let's do pesticides. Again, natural pesticides, synthetic pesticides. Let's focus on synthetic pesticides because that's also chemistry like fertilisers, it's chemistry. So is it the same firms?

Jennifer: Many of the same firms indeed were producing pesticides and fertilisers in the early 20th century. And I wouldn't be surprised if we go back to that, you know, scenario again in the future. But at the time, the rise of organic chemistry, synthetic, in the development of synthetic chemicals from coal tar and other kinds of fossil fuel derivatives, led to the screening basically of a lot of new chemical compounds to see what might be useful as a pesticide. And that's what delivered us DDT and other organic ... organochlorines and organophosphates that were, at the beginning, very effective in terms of handling pests. And pesticides were the result. And that was a big ... a big market for those firms. And again, it was entangled in the Second World War. There was like a government, US government, interest in having access to DDT, which they got from the Swiss firm that had developed it. And then they handed those — basically the the production methods — over to the US firms to produce it for the US military. And that gave those firms a big leg up, you know, by providing these kind of products that were both useful in war contexts as well as in farming, you know. It allowed those firms to basically really consolidate their power.

Jeremy: Yeah, because they had government purchases on the one hand. And in peacetime, maintained that.

Jennifer: Exactly.

Jeremy: Seeds! Nowadays, concentration in the seed industry is associated specifically with F1 hybrid seeds, which are, you know,

force you to as a farmer, you have to go back and buy new seed every year. But to begin with, when they were being developed, they weren't that much better than open pollinated seeds. So how did they get going? How did they achieve superiority?

Jennifer: There's been a lot of historical research looking into this question, which I found completely fascinating to dive into, because you're right that the selected seeds were often performing just as well as these new, you know, newfangled hybrids, which had been developed in the 1920s. And that was sort of selecting and inbreeding and then inbreeding again, and then you end up with this hardy hybrid that has potentially, you know, good yields, but it can't reproduce itself. So you have to buy new seeds every year. And that gave the firms producing those seeds kind of a trade secret because they didn't reveal what the inbreeding lines were. And so then they could actually make sure that nobody could copy what they were doing. But in terms of farmer adoption of those seeds, it wasn't automatically at first that everyone was really excited about them, because the yields weren't that much higher. And the price of those seeds was actually quite a bit more. So the companies tried all these different, you know, methods to try and get farmers to adopt them by saying, "we'll give you free seeds for this part of your field if you share with us half the proceeds from whatever you are able to grow on that field, and you'll see, you know, sort of like, you'll see you'll have higher yields and you'll do better".

But really, what led to the rapid adoption of hybrids was kind of a weird confluence of events. There was a drought in North America in the early 1930s. And interestingly, the hybrid seeds, it wasn't that they were producing more corn, you know, per plant, but they had stiffer stalks and they could withstand fertiliser application. And there was a lot of synthetic fertiliser left over from the war effort. So there was this like pile of fertiliser that they could use. And what it meant was that those plants survived the drought. And also they didn't fall over like other plants would do if you over apply fertiliser. And then combined with that was US government policy trying to discourage farmers from producing too much, because it was overproduction and depressed prices at that time. So they put constraints on how many acres they could actually farm. And by using the hybrid seeds, they could actually plant them more closely together and pile on tons of fertiliser. And so we get this impression that hybrids were these

really productive crops, but really they were just being planted much more closely together and doused with fertiliser.

I'm talking about maize here specifically because those were the first hybrid crops, but that basically gave this illusion that it was a higher production. And then many farmers at the time, because they were adopting tractors, like, adopting hybrids made more sense because they, you know, the ears of corn, for example, would all be at a more or less uniform height on the plant because they were uniform, genetically plant ... genetically uniform plants. Then it was harvesting was much easier. So it kind of was like a bit of a lock in was already beginning. And plugging in the hybrid seeds kind of helped make sense of the farm machinery adoption. And it also made sense of the fertiliser adoption. Of course, then it led to a need for more pesticides because monocultures tend to attract these kinds of pests. But it was this rapid adoption because of these weird, you know, weather patterns, government policies, that sort of thing. But once it happened, it was really hard to turn back for many farmers because of those other inputs, especially like machinery.

