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ABSTRACT

A training workshop for Southern Extension faculty and staff addressed aspects of water quality and related issues. Conference papers discussed: (1) basic information on hydrology--the science of water transport through the natural environment; (2) sources and impacts of water pollution; (3) the role of public policy in water quality protection; (4) risk assessment and risk management related to toxic and carcinogenic chemicals; (5) an extension training program entitled "Pesticide Usage and Its Potential Impact on Surface and Ground Water Quality"; (6) the conceptual basis for public policy education, and suggested subtopics and formats for extension education on water policy; and (7) extension education programs on water supply and wastewater management. This proceedings contains materials from a solid waste management workshop: activities and lesson plans about litter, recycling, and composting for grades 1-12; a bibliography with 129 citations; and a list of free materials and audio-visual materials available on loan from the Washington Department of Ecology Resources. Also included are summaries of 13 roundtable discussions and concurrent sessions on toxic substances, public policy education, water supply and wastewater management, and solid waste management. (SV)

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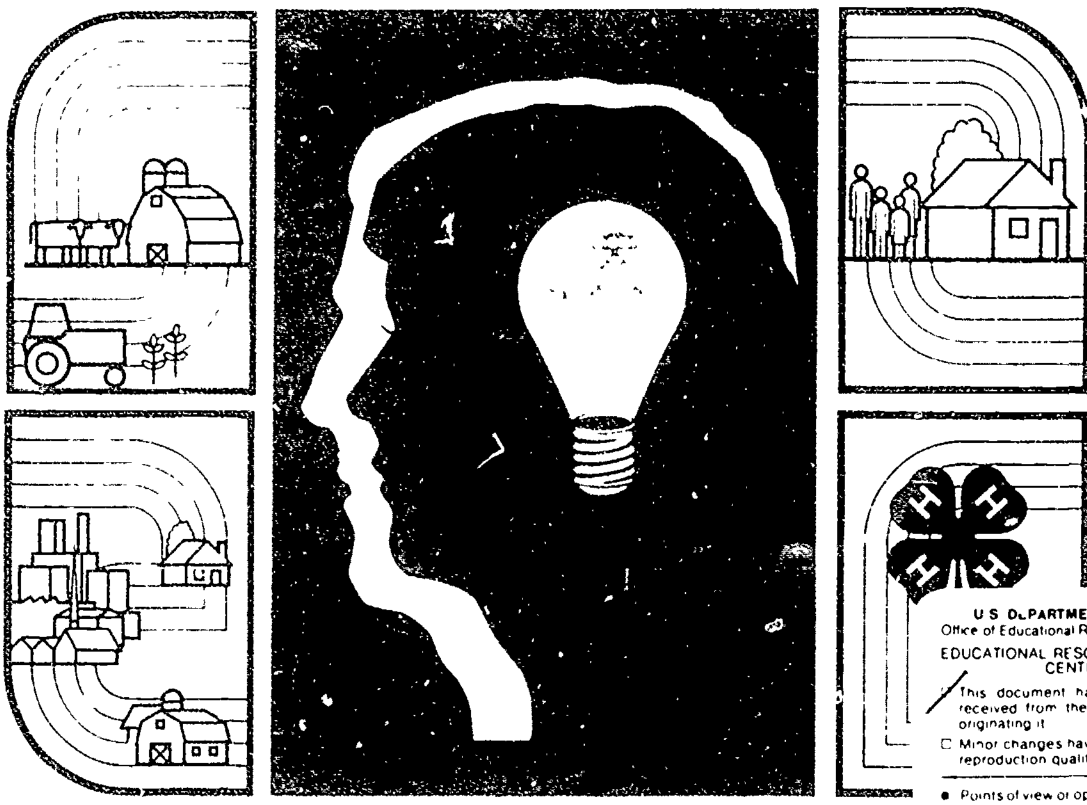
Southern Extension Water Training Workshop: Actions For Working Together



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Proceedings of a Regional Conference

Radisson Hotel Central
Birmingham, Alabama
November 13-15, 1989

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Proceedings

SOUTHERN EXTENSION WATER TRAINING WORKSHOP: ACTIONS FOR WORKING TOGETHER

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CONFERENCE CHARGE: ACTIONS FOR WORKING TOGETHER

C. Wayne Jordan, Director
Cooperative Extension Service, University of Georgia

A little more than a year ago the Southern Extension Directors were unanimous in their endorsement of a regional water training workshop. A mechanism was put in place to select a planning committee, and Dr. Doss Brodnax was asked--in his capacity as Director of Southern Rural Development Center--to coordinate the committee and workshop arrangements. On behalf of the Southern Directors, I acknowledge the good work of the committee under Dr. Brodnax's leadership. We are especially appreciative of the central role of the SRDC in pulling it all together.

Back in chemistry class somewhere I learned that water is the universal solvent. Also, it is a universal natural resource for which we have a universal need and a universal responsibility for stewardship.

Water: transportation for early settlers; subject of landowner disputes; cause of range wars; source of energy; essential for agriculture, industry, fishing, swimming, drinking, and Saturday night baths.

Today water quality is one of the Cooperative Extension System's national initiatives. It is also a presidential initiative. Water is a part of the whole environmental issue so prominently positioned on society's agenda today. Accordingly, it must be on Extension's agenda in a more prominent position than ever before.

Frankly, although we have long advocated soil and water conservation and wise use of pesticides and fertilizers, even pioneering in the concept of Integrated Pest Management, somehow Extension's white hat has become grey or even black in the eyes of our critics. Too often we are being accused of insensitivity to the environment and oriented only toward the capitalistic exploitation of the environment.

It is incumbent upon us to respond in a strong way to these attacks upon Extension's objectivity and credibility. It still take a major effort and some redirection with more than mere tradition to turn this around. An intensified, comprehensive educational thrust on the various aspects of water resource management is required.

Thus, our workshop's theme: <u>ACTIONS FOR WORKING TOGETHER</u>. Several distinctive criteria were considered important for this workshop:

1. That it be a training activity;

2. That it be oriented to Extension faculty and staff;

3. That participation be more than multidisciplinary; that it be multiprogrammatic, resulting in interprogrammatic action; and

4. That Extension communication specialists and other supporting areas be included.

In 1985, another regional meeting was held in Atlanta, Georgia, to discuss the water resources. We should examine our progress since that time. I submit to you that in the next five years Extension must do a better job with water programming. Each one of you is urged to not only be an active participant in this workshop, but to continue the efforts when you return to your respective places of responsibility.

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UNDERSTANDING THE NATURE OF THE WATER RESOURCE

Joel G. Melville, Associate Professor
Department of Civil Engineering
Auburn University

INTRODUCTION

The general objective of this paper is to provide an overview of how water moves through our environment. Here, with clarification of definitions and example calculations, is an attempt to strengthen basic understanding of hydrology. For readers with education and experience in water resources, it will be recognized that statements made here are not in general form and certainly subject to rigorous criticism. For a complete treatment, readers are referred to textbooks on hydrology and geohydrology. (Veissman, Lewis, Knapp, 1989; Fetter, 1988).

All writing has bias, and particularly with a broad topic any focus will naturally omit important ideas and topics. The emphasis here will be on groundwater rather than surface water. The author, with education in engineering mechanics and applied mathematics, has worked in applications of fluid mechanics to problems ranging from physiological flows to hydrogeology. His current position involves teaching and research in civil engineering. His interest is more toward engineering science (explaining how things happen) rather than applied engineering (controlling how things happen). Rather than extensive practical field experience, a significant portion of his effort has been with mathematical descriptions, detailed computer programs and controlled experiments.

The extrapolation from these focused efforts to practical field problems is a step often subject to error. Mark Twain gave us his opinion regarding scientific extrapolation in the following:

> In the space of 176 years, the lower Mississippi has shortened itself by 242 miles. This is an average of a trifle over one mile and a third each year. Therefore, any calm person who is not blind or idiotic can see that in the old oolitic Silurian period, just a million years ago next November, the lower Mississippi was upward of 1,300,000 miles long...

The effectiveness of this example depends on its exaggeration. But, extrapolation based on often very limited data should be recognized as fundamental to science. Continuing the observation by Mark Twain:

> There is something fascinating about science. One gets such wholesome returns of conjecture out of such a trifling investment in fact. Twain's comments are general, but they raise warning flags relative to problems and solutions on water resources. If the computer

had been around in Twain's day, he would have had unlimited fodder to feed his wit. The computer can exaggerate and extrapolate faster than any scientist with pencil and paper. Perhaps even more dangerous, while the programmer is probably quite aware of a model's limitation, much of society is willing and anxious to accept computer graphics or print-out as gospel.

HYDROLOGY

Hydrology is the science of water transport through the natural environment. Engineering hydrology is the application of this science to controls of this water transport such as dams, culverts, detention/retention ponds and erosion control practices. Since all engineering designs are subject to variable natural factors such as precipitation, they are subject to failure under extreme conditions even when all analysis, design, construction and maintenance practices are faultless.

Hydrology is a required course in most civil engineering curricula. At Auburn University we have an "exit" interview with graduating seniors (it gives the students a chance to grade the professors). One group of questions posed to the students is related to the curriculum. The course which consistently garners the most votes for "removal from the program" is hydrology. Part of the reason for the unpopularity is that engineering students, analytical by nature, want to find the answer to problems. Because of the descriptive rather than quantitative character of hydrology and the variable parameters, answers to three significant figures are impossible. Engineers and scientists, particularly those with computers, are unhappy with these no-answer problems.

To refresh your memory, a simplified diagram of the hydrologic cycle is shown in Figure 1. The first written idea of the cycle is credited to Leonardo da Vinci. The cycle is the solar powered movement of water by precipitation, evaporation, transpiration, runoff, infiltration and groundwater flow.

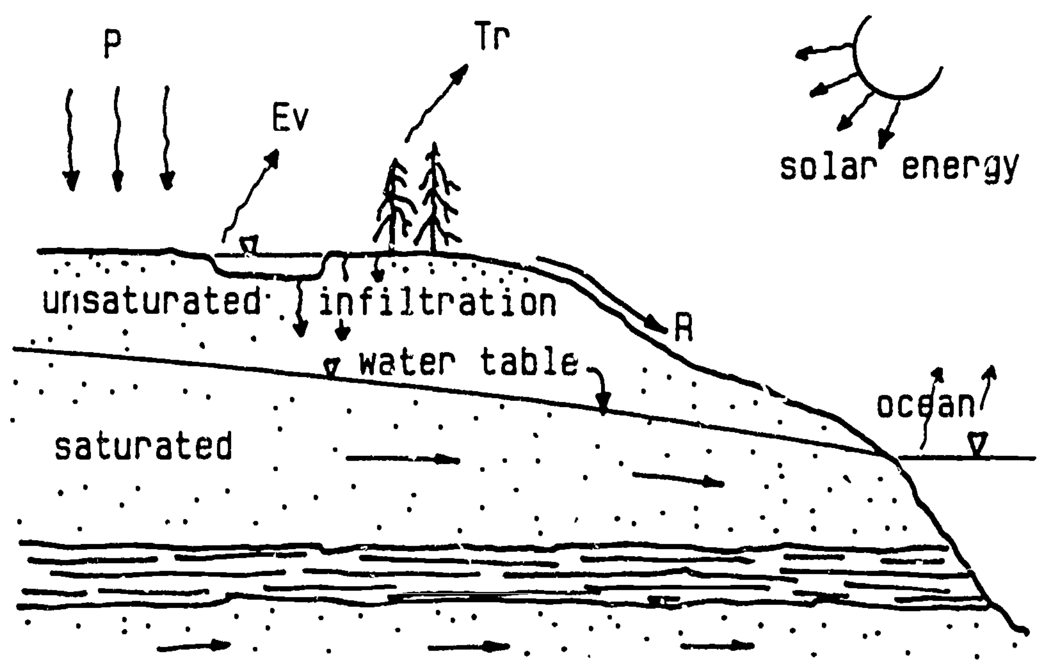

Figure 1. The Hydrologic Cycle

WATER RESOURCE USAGE

The earth's total water resource (approximately 1.5×10^9 km^3) is almost completely inaccessible in the oceans and polar ice caps (Freeze and Cherry, 1979). Approximately 500,000 km^3 of the resource annually passes through the hydrologic cycle and 40,000 km^3 returns as precipitation to the land surface.

To give a physical idea of these volumes, the volume of water in the Great Lakes is 20,000 km^3. Specific to the United States (McGuinness, 1963), water needs are currently around 600 km^3/year and projected to go to more than 1000 km^3/year by the year 2000. The total useful water resource potential of the United States is estimated at 1600 km^3/year. Even if these estimates are erroneous, it is clear that we are stressing our water resource and protection, and wise use of water is mandatory.

Currently in the United States, groundwater is the source for 20 percent of our water consumption. This percentage is variable depending on location. For example, in the table below (Lehr, 1981), total daily water use is shown.

Table 1. Daily Water Usage, 1975 (10^6 gal/day)

STATE	GROUND WATER	SURFACE WATER	% GW
Alabama	370	8,800	4
Florida	3,300	15,000	18
Mississippi	1,100	1,000	52
Kansas	5,000	810	86
Georgia	810	5,100	14

Considering the projected growth of demand, it is expected that the national dependence on groundwater will increase from 20 percent to more than 30 percent. Also, although the figures of Table 1 indicate some dependence on groundwater, if we look at daily use and specific users in Table 2, a more significant dependence on ground water is apparent.

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Table 2. Daily Water Usage for USA, 1975 (10^9 gal/day)

	Total	% GW
Public (Urban & Small Communities	29	37
Rural Domestic/ Livestock	5	80
Irrigation	140	40
Industrial	241	4

It is obviously the industrial use which is dominant by volume of water, but groundwater is a significant factor in meeting the other demands.

GROUNDWATER FLOW

Out of sight for everyone and out of mind for most, groundwater slowly moves through the subsurface. The water, rarely in the form of subterranean lakes and rivers, usually occupies small pore spaces or fractures in soil and rock. Groundwater is never static, although it moves very slowly relative to surface water. Gravity is the driving force and the friction of the very small, interconnected pore spaces is the resisting force. To give an idea of pore space, consider an ideal "soil" consisting of an array of uniformly stacked spheres, each of radius R as shown in Figure 2.

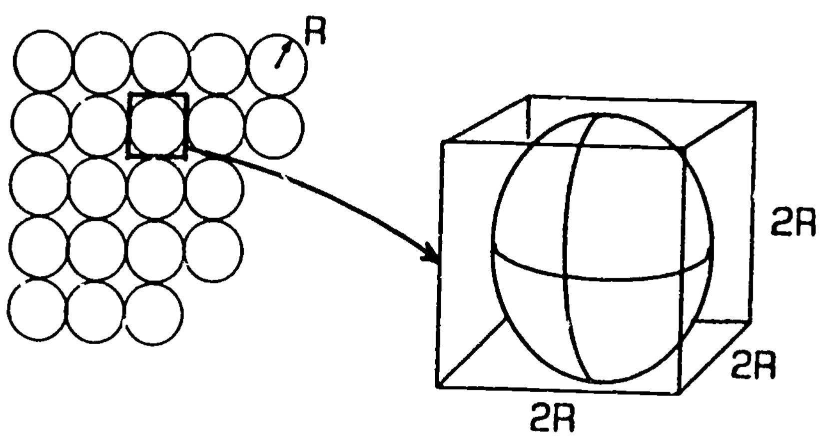


Figure 2. Pore Space and Porosity

Porosity is the property of the porous structure defined as:

$$n = V_V/V = \text{(volume of void)/(volume of sample)}$$

For the idealized material of Figure 2, if we take a cubic sample containing one sphere, then $V = 8R^3$ and V_S = volume of the sphere = $(4/3)\pi R^3$. Then,

$$n = (V-V_S)/V$$

$$= [8R^3 - (4/3)\pi R^3]/8R^3$$

$$= 0.48$$

Thus, for this idealized material, 48 percent of the space is available for groundwater and the transmission of the groundwater through the complex interconnected pore spaces. If the spheres are compacted to minimize the pore space, the porosity of the material can be calculated to show $n = 0.26$. A range, $0.20 < 0.50$, is typical of many natural materials. The point is that there is ample pore space for groundwater to exist and move without obvious indication at the land surface. When water completely fills the pore space, the condition is called saturation. Near the land surface or where water supply is small, unsaturated conditions exist.

Aquifers are defined as formations which contain water and also can transmit water at rates sufficient to support wells and springs. Confined and unconfined aquifers are shown in Figure 3. Confined aquifers are bounded above and below by less permeable geologic formations. If an observation well Number 1 is screened in a confined aquifer, the water pressure in the confined aquifer raises the water level to an elevation in the well which coincides with the potentiometric surface. If the potentiometric surface is above the land surface, then the condition is artesian and water will flow to the surface without pumping.

For unconfined aquifers, water levels in observation wells Numbers 2 and 3 will rise to an elevation referred to as the watertable. This watertable elevation approximately coincides with the elevation of the saturated soil, although in some soils, capillary forces can elevate saturated conditions above the water table. A perched water table is also shown above an impermeable lense. Recharge of water table aquifers usually comes from infiltration of precipitation directly above the aquifer or nearby. Recharge for confined aquifers may occur at great distances. For example, recharge of significant aquifers of Florida takes place in Georgia.

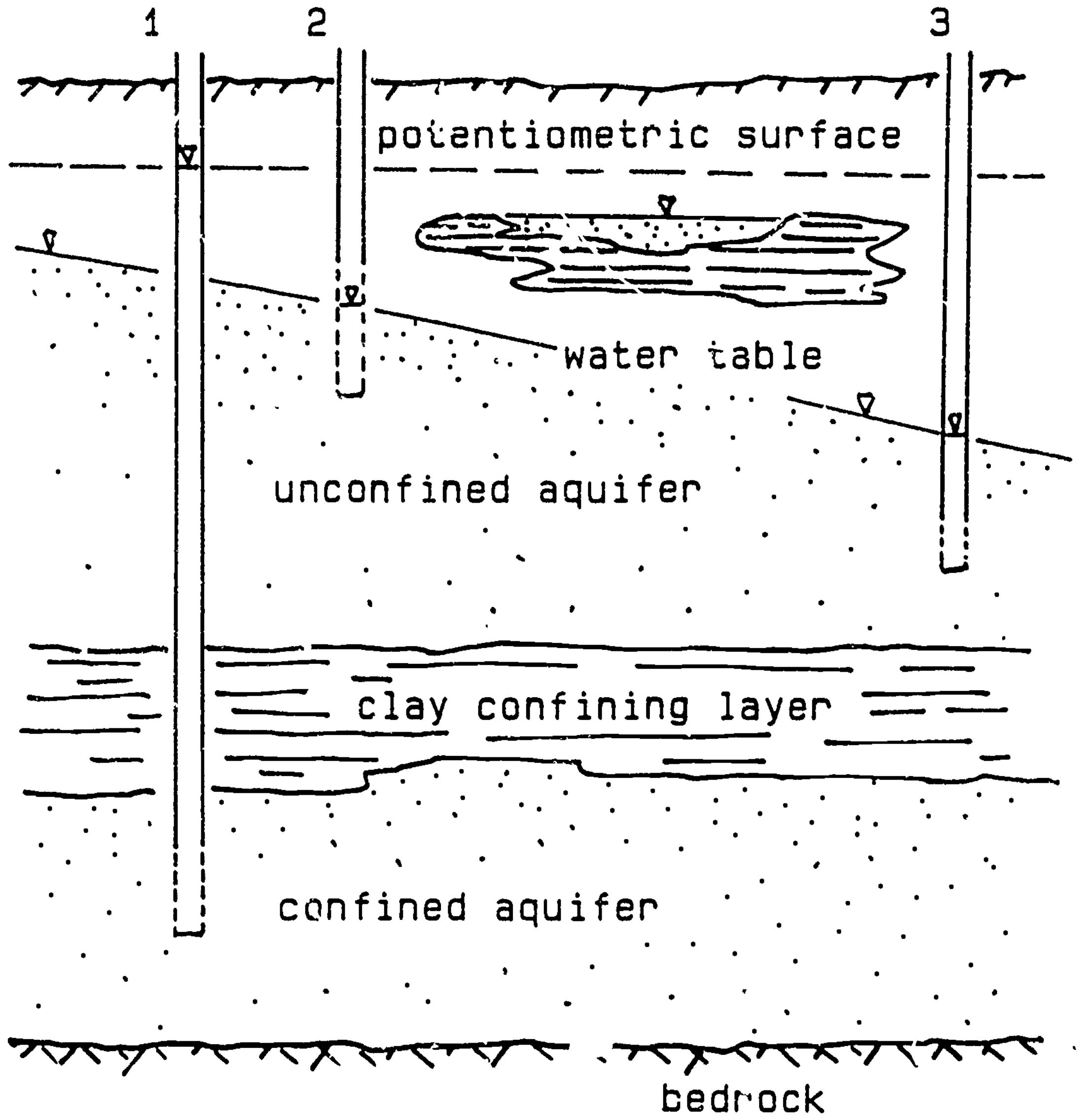


Figure 3. Aquifers and Water T

There are three different velocities referred to in groundwater analysis. In the hypothetical laboratory experiment of Figure 4, the three velocities are described. In this experiment, water is forced through a sample of porous material at a constant rate. Q is the volume of water collected per unit time in the test. The actual particle velocity, V, is variable in magnitude and direction as the fluid moves through the very complex shape of the interconnected pore spaces. The Darcy velocity (specific discharge) is $q = Q/A$ where A = the cross sectional area of the laboratory same. The seepage velocity is $V_S = Q/A_v$ Q/(nA) where A_v = area of the void space for a cross section of the porous medium. Because A_v is less than A, the seepage velocity is larger than the Darcy velocity. The seepage velocity is the average velocity that contaminants are transported in groundwater. Darcy and seepage velocities are related, $q = nV_s$.

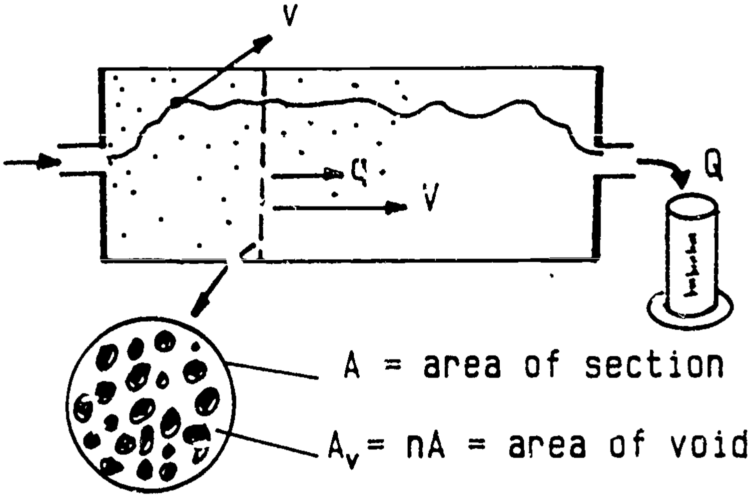


Figure 4. Ground Water Velocities

The fundamental principle in ground water flow analysis is Darcy's Law (Henry Darcy, laboratory experiments with sand, 1856). A diagram of the experiment is shown in Figure 5. If a constant pressure or head difference, h, is maintained across a saturated sand model, then the Darcy velocity (q = Q/A) will be proportional to the head difference and inversely proportional to the length of the model. Algebraically this law is written:

$$q = K(\Delta h/L)$$

The constant, K = hydraulic conductivity (permeability), depends on the soil type. This parameter, K, has an enormous change in magnitude depending on the soil type. In Table 3, typical values of K for three types of soil are shown.

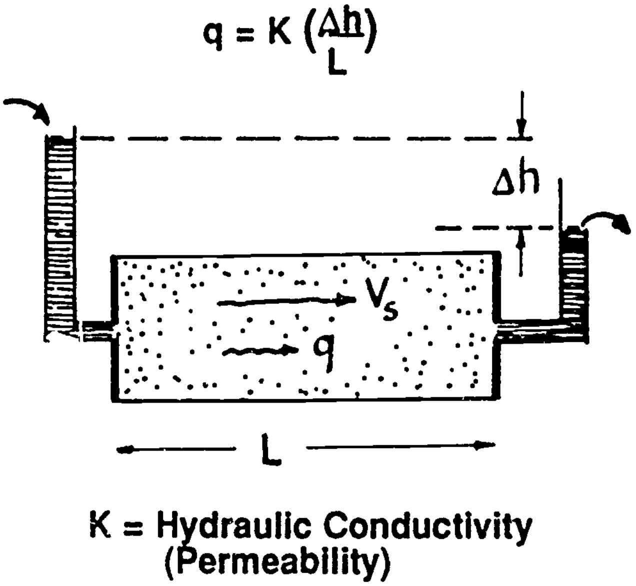
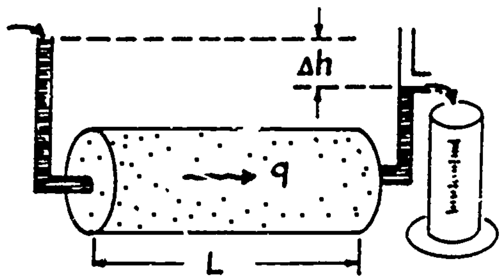


Figure 5. Darcy's Law and Hydraulic Conductivity

Table 3. Hydraulic Conductivity for Typical Materials

Porous Material	Hydraulic Conductivity, K
Gravel	1000 m/day
Fine Sand	1 m/day
Clay	.001 m/day

A difference of many orders of magnitude for K means that velocities and travel times have similar extreme differences. Consider a laboratory scale experiment shown in Figure 6. For the specified geometry, the volumetric flow rate for the experiment can be calculated as $Q = K(\Delta h/L)A$.



$A = 10\ cm^2$

$L = 1\ m$

$\Delta h = 2m$

$Q = qA$

$= K(\Delta h/L)A$

Sand		Clay	
K =	5000 cm/day	K =	0.05 cm/day
Q =	100 l/day	Q =	$1\ cm^3/day$

Figure 6. Laboratory Experiment

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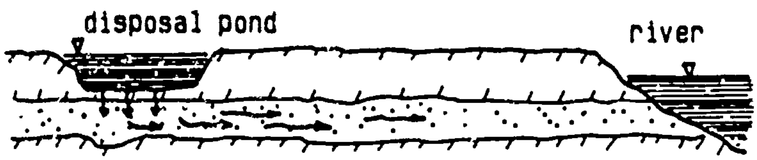
For sand and clay, the volume accumulation rate is very different. For sand, Q = 100 l/day. This would be a volume easily handled and measured in an engineering laboratory. For clay, Q = 1 cm^3/day. This is a small volume and special attention, for example, would be necessary to control evaporation. The same kind of variation is even more dramatic in field situations.

A hypothetical contaminant transport situation is shown in Figure 7. If a disposal pond communicates vertically to a layer of material of hydraulic conductivity, K, the horizontal transport of contaminant to the river will result if the pond surface is at an elevation higher than the river surface.



Δh = 2m L = 500m

V_s = q/m

t = time for contaminant to reach river

= L/V_s

V_s = $K(\Delta h/L)/m$

Sand

K = 50m/day	K = .05 m/day
t = 875 days	t = 2000 years

Figure 7. Field Scale Effects of Hydraulic Conductivity

Travel times to the river can be estimated based on Darcy's Law. The travel time is t = L/V_s. For the sand and clay values of K, the two calculations for the identical geometry result is very different travel times, as shown in Figure 7. Calculations like this (including sophisticated computer models) are subject to significant error. As one projects behavior for times like 1, 10, 100, or even 1000 years, it is obvious that natural or man-made changes in conditions can make prediction impossible.

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CONTAMINANT TRANSPORT

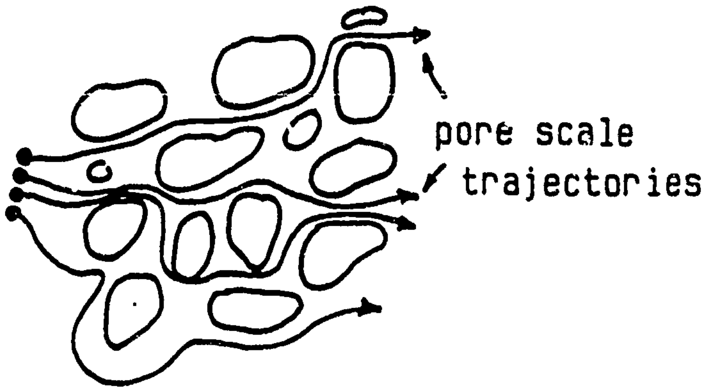
With the variability of geologic and hydrologic conditions, groundwater flow calculations based on Darcy's Law are complex. When the considerations of mixing and chemistry of contaminants are added to the geohydrology, most situations are poorly understood.

From a list of 19 prioritized ground water pollution problems (Lehr, 1981), I have shown the first five from the list in Table 4. It is interesting to note that two from the list, septic tanks and agricultural practices, are distributed rural problems and not associated with more publicized industrial waste and spills.

Table 4. Prioritized Ground Water Pollution Problems

1. Landfills and dumps
2. Waste pits, ponds, lagoons
3. Septic tanks
4. Petroleum exploration and development
5. Agricultural practices

Contaminants are mixed in groundwater primarily by two mechanical processes. The first process is called hydrodynamic dispersion and is described in Figure 8. Examining the detail of groundwater flow at the scale of the soil particles and the pore spaces, individual particles of contaminated water which follow trajectories through the complex pore geometry are slowly dispersed. The effect of this type of dispersion on a spherical cloud of dye in a uniform flow is that the dye will be dispersed into a shape of elliptical cross section and the dye concentration decreases as the cloud is dispersed over a larger volume.



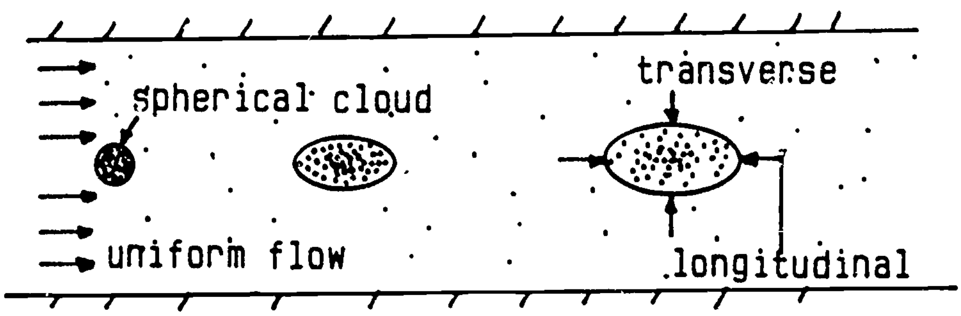


Figure 8. Pore Scale Dispersion

The dispersion in the direction of the flow is called longitudinal dispersion. Perpendicular to the flow, it is called transverse dispersion. Transverse dispersion is slower than longitudinal dispersion, but if exposed to very large areas it can be a significant dispersive mechanism.

