Applied Occupational and Environmental Hygiene

ISSN: 1047-322X (Print) 1521-0898 (Online) Journal homepage: https://www.tandfonline.com/loi/uaoh20

Case Studies

Real-Time Video Monitoring of Noise in Agriculture: An Evaluation and Education Tool

Dawn Tharr Column Editor , H. L. Venable , M. G. Gressel & R. L. Tubbs

To cite this article: Dawn Tharr Column Editor , H. L. Venable , M. G. Gressel & R. L. Tubbs (1994) Case Studies, Applied Occupational and Environmental Hygiene, 9:8, 525-528, DOI: 10.1080/1047322X.1994.10388364

To link to this article: https://doi.org/10.1080/1047322X.1994.10388364

Case Studies

Real-Time Video Monitoring of Noise in Agriculture: An Evaluation and Education Tool

Dawn Tharr, Column Editor

Report by H.L. Venable, M.G. Gressel, and R.L. Tubbs

Introduction

This article describes the use of a video monitoring technique for the real-time assessment of noise in an agricultural workplace. In the evaluation, noise levels were monitored by equipping a farm worker with a sound level meter and a data logger while the work activity was simultaneously video taped. A final edit of the video tape superimposed a graphic representation of the noise exposure, a moving vertical bar, on the side of the video screen to display the audio and video correlation of the noise exposure to the work activity.

Three different farm operations are presented to demonstrate the usefulness of the technique in identifying and quantitating activities that contribute most to the worker's exposure to noise. In addition to providing detailed documentation of noise exposure in the workplace, the combined video recordings have valuable potential for training and educating workers.

Background

Studies have shown that farmers suffer a higher incidence of noise-induced hearing loss than other occupational groups.[1-5] Based on calculated annual exposure to noise, one report estimated that between 6 and 18 percent of all farm employees have a strong likelihood of incurring a handicapping hearing loss by the end of their working lives.[2]

Sources of noise in the agricultural environment are diverse and include both mechanized and nonmechanized sources. Much of the noise is generated by internal combustion engines that serve as power sources for various farming operations, with tractors and other self-propelled machines producing the majority of noise measured at levels near or above 90 decibels (dB).[2,5] Nonmechanized sources of excessive noise exposure include noise levels encountered in animal confinement operations and maintenance activities.[3]

Occupational noise exposure to farm workers is difficult to assess for a number of reasons. Variability in noise-generating farm equipment and variations in the frequency and duration of work practices involving noise exposure are some of the factors contributing to the difficulty. Changes in the farmer's position while operating a piece of equipment or performing an operation also adds variability to the noise exposure.[6] Seasonal variation of these work practices is also an important factor in the difficulty of assessing exposure.[2]

To address some of these difficulties, a video monitoring technique was used to make noise assessments of selected farming activities. By using both the video equipment and direct-reading instruments, the video monitoring technique provided a thorough characterization of the farm worker's job duties and allowed a determination of the activities which contribute most to the farmer's exposure to noise. In addition to providing noise exposure data, the video monitoring technique can provide documentation on the diverse activities and conditions of exposure present in the agricultural workplace.

Methods

The site for this evaluation was a cash-grain farming operation located in the Cincinnati, Ohio, area. The specific operations monitored were mowing with a tractor and brush hog (Figure 1), the construction of a grain storage

FIGURE 1. Mowing with a tractor and bush hog.

