Starting with the Harvester: What are the Benefits and Costs?

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ABSTRACT

This paper examines the costs and economic returns of matching harvest machinery into the CTF system. The common misconception amongst the Australian grain growing community is that it costs too much to modify tractors and other machinery to fit the harvester. This paper demonstrates that Australian and international on-farm research over the past 10 years has found that harvest traffic reduced yields by between 23% and 75%, and costs farmers between $123/ha and $300/ha. Costs of conversions are typically less than $30,000, making the return on investment high.

INTRODUCTION

The effects of compaction on soil properties, fuel use, and grain yield have been researched for many years and results widely agreed on. The soil, crop and economic impact of soil compaction from the grain harvester component of the system are not as widely researched. The harvester is a machine in grain a production system that has the narrowest operating width and the widest tyres; thereby having the largest percentage of compacted area. It is also typically the heaviest machine operating in the paddock, with new machines reaching 20 tonnes plus 7 to 9 tonnes of grain when full.

The harvest operation in sloping landscapes (with contour banks), and without autosteer systems, often leads to huge inefficiencies, which means that harvest traffic can sometimes cover considerable percentages of paddocks (Photograph 1).

Photograph 1: Harvest inefficiencies in sloping landscapes and without autosteer.

This topic has led to considerable debate in the grain growing community about the impacts of the grain harvester compaction on yield and therefore economic return.Yield Many grain producers in Australia believe that harvest mainly occurs during dry periods, therefore there is little or no impact. However, our leading Controlled Traffic (CTF) farmers have a strong message to 'start with the harvester'. This means that all other load bearing machinery wheels be matched to suit the harvester wheel spacing; as it is the most difficult to change.

It is also well known that the most significant soil damage occurs when wheels traverse moist ground, equal to or greater than the plastic limit (Radford, B et al). Whilst this is true, in many harvest scenarios the ground is as least slightly moist. A wet harvest will not only cause significant soil damage and crop yield reduction, it also has substantial effect on the ability to plant the next crop, especially in a no-till farming systems.

So what are the reasons why leading growers are recommending matching the header into the system from the start? What are the costs to achieve this goal, and what are the likely returns?

YIELD AND ECONOMIC IMPACTS FROM HARVEST TRAFFIC

There have been many studies determining the impact of wheel traffic on soils and crop production. Much fewer studies exist on the impact of harvest traffic on yield and economic return, especially in no-till systems (Botta, et al 2008). Below are results from several research trials on the topic.

Research trial A

Jensen and Neale (2001) conducted on-farm research trials on corn (maize), grain sorghum and wheat over a three year period on the black cracking clay soils of Queensland's Darling Downs Region. The cooperating farmer had a unique CTF system whereby the impact of the harvest traffic (harvester, chaser bin) could be differentiated from all other operational traffic (sprayer, planter, and tractor). A small plot harvester was used to gather complete grain yield from each row of crop across the harvester/planter width.

Whilst results indicated that a four fold difference (Figure 1) in grain sorghum yield can occur within a planter width (in this case 9 metres), the average reduction in sorghum grain yield was 50% in those rows adjacent to the highest intensity of harvest machinery (2.40t/ha to 3.59t/ha P=0.07). Taking into account each row's yield, the average reduction in yield across the paddock the paddock was 0.9t/ha. At current grain sorghum prices of $250/tonne, this equates to $225/ha loss.