At the field scale of 10-1000 m in Figure 9, advective dispersion is usually the dominant dispersive mechanism. Because of variation in geologic deposition, even in a well defined confined aquifer there will be some variability of the hydraulic conductivity. If K is variable, then according to Darcy's law so will the seepage velocity be variable. With a variable velocity, a contaminant cloud, shown initially occupying a rectangular region in Figure 9 will disperse rapidly as it is advected with the variable groundwater velocity. This type of dispersion is difficult to quantify since the numbers of multilevel samplers as shown at 3 different levels in Figure 9 may not be sufficient to describe the plume. Fully screened samplers will detect the contaminant, but samples will be diluted with water from a noncontaminated elevation in the aquifer.

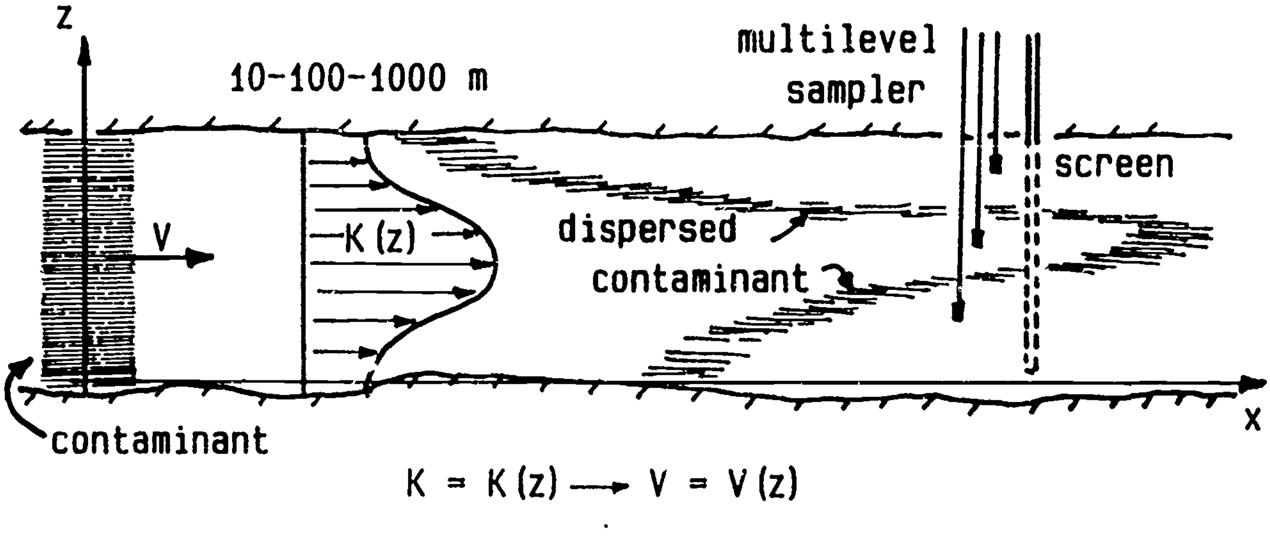


Figure 9. Field Scale Advective Dispersion

TRACER INJECTION FIELD EXPERIMENTS

The importance of this advective dispersion was demonstrated in a series of field experiments conducted by Auburn University with the support of the USEPA from 1983 through 1986. There are many groundwater problems which deserve research effort. This particular activity is summarized here to give the reader one example of research activity which has had significant practical impact.

In a confined aquifer located north of Mobile, Alabama, a groundwater field test facility has been developed, and many experiments have been conducted since 1975. Many wells have been drilled, and many tests have been conducted. Although not so controlled as a scientist would like to have in a laboratory the hydrogeology of the aquifer is well-known.

Two basic tracer experiments are described here. The first type is called the single-well experiment. The second type is the two-well experiment. The single-well experiment, described in Figure 10, was conducted in the following steps:

(1) An injection well was pumped at a constant rate, Q = 140 gpm, to establish a horizontal, radial groundwater flow away from the well. (At a distance 15 ft. from the well, this pumping rate gives a seepage velocity of approximately 0.5 ft/hour.)

(2) Having established the radial flow, a slug of sodium bromide tracer was added to the injection water.

(3) This tracer mixed with the injection water and moved radially from the well. At elevations of higher hydraulic conductivity aquifer material, the tracer moved faster.

(4) Multilevel observation wells were constructed approximately 15 ft. from the injection well and designed so that water samples could be taken from several elevations in the aquifer. These samples were then taken to the laboratory to measure the bromide concentrations.

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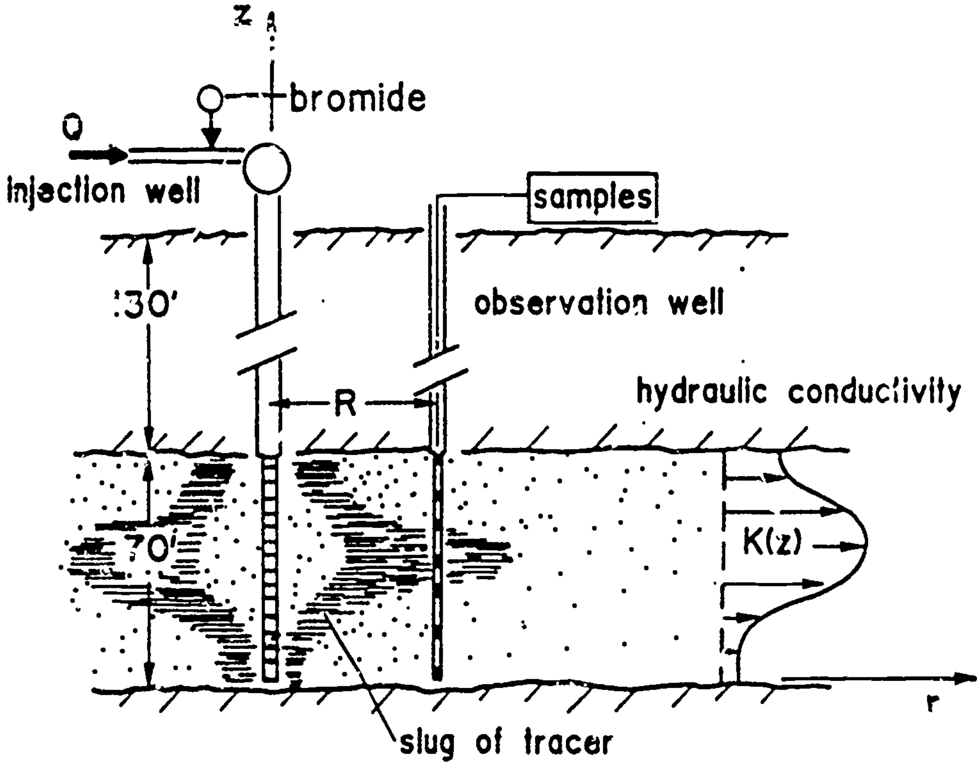

Figure 10. Single-Well Tracer Injection Experiment

The typical single-well injection experiment required 3 days, monitoring 24 hours/day. More than 500 samples were collected and analyzed for a typical experiment. (Four single-well experiments were conducted at the Mobile site). Tracer travel times from the injection well to the observation well depended on the aquifer hydraulic conductivity. At elevations in the aquifer of low permeability, the travel time was larger than it was at elevations with higher permeability. From these data the hydraulic conductivity profile, K(z), was generated. Commonly used aquifer measurements such as pumping tests provide an average value of the hydraulic conductivity for the entire thickness of the aquifer and do not provide the detail of the variation of the hydraulic conductivity through the thickness of the aquifer. This variation, specific for individual aquifers and to location in the aquifer, is very important for accurate prediction of contaminant transport.

A second type of experiment conducted at the site was the two-well experiment. This experiment is described in plane and vertic section views in Figure 11. The objective of this experiment was to simulate a large scale contaminant transport problem and to compare measured results with predicted results which were modeled based on the single-well K(z) data.

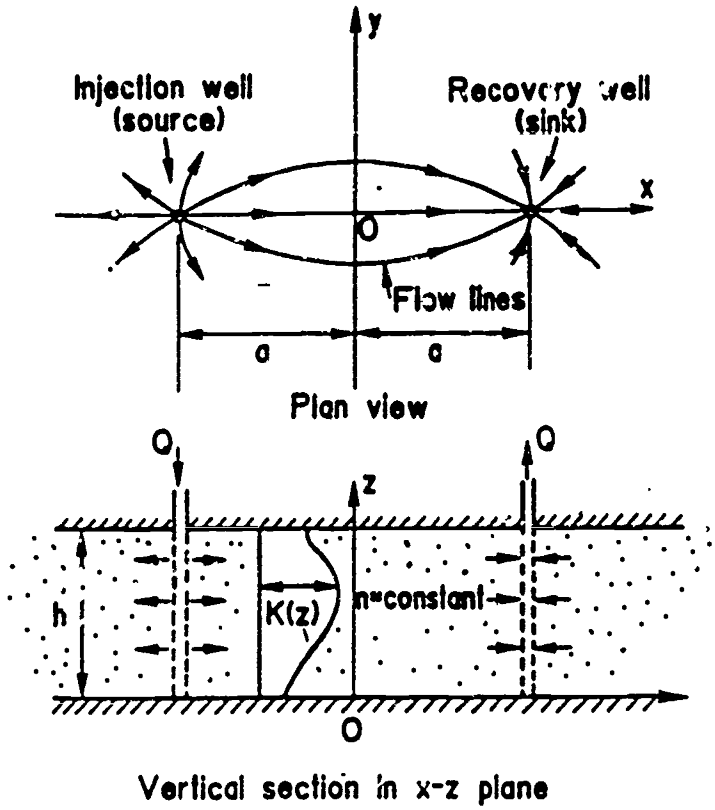

Figure 11. Two-Well Tracer Injection and Recovery Experiment

The two-well experiment was based on flow established between an injection and a recovery well, separated by 125 ft. and pumping at 250 gal/min. The test was conducted in the following steps:

(1) The injection and recovery well were pumped continuously at 250 gal/min to establish the flow field shown in Figure 11.
(2) Sodium bromide tracer was then added to the injection water (C=140 mg/l) for 4 days.
(3) Water samples were then collected at multilevel observation wells (similar to that described in the single-well experiment), and samples were also taken from the water pumped from the recovery well. These samples were then taken to the laboratory for analysis of the bromide concentration.

The recovery well concentration is shown in Figure 12. After addition of the tracer to the injection water, 100 hours was required for the fastest moving tracer following the shortest pathway to arrive at the recovery well. The concentration peaked at about 220 hours, and then began a slower decay. The test, requiring monitoring and sampling 24 hours/day, was terminated after 720 hours (30 days).

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As shown, Case A, in Figure 12 is a predicted recovery concentration from calculations based only on the K(z) data from the smaller scale single-well experiments. For groundwater measurement and prediction, these data are quite remarkable. The conclusion of this study was that K(z) measurement is very important to geologists and engineers who are attempting to model contaminant transport in ground water.

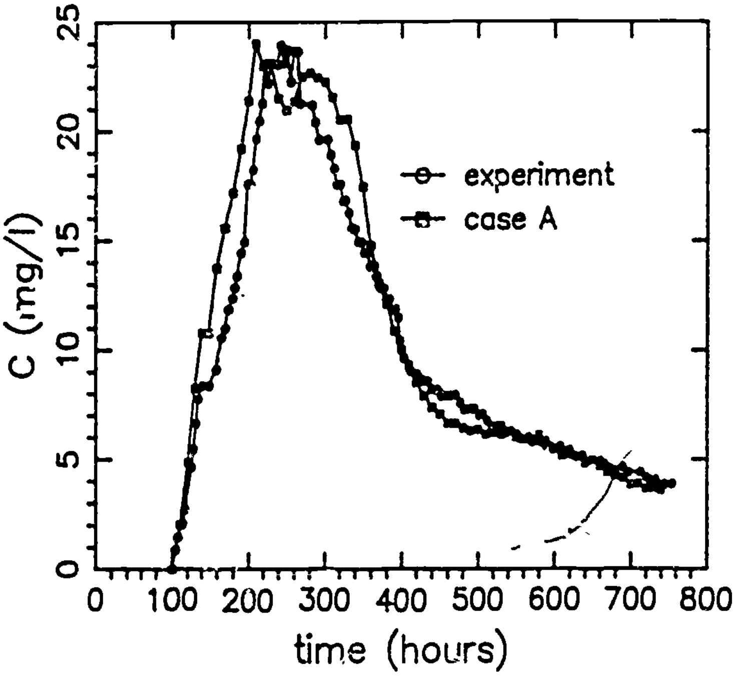

Figure 12. Recovery Concentration in the Two Well Equipment

CONCLUSIONS AND DIRECTIONS

It has been estimated that less than 1 percent of groundwater is polluted. The small percentage should not be a reason to relax concern. Not all groundwater is accessible, and because of the very slow seepage rates mistakes can abide for centuries. Many problems are poorly understood. Here we have discussed only the transport of groundwater. Chemistry of groundwater and contaminants is equally important and probably less understood.

Some clean-up of problems is possible, but it is also clear that many sites must be contained and abandoned. The primary concern is to stop creating new problems. Clean-up, containment and protection will require continued research, money and time. Avoiding future disasters and treating current problems reasonably depends on two levels of education.

At the first level, practice and research in hydrogeology requires educated engineers and scientists. Both specific and general education are necessary. Like the more developed field of structural engineering, there is a developing body of knowledge in hydrogeology which requires specific courses and teachers. Perhaps in contrast to the specific, a broad fundamental background in mechanics, chemistry, thermal science, mathematics and geology is essential to understanding the scope of problems and developments in hydrogeology. Of course capability with computers and instrumentation requires more background. Particularly at the undergraduate level, this essential broadness of study is missing and declining from many engineering programs. It is not that expertise is required or possible in all these areas, but critical communication with colleagues of diverse specialties requires broad education and interest.

The second, and equally important level is public education. Armed with improving scientific knowledge and public concern, political and governmental forces are taking action on concentrated industrial and urban contamination sites. In the long run, however, groundwater education and action associated with distributed rural practice and development will be just as significant to protection of the groundwater resource.

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TRANSITION TO ACTION: WHAT ARE THE ISSUES?

O. Norman Nesheim
Pesticide Information Coordinator
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Everyone drinks water. It is essential to life and health. We use it to drink, for bathing and sanitation, to irrigate our crops, and to water our livestock. We also depend on it for energy and for many manufacturing processes that produce the products we use in our daily lives. We use water for recreational purposes. Water is an integral part of our lives that we are used to having when we need it. We tend to take it for granted that adequate, clean water will be available when we need it.

We are dependent on surface and groundwater for our sources of water; there are no other usable sources. With our complete and total dependence on water, it should come as no surprise that the issue of water quality is receiving so much attention. While it is an issue of world wide importance, it really is not a new issue. Throughout history people have sought clean, adequate sources of water to support settlements. Water influenced where they settled and caused them to move on when the water was no longer suitable or adequate to support their needs. Now we no longer can move on when the water is not adequate or suitable for our needs. We must maintain the quality of existing sources for our needs. Increasing population, urbanization, industrialization and agricultural usage have caused microbial and toxic chemical contamination of water sources and have focused our attention on the protection of this resource. Besides concern for the quality of water, we are facing increasing competition among cities, industry and agriculture for available water resources. For example, south Florida is facing stiff competition between a growing population and extensive agricultural needs for water. Questions are being raised as to who has first priority for the water. Water is not the unlimited resource that many once assumed.

Protection and cleanup of our water has received attention from environmental groups, the media, the public and politicians. Laws such as the 1972 Clean Water Act have been responsible for bringing about significant improvements in surface water quality through the regulation of the effluent from specific point sources such as municipal sewage treatment plants and large industries. Lake Erie and several rivers in industrial areas have had significant improvements in their water quality. The significant successes of legislation such as the Clean Water Act in cleaning up lakes and streams have not caused the issue of water quality to fade into the background, however. Present concerns about water quality are focused on toxic chemicals, groundwater protection, protection of wetlands, and the need to maintain and improve on the water quality success achieved earlier. There is a growing emphasis on nonpoint sources of pollution--the pollution that comes from diffuse, indirect sources such as fields, forests, mines, construction sites, city streets and other areas. The focus is no longer on municipal and industrial waste discharges but on many sources, including small businesses and agriculture.

Contamination of wells from landfills, toxic waste sites, leaking underground storage tanks and pesticides has raised concerns about groundwater quality. Protection of groundwater has become a local, state and national issue currently surpassing concern about surface water quality.

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Groundwater serves approximately 95 percent of this nation's rural residents and 50 percent of its urban residents as their source of drinking water. The discovery of aldicarb in the groundwater in Suffolk County, New York, in 1977 as the result of normal agricultural use focused on agriculture's role in groundwater quality. Many states began monitoring their groundwater for agricultural pesticides and fertilizers and have reported detections of several pesticides and nitrates. According to a 1985 national poll, 80 percent of the U. S. population believes that groundwater pollution is a national problem, and over 50 percent of the people believe it to be a problem in their community. Nearly 70 percent of the persons surveyed responded that they believe agricultural fertilizers and pesticides cause water pollution.

Recent articles in the popular press have questioned agriculture's role in the quality of our surface water, streams and lakes as well as our groundwater. These articles identified agriculture as the major environmental problem and the principal unregulated source of water contamination today. A recent national news magazine singled out agriculture as the primary cause of nonpoint source pollution and stated that industrial and municipal sources have been dealt with under laws and regulations that have excluded agriculture from regulation. Some have been critical of the agricultural research and extension programs of the land-grant universities as contributing to the problem. Low Input Sustainable Agriculture (LISA) is being touted by environmental groups and politicians as the solution.

We have discussed the importance of water and have established the growing public concern about water quality. We have not discussed the contaminants found in water. There are probably several ways to discuss them, but I prefer to consider them as either natural or human made.

There is a perception held by some that water in its natural state, i.e. untouched by man's activities, is pristine and pure--a perception that is not very realistic. Surface water and groundwater naturally contain organic substances, minerals, sediment, bacteria and viruses. Properties of the water such as hardness, salinity, pH, color, taste and odor are dependent on natural contaminants. A bottle of Perrier or the mountain spring water that goes into the golden brew is not just pure molecules of H_2O.

Minerals present in soil and rocks can and do contaminate groundwater. Nitrate is a natural contaminant in some areas; however, high levels of nitrate that cause problems are usually human-made. Other natural contaminants such as radium, barium, fluoride, chloride, lead, zinc, iron, manganese and sulfur also are found. The radioactive contaminants present in some areas are of concern to some because of the cancer risk, but the risk is extremely slight due to the amounts present.

Naturally occurring microbial contaminants come from plants and animals that normally live in water as well as decaying plants and animals and their wastes that find their way into water. The breakdown products of these plants and animals release organic substances to the water.

Manmade sources of contaminants include toxic chemicals and microbes. Microbial contamination occur from manmade sources such as septic tanks and municipal and industrial waste treatment facilities. Toxic chemicals are poisonous substances produced by or used in a chemical process. A substance is toxic if it will be harmful to any animal, insect or plant at any stage in its life cycle. Sources of toxic chemicals include:

Industrial Sources:

Manufacturing: hydrocarbons, solvents, metals, acids, salts, organics
Mining: salts, acids, metals, erosion
Power generation: metals, acids, salts
Food and fiber processing: organics, solvents, preservatives
Construction: solvents, hydrocarbons, erosion
Agriculture: pesticides, nutrients, erosion
Chemical processing: solvents, hydrocarbons
Store and plant parking lots: metals, hydrocarbons
Airports: solvents, hydrocarbons, metals

Local, State and Federal Government Sources:

Schools and universities: anything
Streets and parking lots: metals, hydrocarbons
Waste treatment plants: metals, organics, nutrients
Landfills: anything
Deep well injection: metals, organics, nutrients
Pest control projects: pesticides
Water control projects: erosion, acids
Military: anything

Private Sources:

Automobiles: metals, hydrocarbons
Illegal dumps: anything
Landscape care: pesticides, nutrients
Septic tanks: organics, nutrients, pathogens
Boats: hydrocarbons
Aquatic weed control: pesticides
Home chemical use: solvents, acids, metals, pesticides, hydrocarbons

This is obviously only a partial list of chemicals and sources. The list could go on and on. Even nature releases a variety of toxic chemicals, frequently through unusual or catastrophic events, which can adversely impact the environment.

Whether these natural or manmade contaminants are a cause for concern depends on the intended use of the water. Domestic, agricultural, or industrial uses all have different recommended concentrations for natural contaminants. Standards have been established for some manmade contaminants. Effluent standards have been established for certain industrial and municipal discharges. The use of the water, the amount of the contaminant, and the public's

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perception of the contaminant are all factors in determining the impact of the contaminant. The impacts may be biological, physical, economic or health related.

Biological impacts. We are familiar with the problems produced by high nutrient input into water bodies. Increased nutrients from whatever source when added to a water system will increase biomass production and thus change the plant and animal diversity. Toxic pollutants if present in high enough concentrations may be toxic to plants or animals that are present in the water or that use the water.

Physical impacts. Soil particles from erosion in excessive amounts can make water cloudy, clog bodies of water with sediment and bring about other changes due to pesticides, fertilizers and other chemicals that may be carried in the sediment.

Economic impacts. Economic impacts occur when contaminants prevent the water from being used for desired or needed purposes. Communities whose water supply is contaminated face disruption and increased expenditures. Economic development in communities with water quality as well as water quantity problems is stifled. Agriculture is disrupted if there is a lack of sufficient water or water of the quality needed.

Health impacts. The importance of biological, physical and economic impacts of the contaminants found in water is dependent on the use made of the water. In the public's view, however, the concern about health impacts takes top priority. The health effect that the public is most worried about is the big "C" word, cancer. Do the contaminants cause cancer? Many chemicals in water contributed by man's activities and some by nature are known to cause cancer. Science has basically been unable to come to a conclusion as to what real threat traces of these chemicals in water pose to us. Public health agencies have established limits for certain contaminants in drinking water. Government agencies are faced with making a determination as to how much of a carcinogen or toxic chemical is safe. Such agencies focus on risk assessment to make such judgments. Risk assessment is an attempt to determine the likelihood that a hazardous agent will cause a serious health problem, and if so, how serious the problem might be. These same agencies must make decisions to manage the risks determined in the risk assessment process.

We face many challenges in dealing with the water issue. These challenges are being made on our research and extension programs. We need more research on how to prevent contamination of our water resources, how to clean them up, and we need to have better knowledge of the significance of micro amounts of contamination.

Although the issue of water quality has achieved public prominence, we need to increase efforts for educational programs about the nature of water resources, their importance to human health and the options for keeping them safe.

We need to develop programs about the impacts of agricultural, industrial and domestic chemicals on groundwater quality. We need to increase our programming efforts on the use and fate of these chemicals and their proper handling and disposal.

A particular challenge is to deal with the meaning of small amounts of chemicals in our water and food. We need to effectively communicate the costs of achieving zero risk. Maintaining water quality and food with zero risk is not realistic and is certainly not without costs. Where will the fiscal resources come from? We must learn to effectively deal with risk communication.

We will need to expand our efforts to work with new audiences to include governmental officials at local and other levels to increase awareness and understanding of land use, chemical use, groundwater quality and options for addressing such issues. We will need to work with agencies, organizations and audiences that are outside of those that we have traditionally worked with.

We have created our water quality and quantity problem. We must continue to define it, and we must work together to develop solutions to the problem that we can implement and live with. Since we are the problem, we must become the solution.

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THE ROLE OF PUBLIC POLICY IN WATER QUALITY PROTECTION

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INTRODUCTION: POLLUTION AS A SOCIAL DISEASE

Pollution of ground and surface water is definitely on the national, state and local policy agenda. It is a full-fledged policy problem--causes are being rooted out, defined and attacked in one way or another. As Sandra Batie confirmed in her Presidential Address for the Southern Agricultural Economics Association (1988), agriculture is part of the problem. Thus, it stands to reason that farmers will be called upon to act more responsibly on behalf of all water users. As a part of the loosely defined agricultural establishment, we in the land-grant universities have a stake in that process. Improvement of water quality is an issue that we cannot avoid as various elements of the extension and research clientele square off on questions of how and by whom our water will be used.

The term "pollution" is normative--like urban sprawl or family farm. There are reliable chemical and biological measures of water quality, but the judgment that water is or is not polluted is subject to differences of opinion. Prevailing standards of acceptable quality differ from place to place and depend on expected use. The growing market for "sparkling spring water" served by the quart or gallon in supermarkets all over the country is evidence that for some any faucet is suspect. We had a shot at establishing all encompassing water standards with the Federal Pollution Control Act of 1972, with later amendments, but they could not survive. "Fishable and swimmable water by 1983" was just not an achievable goal--too restrictive for some waters (reasonable people would never swim in Cleveland's Cuyahoga River, and the cost of making it possible would double the budget deficit) and too lenient for others. Catchable fish can survive in very dirty water.

The point is that water pollution is a "social" issue, an emerging pattern of attitudes about certain measurable chemical properties of water. Attitudes about anything are part fact, myth, fear, hope and stubbornness, all subject to new information. Only attitudes that are broadly held and persistently voiced galvanize into a legitimate policy issue. Water pollution has done so. Political groups have formed with the primary mission of pushing policy to change the rules for water users. Pollution is a policy problem because people say it is and are willing to do something about it. Further, the causes and cures of water pollution are products of human behavior. Water becomes unacceptably dirty because of what people do with it or to it as they engage in legitimate pursuit of personal or economic well-being. It stands to reason then, that protecting or restoring water quality will require changes in water use behavior by many people. As is usually the case in policy, those with strongest views about urgency of the problem are not the ones whose water use directly causes the problem. There are two important implications of that--people are generally most adamant about problems imposed by others; and it is easier to be adamant when you do not have to sacrifice much for the solution.

A general economic paradigm may be helpful here. Water is important to people because it produces various sources of utility--income, direct consumption, enjoyment of water recreation, etc. Polluted water generates less utility to many users. Successive increments of quality improvement add increments of value for the user. Salty water, for example reduces crop production. Reducing saline concentration increases returns to irrigation water applied to a crop that will be sold. Thus, demand for water quality improvement is a function of additional utility of clean water. On the supply side, clean water costs something to produce; costs in water treatment or income foregone to reduce pollutant loadings. The optimal level of water pollution in this clever little procedure is that level of pollution reduction where the value of an additional unit of quality enhancement is equal to the cost of providing it. There are all sorts of empirical problems here, but the basic point is that pollution reduction is valuable, but also expensive. At some level of quality enhancement any user might agree that enough is enough. The practical problem is that those who clamor for absolute purity do not perceive a cost. What makes sense collectively breaks down for the individual.

POLICY OPTIONS FOR CHANGING WATER USE BEHAVIOR

There are two basic categories of policy actions to reduce water pollution. First, government may directly restrict the rights or choices available to water users. The regulatory power of government at every level, from national to special purpose district, is a well established means for solving problems. Farmers and other water users exercise various property rights to water in enterprise, rights established in law. Those rights may be redefined in the public interest. Secondly, governments may use taxes or credits to penalize or reward water users in ways that support the public interest. The essential purpose in any policy change is to alter those human actions that seem to cause problems. Any change has gainers and losers, and implies a cost to the public treasury.

All levels of government have established roles in water quality protection. Federal statutes generally establish overriding authority, responsibility and funding. States have their own regulatory and incentive programs that differ with prevailing state attitudes about problem severity and acceptable or reasonable public action. Local governments, including special purpose districts, have been particularly important to agriculture. Land use planning and control are still largely local functions.

Regulatory

The general idea in mandatory water use changes is that protecting the public health, safety and general welfare requires that users sacrifice certain water or land rights. In theory any inconvenience to the individual user is offset by gains to society. There are several types of water quality regulations (Anderson, DeBossu and Kuch, 1989).

Performance Standards. Maximum pollutant discharge rates may be mandated to control what goes into the water. This approach acknowledges that some pollution is acceptable, but a specific limit is defined. The water user has discretion in how the standard is achieved consistent with whatever valid use the person has in mind. A farmer, for example, can apply fertilizer with his irrigation system so long as run-off or leachate does not pollute too much. The U.S. Soil

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Conservation Service has established and attempted to implement an erosion standard for farmland that stops erosion that is greater than the rate of soil replacement. Enforcement of performance standards requires data. Much public effort in water quality programs is focused on collecting data that monitor compliance with the rules. Selecting a standard can be a political process as well, reflecting differences of opinion on how clean is clean and how much risk of future health problems should be borne by the government rather than other water users. Performance standards are generally more feasible for point sources of pollution (a factory or feed lot) than dispersed sources (crop farms).

Design Standards. Requiring water users to employ specific safeguards limits their options even further. Water quality improvement rules near Lake Okechobee in south Florida require dairy farmers to install defined best management practices. Several water management districts in Nebraska may restrict farmers to farm technologies that protect water quality (Aiken, 1987). Fertilizer use is limited, based on type of soil. For example, fall and winter applications are prohibited on sandy soils over groundwater with high nitrate levels. In Pennsylvania, farmers with more than 25 acres must install defined erosion-reducing structures or face a substantial fine (Anderson, DeBossu and Kuch, 198?). Danish farmers must have a nine-month storage capacity for manure and must plow it in within 12 hours of application. Another standard requires 50 percent less pesticide use by 1997 (Dubgaard, 1989). In all such cases, enforcement is a problem. The design regulations may also include requirements for regular reporting of water quality by the land use.

Permits for Use of Potential Pollutants. Not just anyone can spray pesticides these days. Several states require applicator training and certification. The Federal Insecticide, Fungicide, Rodenticide Act (FIFRA) administered by the Environmental Protection Agency, requires that pesticides be tested and registered as safe before they can be sold for use. Data collection is costly for the applicant, often more expensive in sales than the chemical is worth. Some pesticides will be lost to farmers simply because cost of registration exceeds likely returns. The implicit assumption with this category of regulations is that incomplete knowledge of chemical hazard is infinitely unacceptable. No data, no registration, no use. The California Pesticide Contamination Act of 1985 requires the registrant to document effect on groundwater.

