Amish Water Quality and Nutrient Management Education

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Biographical Sketch
James (Jim) Hoorman is a Water Quality Extension Agent for the Ohio State University Extension in Kenton, Ohio. Jim has received a B.S. in Animal Science (84), a M.S. in Ag. Economics (87), and a M.A. in Business (87) all from the Ohio State University. He has worked with the Amish since 1997 on water quality and nutrient management issues with funds from three United States Department of Agriculture - Cooperative State Research, Education, and Extension Service (USDA-CSREES) grants.

Abstract
The Amish are a religious group who live on small eighty to hundred acre diversified livestock farms. Water quality and nutrient management problems occur on many Amish farms. Problems include misapplication of manure, fertilizer and pesticides, over-grazing pastures, livestock in streams, stream bank erosion, and contaminated wells.

With a USDA-CSREES grant, the Ohio State University (OSU) Extension began educating the Amish on Best Management Practices (BMP's). The five major objectives were: 1) to use soil and manure testing to develop nutrient management plans, 2) show efficient manure utilization with demonstration plots, 3) to educate 240 Amish families on BMP's, 4) test for contaminated wells, and 5) conduct stream monitoring.

The results were that a hundred Amish nutrient management plans (1000 soil samples, 7,500 acres sampled) were completed. Twenty-three replicated manure test plots were used to teach efficient manure management. Three calibration clinics resulted in ten sprayers, twenty-three planters, and ten manure spreader being calibrated. Management Intensive Grazing (MIG) concepts were taught with seventeen (94%) of eighteen dairy farmers using MIG in one community and ten thousand feet of fencing being constructed to exclude livestock from local streams. Well water testing on 191 Amish wells was conducted with 75 (39.3%) testing positive for total coliform bacteria and 17 (8.9%) positive for E.Coli.. Stream monitoring on six streams at fourteen sites discovered high phosphorous levels and low biological activity in streams without livestock exclusion. Outcomes included gain in knowledge, change in attitudes, and 75% to 90% adoption rates for selected BMP's.

Introduction: Amish Culture and Farming Practices
Approximately 70 percent of the Amish live in three states: Ohio, Pennsylvania, and Indiana. The Holmes/Wayne County, Ohio Amish settlement is the largest in the world followed by Lancaster County, Pennsylvania and Elkhart/LaGrange County, Indiana. There are numerous smaller Amish communities throughout the Midwest, including new settlements in Wisconsin, Illinois, and Missouri. Each decade the Amish population has increased by 30 to 48 percent. The current Amish and Anabaptist population is estimated to number over 850,000. This Agent is working with three distinct Amish communities in Ohio. About 140 families of Old Order Amish live around Mt. Victory, Ohio. Forty Old Order Amish families recently settled at DeGraff, and about 70 families of New Order Amish live in Belle Center, Ohio.

Old Order Amish are very conservative and do all their farm work with horses. New Order Amish are more progressive and use milking machines, telephones, stationary tractors and limited modern technology. Most Old Order Amish farms range in size from 80 to 100 acres and are milking 6-15 cows, raising 5-20 sows with litters, using 6-8 draft horses and 2-4 standard horses for transportation. New Order Amish have slightly larger farms and most are dairy farms with 25 to 50 cows. The Amish use a crop rotation of corn, oats, hay, and pasture and apply all their manure to their fields for fertilizer. Most Amish farmers purchase very little commercial fertilizer and they use small amounts of herbicides. They prefer to use natural or organic fertilizers. Typical Amish corn yields are 80 to 100-bushel per year compared to 120 to 150-bushel for their "English≅ counterparts. Reduced corn yields can be accounted for by wide rows, reduced corn populations, poor weed control, and low fertility due to inadequate nutrient management.

Major Problems Observed on Amish Farms
The major problems found on Amish farms include a lack of knowledge, misapplication of manure, fertilizer, and pesticides, over-grazing permanent pastures, livestock in streams, stream bank erosion, and contaminated wells. With only an eighth grade education and a rigid cultural tradition, most Amish farmers have a very limited knowledge of nutrient management and BMP=s.