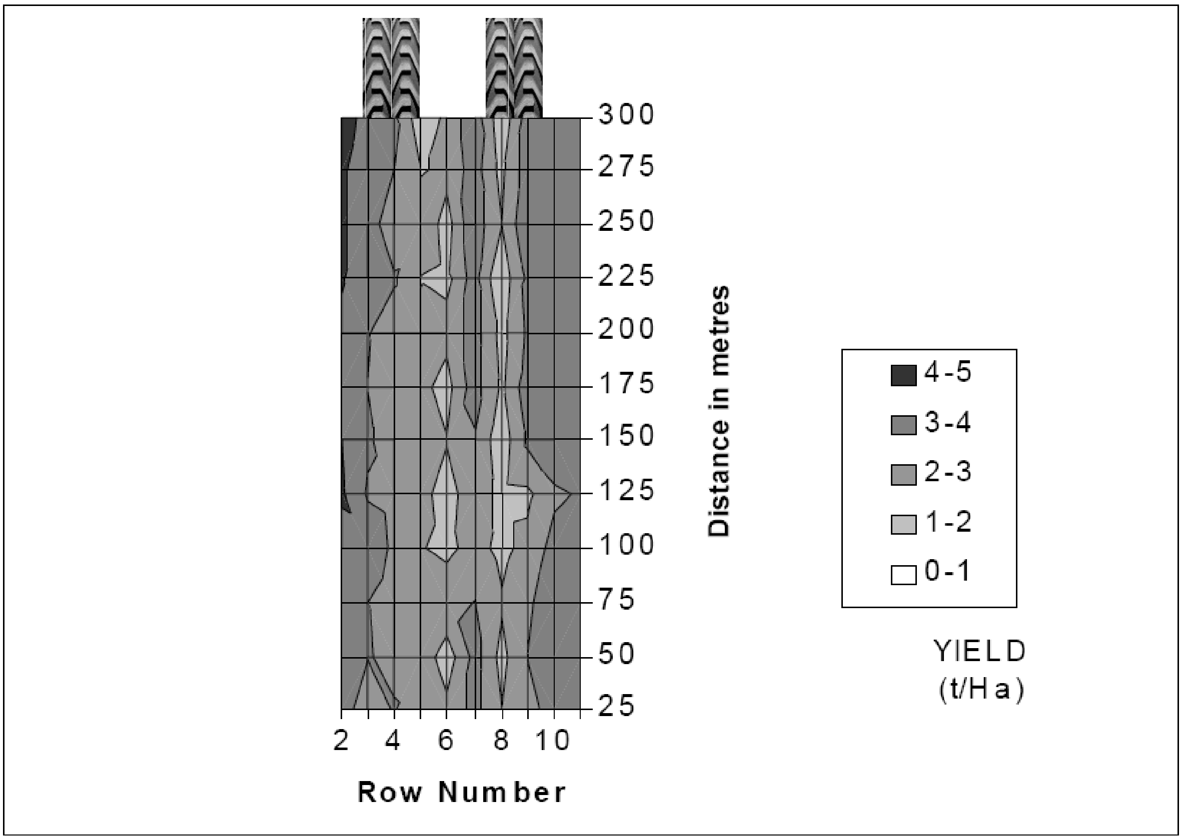


Figure 1: Actual sorghum grain yield map (plot 9m x 300m) showing four fold difference in yield and the position of the harvest traffic

Yield of wheat was reduced from a maximum of 3.5t/ha to a minimum 2t/ha (75% yield reduction) on a smaller plot trial (Figure 2). This 1.5t/ha yield loss, assuming it affected only half of the wheat rows, would equate to an average paddock loss of 0.75t/ha. At current wheat price of $400/t, then financial loss would be in the order of $300/ha.

