

### Improving Worksite Mobility for Farmers with Physical Disabilities

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#### Abstract

Mobility is essential for those who manage most modern farm operations. A farmer who does not have relatively easy access to his or her crops, livestock, and/or facilities is at a distinct disadvantage compared to other producers, and can experience major losses due to inadequate supervision of their operation. The purpose of this special technical report is to (1) point out the barriers that exist for farmers with mobility impairments, including spinal cord injuries, lower limb amputations, arthritis, hip replacements, hemiplegia, Multiple Sclerosis, and Cerebral Palsy; (2) offer possible solutions for specific mobility problems; and (3) provide information on other resources related to outdoor mobility.

#### Barriers to Mobility on the Farm

Considerable attention has been given to the mobility problems associated with living in an urban setting. Curb cuts, elevators, lifts, paved walkways, and ramps have all been used successfully to make urban living less restrictive. Less is known, however, about outdoor mobility, and even less is known about the needs of those who work out-of-doors, such as farmers. Unlike the urban resident with a mobility impairment who primarily travels over hard surfaces, farmers are required to travel over many different types of surfaces. Furthermore, many of these surfaces are changing constantly with weather conditions. For example, a surface that permits wheelchair mobility at one time may not a short time later. The surface type can also change dramatically over short distances. A farmer could easily encounter cement, grass, loose gravel, mud, and tilled soil within the immediate area of the farmstead.

Generally, farmers with mobility impairments encounter a sizable number of obstacles which are not typically faced by farmers who are ambulatory. A summary of some of the special problems is presented below.

#### *Distance*

Farms range from a few acres of vegetables or fruit to thousands of acres of corn, wheat, or other crops. As farm size becomes greater, the required travel distances and travel time increase the problems of accessibility. In some cases, farms or fields may be located miles apart, requiring highway travel.

#### *Growing Crops and Vegetation*

A flat, smooth field presents few mobility problems. However, a standing crop that is seeded in narrow rows or covers the entire field, like hay or grain,

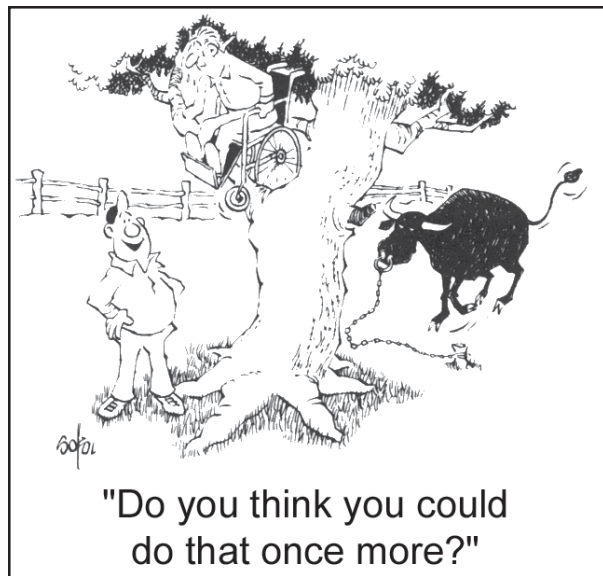


Figure 1. When it comes to outdoor mobility, if there is a will, there is usually a way.



*Figure 2. Tall or dense crops can prevent access to the middle of fields to allow for inspection for insects and weeds.*

becomes nearly impassible to someone using a wheelchair, crutches, or cane. In these situations, lack of access to the innermost portions of the fields prevents adequate surveillance for weeds and insects (*Fig. 2*).

The accessibility of a field may be influenced by a combination of factors such as rain or snow, tillage practices, and height of vegetation. Farmers with woodlots will also have considerable difficulty in getting into the woods using traditional mobility aids. Passage through dense undergrowth and fallen trees can be extremely difficult, if not impossible.

### ***Surface Material, Texture, and Condition***

A farm is a cornucopia of various soil textures and surface materials. Cement, grass, loose gravel, mud, crushed stone, hard-packed dirt, and tilled soil are all commonly found in a farm setting. Each of these surfaces presents unique problems.

