PLOWSHARES #5

Breaking New Ground Technical Report

# Selection and Operation of All-Terrain Vehicles by Physically Impaired Farmers/Ranchers

**John N. Hancock**
Project Coordinator
Breaking New Ground

**William E. Field**
Professor
Purdue University

## Introduction

All-terrain vehicles (ATVs) offer a new sense of freedom to their owners, especially those with mobility impairments. ATVs are designed for year-round use on virtually all ground conditions. Besides use for recreational purposes, they are also an asset to people who must traverse rough terrain in their work, thus making more activities accessible to the disabled. Farmers/ranchers who are physically disabled will find opportunities to pursue outdoor recreation and careers that involve such activities as checking livestock *(Fig. 1)* and fences, and covering otherwise inaccessible territory.

This report will present criteria for the physically disabled to keep in mind when selecting the safest ATV possible for his/her particular situation. In addition to selecting the proper ATV, tips will be given concerning their safe handling and operation.

*Figure 1. ATVs assist physically impaired farmers in many activities around the farm.*

## Terminology

***All-terrain vehicles*** include a very broad range of equipment. They are commonly defined as those vehicles less than 50 inches wide, weighing less than 600 pounds, that are straddled and made for off-road use. ATVs usually ride on three or four low-pressure tires. The definition for this publication will be those machines commonly referred to as "three-wheelers" and "four-wheelers."

***Physically impaired farmers/ranchers*** are agricultural workers who have physical disabilities that either hinder them from completing essential tasks or might eventually force them to prematurely discontinue farming. It is estimated that there are over 560,000 agricultural workers with physical disabilities in the U.S.

## On-Farm Benefits and Uses of ATVs

Farmers/ranchers with disabilities can utilize ATVs on their operations in several ways. ATVs can fill the gap between a pickup truck and wheelchair. Hundreds of acres can be covered in a couple of hours, and areas of the farm that formerly were inaccessible are now accessible. Physically impaired farmers/ranchers can increase their awareness and knowledge of the farming operation. They can keep up-to-date records on the crops or livestock by being able to access these areas of the farm at will. ATVs can help the farmer with a disability become a more productive team member.

ATVs can also be used for pre-plant chemical application, post-emergence chemical application, fertilizer topdressing, snow plowing, mowing, grad-

ing, etc. Many of these jobs need to be done in a timely manner; and getting into the field during adverse soil conditions enables you to complete them as scheduled. Even the wettest fields can often be traversed without leaving wheel tracks *(Fig. 2)*.

*Figure 2. ATV flotation tires enable field work during even wet soil conditions.*

## The Safety issue

"One thing accelerating even faster than the popularity of all-terrain vehicles is their accident rate. In 1985, over 100 people were killed in ATV-related accidents, and another 100,000 were injured" (*Farm Industry News,* January 1986). Information from the Commission's National Electronics Injury Surveillance System (NEISS) indicates that the estimated number of ATV-related injuries treated in hospital emergency rooms jumped from 8,000 in 1982 to 26,900 in 1983; to 63,900 in 1984; and to 85,000 in 1985. Since January 1, 1982, some 415 deaths involving ATVs have been reported to the NEISS. A U.S. Consumer Product Safety Commission (CPSC) survey of ATV-related injuries between May and July 1985 showed that 18 percent of the injured people were children under 16 years of age (*CPSC Alert*, June 1986).

## Consideration in Selecting an ATV for Agricultural Use

The first factor to consider when buying an all-terrain vehicle is intended use. Will it be used for recreation, for farm work, or for both? This report focuses on ATVs intended for agricultural use. Therefore, consider a "workhorse" model rather than a recreational style. The larger, heavier four-wheel ATVs are best suited for jobs on the farm *(Fig. 3)*.

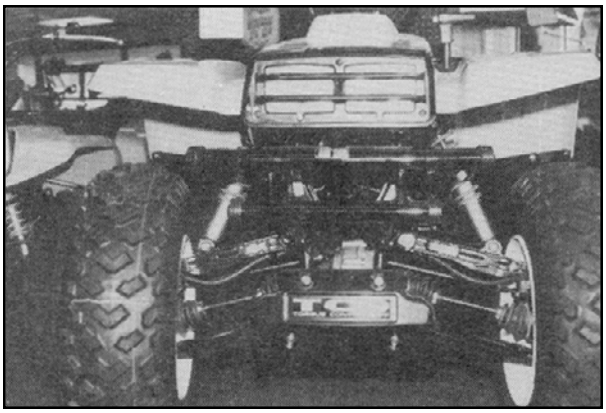
The most important features for physically impaired farmers/ranchers to consider when selecting an ATV for agricultural use are: three- vs. four-wheelers, suspension, power, gear ratio, reverse gear, starters, brakes, seat, machine weight and center of gravity. The following paragraphs will address the importance of each of these mechanical features and how they relate to physically impaired operators.

