PLOWSHARES #23

Breaking New Ground Technical Report

Farming with a Hearing Impairment

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Introduction

The picture many people have of farming is serene—a man and his dog on a sunny day, the only sound a gentle breeze blowing through a tall, golden crop of corn. In reality, farmers are frequently exposed to high levels of noise because of their jobs. Tractors, augers, combines, grain dryers, power tools, chain saws, lawn mowers, snowmobiles—each may produce noise exceeding recommended safe limits. These working conditions can make farmers/ranchers prime targets for a noise-induced hearing loss.

Agricultural producers are also susceptible to other ways of acquiring hearing impairments—traumatic injury, disease, or conditions present at birth.

This publication provides information concerning types of hearing loss most frequently experienced by farmers and ranchers at risk and ways to prevent noise-induced hearing loss. Specific examples of on-farm work strategies and technologies for accommodating a hearing loss are also presented.

Overview of the Problem

An estimated 21 million Americans have some form of hearing impairment.[1] Since approximately 2 percent of Americans are farmers or ranchers,[2] there are probably several hundred thousand who have diagnosed or undiagnosed hearing problems.

According to the National Safety Council, noise ranks as the No. 1 cause of hearing loss, followed by injury and disease. This ranking holds true for farmers/ranchers. A recent study[3] applied a common criterion for determining a hearing impairment to the participants and found the following results:

Not one member of the three non-noise-exposed control groups representing ages 25 to 54 had a clinically significant hearing loss, yet 10 percent of 25 to 34-year-old farmers, 30 percent of 35 to 44-year-old farmers, and 50 percent of 45 to 54-year-old farmers had a hearing impairment. The same study revealed that farm noise exposure, not industrial exposure, is the major cause of noise-induced hearing loss in farmers[3] *(Fig. 1)*.

Research at the National Farm Medicine Center showed that noise-induced hearing damage begins at an early age on the farm: almost 70 percent of teenagers who live and/or work on a farm showed signs of early noise-induced hearing loss.[4] Hearing impairments are a significant concern for farmers and their families. The average age of all farmers is 53.3 years.[2] Impaired hearing can impact communication within the family, hinder social activities, be a barrier to accessing educational and vocational information and present hazards in a busy work place such as the farm.

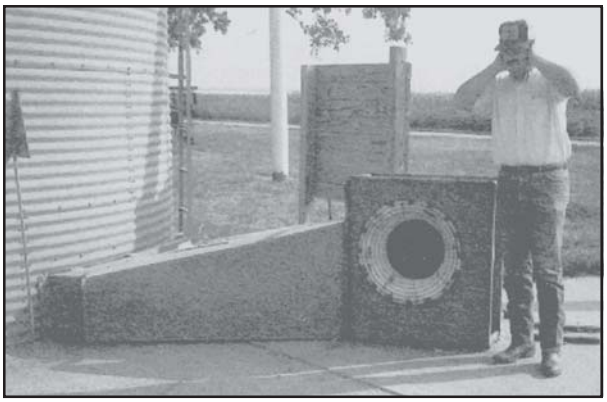

Figure 1. Farms have many noise hazards.

Defintions

Terms for Hearing Disorders

The term ***hearing impairment*** refers to all degrees of hearing and includes the broad terms, *hard-of-hearing* and *deafness*. ***Hard-of-hearing*** implies a specific kind of impairment, the simple loss of sensitivity, either in the ear itself or in the ear nerve.[5] ***Deafness*** refers to the degree or extent of hearing loss. Trouble with a person's hearing may be related to sensitivity to hearing or trouble in the central nervous system rather than the ear. In summary:

- Hearing impairment—the most general term. Includes all hearing disorders.
- Hard-of-hearing—used only to describe an impairment that is caused by the simple loss of sensitivity to sound.
- Deafness—degree of hearing loss, regardless of the cause of the impairment.

Degree of Hearing Loss

One's decree of hearing loss is a quantitative measure of the volume of sound that can still be heard.