Crushed stone, for example, is a common material used for driveways or floors of farm machinery buildings. Its cost is low, and it makes a good surface on which to walk and drive equipment. However, for farmers who use wheelchairs, loose crushed stone

is a detriment (*Fig. 3*). Small, thin wheels tend to push the loose stone ahead, thus causing the front casters to go sideways, rather than ride on top of the stone. In addition, coarse stone increases the roughness of the ride. The result is a greatly increased effort for someone attempting to maneuver over a surface of this type. Loose gravel has a similar effect on wheelchairs and, in addition, can sometimes lodge itself between the hand rim and the tire of the chair.

Because many manual and powered wheelchairs have low ground clearance, even a small amount of sinkage in soft, loose, or wet soil can turn one of these mobility aids into a plow (*Fig. 4*). Low footplates on a wheelchair are often an example of this problem. The more one tries to move ahead, the further the footplates bury themselves.

Sandy soils and muck soils can also significantly hinder access to crops. In fact, these soil types are difficult to walk on without an impairment. A vehicle with high flotation tires which distributes the weight more uniformly can prevent sinking in.

### ***Terrain***

The tall-tale about farmers who hurt themselves when falling out of their fields because of the steepness has a grain of truth for those with lower limb impairments. Steep, rolling farmland can pose serious mobility problems, and also requires higher levels of physical energy to travel over.



*Figure 3. Coarse crushed stone can present a barrier to manual wheelchairs.*

Roadside and field drainage ditches are crossed with out a thought by those capable of walking unaided. These same ditches, however, can pose a tremendous obstacle to those farmers who must rely on mobility aids to travel. Terracing can also present some of the same problems.

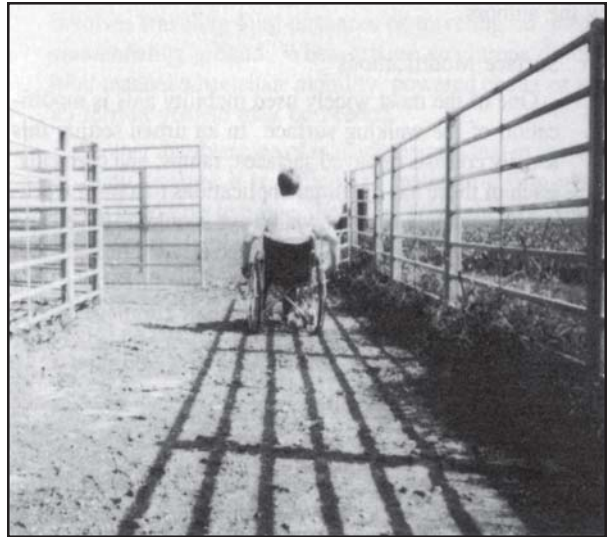
### ***Fences and Gates***

In addition to terrain and surface conditions, physical structures around the farm also present impediments to farmers with mobility impairments.

If livestock are being raised, it's certain that fences and gates are being used in some form. Many farmers find it a nuisance to dismount the vehicle, open the gate, get back into the vehicle, drive through the gate, dismount the vehicle again, close the gate, and finally get into the vehicle once more and drive away. How long does it take an ambulatory farmer to do this? Perhaps 30 seconds to one minute. A farmer with mobility impairments may be prevented from performing this task altogether, if the correct mobility aid is not available. Even with a such an aid, the whole episode of getting through the gate requires substantially more time and effort to accomplish.



*Figure 4. Wet or muddy conditions can severely hinder on-farm mobility. Mud and dirt can also be brought into the home on mobility aids.*



*Figure 5. Fences and gates are designed to make certain areas less accessible to livestock. They are equally as effective at reducing the freedom for someone with a mobility impairment.*

For farmers who must use mobility aids in order to travel around the farm, fences become as effective at limiting human movement as they are at containing the livestock. There are few “short-cuts” for these farmers, as there are for people who are able to step between, or over, the strands of wire in the fence. Only at the gate locations can a person in a mobility aid pass through (*Fig. 5*).