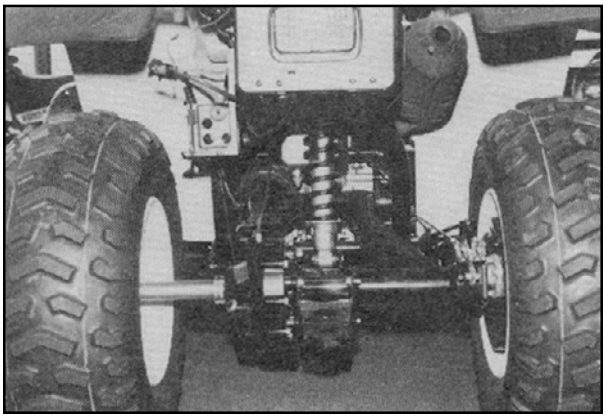
### *Three-Wheeler vs. Four-Wheeler*

The first mechanical feature to consider when looking at ATVs is three vs. four wheels. Four-wheelers have two wheels in front, while three-wheelers have just one. Safety professionals generally recommend four-wheelers for farm work because they are more stable. Also, the four-wheel-drive models offer more traction for towing attachments and doing farm work under adverse conditions. Another advantage of a four-wheeler over a three-wheeler for fieldwork is the ability of a four-wheeler to straddle a row during the early growing stages.

With both rear wheels pulling and a heavy load behind you, steering a three-wheeler becomes difficult in lose or packed ground. The four-wheeler will probably be the best model suitable for any type of fieldwork by farmers/ranchers with a physical disability.

*Figure 3. One of the larger, heavier four-wheelers available on the ATV market.*





*Figures 4 and 5. The complete suspension system necessary for operators with a diability.*

### *The Suspension System*

A study by Dr. Teony Tan, assistant professor of mechanical engineering at Memphis State University, found that ATVs without suspension systems are more likely to pitch, bounce and roll. Three-wheelers with rigid rear axles are very susceptible to side-to-side moving or pitching, and solid forks on the front wheel intensify bounces. Independent suspension on either three- or four-wheelers compensates for uneven terrain and absorbs much of the disturbance. "The safest machines are ones with complete suspension systems for both front and rear wheels," notes Tan in a 1986 *Farm Industry News* article *(Figs 4 and 5)*.

The different types of ATV suspension systems usually include a shock absorber inside a coil spring, shock absorbers by themselves or just a coil spring. The large flotation tires will absorb some of the shock on rough terrain, but to insure a smooth ride, select the best suspension available. This becomes especially important to those operators who cannot use their legs as natural shock absorbers, or who have back problems that could be aggravated by rough rides or machine vibration.

### *Horsepower*

A physically impaired farmer/rancher should select an ATV that has power to spare for the terrain he or she plans to be traveling over. Unlike able-bodied operators, physically impaired operators cannot use speed and momentum to travel uphill or over rough terrain. Physically impaired ATV operators should select a machine that has the power to perform at slow speeds. Most ATVs come equipped with engines in the 125-650 cc range.

### *The Gear Ratio*

Some ATVs are built like racing machines and their gear ratios are unsuited to farm work. "If the ratio is too high, the machine will be all speed; if it's too low, the machine will be all power,'' says Jerry Endrizze, product safety manager for Polaris. "Make sure the gear ratio fits your needs."