1. Slight (25-40 dB)—Difficulty hearing soft or distant speech in church or theater;
2. Mild (40-55 dB)—Difficulty understanding conversational speech in restaurant or group setting;
3. Moderate (55-70 dB)—Difficulty hearing normal levels of speech (at 65 dB);
4. Severe (70-90 dB)—Can't hear loud speech or understand speech on the telephone, but can hear shouted speech; and
5. Profound (greater than 90 dB)—Difficulty hearing even shouted speech.

Types of Hearing Loss

The three major types of hearing loss are conductive, sensorineural, and mixed. ***Conductive hearing loss*** (or mechanical hearing loss) results from disease or obstructions in the outer or middle ear and usually affects all frequencies of hearing. Rarely does one with a conductive hearing loss experience a Severe or Profound loss of hearing. Frequently an individual with this type of loss can he helped medically, surgically, or by using a hearing aid. ***Sensorineural hearing loss*** occurs when the delicate sensor hair cells of the inner ear or the auditory nerve have been damaged. Hearing loss ranges from Mild to Profound. Sounds become distorted only at certain frequencies, so a hearing aid proves to be of little help. With a combination of conductive and sensorineural hearing losses in the same ear, a ***mixed hearing loss*** occurs. This loss includes problems in the outer, middle, and the inner ear.

Sources of Noise

While some individuals are born with deafness or a hearing impairment and others acquire hearing loss through traumatic injury or disease, most farmers' hearing impairments result from noise-induced hearing loss. Because the problem is so widespread, the next three sections will deal exclusively with issues of noise-induced hearing loss.

Prolonged exposure to noise can gradually lead to hearing loss. Major sources of noise on the farm may include machinery, small engines, and power tools. Both large machinery such as tractors and combines and two cycle engines such as lawn mowers and chain saws can damage hearing with repeated exposure.[6] In addition, heaters, generators

Table 1. Decibel levels of common sounds at typical distance from source.

dB	Source
0	Weakest sound
15	Threshold of hearing
30	Whisper
60	Normal conversation
80	Road traffic
85	Inside acoustically insulated protective cab in field
90	Danger level, pneumatic drill
100	Power mower, ATV
105	Tractors, combines
115	Chainsaw
120	Jackhammer
140	Shotgun, jet takeoff

and radios inside the cabs of tractors and combines can emit high noise levels. Table 1 gives a guideline to noise levels of various sources.

The potential for loud noise to cause a hearing loss is dependent on the loudness of the noise and on the amount of time you are exposed to the noise. As the place where you are working gets louder, the amount of time you can safely work there without permanent damage to your hearing gets shorter. Table 2 shows the duration in hours that a person

Table 2. Permissible Noise Exposures

Duration Per Day (Hours)	Sound Level, db
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4	115

can safely be exposed to sound at certain volume levels, based upon guidelines for industrial workers established by the Occupational Safety and Health Administration. Farmers should use these limits as a guide to avoid harmful noise exposure.

One who works longer than these recommended exposure times may feel, "I'm safe as long as I don't have any pain in my ears." However, just because a noise does not cause pain does not mean that it is not harmful. Damage may be incurred before it is diagnosed or before you notice any hearing loss.

Research has shown that farmers have a greater high-frequency sensorineural hearing loss than can be accounted for by aging alone. A repeated pattern of hearing loss in the higher frequencies may show an early stage of hearing loss, particularly noise-induced hearing loss. Much of the hearing loss occurs in the left ear because the left ear is exposed to engine noise when the driver looks over his or her right shoulder during operation and the right ear is shielded by the head shadow.[3,6]

Noise-Induced Hearing Loss Signs

Be alert to a possible hearing loss if any of the following symptoms occur: difficulty hearing, ringing in the ears (hum, roar, or buzz), or dizziness. The following danger signs will occur if the farmer has a hearing loss or is on the brink of developing one.

- It is very difficult to talk to another person while in the operator's position.
- Ears ring or you experience head noises when you get off the tractor after a day's work. The buzzing or ringing remains a few hours after you shut off the engine.
- If after a day's work on the tractor, speech seems to be muffled when others attempt to communicate with you. This loss of hearing disappears in a few hours.

It is recommended that preventive steps be taken before any of these hearing loss symptoms appear.

