Assessing and reducing the risk of ground-water contamination from

Silage Storage

Keeping Idaho's Water Clean

Fact/Worksheet 9

Why should I be concerned?

Silage is an important feed for animal-based agriculture. When properly harvested and stored, silage poses little or no pollution threat. Improper handling and inclement weather, however, can lead to a significant flow of silage juices (or leachate) from the silo. Leachate is an organic liquid that results from pressure in the silo, putting up feed that is too wet, or from extra water entering the silo. It is usually a problem only when silage is fresh or just after it is stored in covered silos. Storage in uncovered silos is not recommended, because exposure to the weather accelerates the decrease of silage quality. Loss of leachate represents a major loss of nutrient value from the silage.

If silage leachate enters a stream, its high organic content feeds bacteria that rob the water of oxygen. The capacity of a contaminant to rob water of oxygen is called biochemical oxygen demand (BOD). The BOD of silage effluent is 150 times greater than that of human sewage. BOD from one ton of silage with a moisture content of 23.4% is equal to approximately 4,755 gallons of sewage. Ground water contaminated with silage juices has a disagreeable odor and shows increased acidity, ammonia, nitrate, and iron.

Silage liquid is often highly acidic and can be corrosive to concrete and steel. In addition to the pollutants found in silage leachate, an even greater potential threat exists. The low pH created by the presence of acids in silage leachate can free up and release naturally occurring metals in the soil and aquifer, which can increase metal concentrations in ground water.

Nitrate-nitrogen levels in drinking water greater than federal and state drinking water standards of 10 mg/L* can pose health problems, including the condition known as methemoglobinemia (blue baby syndrome), for infants less than six months of age. Young animals are also susceptible to health problems from high nitrate-nitrogen levels. Levels of 20-40 mg/L in the water supply may prove harmful to young animals, especially in combination with high levels (1,000 ppm) of nitrate-nitrogen from feed sources.

The goal of Home*A*Syst is to help you protect the environment and your drinking water.

*means milligrams per liter, equivalent to parts per million for water measure

How will these materials help me to protect my drinking water?

- It will take you step-by-step through your silage storage practices.
- It will rank your activities according to how they might affect the ground water that provides your drinking water supply.
- It will provide you with easy-to-understand rankings that will help you analyze the risk level of your silage storage practices.
- It will help you determine which of your practices are reasonably safe and effective, and which practices might require modification to better protect your drinking water.

How do I complete the worksheet?

After reviewing the information provided, follow the directions at the top of the chart on page 5. It should take you about 15 to 30 minutes to complete the worksheet and summarize your risk rankings.

Information derived from Home*A*Syst worksheets is intended only to provide general information and recommendations to rural residents regarding their own homestead practices. It is not the intent of this educational program to keep records of individual results.

Improving Silage Storage

Keeping Idaho's Water Clean

1. Silage moisture content

Silage is the conversion of a wet, unstable forage product to a wet, fermented, and stable forage product. Silage can be made from corn and other forage crops, such as grass and alfalfa. The amount of leachate (silage juices) produced varies with the material stored, its moisture and nitrogen content, and handling and storage conditions. Of these, moisture is the most crucial.

Research indicates that materials stored at 70 percent moisture content or higher can produce leachate. For corn silage, the amount produced varies from a trickle at 75 percent moisture to 79 gallons per ton at 85 percent moisture. About three-quarters of the leachate is produced in the first three weeks of storage, although it can continue to flow for up to three months.

Farmers can use several methods to reduce leachate production from silage. The most effective of these is to vary cutting and harvesting times, allowing the material to dry down or wilt in the field (*Figure 1*). Although this may not always be possible, it can reduce leachate production by 100 percent. Other methods include cutting or crimping the materials or adding moisture-absorbent materials to the silage as it is stored. Adding absorbent materials not only reduces leachate, but can also raise the nutrient value of the silage. Materials to use include alfalfa hay or cubes, beet pulp, rolled barley, ground corn, newsprint, and bentonite clay. Most of these