A person's view from a wheelchair is also lower to the ground than for an ambulatory person. Bushes, fences, or other low barriers obstruct the vision of those in wheelchairs. This can be important in locating and monitoring livestock, surveillance of crops, and enjoying the view.

Fence gates meant for foot travel may be too narrow to permit passage of some mobility aids, and built-in cattle guards can pose a problem if the wheels of the mobility aid are small or narrow.

### ***Buildings***

The amount of clear space needed to work—or just maneuver—in a wheelchair requires a 5-foot turning radius, which is greater than that needed by an ambulatory person. For example, a crowded storage building poses no problem to someone who

walks unaided, but it will not allow passage of a wheeled mobility aid, such as a wheelchair or powered chair.

The width of a doorway may also limit access by being too narrow to allow a wheelchair to pass through. This is especially common in old farm buildings. In addition: door jams of farm machinery buildings can be restrictive; slatted floors in livestock buildings can hinder walking and wheelchair use; spilled grain or loose hay on a smooth floor can prove dangerous; and, of course, the most common restriction that farm buildings impose are steps and ladders. In some cases, however, circular steps, such as those used on grain bins, can improve mobility for some farmers.

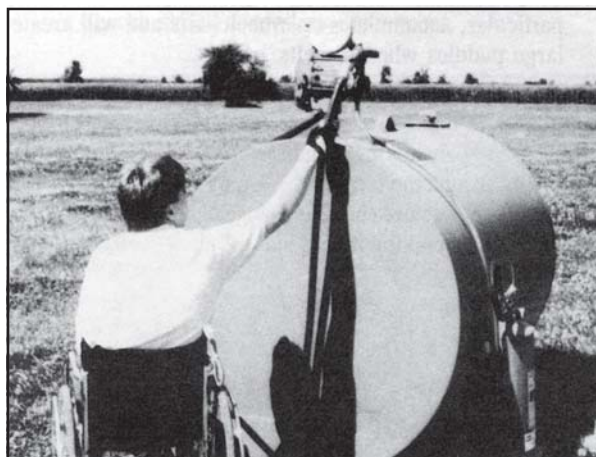
### ***Environment***

Weather conditions like rain, ice, or snow are bothersome, but for most people these conditions do not impair their ability to be mobile. Someone using a mobility aid, however, can often be affected by these conditions (*Fig. 6*).

It is a rare spouse who allows a farmer to wear the same work boots inside the house which were used to walk through mud, manure, gravel, and grease. Consider that work boots can be easily exchanged for clean shoes at the door of the home, but that the problem is magnified tremendously for a farmer who travels using a wheelchair. A second wheelchair used



*Figure 6. Severe weather and snowdrifts should be considered when planning alternative means of gaining access to various farm facilities.*



*Figure 7. Various farm tasks, hindered by being mobility impaired, require various mobility aids.*

only for working on the farm is more difficult to justify due to the expense involved, but the alternative is to thoroughly clean the chair after each work session. Otherwise, material tracked into the home can consist of manure, soil, water, and/or agricultural chemicals, depending on the type of farm and work activity being carried out. Snow, in particular, accumulates on wheelchairs and will create large puddles when it melts.

Some farmers with disabilities have a reduced ability to control their body temperature. This becomes a factor when considering weather to travel considerable distances around the farm in the summer heat or the winter cold. Temperature can also change the texture of the surface, either making it hard and rough or soft and dusty.

