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HEAVY MACHINERY TRAFFIC REDUCES SOIL WATER AVAILABILITY

WHAT'S THE COST TO YOUR BUSINESS?

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Did you know that heavy machinery could be costing you more than just fuel and maintenance? In fact, a single pass of heavy machinery, such as a cotton picker, can reduce the amount of water your soil can hold by up to 750,000 L/ha – water that’s critical for your crops.

The Problem: Soil Compaction.

THREE QUARTER MEGALITRE WATER LOSS PER HECTARE

When large agricultural machines, like the John Deere 7760 cotton picker (now CP690), move across your fields, the soil beneath is compacted. This compaction compresses the soil aggregates, reducing the space for water and air, which are essential for plant growth. The result? Less water infiltration and retention, greater run-off, less space for roots to grow, and fewer nutrients reaching your crops. Whether you’re running conventional farming methods or using advanced controlled traffic farming (CTF), soil compaction remains a critical issue.



PROJECT AIM

The aim was to investigate the impact of heavy machinery traffic on soil water in a Vertosol. Specifically, at a site near Jimbour, Queensland because it had a 15 year history of true controlled traffic farming.

A John Deere 7760 cotton picker with dual front wheels was compared to a true controlled traffic version (single wheel per axle end, all axles matching track width) and a civil construction sheep's foot roller to assess changes in soil physical properties



The top core represents healthy, uncompacted soil, full of spaces for water and nutrients. The middle and bottom cores, taken after traffic from dual-wheeled and CTF machinery, show the difference compaction makes. The structure is denser, with fewer pores to store water, meaning your soil becomes less productive.

Even after 15 years of careful soil management, a single machine pass undid all the benefits. You may not see the effects right away, but as the seasons pass, your crop yields will feel the impact, especially in drier years, or where irrigation isn't available.

The Science Behind Soil Compaction

In our study, we compared the effects of a regular John Deere 7760 cotton picker with dual wheels to a CTF-configured machine that uses a single wheel at each axle end, reducing the area of soil affected. Controlled traffic systems limit compaction to specific lanes, preserving the structure of the rest of your soil. The difference is stark: the CTF machine caused less damage, keeping your soil looser and allowing it to infiltrate and retain more water. The compaction under the CTF wheels is minimised to lanes that can be thought of now as roads, allowing machines into the field earlier in wet seasons.

ONE MACHINE PASS DESTROYS 15 YEARS OF SOIL CONSERVATION

The Cost to Your Business

Heavy machinery significantly reduces the soil's ability to absorb and hold water, with compacted soil losing up to 0.75 megaliters (750,000 liters) of water per hectare. This is critical in regions prone to drought or with limited water access. Soil that can't hold water efficiently leads to higher runoff and less moisture available for plant roots, potentially resulting in weaker crops and lower yields.

Soil compaction isn't just an environmental issue—it's an economic one. Based on the study, we estimate that compacted soil can result in a yield loss worth \$600 to \$800 per hectare.



If your crops aren't getting the water they need, that's money left in the field. For the Australian industry 2017-18 cotton season, these losses could have totalled as much as AUD \$198 million. However, the practical cost of that last megalitre in the soil could be so much more. It could be the water that is the difference between achieving a crop, or the crop failing. This is what you really need to think about when weighing up if CTF is right for you – what is the cost of not doing it?

The Solution: Controlled Traffic Farming (CTF)

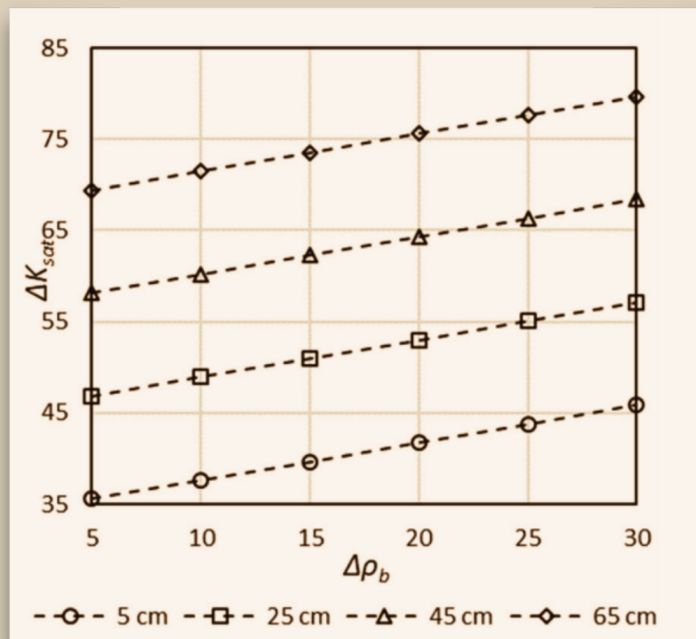
Switching to CTF can dramatically reduce soil compaction and help your fields retain more water. CTF minimises the area of your soil that's compacted by confining machine traffic to designated lanes. The result is healthier soil that stores more water, supports stronger crops, and ultimately leads to higher yields.

While the initial cost of converting to CTF may seem high, you could recover that investment

THAT LAST SOIL STORED MEGALITRE IS MAKE OR BREAK

within just a few seasons through increased production. In water-limited environments, this could be the difference between a successful crop and a failed one. If you're serious about protecting your soil and maximising your yields, CTF is the way to go.

The aim of CTF at the wheel is to condense traffic lanes under CTF wheels into compacted strips, similar to roadways, minimising damage to the surrounding soil, and maximising the window of opportunity for traffic in the field during wetter years. In fact, a single pass of the JD7760, whether in conventional or CTF format, compressed the soil as effectively as a sheep's foot roller used in civil road construction.



The figure above shows how even small increases in soil bulk density (% $\Delta\rho_b$) significantly reduce water infiltration (saturated hydraulic conductivity, % ΔK_{sat}) with soil depth. This is important to your farm, as compacted soils hold less water, affecting crop yields and productivity,

MODERN AG MACHINES COULD BE USED TO COMPACT CIVIL ROADS

The table presents volumetric soil moisture content (θ_v) at different suctions to calculate plant available water (PAW) within the top 65 cm of soil. This data is crucial for understanding how compaction reduces the soil's ability to hold water, potentially lowering yields.

Treatment	Depth (cm)	θ_v (%) at respective suction:			PAW (mm)
		0 kPa	10 kPa	1500 kPa	
Control	0–5	71	66	26	234
	20–25	68	65	26	
	40–45	69	65	28	
	60–65	69	67	29	
Conventional	0–5	64	56	32	159
	20–25	65	54	32	
	40–45	66	53	34	
	60–65	68	52	32	
CTF	0–5	62	54	31	158
	20–25	65	55	33	
	40–45	66	55	33	
	60–65	68	53	33	

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