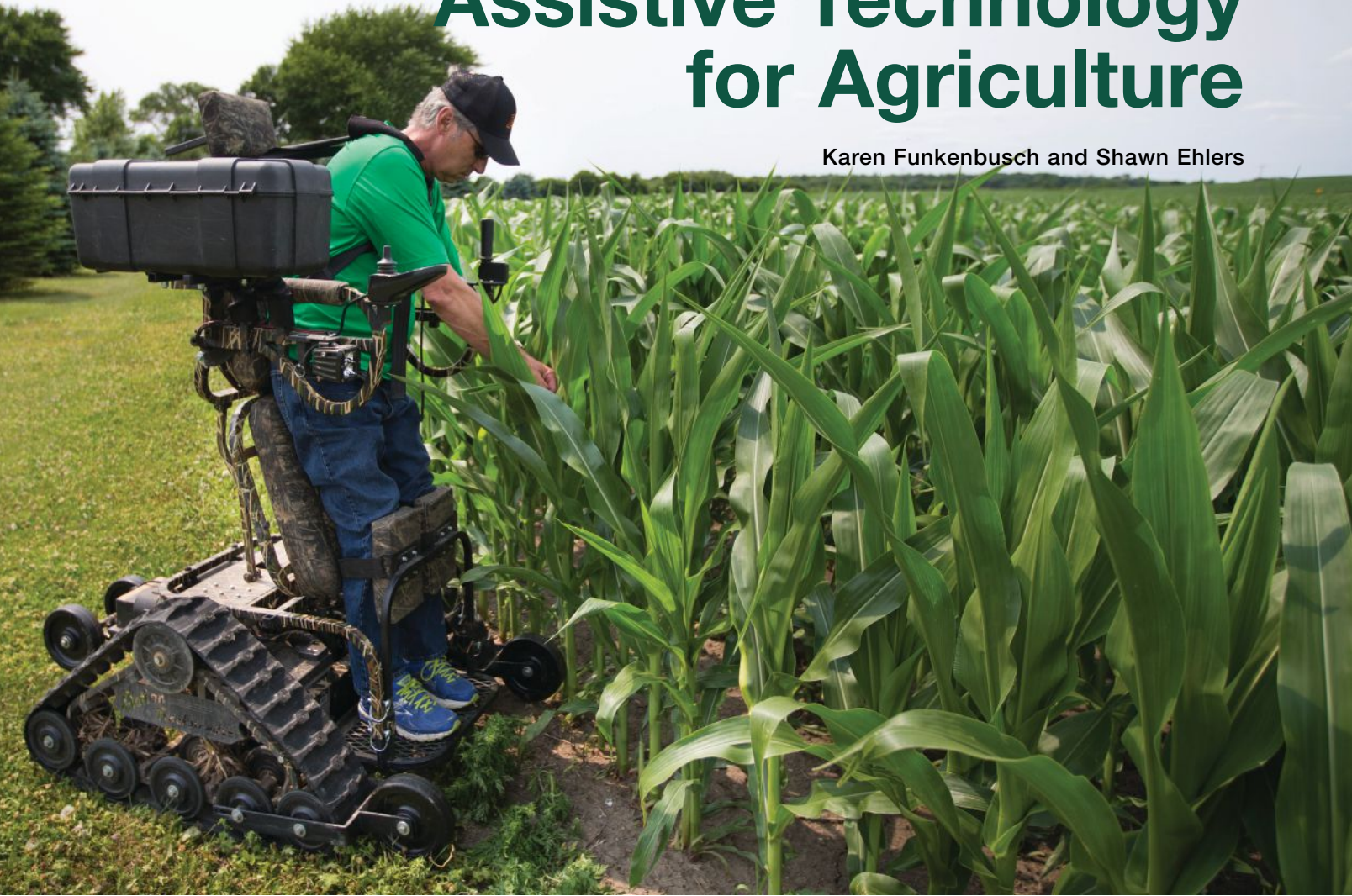


# Assistive Technology for Agriculture

Karen Funkenbusch and Shawn Ehlers



Advances in technology can allow disabled farmers, such as Scott Collier, to continue working. Collier was replacing a tire on his auger when a metal strut collapsed and pinched his spine, leaving him unable to walk. *Photo by Renee Jones Schneider, © 2015 Minneapolis Star Tribune.*

**P**ersonal independence is a pillar of the farming profession. Unfortunately, that independence is often threatened by disability due to accidents, chronic health conditions, and aging. In the past, these limitations would likely end lifelong careers or result in drastic changes in the structure of the family farm. Today, however, with the help of assistive technology (AT) and support programs such as AgrAbility, farmers often retain or regain their ability to live and work independently, safely, and efficiently.

