

ADAPTING TO A CHANGING CLIMATE: CASE STUDY 30

GISBORNE CROPPING FARM
Optimising energy efficiency and improving soil productivity

THE FARM

- Opou Station, Gisborne.
- 400 hectares effective, with most of the farm cropped in maize.
- Dryland farm on heavy clay loam soils.
- Annual rainfall of 800 – 850mm.

THE FAMILY

- Opou Station is owned and farmed by David and Libby Clark.
- David is a long term board member of LandWISE and has held various role with the Foundation for Arable Research.

Soil on left under long term conventional cultivation, soil on right after two years controlled traffic with strip tillage.

The potential to reduce energy inputs and maximise soil quality has seen David Clark implement minimum tillage and controlled traffic farming systems at Opou Station.

David Clark crops maize on Opou Station, a 400ha dryland farm on heavy clay loam soils in Gisborne. Subject to wet soils in spring, and summer drought, David focuses on caring for his soils. Using his vegetable garden as a yardstick, his key philosophy is "taking the load of the soil" to maintain quality.

David was an early adopter of minimum tillage and convert to Controlled Traffic Farming (CTF) principles. The availability of high accuracy GPS and tractor guidance systems made it possible to combine these technologies with immediate benefits. In a CTF system, tractors travel on well compacted tramlines that provide greater carrying capacity and reduced rolling resistance. The plants grow in friable, living soil with improved infiltration and drainage characteristics.

PLANNING FOR CLIMATE CHANGE IMPACTS

The climate change predictions for Gisborne include increased incidence of drought, extreme rainfall events and higher temperatures. Irrigation is not a feasible option at Opou so maximising the soil's natural water holding capacity is paramount. Wet soils in spring already affect crop establishment some seasons and may become more common.

David is focusing on reducing energy inputs and maximising soil quality. The healthier his soil, the better it will withstand adverse climatic events. Enhanced infiltration will assist rainfall capture rather than run off. Improved structure and connected porosity will ensure excess water can drain away rather than become locked in.

As cultivation is reduced, the soil's natural strength and resilience increases. Stronger soils will withstand traffic loads better in marginal conditions, minimising soil damage, reducing the need for reparation, and avoiding a downward spiral of damage to soil structure.

The other promise of CTF is greatly reduced fuel consumption as heavy draught cultivation is avoided and rolling resistance is reduced on established tramlines. So the change offers reduced greenhouse gas emissions, and reduced exposure to associated costs in the future.

RESPONDING TO CLIMATE CHANGE

The key to Opou's future under a different climate regime is its Controlled Traffic System, combined with a policy of minimum tillage. This system has already provided many of its promised benefits.

David has adopted new cropping technologies and practices that ensure his soils are in the best possible condition. All equipment has wheel tracks of three metres and is matched to a standard twelve rows per pass. This ensures the same rows are always tracked and compaction restricted to two of twelve inter-rows.

Most cultivation, if needed, is completed in autumn immediately following harvest as the soil is generally in best condition for cultivation at this time of year. Climate change predictions for Gisborne include that ground conditions could be wetter in spring. The move to autumn soil preparation is a clear way to mitigate this.

The new system means planting is the first task in spring. With no need to cultivate in spring, the window for planting is as wide as possible. This allows longer season hybrids to be used, increasing yield potential. Maize is a C4 plant and can be expected to respond favourably to predicted warmer conditions. David is not currently anticipating a change of crop forced by climate change.

ENERGY EFFICIENCY

The changes at Opou have reduced total field machinery power by 36 percent and seasonal fuel consumption by about 50 percent. More crop is produced per litre of fuel used and per kW of installed machinery capacity.

Adoption of the minimum tillage and the CTF system has seen a reduction from five tractors to two. While each new tractor is larger, the farm's machinery capacity as total kW/ha per hectare has been reduced. Less tractors require less operators, so labour has been reduced. With skilled operators harder to find, this has extra benefits.

Seasonal variability often makes it difficult to clearly see input changes resulting from changed practice. But at Opou, the reduction in seasonal fuel consumption is abundantly clear. Over the five years of transition from a full cultivation regime to Controlled Traffic, fuel expenditure for cropping has stayed the same. However, over the same period, fuel cost doubled – so consumption has approximately halved. Yields are the same (or higher), so the crop fuel use efficiency (kg maize / L diesel) has also doubled.

