Potential For Precision Agriculture Adoption In Brazil

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While Brazil is being touted by some analysts as a good market for U.S. Precision Agriculture (PA) technology, this is largely based on general arguments and informal observation. The economics of PA in Brazil have not been intensively studied. A recent study published in Brazil attempted to apply the lessons of PA adoption from other parts of the world to help understand the Brazilian situation. Brazil is a large country and agriculture differs from one region to another. This analysis focused on the rapidly growing agriculture in the Center-West "Cerrados" region with some comments on how PA adoption in other parts of the country may differ from the situation in the Center-West. This article will provide an overview of the study. A link to the full report (in English) is provided at the end of this article. Some key characteristics of Brazilian agriculture as they affect PA adoption include:

- **Low-Cost Land** – The original PA concepts (e.g. variable rate input, yield monitoring) focused on fine tuning production systems to make the most of high cost farmland in Europe and North America. When land is relatively inexpensive it may be more profitable to farm additional land with uniform rate, embodied knowledge technology, than it is to invest in the technology for information intensive variable rate input application, yield monitoring and other fine tuning. The classic PA concepts may fit better in Rio Grande do Sul and other parts of Southern Brazil where farms are smaller and land prices higher.

- **Large Scale** – PA is essentially automation of certain management tasks. Variable rate application and yield monitoring automate agronomic management. GPS guidance automates part of equipment operations. One of the main benefits of GPS guidance is farming more land with the same equipment by reducing skip and overlap, as well as lengthening the workday. In the Cerrados where land is available for farm expansion, farming more land with a given set of equipment will be a substantial economic advantage.

  In addition, PA tools may be useful in record keeping, supervising employees and quality control for the work of custom operators. As-applied maps and other sensor data can automatically record input application, cutting the time required for record keeping and also reducing human error in data entry. Many trucking companies in the U.S. and Europe use GPS and telemetry to track and supervise drivers. Similar software is being adapted for use by ag retailers. The next step would be adaptation for large farming operations.

- **High Cost of DGPS** – One of the reasons cited for slow growth of GPS use in Brazil is the lack of low cost differential correction. In the 1990s, the only differential correction option was by satellite at around $2,000 USD per year per unit. This was substantially higher than the roughly $300 USD annual per GPS unit for FM sideband differential correction in Argentina. In the U.S., Coast Guard and Wide Area Augmentation Service (WAAS) is available without charge. In cooperation with the Brazilian government, the U.S. Federal Aviation Agency (FAA) plans to extend WAAS to Brazil. Free WAAS availability should reduce this constraint to GPS use.

- **Protectionist Policies & No Frills Preferences** – Precision agriculture innovation in Brazil is hampered by the high cost of imported equipment. Imported equipment can be twice the cost of Brazilian equipment because of import taxes and financing restrictions. This has

motivated multinational companies to invest in manufacturing capacity in Brazil, but it has not necessarily caused them to sell their most innovative products in the country.

- **Preference for "No Frills" Machinery** - The "no frills" preference makes economic sense for farms on the Brazilian frontier far from service and parts. Service for specialized equipment might take days and require hundreds of kilometers of travel. The "no frills" preference also reflects the fact that in Brazil farm equipment is often operated by employees, not by the farm operator and his family as is often the case in the U.S. and Canada.
- **Low Cost Labor** – Some precision agriculture technology is labor saving (e.g. GPS guidance). When labor costs are lower, the value of saving labor is reduced.
- **Commodity Crops** – The main crops in the Cerrados are relatively low per unit price commodity grains and oilseeds. Economic research indicates that precision agriculture is more likely to be profitable with higher value crops (Swinton and Lowenberg-DeBoer, 1998). The original PA concepts of variable rate application of inputs and yield monitoring may be more valuable in citrus groves and on sugar plantations, than in the Cerrados.
- **Input Costs** – Cerrados soils are generally low fertility and acidic. Large applications of fertilizer and lime are required to make them productive. While overall production costs for grains and oilseeds are lower in Brazil than they are in the U.S., Cerrados fertilizer cost per hectare is often 2 or 3 times the cost in the U.S. Corn Belt. Variable rate application of fertilizer could help reduce fertilizer costs in Brazil.