### **Assessing Mobility Needs**

In trying to determine mobility needs, the farmer with the disability should first decide what he wants to do, where he wants to do it, and when. In many cases, a particular job or jobs may require more than one mobility aid (*Fig. 7*). The more the person wants to accomplish, the more versatile an aid should be. Before considering a specific mobility aid, the farmer should ask himself questions about how to accomplish the job. For example, how high does one need to be in order to perform the task? Is the individual working close to the ground, like when

gardening, or does he need to be elevated in order to use a work bench or stationary power tool? Does the job require the worker to carry any cargo or tools? Can the job be done in a wheelchair, or does the job require the power of a tractor? What distance will have to be traveled? Will the vehicle's batteries or gas tank be large enough to travel the distance or complete the task? What kind of terrain is the person traversing while doing the job or traveling to the job? Does transferring in and out of the vehicle require assistance from others, or can it be done independently?

Special consideration should be given if the mobility aid is transported between farms. Canes, crutches, and manual wheelchairs are usually the easiest mobility aids to transport. Other mobility aids, such as electric wheelchairs, may be too heavy or bulky to be easily transported, requiring the use of a truck, van, or trailer. If lifts are being used, the lift's weight capacity and dimensions should accommodate the mobility aid. (*Reminder: The person's weight should be added to the weight of the mobility aid if the person and aid are lifted together.*)

For example, the accessibility of a field may be determined by a combination of factors such as rain, snow, tillage, and vegetation. To be mobile on these changing surfaces and to perform essential tasks, a farmer may have to use more than one mobility aid. A partial list of the possible mobility aid includes all-terrain vehicles, golf carts, garden and farm tractors, trucks, automobiles, snowmobiles, canes, crutches, and three-wheeled carts.

### Selected Mobility Aids

It is not the purpose of this technical report to provide an exhaustive list of mobility aids. Other Plowshares articles have addressed parts of the mobility problem including the use of All-Terrain Vehicles. Those mentioned here demonstrate the variety of mobility aids which are available and applicable to farm use. Mention of a specific brand name in this report does not constitute an endorsement by Breaking New Ground or by the authors.

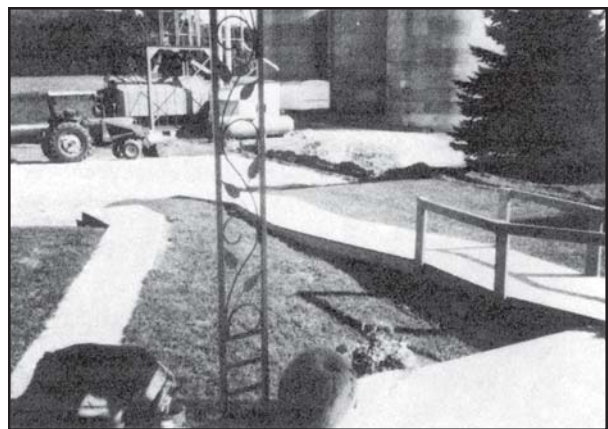
### Surface Modifications

One of the most widely used mobility aids is modification of the walking surface. In an urban setting this usually consists of paved surfaces, ramps, and curb cuts. Each of these has potential applications to a farm worksite. Often-used walkways should be paved and well-drained. In many cases, packed clay or crushed limestone will provide an adequately smooth surface at a reasonable cost. Concrete and asphalt, although more costly, are extremely durable and provide a highly accessible surface (*Fig. 8*).

### Canes and Crutches

There are many cases where the only mobility aid that is needed is a cane or crutch(es). These aids come in a variety of styles and are often customized for use by one individual. Farmers have also been known to improvise by using ski poles and dandelion cutters as mobility aids.

An assortment of cane feet and tips are available from durable medical dealers that provide increased traction, improve stability, and reduce the chance of falling. For example, sharp ice tips are popular in areas that frequently have icy weather and, where greater surface area is needed, cane tips have been replaced with crutch tips. For those who use canes and crutches, a smooth surface is very important. Consequently, the rough terrain found on most farms results in an increased potential of falling.