AT includes any item, equipment, system, or technology that increases, maintains, or improves an operator's functional abilities. In the past decade, agricultural productivity has benefitted enormously from advances in machine technology, data gathering, and data processing. Sophisticated technologies such as robotics, intelligent crop monitors, digital imaging, and geographic information systems are becoming common. In addition to increasing productivity, these advances provide a basis for developing AT solutions for those with physical, psychological, or functional limitations.

## The future of assistive technology

In the future, large agricultural operations will need workers with a variety of skills. This will require job restructuring to match the skills of the workers with appropriate tasks while reducing the risk of injury. Because of improvements in AT, long-time farmers who are affected by disabilities, limited mobility, or aging may be good choices for these jobs because of their experience and maturity. Similarly, some operators with disabilities will be able to own and operate a small farm or agricultural enterprise through task modifications and other accommodations made possible by AT.

Some of these technologies are on the horizon—others are already common in our lives:

- The application of universal design principles to agricultural machinery will help to accommodate the needs of an increasingly diverse farm workforce.
- Automation and labor-saving technologies will increase employment opportunities for workers with disabilities.

- Pocket-size devices and wearable technology will provide a readily accessible interface between the farmer, the machines and systems that the farmer manages, and the farmer's support network of family, medical providers, and coworkers.
- The IoT (internet of things) will reduce the farm management burden by providing communication between smart devices and equipment on a common network. The IoT is already common in smart homes and offices, performing many day-to-day tasks automatically or in response to voice commands.
- Intelligent, self-learning devices will monitor and adjust their actions in relation to both the operator's safety and the agricultural production system.
- Deployable technology, such as aerial drones, in-field sensors, and livestock tags, will allow the operator to monitor and manage the production system while minimizing the physical demands and avoiding exposure to unsafe conditions.
- Behind all technologies are people. In particular, social media will continue to expand, creating connected communities and bringing people together around a common interest or shared goal.

Advances in AT will help farmers with disabilities remain independent and productive. Examples include "smart" wheelchairs that integrate separate technologies into a single device. In the near future, "smart" wheelchairs will monitor the user's health and provide surveillance functions to detect falls and injuries. Similar innovations in prosthetic devices are being developed for amputees. For example, 3D printing will allow prosthetic devices to be more durable, affordable, and accessible. In the near future, prosthetics will be seamlessly integrated into amputees' everyday lives with little effort and expense. These devices will be more natural in their fit and appearance, and they will be equipped with integrated sensors and control algorithms to provide more natural movement with less effort.

### Farm machinery

Farm machine systems will continue to evolve, especially at the operator-machine interface. Manufacturers continue to improve control systems with electronic proportional controllers. These advances have benefitted operators with mobility or strength impairments, and they have significantly reduced the need for extensive third-party modifications. Other examples include electronic-controlled steering (auto-steer), hydraulic accessory controllers, and transmission options such as continuously variable transmissions (CVT), infinitely variable transmissions (IVT), and hydrostatic and shuttle-shift transmissions, which eliminate the floor-mounted clutch and brake pedals. Highly automated agricultural machines (HAAM) continue to advance, with many more innovations to come. Following the lead of smart home technology, voice control will likely replace some manual or

foot-operated controls, which will accommodate operators with arm or leg disabilities.

### Safety automation

Influencing farmers to follow "safety first" practices will continue to be difficult. Accomplishing this change through machine technology may prove easier. Transportation and manufacturing industries have made great strides in assisting operators in making safe decisions. Current highway vehicles include hazard-detection systems and even automatic braking. The construction industry, which uses equipment similar to agriculture, is incorporating hazard-detection devices that can recognize bystanders and obstacles in the path of travel.

With current smartphone technology, farm managers can perform logistics planning, monitor their production systems, and even receive automatic notifications when a hazard is detected, such as when someone enters a dangerous area by crossing a virtual fence. This automation has great potential to improve farm safety without compromising the manager's decision-making authority.

### Other areas for AT development

Emerging technologies extend beyond individual applications. Examples include inexpensive or open-source designs for rapid adaptation of standard AT devices, such as 3-D printer designs for modified handgrips, ergonomic controls, and other aids. Participants can share modifications, designs, and solutions with others who face similar challenges. Other practical benefits include tutorials (in print, photo, and video formats) and like-minded community involvement.

Acceptance of new technologies is critical for improved safety and sustainability on the farm. These technologies can also improve the quality of life for farmers with disabilities, which will encourage their acceptance by all farmers. However, despite all the recent advances in technology, farming remains hard work. Ag and bio engineers, agricultural safety and health specialists, and AgrAbility professionals must work together to educate farmers about the advantages of AT.

Both private and public funding will be required for the further development of the ideas identified here. Identifying funding sources and motivating public support for programs such as AgrAbility will continue to be a challenge. In the meantime, ASABE members are advancing agricultural technology through basic research and development, which underlies the AT advances mentioned in this article. These advances are already impressive, and many more are on the horizon.

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