

## **How GPS Auto-Guidance Affects Existing Farms**

Terry Griffin

### **Introduction**

GPS auto-guidance systems (AGS) are becoming more common. Since Watson and Lowenberg-DeBoer's article in the November 2003 SSMC newsletter, I've talked to several producers who have at least tried AGS technology on their farms either by purchasing the equipment or demonstrating it from the manufacturer. A recent study by Whipker and Akridge (2004) reported that a little over 5% of ag retailers use AGS on their equipment when making custom applications to farmer fields. Everyone we've spoken to says they are firm believers in the technology and want to continue using it. From the economist's point of view the main advantage of AGS in the Corn Belt is being able to farm more acres with the same equipment set, however, the farmers who have used the technology shared with us that they feel that AGS makes operating equipment so much less stressful and fatiguing that it is worth it just on those attributes. A more complete analysis of AGS needs to be made on how it influences profitability, timeliness and risk. The goal of this article is to report on how AGS may impact an existing farm operation in profitability and timeliness. This article goes beyond the work of Watson and Lowenberg-DeBoer (2003) by asking similar questions in a linear programming framework that takes whole farm constraints, including timeliness, into account.

### **How Study was Conducted**

This article is intended to be a preview of the study which will be presented in full at the 37<sup>th</sup> Purdue Top Farmer Crop Workshop July 18 to 21, 2004. The study was conducted using Purdue's PC-LP computer software which is better known to Top Farmer participants as the B-21 model. Using the same software as thousands of farmers have used to evaluate their equipment sets and sizes or possibly renting an additional farm, the impact of adding AGS to existing farms was evaluated. Questions to answer were: which farmers benefit from AGS, how many acres are needed to justify AGS, how farm acreage can expand with AGS, and how AGS affects cash rental rates.

### **AGS Results**

Both a conventional and strip till system was evaluated in a corn and soybean rotation. Farm sizes of the study ranged from small farms with no hired labor to multiple employee farms. Farms with only one 12-row 30-inch planter, one 30-foot grain drill, and one 6-row combine, which would be considered a single equipment set, were used in the following examples.

Figure 1 shows the impact of AGS on a hypothetical conventional tillage farm. This figure reports both contribution margin and returns to machinery, management and unpaid labor (labeled returns to machinery in the legend for space). The contribution margin can be thought of as returns to fixed costs or land, unpaid labor, management and machinery (including the AGS itself). Returns to machinery, management, and unpaid labor effectively account for land costs. Land costs are assumed to be \$126 per acre. Optimum acreage for with and without AGS is the maximum value of points when land costs are taken into account. In this example, the farm has three tractors, one with AGS.

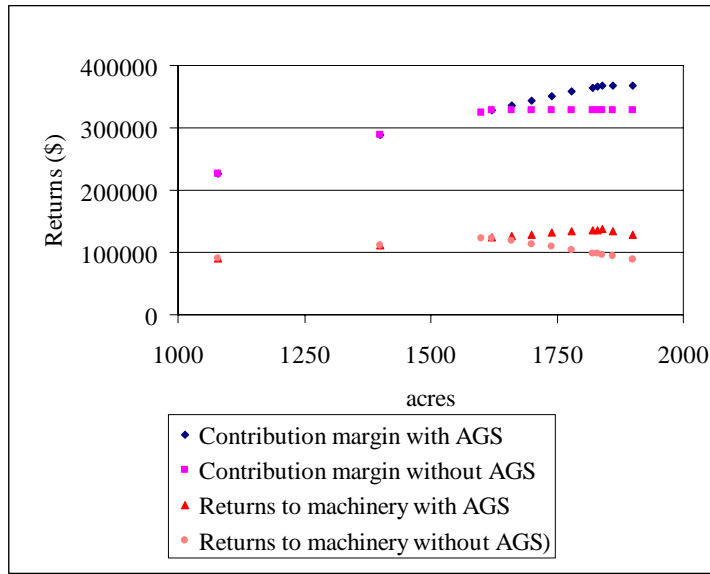


Figure 1: Effect of AGS on Returns

This is compared to an identical farm without AGS. Differing farm sizes (i.e. acreage) were evaluated. Without AGS, 1660 acres is the optimum farm size with the given equipment set on this hypothetical farm. When AGS is included, 1830 acres is the optimum acreage. The 170 acre difference with AGS comes from being more timely due to increased speeds, reduction in tillage overlap, and expanding hours worked per day for unpaid labor. Notice how the contribution margin remains at the same level when acres greater than optimum are farmed. Figure 2 gives detail to how returns change at differing farm sizes with and without AGS.