Land Use Zoning. Sensitive groundwater recharge areas may be protected by regulating use of those lands. Zoning and subdivision regulations are essentially local government actions though state guidelines may be provided. In Virginia, the state legislature has given local governments specific authority to protect groundwater recharge land. In southern Minnesota (Batie and Diebel, 1989, pp.30-33) and central Michigan (Tri-County Regional Planning Commission, 1982) local governments are collaborating to regulate land important to the groundwater aquifer. Crystal Lake, Illinois, has established four watershed protection zones that limit development that might threaten lake quality (DiNova and Jaffe, 1984, pp.104-107). Rules to restrict land use within 200 feet of sole source aquifers in Florida have been debated (Carriker, 1989, p.25). The Netherlands has had a program similar to the Florida proposal since 197? with protection zones based on rate of groundwater movement to the wellhead. Farmers are prohibited from applying certain pesticides within those zones. While zoning authority is well established in law and practice, experience in protecting ground or surface water through land use zoning is limited. There is more potential than experience. Transfer of Development Rights (TDR) approaches offer a means by which those asked to keep land undeveloped to protect recharge areas could be compensated by landowners who may sell for development. Again, there is little real experience with this approach, but the potential is there (DiNova and Jaffe, 1984, pp.100). TDR programs establish an administered market for the right to develop and is operated in conjunction with a zoning ordinance.

Controls on Specific Pollutant. State and federal regulations may also control use and disposal of substances that could contaminate water. There are rules for disposal of solid waste, an increasingly troublesome issue for many different reasons. We have chosen to ignore the fact that most products leave a residual to be dealt with in some way. Yet in our economic system, the price of a product makes no allowance for cost of disposal. We handle waste disposal the way we do fire and police protection--an external safeguard to protect us from each other. The right to create waste remains with producers in our economic system, with the obligation to get rid of it borne by taxpayers. Perhaps we need some institutional reform here to force the buyer of a product to account for disposal cost in price paid. That could mean higher prices for plastic cups than pape higher junk fee for a Cadillac than an Escort. But that is another paper. From a water pollution standpoint, the important thing is that waste be disposed of properly to avoid leaching or run-off. When costs of proper disposal get high enough, we may get serious about major institutional reform.

There are special regulations on hazardous waste disposal at both state and federal levels. The Toxic Substance Control Act and FIFRA are the main actors at the federal level, and most states have their own hazardous waste management acts. Radioactive wastes are a special category of hazardous substances with their own rules. There are state regulations on underground storage tanks, oil and gas production sites, waste water treatment facilities, sand and gravel pits, and other land uses that may contaminate ground or surface water (DiNova and Jaffe, 1984). The Federal Safe Drinking Water Act of 1974, specifies maximum contaminant level and requires monitoring of water quality and enforcement.

California may have a far-reaching and dramatic environmental proposal on the ballot in 1990. It would ban all pesticides and herbicides known to cause cancer, fully implemented by 1996. In cases of severe economic hardships, a three-year extension would be available (Reinhold,1989, pp.1).

Implications of Regulations. Regulations achieve changes in water use behavior the old-fashioned way--they force it. Users lose options they once had, with greater discretion exercised by a government unit on behalf of other water users. Not all who lose rights do so gracefully, even though they may acknowledge the health hazards of dirty water. Problems arise when the source of contamination is unclear, or where the loss of specific land use action has no obvious impact on water quality. Economists speak of free rider or unwilling rider situation when a resource user is asked to pay for a good or service that can be withheld from no one. A more descriptive concept may be the "why me syndrome." The sense of security one gets from knowing that drinking water is safe is available to all whether they pay something or not. Similarly, the inherent natura aste processing capacity of ground or surface water source is available to all with access to wa .r. Sacrifice by one user is likely to have little direct and attributable effect on quality. Thus, it is not surprising that people object when required to avoid certain income producing land or water uses that may make people feel better about their water supply. That does not make regulatory approaches any less viable. They are important to the overall policy package.

Economists also fuss about the inefficiency of regulations because they give inadequate attention to the marginal costs imposed by various polluting activities. Since the consequence of a water quality level differs from place to place, a single standard or rule creates cleaner water than is "needed" by some users, under some circumstances. The more zealous among us have gone so far as to suggest that economics say that regulations are less desirable than taxes or incentives. That is nonsense, of course. Disciplines do not decide things, people do. Some economists definitely feel that regulations are inappropriate--they certainly have that right. But there is nothing inherent in the discipline that must bring all analysts to that normative judgment. A far more productive strategy, in my judgment, is for economists to assist in analyzing the performance of regulations along with other ways to change pollution behavior. The important questions are how much measurable water quality change are we buying at what price in enforcement or administrative cost, and perhaps more importantly for the policy process, who is paying or gaining from those quality changes. The distribution of impact is what drives policy. Cost in this sense could include foregone income by a water user or any other inconvenience that may produce a political response.

Bribes and Penalties

The other major way to get the attention of water users who may be causing problems for others is to bribe them to do good or penalize them if they don't. Users retain the options they always had to irrigate, apply chemicals, use water in a manufacturing process--but the costs or benefits of those actions may be altered by public policy.

Penalties. A specific tax, or other penalty, may be levied on actions that create water quality problems for other users. Purpose is twofold. First, by raising the relative cost of polluting actions, people may be dissuaded from those activities. Secondly, any money raised by the tax may be used to monitor progress, research new ways to mitigate pollution, or educate water polluters about the consequence of their actions. All are intended in the Iowa fertilizer tax. The 75 cents per ton will not discourage many farmers, but is at least an acknowledgement that a higher price is defensible to internalize those costs imposed on others. In Sweden a 10 percent tax on nitrogen and phosphorus fertilizers is used for environmental research and extension and has reduced fertilizer use (Kum, 1989). A tax may be levied on the output of a polluting activity or an input (Segerson, 1989, p.12-17). In the former instance, a per bushel fee might be imposed on corn or soybeans produced on soils known to require substantial added nitrogen and to overlay an important groundwater aquifer. Experience with this approach is limited to nonexistent, but it is technically possible. An input tax seeks to alter the production decision by making those polluting inputs (fertilizer, pesticides, irrigation water) more expensive. It has to be a purchasable input, though, and so far irrigation water is basically free to anyone with rights to it. An energy tax might be imposed to make pumping more expensive, but it could have unintended side effects on other energy uses. Specific registration fees might be charged, as in Wisconsin where producers of agricultural chemicals known to be likely polluters pay a substantial fee that is used for groundwater protection programs, monitoring and research (Bptie and Diebel, p.38).

Cross compliance provisions of the 1985 Food Security Act introduce a different kind of penalty for actions deemed to create social problems. To retain eligibility for commodity price supports, subsidized credit and other income protection, the farmer must develop and implement a conservation plan. That provision could extend specifically to actions that pollute ground or surface water. Senator Wych Fowler's proposal for the 1990 farm legislation would require a farmer to have his well water tested regularly or lose eligibility for other farm programs (Zinn, 1989, p.CRS-8).

Liability for pollution can be a penalty as well. Under Connecticut's Potable Drinking Water Act of 1982, a polluter must provide an alternative water supply. There is no requirement that the polluter has acted negligently or fraudulently, or that he actually harmed someone else. The fact that the polluter's water use limited opportunities for other users is sufficient grounds to require that an alternative source be provided. That could be expensive; thus the penalty for using water inappropriately could be rather high. The Act was subsequently amended to reduce the burden for farmers who follow chemical application instructions--they are still liable for any damages, but need not provide an alternate supply. An advantage of this approach is that public agencies can back out of the water quality business. With all enforcement in the hands of private parties acting through the courts, government need not maintain elaborate monitoring programs. The obvious disadvantage is that we must rely on an overworked and often under-informed legal system responding to water quality crises (Batie and Diebel, pp.18-21).

Subsidy. The final general category of policy approaches to groundwater quality protection is to subsidize water users who protect the general public interest. Acreage reduction programs of USDA could be directed at crops that pollute water rather than those in surplus. The Conservation Reserve Program under the 1985 Food Security Act essentially rents erodible land from farmers for a defined contract period. Instead of regulating against farm practices that might pollute ground or surface water, government may bid that land away from the farmer. Proposals by Senator Bob Dole of Kansas and Senator Sam Nunn of Georgia would extend that concept to special environmental land in 1990. Public support of research and extension programs on water quality can subsidize a water user's gathering of relevant information, leading to a decision that protects water quality.

Florida's "Blue Belt" amendment to the state Constitution permits legislation that would lower the property tax on land important to groundwater recharge Cost sharing programs in many states help farmers bear the cost of installing pollution control structures or practices.

If these incentives are available on a "take it or leave it" basis, the landowner decides whether the incentive is sufficient to replace the returns to water in a use that may be polluting. Each landowner decides for himself. The rest of us have to hope that we are penalizing or bribing sufficiently to acquire the water quality we need. Of course, farmers and other water users are motivated by more than income. Most do care about the health of their neighbors, do have a resource stewardship ethic, and may act on that sense of responsibility. While no one would suggest that farmers and other water users lack concern for other people or the integrity of the resource, few policy makers are naive enough to believe that good will is a sufficient force for policy choice.

THE EDUCATOR'S CHALLENGE

The basic purpose of Extension education in this area of water quality improvement is to help people make better water use decisions. "Better" in this instance refers to water use choices that protect the health, safety, and general well being of people, including the integrity of natural systems. "Decisions" are both individual and collective. There are various invention points for education from planning and discussing new ideas, to helping voters understand particular proposals, to rule-making and permitting by agencies.

Fundamental to water use decisions that reduce water pollution is information on sources, fate and effects of various contaminants. Farmers and other water users need to know how their actions affect water quality and how water quality differences are likely to affect human health, both their own and their neighbors'. Communities need information on types of pollution sources, mechanics of water movement, and risks associated with various contaminants. These are complex topics.

But, success requires far more than information. We need thoughtful policy changes, adjusting the obligations and opportunities of water users. To repeat the assertion made earlier in this paper, pollution is basically a policy problem to be reduced by changes to the rights and obligations of water users. Thus, a major challenge for water quality education is to identify the techniques by which water use behavior may be changed, the costs and effectiveness of those options, and who pays or gains under each action. Voters, policy makers and taxpayers need information on the current experience with the various policy techniques. Other states, localities, and nations have had to deal with pollution. Hopefully, we can learn from their experience. Regulatory measures may force the water user to change behavior, whatever the personal cost. A zoning ordinance that prohibits the landowner from developing land in order to protect the recharge area may cost the owner substantially in capital value or income. Simply buying that recharge area or leasing it through a special Conservation Reserve program costs the taxpayer, but reimburses the individual being asked to change. The regulatory approach implies that land and water rights reside with the public and need only be exercised in the public interest. Subsidy and acquisition methods imply that the owner retains the relevant rights, and reduced water pollution must be <u>bought</u> in some way. There are outraged proponents on both sides of that basic policy issue. Policy education must help clarify the cost and benefit implications of all options under consideration.

The question of who will pay for pollution reduction may be the most fundamental for future policy in this area. This is dangerous ground for the educator, particularly in the land-grant university. Our traditional clientele, agriculture, is a major part of the water quality problem. While farmers and food processors may acknowledge that they occasionally inadvertently pollute ground or surface water, they object to being forced to pay the full cost of pollution abatement. They look to the research and extension expertise of the land-grant university to help find less polluting technologies. They also ask for analysis showing how much it costs the farmer or rancher to change water use. Then there are the inevitable references to impacts on the local economy when a farmer must change his operation.

We have other clientele, however. Part of our job is to help state and local officials deal with water pollution and other social problems. We must help families and, yes, even environmental

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groups and agencies make reasoned choices about water quality. There will be times when university faculty are found on both sides of a particular policy conflict over who should pay for pollution abatement. That is not a new situation for many of us, but the intensity of the issue is picking up. These are interesting times.

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TRANSITION TO ACTION: WHAT ARE THE ISSUES? RISK AND RISK MANAGEMENT IN A FAIRLY ORDINARY WORLD

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We are gathered here to talk about risk, whatever that is, and the way it is perceived, and the way information about risk is transmitted from the people who are presumed to know about it to the people who are presumed not to know about it. It is difficult sometimes to tell which is which.

I am also supposed to discuss risk management. We may be in for trouble. The fact is that risk management is not my field, which means that I can discuss it as freely as I do sociology, which is also not my field. My view of risk management is therefore either exquisitely simple, or as complex as ignorance can make it. I tend toward the former, and the precept is certainly simple: if you don't want it in you, don't get it on you.

I said, "risk, whatever that is," because everyone seems to have a personal and unique conception of risk. We all have some kind of a private, often subconscious position, about what risk means in personal, social and political decision making.

We must start with a simple definition. Risk is the probability of some adverse consequence resulting from a given set of circumstances or actions. Here, we consider risk as the probability of biological harm, actually human harm, arising from possible exposure to chemicals. We could as well consider livestock or fish with the same approaches, except in these cases the individual would usually not be as important as the population as a whole.

Why should such stuff as risk and risk assessment be important to anyone but scientists? In your own scheme of things you may believe that only scientists worry about things like risk, and tell us that saccharine will give us cancer. So why worry? Everybody uses saccharine. Perhaps your viewpoint is just the opposite; scientists tell us that pesticides are not causing cancer, but "everyone" knows they are.

Virtually every political or social decision has a risk assessment buried in it somewhere. (Often, as a matter of fact, chemicals are involved in even seemingly social decisions.) People who influence or who make policy have choices of considering risk as carefully as possible, or proceeding without such information, or proceeding on the basis of perceptions that may have no connection to real information. Even the risk assessment that is ignored is a factor in the decision.

The point of this discussion of risk is to show you that there are orderly ways to arrive at estimates of the risks that confront people as results of our daily, ordinary, and not so ordinary exposures to chemicals or other hazards. The methods are imperfect, to be sure, but they provide

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a reasonable view of unseen impacts that is infinitely superior to just guessing with no information but our own personal biases and fears.

The difficulty is that none of us deals with risk in a completely rational fashion. I try, but I can't claim to be completely without some passion about such things. Therein lies the problem. If we are unable to be objective ourselves, how do we expect communities or legislators or mothers to bring themselves to examine issues of possible human harm objectively? When we consider the barrages of fear-provoking statements and postures confronting the society, rational analysis becomes doubly difficult. All we can do is try to help.

Risk and risk assessment are not uncommon ideas. I would expect that almost everyone has done risk assessments. If you have never done a risk assessment, you would not have survived long enough to get to this meeting. Didn't your parents tell you to look both ways before you cross the street? Back then, you did a very conservative risk assessment, and you probably didn't cross until there was nothing in sight, let alone six blocks away. Eventually you acquired experience, judging the distance of cars, their speed, your own foot speed, and so on. Then, after your assessment, you ignored all the information and almost got run over.

A risk assessment is nothing more than gathering all the available information about possible harmful consequences of a situation before making a decision. Mortgage companies make a risk assessment before they loan on a house. International bankers do the same thing, except they loan anyway and expect somebody else to bail them out.

To use the same analogy, the degree of risk represents the probability that the lender is not going to get all the money back, or be paid the interest for letting someone else use it. Presumably the degree of risk in that case is balanced by the quality of information about the borrowers' prospects, together with the interest rate. As we will see, the quality of information is critical to the quality of any risk estimate, and as quality decreases, the ability to accurately predict decreases.

The fundamental concepts of risk are rather simple. The strategies and methods are not at all simple, but fortunately it isn't necessary to worry about them here. Some very good mathematicians and statisticians spend all their time trying to improve the way we use information to judge risk, and I do not presume in that realm.

We can be as generic as we wish when we say "chemicals." It doesn't matter whether the concern is a pesticide, a component of auto exhaust, smoke, natural food constituents, or materials in a hazardous waste dump. The basic principles are the same, across the board.

The medium may be air, water, food, abuse of drugs, or anything else. For our part here, water is our concern, but the ideas and processes are the same, no matter what the issue.

Chemical risk assessment is a process in which, first, all of the information and experience that relates to a chemical in some part of our environment is gathered, and second, a judgment is made about the prospect that it might produce some bad consequence.

There are three sets of components that are the building blocks of a risk assessment. Each set has three pieces, and is a log supporting the final structure, which we can call "risk characterization." Risk characterization is a summary of the overall magnitude of the risk that can be attributed to chemical exposure. There is some duplication in the pieces, but I like to arrange them as in the diagram below to preserve context.

RISK CHARACTERIZATION

Population must be specified	Toxicology	Exposure
Source of impact	Epidemiology	Evaluation of Dose-response
Hazard Identification	Environmental Chemistry	Hazard Identification
Subjects of Assessment	Scientific base of Assessment	Processes of Assessment

I describe the first supporting leg as the <u>subject</u> of the risk estimation. In other words, what are we talking about?

The population of concern must be specified. It could be the entire citizenry, but more likely it will be a group of workers in a factory, or children under 15, or softball players, or police, or farmers.

The source of the impact has to be identified. Again, it might be all causes, but more likely it will be something specific enough to work with, like a chemical, or auto accidents, or being hit by a meteorite.

The hazard must be known. It is pointless to simply say people will get sick. We would identify the kind of effect; cancer, or hepatitis, or spots before the eyes, or some other specific response.

For example, lung cancer is a hazard associated with smoking. The two obvious populations are those who smoke and those who live with them. Perhaps there might be a subset, such as smokers who also drink. The risk to smokers is a probability that is directly related to how many cigarettes they smoke per day. We will not concern ourselves with the risks that occur to and because of smokers who drop a hot lighter in their lap at 65 miles an hour.

The next leg might be called the scientific base of risk characterization. There are three general fields of scientific study that come together for estimation of risk.

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One is toxocology, the group of sciences that deals with the adverse effects of chemicals on biological systems. Another is epidemiology, which is the study of associations between disease conditions and environmental factors. Both of those fields must be coupled with study of the physical and chemical processes that govern environmental behavior of the chemical, which eventually tells us how much material will actually reach the subjects. For short, call that area environmental chemistry.

Don't be misled by the use of the word "environmental" here. It can mean the entire surrounding world, or the very small system defined by the combustion of a cigarette and inhalation of those several hundred chemicals produced by the fire.

The third leg is really a set of processes or stages. The first is hazard identification. We have already recognized that it is first necessary to learn whether a chemi actually can cause some effect of concern, and then learn the nature of that effect. What kind of injury does it cause?

The second is evaluation of the dose response relationship, which is part of toxicology, and in my view the single most important part of the puzzle. Perhaps it could be called hazard quantitation.

The last piece of this leg is exposure assessment of the subject population. Who has had contact with the materials, how many, how long, what concentration, and so on. As I have already said, the sciences that make up the field of environmental chemistry enable us to find that answer.

Everything comes together through a mathematical and common sense exercise that processes all of that information or experience to give us the answer as a risk characterization. Excuse me. Not THE answer; AN answer. As I hope you will see, the quality of the answer is directly related to the quality of the information used to derive it.

Therefore, a very important part of that characterization is some statement about the extent of scientific uncertainty about each conclusion. If there are four studies giving good data, the evidence might be combined to give an estimate about which we can have more confidence than if there is only one experiment. Along with the best judgment of good scientists, it is up to the statistician to determine some range within which the real answer may be expected to lie.

It sould be no surprise that there are ranges of error in specific data, as well as ranges of interpretation of data. The idea of scientific controversy or disagreement has been given much more social meaning than it deserves, however. Scientific uncertainty is not the controversy generated by some individual on the fringes making statements that have no foundation in fact and scientific principle. The real uncertainties derive from the quality of individual experiments, amount of real information, divergence or agreement of the various data, and range of judgment of competent scientists as they evaluate the information. Experience tells us clearly that when good scientists examine information, for example a scientific publication, they will agree quite closely on what the paper says. As to the interpretation of the paper relative to a given question, they will diverge to a greater extent, but there will rarely be some vast range of opinions about what the work means.

TOXICOLOGY IN RISK ASSESSMENT

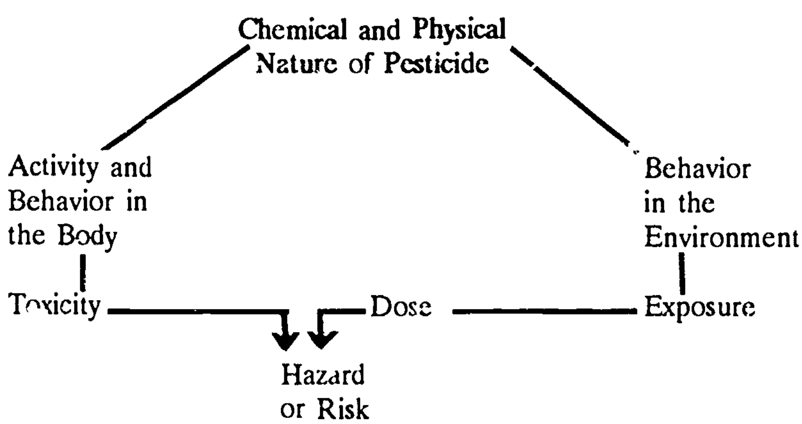
Possibly because I am a toxicologist, we are going to delve into some details of the nature of risk and risk estimation from the basis of toxicology, and perhaps a little environmental chemistry. I have already told you that toxicology is the science or collection of scien . that deals with the adverse effects of chemicals on biological systems. There are a few qui damental ideas that are the basis of toxicology, and while you may be unaware of it, yo probably quite familiar with them. You just haven't thought of them in this way, and I want to view them.

The most important consideration is that we occupy an orderly world. You may not believe that, but if the people were not here, everything would behave in an orderly and explicable fashion, complying with all of the laws of physics, chemistry and biology. Order is, of course, relative. Earthquakes and other catastrophes are simply disorderly manifestations of orderly processes. They do not occur in defiance of natural laws; they do occur in defiance of our preferences.

We know from experience and common sense there are no non-toxic chemicals; the basic order of things also makes it obvious that neither are there magical chemicals that do strange and wonderful things that cannot be explained.

The reason those simplistic statements are correct is that every chemical has a set of physical and chemical properties, and they are unchangeable. The solubility, or vapor pressure, or the various molecular factors that govern its reactivity do not change. The properties of the specific components of the environment, however you wish to define environment, do not change. The chemical entities that make up the body and govern its functions, complex though they may be, have their properties, and they do not change.

This diagram suggests the relation of all these factors:



Interactions between chemicals and the environment, then, are more than somewhat predictable if we can know those properties, just as are the interactions in the body. We have to know what happens to chemicals in the environment because that governs access of the chemical to the organism.

That access or contact with an organism is the exposure. Exposure to a chemical may be defined as the amount of material that reaches a surface from which it can be absorbed--in other words, the skin, the lung, and the digestive tract. If you wish, consider those hollow organs to be modifications of the surface of the body. Exposure isn't that amount that happens to be out there on the ground, or as a residue on the trees. It can't get in you if it doesn't get on you. It doesn't matter whether your concern is exposure to an urban pollutant, exposure of a community to a groundwater contaminant, or exposure of fish to a gasoline spill. From the standpoint of risk, the concern is only the amount that eventually reaches a target.

Once a chemical is on you, another exercise is played out. Two kinds of things happen. The effect of the chemical on the organism is only part of the story; just as important is what the organism does to the chemical. It has to absorb the material, and transport it in the circulation to some target site. A chemical can't do anything until it gets somewhere to react. If it is an acid or caustic, it will do its thing right at the surface, and the whole process becomes very simple. Generally, though, it will be brought into the body to some extent, across the barrier of the skin or lung or digestive tract. Perhaps it is very soluble, like glyphosate herbicide, and will probably be excreted rapidly before anything happens, or like carbaryl insecticide, the liver will change it to a more soluble form so it will be excreted, again without harm if the dose is not too great. Perhaps it is very reactive like the herbicide paraquat, which moves in the blood to the cells of the lung, kidney, and liver very quickly and potentially can cause considerable damage.

Finally, we have gotten to something the chemical is doing to the organism! The point here is that when and if a sufficient amount of a chemical gets to a place where it can react with an important organ or function, then, finally, it can do something to the organism. However, even a chemical that has relatively little ability to exert much effect will find some way to produce harm if the amount in the body can be raised high enough. Remember that there are no non-toxic chemicals.

Those responses are the pattern of adverse effects that we call toxicity. The reactions that produce the pattern are characteristic of the chemicals that come from the outside, or their products, as they interact with those on the inside. Consequently, the pattern of toxicity is characteristic of each chemical in a given species, and the pattern is fairly consistent across species. The toxicity is therefore a property of the chemical. This consistence is far from perfect, but it is good enough to provide the basic rationale for using data from animal studies to predict potential impacts on humans.

All by itself, the toxicity doesn't mean much until the dose is known. The dose is the amount of a chemical that actually enters the circulation and distributes in the body The dose is governed by exposure. Remember exposure? If you get some on you, some will get in you. A small fraction will absorb if the exposure is on the skin, and a large fraction, perhaps all, if it is in the gut or lung. Someday we may be able to discuss dose in terms of how much reaches individual cells, and even parts of cells, but that is now very rarely possible.

That brings us to the cornerstone of this entire discussion, the dose response relationship. I wonder how many people would admit to being familiar with the dose response relationship? Possibly not many. I would be surprised, however, if those who claim no familiarity have never

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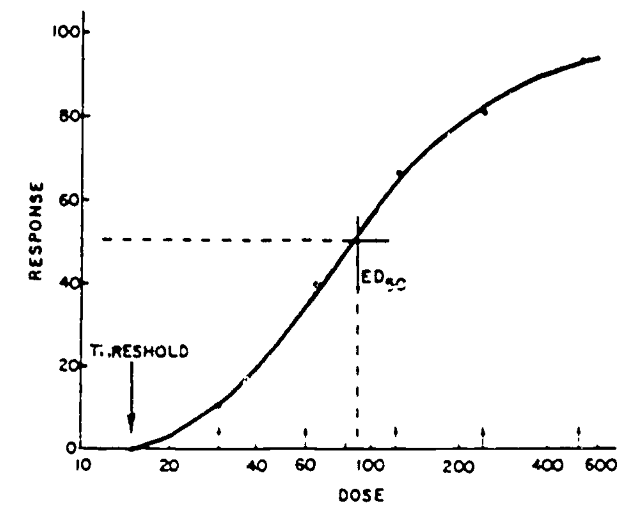
been to a cocktail par'y or drunk too much coffee? The principle could not be more straightforward. As the dose increases, the response increases, and as it decreases, so does the response. That concept may be the simplest major idea in science, and it applies to every interaction between a chemical and a biological system, whether to whole populations of humans, or tweety birds, or bacteria in culture, or even single animals.

It is very easy to show graphically. In this typical dose response curve for effects other than cancer, the dose is expressed in logarithmic form on the horizontal axis, and response is linear on the vertical. The log scale is used because often dosage spans a wide range, and it is inconvenient to use paper 20 feet wide. The log scale also gives us a mathematical form that is easier to use.

Log dose-response relationship.

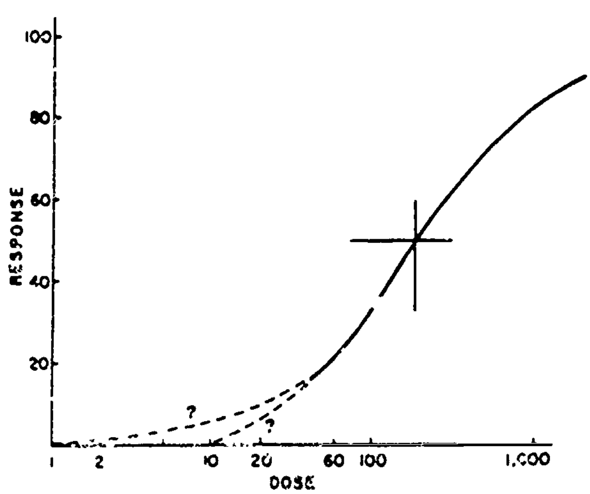


Non-carcinogenic responses are generally agreed to have a threshold, or no-observed-effect level, below which nothing happens. That threshold obviously depends on the sensitivity of analysis. The biochemist may look at events that the clinical physician cannot detect, but there will be such a point of non-response down there somewhere.

There is a simple kind of risk assessment for non-cancer effects. It involves many of the same components, but because there is a threshold, the process simply compares the real world dosage with the established threshold, with accommodations for species and individual differences. If the actual dose is 100 or 1000-fold lower than the threshold, we consider that the exposure will result in no harm. In this case, risk is not really represented by a probability, but rather by such a large difference from any effective dose that there is no reasonable expectation of harm.

For cancer, there is no threshold. At least, we cannot prove there is one. There just isn't enough empirical evidence to describe the curve at the low dose end. Because proof of a threshold is lacking and may not be possible, there is no choice but to use a conservative curve that has no threshold, for regulatory and health protective purposes. By removing the argument about the existence of a threshold from health protection activity, we are free to pursue the question of the presence or absence of a no effect dose for cancer as an academic question, which may or may not be settled at some time.

Dose Response for Genetic Toxicity



Risk assessment would certainly be simple if cancer was threshold related. Some chemically caused cancers are likely to be threshold dependent because they are caused by some other kind of change, such as a hormonal imbalance, that is known to be threshold dependent. It is expected that in certain individual cases, sufficient evidence to demonstrate such a mechanism will emerge. In theory, the absence of a threshold means that any dose, no matter how small, has some probability of causing cancer. Keep an eye on that word "probability." It has taken me a long time, but that is really where we are headed.

Anyway, the dose response governs the probability that a cancer might be caused by a chemical. The smaller the dose, the smaller the probability that it can have an effect; there is presumably no lower limit until zero dose and zero effect are reached. Occasionally someone will take this construct and claim that one molecule of a carcinogen can cause cancer, which approaches the ultimate nonsense. Chemical reactions just will not start until a sufficient number of molecules are present. However, on the basis of a fully linear dose response, it is possible to calculate the probability or odds or risk of one molecule of a very potent carcinogen causing cancer. It comes out at a risk of roughly one chance in 20 billion times the earth's population. The risk number representing that chance would be about 1×10^{-20}. I think that is not a significant problem.