Prevention of Noise-Induced Hearing Loss

The first step in preventing a noise-induced hearing loss is to identify sources of noise. They may have been taken for granted previously, so investigate thoroughly. Once sources are identified, reduce exposure to high levels of noise in any one of the following three ways:[7,8]

1. Reducing Level of Noise at Its Source

The best method of preventing noise-induced hearing loss is to remove the source or reduce its volume to a safe level. Rarely will it be either possible or feasible to remove the source of noise; so it is important to identify steps that may be taken to reduce its volume. For example:

- Replace worn, loose, or unbalanced machine parts to reduce vibration.
- Lubricate machine parts to reduce noise created by friction.
- If possible, enclose the source in a sealed compartment to reduce noise levels.

- Install a high-quality muffler on all engine-powered equipment to reduce vibration and noise produced by airflow.
- Mount the noise source on rubber blocks or springs to reduce vibrations.

2. Isolating Operator from the Noise Source

If the noise cannot be reduced to a safe level at its source, attempt to isolate the operator from it. An obvious example is a tractor cab. In recent years, farm machinery manufacturers have designed cabs that reduce noise exposure to within safe limits by isolating the operator from noise source *(Fig. 2)*.

3. Wearing Hearing Protection

Hearing protection devices can dramatically reduce the level of noise reaching the ear drum and thus reduce the risk of hearing loss. However, it is best to reduce noise at the source or isolate the operator from it because hearing protection devices can be improperly fitted or used, resulting in damaging levels of noise reaching the ear. Hearing protection devices may also be lost, forgotten, or damaged, again resulting in no protection from harmful noise.

If a farmer must work in an environment with harmful levels of noise, there are many hearing protection devices sold commercially. They fall generally into the categories of ear plugs or earmuffs.

Ear plugs are small, soft inserts placed into the outer ear canal. They must totally block the ear canal with an air tight seal to be effective. Plugs are

Figure 2: The tractor cab is an example of isolating a person from a noise source.

Figure 3: Ear plugs are an efficient means of safeguarding against noise-induced hearing loss.

available in many shapes and sizes to fit individual ear canals and they can be custom made *(Fig. 3)*.

Earmuffs are worn outside the ear, actually covering the entire outer ear. A soft rubber "gasket" is attached to the plastic shell for each ear. This gasket rests against the head to form the air tight seal necessary to be effective. For this reason, most earmuffs will not seal around eyeglasses or long hair. Earmuffs are held in place by an adjustable band, and the tension must be sufficient to hold the earmuffs firmly in place around each ear.

Properly fitted ear plugs or muffs reduce noise 15 to 30 dB. Quality plugs and muffs are approximately equal in sound reduction, although ear plugs are more suited for low frequency noise and earmuffs for high frequency noise. Simultaneous use of ear plugs and muffs usually adds 10 to 15 dB more protection than either used alone. Combined use should be considered when noise exceeds 105 dB.[9]

Ear plugs offer two distinct advantages over ear muffs—(1) they are more comfortable and portable than muffs; and (2) they reduce sound levels without masking the direction from where sounds come. In summertime, muffs can be hot to wear and sweating will harden the muffs' cushions. A hard cushion can cause a poor seal, which diminishes the earmuffs' effectiveness to block damaging sounds.[10]

Accommadating a Hearing Loss

Technology

There is an abundance of technology that attempts to aid communication by persons with hearing loss. Examples of personal, group, and telephone communication are presented below. Technology that assists daily activities is mentioned, as well.

Before considering buying a hearing aid for the first time, consultation with a hearing specialist or a doctor is essential. Hearing aid sales offices will also test your hearing. Most sales staff are reputable, but some will put selling their product above your needs and best interests. Instead, seek recommendations from a certified audiologist or otorhinolaryngologist.

Personal aids. The most common form of technology used to accommodate a hearing impairment is the hearing aid. It is a miniature amplifier, microphone and speaker that is placed into the ear to make sounds louder. As with most technology, options are available.

One option many users appreciate is a telecoil-switch (T-coil or T-switch). With the T-coil off, the hearing aid operates in standard mode, receiving audible sounds through the microphone and amplifying them. When the T-coil is turned on, audible sounds are not amplified but other signals (magnetic induction signals) are. The T-coil eliminates most background noise when used with compatible telephones and devices called neck loops (see following paragraph).