The lack of understanding of nutrient management is an educational problem on Amish farms in North Central Ohio. Nitrogen levels are generally good for first year corn but too low for second year corn. Fields close to the barn tend to be high in nutrients while fields further away tend to be lower in nutrients, since it is more difficult to haul manure to those fields. If commercial fertilizer is used, it is usually applied at low rates and is commonly an organic-based fertilizer with low nutrient analysis. Lime applications are often excessive since the Amish liberally use water treatment lime from local municipal water treatment plants which is generally free except for the hauling. The Amish use only a limited amount of pesticides and often one sprayer is shared by several families. Most Amish sprayers have never been calibrated.

Most pastures are over-grazed and stream bank erosion is a problem. Horses, cattle, and hogs graze large permanent pastures, often with a stream for water. Without rotation and rest, pastures quickly become over-grazed. During the summer months, the livestock tend to stay close to the stream causing stream bank degradation. Permanent pastures tend to be high in manure nutrients.

Amish water wells are often poorly maintained and constructed. Springs are often used to cool farm produce. Total coliform bacteria and E. Coli contamination in the drinking water have been identified as problems. Old well casings, shallow wells, well pits with poor drainage, well casings without caps, human sewage from outhouses and manure runoff have been identified as water quality problems on Amish farms.

USDA-CSREES Water Quality Grant Objectives
With nutrient management and water quality problems identified on Amish farms, additional funding was sought to address these problems. Two USDA-CSREES water quality grants called "Promoting Best Management Practices in Northwest Central Ohio Amish Communities≅ and "Promoting Best Management Practices and

Nutrient Management in Northwest Central, Ohio≅ were accepted in September 1998 and January 1999 and completed. Another three-year USDA-CSREES grant AWater Quality and Nutrient Management for Amish and Anabaptist Clientele≅ was approved and is being implemented. This grant includes the two largest Amish settlements in Ohio, the Wayne/Holmes County and the Geauga County settlements.

Traditionally, Amish farmers have not participated in government sponsored programs. Extension Agents have learned to work with local Amish farmers to improve water quality in Northwest Central Ohio by adapting educational materials to accommodate the Amish culture. The Agents also work with the Amish on other issues to find ways to improve their daily lives. The major objectives of the USDA-CSREES water quality grants were:

1) Educate Amish farmers on use of Best Management Practices through on-farm visits, meetings, and newsletters.

2) Soil sample and utilize manure testing on a hundred Amish farms to develop a hundred nutrient management plans to utilize crop and manure nutrients efficiently. Extension Agents will work individually with farmers to utilize all available nutrients on and off the farm to optimize crop production.

3) Use nitrogen and phosphorous demonstration plots utilizing poultry manure to promote optimum crop production. With excess manure being generated daily from three local layer and pullet operations, the poultry manure is a natural fertilizer which can be economically applied to crop land to balance crop nutrients needed for optimum crop production.

4) Collect and analyze well water samples from two hundred Amish farms. Recommend remedial action if needed. Tests include bacteria, nitrates, phosphorous, sulfur, and specific conductivity.

5) Conduct biological and chemical monitoring on six major streams at fourteen sites in the Amish communities. Major parameters include identifying biological fauna and measuring dissolved oxygen, nitrates, phosphorous, temperature, pH, and turbidity in the streams to establish a baseline and measure improvement in water quality with changes in Amish farming practices.

Results

To communicate with the Amish and to effectively change their farming practices, extensive one-on-one contact was used. Extension Agents have made more than 1,600 Amish farm visits since 1998. Since the Amish do not use telephones, automobiles, or radios; personal contact is important in communicating with Amish clientele on a regular basis. The Amish read extensively, so a newsletter was developed for this unique audience. Our newsletter, called AFocus on Farming≅, is sent to more than 225 Amish homes in the Kenton , Ohio area. It is also sent to seven other counties in Ohio and to Extension Agents in seven states with Amish communities.