Jeremy: That lock in thing that you mentioned is really interesting because of course, when you think of seeds, modern seeds, you think of companies like what used to be Monsanto — was Monsanto at the time — breeding seeds that actually required farmers to use the herbicides that the company was producing. Bring in machinery as well, and I suppose fertilisers as well, and it seems like a sort of self-reinforcing flywheel.

Jennifer: And yes, in fact, people call it, you know, this technological treadmill. Once you're on it, you almost have to start running faster and faster and it's really hard to get off. But for sure that development of agricultural biotechnology in the 1990s, those crops were first commercialised, what they did was put a lot of effort into engineering the crops to be resistant to the application of their own brand of herbicides. And that really encouraged more herbicide use. And in fact, in the decades that followed, we saw a massive increase in the use of herbicides. In fact, you know, we used to be concerned in the 1940s and 50s about pesticide use, largely talking about insecticides. But now most of the chemicals farmers use are actually herbicides, that that attack weeds but leave the crops standing.

Jeremy: So far we've been talking, it's sort of all been good for the companies and possibly good in some ways for people who eat food. Maybe even for farmers if they got out of debt and so on. But are there any real benefits? I'm thinking, for example, of research and development. a company ... maybe a well capitalised company is better placed to find new pesticides or new GMOs. Isn't that a good reason to have big companies?

Jennifer: Well, that's a good question. And I would say that's a long standing argument that especially, that you hear from the large companies, is that they're the only ones with a large enough research and development budget to actually make these kinds of really innovative new technologies that transform the farming sector. And there are reasons to be a little bit skeptical of that argument. And this is a long standing debate in the economics field as well, with, you know, Joseph Schumpeter, Schumpeter saying big firms are more likely to be innovators. Kenneth Arrow saying, well, wait a minute, we need competition to actually spark real innovation. And I would say that, you know, it's an interesting debate. I tend to agree with many, many of Arrow's critiques because he basically says, if you just have two or three or four firms at the top of the market and they're able to sell their products, what is the incentive for them to innovate if they don't have to?

Jeremy: Yeah, I would counter that what forces them to innovate is nature. Because, you plug pesticide resistance into plants, you get pesticide resistant insects. that's why they have to innovate.

Jennifer: Yeah. And they have tried to deal with some of those issues. But as we've seen in in the case of the genetically modified organisms you raised earlier, this whole idea of making seeds resistant to herbicides was trying to make this argument that glyphosate, which was the chemical in that herbicide, was relatively safe compared to other chemicals that were quite toxic, acutely toxic. So there is a history of firms trying to respond to these issues, but they often are responding in a way that benefits their bottom line, not necessarily benefits public, the public good more generally. But because, of course, there are companies that are beholden to their shareholders and they're trying to make innovations that are more profitable. So I think we can just assume that companies are always going to do that.

Jeremy: Let's talk about the future. the big trend at the moment, at least among the sort of wealthy farmers, but also in developing countries, is this idea of smart agriculture, of using information technology. And again, it's the same companies who will equip your equip your tractor with GPS so that it delivers the herbicide at just the spot that needs it. Is this the future of consolidation and of consolidation and bigness?