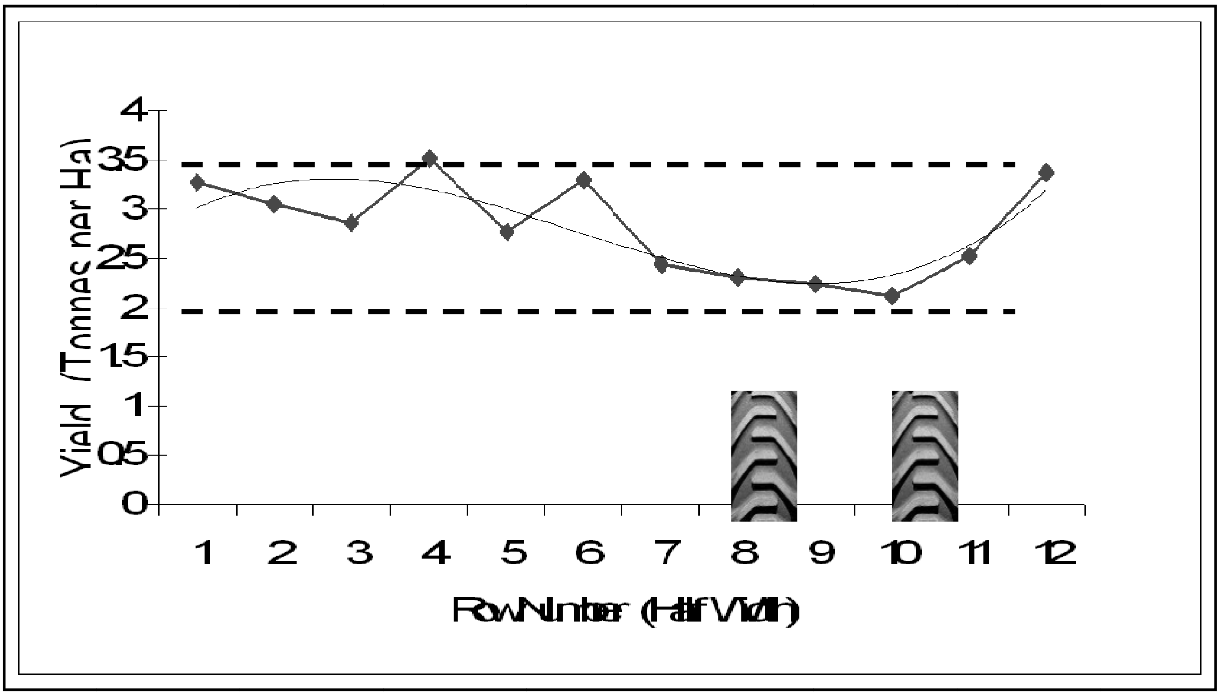


Figure 2: Wheat grain yield (one half of planting width) showing position of harvest wheel tracks

Corn (maize) yield for each row across the planter was also determined using the plot harvester. Results are indicated in Figure 3. It can be clearly seen that corn yield was directly related to number of established plants. Compaction resulted in lower plants established, therefore yield. Yield has been reduced by approximately 50% in the heaviest wheeled areas (4.4t/ha vs. 6.9t/ha). Taking into account average row yields, overall paddock yield has been reduced by 0.41t/ha, which at current corn prices of around $300/t, then this equates to $123/ha.

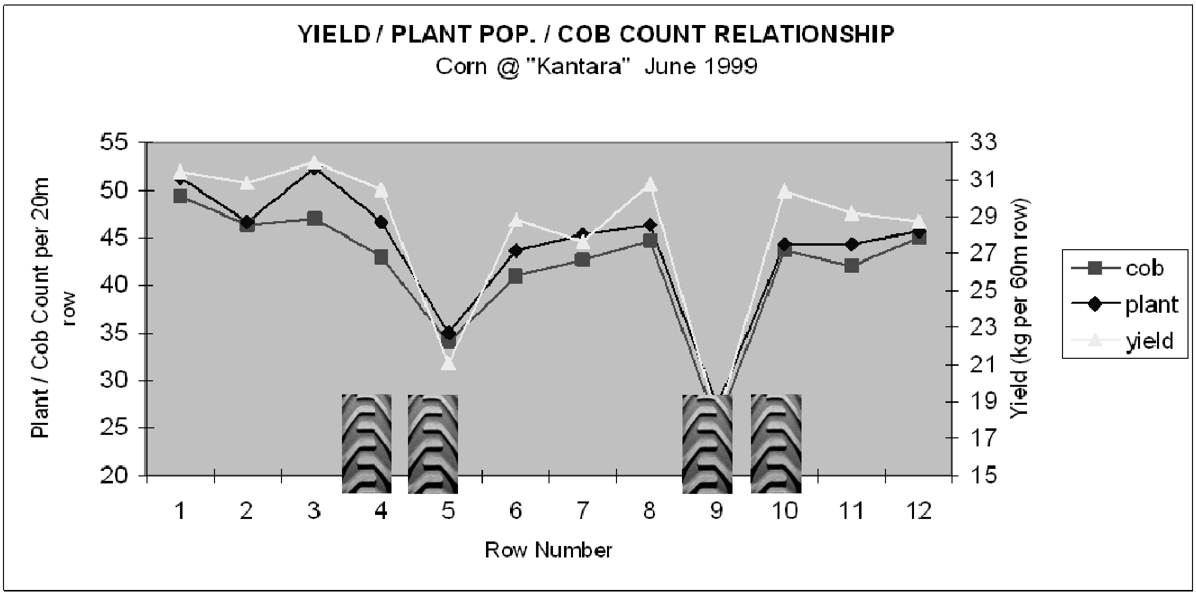
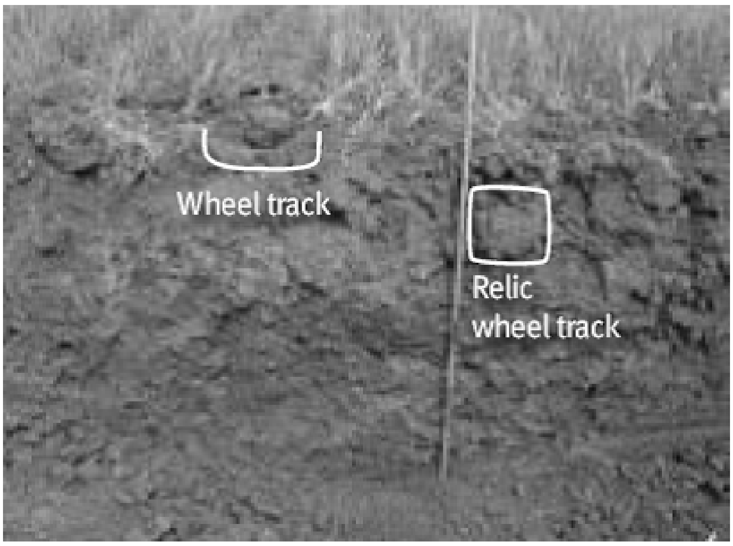