The newsletter is designed specifically for Amish audiences. Nutrient management, water quality, management intensive grazing (MIG), integrated pest management, and best management practices are highlighted. Other topics include marketing, gardening and horticulture, and farm safety. Edith Spencer, Food and Nutrition Program Assistant, writes a section on Food Nutrition and Safety and includes recipes for the Amish women. A popular section called "Uncle Joe and Tom≅ is a two-page series of humorous stories about two neighbors dealing with problems on their farms. This series is about 75 percent fact sheet and 25 percent story line and outlines common agricultural nutrient management and water quality problems observed on many Amish farms. Uncle Joe and Tom discuss and find ways to solve these problems using accepted BMP=s. Using the Amish tradition of story telling and respect for elders, Uncle Joe and Tom have fun yet solve many problems. To help young scholars increase their scientific knowledge, the Question of the Week offers an in-depth section on science, water quality, and the environment. A coloring page for young children and educational word games are also included to entice the whole family to read the newsletter. Some of the water quality and nutrient

management problems observed in the Amish settlements may take a decade or more to solve. The young Amish who are starting new families are the ones making the changes in the Amish community.

To better utilize limited pasture acreage and to exclude livestock from local streams, management intensive grazing (MIG) concepts were introduced to the Amish. Seventeen (94%) of eighteen New Order Amish dairy farmers began using MIG in 1999. Ten Old Order Amish farmers started trying MIG on their farms in 2000. Over ten thousand feet of fence has been voluntarily erected to exclude livestock from the streams. At their own expense, two Amish farmers have voluntarily installed roofs over their manure holding areas to conserve nutrients and prevent leaching and pollution. Two Amish farmers installed geo-textile fabric to be able to move cows around the barn lot and pastures without causing soil erosion.

More than one thousand soil tests have been analyzed from one hundred ten Amish farms and one hundred whole farm nutrient plans have been developed. The soil test show that phosphorous levels are low (LT 15 PPM Bray-Kurst P_1) on about 40 percent of Amish fields but high (GT 50 PPM Bray-Kurst P_1) on 20 percent of the fields. On two-hundred Amish farms, an estimated 6,000 acres are too low in phosphorous and nitrogen to obtain optimum crop yields. About 17 percent of Amish fields were low in potassium (LT 100 PPM K), 62.2 percent were adequate (between 100 and 200 PPM K) and 20.8 percent of the Amish fields were high (GT 200 PPM K)). Approximately 11.9 percent of the Amish fields are low in pH (LT 6.0 pH), 50.6 percent are considered adequate (between 6.0 and 7.0 pH), and 37.5 percent are considered high (GT 7.0 pH). About 60 percent of Amish fields were found to be deficient, either in nitrogen, phosphorous, or potassium; to achieve optimal crop production. Permanent pastures, feedlots around the barn, and vegetable fields had the highest fertility levels. Fields the farthest from the barn, farms with a low animal density, and fields with row crops had the lowest soil fertility.

Due to their limited use of commercial fertilizer, Amish farms with higher animal densities tended to have higher soil fertility. Animal density was measured as animal units per acre. One animal unit is equal to feeding one thousand pound animal for one year. About 15.7 percent of the Amish farms had animal densities greater than one animal unit per acre, 22.4 percent had an animal unit per acre ratio of .75 to 1.0, and 61.9 percent had animal units per acre ratios less than .75. Thus, most farmers in this area had more cropland than animals. The New Order Amish, who are more progressive, had higher animal units per acre ratios (average of 1.0) than the more conservative Old Order Amish (average .65).