*Figure 8. Paved walkways reduce the effort required to get around the farm yard, especially to those locations visited most frequently.*

## Manual Wheelchairs

Manual wheelchairs are frequently used successfully around the farm. Many farmers prefer lightweight sports chairs. These lightweight manual wheelchairs are easily maneuverable and require less energy to move about than standard-weight chairs (Fig. 9). Other farmers report successfully using a more rugged chair like the Iron Horse to perform their tasks. These farmers feel that heavier chairs are better suited to the punishment of farm work, and require less maintenance.

Manual wheelchairs are adequate when doing tasks in a localized area (Fig. 10), but they have limitations when the job involves traveling long distances or traveling on unaccommodating ground. When ground conditions do inhibit manual wheelchair mobility, powered chairs or an all-terrain vehicle may be needed.

Another disadvantage of manual chairs is that in snowy or rainy weather it is difficult to maintain a firm grip on the hand rims to propel the chair. When the hand rims are slippery, the tires can be grabbed to maneuver and to move the chair forward. For better traction in snow, baler twine can be wrapped around the wheels like a set of tire chains to help



Figure 9. It appears that most farmers using wheelchairs prefer the lightweight, sports-type chair with pneumatic tires and inserts to reduce the frequency of flat tires.



Figure 10. Discarded rubber belting used in grain elevators provides an inexpensive means to temporarily access the garden area.

improve traction. Upon entering a building, the twine can be easily cut off.

Many manufacturers of wheelchairs offer the choice of mag wheels or spoked wheels. Mag wheels offer the convenience of not having to worry about spokes; however, spoked wheels absorb some of the shock of crossing rough terrain. A chair can also have solid rubber tires or pneumatic tires. Pneumatic tires absorb more shock than hard rubber tires but are more prone to flats. A variation of the pneumatic tire is to have a plastic inner tube or a Kevlar lining. This insert prevents flat tires, but does not absorb shock as well as inner tubes.

Many farmers use bicycle tires instead of the traditional wheelchair tires. A good quality bicycle tire will last longer and is much more resistant to punctures than the standard wheelchair tire. There is a greater variety of bicycle tires than wheelchair tires. Bicycle tires range from the wide-knobby ones for better traction in dirt, to the skinny racing types. They are also considerably less expensive than standard wheelchair tires. One disadvantage of black bicycle tires is that they may leave dark scuff marks on a floor.

Using any manual chair requires the expenditure of energy. What most people don't realize is that, on

uneven terrain, one arm is usually working harder than the other arm. A farm is seldom level, so additional energy is required for propelling and maneuvering a manual wheelchair.

### ***Powered Wheelchairs***

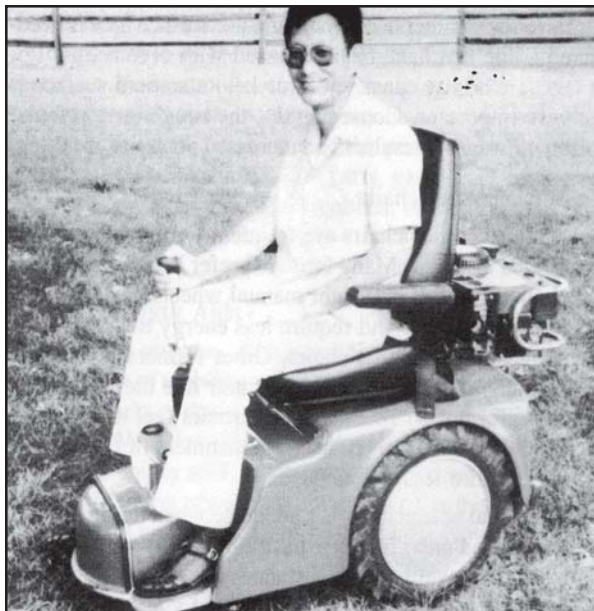
Electrically powered chairs are produced in a wide variety of weights, sizes, and prices, and each is built for a specific use. Only a portion of them are adequate for farm application; these are labeled as “outdoor” chairs and have motors with increased torque, as well as ground clearances and tires that enable maneuverability in rough terrain. Nearly all are battery powered. Some examples of these are the Invacare Arrow X-T, Everest and Jennings Lancer, Braun, Little Rascal, Gaymar Hi-Rider, and Amigo wheelchairs.