In addition to hearing aids, the following are a few of the many personal aids available. ***Neckloops*** are worn around the neck for use with a hearing aid T-coil. The neckloop has a plug that can connect to the output jack of a personal receiver, a television set, a radio, or other audio instrument. Some ***alarm clocks*** flash a strobe light or vibrate your pillow or bed to signal, "Time to wake up!" ***Phone call signalers*** alert you of an incoming call by flashing a lamp on and off. ***Closed captioning decoders*** print a TV program or videotape's dialogue and sound effects on the TV screen, similar to subtitles

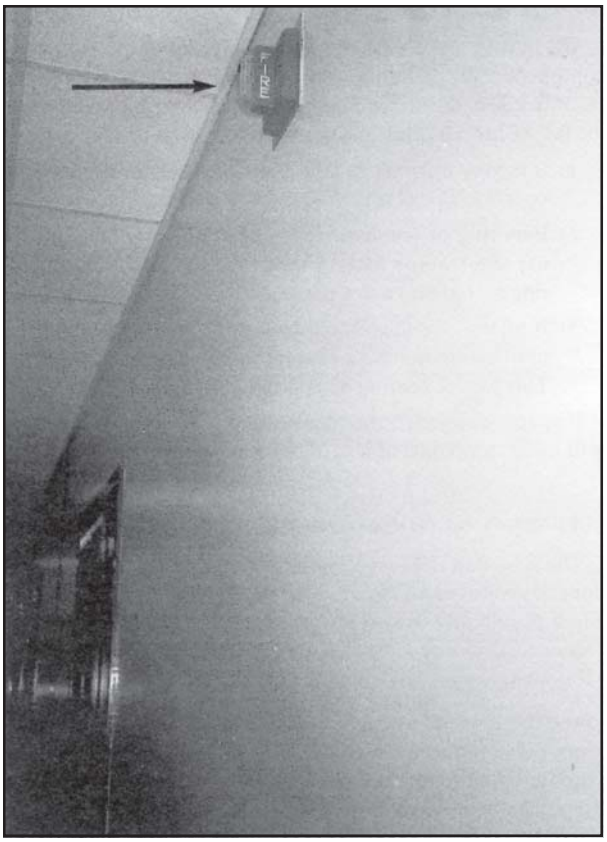

Figure 4: Strobe lights on fire detectors flash when the alarm is activated.

(not all programs or videotapes have closed captions). ***Smoke/ fire detectors*** are available that flash a strobe light when activated *(Fig. 4)*. ***Portable computers*** can serve as a communication aid by typing messages on the screen.

Large Area Listening Systems. Being part of a listening audience can make communication more difficult for someone with a hearing impairment. Technology is available that helps to improve communication between a speaker and the audience.

Two types of systems are in common use. The first uses frequency modulated (FM) radio signals that are broadcast throughout the room and the second uses invisible, infrared light (like some TV remote controls) to transmit the signals through the listening audience. With either system, listeners use a receiver and ear phone to hear the message directly with reduced background noise. See Table 3 *(next page)* for a comparison of infrared (IR) and FM systems.

Table 3. Comparison of FM and Infrared (IR) Systems		
System Function	**FM**	**IR**
Transmitter uses existing sound system for signal, or preamplifier and microphone may be purchased.	**X**	**X**
No limit to number of receivers in use at same time.	**X**	**X**
Receivers allow listener to adjust volume to meet his/her own need.	**X**	**X**
Can be used outdoors.	**X**	
Can be used in adjacent rooms simultaneously.		**X**
Subject to radio frequency (RF) interference.	**X**	
User must face transmitter.		**X**

Large area listening systems are being used in places of worship, in classrooms and lecture halls as well as in theaters, auditoriums and cinemas. Many facilities have receivers available for loan during performances.

These systems can fulfill the Americans with Disabilities Act (ADA) accessibility requirements for hearing assistance. IR and FM systems may be purchased through local dealers or through catalog vendors *(see last page for limited vendor list)*.

Telephone Aids. The telephone plays an important role in most of our lives by allowing quick communication over long distances. Because of its importance, there are many products that make the telephone easier to use by individuals with a hearing impairment.