The main reasons are:

- avoidance of soil compaction and the need to remove it;
- avoidance of energy used to reconsolidate soil for traction;
- reduction of cultivation to about one third of each row width;
- avoiding some cultivations altogether.

Controlled traffic farming

Controlled traffic farming (CTF) is about managing soil compaction. In practice this means confining all field vehicles to the least possible area of permanent field traffic lanes, thereby maximising the remaining undamaged soil area for cropping. Separating the traffic bearing zones from the cropping zones allows growers to reduce fuel consumption as the wheels travel on already compacted soil with less friction. Soil compaction is avoided in the cropping zones of the soil, maintaining soil structure and hence porosity and productive capacity.

Developments in GPS guidance systems have facilitated the implementation of controlled traffic farming, in particular the development of real time kinematic (RTK) GPS systems. This allows for GPS signals to be transmitted in real time, providing greater accuracy and hence repeatability.

INCREASING SOIL RESILIENCE

David sees healthy soil as a key to capturing limited summer rains as well as coping with predicted extreme rain events. Healthy, well-structured soil will have higher infiltration capacity, better internal drainage and minimum limitations to root growth. All three optimise growth conditions and maximise potential yields.

The soil at Opou has responded quickly to the removal of traffic. Earthworms, once rare, are again common. The soil is friable and seldom shows water-logging even when surrounding areas are clearly saturated. Cultivation is often not required – a no-till regime is proving to be not only possible, but yields appear to be increasing more than those in cultivated areas.

In July 2009, the farm received over 230mm of rain in three days. By midday on day two, over 175mm of rain had fallen. Surrounding areas had severe surface flooding. Opou showed little sign of overload. Opou farm manager, Matt Shann noted, "Our fields flooded half a day after the rest of the Flats, and within half a day the flooding was gone."

Narrow tracks on permanent tramlines keeps all compaction in defined zones. Strip tillage, used where necessary, minimises soil disturbance and maximises quality.

The same tramlines have been maintained for more than five years with little or no track maintenance required. Even the fifth year's very wet harvest caused surprisingly little damage. Where remediation is required, strip-till is used - typically in headland turning areas or where harvest traffic has moved off tramlines.

Conversion to CTF has not been without problems. The high accuracy guidance systems can plant a row of seed into the centre of the root balls of old maize crops. This reduces crop establishment so is avoided. David has responded by shifting the planting lines by 75mm each year. But that has itself caused problems. Small shifts made by adjusting implement position pulled equipment off-line. Shifting the whole tractor widened wheel tracks and compacted soil near plant rows. A check of equipment row widths soon showed wide variation, despite nominally identical spacing.

The shift to CTF remains a work in progress.

THIS IS ONE IN A SERIES OF CASE STUDIES CALLED *ADAPTING TO A CHANGING CLIMATE* THAT CAN BE FOUND AT WWW.MAF.GOVT.NZ/CLIMATECHANGE

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Key points

1. **Adopting high accuracy RTK-GPS and tractor guidance has enabled a change to controlled traffic farming at Opou Station.**
2. **Combined with strip-till and no-till maize, this has greatly reduced soil disturbance, reducing energy inputs and increasing soil quality.**
3. **The soil has responded rapidly and is increasingly resilient under high rainfall conditions. The soil is stronger and carries traffic more easily and with less fuel demand.**
4. **The soil copes well with sever rain events, and certainly better than conventionally cultivated paddocks in the area.**
5. **More frequent and extreme weather events are predicted. The cropping system being developed at Opou Station will offer maximum ability to cope and to recover.**

After 175mm of rain in two days, the controlled traffic area showed little sign of surface ponding.

FURTHER INFORMATION

Details and reports of the following Sustainable Farming Fund projects are available on the Ministry of Agriculture and Forestry's website **www.maf.govt.nz/sff**. Search by project name or number.

- C08/111 Using Advanced Technology to Create Sustainable Cropping Systems.
- 08/116 Holding it together – soils for sustainable vegetable cropping.
- L07/033 Rapid assessment of soil compaction contributions to losses in field crops.
- 06/035 Reduced tillage techniques (including broadcasting) and their long term effects on soil health.
- 03/095 Controlling the Strip: Innovative field cropping practices.

Further information on minimum tillage and advanced farming systems can be found on **www.landwise.org.nz**.

New Zealand Government

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