When making your decision, consider the ground speeds needed. For example, one of the first farm tasks the ATV performed was seed sowing *(Fig. 6)*. Slow speeds are necessary to sow the appropriate amount of seed per acre, so for this task, a

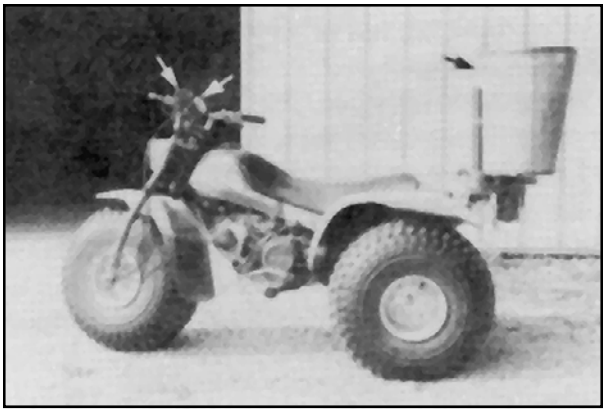


*Figure 6. Grass seed sower mounted on three-wheeler ATV, with speedometer and seeder control switch (arrows).*

wide variety of ground speeds are required. Depending on the model, high and low range gives an additional four or five forward speeds.

### *Reverse*

Many times during the course of riding you need to reverse your direction of travel. Most able-bodied ATV operators can simply put the machine in neutral, get off and push it backwards. This procedure, however, would be difficult for someone with a mobility impairment or who could not tolerate the strain of manually moving the machine around. The simple solution is to select an ATV equipped with reverse, which gives any driver the luxury of backing up without getting off the machine.

### *The Starter*

Most ATVs are equipped with electrical push-button starters and recoil or kick-starters. An electric starter must be in neutral to operate, but it gives you a quick, almost effortless, start. Recoil starters, on the other hand, can be quite difficult for the physically impaired driver. The pulling action required can be a problem for some, especially when the engine is cold. The electric starter is by far the easiest system for starting, but the recoil does have a few advantages. First, the recoil will start your ATV without the transmission being in neutral. Sometimes an ATV has to be rocked back and forth to get it shifted into neutral—a difficult task for someone impaired in their lower limbs. A second advantage is that the recoil starter does not require a battery. If you are out traveling and the electrical system goes down, you still have the recoil starter as a substitute. An option would be to select an ATV that has both a recoil and electric starter.

### *The Brakes*

Front and back brakes with independent controls are recommended. Operators with a disability normally drive with one hand on the shifter and one hand on the throttle. Having independent brake controls insures that the driver will always have a brake control near a hand.

### *The Seat*

One of the last, but not least important features to consider when selecting an ATV for physically impaired operators is the seat. The seat should be well padded to guard against pressure sores, and wide enough to give the needed support for balancing the upper body *(Fig. 7)*. Most ATV seats are a dark all weather vinyl, which means the surface could become very hot when exposed to the sun. To avoid any contact with this hot surface, leading to possible skin burns, always wear appropriate clothing.

### *Weight and Stability*

Choose a vehicle that is appropriately sized for its intended use. For pulling heavy loads, choose a heavier machine. Generally, the center of gravity is lower and the ATV is less likely to flip or roll (*Farm Industry News*, 1986). The unique characteristic of an ATV is that the operator can effectively adjust the center of gravity by moving his body forward or backwards on the seat. By transferring the operator's weight forward, the machine has less chance of flipping backwards when carrying or pulling heavy loads. A good rule of thumb is that the towed load should not be heavier than the towing vehicle, especially if operated on inclines.

## Considerations in Modifying an ATV for Agricultural Use

It is important for a disabled person considering the purchase of an ATV to remember that adaptations must be made to accommodate their individual needs. Many of today's ATVs are already designed so that only minor alterations are necessary. The following section discusses modifications and accessories that will help make physically impaired ATV operators more independent.

### *Shift Lever*

ATVs with multi-speed transmissions are shifted with a foot actuated control, and naturally this is a problem for some physically impaired operators.

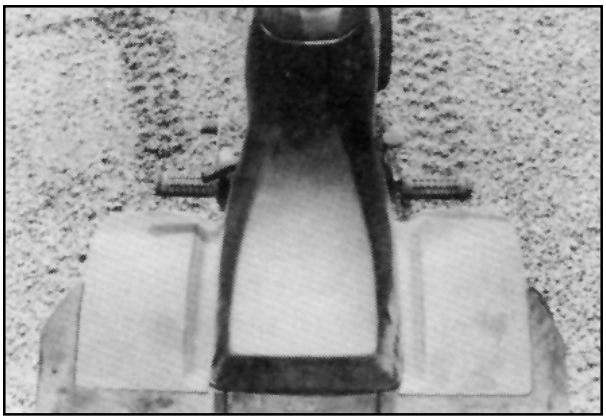


*Figure 7. Top view of seat on one of the many three-wheel ATVs available.*

Adding some type of vertical extension or hand control to the foot shifter *(Fig. 8)* solves this problem. The vertical lever should be mounted close enough to the ATV so it doesn't interfere with transferring, and padded to avoid bruising the leg when riding or transferring. The lever should be retained with an eye bolt or bracket at the top, so the shifting motion will be straight up and down. A shifter that moves back and forth would interfere with leg room on the left side.