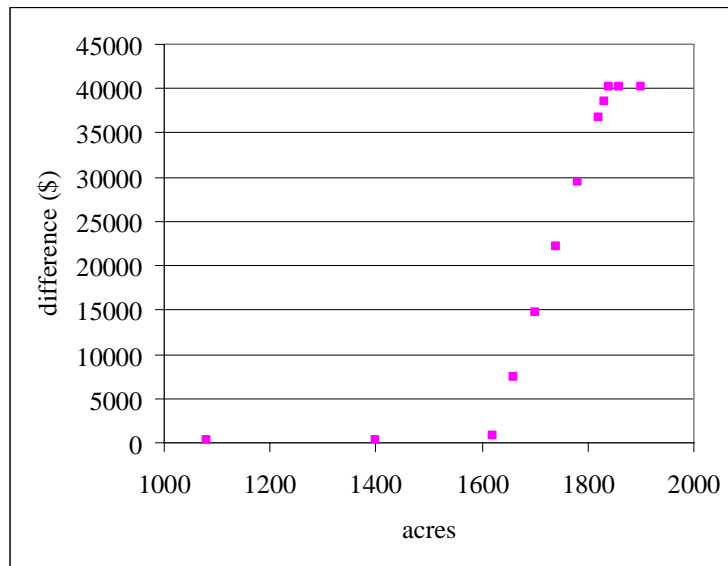


Figure 2: Difference in Returns with and without AGS

Cash rental rates are always a hot topic in farm management. Figure 3 presents the shadow value of land in those same runs used in Figure 1. In this particular case (i.e., this hypothetical farm only, these values should not be taken as what you should do on your farm) the shadow value for land is in the low \$180's. This means that this hypothetical farm would be willing to pay \$180 per acre cash rent for the next acre of land rented. In this case, the \$180 shadow price on land remains fairly constant until the farm reaches its optimum acreage at which point shadow values go to zero and the farm would not rent any more acres.

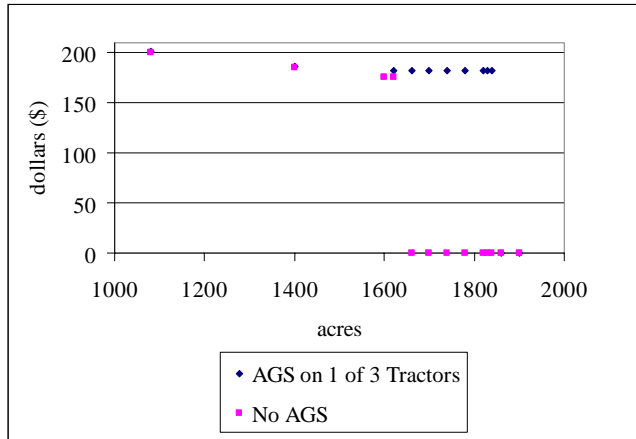


Figure 3: Effect of AGS on Cash Rent Shadow Value

When the farm size approaches 1660 acres, it can be seen in Figure 4 (Figure 4 is the same as Figure 3 but has a different y-axis scale to show detail) that the AGS farm is willing to pay \$182.74 for the next acre while the farm without AGS is only willing to pay \$176.36 for the next acre. The \$6.38 per acre difference may not be enough to entice land away from long-term farmer-landowner relationships but I've seen sealed bids with differences of \$1 per acre. It should be noted that the non-AGS farm would not bid on land once more than 1660 acres were farmed but the AGS farm would still be willing to pay \$180 per acre until 1830 acres were reached. AGS means more competition for land and all other things held equal, higher rents.

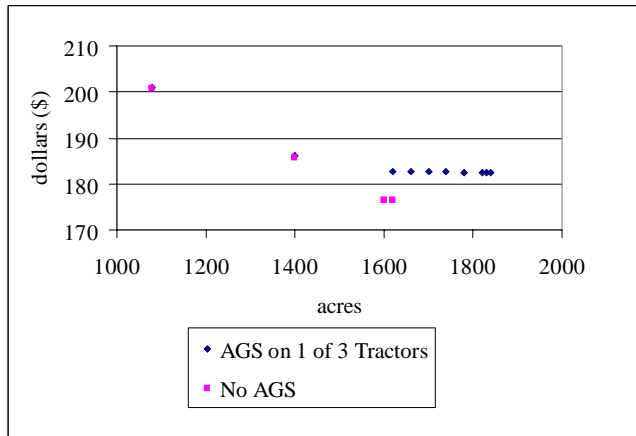


Figure 4: Detail of Effect of AGS on Cash Rent Shadow Value

### **Conclusions**

These results indicate potential returns to AGS, however this study leaves the decision to adopt up to the farmer. The farmer should decide if the extra returns to AGS more than pays for the technology. When doing so, the cost of the technology should be annualized by depreciating it over the number of useful life of the equipment.

### **More Information**

These and other AGS examples and topics will be presented and discussed at Top Farmer next month. In Australia and Denmark, AGS is being used for mechanical weed control Will AGS encourage U.S. farmers to revisit the idea of row cultivation? If herbicide resistant weeds require more mechanical weed control, will AGS help growers cover more acres. PC-LP (Model B-21) will help us understand the implications and I'm interested in what you have to say about this idea. See you at Top Farmer.

Watson, M. and J. Lowenberg-DeBoer. 2003. Who Will Benefit From GPS Auto Guidance In The Corn Belt? SSMC Newsletter [www.purdue.edu/ssmc](http://www.purdue.edu/ssmc)

Whipker, L.D, and J.T. Akridge. 2004. 2004 Precision Agricultural Services Dealership Survey Results Staff Paper No. 04-07. [www.purdue.edu/ssmc](http://www.purdue.edu/ssmc)