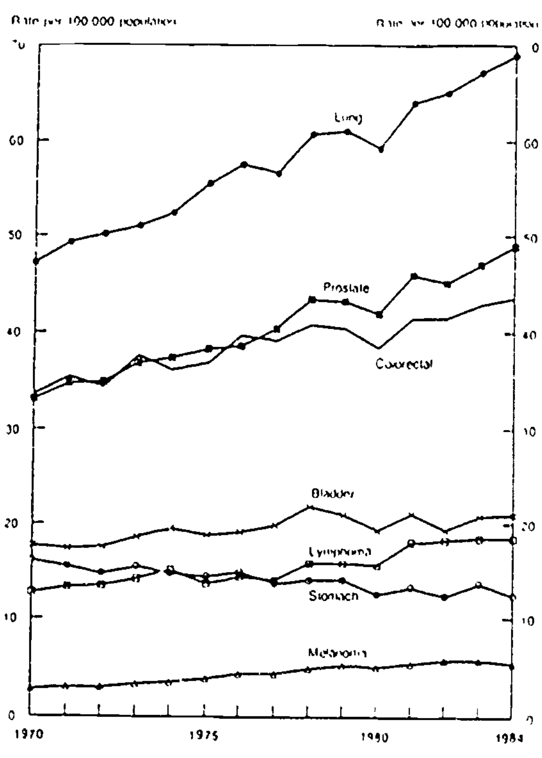
There are very good reasons why we cannot easily determine whether a threshold for cancer exists. The background cancer incidence in all species is very high. Because of the high frequency of tumors in experimental animals at advanced age at the end of a study, it is not possible to do a big enough study to definitely prove whether a true zero response has occurred. With 200 mice, it may not be possible to show a difference between a normal rate of 20 untreated animals with tumors and, say, 22 or even 25 cases in treated animals. Statistically they are probably the same.

There is a moderating characteristic that helps a little. Chemical carcinogens tend to cause specific kinds of tumors in specific organs, and if the increase is in a very rare kind of tumor, it is at least a little easier to recognize. Unfortunately, because of differences in the way chemicals are handled in the body of different species, a given chemical may cause different typical tumors in different species.

The very high incidence of tumors as all species age also includes humans. For humans, the odds at birth of having cancer at some time during life are more than one case in four lifetimes. As things stand, at least one in five of us will die of cancer. Those odds have not changed much since we began keeping track, except that hollow organ cancers like those of the stomach and uterus are becoming less frequent, and lung cancer is skyrocketing. The overall age-corrected cancer rate is not changing much, in spite of increased success against other lethal diseases.

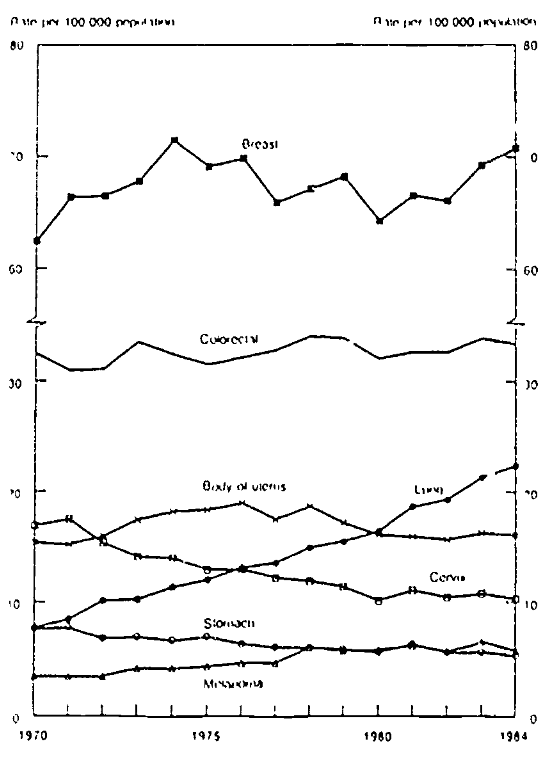
In fact you may be interested in what is happening over time with respect to cancer in humans. These particular incidence data are for Canada but are not different from the experience in the United States. The graphs are statistically corrected for population age, because cancer incidence increases with age.

Age-standardized Incidence Rates [1,2] for Selected Cancer Sites, Males, Canada, 1970-1984



[1] Rates are adjusted to the age distribution of the world population.
[2] Rates prior to 1977 have been adjusted for underregistration in one province.
Source: Vital Statistics and Disease Registries Section, Health Division, Statistics Canada.

Age-standardized Incidence Rates [1,2] for Selected Cancer Sites, Females, Canada, 1970-1984



Rates are adjusted to the age distribution of the world population.
Rates prior to 1977 have been adjusted for underregistration in one province.
Source: Vital Statistics and Disease Registries Section, Health Division, Statistics Canada.

Overall incidence of cancer except lung cancer is slowly declining, especially in women. In addition to the high background, another reason that cancer must be considered to be a non-threshold phenomenon lies in the apparent biological character of cancer and the process by which it starts. A chemically induced skin irritation, or liver effects, or spots before your eyes, or even the effects of too many cocktails, are graded responses. That is, an individual will begin to respond when some threshold dose is reached, and will experience greater and greater effects as the dose is increased. The reason is that vast numbers of cells are involved, each being affected by large numbers of molecules of the chemical, producing greater and greater effect as the dose is raised. Not only are more and more cells affected, but effects on each cell increase. Consider the following example:

> We have a chemical with molecular weight 300 (for comparison, malathion has a molecular weight of 330), at a dose of 100 mg/kg. With Avogadro's number (6.023 x 10^{23} molecules per gram molecular weight), we know that at 100 mg/kg the dose is almost 2 x 10^{20} molecules per kg. There are roughly 10^{12} cells per kg. This means roughly 2 x 10^{8} or 200 million molecules per cell, if distribution was uniform. Intensity of response would be a function of the number of molecules.

Cancer, on the other hand, is a quantal response. It either occurs or it does not. Once it starts, it is there. The reason is that cancer can theoretically start from a single cell in which genetic control has been altered, and which has divided to form similarly defective daughters before intracellular repair of that genetic defect could take place. The later cells would also have to evade the immune responses that appear to destroy cancer cells early in the process. At least in theory, then, that whole process could start from a relatively small amount of chemical, perhaps only a million molecules or so, at a single cell, at just the right time and place.

The upshot is that for non-genetic responses, the effect or number of individuals affected, or whatever index you choose, truly diminishes until the effect is no longer detectable.

For cancer, which is already identified as an all-or-none disease which cannot be detected at very low doses, we have to consider the incidence or frequency of the disease, not its intensity, and the incidence in a population is related to dose. To be sure, when the dose is low enough it is practical to say that the probability is virtually equivalent to zero.

EPIDEMIOLOGY IN RISK ASSESSMENT

For the moment, laboratory toxicology can be left alone, while we explore the kind of information available from the study of humans that may be used in risk assessment, if it is strong enough.

Certainly laboratory experiments cannot be done with people when there is any probability of harm. (There are people who insist that if we have less than perfect knowledge about a chemical in use, we are using humans for guinea pigs.) There are experiments that can legitimately be done with human subjects after all the animal study is done, particularly in learning about the way small amounts of specific chemicals are handled in the human body. That information, compared with that from animal models, is important in judging how well the experimental animal predicts behavior in humans. Generally, species that alter and excrete a given compound in the same way and to the same degree tend to respond similarly to the chemical.

The study of effects of environmental agents on populations is called epidemiology. Studies of infectious disease such as yellow fever or typhoid are the best known among epidemiological studies, as is the association of smoking with lung cancer. Studies may start with a set of conditions (Love Canal, for example) and search for disease patterns that are consistent with the distribution of the chemicals. Or a disease may be perceived as being present in unusual incidence, and the study may seek some environmental factor that seems to consistently be found with the disease.

With all of its uncertainty, epidemiology does have the advantage that it studies the world as it exists, or existed; where as in experimental work, we create a world. The link between smoking and lung cancer was established by retrospective epidemiological study. That is, studies were made of the histories of people with lung cancer, looking for factors that might be sufficiently common among the group that an association might be made. It did not take long to discover that not only was there an association, that is, a very high percentage of people with lung cancer had been smoking cigarettes, but the number of cigarettes each day was directly correlated with incidence of lung cancer in the population, as was the duration of the habit. This kind of problem is usually very difficult because it takes decades for chemically derived cancer to become evident. It happens that when these studies were done, most smokers were still smoking at diagnosis or had only recently stopped. The identification of a common exposure and therefore correlation was easier.

For some kinds of problems it is possible to look toward the future by following current populations who are subjected to some common past or present environmental impact. The big problems come with trying to make such associations when the exposures may have occurred 20 years ago, or the numbers of people exposed were so small there wasn't enough information, or when the percentage affected was too small to get good numbers. Memories tend to fade, and often it is necessary to rely on memories of next-of-kin. Still, when those kinds of findings can be correlated with laboratory work, the conclusions of both become firmer.

Strangely enough, it is often possible to derive some modest estimates of the extent of human exposure, even after long time lapses, and correlate it with the frequency of tumors.

Obviously the accuracy of such information is not high, but when the information carries an association it can be incorporated into the data base that is used for a risk assessment. There are really not many chemicals for which good epidemiological data exists, but there are enough for which there is positive data from both sources that confidence about the use of laboratory data is improving.

PROBABILITY IN RISK ASSESSMENT

It is difficult to really talk about risk assessment until we try to deal with the idea of probability. Before we get far, the words "probable" and "probably" have to be set aside, at least for a moment, because they get confused with the word "probability." The word "probable" means that we believe something is likely to happen, but there are no specific numbers, or frequency, or chance attached.

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If you step into the street in front of a car you will "probably" get hit.

When the weatherman predicts that there is a 40 percent chance of rain tomorrow, he is saying that he sees a probability of 0.4 that it will rain. It may rain. If he says 90 percent, he is saying there is a high probability of rain. I would hear this and turn to you and say, "It will probably rain tomorrow." This is where the weatherman has "gotcha." When he ways there is a 90 percent chance it will rain, and it doesn't, he is not wrong. If he said it will rain, and it doesn't, he is wrong. The 90 percent is a calculation, or a guess, or something he heard on another channel, that estimates the chance it will rain. It is not a promise. It is a very nice arrangement; he is never wrong.

Let's try something that may be easier to visualize. When flipping coins, the probability of a given toss coming up heads is 50 percent or one-half, or 0.5. We obviously assume no bias. Probability that tomorrow will arrive is very close to one; conversely the probability that it won't is very close to zero. Few would change plans on the basis of the latter probability. It is reasonable to consider very low probabilities as being essentially equivalent to zero.

To go back to the coins, the odds of each individual throw coming up heads are the same even if there have been five in a row. (That is if you are not playing with a former acquaintance of mine.) If this was done 1000 times, and there is no bias in the way the coin was tossed, there would be very close to 500 of each. Now, let us see how the odds, or probability, would describe some other possibilities. The probability of several heads in a row is learned by multiplying the odds or probabilities that each toss will come up heads: 0.5 x 0.5 x 0.5 and so on. We won't fool with the edges. For ten tosses the probability may not be too bad, at one chance in 1024. If one wants to try for 20 straight, the odds are over a million to one against. Hang on to that example, because it is the best connection with common experience that I know, and because you will want a sense of what a million to one means as we discuss cancer.

It is easy to get confused when discussing cancer risk. Risk of cancer resulting from some specific agent, such as a chemical, is always expressed as the excess or added risk, because of the already large background. The risk may be described in one of two ways. It may be the "chance" that an exposed person will have the bad luck to get cancer from some specified chemical exposure, over and above the existing risk of about 0.25. In slightly different terms with the same real meaning, it could be called the expectation that some number of people in the exposed population would acquire the disease in addition to the 25 percent already expected to have cancer.

Added risk is almost always very small. An excess risk of 10^{-4} or one in 10,000 is considered to be high and unacceptable, even though the background is 2500 times greater. Regulatory processes usually consider a risk of one in a million as virtually equal to zero. Examples of one in a million cancer risks include a transcontinental round trip by air, living in a masonry house instead of wood for two and a half months, or drinking 200 gallons of New Orleans water (at whatever rate you choose).

It might be worth noting the background incidence of some other irreversible diseases that concern us, although we are not discussing them beyond otherwise. Birth defects are found in about five percent of live births. Genetic anomalies (mutations) afflict about 1.4 percent of surviving newborns. Miscarriages are very common, terminating 15 to 20 percent of known pregnancies, and estimates of losses among all conceptions, including those never recognized, is on the order of 50 percent or more. There is no evidence that incidence of these problems has changed appreciably, other than fluctuations up and down year by year.

Now comes another problem. Not only is it very difficult to detect most cancer risk factors, but if we do, who among us will be affected, and when? A probability estimate cannot tell us that, either for the baseline risk or the added risk. If it did, 75 percent of us would be elated, and the rest would be very depressed. About all we can say is that a person can improve or worsen personal background odds a bit by modifying behavior, and if a risk is associated with chemical exposure, by reducing contact.

It is time to consider a simple kind of problem, as an attempt to show how everything fits together. We will estimate the risk associated with exposure to some carcinogen. It should be obvious that predictions can only be made on the basis of some kind of experience. We cannot use sorcery or tea leaves. The experience may be direct or indirect, but it has to have some logical and demonstrated relation to the question. The closer the relation of experience to the conditions for which the prediction is made, the better will be the prediction.

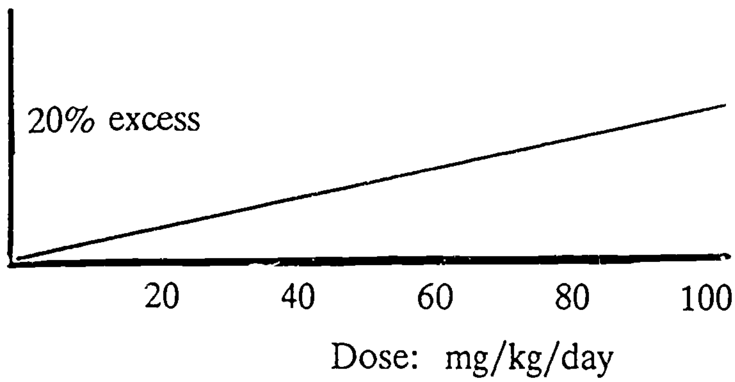
If the question is how many head injuries will arise from auto accidents this year, a very close answer will almost surely arise from last year's numbers. If some drastic change has been incorporated, such as fitting all cars with air bags, the figure would be modified by an estimate derived by engineers in the laboratory, which would still be pretty close, but not as good as if everything remained just as it was a year ago. If the problem were ever attacked by changing the speed laws, several relatively unreliable variables would enter. The difference in the two new situations would be reflected by the statistical error that accompanies the two answers. The first would be very tight, because it depends on an almost identical experience, with a single well defined difference. The second would be much broader because of the undefined variables, and all we could say is that in each case the real number will fall somewhere between two extremes, which are close in the case of the first change and farther apart in the second.

Now we can have a general look at the way this might work on a problem about a toxicological effect for which there is no threshold, i.e., cancer. A cancer experiment is done that tells us, first, that the chemical does cause cancer. The next question, is how bad is it, or in our terms, what is the dose response? After the background or control incidence is adjusted out, we find that some dose, say 100 mg/kg/day, causes 20 percent excess tumors over a lifetime. Cancer studies are usually conducted with the highest dose at a level that can just barely be tolerated without other major effects. This dose rate is known as the maximum tolerated dose (MTD).

Let us begin with an extremely simple risk assessment for mice. The experimental information available would suggest to us that a similar group of animals, treated similarly, could be predicted to also have an incidence of 20 percent at that dose. For our purposes, that identical experimental group is, for the moment, the population at risk. The probability of tumor at that dose would be 20 percent of the population, and the risk for an individual animal would be 0.2. That is quite straightforward because the population in question and their conditions are identical to those of the group already studied. The quality of information relating to the prediction of tumor incidence in the second group is very high in this case.

The original experiment also included a similar group of animals at a dose of 10 mg/kg/day, one tenth of the other dose rate. There was no detectable increase in tumors. Is that a no effect dose? No. We already said that game does not play for cancer. The usual procedure is to use a second dose that is one-half of the maximum tolerated dose.

We have a working premise that there is no threshold, and we will ignore the biological evidence that argues for cancer dose response curves that are shaped like a hockey stick, approaching but not reaching a threshold, because they cannot be certainly demonstrated. We assume that at low doses the dose response curve is a straight line from the lowest known positive data point, through zero dose and zero effect. The dose response is assumed to be linear, at low doses.



It is highly likely that such a straight line overestimates risk, although there is some argument about that. There may be other useful animal cancer experiments and other kinds of data, particularly those describing the way the chemical moves and reacts in the body. Studies of the ability of the chemical to interact with genetic material (DNA) in the cells are also important. The data from those studies would have to be evaluated for quality and decisions made about its utility to the analysis.

There is no set formula for bringing such data together and integrating it. It is not scientifically sensible to simply plug data into some kind of crossword puzzle and have an automatic answer emerge. In fact, the newer guidelines for risk assessment make a very strong point of the value and need for professional and scientific judgment in considering toxicological data.

If there is human epidemiology data it would also be examined to see that it is high quality work and to determine if there is any evidence of a dose response. All of the information would be factored together to provide a potency figure for the chemical. The potency is a measure of how strong a carcinogen it is, and is defined as the risk associated with a daily intake of one mg of a chemical per kg body weight per day for life. The term "potency" often seems to crop up outside the scientific community, and it is useful to be able to see that it is not misapplied.

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Go back to these poor mice. The dose rate of 100 mg/kg/day is associated with a 20 percent probability of tumors, and the probability is a linear function. At every other dose, the response is assumed to be proportional. In the case of these mice the risk at one mg/kg/day is 1/100 of the risk at 100 mg/kg/day, or 0.002. That figure is the potency, at least for the mouse. From here we can plug in any average daily dose and make a probability or risk estimate for the mice.

How do we get to people? Humans are not just big mice. Because we have a smaller surface per unit weight, there is an assumption that humans are more sensitive, and the factor used is about six-fold, depending on the specific method. There are arguments that a weight/weight relationship is correct regardless of surface area, but the adjustment for surface area is more conservative, so we use it.

Because we have not been unfortunate enough to have any direct human disease experience in this case, we will just translate straight across from the animal data. We will also assume that humans handle the chemical in the body just as mice do. The potency for humans would be about six times higher, with a relative risk of 0.012, rather than 0.002. That would be a pretty hot carcinogen.

Let us now pretend to go to the real world, in which not only the potency of the chemical must be known, but the exposures must be estimated. No matter how potent, if the exposure is zero or very very low, the risk will be as well. It just happens that all of us have different jobs in a factory that makes the chemical that we have just been studying in mice, and someone has learned that it causes cancer. After we all panic, industrial hygeinists come in and make estimates of our exposure.

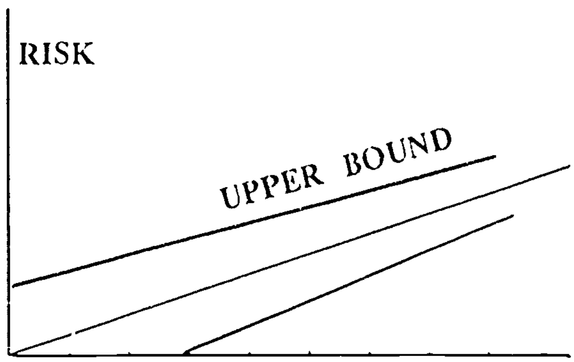
Some of you are shoveling this chemical into sacks (they used to do it this way), and you have an estimated average daily dose of one mg/kg/day. That is kind of bad, because that is right at the potency index, where risk is 1.2 in a hundred. Some of you just haul it to the freight shed, and your exposure is only 0.1 mg/kg/day. Your risk is 1.2 in a thousand. I stay in the office, and my exposure only occurs when the rest of you don't wipe your shoes. It amounts to 0.01 mg/kg/day, and the risk is 0.00012.

By our current standards those numbers constitute enormous risk, and that plant would shut down. But, don't start worrying yet; the risk will be much smaller than the number I just gave you. The effective dose is assumed to be the daily dose, <u>averaged</u> over a lifetime. As yet we do not have better methods for determining the effect of shorter term exposures.

The first group only stays on that job about five years on average. The product is only made during three days each month, from April through September. The total days of exposure are 3 days x 6 months x 5 years or 90 days total, of a 25,550 day life span. The estimated added or excess risk of the group with the greatest exposure would then be 0.012 x 90/25550 or 4.23×10^{-5}. That is 4.23 chances in 100,000, or 1 chance in 23,640, which is about the same as the odds on throwing 14 or 15 heads in a row. That risk may not be acceptable to some, but others would consider it quite acceptable, especially if well paid.

For the second group of workers, if they too only stayed on the job five years, their risk would be proportionally lower at 4.23×10^{-6} or one chance in 236,400, which is near the odds of tossing 18 heads in a row. My risk would be another ten-fold less, less than 0.5 in a million.

We have projected a dose-probability curve, but something else must be added. Obviously, this dose response curve that has been constructed for the case just discussed has some uncertainty. Statisticians deal with this in a rather sensible fashion. They construct confidence limits, based on the quality and extent of the data, that set upper and lower boundaries within which the real set of events should fall. An idealized set of limits might look like the following figure:



The calculated value that we have been talking about is the slope right through the middle, often called the maximum likelihood estimate (MLE). There is a calculated upper bound above and a lower bound below. Typically, the upper curve would represent a 95 percent certainty that the real curve is somewhere below that curve. Usually when a risk slope or figure is presented, it is this upper bound estimate, which is intended to overstate the real risk.

An example of risk associated with water contamination might be useful now. As an example of a simple assessment of the risk associated with a water contaminant, we can use trichloroethylene (TCE). The question might be, "what risk is associated with TCE in water at a concentration of 5 ppb (5 micrograms per liter)?" The potency or unit risk of trichloroethylene has been estimated as 1.7×10^{-3}, which means that a lifetime intake of one mg/kg/day presents an added cancer risk of 1.7 chances in a thousand.

We now have to know the dose. If daily water intake is two liters and body weight is 50 kg, the daily dose is 0.2gμg(0.0002 mg/kg/day). The estimated risk in this example is a proportion of the unit risk:

$$\frac{1 \text{ mg/kg/day}}{1.7 \times 10^{-3}} = \frac{0.0002 \text{ mg/kg/day}}{3.4 \times 10^{-7}}$$

or 3.4 chances in 10 million. Technically this is a trivial risk. Any decrease in intake because of consumption from other sources would obviously decrease risk. The real question is how will the community respond? Can the residents really bring themselves to accept some small intake of a chemical identified as carcinogenic?

RISK MANAGEMENT

Most of the discussion has been about risk. What about risk management? Risk management involves many different activities, and we Extension people are probably better equipped to work with some of them than are certifiable experts.

A fair amount of risk management is engineering and administration, but even more is common sense. Processes in factories are redesigned to keep better control of whatever material is handled. At the farm level that is something you can often work with, because much of the straying of pesticides to places they ought not to be is due to poorly 'ept equipment and poor practices. Remedying those factors requires neither a toxicologist nor an engineer.

What interests me most, and ought to interest you, is how we help people manage risk. For the society, that process must include all of the administrative activities such as developing rules and enforcing them. The problem in that realm is that often terror creeps in either through ignorance or by design of some individuals, and attitudes and rules are created that have no relation to the real problem. Furthermore, all too frequently the response is to the wrong problem, eliminating or purporting to eliminate one risk that is trivial and leaving unattended other problems of much greater magnitude.

If people can understand risk they probably can deal with it more rationally. For example, much of the concern about water quality degradation as it exists now is misplaced. The issue is really management, because most findings indicate not a health risk, but a management failure that must be found and corrected before the situation deteriorates to a point where risk does become real. Too often the reality of a risk gives way to the politics of risk, to be exploited for ends unrelated to health.

It isn't easy. I may have given you some of the scientific basis for understanding what risk is technically, but the incorporation of people and their emotions in that rational structure does not come easily. I have already told you that none of us deals with risk rationally, neither you nor me, nor the people we serve. That all makes education difficult, and also results in resources being spent on the wrong problem. What is felt is more important than what is known, so we must work very carefully as we discuss risk with our clients.

The playing upon that sentiment with destructive consequences was illustrated by a recent article in the Wall Street Journal. You saw what happened with alar. The journal described how the whole thing was put together by a PR firm for NRDC at a great cost that was more than met by increased donations from a misled public. Naturally, CBS was delighted to join in, because whatever sells is news. Real information is dull and best left to PBS. They all knew surely that the data they were using did not even deserve to be called invalid. That is a classic example of negative risk management. In a few seconds, an activity like that can destroy all the work you can do in a year as you try to help them manage risk rationally.

How best do you work with people so they will approach these questions rationally? The answer is, very slowly and carefully. Remember that we have managed to erode most of the trust that was once accorded government. Yes, we have trusted government on occasion! Institutions are doing little better, including universities. I see polls suggesting that scientists are trusted above other groups, but even that is pretty thin.

I doubt also that you would want me as an outsider to balance your risks against your benefits either, no matter how you trust me. They are different exercises and cannot logically be compared, except when the benefit is decreased risk from some other source.

I would advise as well that you cannot get far trying to rationalize some risk by saying that it is less than that associated with a peanut butter sandwich, or black pepper, or aspirin, or the cancer risk associated with a transcontinental flight, or living in a stone house instead of wood. Those are all valid comparisons, but people will become annoyed when you try to impose them.

What do you do when the community becomes terrified or terrorized? When you bring advice--no matter how correct--you will be seen as an advocate for some kind of position. When questions like this become issues, everyone takes sides, and if you become identified with one side or another, you are done for.

The fact is that there are no sides. I have already tried to make the point that data can be interpreted by competent people only in a relatively narrow range of meaning. The problem is how to get that reasonable meaning across.

Health risk is a highly salable commodity, because it can be attached to all kinds of enterprises and in[illegible]tions. It has made analytical chemistry highly marketable, something analytical chemists have succeeded in doing only modestly. How? By implying that produce is safer because it is analyzed for pesticides. Nothing is different now; those grocery chains are finding nothing that FDA hasn't been finding. They may actually cause a few suppliers to be more attentive to good practices, but the safety of the food supply is really no different.

There are some very simple management steps that can both lessen risks and lessen perception of risk. Get agencies to train and certify personnel better. Careless right-of-way applicators or pest control operators not only injure people, but they are highly visible and create a public picture that will spill over into every aspect of community perception. Try to convince state government to invest in competent expertise for analysis of risk and education of the community. This sounds a bit like a proposal to expand the Extension Service in the area of toxicology, and it is just that. Questions of water quality or any other chemical impact on health cannot be answered with administrative platitudes. Neither can they be answered by propaganda of groups who have little to do with health protection.

I can repeat what I said earlier. It is possible to make rational estimates of chemical risks. The methods are still replete with imperfection, but conservatism and the use of assumptions that maximize estimates of risk provide useful and usable tools in judging the impact of environmental chemicals.

TOXIC CHEMICALS AND EXTENSION EDUCATION PROGRAMMING

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Professor of Soil Science
University of Florida

INTRODUCTION

The media is fu . with stories of occurrence of toxic chemicals in our everyday lives. Ruptured railroad chemical tank cars, leaking underground storage tanks contaminating groundwater, detection of agricultural pesticides in rural water wells, nitrate nitrogen found in wells at levels greater than drinking water standards, and failing septic and sewage systems that contaminate surface-and ground-water systems are examples situations that citizens read about in newspa .s and popular magazines, hear on th. radio, or see on television and become concerned about They are particularly concerned about the potential health effects of being exposed to such toxic chemicals.

At the same time, they are comfortable using pesticides in their lawns, gardens and houses to control pests, and in using other toxic organic chemicals in household cleaning products, paints, and cleaning fluids. Many people do not make the connection between what is presented in the media and what they personally do with toxic chemicals. Some resist efforts to construct hazardous waste transfer facilities in their communities for fear of some unknown disaster, even though such facilities provide a margin of safety far greater that the delivery system that brings the toxic chemicals into the community.

Such contradictions between perceptions and behavior provide a challenge to extensionists in developing educational programs that both reduces the exposure of the public to toxic chemicals and encourages responsible use of these mate

SOURCES OF TOXIC CHEMICALS

Sources of toxic chemicals that the general public encounters are numerous. For this workshop, I would like to focus on those toxic chemicals that present water-related health problems and which can be managed to reduce exposure. Thus, agricultural and home use pesticides, household and industrial chemicals, pathogens (from septic systems) and nitrate (from either septic tanks, septage, or fertilizers) become the principal areas of interest.

Pesticides

Pesticides used in production agriculture, golf courses, urban lawns, home gardens, landscaping and other areas present a threat to public health if they find their way to drinking water supplies.

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The nature of the health threats posed can be acute or chronic. Generally, the chronic effects are of most concern to the publ... Pesticides that cause chronic health effects can be classified as: (1) oncogens (cause tumors); (2) carcinogens (causing cancer); (3) mutagens (inheritable changes in genetic material), or (4) teratogens (physical of functional defects in developing offspring).

Household Chemicals

Consumer goods used in households contain many toxic chemicals. Batteries may contain mercury, zinc, silver, lithium or cadmium. Drain cleaners contain petroleum distillates. Rug and fabric cleaners may contain naphthalene, perchloroethylene or diethylene glycol. Floor and furniture polish may contain diethylene glycol, petroleum distillates or nitrobenzene. Mothballs may contain naphthalenes or paradichlorobenzene. Waste auto products may include ethylene glycol, glycol ethers, heavy metals and/or benzene.

Septic Systems

The primary toxics associated with septic systems are nitrates and [illegible] nisms. However, any number of the household chemicals find their way into the s[illegible] in the normal course of family activities.

MODEL PROGRAM

This training program, entitled "Pesticide Usage and Its Potential Impact on Surface and Ground Water Quality", has been conducted annually for the past five years in Florida. It was developed in response to the presence of pesticides found in the groundwater at low concentrations within the state. From the outset, the program was atypical in that it did not arise from county plans of work but rather was a top down approach to educate and inform county agents about the issues and possible resolutions to those issues.

Objectives

The objectives of the training program are:

1. to develop a good understanding of the water resources in the state;

2. to develop an understanding of health effects of contaminated water supplies, and risk assessment and risk management concepts;

3. to develop an understanding of the processes that control chemical movement in soils; and

4. to relate these processes to management practices that improve water quality.

In order to meet these objectives, a multi-disciplinary team of instructors are used including a soil physicist, an agricultural engineer, an entomologist, a toxicologist and an attorney. This mix of disciplines provides excellent resource expertise and materials that the agents can draw upon as they develop materials and programs for county use.

Audiences

Although this in-service training course is conducted primarily for county agents, other individuals have taken the course. These include Extension specialists, staff from the Florida Department of Agriculture, staff from the Florida Department of Environmental Regulation, and regional water management district staff. When it is particularly appropriate and topical, members of these agencies have made presentations relevant to their agencies activities during the training course.