Tire selection for powered mobility aids is extremely important for farm applications. Small, smooth tires will prove less effective than larger tires with all-terrain treads. Slightly softer tires can help improve the smoothness of the ride, but may require additional power to maneuver.

Another consideration is seat type. Seats should provide adequate support and arm rests to reduce fatigue. Some seats come with suspension systems that reduce shock. All-weather seats are preferred due to the potential exposure to the elements.

Some farmers capable of propelling a manual wheel chair prefer to use an electric chair for farm work. The powered chair conserves their energy for other tasks. Battery-powered chairs offer the convenience of fingertip control of speed and maneuverability. They are also generally allowed inside public buildings whereas gasoline engines are not. The main disadvantage is that the batteries may need frequent recharging under heavy use.

One powered mobility aid that offers the advantage of both gas and battery operation is the *Freedom One* wheelchair from Ameripower (*Fig. 11*). The gasoline engine can be removed so that the chair may be used in public facilities, running off the battery. Once outside, the chair can be powered



*Figure 11. The Freedom One is an mobility aid that's designed for rough terrain and conditions.*

by the gasoline engine, while recharging the batteries at the same time.

The Gaymar *Hi-Rider* electric chair has a feature unique among other outdoor chairs. Using a specially-designed bracing and lifting system, the chair seat lifts the user into a standing position. This could be useful in reaching maintenance areas of machinery, or a number of other daily activities for those who can no longer stand unaided. There is also reported increased blood flow and various other health benefits for the user when standing. This chair steers from the rear, requiring a shorter turning radius, and has a front suspension to reduce shock over rough surfaces.

### ***All-Terrain Vehicles***

An all-terrain vehicle (ATV) may help fill the gap between a wheelchair and a truck. It provides the disabled farmer access to outdoor facilities and fields that are either too rough or too far to travel using a manual or powered wheelchair (*Fig. 12*). There are many brands and options to choose from. The Polaris ATV, for example, is operated totally by hand controls, while the Yamaha Terrapro has a PTO and an assortment of PTO-operated equipment. The



Figure 12. All-terrain vehicles have proved to be useful mobility aids. Some offer a wide range of accessories to complete numerous farm chores.

buyer should consider his needs and safety when making a selection. For more information on selecting and safely using an ATV, see Plowshares #5, *Selection and Operation of All-Terrain Vehicles by Physically Impaired Farmers*.

Farmers with hip replacements or who have difficulty in positioning their legs may benefit from an ATV with a bench seat such as the Kawasaki Mule or the John Deere ATM.

### ***Other Vehicles/Alternatives***

Other sources of mobility that have been used by farmers with physical disabilities include, but are not limited to, golf carts, riding mowers, garden and farm tractors, trucks, cars, and snowmobiles. When solving mobility problems, these vehicles should be considered (Fig. 13). They may already be on the farm and may keep the farmer from having to invest in other mobility equipment. However, some modifications, such as hand controls and grab bars, might have to be installed. In addition, transfer platforms may need to be constructed for individuals with high level spinal cord injuries. For on-the-road vehicles, it is recommended they be equipped with automatic transmissions, power steering, and power brakes.

Two-door automobiles provide the most room for pulling a wheelchair into the car between door frame

and seat. There are also wheelchair carriers that mount on the car's roof. These carriers are equipped with devices that will lift and store the wheelchair. The chair carrier does add height to the car and may limit the car's access into certain garages.

Most farmers prefer pickup trucks and consider them essential to completing many farm chores. However, pickup trucks are often more difficult to access, and require the use of standard transmissions—making them more difficult to modify.

There are lifts for pickup trucks that will raise a wheelchair and store it in the bed of the truck (Fig. 14). Many of these types of lifts will not store the chair where it is protected from the environment; consequently, it may get wet or dirty. For that reason, some farmers prefer an extended cab; it provides a place to store a wheelchair inside the cab.

