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Land Application of Municipal Sludge: what is it and what are its potentials?

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# Land Application of Municipal Sludge

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INTEREST IN APPLYING MUNICIPAL SEWAGE sludge to land is increasing each year. Many questions are being asked by farmers, local government officials, and others about this sludge management alternative. This bulletin provides a source of general information that will help answer some of the most frequently asked questions.

## 1. What is the general concept of land application of sludge?

Applying sludge to land has been practiced in foreign countries and in the U.S. for several decades. More recently, land application has become associated with national goals of improving environmental quality. Land application is viewed as one alternative which can provide an environmentally accepted method of managing sewage treatment products. At the same time, these materials can be utilized in a beneficial way for re-vegetating mine spoils areas or helping to produce feed and fiber on America's agricultural and forest land.

## 2. Why is there increased interest in land application of sludge?

In 1972, amendments to the Federal Water Pollution Control Act (Public Law 92-500) established a goal of "zero discharge" of pollutants into navigable waters by 1985. This law also requires the Administrator of the U.S. Environmental Protection Agency to encourage waste treatment management which results in the recycling of potential sewage pollutants through the production of agricultural, forestry, and/or aquacultural products. Land application of sludge is one treatment alternative which provides for recycling and is economically attractive to small rural communities. Energy costs, a continuing awareness of environmental protection, and a growing recognition among farmers of the nutrient value of sludges are also responsible for the increased interest.

## 3. What government agencies regulate land application of sludge?

Specific regulation of sludge application to agricultural land rests with the Water Quality Division, Michigan Department of Natural Resources. However, other levels of government may have authority over certain aspects of land application programs.

Local zoning, nuisance, and health codes may influence specific projects. Efforts should be made to seek involvement of local officials and other potentially interested individuals in the development of land application projects to assure full understanding before implementation. Advice from county extension agents can be very valuable regarding individuals or groups who should be involved in the development of such projects and the decision-making process.

## 4. Is sludge being applied now to Michigan farmland?

Land application of sludge is being developed under a program established by Monroe County. Other communities returning sludge to land include Allegan, Bad Axe, Cadillac, Constantine, Hastings, Nashville, Petersburg, and Traverse City.

The most widespread future use of land application programs for sludge will probably be in small to medium-sized communities with a nearby agricultural base.

## 5. Is sludge treated before land application?

Yes. Sludge is largely a biological material produced during the treatment of sewage wastewater. As the wastewater is treated, it passes through sedimentation tanks (clarifiers) to allow solids to settle out. These solids (sludge) then undergo additional treatment (most commonly anaerobic digestion). This treatment stabilizes the sludge by reducing the quantities of easily-decomposable organic materials and pathogenic (disease-causing) organisms.

## 6. How is sludge applied to agricultural land?

Sludge can be applied to land in a liquid form, using equipment similar to liquid manure handling equipment. It may be injected directly into the soil, using a tankwagon and chisel plow arrangement which injects the liquid sludge into a furrow. Injection systems have also been adapted to crawler tractors, using a flexible "dragline" which carries sludge from a pipeline to the plow or disc being pulled by the crawler. Digested sludge may be successfully spread on the surface and later incorporated by discing or plowing. Some wastewater treatment plants partially dewater sludge which can then be spread with conventional manure handling equipment.

**7. What nutrients and other components does sludge contain? Are these components harmful to soil and crops?**

Sludges contain plant nutrients and organic matter which make them a beneficial soil additive for crop production. They can be used as a low-grade nitrogen (N) and phosphorus (P) fertilizer containing up to about 3% total P and 4 to 5% total N. However, they are a poor source of potassium. Sludges also contain varying amounts of the minor plant nutrients present, but not all of these nutrients are available for plants to use. Due to their organic matter content, sludges are good soil conditioners, helping promote desirable soil conditions for microbial activity and plant growth.