### *Handgrips*

Extra handgrip pads can aid persons with limited hand strength. The extra pad increases the diameter of the handgrips, making them easier to grip.

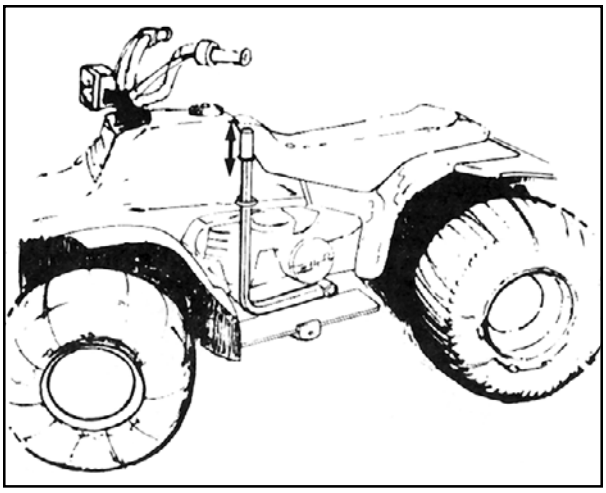


*Figure 8. Hand control with a vertical shifting pattern.*

### *Throttle*

Most ATVs have a thumb-control throttle on the right handle bar. If this is a problem, twist throttle conversion kits are available for some models.

### *Communication*

Some form of communication should accompany the rider while operating an ATV. A CB radio is one method of communication. It can be used to call for help in an emergency situation, or as a management tool during busy times of the year such as harvest and planting. A long whip antenna should be used to increase the transmitting distance. A bright colored flag can be attached to the antenna to make others aware of the rider's location.

### *Fire Extinguisher*

A small dry chemical fire extinguisher mounted on the ATV could be helpful in the case of an emergency. Mobility impaired ATV operators may not be able to get away from a fire fast enough and the mounted fire extinguisher could prevent serious burns, and serious damage to the machine.

### *Backrest*

Some type of backrest is recommended for support while riding and for improved balance while turning the ATV *(Fig. 9)*. A backrest provides good lower back support and also cuts down on fatigue

*Figure 9. Foam rubber backrest with wire basket support.*

and extended back pain. A source of backrests for ATVs has not been identified, but motorcycle backrests can be adapted.

### *Rearview Mirrors*

One feature to consider for your ATV, though not found on most models, is the rear-view mirror. Rearview minors are extremely helpful for physically impaired operators who have trouble looking over their shoulder. Small rearview mirrors used on motorcycles can be adapted to ATVs.

### *Foot Plates*

Foot platforms or baskets *(Fig. 10)* should be used by physically impaired operators, as opposed to the use of normal foot pegs. Normal pegs do not have a large enough surface area to set your feet on and keep them in place. The platforms or baskets are available commercially or could be made locally. They will decrease the chance of a foot slipping off when riding in rough terrain.

## Commercially Available Accessories for ATVs

A number of ATV accessories are commercially available to make your riding safer and more enjoyable, especially for the physically impaired operator. Before an accessory is purchased it should be tested to ensure that it does not interfere with operation or transfer, or create an operator hazard.