Telephone amplifiers are portable, battery-operated units that quickly attach to any phone earpiece to increase listening volume. ***Amplified handsets*** have adjustable volume, and directly replace the old phone handset. ***Telephones with built-in amplifiers*** may be purchased that increase volume 15 to 20 dB.

Individuals who are deaf or have speech impairments can still use telephone lines to communicate. Instead of talking, they type messages using a device called a text telephone (TT). Each party must have a TT in order to communicate *(Fig. 5)*.

The ADA now requires all states to have a telephone relay service to allow communication between one party that has a TT and one that does not. As of July 26, 1993, every state should have had a telephone relay service operating. If you would like to obtain the telephone number for the relay service in your state, call the operator or your telephone company.

Public telephones now frequently have a button to adjust the listening volume. If a pay phone you use regularly does not have volume control, you may wish to call the telephone company to request one. Note: Any pay phone with a blue grommet on the handset where the cord attaches is hearing aid T-coil compatible.

Other Aids. There are also many strategies for coping with hearing loss that do not involve technology. These include speech reading, sign language, use of interpreters, hearing dogs, even paper and pencil.

One increasingly popular aid for individuals with deafness is the "hearing ear dog." These work animals are trained to perform tasks such as alerting the owner when the doorbell sounds, the telephone rings, or the oven timer goes off.

Work Strategies for the Farm

Farmers who have a hearing impairment will need more than technology to accommodate their loss of hearing. They will also need to develop accommodating work strategies for the farm.

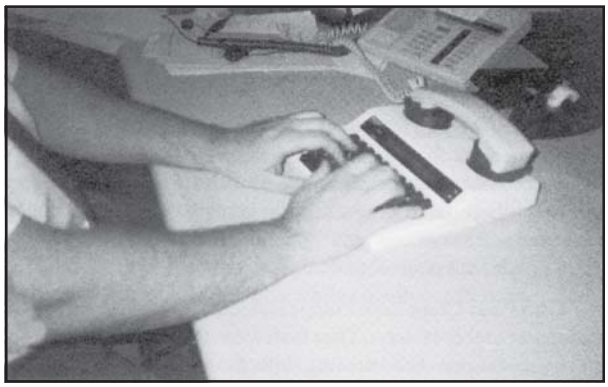

Figure 5: Individuals with speech impairments can also use text telephones (also known as TTYs or TDDs) to communicate by telephone.

When working with others on or around farm equipment, a farmer with a hearing impairment is encouraged to use a clearly defined set of hand signals for safe, efficient, unambiguous communication. The American Society of Agricultural Engineers developed a set of hand signals[6] to be used around high-sound-level farm equipment that should be suitable for use by most farmers with hearing impairments. Wherever audible alarms are used on the farm, visual alarms should be installed as well. This will warn an operator who may not hear the alarm.

Farmers who wear hearing aids may find communication difficult inside farm buildings constructed with sheet-metal roofs and siding. Metal surfaces tend to reflect background noises that are then amplified by the hearing aid, making the noise more likely to "cover up" any intended message. Adding sound-absorbing materials to the inside surfaces of metal buildings may reduce the amount of background noise amplified by the hearing aid and result in clearer communication while inside those buildings. Fibrous and porous materials such as mineral fibers, glass fibers, and open-cell foams have good sound-absorbing qualities.[11]

Farms often have a great deal of "traffic" as automobiles, tractors and other equipment are moved from one point to the next. For safety, a farmer with a hearing loss must learn to always look before crossing any road or vehicle path on the farm.

Case Studies

Adam Jones (Indiana)

Adam Jones *(not his real name)*, 28, operates a cash grain farm and raises swine and sheep. Adam has operated chain saws and farm tractors for several years. After two years with difficulty in hearing, Adam was diagnosed in 1982 as having a noise-induced hearing impairment that resulted in a mild hearing loss. He lost 40 percent of his hearing in one ear and 30-35 percent of his hearing in the other ear. Adam continues to operate farm tractors and other equipment, but now wears earplugs and/or earmuffs to protect the remainder of his hearing. He no longer hunts because of his feeling that firing a gun will further injure his hearing.

Background noise from crowds makes hearing more difficult for Adam. His hearing aid amplifies the background noise and makes speech more difficult to understand. Adam has also compensated for his hearing loss by learning lip-reading.