Sludges may also contain components which can be harmful to the soil-plant system. The most common problem is metals like copper, zinc, nickel, cadmium, and others. These metals can potentially cause plant toxicity problems or increase metal uptake by plants, if high amounts are applied to soils. Therefore, sludges must be tested for metal concentrations to determine whether a sludge is suitable for application to farmland. Most sludges from domestic communities, i.e., those without industrial discharges, will contain safe levels of metals.

**8. What are the public health implications of applying sludge to land?**

Sludge contains varying levels of pathogenic (disease-causing) organisms. The danger of disease transmission can be lessened through good hygiene by those associated with the application process, avoiding unnecessary employee or public exposure to the sludge, and careful consideration of the application site and the characteristics of the sludge.

Public health authorities do not advocate the use of sludge on crops intended for human consumption in the raw form because of the risk of disease transmission. While most toxic materials found in sludge have not been shown to enter the human food chain, some contaminants with public health significance, such as cadmium, have been found at higher concentrations in some crops following the application of sludge. Care should be exercised in determining whether the specific sludge to be applied is compatible with proposed crop selections.

**9. Will sludge cause offensive odors to surrounding communities?**

Odor generation from sludge is usually the result of rapid decomposition of organic matter, with the nature and intensity of the odor depending on the quantity of material and the conditions under which decomposition occurs. In most cases, stabilization of the sludge will be necessary prior to its application to the land to avoid odor nuisances. Stabilization is the controlled decomposition of organic material in sludge

and can be accomplished using anaerobic or aerobic sludge digestion or chemical treatment systems. Special methods of sludge application, such as subsurface injection, can also be used as a way of minimizing the odor potential. A fully developed program for sludge application to the land, including proper consideration of the site selected and good management, can eliminate virtually all nuisance odor potential.

**10. Does land application of sludge pose problems to surface and groundwaters?**

Sludge does contain material which can pollute surface and groundwaters, but if proper application rates and methods are utilized, pollution need not occur. If sludge is incorporated into the soil at the time of, or soon after, application, surface water pollution can generally be avoided as long as good soil conservation practices are utilized to prevent excessive soil erosion. Pollution of groundwater can be prevented if the sludge application rates are planned in order to supply the nutrient needs for crops, particularly nitrogen. Excessive nitrogen applications can cause nitrate leaching and groundwater pollution.

**11. What crops and soil types are best suited to sludge utilization?**

Since sludge should be incorporated into the soil for best utilization, annual crops are preferred. Sludge-treated soils could be planted to a variety of field crops, such as small grain, forages, corn, etc. Where farmers want to maximize organic matter additions, annual crops which utilize high amounts of nitrogen and phosphorus can be selected so rates of sludge application can be maximized. Soils at sludge application sites should be well or moderately well drained with shallow slopes to prevent runoff and erosion. Good choices are soils which are low in organic matter and can benefit from the organic matter contained in sludge. In several instances sites which have been strip mined and the soil left in need of reclamation have been utilized for sludge application. A good soil management program including pH maintenance is necessary on sludge application sites.

**12. Would a farmer encounter difficulties marketing crops and livestock produced on land where sludge is applied?**

The impact upon crops from the sludge applied cannot be disregarded. There is currently no indication of problems which threaten crop or livestock marketing. However, when a program for sludge application to cropland is developed, specific attention should be given by the originator of the waste (municipality or industry) to avoid the possibility of any type of threat to the crops being grown. This may include specific control of certain waste discharges, e.g., cadmium and other metals.

**13. What are the primary advantages of using sludge for crop production? Is it economically feasible?**

The primary agricultural benefit of applying sludge to cropland is the addition of phosphorus, nitrogen, and organic matter to the soil. The nutrients can help reduce the quantity of commercial fertilizers needed for crops. The organic matter in the sludge acts as a soil conditioner which also will be a benefit to crop production.

As a management option, application of sludge to land also helps eliminate some of the demand for sludge landfill sites and the high cost of incineration. Thus, land application of sludge can be a useful way to manage municipal sludge and provide some beneficial return at the same time.

Sludge application to cropland can be economically feasible for the farmer with appropriate crop selection, proper management and suitable cost-sharing arrangements. Costs for the transportation of sludges to the land site and their application to the soil will not be offset by the fertilizer value of the sludge. Therefore, to bear these costs alone would be uneconomical.