Course Content

The content of the training course consists of four principle segments which make up the core materials offered each time, and two or three segments which vary depending on availability of resource persons and current issues regarding pesticide use in the state. A concerted effort was made to ensure that the audiences make the connection between the water resources potentially being impacted, the processes that control chemical fate and transport in the environment and management alternatives that can reduce or prevent these impacts.

The core segments of the training course are as follows:

1. Geohydrology and the water cycle
(delineation of principle aquiferers and surface water bodies in Florida; discussion of aquifer classification system, recharge areas, sinkhole areas, relative recharge rates, and confining features of aquifers)

2. Sources of contamination
(identification of potential contaminant sources from agricultural, industrial, municipal, household, and petroleum products storage activities)

3. Physical, chemical, and biological processes that control pesticide fate in the environment
(discussion of the processes that affect the fate of pesticides in the environment, including sorption, degradation, volatilization, and leaching; effects of climatic, soil, and chemical parameters on pesticide fate

4. Management practices to reduce or prevent water quality impairment
(formulation and discussion of alternative management practices that relate process to desired effect in controlling water quality impacts; emphasis on connecting management practice to processes that lead to positive or negative water quality impacts; promote integrated pest management concepts as alternative or adjunct to chemical use)

The ad hoc segments have included:

1. **Environmental and health concerns associated with pesticide use**
   (discussion of health effects of ingesting pesticide residues in water and foodstuff, concepts of risk assessment and risk management, criteria for monitoring groundwater supplies, the pesticide registration process)

2. **Liability and pesticide recommendations**
   (discussion of pesticides laws, federal and state statutes; common law liability, sovereign immunity of state employees; chemigation and groundwater contamination; RPAR and the administrative hearing process)

3. **Pesticide assessment procedure**
   (discussion of a procedure developed by the Pesticide Review Council to aid in priortizing areas within the state to focus monitoring efforts for pesticide residues in groundwater)

4. **Pesticide waste anagement and disposal**
   (discussion of ways to reduce or eliminate excess tank mix; tank mix waste treatment systems, disposal of empty pesticide containers)

5. **Public policy education related to water quality issues**
   (discussion of approaches to bring about participation of the public in water quality issues)

Of these ad hoc segments, items 1 and 3 have been more frequently used than the others due to their widespread applicability and interest by the audiences.

Adaptation by Other States

Certain elements of the above described training program can be adapted readily for use in other states due to the generic nature of the concepts and processes being presented. Items 2, 3 and 4 of the core segments and items 1, 2, 4, and 5 of the ad hoc segments can be used with little change. The other items will require major change to deal with site specific aspects of those items in other states.

Support Materials

A manual is produced for each training session that consists of Extension fact sheets, circulars, research articles, and other available relevant materials that contribute to the understanding of the subject. Examples of these materials are as follows:

Florida's Water Resources. Fact Sheet FRE #40, Florida CES.
Groundwater: The Hidden Resource. Fact Sheet SL #48, Florida CES.

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Groundwater: A Community Action Guide. Concern, Inc.
Basics of Soil-Water Relationships - Part 1. Soil as a Porous Medium. Fact Sheet SL-37. Florida CES.
Basics of Soil-Water Relationships - Part 2. Retention of Water. Fact Sheet SL-38, Florida CES.
Basics of Soil-Water Relationships - Part 3. Movement of Water. Fact Sheet SL-39, Florida CES.
Pesticides and Their Behavior in Soil and Water. Fact Sheet SL#40(revised) Florida CES.
Fate and Transport of Agrochemicals in Florida. Symposium papers reprinted from the proceeding of the Soil and Crop Science Society of Florida, Vol. 44, 1885, pp 1-24.
Drinking Water: A Community Action Guide. Concern, Inc.
Organic Pollutants in Groundwater: 1. Health Effects. Fact Sheet SL #54. Florida CES.
Organic Pollutants in Groundwater: 2. Risk Assessment. Fact Sheet SL #55. Florida CES.
Organic Pollutants in Groundwater: 3. Criteria for Monitoring. Fact Sheet SL #55. Florida CES.
Regulation of Pesticide Use. Fact Sheet SL #53. Florida CES.
Home Water Quality. Circular 703. Florida CES.
An Integrated Pest Management Primer. Fact Sheet IPM-1. Florida CES.
BMP Selector: General Guide for Selecting Agricultural Water Quality Practices. Fact Sheet SP-15. Florida CES.
How Agriculture Affects Aquatic Systems. Fact Sheet SP-26. Florida CES.
Controlling Pesticide Pollution. USDA/SCS Tech. Pub. 160.

Other topical materials are included as appropriate (especially when other agency speakers make presentations as ad hoc segments) to provide the audience with take-home information for use in developing county-specific educational programs. For the most part, the above materials have been developed to promote understanding water quality issues and improvement in management practices that affect water quality of receiving waters.

In addition to the above materials, microcomputer software has been developed as a teaching tool to reinforce understanding of pesticide fate in soils. "Chemical Movement in Layered Soil" (CMLS) was developed to illustrate the influence of soil properties, chemical characteristics, and weather factors on chemical movement and persistence in soils. It complements the materials presented in segment 3 of the core materials discussed previously. With full understanding of the assumptions inherent in the model and with local soil and weather data, the software can be used as a management tool to aid in selection of pesticides to avoid groundwater contamination. Figure 1 depicts the main menu of CMLS. Figure 2 and Table 1 depict typical graphics and text outputs available from this software. In these examples, the herbicides atrazine and alachlor are assumed to be surface applied to an Orangeburg fine sandy loam soil on March 1, 1985. The software is available from the Florida CES Software Support Office for a nominal charge. This software has been an excellent teaching aid both in extension training courses and in formal university classes where students are being taught the processes of chemical transport in soil water systems.

SUMMARY

While toxic chemicals are pervasive in our lives, there are many ways to reduce our exposure to them and to educate others about their hazard, proper use and disposal, and management practices to reduce water quality impacts. While this paper has focused on a model program for pesticides, similar programs could be formulated on other subjects, such as, household chemicals, nitrate leaching from fertilizer use, and septic systems. Furthermore, there is an opportunity to develop materials for a broad audience in all programming areas.

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                CHEMICAL MOVEMENT IN LAYERED SOIL

                               by

               D. L. Nofziger and A. G. Hornsby

                          Version 4.0
                         Copyright 1987

     OPTIONS:
          A. Calculate Chemical Movement in Soil
          B. Enter, Modify, or Print Soil Data File
          C. Enter, Modify, or Print Chemical Data File
          D. Enter, Modify, or Print Rainfall File
          E. Enter, Modify, or Print Evapotranspiration File
          F. Display File Directory
          G. Select Default Files and Options
          I. Import ASCII Data Files
          Q. Quit. Terminate Program and Return to DOS

     Desired Option ? __
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Figure 1. Main menu of CMLS software program.

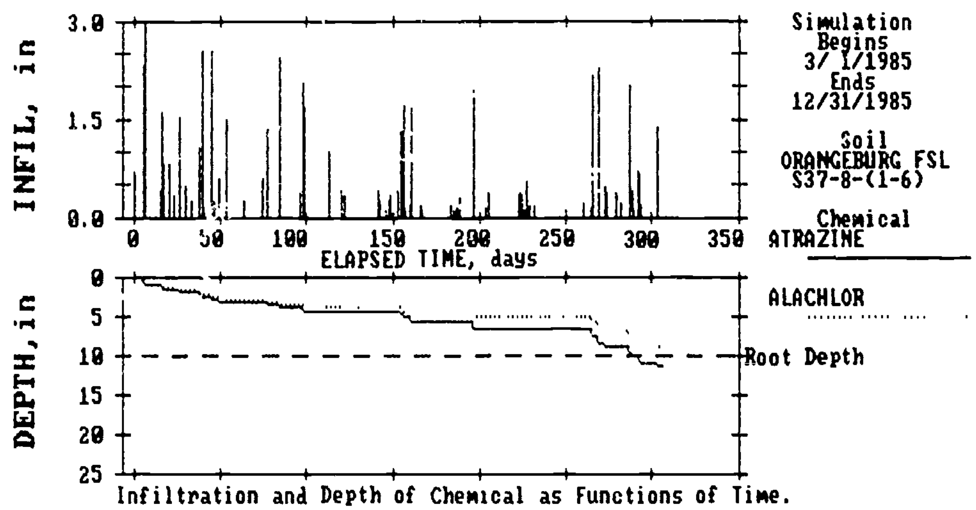

Figure 2. Graphical output from CMLS software depicting effective rainfall (infiltration) and the depth distribution in soil of two user selected pesticides with time after application.

Table 1. Travel times for chemicals to move to user selected depths and relative amounts of the chemical remaining in the soil at those times using "table of travel times" output option.

Chemical	ATRAZINE	ALACHLOR
Partition Coefficient, Koc, (mg/g OC)	163	190
Application Date, (month/day/year)	3/1/85	3/1/85
Ending Date, (month/day/year)	12/31/85	12/31/85
Application Depth, (in)	0.00	0.00
Rooting Depth, (in)	10.00	10.00
Time (days) to 5.00 in	156	98
Relative Amount Remaining	0.1051	6.1E-005
Time (days) to 10.00 in	291	23
Relative Amount Remaining	0.0151	2.7E-012
Time (days) to 15.00 in	>305	>305
Relative Amount Remaining		
Time (days) to 20.00 in	>305	>305
Relative Amount Remaining		

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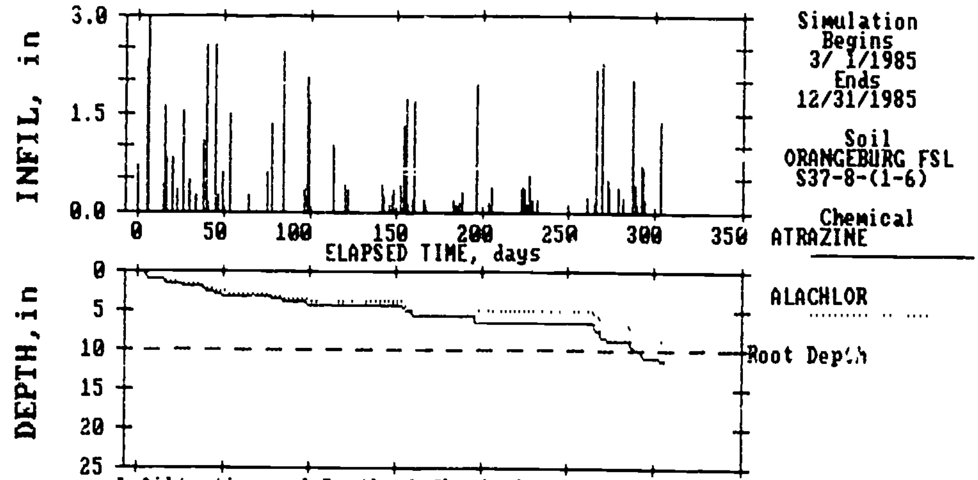
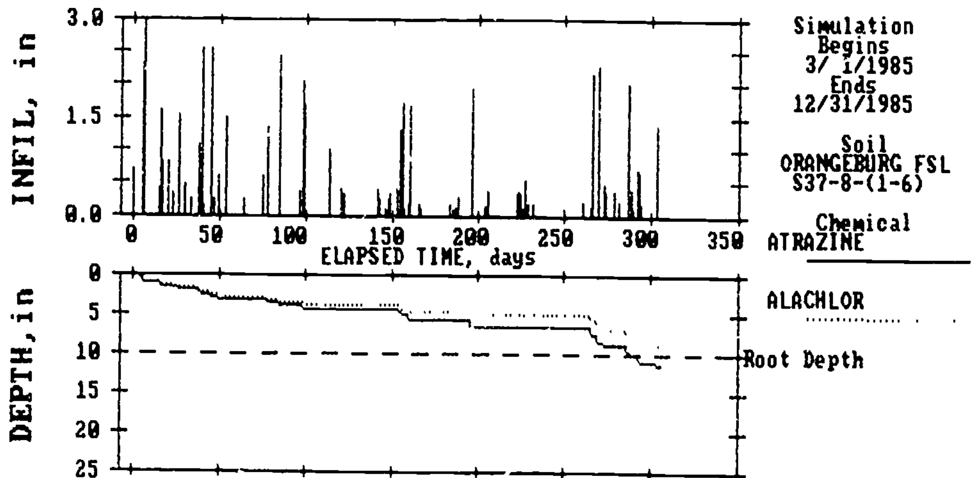


Infiltration and Depth of Chemical as Functions of Time.



Infiltration and Depth of Chemical as Functions of Time.

PUBLIC POLICY EDUCATION AND WATER QUALITY

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University of Florida

CONTEXT FOR WATER POLICY EDUCATION

When traces of contaminants show up in well water, chances are the news media and the public health authorities will show up as well. The public response to media reporting of groundwater contamination incidents has been substantial: a 1986 Harris poll reported that 86 percent of Americans surveyed considered drinking water contamination a serious problem.[1] The reasons for widespread public concern are simple enough: groundwater is a source of drinking water for almost 50 percent of the United States population.[2] The concerns of consumers are reflected in the fact that sales of bottled water in the United States tripled between 1976 and 1988, reaching nearly $2 billion yearly.[3]

Another reaction to groundwater contamination has been an increase in governmental activity aimed at groundwater quality protection. The federal government has been a central force in water pollution control, protection of drinking water quality, and registration and regulation of pesticides over the past two decades. The three major regulatory programs stem from three separate pieces of legislation: the Federal Water Pollution Control Act Amendments of 1972 (now called the Clean Water Act); the Federal Insecticide, Fungicide, Rodenticide Act Amendments of 1972; and the Safe Drinking Water Act of 1974.

State governments have also enacted legislation and implemented programs that have water quality protection as their objective. These programs vary greatly from one state to another. Some states have instituted geohydrologic studies to learn more about groundwater and surface water resources. Some have classified water bodies according to the intended use as a first step to defining standards of water quality to be maintained in those water bodies. State programs sometimes include systematic monitoring of water bodies, including underground aquifers, to establish background levels of quality and to identify changes in water quality over time. Some programs include inventories of potential threats to water quality and measures to restrict discharges of potential contaminants into the environment in ways that could pollute the water.

WHY DOES GOVERNMENT BECOME INVOLVED?

Simply stated, government becomes involved in water quality protection because human actions cause water pollution, and human action is needed to prevent water pollution. Public policy represents an attempt to induce changes in human behavior that are needed in order to achieve water quality goals. Generally speaking, government does this by acting on the rights, obligations, incentives, and opportunities that influence the behavior of people with respect to water. Some general powers of government that have been or could be called upon include the power to tax, regulate, purchase (by eminent domain, if necessary), manage and subsidize.

WHAT DO WE MEAN BY WATER POLICY "ISSUES"?

In choosing among policy tools that could be used to pursue water quality goals, policymakers encounter some vexing public policy issues. For example, is it better to "use the carrot" or to "use the stick"? That is, should government provide positive incentives in the form of subsidies to induce people to avoid polluting, or should government provide stiff penalties for people who pollute, or both? Should participation in water quality protection programs be mandatory? Or voluntary? In establishing the standards of water quality that will be used to define "pollution," policymakers often encounter sharp disagreement over the meaning of "acceptable risk"--an important issue given the difficulty of eliminating all contaminants completely, and thus the difficulty of eliminating all risk of adverse health effects from contamination. Policymakers disagree over the appropriate level of government for instituting water quality programs. How should we decide whether water quality programs are most appropriately implemented by the federal government, state government or the local units of government? Should pollutors be held strictly liable for any adverse impacts of their polluting activity? Even if they exercised normal caution and did not intend to pollute?

CONCEPTUAL BASIS FOR PUBLIC POLICY EDUCATION

The philosophical basis for public policy education is rooted in the concept that the land-grant university in general, and Extension in particular, is concerned with the problems of people and is committed to using the knowledge of the university to improve the quality of life for the people of the state.[4] A basic premise underlying the concept of public policy education is that people can make "better" public policy choices if they have better knowledge and understanding of public policy issues, public policy alternatives, and public policy consequences. It is also important that people have knowledge and understanding of the public policymaking process.

Public policy education is based on a pluralistic view of the democratic process in which there is no single public interest, but rather, many interests, interest groups, and decisionmakers. Accordingly, there is no single optimal policy choice for any given issue. The issues themselves are defined by the conflicts in interests expressed in debate. Because many interests compete in the policy process, any resolution of an issue will favor some groups and hurt others.

Disagreement over what constitutes the "best" policy choice usually reflects fundamental differences in the basic values held by the individuals who are party to the debate. Scientific knowledge (the wisdom of the university) cannot be used to determine the "correct" policy choice for society because science cannot supply the value judgment that ranks the interests of one group as more important than the interests of others.[5]

Public policy education is also based on the premise that public participation in the policymaking process is good. But to participate effectively in that process, citizens must be informed of the issues, and they must know how to participate (and must be allowed to participate).

EDUCATORS' VALUES

To be effective in public policy education, educators must adhere to several fundamental values as well. First, a public policy educator must believe that enlightened self-interest is a reasonable guide to human behavior. That is, informed people are smart enough to make their own political decisions and do not need an "expert" to tell them what to vote for.

A public policy educator must believe that democracy is a legitimate way to make decisions when not all parties agree on the course of action to be taken. It is interesting to note that Americans have demonstrated a willingness to fight and to risk their lives in the defense of democracy, but many of those same individuals also express distaste for "politics". Public policy education recognizes that democracy without politics probably is not deserving of the name.

Finally, and most importantly the public policy educator must respect the right of students to make their own political decisions.

WHOM TO TEACH?

Students of public policy education can legitimately include anyone interested in or affected by a policy issue homemakers, homeowners, agriculturalists, business and industry groups, youth groups and elected officials--could all be beneficiaries of a public policy education program.

WHAT TO TEACH?

Water policy education can focus on five subtopics:

1. Issues (identification and clarification)
2. Existing role of government (what existing programs are being implemented at the federal, state, and local levels of government?)
3. What basic choices among public policies are available to policymakers confronting the issue that has been identified?
4. What are the likely consequences for the various stakeholders if any particular policy alternative is adopted? How do those consequences differ if a different alternative is chosen?
5. How does the policymaking process work? How can an interested individual participate effectively in that process?

HOW TO TEACH?

A variety of formats are available for conducting public policy education. Inservice training for county Extension agents on public policy education concepts and methodology will increase the capacity of the agents to participate in and conduct educational programs relating to water policy issues. Educational content relating to water policy can also be combined with other more traditional inservice topics as a way to gain acceptance of what might otherwise be viewed as a risky and unorthodox subject. A statewide water policy conference provides one type of format for water policy education. County level workshops or "schools" (meeting, say, once a week in the evening for several consecutive weeks) have been effective in bringing together a core group of concerned citizens to learn from each other and from knowledgeable resource people who share expertise and teach the subject matter to participants. Newsheets, fact sheets, and audiovisual materials are useful vehicles for conveying information about water policy issues, alternatives and consequences.

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WATER SUPPLY AND WASTEWATER MANAGEMENT

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Water, which is absolutely essential for life, is fortunately the most common substance on earth. It covers more than 70 percent of the earth's surface. Every living thing must have water to live. In fact, every living thing consists mostly of water.

Everyone depends on either surface or groundwater for life's necessities, conveniences and luxuries. However, these sources are increasingly becoming contaminated by many of man's activities and a more industrialized or technological way of life. Analytical capabilities to determine contamination have greatly outstripped knowledge about the effects of ingesting small concentrations of many substances.

Thirty-four states have identified agricultural nonpoint source pollution as a major cause of their failure to achieve state water quality goals. Twenty-nine states have identified nonpoint source pollution of groundwater as a major problem, citing such specific and diverse concerns as agricultural pesticides and septic tank seepage. National concern about groundwater quality has escalated to the point of proposed legislation to implement regulatory programs.

There are an estimated 181,000 lagoons; 16,500 industrial landfill sites; 18,500 municipal landfills; and 20 million septic tank systems. Virtually all of these are located in rural areas. Each year an estimated 3.5 million to 21 million pounds of pesticides reach ground or surface water before degradation.

RELEVANT EXTENSION ISSUES

Programs conducted by the U. S. Department of Agriculture in conjunction with cooperative agencies such as the Rural Clean Water Program have demonstrated that voluntary programs targeted to implement best management practices to reduce impacts on receiving waters can be effective. The most successful efforts utilize a mix of educational/technical assistance and financial assistance programs.

Educational programs build public awareness and transfer knowledge and information that provide the public and private sectors with an understanding of the appropriate responses. Technical assistance programs provide site specific technology to solve problems. Financial assistance programs both demonstrate that society attaches importance to problem solutions and spread the cost of pollution control among those who want or benefit from improved water quality. When such programs are planned and delivered in a coordinated and cooperative manner, they provide a synergism that cannot be achieved by unilateral efforts.

ERIC

Many organizations conduct research and have programming on water quality. Land-grant colleges, private institutions and state agencies are involved in research to document the nature and extent of the problem. Few, if any, of these agencies or institutions have a mandate, responsibility, or mechanism to develop and deliver programs for public education on water quality and waste management.

Extension has such a mandate, such a responsibility, and such a mechanism. Therein lies the challenge and opportunity. Extension as an educational organization can deliver and develop important and effective educational programs for water quality and waste management. In addition to the need to continue traditional programs, new issues and priorities continue to develop, such as health effects of contaminated water, contamination sources and movement, best management practices, on-site wastewater management, solid and hazardous waste management, legal and economic considerations, public participation, public policy determination, residential water treatment and water conservation, to name just a few.

Many of these are not traditional Extension topics. However, these are high priority local needs about which an expanding clientele group is looking to Extension for assistance. Herein lies another opportunity and challenge for Extension to gain added recognition and resources for addressing important societal needs. Addressing these topics will require new staff resources, new linkages to relevant cooperative agencies or institutions, new delivery methods and even expanded resources. In addition, expanded and more efficient work with traditional resources, institutions, methods and clientele will be necessary.

In delivering educational programs, Extension must adapt a positive and progressive stance. Extension must avoid appearing as an apologist for agriculture or as an apostle of the status quo. Extension must cope with the urgency of public concern and the lack of data and programming capability in newly developing areas.

OPPORTUNITIES FOR EXTENSION EDUCATION PROGRAMS

Agriculture and Natural Resources. Agriculture is often cited as the largest consumer of water. Agriculture has also been identified as a major contributor to surface and groundwater pollution. Each of these issues presents significant opportunities for expanded Extension education programs associated with crop and animal production as well as water and wastewater management for rural areas.

Home Economics and Human Nutrition. Concerns about drinking water quality are heightened by a lack of knowledge and understanding. No long-term epidemiological data exists about the impacts of ingesting low levels of hazardous compounds, nor will there be any such data for a long time. The best professional judgments about safe limits, standards and likely effects must be used as an interim basis for educational programs.

The importance of monitoring drinking water quality, appropriate testing, result interpretation, impacts on human health and the development of strategies to minimize risk to families all constitute major educational challenges and opportunities for Extension.

Community Resource Development. Many water quality and waste management issues are decided within the context of local government in which the interests of rural land holders and communities may be adequately represented. Opportunities abound for educational programs which deal with community issues, structures and organizations.

Other community-wide educational opportunities exist in policy issues such as land use, community water supply and treatment alternatives, groundwater resources and impact of contamination on real estate values and tax base.

4-H and Youth. It is very important to educate youth about the scope and dimension of water quality and waste management problems. These youth influence society today, and in the future many will assume positions of responsibility and leadersnip. They will be involved with the alternatives and impacts of individual and collective decisions on the quality of life in their communities. Although specific problems may change with time and location, the basic principles of hydrology and waste management will not. Extension can educate this important audience on water quality and waste management issues.

MODEL PROGRAMS IN NORTH CAROLINA

Some new and successful water quality and waste management programs in North Carolina that may be viewed as somewhat non-traditional include the following.

The Water Watch water conservation program which is cooperative among the Departments of Biological and Agricultural Engineering, Soil Science and Home Economics resulted in posters and publications which have been used extensively by county staffs throughout the state. The state water quality agency also promoted this water conservation program and used public service announcements to encourage implementation across the state. The Governor's Mansion was retrofitted with water conserving devices to emphasize the importance of water conservation and also direct added attention to this important and successful Extension program.

The groundwater Model developed in Wisconsin has been used particularly for 4-H programming. The demand for this model by county staff in conjunction with uses at the state level has been so high that three of these groundwater models have been purchased. A variety of awareness and educational activities can be supported by this simple but very effective model to demonstrate groundwater systems and dynamics.

A slide script has been developed on water quality for general audiences and 4-H youth to support county programming under the Water Quality Initiative. The script could be used by county staffs or revised to meet local needs and thus support county staff in providing program leadership.

Extension has developed contracts with county governments to assist with environmental quality evaluations and conducting educational programs. One that has brought gratifying recognition to Extension at the county and state level has been a contract to conduct an educational program on waste management alternatives for a coastal county. This county was at an impasse in determining and implementing waste management programs to serve an ever-expanding population and environmental need. Waste management options being considered were deep well injection, ocean outfall, inland water discharge and land application. No consensus could be reached, and thus local government leaders were unable to get support for any alternative. Therefore the county government entered into a contract with Extension to conduct a telephone survey to determine public opinion and provide an analysis of potential sites for land application. Results of these evaluations were presented to community leaders, who have requested the development and conduct of an educational program building on this information. A slide tape is being developed to be used in conjunction with the factfinding requirement for an environmental impact assessment being conducted by the county officials. County Extension homemakers will provide leadership in using the slide tape pursuant to a large public meeting which will be supported by state Extension specialists participating in this project. Thereafter county leaders will make a decision concerning the best wastewater management alternative.

A statewide groundwater education program is being conducted with special funds from federal Extension for the Water Quality Initiative. Program emphasis is to conduct a statewide groundwater education program with the opportunity to sample 1000 wells in each of the eight Extension districts across the state. Volunteers are trained to sample and assist completion of a survey form on well characteristics and land use around the well. Samples are tested for nitrate, chloride and conductivity to indicate the potential of pollution potential from on-site wastewater management, improper animal waste management and over-fertilization. Cooperative arrangements are made with county health departments to further test samples with nitrate levels above drinking water criteria to determine drinking water safety. After sampling, an appreciation and education program is held in the county to discuss sampling results and present appropriate educational material. To date, this has been a very successful program which has brought recognition to the Extension Initiative on Water Quality.

SOLID WASTE MANAGEMENT WORKSHOP

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The following is a workshop on solid waste management that was highlighted during the concurrent session of the Actions for Working Together conference. Much of the material is borrowed from A-Way with Waste curriculum guide, a program of the Washington State Department of Ecology.

Workshop objectives are:

To provide information on solid waste problems and the role of the individual and community in developing and inplementing integrated solutions.

To link solid waste to the use of energy and natural resources and the creation of pollution.

To provide step-by-step instructional materials and workshop examples on how to increase awareness and involvement of the individual and community in solid waste management.

To provide step-by-step procedures on planning a recycling project or program.

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SOLID WASTE MANAGEMENT

WORKSHOP CONTENTS

WORKSHOP OBJECTIVES

AWARENESS
- QUANTITY OF GARBAGE
- NATURAL RESOURCES
- ENERGY WASTE
- POLLUTION

THE INDIVIDUAL
- WASTE DISPOSAL HABITS
- BUYING DECISIONS
- REUSE
- RECYCLING

THE COMMUNITY
- LANDFILLS
- WASTE-TO-ENERGY
- RECYCLING
- COMPOSTING

PLANNING A RECYCLING PROGRAM
- DEGREE OF INVOLVEMENT
- COST/FUNDING
- SITE LOCATION
- MANAGEMENT
- PUBLICITY

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SOLID WASTE AWARENESS

THE MEDIA

Solid Waste is <u>not</u> the hot environmental topic. A scan of top daily newspapers, wire services, and business and trade publications using Mead Data Central's NEXIS News Monitor information service found 80,980 environmental related stories in the past five years. (Chemecology, 1989).

The order of frequency was:

Topic	Number of Articles
Pesticides	23,261
Toxic Waste	15,066
Acid Rain	13,362
Nuclear Waste	10,945
Oil Spills	6,511
Ozone Layer	4,109
Greenhouse Effect	3,612
Radon	2,966
Chemical Dumping	1,148

PUBLIC ATTITUDES TOWARD GARBAGE DISPOSAL (NSWMA, 1989)

- Each individual produces 3.5 lbs of solid waste a day
- 150 million tons per year in U.S.
- Fill 3,000 football fields 10 stories high
- By year 2000 estimate 193 millions tons

Most Serious Environmental Problems (%)

	1983	1988
Hazardous Waste	22	18
Air Pollution	22	14
Water Pollution - business and industry	10	13
Water Pollution - cities and towns	9	10
Contaminated underground water supply	4	8
Disposal of household garbage	1	5

Problems Facing Local Officials

	(% extremely or very serious)
Improving Education	51%
Garbage Disposal	46%
Affordable Housing	39%

(NSWMA, 1989)

PUBLIC OPINIONS (JULY/AUGUST 1989)
(NSWMA, 1989)

	NATIONAL		SOUTH	
	Favor	Oppose	Favor	Oppose
Building New Landfills	20	65	15	70
Building Waste-to-Energy	36	47	36	46
Overriding Local Authority	33	46	28	47

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PUBLIC OPINION

	Percentage of Waste That Can Be Recycled				
	1-25	26-50	51-75	76-100	Not Sure
National	27	26	12	6	13
South	19	15	19	5	16

How To Pay For Recycling

	National	South
Tax Package	41	48
Landfill Surcharge	17	17
General Tax Revenue	12	9
Direct Household Fee	11	5
Don't Know	19	20

THE QUANTITY OF GARBAGE

The 3-1/2 Pound Garbage Bag

Illustrate that each person discards approximately 3-1/2 pounds of waste per day by filling a garbage bag.

How many tons of garbage would our group generate in a year?

Place this in perspective. Let's add our weights.

Another perspective, how many football fields would we fill 9 ft deep. (Each ton of compacted solid waste occupies about 40 ft^3. A football field is roughly 300 ft by 100 ft or 30,000 ft^2 and 9 ft deep equals 270,000 ft^3.)

Where does the garbage go?

(6,000 plus landfills nationwide using about 1/2 million acres)

What does it cost?
(about 4 billion/year) (Hayes, 1978).

What is your educational budget?

