

The Unmanned Farmer

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October 15, 2011

When most people survey one of America's 2.2 million farms, they see fields of wheat, rows of corn, and herds of cattle. Developers of unmanned systems see expanding markets. Robots are being built for picking, grafting, cultivating, weeding, spraying pesticides, planting, timber cleaning, feeding stock, and even egg inspection.

Superficially, unmanned agricultural systems seem counter-intuitive. Farm workers are among the lowest paid in America. Why build expensive robots to replace people who barely make minimum wage?

Farm labor may be cheap, but it is not without its problems. There is an increased demand for workers at planting and harvesting. Gathering enough workers at these times has always been a challenge, and has become more so, as farms become larger and larger. Crops can rot in the ground if not enough workers are found in a critical time window.

While wages may be a small part of the cost of farm production, they are not negligible. It has been estimated that \$70,000 in labor would be needed for the production of a 1,000 acres field of corn, while 1,000 acres of vegetables would require \$2 million to \$3 million in wages ([The Packer](#).)

High wages certainly has fueled an interest in agricultural robots in Europe. Strict employment laws makes hiring and firing workers more expensive there than in the U.S. Also, tax regulations encourage investment in equipment.

Still, China, which is famous for its low-cost labor, is a major source of scholarly papers on agricultural robots. This suggests that other forces are driving the creation of "farmbots."

I asked Dr Bob Norris, a roboticist who worked for John Deere and who is now associated with AMREL, about the reasons behind the robotization of agriculture. He confirmed that "It's not about wages. It's about efficiency — fuel, feed, and fertilizer."

Dr. Norris reports that unmanned farm systems are part a trend that is sometimes called "precision agriculture." GPS enables tractors and other farm equipment to be accurate

within 2 cm. That means that within any given acre, there will be more seeds planted, and more rows hoed.

In farming, even a small efficiency can make a huge difference. Suppose the utilization of unmanned systems saves the farmer two dollars an acre per harvest. Since farms can easily run into thousands of acres (up to 50,000), and may have more than one harvest a year, hundreds of thousands of dollars may be saved annually. Dr. Norris says that, precision agriculture can save farmers up to 7 or 8% for fuel expenditures alone.

Precision agriculture has caught on in a huge way. In 2008, more than half of all agricultural retail outlets offered GPS-driven autosteering ([Wired.com](#)). In fact, precise location applications have become so critical, that when a controversy arose about a proposal to install thousands of wireless ground stations nationwide, fears were expressed about the potential harm to agriculture*. A press release opposed to the ambitious wireless proposal stated, "Farmer business plans depend on GPS information such as yield data, harvest weights, moisture data, and other precision agriculture data. Interference with GPS signals up to 22 miles away would devastate productivity and impede U.S. agriculture ability to help meet the compounding worldwide demand for food" ([Farm Press](#)).

GPS-based guidance means reduced skips and overlaps, the ability to work with poor visibility, less reliance on the uneven skills of human drivers, better yields, energy savings, and enhanced safety. The latter is significant since farming is one of the most dangerous occupations in America (In 2004 alone, over 8,000 children and adolescents were injured performing farm work [[Wikipedia.com](#)]).

One key phrase in precision agriculture is "variable rate." It makes no sense to evenly distribute valuable pesticide, water, or fertilizer over an entire field; land varies greatly in its needs and productivity. Real-time kinematic (RTK) navigation enables a farmer to precisely target the areas that need resources. Satellites (and increasingly Unmanned Aerial Vehicles) collect this information and then relay it to automated ground machinery, which can deliver the exact amount of substance needed. Observers of modern warfare will notice the similarity: the use of high-tech Intelligence, Surveillance, and Reconnaissance (ISR) to provide actionable data that enables ground forces to precisely target resources.

**Note: I have no idea if this or any wireless plan would actually interfere with farmers' GPS; the wireless plans promoters deny that it would. I mention this controversy merely to highlight the importance of GPS to farming.*

However, there are significant differences between the worlds of defense and farming technologies cautions Dr. Norris, who has worked in both. Unmanned system developers looking to expand from military to agricultural sales need to be aware that they are moving from a contract-based culture to a consumer one. While there has been an increased emphasis on bringing warfighter input into the development process as early as possible, the military still hasn't matched the civilian sector for sensitivity to the consumer.

The Defense supplier examines Requests For Proposals (RFP) for specifications before he develops his solution. A provider of agricultural equipment conducts market research before he builds his product. One interacts with a bureaucracy and procurement officers, the other with the end user. The Defense vendor sells maybe hundreds or thousands of units with one contact. The agricultural vendor sells *thousands of units one at a time*.

Probably the biggest single biggest difference is the effect of the law. While questions of legal responsibility have impeded the creation of lethal autonomous unmanned systems, the impact on farming robots is much greater.

"If someone gets hurt by an autonomous farming robot, who's responsible?" asks Dr. Norris. "Generally it comes down to who has the deeper pockets, and manufacturers don't want to be the ones left holding the bag."

For the foreseeable future, agricultural robots will always have a human in the loop, even when he's not really needed. Expect to see the application of principles similar to force multiplication. Instead of a driver piloting one combine, he may be operating five or ten. Just as robots will not completely replace human soldiers, human farmers will be augmented, not displaced, by their unmanned counterparts.