Jennifer: I think that it's leading to pressures of further consolidation. And I wouldn't be surprised if we see consolidation across at least the chemical seed industry, which is one now, which used to be separate industries, but they merged with agricultural biotechnology. So we have a precedent that this happens. It's happening in the farm machinery industry. They're also going all in on these digital farming platforms, as well as in the fertiliser industry. So we are at this moment right now where we have competition across these sectors, whereas they used to kind of stay in their lane, until seeds and chemicals merged in the 1980s and 90s. And now we're seeing all three of those sets of companies vying to be the dominant digital farming platform. And what I mean by that is, they're selling software packages that connect farmers to satellites and cloud servers and use of AI, basically, as you say, using sensors on machinery to detect what's going on in the soil here, what's the weather like? Using little cameras to detect, oh, there's a weed there. We can spray exactly that weed. And it's, in a way, it's built on this idea of efficiency of resources. But these companies make a lot of profit off of the software packages, in fact, much more than the physical products that they sell. So I would say that data is becoming almost a fifth major input. It is a fifth input in the sector for those farmers that are moving towards digital farming. And so because they're all vying for this dominance in the platform, I wouldn't be surprised if we start to see some kind of consolidation across the sectors.

Jeremy: It's interesting that you mentioned data as a as a fifth input because it's always been there, but it's been in the farmer's head and their experience. So, time was when a farmer would decide what to do, when to do it, how to do it. But if you've got enough capital and you can buy all the machinery, anyone with land can become a farmer. There's no skill involved, is there?

Jennifer: Yeah, exactly. It's ... some would say there's some skill in being able to use the digital technologies, but it's de-skilling.

Jeremy: It's not farming!

Jennifer: Yeah. It's not farming. Yeah. Well, exactly. You think of farming as an art, that the decisions are coming from the farmer's own understanding of their land and the environment in which they are living. And so we've basically, with the rise of all of these technologies and especially digital agriculture, there's been this concern among scholars that it's leading to de-skilling. So it's de-skilling farmers. And it's going to lead, or it could lead, rather to a situation where farming is basically done by robots. All the decisions are made by AI. We don't need any farmers. And that's going to lead to further consolidation of farmland.

Jeremy: And what does it mean to be a farmer in a developing world? has it changed, or does it threaten the kind of small scale subsistence farming on which so much of the world depends for food?

Jennifer: Yeah, that's a great question because many civil society organisations looking at these dynamics say that around 70% of the world is actually fed by small scale farmers. And it's the, you know, the 30% that is this large scale industrial agriculture that people are fed from that. But dynamics are constantly changing, and it's hard to verify all of these data. But definitely small scale farmers are really important in the global South and the small markets in which they market their goods are also really important for feeding people. But these big changes, I would argue, threaten the capacity of small scale farmers to continue the livelihoods that they have had for so many thousands of years. And this move towards digital farming, for example, it's making its way to Asia, it's making its way to sub-Saharan Africa and to Latin America. A lot of new apps, farming apps, you know, digital applications, are being developed in these contexts, and while they look like they're local kind of initiatives, they're actually often connected to the big, big companies. So it's a situation where we're seeing, I would call it kind of like an onward march of the spread of industrial agriculture. And it does threaten that kind of more low input, smaller scale agriculture.

Jeremy: You've gone through basically the downsides of big and consolidated agriculture. But, especially politically, given the current kind of political and market belief system, given that, how do you see

any of this changing? Where will change come from? It surely won't come from the industries.

Jennifer: Right. And I point that out in the book, that I don't think we can rely on corporations to suddenly see the light and change the model, because I think the model does need to rely less, or maybe not at all, on these expensive external inputs that cause a lot of problems. And the corporations, their innovation model is to basically earn money, and they're beholden to their shareholders, and they're often merging and acquiring one another because of this pressure from investors. So I don't think we're going to see the solutions coming from there. But I do think we have to have solutions. And what I found really interesting in writing the book was — this real lesson to me was — that the transformation to industrial agriculture took, first of all, it took a long time. It took over a hundred years. It's still evolving. But if we want to have a transition to a more sustainable agriculture, I think we have to think more long term than we have been, although we don't have a lot of time. So for me, this sort of keeps me up at night, this worry that if we don't have a quick transition, we're we're kind of cooked. So we have to push it along. So how do we push it along? How do we implement a real transformation more quickly than what happened over the past 150 years?