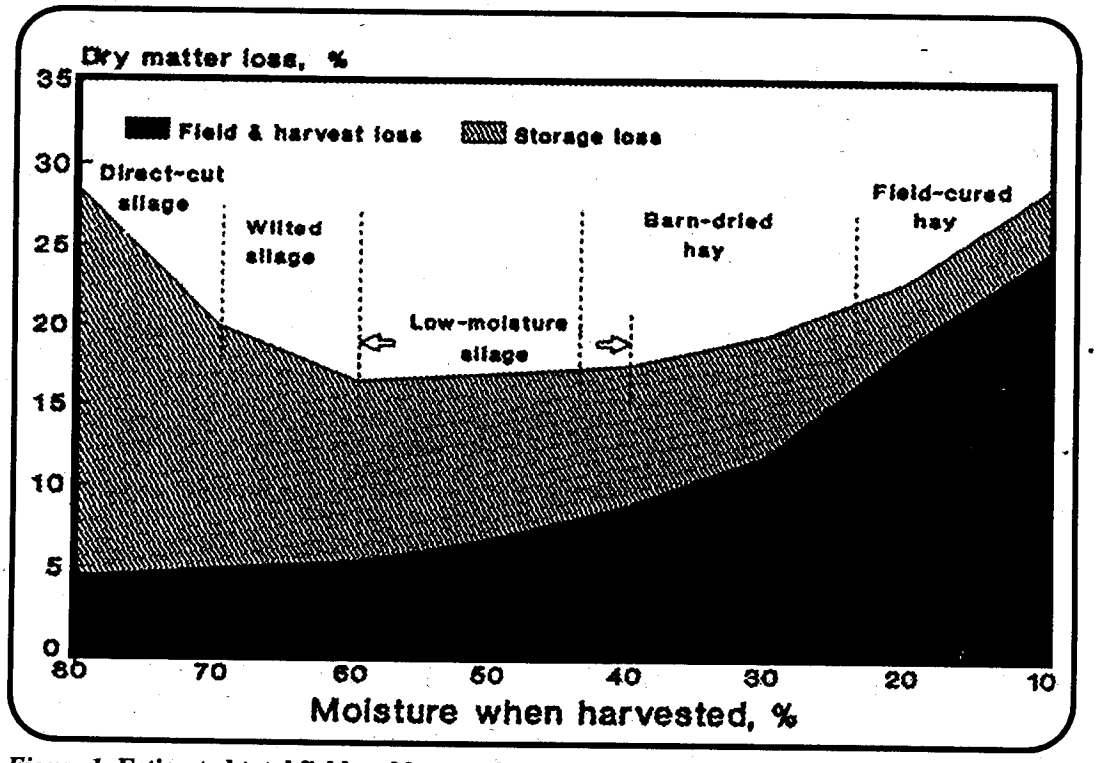

Figure 1: **Estimated total field and harvest loss and storage loss when grass or legume forages are harvested at varying moisture levels and by alternative harvesting methods.** *Source: Forages: The Science of Grassland Agriculture, 1980.*

materials will absorb from one to 200 times their weight in water. To be effective, enough must be added to absorb the anticipated leachate.

2. Silage storage

The crop is allowed to field wilt to the proper moisture content before chopping to ensure proper ensiling. Silage with a higher moisture content is usually put into horizontal silos. High-moisture silage and haylage may produce significant amounts of silage juice. A system for collecting any leachate is needed in these situations.

Although many older silos may have dirt floors and may have been dug into the subsoil three to six feet below ground level, new silos are built with concrete foundations and floors. Bunker, pit, or trench silos on bare ground present a greater risk to ground water.

3. Silo location

To prevent possible water contamination, silos should be located as far away from wells and surface water sources as practical. Silos should be located downslope from wells and surface water whenever possible. State regulations require that any potential contaminant source be located at least 50 feet away from any water supply well. Proper location will also prevent silage juices from entering surface water sources.

Minimum separation distances should guide new well installations. Make every effort, however, to meet or exceed current recommendations whenever possible. This will help to assure protection of your well water from contamination.

4. Silo design and construction

Most tower silos being built today have concrete interiors. They are built on concrete foundations, with a drain near the base to allow venting of pressure that may develop.

Silage bags are increasing in popularity in the Pacific Northwest. They can be used to store silage varying widely in moisture percentage. Leachate can pool in the bottom of the bag and leak out when the bag is opened or ripped accidently. The floor of an area used to store bags of silage should be graded, so leachate moves to a lagoon. Most silage bags are used only one time and then discarded.

Horizontal trench silos excavated into the ground may affect ground water, especially in coarse soils and sites close to the water table. Properly compacted clay soils and concrete floors can limit leachate seepage.

The type of silo on your farm often has less effect on the potential to contaminate ground water than the condition of the silo. For example, an old wooden silo with an earthen floor may pose a higher risk than a bunker silo with a concrete floor (*Figure 2*). However, older structures can be re-lined to make them relatively watertight.