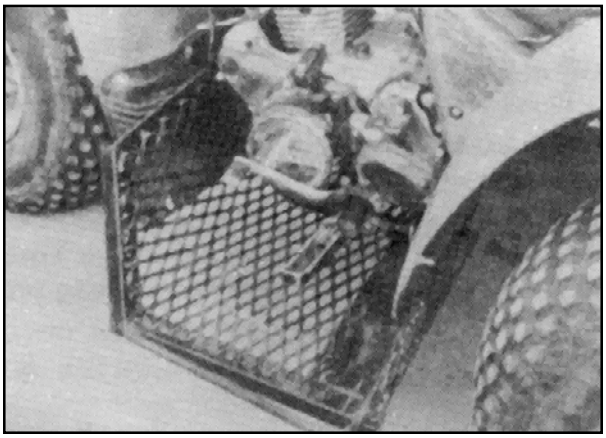


*Figure 10. Safety guard mounted on the belly of a three-wheel ATV.*

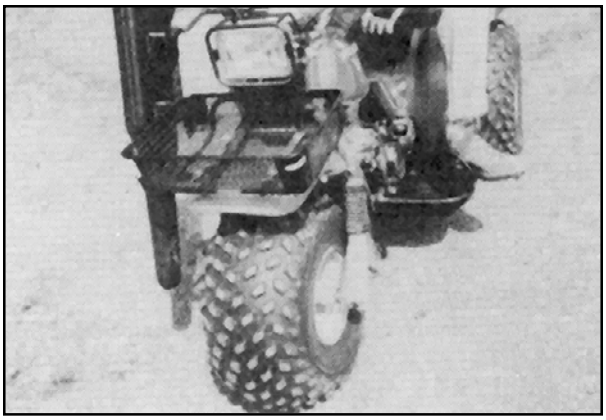


*Figure 11. Front rack with attached basket.*

### *Carrier Racks*

Front and rear carrier racks are available for carrying items while driving. The front carrier rack offers additional accessories such as a refreshment cooler and baskets *(Fig. 11)*. The rear carrier rack is usually designed for heavy duty hauling or carrying tools. Remember to distribute the weight evenly when loading your carrier racks in order to avoid steering or handling problems. The front and rear carrier racks are very helpful features for carrying small items around the farm.

### *Gun Racks*

Gun racks are available to safely carry guns or rifles for hunting. These same racks work very well for carrying crutches or a walking cane. Racks with different mounting positions are available for operator convenience.

### *Other Accessories*

Other accessories to consider for ATVs being used on the farm are: headlight guard, grille, work light, front bumper, mud guards, speedometer, odometer and trailer hitch.

## Safety Factors in ATV Operation

The majority of accidents occur when the ATV collides with an object or overturns (CPSC 1986). It is imperative that every ATV operator understands how to safely operate the machine. The following

sections will discuss the proper attire *(Fig. 12)* and riding practices that will enhance safe ATV use.

### *Helmet*

Always wear an approved protective helmet. The helmet should meet or exceed your state's safety standards and bear the Department of Transportation label, the American National Standards Institute label (ANSIz 90.1) or the Snell Memorial Foundation label (CPSC 1986).

"Your helmet should fit snugly and it should be securely fastened. Full face helmets help to protect your face as well as your head, especially if used in wooded areas. Open face helmets are lighter and cooler and should be used with mouth protection" (*Tips For the ATV Rider—An Adventure in Safety,* Specialty Vehicle Institute of America).

### *Face Shield*

Regular sun glasses do not provide proper protection on an ATV. A face shield or goggles will help protect you. They should be: (1) free from scratches and should bear the standard markings VESC8, (V-8) or z87.1 in one corner, or be constructed of hard coated polycarbonate; (2) securely fastened; (3) well-ventilated to prevent fogging; and (4) tinted for riding on bright days, or clear for night riding, and yellow for overcast days.

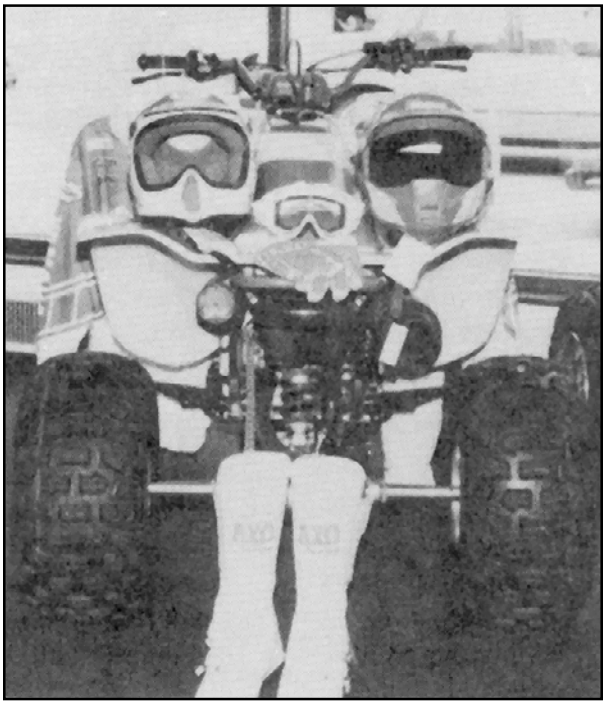


*Figure 12. Safe ATV use includes items such as helmet, gloves, goggles and boots.*

### *Clothing*

Clothing, including sturdy boots, is very important for the physically impaired operator. In particular, a physically impaired operator with paralysis could suffer frostbite or heat burns and not be aware of the injury. The chance of frost bite increases when riding an ATV during the winter months. The cooler temperatures at this time of the year combined with the wind-chill factor can present serious health risks. Conversely, the engine can become extremely hot while riding, and exposed areas of your feet and legs could suffer severe burns. Off-road style motorcycle boots and layered clothing offer the best protection for feet, ankles and legs.