Farm tractors are an excellent means of covering rough terrain. There are commercially available lifts to assist the disabled farmer in mounting a tractor. Plowshares #8, *New Concepts in Manlift Attachments for Tractors and Combines*, describes recent developments in tractor modifications.

In some cases, there may be alternatives to needing direct access to a part of the farm operation. For



Figure 13. Some lawn and garden equipment is hand-operated and provides a way to both mow the lawn and travel around the farm.





*Figure 14. On most farms, the pickup truck is the most important means of transportation. In some cases, it is considered a mobile office. Here a hoist has been mounted in the bed of the pickup to lift the chair for storage.*

example, a silo or grain bin could prove extremely expensive to modify, but there are available electronic monitoring devices that provide information on grain temperature and moisture, as well as the level of grain in the bin. Remote video cameras can be used to monitor livestock to reduce the frequency of trips to the barn, and automatic gate openers could make traveling through livestock pastures less time-consuming.

For some individuals, the best alternative might be to have someone else complete the desired tasks (*Fig. 15*). This can often be accomplished through a careful reallocation of responsibilities. In cases requiring considerable economic investments, a careful cost/benefit analysis should be carried out. In other words, what is the best way to use limited resources to operate the farm effectively.

### **Safety**

Farming is one of America's most dangerous occupations. The diversity of activities, exposure to the elements, and the varied terrain are major contributing factors to the high injury rate. It is fair to conclude that a farmer with a serious mobility impairment is at greater risk of injury and, consequently, needs to take additional precautionary measures. The first step might be to better plan the day's ac-

tivities, in order to reduce the stress and mistakes often associated with haste and unplanned events. This will give the farmer the opportunity to let others know where he/she will be and to arrange for assistance for certain tasks.

Overturns of agricultural equipment, primarily tractors, are the single most frequent cause of farm-related deaths. Use of any type of mobile equipment on rough ground, around ditch, stream, and pond banks and on hillsides should be done with extreme caution. If at all possible, equip all tractors and ATV's with rollover protection. Traveling across inclines, as opposed to up or down inclines, should be done with great caution. This motion occurs, for example, when mowing ditches. Many powered mobility aids have difficulty traveling in a straight line under these conditions. Some become less stable and may have a tendency to roll over, causing injury to the user. The user should know the manufacturer's recommendations for rough terrain use. Anti-tip bars are available for many outdoor powered chairs to prevent rear overturns.

All mechanical equipment has the potential for failure and could leave you stranded. Since many types of breakdowns are not repairable in the field, routine maintenance and two-way communications—such as C.B. radios, a cellular phone, or an FM system—become extremely important. It might also be wise to take along extra water and clothing in



*Figure 15. Sometimes the most effective way to perform tasks is to have others do them. The energy expended might be better utilized elsewhere.*

case help is slow in arriving. An air horn or siren could also be added to the vehicle to provide an audible alarm in the event of an emergency around the farm yard.

An appropriate fire extinguisher is highly recommended for all modified farm vehicles. This is especially true in cases where the exit time may be greater due to an impairment.

It is firmly believed that a farmer, even with a severe mobility impairment, can safely participate in many of the daily activities of a modern farm operation. With the increased use of new technology, and through reorganization of work responsibilities, there is no reason that improved mobility cannot be safely achieved.

## Resource Materials

*Selection and Operation of All-Terrain Vehicles by Physically Impaired Farmers*, Plowshares #5. W.E. Field and J.N. Hancock. 1987

*Farming Following a Spinal Cord Injury*, Plowshares #6. W.E. Field and J.N. Hancock. May 1989.

*New Concepts in Manlift Attachments for Tractors and Combines*, Plowshares #8. J.W. Bowles and W.E. Field. May 1990.

*Agricultural Tools, Equipment, Machinery and Buildings for Farmers and Ranchers with Physical Handicaps*, Volume I. Breaking New Ground Resource Center, Purdue University, West Lafayette, IN.

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