Silo caps or covers keep rain water from entering the silage, preserving a quality silage, and reducing weather loss and spoilage. They also reduce the potential for producing leachate. Horizontal silos should be covered with a plastic sheet. Tires can be used to keep the cover in place.

It is important to divert clean water away from new and existing silage storage structures. Diverting clean water away from silage in vertical and horizontal silos can protect surface and ground water.

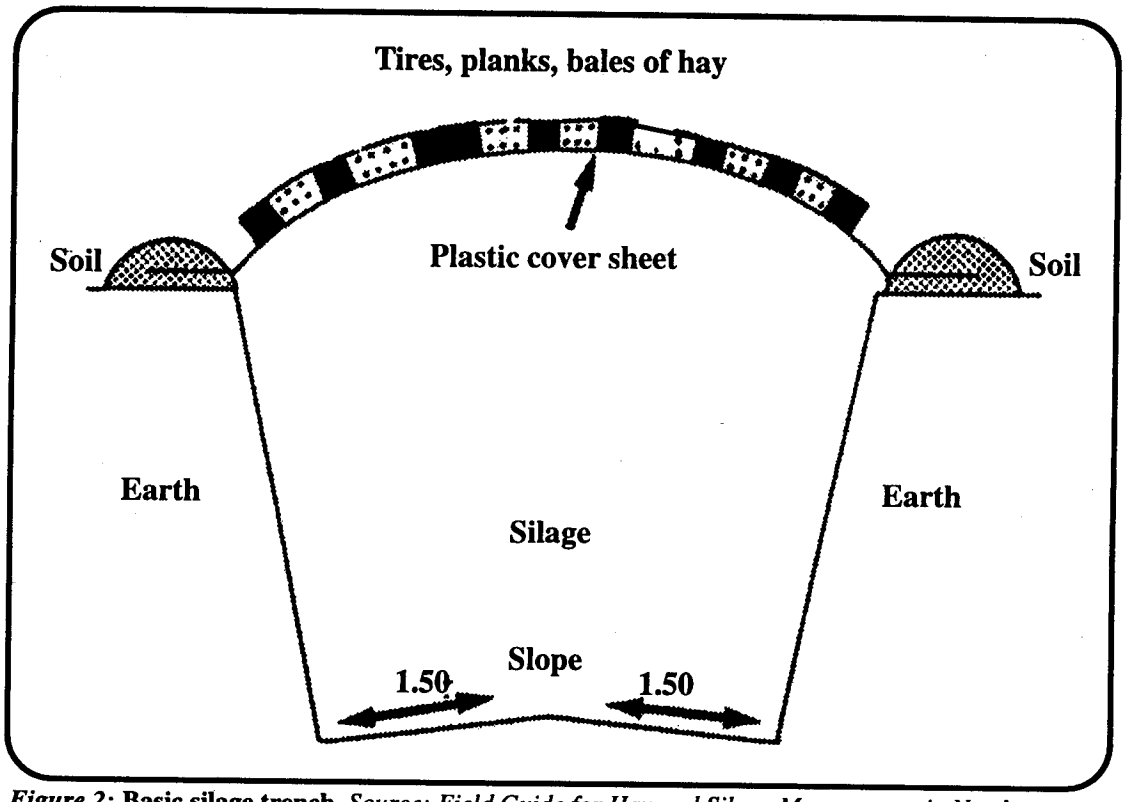

Figure 2: **Basic silage trench.** *Source: Field Guide for Hay and Silage Management in North America, 1991.*

5. Leachate collection and use

Leachate can be collected from tower, trench, and horizontal silos by channeling the liquid into a water retention structure, usually a pond or lagoon lined with concrete, clay, or plastic. Drain tiles around tower silos can be used to collect any seepage from the silo. Horizontal silos use channels to direct seepage into a collection area. Contact the Natural Resources Conservation Service (NRCS) for assistance with design.

Nitrogen in leachate has significant fertilizer value if applied during spring or early summer. Because of its high ammonia content, leachate can burn grasses and remove oxygen from the soil. Farmers who consider spreading leachate on land should consult a soil specialist to determine how much leachate can be safely spread on each field.