Figure 3: Corn yield and associated cob and plant counts; and the position of harvest wheel tracks.

In sorghum and corn, the harvest traffic never actually drove over the top of the crop rows. In wheat, some harvest traffic wheel drove over the crop rows as the row spacing in Queensland is 0.375m and tyre widths are nominally around 0.8m on a grain harvester, so this was inevitable.

Research trial B

Braunack (2008) conducted on-farm research in Central Queensland to determine the effect of a wet harvest on crop biomass and subsequent grain yield. He found that there was a 16% reduction in biomass and a 24% reduction in crop yield associated with previous harvest traffic. A suggested loss of $120/ha had occurred, however this was based on a wheat price of $300/t. Wheat in today's price is around $400/t, so losses could be in the order of $160/ha this season. Photograph 2 shows the remnants of previous wheel tracks in a soil pit in the paddock.



Photograph 2: Remnants of old wheel tracks in trial paddock are causing significant financial losses (Photo courtesy of QDPI&F)

Research trial C

Research in Argentina by Botta, et al (2007) was conducted on a large plot experiment using farmers' equipment to ascertain damage cause by harvest traffic in no-till farming situations. Whilst many soil measurements were conducted by the research team, it was interesting to note that work rate, fuel consumption and yields were also examined. After three years of research, results were surprisingly consistent. Yields improved in soybean crops by matching harvest traffic was up to 30% and returns were improved by US$134/ha based on soybean price of US$170/t.

Research trial D

Radford experimented with applied harvest compaction over a long term trial at Biloela in Central Queensland. Axle loads of 10t on wet soil reduced seedling emergence, soil water storage, crop Water Use Efficiency (WUE) and grain yield of sorghum, maize and wheat. Average yield reductions of 5 crops were in the order of 23% (0.79t/ha). Assuming and average price of $250/t for these crops, average annual loss of income is around $200/ha.

COSTS AND RETURNS OF A CTF SYSTEM THAT INCLUDES THE GRAIN HARVESTER

The common misconception amongst grain growers in Australia is that converting to a fully matched CTF 'costs too much'. It is fair to say that CTF Solutions deals with more farmers converting to CTF than any other company or organisation in Australia. CTF Solutions has helped over 300 farmers convert to CTF systems; with an estimated 90% of these being able to use and modify their current machinery suite. Obviously many farmers come to our company for advice when upgrading equipment, as to ensure they purchase the right gear for CTF. In this case, we look at marginal capital – i.e. how much of the new purchase price is directly related to CTF. Most people see a CTF grower with a new tractor and immediately assume that you need a new tractor for CTF.

The reality is that modifications to 3m fully matched CTF systems are almost always between $5,000 and $30,000, depending on the available equipment. The main exception to this is in situations where the client has purchased a header with an offset front. In this case, centred fronts would need to be purchased and are normally around $80,000 to $90,000 brand new.

Assuming grain yield losses from harvest traffic are in the order of $200/ha, then an area of only 150 hectares is required to pay back the $30,000 investment in following year. Typically, the average farm size CTF Solutions deals with is normally between 1000-3000 hectares, the economics of matching the harvester in the system is a 'no-brainer'. If a new header front is required, then an area of 600ha will pay back a $120,000 investment in one season.

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