THE FUTURE OF FOOD IS...

AN END TO PLOUGHING?

NO-TILL AGRICULTURE ALLOWS FARMERS TO INCREASE YIELDS AND REDUCE THEIR WORKLOAD. SO WHAT IS ITS POTENTIAL?

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In 1943, the American agronomist Edward Faulkner published a book in which he challenged the wisdom of something that farmers had been doing for thousands of years: ploughing the field. Many take it for granted that ploughing is what you do before planting. But why, exactly? 'The truth,' wrote Faulkner in the opening paragraph to *Plowman's Folly*, 'is that no one has ever advanced a scientific reason for plowing.'

Although abandoning the plough was a shocking proposition at the time, in recent years farmers around the world have been adopting the idea enthusiastically: between 1999 and 2009, the global area cultivated with no-tillage systems grew from 45m to 111m hectares. Rather than turning the soil to aerate it and bury residues, these farmers prefer to minimise soil disruption. They leave crop residues on the field and plant the next crop in the undisturbed soil below with direct-drill seeders designed for the purpose.

One of the original benefits of no-till farming was the prevention of soil erosion. Faulkner's proposal came on the back of the Dust Bowl era of the 1930s, when soil that had been heavily ploughed in previous years simply blew away when drought hit because there was nothing to anchor it. No-till farming helps to prevent this happening because it leaves protective ground cover and maintains soil strength and structure.

The Dust Bowl itself may be history, but no-till farming is increasingly recognised for its potential to address issues other than soil erosion. It now sits under the broader umbrella of conservation agriculture, a concept the UN's Food and Agriculture Organization (FAO) promotes to save resources, maintain profits, sustain production and protect the environment.

In other words, no-till farming can help to create a sustainable food-production system, because it's a way of maintaining high yields with lower energy inputs and fewer negative environmental outputs. For example, leaving crop residue in place can help conserve water in the soil. It also encourages soil flora and fauna, such as earthworms, which increase the quantity of organic matter in soil and create tunnels that funnel oxygen to roots and further help the soil to hold water.

A number of studies have found that no-till farming increases carbon sequestration in the soil. Organisations such as the United Nations Environment Programme now promote it as a measure to reduce greenhouse gas emissions in agriculture. But evidence on the precise extent and soil depths at which this occurs is inconclusive, and one recent report by the German development agency Misereor even concludes that no-tillage makes 'little or no contribution to carbon sequestration and does not prove to reduce greenhouse gas emissions in croplands'.

BARRIERS TO UPTAKE

Making the transition from conventional to no-till farming is still difficult for many. There's a lot to take in, and yields don't increase automatically. 'In our case, in year one it was more or less the same,' says Tony Reynolds, who farms 246 hectares in Bourne, Lincolnshire, and started converting to no-till in 2004. 'In year two, we'd used up residual nitrogens and yields declined. In year three, they declined even more. But yields began to return, and after year five we were pretty much back to where we started. Now we're finding on one of the farms that we yield more than before.'

Weeds can also be a problem. One of the effects of ploughing is to turn the soil and bury weeds. When farmers practise a no-till system, they can become more reliant on herbicides to control weeds, and sometimes weeds become resistant. On the other hand, there are immediate savings to be made in labour and other inputs, because if you don't have to plough the field before planting it, you don't have to make so many 'passes'.

'If you're going through the field to establish the crop in a single operation, it takes much less time than doing a more typical cultivation,' says Nathan Morris, farming systems and soil specialist at the National Institute of Agricultural Botany. 'You might be looking at three operations on a more conventional site, because you do a primary then a secondary cultivation and then drill. There are large gains to be had by reducing the number of field passes.' This also means you need less fuel. Reynolds estimates that conventional agriculture uses 90 to 95 litres of diesel per hectare, whereas the no-till method uses 40 to 43 litres.

Reducing fuel consumption is useful in its own right. But paired with greater yields it makes no-till farming compelling from a sustainability point of view. The FAO estimates that by 2050 the world's population will reach 9.1bn, requiring food production to increase by as much as 70%. If no-till farming can help us to produce more from the same amount of land, without additional inputs such as fertiliser and fuel, it seems like a winner.

There is already some evidence for this. In Zimbabwe, for example, an estimated 300,000 farmers have adopted no-till and are producing maize at a rate of around two tonnes per hectare, nearly triple the amount yielded under conventional agriculture. Such results are particularly relevant for resource-limited countries such as those in sub-Saharan Africa, where achieving food security for growing populations will depend to a great extent on building the productivity of the millions of smallholders that account for most food production.

But although no-till farming is beneficial in theory, there are also some specific barriers for smallholders in developing countries. Some of the farmers who rear cattle as well as growing crops, for example, use the stubble left after harvesting as feed, so they wouldn't want to leave it on the field as crop residue. This type of issue, as well as the need to train millions of individual farmers in the first place, is a barrier to the widespread uptake of the practice.

Elsewhere, major food-producing countries such as the US, Australia and Brazil have embraced no-till, but they have structured support for farmers to encourage the transition. Brazil, for instance, adopted the national Agricultural de Baixo Carbone (Low Carbon Agriculture) plan, which explicitly promotes no-till cultivation, in 2011. Credit and training services help farmers invest in equipment like direct-drill seeders and learn how to manage different patterns of weed growth and pests that can emerge. The legacy of soil erosion in the US means that farmers there are also subsidised to practise no-till farming as part of conservation agriculture.

By contrast, no-till farmers are still relatively rare in the UK and Europe. With a range of longstanding farming traditions and a history of relatively high, stable yields, European farmers appear to have had less incentive to try this method. The Common Agricultural Policy has also historically rewarded production, although this has now changed so that subsidies under the Single Payment Scheme — the primary support mechanism for agriculture — are also linked to public goods and environmental objectives.

'Of particular note in this arena is the Soil Protection Review, an annual requirement since 2010 to identify soils susceptible to erosion and compaction, and those areas where the loss of organic matter, which would otherwise provide nutrients, is likely to occur,' says Ashley Taylor MRICS of Townsend Chartered Surveyors. 'Once identified, farmers must then implement preventative measures at an individual farm level.' Although this approach aligns with no-till farming, without more explicit policy support, more widespread adoption of the technique may only come gradually through farmer-to-farmer diffusion.

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Will Scale, a Pembrokeshire farmer and founding member of the UK No-Till Alliance, is convinced of the technique's value. 'The aim certainly isn't low input, low output,' says Scale, who has held open days at his farm to try to inform other farmers of the benefits. 'I've found that yields can be as good or better. You're saving fossil fuels, it doesn't take as much time, it's better for soil biology, better for water infiltration, and I see less erosion. But it's a steep learning curve, and you've just got to decide you can make it work.'