What Do We Throw Away

Item	Percent
Paper	30
Yard Waste	16
Food Waste	15
Glass	10
Metal	10
Plastic	6
Other	13

(White, 1983)

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CHANGING SOLID WASTE STREAM
(Millions of tons)

	1960	1970	1986	2000
Paper & Paperboard	29.8	43.9	64.7	86.5
Glass	6.5	12.7	12.9	13.4
Metals	10.5	13.7	13.7	15.9
Plastics	0.4	3.0	10.3	15.7
Rubber, Leather, Textiles	6.8	9.3	12.6	13.4
Food	12.2	12.8	12.5	12.3
Yard	20.0	23.2	28.3	32.0
Misc. Inorganic	--	1.9	2.7	3.3

Municipal Waste
(in pounds per person per day)

	1960	1970	1986	2000
Gross	2.65	3.22	3.58	3.94
Recycling	0.18	0.21	0.22	0.65
Energy Recovery	--	0.01	0.39	0.49
Net	2.48	3.00	2.98	2.80

1985 Recovery Rates (%)

	U.S.	Netherlands	Japan
Aluminum	28	40	32
Paper	27	46	51
Glass	10	53	17

(Pollack, 1987)

Is all this waste necessary?

Can it be reused or recycled?

Make a cardboard poster of a garbage can and attach different colored strips of cardboard each labelled with the item and percent.

Paper
List items discarded.
(newspapers, magazines, cereal boxes, packaging)
(30% is paper, 40% of all household refuse is packaging material (White, 1983), 50% of nation's municipal waste by volume is paper).

Glass
List items:
beverages, food jars, cleaning containers)
(In 1981 46 billion bottles and jars were produced - 6% recycled) (White, 1983)

Metal
List items:
(cans, beverage containers, appliances, equipment)
(In 1981 on the average, each American used 56 pounds of aluminum.)

Food Waste
List items:
(rotten food, uneatened food, orange peels, egg shells).
(World's largest compost pile, the Netherlands VAM, or Waste Treatment Company compost 125,000 tons a year (White, 1983).

Plastics
List items:
(milk bottles, packaging, plastic wraps for meat, vegetables, etc.)

Yard Waste
List items:
(grass, hedge clippings)

Other
List items:
(clothing, rubber tires, rubber products, hazardous waste, oil)

How can we reduce the amount of waste going into a landfill?

Paper	- Recycle	-	30%
Glass	- Recycle	-	10%
Metal	- Recycle	-	10%
Plastic	- Recycle (difficult)		?
Other	- Recycle (tires, oil)	-	3%
Yard Waste	- Composting	-	16%
Food Waste	- Composting	-	15%
	Landfill	-	16%
	Savings	-	84%

HAZARDOUS WASTE IN YOUR HOME

What is hazardous?
Cause harm to humans or the environment.

Toxic - poisonous
Flammable - quickly burn
Reactive - explosive
Corrosive - rapidly eats into or dissolves what it touches
Examples:

Rat poison	-	toxic
Drain cleaners	-	toxic
Car battery	-	corrosive
Car antifreeze	-	toxic
Paint strippers	-	toxic
Roach spray	-	toxic
Laundry soap	-	toxic
Bleaches	-	toxic
Floor polish	-	toxic

How to dispose of ?????

Most communities do not provide a solution except disposal in a landfill.

NATURAL RESOURCES, ENERGY, AND POLLUTION

PAPER PRODUCTION EXAMPLE
The life cycle of a newspaper.

Topic	Resources	Energy
Seedling production	Greenhouses, fertilizers, water,	Heat, light, ventilation,
Site preparation, planting	Trenches, fertilizers,	Gas, diesel, oil
Tree production	Pesticides, fertilizers, water, soil nutrients	
Harvesting	Soil loss, (erosion) etc.	Fuels,
Lumber mill	Water, steel for blades, etc.	Electricity, fuel
Paper mill	Bleach, waters, steel for machinery	Electricity, fuel
Newspaper production	Dyes, inks, materials for paper presses	Electricity
Disposal	Transportation	Fuels

(Choice - landfill, recycle, waste-to-energy)

TITLE: BIKES AND BY-PRODUCTS

RATIONALE: Sometimes making the things we do want creates things we don't want such as hazardous waste.

SUBJECT: Science, Social Studies

GRADES: 3-6

LEARNING OUTCOME: Students will learn what the term "hazardous waste" means and will learn some of the hazardous wastes created by the manufacturing of a bicycle.

MATERIALS: Bicycle (select a student to bring one to class)

LEARNING PROCEDURE:

1. Ask the class: How many of you have bicycles? Of what are they made? What are the frames made of? How about the tires? The handle bar grips? Where are the metal and rubber and plastic that go into bicycles made? (In mills and factories that transform raw materials such as petroleum, bauxite and iron ore into bicycle components.) Ask: What makes your bike special - different from others? How many different colors of bikes do we have? Whose bike is shiny? What is the shiny metal on bikes called? Ask: Which natural resources are used in the making of bikes? (iron, petroleum - for plastics, synthetic fibers and synthetic rubber, petroleum distillates for paint and paint solvents, bauxite for aluminum, chrome, coal for coke to smelt the iron ore into steel and others.) Ask: What had to happen to the natural resources before they could be used to build your bike? (They had to be processed in factories.) Direct the discussion from here with the aim of having students realize that when natural raw materials are processed, by-products and waste, some of which may be harmful, are produced. Ask: What are by-products? For example, what by-products are produced when you burn wood and paper in your fireplace or woodstove at home? Are some of these by-products harmful? What kinds of things might be by-products of the building of your bicycle?

2. Distribute: the manufacturers accompanying diagram of a bicycle that lists some of the materials and by-products associated with the manufacturing of bike or ask a student to bring his or her bike to class. In the latter case, have students make their own diagrams of the bike. Guide students in identifying the bike's component materials (steel, synthetic rubber, plastic, chrome, synthetic fibers, aluminum, paint, etc.) Then, by referring to the diagram, point out some of the by-products and wastes resulting from the manufacturing of these components.

(A-way With Waste. 1985)

3. Explain: Some (of course, not all) of the by-products and wastes from making a bike are hazardous. What does hazardous mean? (Teacher note: Hazardous means dangerous. Hazardous wastes are likely to cause harm to the environment or to humans because they are either toxic (poisonous), flammable (ignitable, highly burnable), reactive (explosive), or corrosive (substances that rapidly eat into and/or dissolve what they touch.)

   Ask: Does this mean that you will get sick from handling or riding your bike? Why not? What happened to the hazardous by-products and wastes produced when your bike was made? (NOTE: Some are captured and recycled for industrial reuse. Some are captured and disposed of in hazardous waste disposal sites such as the one in Arlington, Oregon. Some escape into the air and water such as into Tacoma's Commencement Bay, some in small quantities, are sent to conventional landfills and some are dumped illegally.)

   Ask: How should hazardous wastes and by-products be managed? Why is it important to use great care in disposing of these wastes and by-products?

   Ask: Because hazardous wastes and by-products are made when bikes are built, should we stop making bikes? What should we do that makes more sense? What are some other things you use that might also have produced hazardous by-products when they are made?

4. Discuss: Why there has been so much news about hazardous waste lately?

PRE & POST TEST QUESTIONS:

What raw material is plastic and synthetic rubber made from?

What happens to hazardous industrial wastes?

(2nd & 3rd Grades) What is a natural resource? Name two.

ACKNOWLEDGEMENT:

Special thanks to John Conroy, Washington State Department of Ecology, for help with this activity.

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(A-way With Waste. 1985)

By-Product & Waste Information From

Liquid Waste of Industry, Nelson L. Nemerow, Addison-Wesley Pub. Co., Menlo Park, CA, 1971

Chromed & Plated Metal Parts

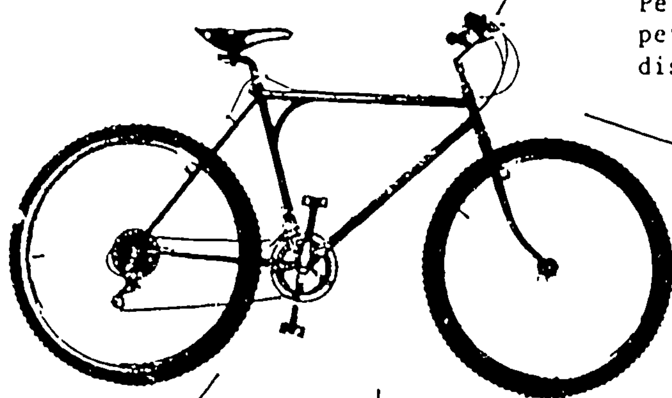
Materials
Chrome, nickel, copper, zinc.

By-Products & Waste
(Highly toxic liquid wastes)
Acids, chromium zinc, copper, nickel, tin, cyanides.

Handle bar grips, plastic seat cover, paint, synthetic fibers, synthetic rubber tires

Materials
Petroleum & petroleum distillates.

By Products & Waste
Waste oil from leaks, caustic & acid sludge, alkaline & acid waters, acid gases & filtering clays.



Frame & Other Metal Parts

Materials
Iron ore & coal to make steel.

By Products & Wastes
Ammonia, tar, acids (pickling liquor waste), blast furnace flue dust.

Paints & Coatings

Materials
pigments
solvents
resins
cleaners

Wastes
paints
solvents
cleaners

Fenders & Other Metal Parts

Materials
Aluminum from Bauxite.

By Products & Wastes
Large volumes of "Red Mud" consisting of iron oxide, titanium & silica.

(A-Way With Waste. 1985)

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If you recycle paper
-- reduce energy use by 30-55%
-- reduce air pollution by 95%
-- reduce solid waste by 130%
(Chandler, 1983)
-- 20,400 BTU/lb energy cost
(Fritsch, 1975)

THE INDIVIDUAL

Each individual can solve the solid waste problem, reduce pollution, and reduce the depletion of natural resources and energy by: (1) selective shopping, (2) reuse of materials, (3) recycling, and (4) composting.

PACKAGING

Why is packaging used?
Protection of products and consumer
Preservation of products
Produce identification
Prevention of theft
Instruction
Regulatory standards
Advertisement
Increase profit
-- 40% of American household garbage is packaging material.
-- if we fail to recycle we waste energy and natural resources
-- packaging contributes to littering problems

Teaching projects:
-- design packaging for a given product that may be reused or recycled
-- select products and answers
1. Is the packaging made from recycled materials?
2. Could it be bought in bulk?
3. Could it be bought in a less processed or packaged form?
4. How is a product price influenced by
-- quantity
-- processing
-- packaging

-- review a potato by any other name
(Ag Biz Tiller, Aug. 1976).

Classroom or Office Paper
Wise Use of Paper (A-Way With Waste, 1985)
-- 30% of household waste is paper
-- each person uses 580 lbs of paper per year
-- each person uses 2 trees worth of paper per year
-- if we recycle 1 ton of paper
-- preserve 13 to 20 500-pound trees
-- reduce energy used by 30 to 55%

A POTATO BY ANY OTHER NAME

PRODUCT	PACKAGE SIZE	PRICE	PRICE PER POUND
Fresh potatoes	10 lb.	$ .98	$ .098
Fresh potatoes	2 lb.	.49	.245
Del Monte canned whole new potatoes	16 oz.	.28	.28
Bel-Air* Southern Style hashed browns	32 oz.	.59	.295
Bel-Air* Tater Treats	16 oz.	.45	.45
OreIda Tater Tots	16 oz.	.49	.49
Bel-Air* frozen french fries	9 oz.	.28	.496
OreIda dinner fries	24 oz.	.77	.51
OreIda frozen shoestring potatoes	12 oz.	.45	.60
Idahoan instant mash potatoes	8 oz.	.37	.74
Pillbury artificially flavored mashed potatoes	15 oz.	.85	.85
Butterfield shoestring potatoes	16 oz.	1.19	1.19
Betty Crocker potato buds	5 oz.	.41	1.31
Granny Goose potato chips	8 oz.	.75	1.50
French's potato pancakes	6 oz.	.57	1.52
Small order McDonald's french fries	3 oz.	.32	1.69
Betty Crocker AuGratin potatoes	5.5 oz.	.59	1.71
Procter and Gamble's Pringles	4.5 oz.	.49	1.72
Nabisco potato snacks	5 oz.	.62	1.98
Nabisco tater puffs	5 oz.	.64	2.05
Granny Goose potato chip packets (½ oz. @)	6 oz.	.95	2.52

*Bel-Air is Safeway Stores, Inc. private label. All items priced on July 13, 1976, at Safeway Stores and McDonald's in San Francisco.

From: The AgBiz Tiller, August 1976.

(A-way With Waste. 1985)

-- reduce air pollution in manufacturing process by 95% (Chandler, 1983)

-- 80% of recycled paper is used in packaging

Collect paper for one week and divide into two boxes: Box 1 - paper we can still use , and Box 2 - paper which has been used completely. Reuse paper from Box 1, when practical, and place into Box 3 when fully used. Weigh each box.

Discussion: How much paper was reused?
How much energy was saved?
How many trees would be saved in one year if all classes (offices) reused and recycled paper?
Etc.

THE COMMUNITY

ALTERNATIVE SOLID WASTE DISPOSAL OPTIONS

Review

-- Recycling/Waste Reduction System
-- Recycling/Resource Recovery System
-- Waste-to-Energy System
-- Landfill (State-of-the-Art)
-- Composting

U.S. EPA Goals (Chemecology, Sept. 1989)

	Landfill	Recycled	Incinerated
Current	80	10	10
1993 Goal	55	25	20

-- 160 million tons per year waste disposal
-- a convoy of trucks reaching halfway to the moon
-- 1/2 of 6,000 landfills to be filled by mid-1990's
-- 80% of existing permitted landfills will close within 20 years

Landfill Capacity
(NSWMA, 1989b)

-- Projected Landfill Closing, 1988 - 2,000

	Landfills	Annual Intake (million tons)
1988	5,499	187
1993	3,332	131
1998	2,720	94
2000	2,157	76

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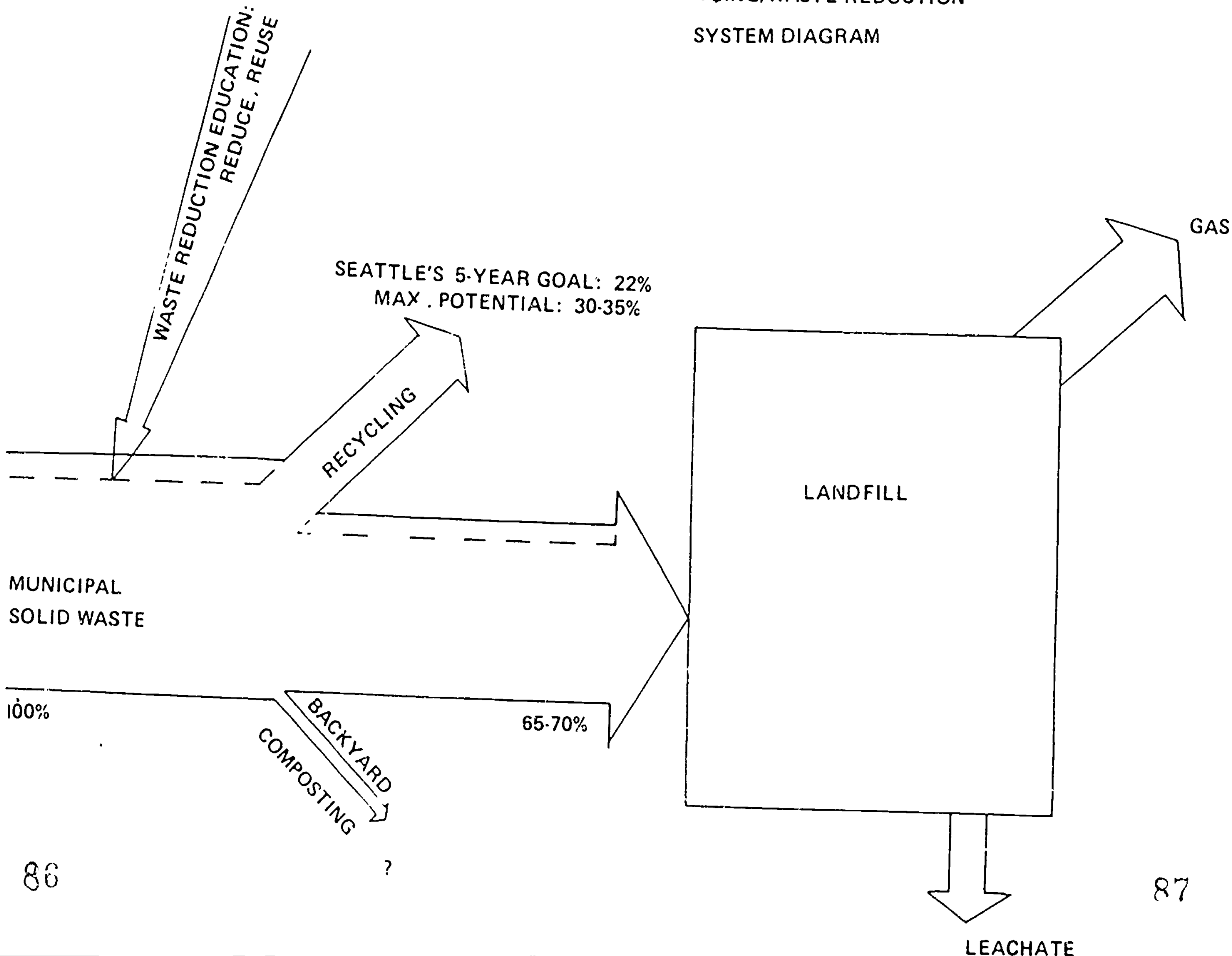
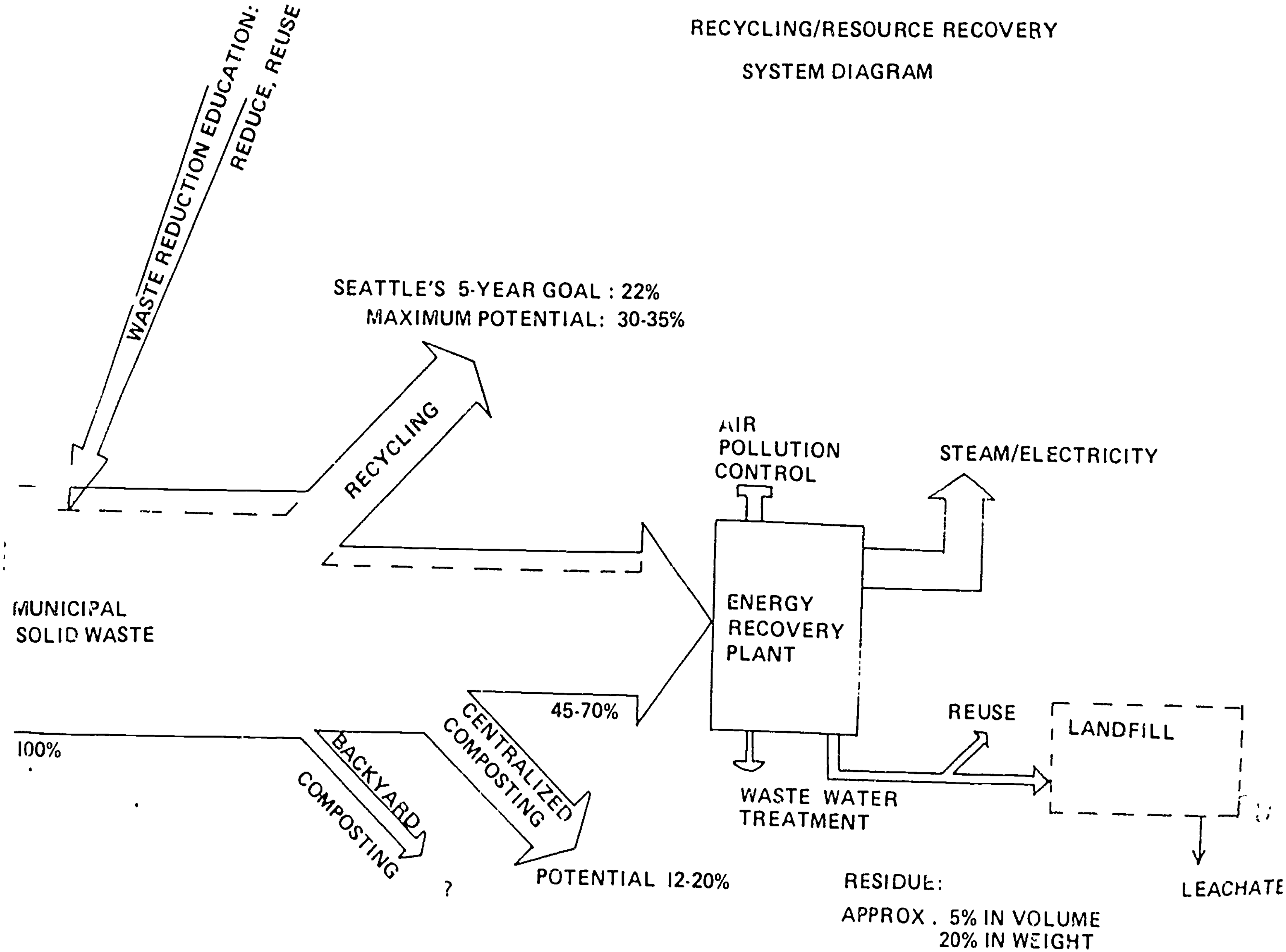
RECYCLING/WASTE REDUCTION SYSTEM DIAGRAM



(A-way With Waste. 1985)

RECYCLING/RESOURCE RECOVERY SYSTEM DIAGRAM



(A-way With Waste. 1985)

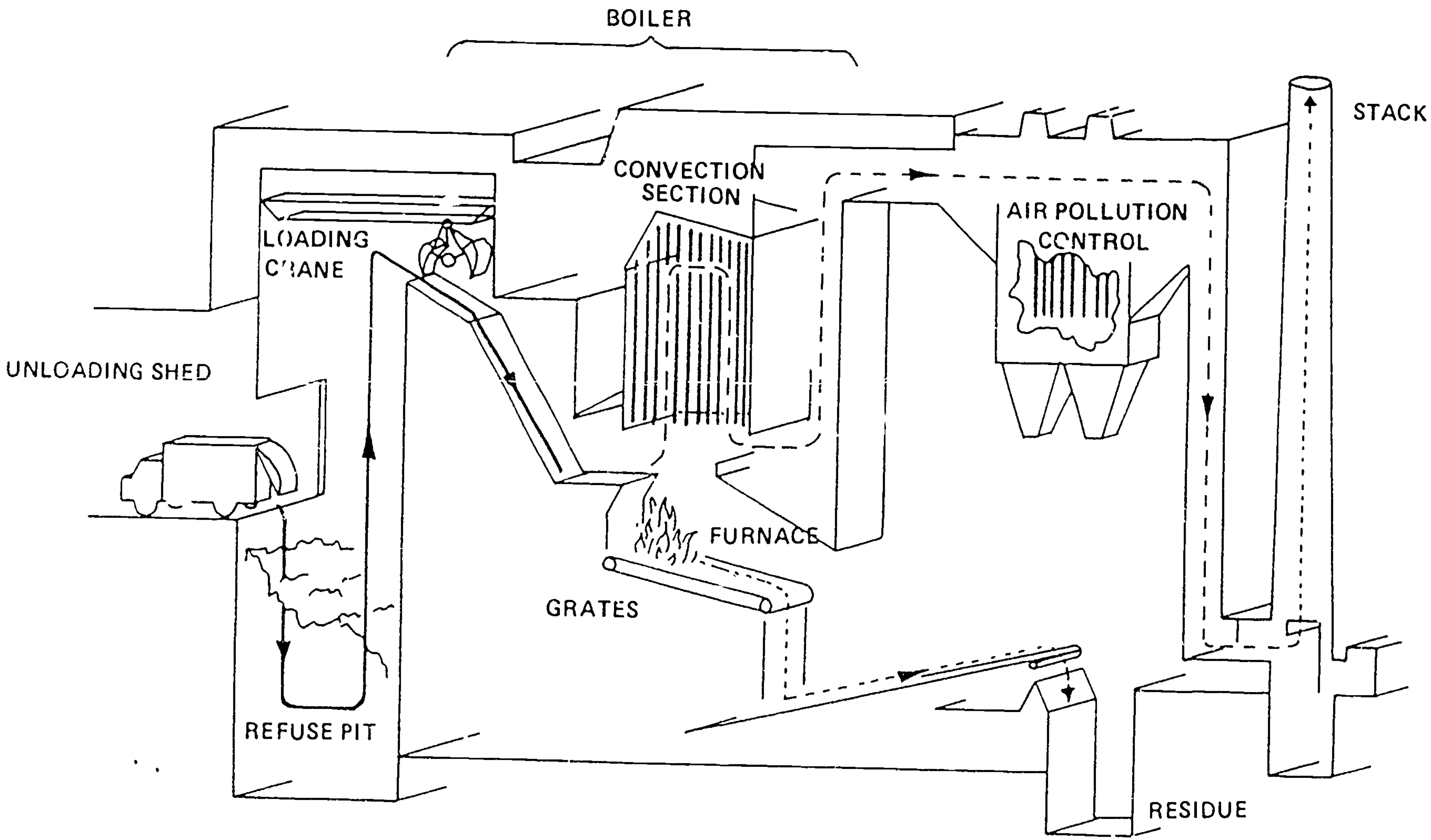


Figure I. Typical Water wall Furnace for Unprocessed Solid Waste

A-Way With Waste. 1985)

-- Who Owns Landfills

	Number of Facilities	%
Local and County	3,343	57
Private	802	14
Federal	193	3
Other	1,465	25

-- Landfill Size

Acres	Number	%	Tons/day	Number	%
<10	2,944	42	<30	5,309	67
10-100	3,572	52	30-500	2,211	28
>100	229	6	>500	408	5

-- Since 1978 70% of the 14,000 landfi.l closed.

	New Landfills
1970's	300 to 400 per year
1980's	50 to 200 per year

State Landfill Capacity	
KY	<5 yrs
FL	5 - 10 yrs
AL	5 - 10 yrs
OK	5 - 10 yrs
other SE States	>10 yrs

Current Landfill Facts

-- 14% are located in floodplains
-- 6% are located in wetlands
-- 35% are located in counties that contain active faults
-- 28% have liners (synthetic or natural)
-- 22% have leachate collection systems
-- 61% have run-on/run-off control
-- 2% have methane control
-- 22% of Superfund National Priorities List (May, 1986) were Municipal Solid Waste Landfills (NSWLF) (older facilities, pre-1980)
-- 54% of existing NSWLFS are greater than 1 mile from a down gradient drinking water well
-- States identified greater than 32,000 closed solid waste landfills

Waste-to-Energy
(NSWMA, Sept. 1989)

	Capacity (Tons per Day)
1980	10,000
1983	24,000
1986	41,000
1988	65,000
1992	175,000?