  In addition, some PA technologies have the potential to reduce energy costs. Using GPS guidance to reduce overlap cuts energy use because less land is unnecessarily covered twice. Controlled traffic farming with GPS auto-guidance can reduce fuel use because equipment is always traveling on a firm path, rather than making its way through soft soil.
- **Soil Variability** – Variable rate fertilizer application is only profitable if there is substantial soil variability. In the U.S., natural soil variability has been increased by management-induced variability due to former feedlots, lanes and fence lines, as well as by fertilizer spreading patterns. Much of the farmland in the Cerrados is newly cleared and does not suffer from this long history of management-induced soil variability. Management-induced soil variability may be much more common in long-term farmed eastern and southern parts of Brazil than it is in the Cerrados.
- **On-Farm Computer Use** – Evidence suggests that computer use in farm offices is lower in Brazil than it is in the US or in Argentina. A survey in Sao Paulo state found that in 2001, about 13% of farms had a computer. A PA market study in 2004 estimated about 14% of commercial farms in Brazil have computers. In the US, about 50% of farms owned or leased a computer in 2001, and about 55% in 2005. US computer use is higher than the national average in the Corn Belt states that have been the center of PA adoption. A 2001 survey in Argentina showed that 47% of farm managers used a computer at that time. The relatively low computer use on Brazilian farms can be linked to protectionist policies in computer markets in the 1970s and 80s. Will precision agriculture in Brazil suffer a similar fate because of barriers to technology imports?

- **Site-Specific Research** – Classic precision farming technologies, like variable rate input application and analysis of yield maps require site-specific research. Some Latin American countries, such as Argentina, have cut back funding for agricultural research in favor of a strategy that relies on borrowing technology from abroad. For conventional uniform rate technology this was a successful strategy because it is usually much less expensive to borrow or buy technology than to develop it. Classic precision farming technologies are difficult to borrow because they rely on site-specific research.

  Brazil has the advantage over many of its neighboring countries because it has an effective and relatively well financed public agricultural research system that could do much of this site-specific research. One weakness of the Brazilian public agricultural research system is that there is relatively little farm and field-level economic work providing growers and agribusinesses guidance on which technologies are likely to prove profitable in their conditions. The publicly available Brazilian PA economics research has often focused on use of PA tools in decision making (e.g. profit maps), instead of the "head-to-head" comparisons of profitability that have characterized much of the U.S. PA economics literature.

Conclusions:

The characteristics of Brazilian agriculture suggest that PA adoption will be relatively slow and uneven, as it is in most of the world. Relatively low land prices, modest labor costs, low management induced soil variability, relatively low on-farm computer use, production of relatively low price commodities and the relatively high cost of imported high tech equipment suggest that Brazilian growers as a whole may lag in PA adoption, particularly the classic PA concepts of yield monitor data analysis for fine tuning crop management and variable rate application.

The conditions of large scale farming operations, particularly in the Cerrados, would tend to favor adoption of GPS guidance technologies, especially as the cost of technology and GPS differential correction declines. PA technology automation of record keeping, employee supervision and quality control would also have its greatest advantage in large scale operations.

These overall adoption trends may differ widely in specific areas of Brazil. For example, the classic PA technology may be rapidly adopted for higher value crops (e.g. citrus) and in areas higher farmland values (e.g. Sao Paulo, Parana and Rio Grand du Sul). If fertilizer and energy prices continue to rise rapidly, growers in the Cerrados may find it worth their while to do variable rate application. Some areas or groups of farms may benefit from targeted public or private research that adapts the general PA concepts to their particular problems.

More Information:

Griffin, Terry, and J. Lowenberg-DeBoer, "Worldwide Adoption and Profitability of Precision Agriculture: Implications for Brazil," *Revista de Politica Agricola*, 14:4 (2005), http://www.embrapa.br/a_embrapa/unidades_centrais/sge/publicacoes/tecnico/revistaAgricola/index_htm, p. 20-38.