With over 13 million poultry layers and pullets from three companies located within miles of the Amish community, raw poultry manure (approximately 500,000 tons) is readily available for fertilizer. The Amish need a good natural fertilizer and the egg farms need a place to spread it. Prior to 1998, only a few Amish farmers had attempted to use the poultry manure. Some Amish who tried to use the manure applied it too heavily and burned their crops or they did not apply enough poultry manure to see a yield response. Most of their spreaders were not designed to handle poultry manure. Renting manure (spreading) equipment was expensive and not adaptable to Amish horse equipment.

In 1999, six poultry manure demonstration plots were used by OSU Extension to show the value of using poultry manure as a fertilizer. The demonstration plots showed an average corn yield increase of 22.4 bushels (162.1 actual yield) and 21.9 bushels (161.6 actual) of corn for raw poultry manure applied at 4 and 2 ton rates respectively compared to a farmer check plot (139.7 corn bushels). In 2000, eight corn plots showed an average increase of 34.7 bushels (118.1 actual yield) and 33.3 bushels (116.7 actual yield) for 5 and 2.5 ton application rates of raw poultry manure over a farmer check plot (83.4 actual yield). In 2001, eight corn plots showed an average increase of 40.3 bushels (139.4 actual yield) and 19.8 bushels (119.0 actual yield) for 5 and 2.5 ton application rates of raw poultry manure over a farmer check plot (99.2 actual yield). The Amish community use the poultry manure since it is a natural fertilizer , it is relatively inexpensive to purchase compared to commercial fertilizer, and it improves their crop yields. The egg farms benefit from having local Amish farmers apply poultry manure to low fertility fields where the nutrients can be used without harming the environment.

Calibration clinics for manure spreaders, sprayers, and planters have been conducted annually by OSU Extension. Ten manure spreaders, ten boom sprayers, and twenty-three planters have been calibrated in three years. Most Amish spreaders are designed to spread dairy and horse manure with straw. To help Amish farmers spread poultry manure accurately, Amish manure spreaders were retrofitted. With some simple modifications, the Agent with several Amish farmers designed a simple solution to spreading poultry manure accurately with their existing equipment. Amish farmers were then able to utilize the inexpensive poultry manure as a fertilizer for their crops. Nine of ten (90 percent) boom sprayers were found to be more than 10 percent off the desired application rate or had significant equipment problems that impaired the desired application rate. Twenty-three planters have been calibrated to improve seed placement, seeding rates, and reduce row width.

Bacteria, nitrates, phosphorous, sulfur, and specific conductivity tests were conducted on 191 Amish wells and springs in four years. Seventy-five (39.3%) tested positive for total coliform bacteria and 17 (8.9%) positive for E.Coli . The Extension Agent visited each farm and made suggestions on well improvements. In 1999, twenty-two wells were re-tested and nineteen (85%) of the Amish followed OSU Extension recommendations and attempted to make improvements to their wells. The most common problem identified was well pits with poor drainage. Other problems included well casings less than 6 inches above the ground, no well caps, leaking fittings on well equipment, back siphoning from watering tanks, inadequate or poorly constructed floor drains near the water pump, pumps not securely attached, and abandoned wells which were unsealed. Many Amish men did not know that they needed to shock chlorinate the well to disinfect it from contamination. With Extension education and training, the quality of drinking water has improved in many Amish homes.

Six streams are being monitored at fourteen sites to document changes in water quality. Macro-invertebrate counts are being conducted at each site yearly. Chemical monitoring once a month includes dissolved oxygen, nitrates, phosphorous, turbidity, pH, and temperature. High phosphorous, nitrates, and high turbidity with low oxygen has been recorded on streams where livestock has not been fenced out of streams. The Extension Agent is working with Amish farmers to fence livestock out of streams and find solutions to these problems.

Summary

Working with Amish clientele is challenging and rewarding! The Amish have a strong culture and tradition but a limited knowledge base. Nutrient management and water quality problems have been identified as problems on many small and large farms in Ohio. Extension Agents need to be creative and flexible to help Amish audiences improve their knowledge and change their farming practices. With targeted educational programs, some of these issues and problems are starting to be solved.

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