Types

Mass burn facilities
-- Burn municipal waste after recycling

Refuse - derived fuel (RDF) plants
-- Removes recyclable or unburnable material, shred or processes remainder into a uniform fuel

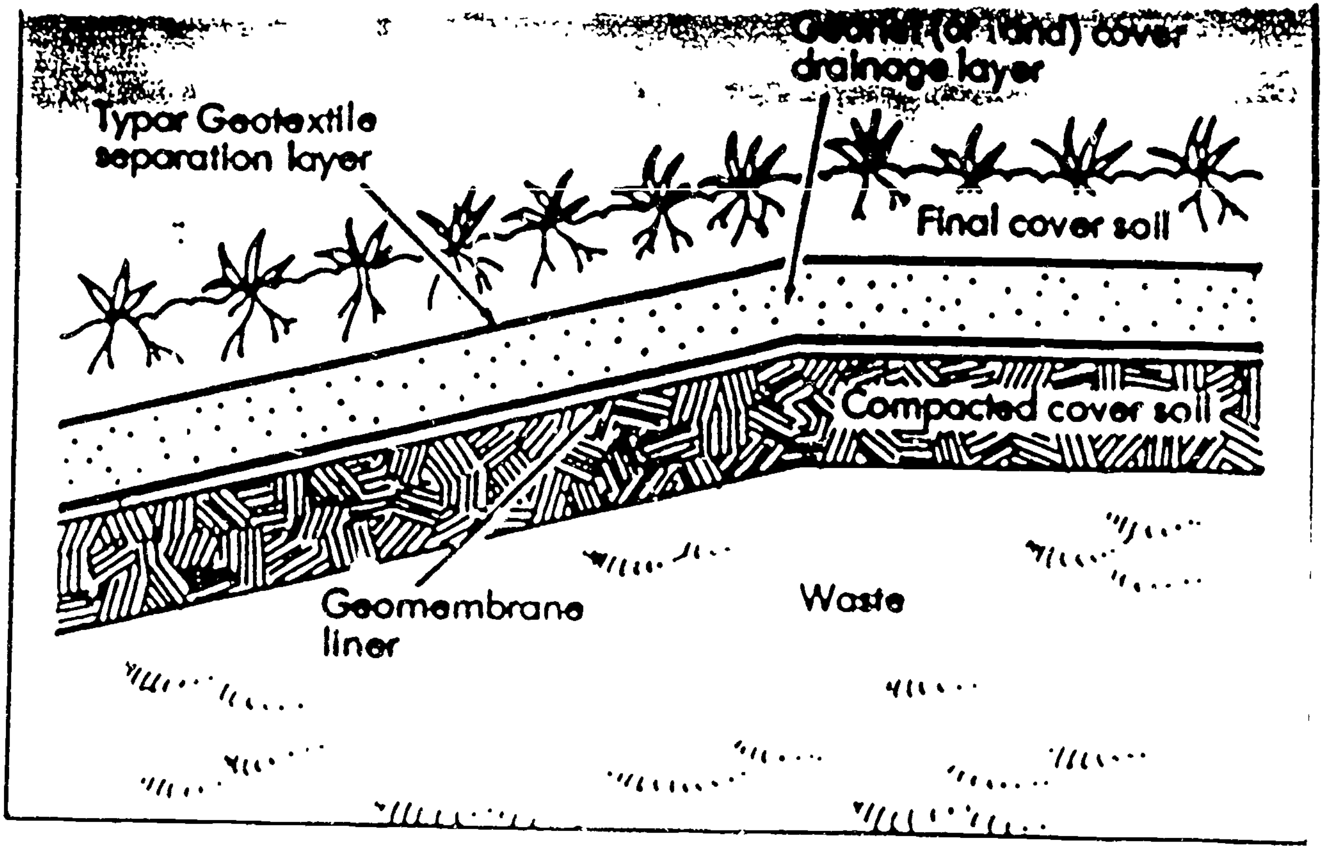
Modular Facilities
-- smaller prefabricated mass burning facilities

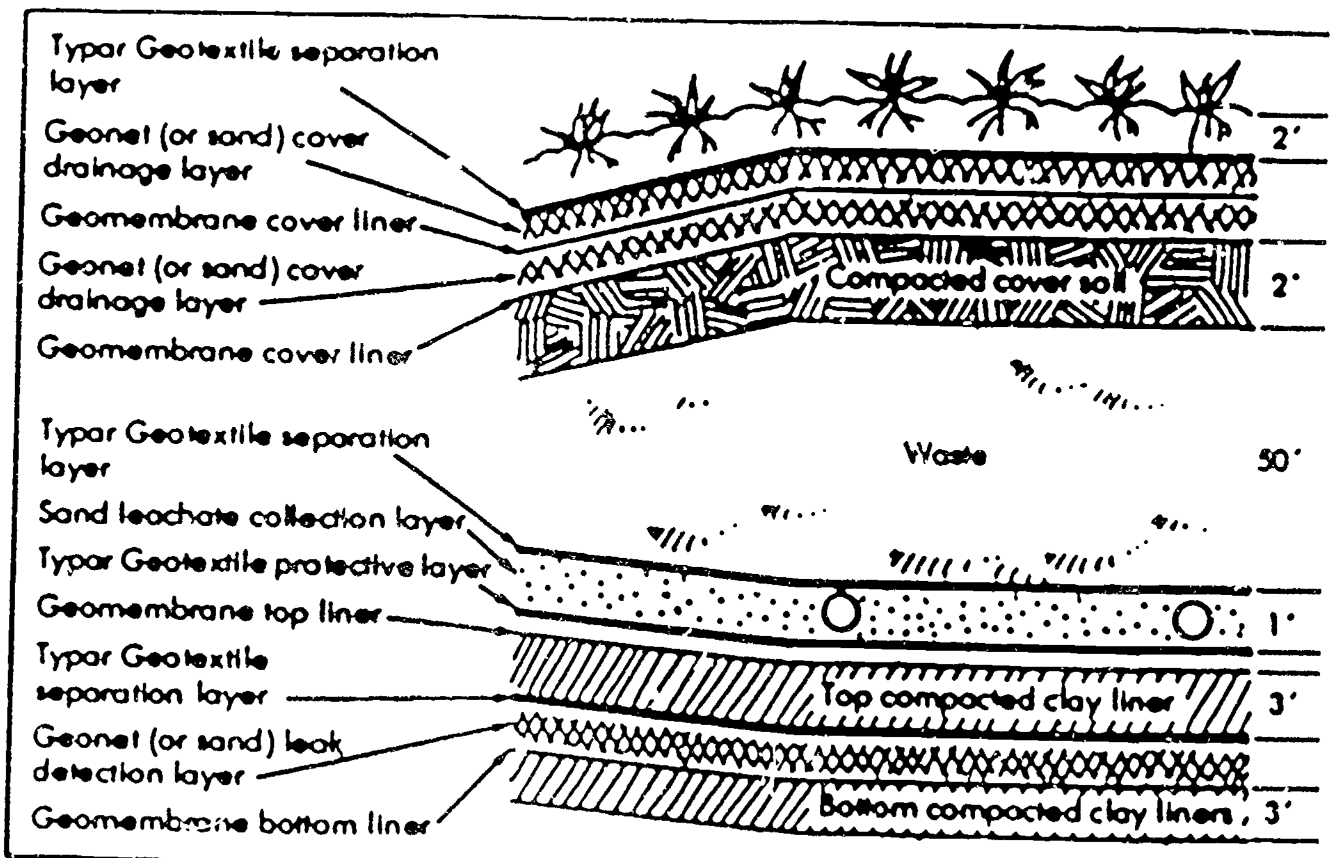
Average Capacity

Mass burn facilities	- 814 tons/day
Refuse derived fuel	- 952 tons/day
Modular facilities	- 122 tons/day

Waste-to-Energy Facilities in Southeast
(NSWMA, Sept. 1989)

State	Number	Capacity (tons/day)
AL	1	300
AR	3	250
FL	9	9,270
GA	1	500
KY	1	75
MO	1	75
MS	1	150
NC	1	200
OK	2	1,233
SC	1	240
TN	6	1,740


Geonet (or sand) cover drainage layer
Typar Geotextile separation layer
Final cover soil
Compacted cover soil
Geomembrane liner
Waste


Typar Geotextile separation layer
Geonet (or sand) cover drainage layer
Geomembrane cover liner
Geonet (or sand) cover drainage layer
Geomembrane cover liner
2'
Compacted cover soil
2'
Typar Geotextile separation layer
Waste
50'
Sand leachate collection layer
Typar Geotextile protective layer
Geomembrane top liner
1'
Typar Geotextile separation layer
Top compacted clay liner
3'
Geonet (or sand) leak detection layer
Geomembrane bottom liner
Bottom compacted clay liners
3'

Design Procedures

Table One
Sanitary Landfill Design Steps

1 Determination of solid waste quantities and characteristics
  a Existing
  b Projected

2 Compilation of information for potential sites
  a Performance of boundary and topographic surveys
  b Preparation of base maps of existing conditions on and near sites
    —Property boundaries
    —Topography and slopes
    —Surface water
    —Utilities
    —Roads
    —Structures
    —Land use
  c Compilation of hydrogeological information and preparation of location map
    —Soils (depth, texture, structure, bulk density, porosity, permeability, moisture, ease of excavation, stability, pH, CATION exchange capacity)
    —Bedrock (depth, type, presence of fractures, location of surface outcrops)
    —Groundwater (average depth, seasonal fluctuations, hydraulic gradient and direction of flow, rate of flow, quality, uses)
  d Compilation of climatological data
    —Precipitation
    —Evaporation
    —Temperature
    —Number of freezing days
    —Wind direction
  e. Identification of regulations (federal, state, local) and design standards
    —Loading rates
    —Frequency of cover
    —Distances to residences, roads, and surface water
    —Monitoring
    —Roads
    —Building costs
    —Contents of application for permit

3 Design of filling area
  a Selection of landfilling method based on
    —Site topography
    —Site soils
    —Site bedrock
    —Site groundwater
  b Specification of design dimensions
    —Trench width, depth, length
    —Cell size
    —Cell configuration
    —Trench spacing
    —Fill depth
    —Interim cover soil thickness
    —Final soil cover thickness
  c Specification of operational features
    —Use of cover soil
    —Method of cover application
    —Need for imported soil
    —Equipment requirements
    —Personnel requirements

Design features
  a Leachate controls
  b Gas controls
  c. Surface water controls
  d Access roads
  e Special working areas
  f Structures
  g Utilities
  h Fencing
  i Lighting
  j Washracks
  k Monitoring wells
  l Landscaping

5 Preparation of design package
  a Development of preliminary site plan of fill areas
  b Development of landfill contour plans
    —Excavation plans (including benches)
    —Sequential fill plans
    —Completed fill plans
    —Fire, litter, vector, odor and noise controls
  c. Computation of solid waste storage volume, soil requirement volumes, and site life
  d Development of final site plan showing
    —Normal fill areas
    —Special working areas
    —Leachate controls
    —Gas controls
    —Surface water controls
    —Access roads
    —Structures
    —Utilities
    —Fencing
    —Lighting
    —Washracks
    —Monitoring wells
    —Landscaping
  e. Preparation of elevation plans with cross-sections of
    —Excavated fill
    —Completed fill
    —Phase development of fill at interim points
  f Preparation of construction details
    —Leachate controls
    —Gas controls
    —Surface water controls
    —Access roads
    —Structures
    —Monitoring wells
  g Preparation of ultimate land use plan
  h Preparation of cost estimate
  i Preparation of design report
  j Submission of application and obtaining required permits
  k Preparation of operator's manual

(Conrad *et al.*, 1981)

PLANNING A RECYCLING PROGRAM

RECYCLING OPTIONS

1. Account of local recycling center materials from parents and community members credited to fund projects.
2. Monthly recycling drives.
3. Bins at schools, arrange for pick-up and payment.
4. Short-term recycling center.
5. Long-term recycling effort.
   (Ex. Polyvalent Leboise Victoriaville Secondary School - Quebec, Canada)
   -- 7,000 tons of recyclables annually
   -- 13,000 households
   -- $600,000 annual budget
   -- 70% participation rate
   -- 15% of waste stream
   (Grady, 1989)

RECYCLING SURVEY
(A-Way With Waste, 1985)

Ask: What information from families and the community would be useful in preparing the take-home recycling kit?

Questions might include:

a: Which of the following do you recycle? (circle)

compostables	steel (tinned) cans
paper (list kinds)	glass (all, some)
newspaper	plastic
aluminum cans	none of the above

b. If you do not recycle, would you be willing to do so if you had more information about how to do it?

c. Do you think it is important for school children to learn about recycling and resource management?

d. If you do recycle, where do you take your recyclables?

e. Would you be willing to accompany the class on a recycling field trip?

f. Would you be willing to help the class set up a recycling project at the school?

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TITLE: SOME CANS ARE MORE "ATTRACTIVE" THAN OTHERS

RATIONALE: There are three general categories of metal cans: aluminum, tinned, and bimetal. Of these three, bimetal is the most difficult to recycle and should therefore be avoided.

SUBJECT: Science, Social Studies

GRADES: 1-3

LEARNING OUTCOME: Students will learn how to tell the differences between aluminum, tinned and bimetal cans by using magnetism and by observing differences in appearance.

MATERIALS: Small magnets (Provided by Department of Ecology - order by referring to p. 343). Samples of aluminum, tinned and bimetal cans.

LEARNING PROCEDURE:

1. If you have not already done so, discuss how waste is reduced by recycling. Review what recycling means (you may want to refer to the activities Recycle Bicycle, p. 212, or What's in a Cycle?, p. 222).

2. Tell students that cans are recyclable, but that some are much easier to recycle than others. Hold up samples of the three major types of cans: aluminum (i.e., pop cans), tinned -- these are really 99 percent steel with a thin coating of tin (i.e., soup cans) and bimetal (i.e., often tuna fish cans, small apple juice, and tennis ball cans are bimetal). Explain that bimetal cans are cans that have an aluminum top and a steel body. "Bimetal" <u>does not</u> refer to a can that has two metals combined to form an alloy.

3. Note that, at first glance, these cans are very similar in appearance, but that it is important to tell the differences because the bimetals are not easily recyclable, and we should therefore avoid buying these. It is also important to be able to identify the type of can because different types need to be separated before being brought to the recycler.

4. Explain and demonstrate to students the following ways to tell the differences between metals:

   a. Magnetism

      (1) Hold up a magnet. Ask for a show of hands of those who have experimented with magnets. Did they notice the things that magnets will attract? Explain that magnets are pieces of

(A-way With Waste. 1985)

ERIC

iron or steel that can attract iron or steel. (This property may be naturally present or artificially induced.) Experiment with some object to show some of the metals the magnet will attract and others that are not attracted.

(2) Demonstrate that magnets attract tinned and bimetal cans, but not aluminum cans.

b. Appearance

Pass out can samples. Ask class to point out the differences they see between the cans (i.e., weight, seams, color, shininess). Tell them that bimetal cans look almost identical to aluminum cans. The following is a chart which lists the differences. It is best to compare the cans at the same time to see some of these differences.

Aluminum	Bimetal	Tinned
*1. Is <u>not</u> attracted by a magnet	*1. Is attracted by a magnet	*1. Is <u>attracted</u> by a magnet
*2. Almost all of these cans say "All Aluminum Can" on the side	*2. Bottom has a rim	2. <u>Always</u> has a seam
*3. No seam	3. If you look closely, the bottom is not finely brushed. It is also usually spray painted	3. Heavier weight than aluminum
*4. If the bottom of the can is round and more shiny then it is aluminum	4. (May or may not have a seam)	4. (Usually has ring or ribbing on the can and normally has a paper label
5. Shiny, silver, smooth		
6. Light weight		
7. Aluminum cans, if you look closely are <u>finely</u> brushed on the bottom		
8. Printing is usually directly on the can as opposed to on a paper label.		

(*"sure thing" identification)

5. Set up a station in the room so that one person or one group of students at a time can practice separating cans using magnets and observing the above differences. (You may want to provide a magnifying glass.)

(A-way With Waste. 1985)

6. Demonstrate how to prepare cans for your recycler (Contact the WDOE toll-free Recycling Hotline, 1-800-RECYCLE, for the name and number of the recycler nearest you. Find out what kinds of cans are accepted and how to prepare them. For example, many recyclers do not accept bimetal cans. Find out how much is paid for different types of cans.)

   Ask: Do you know how to tell the differences between cans? What kind of cans should be avoided when possible? What would save more energy and resources than recycling? (Answer: not buying in the first place. Is that possible? Sometimes? All the time?)

EXTENDED LEARNING:

1. Start a classroom recycling center for metal. Make sure all cans are already cleaned and flattened when brought to school.
2. Have students draw a cartoon or write a description of how to ready cans for recycling.
3. Study maps of where aluminum is mined.
4. Investigate how steel is made.
5. Discuss percentage of energy saved by recycling iron and steel (60-70 percent) and aluminum (90-95 percent).

PRE & POST TEST QUESTIONS:

Name three ways to tell if a can is aluminum or bimetal.

Name three ways to tell the difference between tinned and bimetal cans.

ACKNOWLEDGMENT:

Special thanks to Armen Stepanian, Fremont Recyclng, 3505 Evanstone N., Seattle, Wa. 98103, for information on bimetal cans.

RESOURCES: Available from the Washington State Department of Ecology. To order see page 343.

Washington State Department of Ecology. <u>Guide to Household Recycling: An Introduction to Why, What and How to Recycle in the Home</u>. Olympia, Wa.: 1983.

Magnets used to test and separate aluminum, tinned and bimetal cans for recycling.

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TITLE: WHERE IT'S AT

USE WITH: Recycling Is Our Business, Is it Yours?, p. 225.

RATIONALE: There are many important groups and individuals that need to be recognized and consulted in the successful operation of a business. Mapping a business district and key business contacts is a valuable tool in the management of a business or project.

SUBJECT: Business

GRADES: 7-10

LEARNING OUTCOME: Students will map the geographic boundaries of a recycling program's "complimentary region" (service area) and include the location of contacts important to the program. They will use this map as an aid in managing a school recycling program or project.

LEARNING PROCEDURE: Students will:

1. Use the data from the feasibility study survey to establish the geographic boundaries of the recycling program's service area. (see School Recycling Program options)

2. Map the boundaries of the program's service area.

3. List contacts important to the recycling program and create a map symbol for each. Some might be:

   a. Individuals and groups willing to contribute financially to the program.

   b. Major contributors of recyclable materials (industries, restaurants, households in community, etc.).

   c. Neighborhood groups that expressed interest in the recycling effort.

   d. Government agencies involved.

   e. Local recyclers (call the WDOE Recycling Hotline, 1-800-RECYCLE, toll free).

   f. Media for publicity.

4. Using the symbols you create, draw a map.

(A-way With Waste. 1985)

ERIC

5. Use this map to devise "action plans" -- methods to systematically contact contributors, pick up materials, etc.

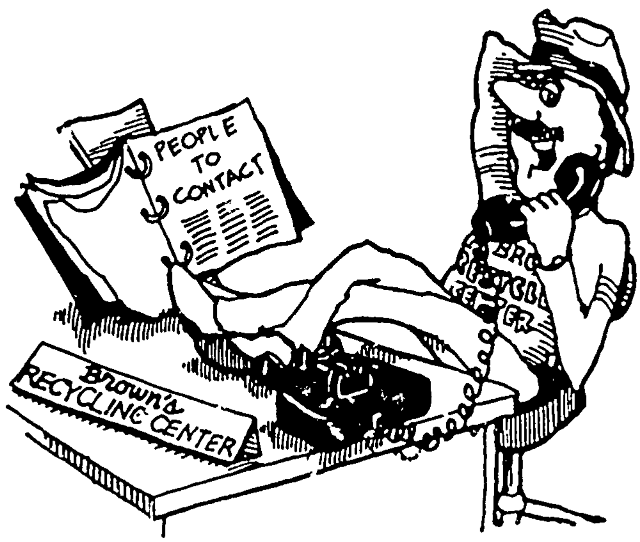
These materials would then be forwarded to the local recycler.

PRE & POST
TEST QUESTIONS:

Which businesses in your community would be interested in a school recycling program? Why?

Who are the most important people to contact in your community to help your school recycling program?

How will a map with symbols of important contacts help your recycling program?



(A-way With Waste. 1985)

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TITLE: A COMPUTER MODEL OF A RECYCLING CENTER

USE WITH: Computer Talk, p. 284.

RATIONALE: A computer can save a business time and money.

SUBJECT: Computer Science, Math

GRADES: 7-12

LEARNING OUTCOME: Students will develop a working model computer program of a recycling center which can be used to make decisions about a school recycling program.

LEARNING PROCEDURE:

BACKGROUND:

A recycling center has three suboperations for which computer programs should be developed. These suboperations are: 1) materials management at the recycling site; 2) work schedules during the hours of operation at the recycling site; and 3) the business finances of running the recycling center.

1. Materials Management - This aspect involves: a) the quantity of materials being donated to the school center; b) the size of the containers and the volume/mass they will hold at the school's recycling site; and c) the scheduling of pickup and transportation of materials to the local private recycler.

2. Work Schedules - This aspect involves: a) scheduling individuals to perform the following tasks: breaking glass, cleanup, separating materials, tying and stacking newspapers, closing up the school center, etc.; b) providing a schedule for pickup of recyclables; and c) providing the appropriate number of workers for peak periods.

3. Business Finances - This aspect involves: a) monitoring the income, expenses, and profit of the program; b) distributing the profit to the various organizations involved in running the school center.

PROCEDURE: In order to develop the computer programs:

1. Raw data involving the three aspects mentioned above must be obtained from the individuals operating the school center. Once the data is obtained, the programs should be developed and continually modified to accurately reflect the operation of the recycling center.

2. Daily or weekly entries should be made in the program to keep track of the center's operations.

(A-way With Waste. 1985)

3. Periodic printouts of the three aspects of the center will be made available to the individuals in charge of running the recycling center. The information provided will enable them to make sound decisions concerning the center's operations.

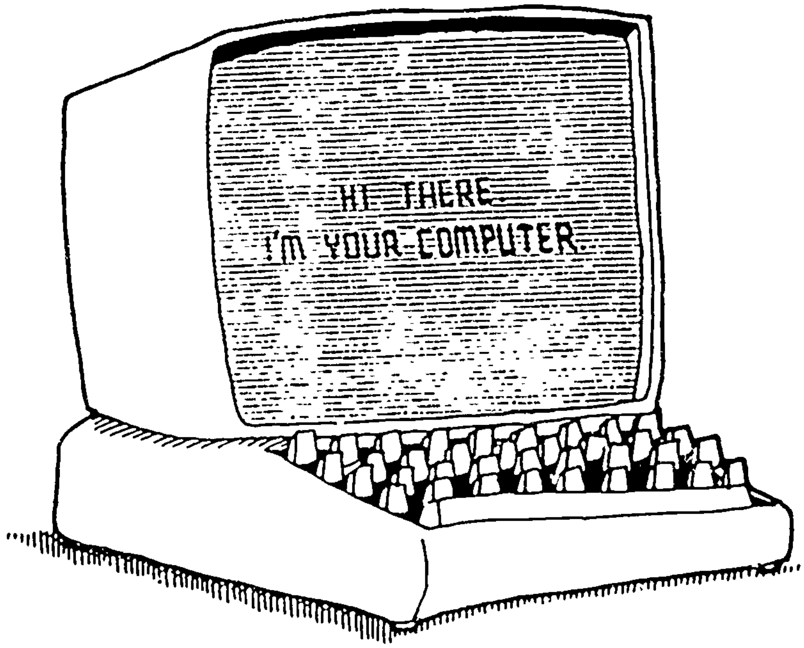
PRE & POST
TEST QUESTIONS:

List three operations involved in a school recycling center which might be efficiently handled by a computer program.

Who could develop and process a computer program for a recycling center in your school?

Once a computer program for a recycling center has been established, estimate the savings in time to operate the center.

How might a computer program save money for a recycling center?



(A-way With Waste. 1985)

How To Recycle Glass

As much as possible, buy returnable or reusable bottles. To prepare glass for recycling, do the following:

1. Wash glass - no need to remove labels.
2. Check with recycler to see if it is necessary to remove all metal caps and rings. Discard caps.
3. Separate glass containers by color, either at home or at the recycling center.

How To Recycle Paper

Newsprint

1. Stack newspapers in a fire-safe area.
2. Check with recycler to see if newspapers should be tied in stacks.

Other Papers

Corrugated cardboard - (two layers of heavy cardboard with a ribbed section in between) Check with your recycler. Flatten for easy storage and transportation. Store in fire-safe area.

Hi Grades - (this is computer paper, tab cards, and ledger paper.)

Check to see what types of paper your recycler accepts.

How To Recycle Aluminum

1. Check to make certain the cans are all aluminum. (See "Some Cans are more Attractive than Others" p. 214.)
2. Rinse. (You may wish to flatten to save storage and transportation space.)
3. Separate aluminum cans from other aluminum products; i.e., TV dinner trays, foil, etc.

How to Recycle Tinned Cans

These are typical food cans - 1% tin, 99% steel.

1. Wash them out and remove labels.
2. Remove both ends and flatten.

(A-way With Waste. 1985)

ERIC Full Text Provided by ERIC

TITLE: COMPOST - THE END AND THE BEGINNING

RATIONALE: Recycling by composting improves soil structure and fertility and reduces the volume of household solid waste.

SUBJECTS: Biology, Horticulture, Vocational Agriculture

GRADES: 7-12

LEARNING OUTCOME: Students will learn the basic principles necessary to construct a good compost pile. Students will understand how composting reduces household waste.

MATERIALS: Organic waste (manure), soil, five-five gallon buckets, thermometer.

LEARNING PROCEUDRE:

1. Read about composting and the alternatives for construction of compost bins or containers. (See Resources at the end of this activity for some good book suggestions. Choose the methods which are within your time and budget limitations.)

2. Using grass clippings, manure, weeds, hay, sawdust, coffee wastes, etc., start five small experimental compost piles. Make sure not to include bones, meat, grease or other materials that may attract rodents and pests. Try to keep compost piles about one cubic yard, or if necessary, use five 5-gallon buckets with holes drilled in the sides.

3. Each compost pile will be unique in one of the following ways:

   The five experimental conditions:

   a. Low in nitrogen

      - no manure or garbage that is high in nitrogen.
      - moisten, don't soak.
      - turn over regularly, every 3-4 days at first, then once a week.
      - include a mixture of ingredients: garbage, clippings, leaves, weeds, etc.

   b. Not enough moisture

      - include manure and contents which are hign in nitrogen.
      - turn regularly.
      - have a good mixture of ingredients.
      - don't water at all and make an effort not to add garbage that has a lot of moisture in it.

(A-way With Waste. 1985)

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c. No air circulation

- include nitrogenous materials.
- good mixture of ingredients.
- keep moist.
- do not stir.

d. Too much of a single ingredient

- put all leaves or grass clippings in this pile.
- moisten.
- stir regularly.

e. Good compost pile

- include nitrogenous material (manure and blood meal are good sources).
- keep moist.
- stir regularly.
- include a good mix of ingredients which are layered.

Keep a daily record of the temperature of each pile.

After a few weeks discuss the results. Why does one pile break down wastes faster than others? What are the essential ingredients of a good compost system?

Discussion questions:

How is the compost pile like the nitrogen cycle and other natural cycles in our biosphere? (The nitrogen cycle is "the continuous cyclic progression of chemical reactons in which atmospheric nitrogen is compounded, dissolved in rain, deposited in the soil, assimilated, and metabolized by bacteria and plants and returned to the atmosphere by organic decomposition."[1]

Where is composting occurring naturally?

What are consequences of not recycling vital chemicals to their origins?

PRE & POST TEST QUESTIONS:

What is composting?

What are the necessary "ingredients" for a good compost pile?

How is composting related to the concept of recycling?

How can composting reduce waste?

(A-way With Waste. 1985)

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SOURCE: [1]Webster's II New Riverside University Dictionary, Boston, MA, Houghton Mifflin Co., 1984.

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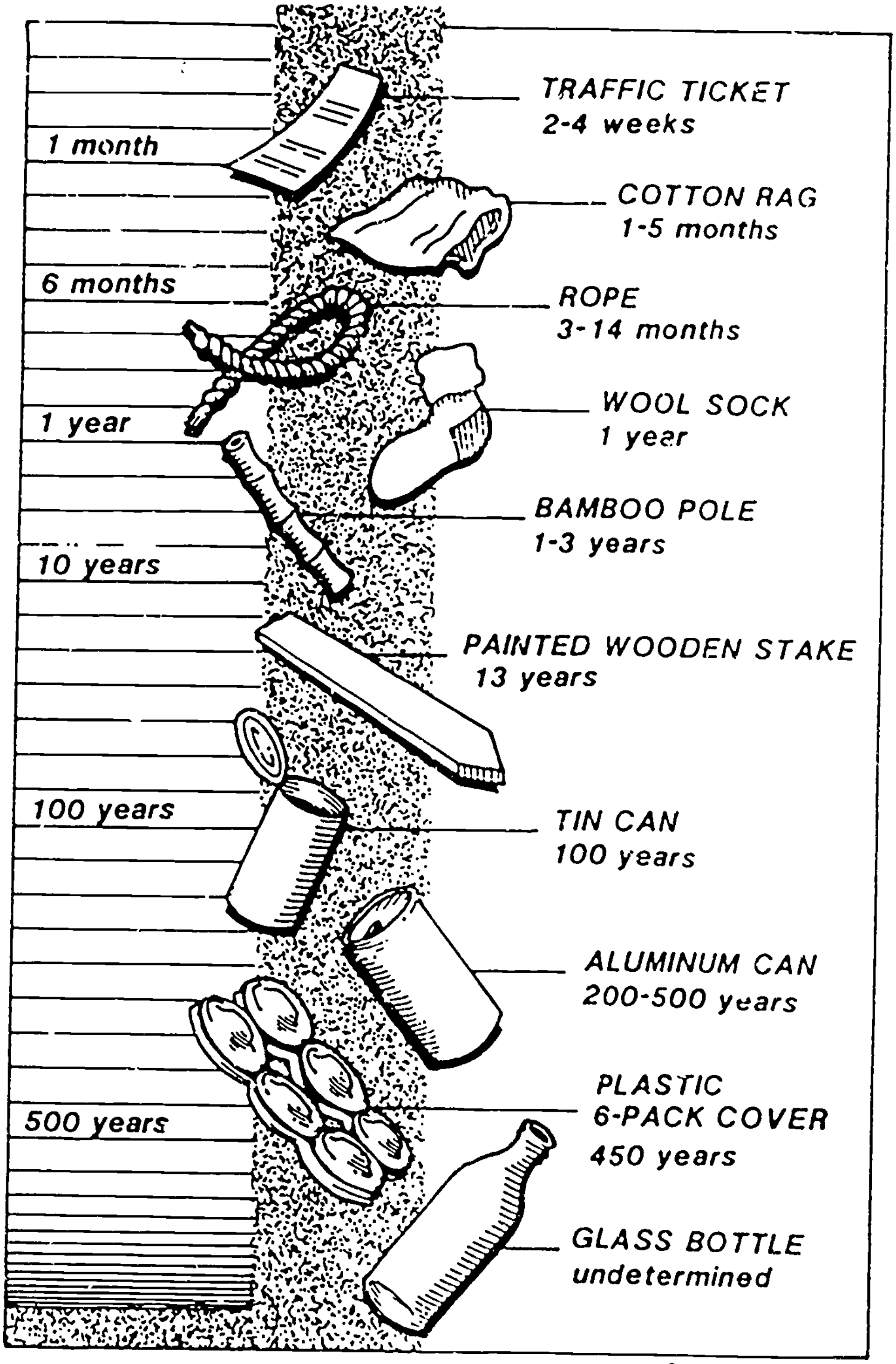
City of Seattle Composting Hotline, 625-2089, Seattle Engineering Department, Solid Waste Utility.

King County Extension Service, 344-7984, 9:00 a.m.-1:00 p.m. Tape Number 444, "Making a Compost Pile."

Enduring Litter

Litter at the roadside is ugly. How long it will stay before decaying may be an ugly surprise

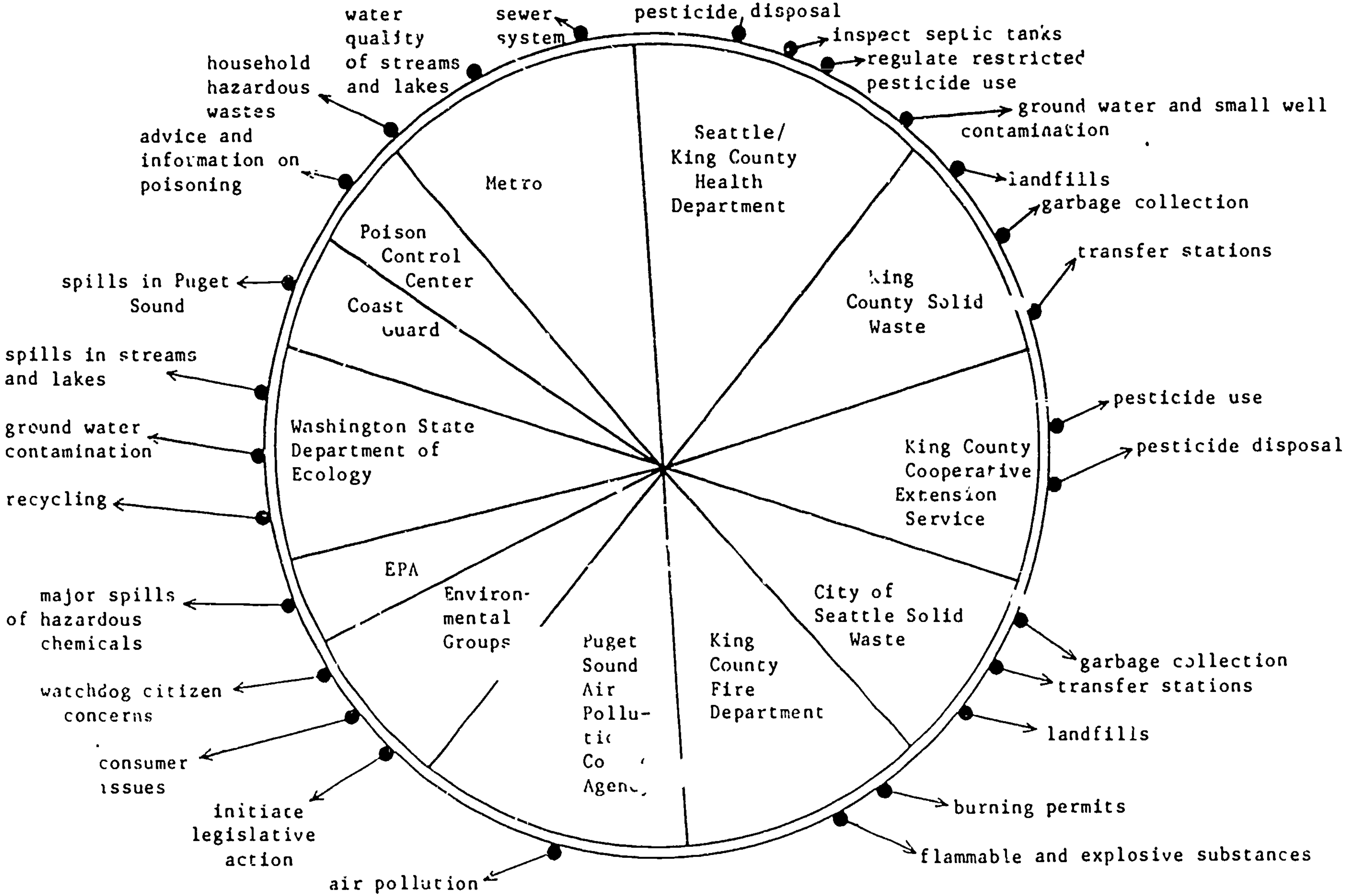


Source: Book of Lists 2

(A-way With Waste. 1985)

(A-way With Waste. 1985)

WHO IS RESPONSIBLE?