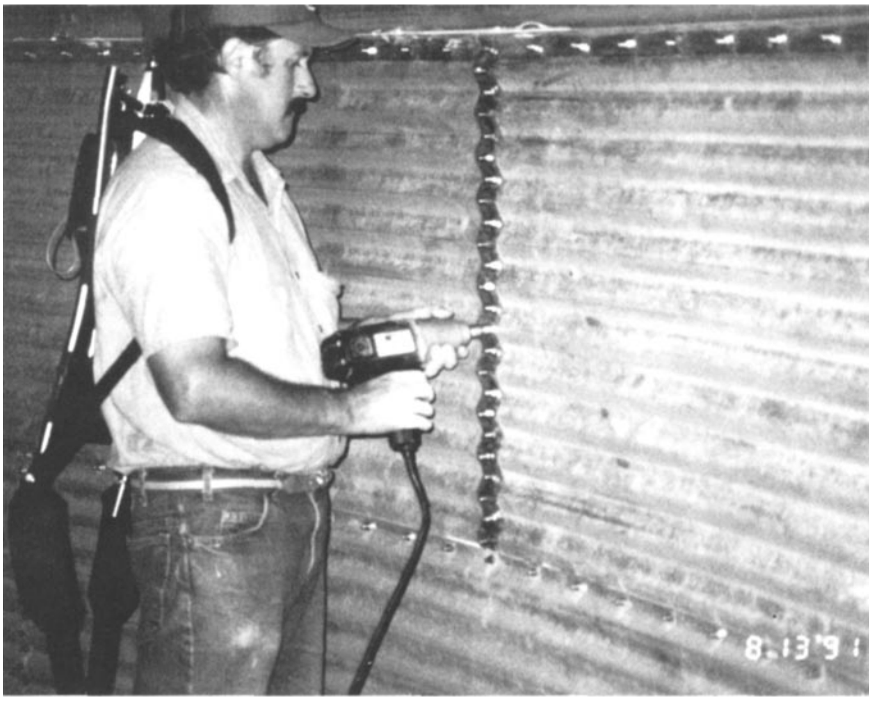


FIGURE 2. Construction of a grain storage bin using power hand tools.

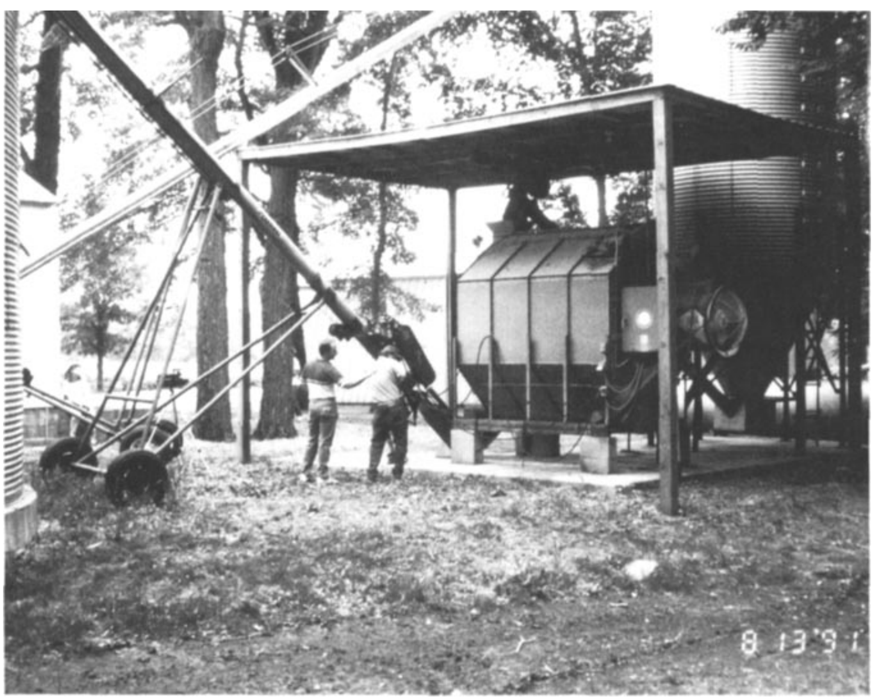
bin using power hand tools (Figure 2), and a grain drying operation (Figure 3). For this project, the video monitoring period was arbitrarily set at a maximum of 30 minutes. It was expected that a representative sample of noise exposure for each operation could be collected during this period of time. A brief description of equipment and procedures required for conducting real-time video monitoring is provided here. A more detailed description is presented elsewhere.[7]

A Quest Type I sound level meter, model number 1700 (Quest Electronics, Oconomowoc, Wisconsin) set to the "A" scale was used to measure sound levels. A data logger (Rustrak Ranger, Gulten Inc., E. Greenwhich, Rhode Island) was used to store the data from the analog signal output of the sound level meter. Both instruments were attached to a backpack frame which was then placed on the farmer (Figure 4). The sound level meter was positioned on the backpack frame as close as possible to the right ear of the farm operator, with the microphone approximately 10 inches from the ear.

A video camera, mounted on a tripod, was used to video tape the activities of the farmer. The video camera was at a fixed position approximately 15 to 30 feet from the farm operator. The clock on the camera was synchronized with the clock on the data logger to allow for a second-by-second association between the activities of the worker and the noise exposures.