Worksheet 9

Silage Storage: Assessing Drinking Water Contamination Risk

1. Use a pencil. You may want to make changes.
2. For each category listed on the left that is appropriate to your homestead, read across to the right and **circle** the statement that **best** describes conditions on your homestead (skip and leave blank any categories that don't apply to your homestead).
3. Then look above the description you circled to find your "rank number" (4, 3, 2, or 1) and enter that number in the blank under "your rank."
4. Complete the section "What do I do with these rankings?"
5. Allow about 15 to 30 minutes to complete the worksheet and figure out your risk rank for silage storage practices.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
Silage moisture content	Less than 65%. Wilted silage.	Between 65% and 75%.	Between 76% and 85%.	More than 85%. Direct-cut.	____
Silage storage location	At least 100 feet downslope (bunker or trench). Water drains away from storage to field or pasture.	At least 100 feet downslope from well (silos, plastic tubes). At least 250 feet downslope (bunker or trench). Water drains to field or pasture.	Within 50 feet of well Within 500 feet upslope (bunker or trench). Water pools or stands near storage.	Within 50 feet of well (silos, plastic tubes). Within 250 feet (earthen trench). Water pools on soil surface.	____
Silage storage floor or surface condition	Concrete or asphalt surface. No cracks.	Concrete or asphalt surface with some cracks or compacted clay soil surface.	Surface has some permeable soils (silt loam) and has some cracks.	Surface has permeable soil (sand), not compacted.	____
Silage storage cover condition	Roofed or tight fitting cover. No leaks.	Cover tight-fitting (tower silo). Minor leaks repaired. Plastic covering tight (bunker or trench).	Cover, but many large leaks not repaired (tower silo, bunker, or trench).	No cover.	____
Leachate collection system	Designed system in place and maintained.	Designed system in place but not maintained.	No system in place. Temporary management measures employed.	No system in place. Leachate collects in low area **or moves to waterway.**	____
Silo absorbents	Always used.	Frequently used.	Periodically used.	Not used.	____

***Boldface type*:** Besides representing a higher-risk choice, this practice violates Idaho law.

What do I do with these rankings?

Step 1: In the table below, summarize your risk scores by checking the appropriate box for each category you answered on this worksheet.

Silage Storage Risk Rankings Summary

CATEGORY	Risk Rank			
	Low 4	3	2	High1
Silage moisture content				
Silage storage location in relation to well				
Silage storage floor or surface condition				
Silage storage cover condition				
Leachate collection system				
Silo absorbents				

Step 2: Look over your rankings for individual activities:

High Risk Practices (1) Pose a high risk for your health and for contaminating ground water.

Moderate to High Risk Practices (2) Are inadequate protection in many circumstances.

Low to Moderate Risk Practices (3) Provide reasonable ground-water protection.

Low Risk Practices (4) Are ideal; try to make this your goal.

Any shaded rankings require immediate attention. Some concerns you can take care of right away; others could be major or costly projects, requiring planning and prioritizing before you take action . The long term goal of the Home*A*Syst program is to improve homestead practices and structures so that they are classified as low risk. Activities classified as low risk generally reflect best management practices.

Transfer any activities that you ranked in the shaded areas in step 1 to the "High-Risk Activities" on pages two, three, and four of Worksheet B.

Step 3: Read the materials provided in this document, if you haven't already. Consider how you might modify your homestead practices to better protect your drinking water.

Contacts and References

Who to call about...

Silo design and construction

• Your local Natural Resources Conservation Service (NRCS), county Cooperative Extension System office, or Extension agricultural engineer, (208) 885-6182.

Leachate control planning and design

• Your county Cooperative Extension System, NRCS, or Soil Conservation District office.

What to read about...

Publications are available from sources listed at the end of the reference section. Refer to number in parentheses after each publication.

Planning and design criteria, general information

• *Field Guide for Hay and Silage Management in North America,* 1991. Published by the National Feed Inde-gredients Association, this document is an extensive, practical reference on hay and silage managment. (1)
• *Silage Managment in Queensland,* 1984. This Australian publication contains a wealth of information on silage, including growing, harvesting, ensiling, and feeding out to animals. QI83028. (3)
• *Dairy Housing and Equipment Handbook.* Midwest Plan Service. MWPS-7. (2)
• *Beef Housing and Equipment Handbook.* Midwest Plan Service. MWPS-6. (2)
• *Farm and Home Concrete Handbook.* Midwest Plan Service. MWPS-35. (2)
• *Tilt-Up Concrete Horizontal Silo Construction.* AED-15. (2)

Publications available from...

• Your county Cooperative Extension System office. There may be charges for publications, postage, and sales tax.
• Your county Cooperative Extension System office or the Midwest Plan Service, Iowa State University, Ames, Iowa, 50011, (515) 294-4337.

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Idaho Association of Soil Conservation Districts (IASCD)
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Idaho Soil Conservation Commission (SCC)
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Information derived from **Home*A*Syst** worksheets is intended only to provide general information and recommendations to rural residents regarding their own homestead practices. All results are confidential.

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