Sludge management alternatives must be evaluated by the community as well to determine the most economical, environmentally-acceptable alternative. With reasonable transportation distances, available agricultural land nearby, and an equitable cost sharing arrangement, land application can often be the most economical sludge management alternative, especially for small rural communities.

**14. Can sludge application be adapted to private agriculture?**

Yes. Various agreements between community and farmer can be adapted, depending on the particular situation.

**15. What are the possible institutional arrangements for farmers and communities to utilize sludge?**

Several options are available. Selecting among them depends upon local circumstances. The farmer wants to maintain sufficient discretion to keep his farm competitive, while avoiding as much of the system cost as he can. The local government wants the option that will accomplish desired treatment at least cost, and with long-term reliability. There is clearly room for negotiation, but the institutional arrangement must provide benefits to both parties to be workable over time. The community must also accept overall responsibility for the program. Options include the following:

a. **Contractual agreements** can insure access to land without any permanent transfers of real property rights. Many agreements can be arranged between the farmer and community with terms specified in the

contract. Terms can include a description of application sites, basis for determining application rates, cropping practices, cost sharing for the transportation and application of sludges, periods when sludge could not be applied, the program to be followed for maintaining soil pH, monitoring of sludge quality and soils, etc.

b. **Special cooperatives** for land application of sludge are an alternative to the two-party contracts. Basically this would involve a group of farmers dealing collectively with the sludge management authority to provide for the transportation and application of sludge. Under this arrangement, the community might pay a flat fee for the cooperative to take the sludge. More of the management decisions would then reside with the cooperative.

c. **Partial transfer of ownership rights** from farmer to the management authority may be accomplished in several ways. The advantage of partial transfer is that the community acquires only the rights necessary for operating the treatment system; the farmer retains rights necessary for operating the farm and is compensated for rights transferred to government. Possibilities include:

**Purchase and leaseback** — the wastewater authority acquires full title to the land and leases it to a farmer for an appropriate time period, with necessary lease terms.

**Purchase and resale on condition** — land is purchased in full and resold to a farmer with appropriate deed restrictions. Alternatively, the wastewater authority may buy the land and hire a manager.

**Negative easement** — the wastewater authority may acquire only the right to change use of land from farming to something else. The farmer retains all rights necessary to the farm business. Price and term of the transfer of rights are negotiable.

**16. What adjacent land uses are compatible with land application of sludge?**

The most compatible adjacent land uses are those involving low population, predominantly rural in character, where use of the site is not in sharp contrast to adjacent land uses. To avoid negative public reactions, sites should not be selected adjacent to high population areas or recreational facilities.

**17. What research is being conducted to provide information on land application of sludge?**

Many universities as well as the U.S. Environmental Protection Agency and the Agricultural Research Service of the U. S. Department of Agriculture are conducting research on sludge utilization. Research at Pennsylvania State University and at the University of Minnesota is providing information on the

utilization of sludge on agricultural land as well as for strip mine renovation. The Environmental Protection Agency maintains a laboratory in Cincinnati, Ohio, which is headquarters for its sludge application research. Work is underway at Michigan State University to evaluate the use of various sludges on agricultural soils.

#### **18. Where can one obtain further information on land application of sludge?**

Several excellent sources are available. These include the following:

Department of Natural Resources  
Stevens T. Mason Building  
P.O. Box 30028  
Lansing, Michigan 48909

Department of Agriculture  
Lewis Cass Building  
P.O. Box 30017  
Lansing, Michigan 48909

Public Affairs Division  
Michigan Farm Bureau  
P.O. Box 30960  
Lansing, Michigan 48909

Department of Public Health  
3500 N. Logan  
P.O. Box 30035  
Lansing, Michigan 48909

Cooperative Extension Service  
Michigan State University  
East Lansing, Michigan 48824

Other sources are county or district health departments, county extension offices, and officials of communities presently operating sludge application systems utilizing land.

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