In his job, Adam receives and makes many telephone calls. He conceived a clever idea to keep his hearing aids from "squealing" over the phone. He places a Styrofoam pad over the receiver in order to more clearly understand the caller and prevent the caller from being interrupted by the squeal.

Adam recommends hearing protection. He advises others to wear earplugs and/or earmuffs as much as possible when working around small engines, machinery, and when hunting. He emphasizes, too, that a communication system between farmer and co-worker is essential to effective farming.

Robert Schendel (Wisconsin)

Bob Schendel, a 47-year-old dairy farmer, has four children. He has had a hearing loss since he was a little child and now wears a cochlear implant. His hearing was degenerative to the point that he could not even hear a forage chopper run. He tried hearing aids before the cochlear implant, but without satisfactory results.

The cochlear implant is the only adaptation Bob has made. He does not wear the implant when he milks because he doesn't want to get the microphone dirty from feed dust. He doesn't wear it driving tractors either because the turbochargers' noise bothers his ears. The word processor box that he wears in his shirt pocket cost more than $5,000. "You don't want to ruin it," says Bob. He advises other farmers "to wear ear plugs when running noisy equipment no matter how uncomfortable it may be. If they ever had a hearing problem and lived with it for 45 years, they would take my advice."

Steve Hawkins (Indiana)

Steve Hawkins, who has a severe hearing loss, works in the Agronomy Department at Purdue University where he does plot work and research. He also farms with his father, mainly producing hay.

Steve worked during his teen years with lawn mowers and farmed with noisy equipment. He wore cotton in his ears to protect him from the noise. Cotton does not work, however. Now he uses earplugs or muffs *(Fig. 6)*. There are a number of things Steve does to help him in his work as well as at home. He wears a hearing aid in his right ear but not his left because he cannot talk on the phone because of background noise and feedback.

Steve uses a combination of planning and hand signals in order to communicate with his father on the farm and with his co-workers. He plans what is going to happen so there is not a mix-up or misunderstanding which in turn can cause an injury.

When Steve attends a meeting or convention he lets people know he has a hearing problem which saves inconvenience and embarrassment. He suggests that meeting organizers consider that someone attending may have a hearing loss, so they should prepare for such participation.

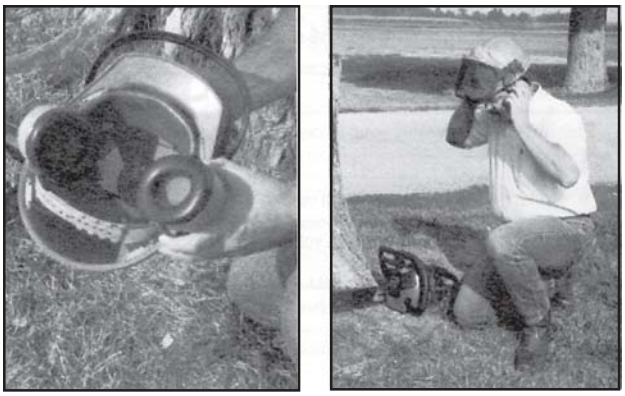

Figure 6: Steve demonstrates wearing a hard hat fitted with ear muffs for hearing protection which he wears when using a chainsaw.

Steve uses a light system in his home which warns him if someone is at the door or the phone rings. Steve capitalizes on the visual aspects of communication as well as vibrations or tapping.

"No piece of equipment is too small not to cause a problem," says Steve. In other words, do not let the small engines fool you. They make as much noise or more than full-size auto or tractor engines.

Chris and Craig Bell (Indiana)

Chris and Craig Bell are ages 8 and 13, respectively. The boys and their older brother help their parents raise grain (corn) and beef cattle. Craig assists his father and older brother in herding the beef cattle and mowing the lawn. Chris helps with barn chores. The boys enjoy spending much time in the woods and are members of 4-H.

Chris and Craig both have severe hearing losses. They were born with hearing impairments, although Craig's hearing loss was not diagnosed until he was four. He was initially diagnosed with a mild hearing loss that gradually worsened and has since stabilized. Chris's hearing loss registers at 105 dB, which is equivalent to maintaining 5 percent of his hearing.