At the end of the sampling period, data recorded on the data logger were transferred to a portable computer imported into a spreadsheet. The spreadsheet program was used to manipulate the data and calculate descriptive statistics. The spreadsheet was also used to key associated activities into the exposure data set. Following data analysis, the exposure data were displayed on the video recording of the worker's activities to produce a single video recording showing the noise exposure for each farm activity. The exposure data were represented by a bar placed on the right-hand side of the video showing the worker's activities; the bar moved up and down, indicating the farm operator's relative noise exposure.

FIGURE 3. Grain drying operation.



Results

The average noise exposure measured for the mowing operation was 85 dBA (Table I). Sound levels ranged from a low of 57 dBA when the tractor was in an idle mode to a high of 91 dBA when fully engaged. Little fluctuation in noise levels was observed, even when raising and lowering the mower deck in conjunction with turning. The tractor used for this operation was not equipped with an enclosed operator's cab. As a result, the farmer would be exposed to a fairly consistent noise level (85 dBA) as long as he was operating the tractor. Over an 8-hour workday, the average sound levels measured would be at the threshold limit value (TLV) of 85 dBA established by The American Conference of Governmental Industrial Hygienists (ACGIH). The need for hearing protection, therefore, would be dependent on the amount of time spent on this task.

The sound levels measured during the construction of the grain storage bin ranged from 60 dBA to 98 dBA with an average of 80 dBA. The major source of the noise was the operation of an electric wrench. This activity was performed while inside the grain bin, thus creating a reverberating chamber for the noise.

In this situation, the average sound level recorded was not a good indicator of overall risk of overexposure. Whenever the wrench was in use, sound levels ranged from 95 to 97 dBA. The TLV states that duration of exposure at 95 dBA should not exceed 2 hours, regardless of whether the exposure is continuous or a number of short-term exposures. The actual time spent using the power wrench for construction of the storage bin would definitely exceed this 2-hour limit over an 8-hour workday. However, the measured average exposure of 80 dBA would not

FIGURE 4. Backpack frame holding sound level meter and data logger.

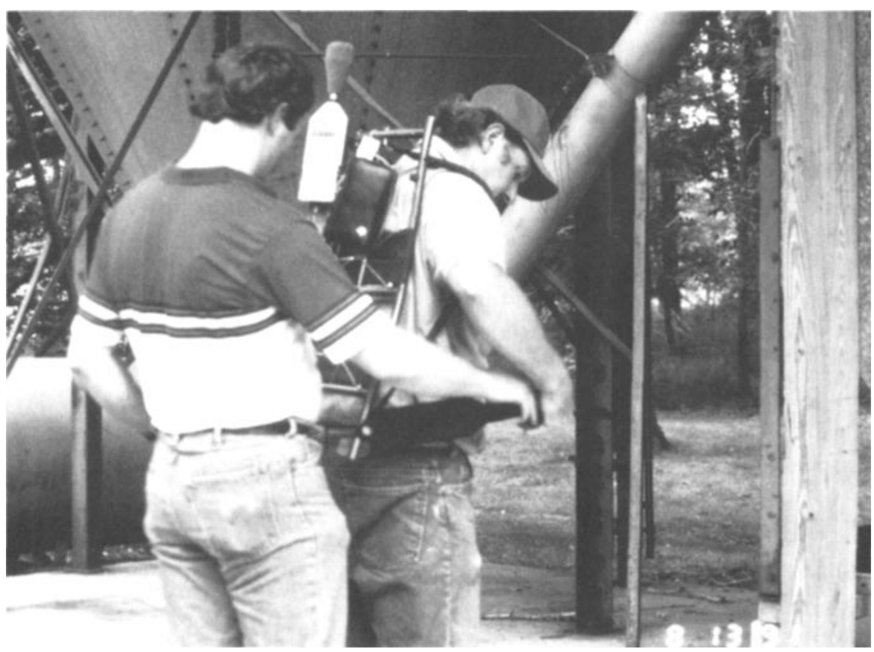


TABLE I. Range of Noise Levels Recorded for Selected Farm Work Activities[A]

	Range of Noise Levels Recorded[B]		
Activity Monitored	**Minimum**	**Average**	**Maximum**
Mowing with tractor and brush hog	57	85	91
Construction of grain storage bin	60	80	98
Operating a grain dryer	76	96	106

[A]Length of time for recording varied but was no longer than 30 minutes for any one activity.
[B]Root mean square expressed in dBA.

have indicated a need for hearing protection.