### *Gloves*

Good riding gloves will help prevent hands from getting sore, tired or cold, as well as protect against cuts and blisters. The off-road style gloves available at your local dealers are well padded and made for riding ATVs. The same gloves will protect your hands during very strenuous wheelchair activities.

### *Special Protective Items*

Some special protective items that physically impaired ATV operators might need are a back brace or support and/or a kidney strap. The kidney strap could serve as a back brace and protect you against vibration, which can cause muscle spasms for operators who are affected by paralysis.

### Pre-Ride Inspection

Inspecting the mechanical condition of your ATV before each ride is important to minimize the chance of injury or being stranded, as well as to ensure long-term enjoyment of your ATV. Inspect your ATV every day before you start the engine. The following items found on a typical pre-ride inspec-

tion checklist will only take a few minutes to check and in the long run can save time, expense, and possibly prevent an injury.

- Engine oil level—add if needed; check for leaks.
- Fuel level—fill when necessary; check for leaks.
- Brakes—check condition.
- Tires—check condition and pressure.
- Drive chain—check condition and slack; if necessary adjust and lubricate.
- Throttle—check for smooth opening and closing in all steering positions.
- Headlight—check for proper function.
- Engine stop switch—check for proper function.
- Nuts/bolts/fasteners—check wheels to see that axle nuts are tight and secured by cotter pins; check all other nuts, bolts and fasteners.
- Steering—check that the wheels turn properly as you steer the handlebars.

**Safe Riding Practices**

Many of the routine inspections and procedures learned in rehabilitation apply when riding an ATV.

The riding is strenuous and will increase body temperature, especially in the summer months. Anyone who is paralyzed knows that the body can overheat without being fully aware of it. Be prepared by wearing a cold, damp cloth around your neck.

The opposite also applies when riding during the cooler months of the year. Clothes should be properly layered, and exposure to cold conditions should be limited. Layered clothes should not be tightly fitted because this may restrict circulation.

Pressure reliefs are another aspect of skin care that should be practiced while riding an ATV. Every 10 to 15 minutes the rider should change positions on the seat to relieve pressure.

Extra care should be given to legs and skin while riding an ATV. As you know, your legs are on each side of an engine that becomes very hot. Avoid contact with any part of the engine, especially around your ankles. Once you've got the wheels rolling, be sure to obey the following safe riding practices:

- Know your operators manual.
- Ride with others, never alone.
- Ride within your skills; know your limitations.
- Carry no passengers, especially children.
- Ride off-road only, never on public roads.
- Keep noise levels low; respect the rights of others to enjoy the outdoors.
- Ride straight—no alcohol or drugs.
- Be courteous to all you meet.
- Always supervise youngsters.
- If you need assistance, ask for it; learning by trial and error can be hazardous.

Some farm-related jobs present serious risks to the ATV operator. For example, application of chemicals from the seat of an ATV can expose the operator to harmful pesticides. There are some who suggest that this practice presents an unacceptable risk. Towing loads that exceed the weight of the ATV can also be risky, especially on inclines. Common sense is needed when putting the ATV to work.

**Conclusion and References**

These are only some of the tips you should keep in mind before and after purchasing an ATV. The ideal person to talk with about ATVs is your local dealer. He knows all the angles in selecting an ATV for able-bodied operators, and you know the needs of your disability. Together, a suitable machine can be identified. But always remember — the ATV should not exceed your physical capabilities. Pound for pound, ATVs can be a workhorse on the farm, so selecting the right machine is very critical.

Once the selection of your ATV is made, you are only half finished. Safe operation and training will be your next step. Breaking New Ground suggests you follow the safe operation procedures in this publication, and we recommend that all riders receive proper training on how to ride an ATV. Specialty Vehicle Institute of America offers ATV skill development courses, as well as a practice guide.