Chris and Craig have compensated for their hearing losses through a number of ways. They both wear hearing aids in each ear and try to sharpen their listening skills through methods taught to them by their school teachers and parents. The boys lipread and use sign language, but they try to concentrate on listening.

Getting the boys' attention presents quite a challenge for everyone, especially their parents. The Bell family has developed its own system of communication and strives to improve communication as the boys grow older. Chris and Craig wear their hearing aids at full volume most of the time in order to hear; but Mrs. Bell still has trouble getting the boys' attention in the barn, for instance, because of the echo from the metal pole barn.

The boys' hearing aids do squeal, but rarely so. To use the telephone at home, both can use a speaker to talk with other people, instead of placing the telephone receiver against their hearing aids and interrupting the caller with the squealing. The speaker has worked very well for the boys and their family.

Everybody in the Bell family constantly looks out for one another to assure themselves of the boys' whereabouts. No one wants to experience any farm accidents or "close calls" due to the boys' hearing impairment.

The family constantly seeks to improve communication on the farm. They notified the town highway department to install two "deaf child area" road signs to alert motorists. To further improve communication, the Bells are now investigating various communication systems to notify the boys and get their attention. They may invest in a simple FM system of two-way radios so that everyone can better communicate with one another.

Matt Getts (Indiana)

Matt, 23, a Purdue graduate and one of the co-authors of this article, was diagnosed with a hearing loss when he started school at age 6. Matt helps his parents manage their dairy herd. As a 4-H member for 10 years, he showed dairy steers, dairy goats, and swine. Matt wears hearing aids in each ear and uses an amplifier on the telephone.

The biggest problem Matt encounters is trying to hear people while in large crowds. The background noise floods the sounds he wants to hear. Matt tells the person(s) with whom he is talking to speak louder or go with him to a quieter place to talk.

While on the farm, Matt only had problems when around loud equipment. He could not tell if the machinery was running properly or not. He also could not hear people with whom he was working while operating equipment. He alleviated these problems by planning his activities and communicating his needs to his co-workers or family members prior to starting the equipment.

Conclusion

Farmers and ranchers work in conditions that frequently expose them to high noise levels. Their risk of sustaining a noise-induced hearing loss can be reduced or prevented by first identifying sources of loud noise, then by taking steps to reduce exposure to those sources. If a hearing loss occurs, appropriate technology and on-farm work strategies may be employed to accommodate the hearing loss while continuing to farm.

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Organizations and Vendors For Persons with Hearing Impairments

Organizations

Paws to Listen, Incorporated.
Roberta Bishop
P.O. Box 2941
South Bend, IN 46680
219-287-4273 (Voice)
800-743-3333 (TT)

International Hearing Dog, Incorporated
5901 E. 89th Avenue
Henderson, CO 80640
303-287-3277 (Voice)
800-659-3656 (TT)

Self-Help for Hard of Hearing People, Inc.
7910 Woodmont Avenue, Suite 1200
Bethesda, MD 20814
301-657-2248 (Voice)
301-657-2249 (TT)

National Captioning Institute
5203 Leesburg Pike
Falls Church, VA 22041
800-533-9673 (Voice)
800-321-8337 (TT)

National Easter Seal Society
70 East Lake Street
Chicago, IL 60601
312-726-6200 (Voice)
312-726-4258 (TT)
312-726-1494 (FAX)

National Hearing Aid Society
20361 Middlebelt Road
Livonia,MI 48152
(800) 521-5247 (Voice) No TT

National Information Center on Deafness
Gallaudet University
800 Florida Avenue, NE
Washington, DC 20002
202-651-5051 (Voice)
202-651-5052 (TT)

Vendors

HARC Mercantile, Limited
P.O. Box 3055
Kalamazoo, MI 49003-3055
800-445-9968 (Voice)
616-381-2219 (TT)

Harris Communications
6541 City West Parkway
Eden Prairie, MN 55344-3248
800-825-6758 (Voice)
800-825-9187 (TT)

Ultratec
450 Science Drive
Madison, WI
800-482-2424 (V/TT)

Williams Sound Corp.
10399 West 70th Street
Eden Prairie, MN 55344-3459
800-328-6190 (V/TT)
612-943-2252 (V/TT)

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