The average noise level recorded during the operation of the grain dryer was 96 dBA. Levels ranged from a low of 76 dBA when the operator was the greatest distance from the dryer to a high of 106 dBA when he was positioned next to the burner and fan unit during inspection and maintenance activities. Although sound levels varied by location around the dryer, analyses of the work activities and associated noise exposure suggest it would be prudent for the farm operator to wear hearing protection at all times in this work location.

Discussion

Real-time video monitoring can provide detailed information in assessing noise exposures in agricultural settings. In addition, the information collected can be used for training and educational purposes. For example, the video tapes could be used in course development in training programs such as those used for training industrial hygienists or safety engineers who are frequently unfamiliar with agricultural activities. These video tapes might also be used by equipment manufacturers in the validation and design of prevention strategies in reducing equipment noise. Most important, these video tapes could be used to alert and educate the farm population about hazardous exposures to noise. Educating the farm population may be particularly challenging in that farm workers experience a greater degree of autonomy in their day-to-day work activities than workers in other occupations. Consequently, they may be less aware of or receptive to the need for training and education in occupational safety and health.

Graphic presentation of information through the use of a video tape might be more effective in providing training and education to farmers who may not be inclined to read and/or understand complex data presented in charts and graphs. Greater relevance could be achieved by presenting hazardous noise exposures in the context of real farmers using identifiable farm equipment and performing recognizable farm activities. This could result in a more effective transfer of information to the population at risk.

Rosen and Anderson[(8)] reported that films generated in the assessment of solvent exposure in the screen printing process were shown to employees and supervisors of screen printing plants. The film presentation was followed by enthusiastic question and discussion sessions that "often resulted in improvements to exhaust equipment and changes in work routines which led to a drop in exposure to solvent."[(8)] The authors further stated that the use of the film (video tape) "achieved results which would not have been obtained by ordinary means . . . because the film provided insight into the causes of problems and knowledge of appropriate countermeasures."

Exposure to noise continues to be a hazard on the farm. The equipment and methods used in this study could be improved and refined to provide a more accurate and useful product in both evaluating and educating the farm population about exposure to hazardous noise.

References

1. Gregg, J.B.: Noise Injuries to Farmers. Agric. Eng., pp. 12–15 (March 1972).
2. Sullivan, N.W.; Schneider, R.D.; Von Bargen, K.: Noise Exposure Patterns of Agricultural Employees. Professional Safety, pp. 16–21 (December 1981).
3. Plakke, B.L.: Noise in Agriculture and Its Effect on Hearing. Hearing Instruments 41(10):22–24 (1990).
4. Splinter, W.E.; Mumgaard, G.W.; Steinbruegge, G.W.; et al.: Sound Level Test of Agricultural Tractors. In: Nebraska Tractor Test Laboratory Report, 2147–2151. Presented at the 1972 National Combined Farm, Construction, and Industrial Machinery and Powerplant Meeting (1972).
5. Suggs, C.C.: Noise Characteristics of Field Equipment. Presented at the December 1987 International Winter Meeting of the American Society of Agricultural Engineers (1987).
6. Jones, H.H.; Oser, J.L.: Farm Equipment Noise Exposure Levels. Am. Ind. Hyg. Assoc. J. 29:146–151 (1968).
7. National Institute for Occupational Safety and Health: Analyzing Workplace Exposures Using Direct Reading Instruments and Video Exposure Monitoring Techniques. M.G. Gressel and W.A. Heitbrink, Eds. DHHS (NIOSH) Pub. No. 92-104. NIOSH, Cincinnati, OH (1992).
8. Rosen, F.; Andersson, I.: Video Filming and Pollution Measurement as a Teaching Aid in Reducing Exposure to Airborne Pollutants. Ann. Occup. Hyg. III:1–10 (1992).

Editorial Note: Herb Venable and Randy Tubbs are with the Division of Surveillance, Hazard Evaluations and Field Studies, and Michael Gressel is with the Division of Physical Sciences and Engineering of NIOSH.