Use the Telephone Directory to locate phone numbers for these ...cies.... (Try the Blue Pages)

SOURCE: Se. Bibliography. Dyckman, Claire, p. 171

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WASHINGTON DEPARTMENT OF ECOLOGY RESOURCES

Order from the Regional Office serving your county. See page 343.

AUDIO-VISUAL MATERIAL AVAILABLE ON LOAN

MOVIES - 16mm

Garbage. Educational Media, 1969, 10 min. color.

See activities:

Litter is Waste Out of Place, p. 27
Nowhere is Away or Where Is There Space for Waste, p. 31
Why Bury Waste?, p. 68
2001: Trash Odyssey, p. 146
Garbage: Its Possibilities!, p. 161
Disneyland It Ain't, p. 247

Go. Dowling - Shepard Productions, 1979, 10 min. color.

See activities:

What's in a Cycle?, p. 222
Take-Home Recycling Kit, p. 229

Home. Radio and TV Commission of the Southern Baptist Convention, 1972, 20 min., color.

See activity:

Waste, Then and Now, p. 92

The Litterbug. Walt Disney Productions, 1955, 10 min., color.

See activities:

Litter is Waste Out of Place, p. 27
Litter, Litter Everywhere, p. 45
Nurture Some Nature, p. 52

Toast. Earth Chronicles, 1974, 12 min., color.

See activity:

What Does It Cost for a Piece of Toast?, p. 164

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FILM STRIPS/CASSETTE TAPES

Closing the Loop. California Solid Waste Management Board, 1980, 10 min., color.

See activities:

Disneyland It Ain't, p. 247
Closing the Loop, p. 260

Industry Recycles. California Solid Waste Management Board, 1980, 10 min. color.

See activity:

Industry Recycles, p. 262

Life Before Litter. Ohio Department of National Resources, Office of Litter Control, 8 min., color.

See activity:

Be a Garbage Detective, p. 25

Trash Monster. California Solid Waste Management Board, 1980, 12 min., color.

See activities:

Making a Mini Landfill, p. 36
Solid Waste Survey, p. 76
Brainstorming and Landfills, p. 95
Research Into Recycling, p.227
Take-Home Recycling Kit, p. 229
Disneyland It Ain't, p. 247

Waste to Energy. California Solid Waste Management Board, 1980, 10 min., color.

See activities:

The Road to Recovery, p. 297
Waste to Energy, p. 315

Wizard of Waste. California Solid Waste Management Board, 1980, 12 min., color.

See activities:

Litter is Waste Out of Place, p. 27
Nowhere is Away or Where Is There Space For Waste, p. 31
Making a Mini Landfill, p. 36
Biography of a Favorite Thing, p. 207
Recycling is Our Business, Is It Yours?, p. 225
Research Into Recycling, p. 227
Take-Home Recycling Kit, p. 229

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VIDEO TAPES

PSA's. Washington State Department of Ecology, public service announcements, VHS 1/2" tape, 3 min., color.

See activities:

Litter, Litter Everywhere, p. 45
Ads Add Up, p. 49
Public Service Announcements - Can You Say It Better, p. 126

SLIDE SHOW

WDOE solid waste slide show
"Recycling in Washington" slide show

See activities:

Why Bury Waste, p. 68
Out of Sight, But Not Out of Mind, p. 70
Solid Waste Survey, p. 76

FREE MATERIALS

BROCHURES

Washington State Department of Ecology. Guide to Household Recycling. Olympia, Wa., 1982.

See activities:

Garbage: Its Possibilities!, p. 161
Some Cans are More "Attractive" Than Others, p. 214
Research Into Recycling, p. 227
Disneyland It Ain't, p. 247

Washington State Department of Ecology. How To Go Recycle!. Olympia, Wa., 1985.

BAGS

Litterbags, three sizes: car, one-cubic-foot, and two-cubic-foot.

See activities:

Litter, Litter Everywhere, p. 45
Nurture Some Nature, p. 52

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CERTIFICATE OF AWARD

Model Litter Control & Recycling Program, Certificate of Award. Washington State Department of Ecology, 1983.

See activities:

Take-Home Recycling Kit, p. 229
Logos and Slogans for Recycling, p. 27

POSTER

"The Seven Sources of Litter"

See activity:

Litter is Waste Out of Place, p. 27

MAGNETS

With 1-800-RECYCLE information.

See activity:

Some Cans Are More "Attractive" Than Others, p. 214

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Additional Magazines

Waste Alternatives - National Solid Waste Management Assoc.
202-861-0708

Waste Age - National Solid Waste Management Assoc.
202-861-0708

Bio Cycle - The J.G. Press, Inc.
215-967-4135

Chemecology - Chemical Manufacturers Assoc.
202-887-1100

ERIC Full Text Provided by ERIC

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SOLID WASTE: HOME COMPOSTING EDUCATIONAL MATERIALS

May, 1989, prepared by:
Tom Richard
Department of Agricultural & Biological Engineering

Brochures:

1. "Home Composting." Fact sheet series, Cornell University Cooperative Extension. Available from: Distribution Center, 7 Research Park, Cornell University, Ithaca, NY 14850.

2. "Compost for the Home Garden." L.H. MacDaniels and R.E. Kozlowski. March 1985. Home-Grounds-Garden fact sheet series, page 700.00, Cornell University Cooperative Extension. Available from: Distribution Center, 7 Research Park, Cornell University, Ithaca, NY 14850.

3. "Ecc ogy of Compost: A public Involvement Project." D.L. Dindal. Available fro. . SUNY College of Environmental Science and Forestry, Public Relations Office, 123 Bray Hall. Syracuse, NY 13210.

Slide Sets:

4. "Home Composting" 48 slides and script on backyard composting, developed by Cornell Cooperative Extension. Available from Home Grounds lending library, IE Roberts Hall Cornell University, Ithaca, NY 14850. $35 purchase price.

5. "The Decomposer Food Web." Copyright 1980 by Daniel L. Dindal. 70 slides and script focusing on the organisms of aerobic decomposition and composting. Available from: J. G. Press, Inc., Box 351, Emmaus, PA 18049. Available on loan from Home Grounds lending library, IE Roberts Hall Cornell University, Ithaca, NY 14850.

6. "Home Composting Slideshow." 55 slides and script on backyard composting. Available from: Community Compost Education Program, 4649 Sunnyside Ave. N., Seattle, WA 98103. $85 purchase price. Available on loan from Home Grounds lending library, IE Roberts Hall Cornell University, Ithaca, NY 14850.

Video:

7. "Zoo Doo and You Can Too." August 1987. 60 minutes focusing on a composting program at the Seattle Zoo and the demonstration composting facility run by the Community Compost Education Program in Seattle. Produced by Dr. Paul Connett, Chemistry Department, St. Lawrence University, Canton, NY 13617. Available or ' ı from the Cornell Waste Management Institute, Hollister Hall, Ithaca, NY 1 -3501.

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Books:

8. Home Composting: A Training Guide. N. Dickson, T. Richard, B. Kozlowski, and R. Kline. 1989. Available from: Home Grounds Lending Library, 1 E. Roberts Hall, Cornell University, Ithaca, NY 14853. Purchase Price: $10

9. Let it Rot: the Gardeners Guide to Composting. S. Campbell. 1975. Garden Way Publishing. Storey Communications, Inc. Pownal, Vermont 05261. 152 pp.

10. The Incredible Heap: A Guide to Compost Gardening. C. Catlon and J. Gray. 1983. St. Martin's Press, Inc., New York, NY 10010. 63 pp.

11. The Rodale Guide to Composting. J. Minnich and M. Hunt. 1979. Rodale Press, Emmaus, PA 18049. 405 pp.

12. Worms Eat My Garbage. M. Appelhof. 1982. Flower Press, 10332 Shaver Rd., Kalamazoo, MI 49002. 89 pp.

13. The Earth Worm Book. J. Minnich. 1977. Rodale Press, Emmaus, PA 18049. 327 pp.

14. The Complete Book of Composting. J. I. Rodale. 1960. Rodale Books, Inc. Emmaus, PA 18049. 1007 pp.

Note: The Cornell Waste Management Institute and Home Grounds Lending Library can only loan materials within New York State.

State Recycling Programs

State	Telephone	No. Centers	Publications
AL	205-277-7050	200	Enviro South
AR	501-562-7444	--	--
FL	1-800-FLA-BIRP	190	Recycling Times
GA	404-656-3898	64	Litterally Speaking
KY	502-227-7481	35	Instant Reply
LA	504-342-8148	155	Louisiana Update
MO	314-947-9766	--	--
NC	919-821-1647		
	919-733-2178	24	--
OK	918-227-1412	46	RECAP
SC	803-734-0143	--	--

Associations (selected listing)

Aluminum Assoc.	202-862-5100
American Paper Institute	202-340-0600
Can Mfgs. Institute	202-232-4677
Council on Solid Waste Solutions	202-371-5319
Glass Packaging Institute	202-887-4850
National Recycling Coalition	402-475-3637
National Soft Drink Assoc.	202-463-6732
Plastics Recycling Foundation	202-371-5212

CONCURRENT SESSIONS: AN INTRODUCTION

Horace Hudson, Head
Community Development, Georgia Cooperative Extension Service

Concurrent sessions provided the Southern Extension Water Training Workshop attendees with an opportunity to hear and discuss three of four major topics on the overall water issues. Each session began with a presentation followed by group discussion. Presentations are located in the previous section of this proceedings. The discussions of each session were consolidated into a group report on each topic that was presented to the entire conference. During the discussions, facilitators asked questions to stimulate discussion and to provide input into the final reports that are presented on the following pages. The discussion questions were:

Who are the target audiences for Extension to be involved with?
What should be delivered to the target audience?
How should Extension take the information to the audience?
What is the group's assessment of Extension's current emphasis? Is it adequate?
What other agencies should be involved?
What is Extension's educational role.

The topics, presenters, facilitators and recorders were:

Toxic Substances
Presenter: Arthur Hornsby, University of Florida
Facilitator: Mac Horton, Clemson University
Recorder: George F. Smith, University of Tennessee

Public Policy Education
Presenter: Roy Carriker, University of Florida
Facilitator: Waldon Kerns, Virginia Tech
Recorder: Linda Heaton, University of Kentucky

Water Supply and Wastewater Management
Presenter: Frank Humenik North Carolina State University
Facilitator: Virginia Peart, University of Florida
Recorder: Charles V. Privette, Clemson University

Solid Waste Management
Presenter: Richard Warner, University of Kentucky
Facilitator: Horace Hudson, University of Georgia
Recorder: Bill Branch, Louisiana State University

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CONCURRENT SESSION REPORT
Toxic Substances

George F. Smith, Professor
Department of Agricultural Economics and Rural Development
University of Tennessee

Art Hornsby's presentation presented a model program to train County Extension personnel (and other interested audiences) about pesticide usage and water quality. The approach can be used in any program area and deals with industrial chemicals, household chemicals, and nutrients and pathogens from septic systems as well as pesticides.

Key elements are (1) the water resources in the state (or other area of concern); (2) the health effects and risk assessment concepts; (3) the movement and fate of chemicals in soil; and (4) relation of these processes to management practices that improve water quality. Other topics can be added to address specific audience concerns or interests. Dr. Hornsby pointed out elements of the program that would require major change in moving to other states and elements that generally apply to all states as well as possible ways to adapt the presentation for other program areas.

Turning to six discussion questions, the group offered the following suggestions:

Who are the target audiences for Extension to be involved with?

* Ourselves - from county staff through state administrators
* Sources of problems
* Agricultural producers
* Agricultural chemical users--many more than farmers
* Other agencies--USDA, natural resource agencies
* Policymakers
* Local government leaders
* Congressional staff
* Youth
* Media
* School teachers--kindergarten through university
* Business and industry
* Environmental groups
* Health care deliverers
* Farm organizations--commodity organizations to Farm Bureau
* Consumers--rural and urban (different techniques are needed to reach them)

What should be delivered to the target audience?

That depends on the audience, the problem and perhaps pending public decisions. However, some things mentioned were:

* Understanding of the resources, their inter relationships and the system in which decisions are made and the effects played out
* How to use this information to make better decisions including risks, costs and benefits from alternatives and reasons for the concern
* Laws and regulations governing behavior
* Whatever we do, we must offer unbiased, scientifically defensible and honest, factual information

How should Extension take the information to the audience?

Again it depends on the audience. All traditional Extension methods from one-on-one contact to result demonstrations are lid and useful. An interdisciplinary approach was mentioned in all groups. Water is one area where we can really work together.

More non-traditional methods mentioned were:

* Curriculum development--kindergarten through university
* Computer modeling, simulation and information systems
* Develop data base and expertise to address issues
* Interagency workshops
* Regional cooperation on a systematic basis
* Services to improve resource use efficiency--equipment testing and calibration for example
* Providing specific information on products at point of purchase

What is the group's assessment of Extension's current emphasis? Is it adequate?

Generally, it is inadequate but moving in the right direction. Adjectives used by the group include evolving, fragmented, timid, defensive and reactive rather than proactive. The groups felt we were seen by the public as too agriculture production-oriented and pro chemical industry rather than being unbiased. Recommendations included taking stronger stands, taking risks, developing more encompassing and comprehensive programs, interdisciplinary work and incorporating water quality into traditional Extension programs

What other agencies should be involved?

This can vary with the issue and the state. Many of the audiences identified in the first question, if not all of them, should be involved. Agencies mentioned include regulatory, health, USDA sister agencies, USGS, Farm Bureau, other agricultural agencies including commodity groups, other educational organizations, Experiment Stations and other research groups, environmental organizations, industry groups and advocacy groups.

What is Extension's educational role?

Extension should provide unbiased information and bring about change by motivating clientele to action. Other roles include that as facilitator, self evaluator to measure effectiveness, and communicator especially back to the research station in order to influence the research agenda. The need to make special efforts to target youth was a common thread Also mentioned was the need to be a leader or a willing participant according to the issue.

After one session, the comment was made that Extension may still be tempted to try to be all things to all people. Difficult decisions about priorities, resource allocations and yes, even programs needing to be dropped appear unavoidable.

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CONCURRENT SESSION REPORT
Public Policy Education

Waldon Kerns, Professor and Extension Specialist in Water Quality
Virginia Tech

Most of our severe pollution problems are caused by human action, therefore, change in human action is needed to correct or mitigate any detrimental impacts. Public policy education provides one mechanism to help induce change in human action.

Public policy education provides necessary information to help individuals affected by water quality impacts, as well as all interested individuals, make better choices. The process helps these individuals understand policy issues, available alternatives and the consequences of the alternatives. In addition, public policy education helps individuals understand the policy process.

The education process is generally based on the context of policy and programs at the federal, state and local levels of government. Numerous pieces of legislation exist at the federal level. With respect to federal policy or programs, the interpretation of regulations often varies from one region to another.

States have varying degrees of water quality policy and programs. Much enabling federal legislation allows states a great deal of flexibility for the state program. Public policy education must be conducted within the context of each state's policy and programs.

Local level policy and programs are becoming more and more important for public policy education in water quality. As more responsibility for water quality is shifted to the local level, issues such as land use and growth and development are extremely important inputs into the process. Because many local governments do not have adequate funding or staff expertise to sufficiently address water quality issues, they often ask for and expect Extension to provide that assistance.

Extension must accept the idea that democracy is a legitimate concept--that is, people must have the opportunity to make their own decisions. Furthermore, people will make the correct decision if given adequate information. Extension must respect individuals' rights to make their own decisions. However, Extension can provide the empowerment for those individuals to participate in the decision process.

The audience for public policy education on water quality is anyone affected by a policy issue or anyone interested in the water quality issue. It is important that these individuals have an input at the beginning of the policy process.

Discussion of the questions included:

Who are the target audiences for public policy education on water quality?

* Our own Extension staff, administrators and agents must be a priority audience for specialists.

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As we move into the educational effort, however, agents must be treated as partners. In addition to providing the educational materials, specialists must help agents feel comfortable about public policy education. Agents, in particular, must earn credibility for their public policy education efforts.

* The media is an important audience. But, the media contacts must go beyond the agricultural media center to include the total industry. Effective use of media sources can multiply our educational effort.

* Local elected and appointed officials, as well as state and federal legislators and their staff are a very important audience for public policy education. Because elected officials and legislators are extremely busy, the best approach is often to give them a one-shot effort, and then cultivate a good working relationship with their staff.

* Our agricultural, youth and homeowner/consumer audience will continue to be targeted for public policy education. However, Extension must cultivate a much broader audience. Those involved in public policy education must provide education to other educators both within and outside Extension. State and local level water quality management agencies often depend on advice and assistance from Extension. Extension should provide encouragement for these agency employees.

* Our audience must include anyone involved in the entire legislative process. That involvement should include anyone who will be affected by the water quality impacts or anyone interested in the process.

What should be delivered to the target audience?

* Awareness of all aspects of water quality is a good entry into the topics. One aspect of awareness is to help overcome the scientific ignorance of the general public. Too often emotions play a major role in the policy process. Perceptions sometimes play a more significant role than biological, physical scientific facts.

* One often hears the comment that Extension must deal with facts. But, are biological, physical facts enough? Extension must provide the alternatives which show all sides of an issue. Alternatives provide the basis for making choices. Therefore, the consequences of those alternatives must be provided in order to provide sufficient information so that individuals can make the appropriate choices. Extension must provide information to address the question of "what this policy means to me" for all persons involved in the process.

* Information on the policy process itself is program content to be delivered to the target audience. Too often individuals are unaware of the process until a policy is adopted or a given program is implemented. Input at that point is severely limited. In many cases someone else has made the decision for the affected party.

* Although land use and growth/development decisions may involve considerable controversy, public policy education must deal with these issues. Information on alternatives of choice and the consequences of alternatives must deal with land use and growth/development issues.

How should Extension take the information to the target audience?

* Extension must become more comfortable in delivery of public policy education on water quality issues. Extension must educate its own agents before going public with programs. In many cases agents are the first ones to be contacted by citizens, and it may be advantageous to deliver programs through the agent network.

* As much as possible, work public policy education into existing program topics. Extension needs to plan fewer meetings but better prepared meetings. Extension competes with many other groups for the audience's time.

* A good approach for some agents has been to foster locally planned and organized groups which can study a situation, develop a strategy and help deliver a program to the intended audience. Where public policy education is controversial, this group approach may be the only feasible alternative.

* Extension must develop good rapport with the media, and let them multiply the effort. Good visibility for any program is important, and the media can help establish this visibility.

What is the discussion group's assessment of Extension's current emphasis? Is it enough?

*The federal CES water quality program plan provides for a very narrow goal related to chemical use, i.e., nutrient management and pesticide use. Consequently, we see little if any support for public policy education on water quality. At present, there is a general lack of communications from the federal level on the entire water quality issue.

* Extension is under attack from a number of levels, and administrators at the state level have a tough time knowing what to emphasize. Administrators in all states have recognized the need to emphasize water quality. However, many of the administrators are reluctant to emphasize public policy education because of the potential risk involved in controversial issues whether it be water quality or any other issue.

* Many specialists are closely tied to commodity groups. Quite often their effort on water quality issues reflects the level at which that commodity group is addressing water quality issues. Most states do not have specialists who have water quality as a primary responsibility. More resources are needed.

* At the local level, external factors often prevent units from emphasizing water quality education. For those areas who do have programs, involvement of many groups and sharing of each groups' resources are important for a successful program.

* Emphasis on water quality and communication both within Extension and with other agencies/groups go hand-in-hand. Within USDA, Extension is not always involved at all levels. Communications among agencies, particularly those outside USDA, within any given state has often been extremely poor. Extension must emphasize communication on water quality education. Communication is a major component of the public policy process.

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What other agencies should be involved?

The discussion group mentioned many groups. However, no list would be complete. Any group involved in water quality must have an opportunity to be involved in Extension programs, and Extension should be willing to get involved in other's programs. In many cases, Extension may be the most appropriate agency to coordinate these joint efforts. The following agencies/groups were mentioned:

* producer groups	* consumer groups
* river authorities	* chambers of commerce
* county commissioners	* municipal league
* soil conservation agencies	* schools
* business and industry	* corporation commission
* League of Women Voters	* health departments
* state management agencies	* councils on the environment
* TVA	* U.S. Geological Survey

What is Extension's educational role?

* Much has been said and written about Extension's traditional role and Extension's traditional audience. Many participants in the discussion sessions are relatively new employees in Extension and do not have a hang-up on the traditional role or traditional audience. Maybe our traditional role has changed or is rapidly changing. Extension's role is to educate those who will be affected by water quality impacts or who are interested in water quality.

* In the past few years, many of our state agencies have developed an educational capability. A better understanding between Extension and these other agencies must occur so that all educational efforts can enjoy credibility. The administrative structure is often at conflict over who gets the credit. Oftentimes, the middle level can work cooperatively together to overcome and/or bypass these problems.

* More and more often, Extension is having to work cooperatively with other educational groups on our own campuses. In the public policy education arena, many of these groups have considerable expertise in the education role. They have ongoing programs in such areas as land use, growth/development, landfills, waste management, toxics--topics that are now extremely important to water quality. Extension must develop and deliver programs in close cooperation with these new actors.

CONCURRENT SESSION REPORT
Water Supply and Wastewater Management

Charles V. Privette, Extension Agricultural Engineer
Clemson University

Water, which is absolutely essential for life, unfortunately is increasingly becoming contaminated by many of man's activities. Some of these activities involve agricultural production practices as a nonpoint source pollutant, agricultural pesticides and septic tank seepage. Across the U.S. there are an estimated 181,000 lagoons; 16,500 industrial landfill sites; 18,500 municipal landfills; and 20 million septic tank systems.

Relevant Extension Issues

Programs conducted by USDA in conjunction with cooperative agencies have demonstrated that voluntary programs targeted to implement Best Management Practices can be effective. Educational programs build public awareness and transfer knowledge and information that provide the public and private sectors with an understanding of the appropriate responses. Technical assistance programs provide site specific technology to solve problems. These two programs are supported through the land-grant college system by research and data which document the nature and extent of the problem.

Challenges to Extension are:

* Non traditional Extension topics
* Avoid appearing as an apologist for griculture
* Cope with the urgency of public concern
* Lack of data
* Establish new linkages with relevant cooperative agencies
* Utilize new delivery methods of information transfer
* New funding/support

Opportunities for Extension Education Programs

Agriculture and National Resources--Agriculture is looked upon as the largest consumer of water and identified as a major contributor to surface and groundwater pollution. It presents magnificent opportunities for expanded Extension programs in: 1) crops; 2) animal production/waste; 3) irrigation and water use.

Home Economics and Human Nutrient--Concerns:
* Drinking water quality
* Water treatment
* Well protection
* Monitoring drinking water

* Analysis interpretation and risk management

Community Resource Development--Concerns
* Local government vs individuals
* Community issues, structure, organization
* Policy issues

4-H and Youth--Concerns:
Educations dealing with:
* Scope and dimension of water quality and waste management
* Basic principles of hydrologic cycle
* Informed view of alternatives and inputs
* Leadership positions and responsibility

Who are the target audiences for Extension to be involved with?

Water supply
* Traditional - agriculture production, irrigation, rural residents, livestock producer
* Nontraditional - water authorities, everybody, urban-conservation, low income individuals, regulator agencies, 4-H, other audiences being ignored by other agencies

Wastewater management
* Nutrient management concerns--livestock producers, fertilizer dealers, pesticide dealers, urban/master gardeners, 4-H, county legislative delegates, regulatory agencies

What should be delivered to the target audience?

* Water testing program
* Identified problems of water quality and proper treatment methods
* Pitfalls new home owners with private water systems face
* Awareness of water quality problems and testing programs
* Expertise available through Extension
* Factual, unbiased information
* Surveys
* Data

How should Extension take the information to the audiences?

* Use of the medium to reach audiences, but the video presentations must be very high quality, professionally produced
* Trained volunteers
* Through county personnel information provided by specialists
* Home study courses
* Demonstration project
* Slide/script/tape sets
* Direct mail to those requesting information

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* Newsletter, newspaper
* Publications, posters, etc.
* With a total staff effort; involve all segments of Extension

What is the group's assessment of Extension's current emphasis? Is it adequate?

* 1972 Clean Water Act and later acts have set the tone for the present emphasis
* Just getting started
* Problem of reallocation of time to do water quality effort; no one in the sessions was relieved from any current duties to take on new emphasis
* It's not adequate; otherwise why are we here
* Need help from administration in setting priorities

What other agencies should be involved?

* Those agencies involved and that have water responsibilities
* All government agencies
* Appears that Extension has not gotten involved in areas where other agencies have responsibility
* Health department
* Local planning commissions
* So many agencies seem to be involved with water, the public does not identify with the exact agency responsible for a particular program

What is Extension's educational role?

* Work as a coordinator since many agencies have water quality responsibilities; not necessary to develop total expertise
* Trainer of other agencies
* Calm people down on water quality issues
* Aid in decision making
* Audience "getter"
* Non biased source of information

CONCURRENT SESSION REPORT
Solid Waste Management

Bill Branch, Extension Specialist, Engineering
Louisiana State University

Opening:

Horace Hudson introduced each session with comments about environmental concerns and economics as forces driving interest in solid waste management. The Southern Region has responded less because landfill costs are lower. Lower costs have attracted more sewage barges than other regions as well as the "Poo Poo Choo Choo."

Presentation:

Richard Warner presented a 51-page resource document which should be invaluable to Extension agents and specialists. The first few pages describe the problem and provide statistics to characterize its magnitude and variety. He then related solid waste reduction to conservation of natural resources, energy savings and pollution reduction. Recycling newspapers was discussed as an example.

Increasing costs of landfills due to stricter construction specifications are forcing municipalities and industries to recycle and minimize waste. Many states have banned landfilling of some wastes. The public has a "Not In My Back Yard" (NIMBY) attitude about landfills, incinerators, waste-to-energy and recycling facilities. The document includes numerous lesson plans and an extensive bibliography.

Discussion of the questions included:

Who are the target audiences for Extension to be involved with?

* Each group agreed that 4-H youth should be a primary audience. Awareness and a change in lifestyle are required. It has taken many years to get where we are. It will take time to recover. 4-H youth can help change adult attitudes. Youth need to be taught responsibility for protecting the environment.

* Local officials need to understand alternative technologies, costs and risks. Additional revenues must be secured in most counties to pay for upgrading solid waste facilities.

* Landfill costs may exceed county budgets.

* Consumers must be taught to demand less packaging.

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* Regulatory agencies r ·ed research-based information.

* Industry officials need to understand management alternatives including minimization.

What should be delivered to the target audience?

* Awareness of need to reduce solid waste volumes going to landfills.

* Options and associate costs and risks must be communicated to officials and voters. All must understand that cost-avoidance is the driving force for recycling, rather than potential profits. It may be better to pay someone $20/ton to take recyclables than to pay $30/ton to dump into a landfill.

* Extension is not in the business of designing landfills or waste-to-energy facilities. Extension does not promote the selection of a technology. Once the selection has been made, Extension does provide educational assistance. An example was given of one state that had helped with location of dumpster sites, routing collection trucks and locating sources of financing.

How should Extension take the information to the audiences?

* Traditional education and demonstration techniques will be utilized with 4-H and existing clientele. The audience will expand as solid waste management affects all taxpayers and consumers.

* Non-traditional audiences such as local officials, business, industry and regulators must be made aware of Extension capability for bringing about change. Contacts with other agencies and associations involved in solid waste must be made through presentations and poster sessions a seminars and conferences.

* Participation in household hazardous waste collection days, litter clean up programs and recycling efforts are part of the investment required to obtain recognition and credibility with this non-traditional audience and subject area.

What is the group's assessment of Extension's current emphasis? Is it adequate?

* Resources are needed to support any new program. If additional resources are limited, some staff must be allowed to shift from present duties to allow time for solid waste efforts. Regional publications, audio-visuals, training and expertise would allow multiplication of existing capabilities. Each state or area should not have to develop a separate program on its own.

What other agencies should be involved?

* USDA agencies such as SCS and FmHA have existing programs which can provide assistance. Regulatory agencies such as environmental protection and health need education and

demonstration activities to assist them in meeting state and federal laws. USGS and both land-grant and nonland-grant universities are sources of research-based information.

What is Extension's role?

* Objective information based on research, development and regulations needs to be delivered to traditional and new audiences. At least one question was raised about Extension's involvement, but most comments favored solid waste management education as an Extension responsibility.

Frequently Mentioned Topics:

* Recycling. Prices received are highly variable. Gluts will occur from time to time. Costs of recycling will raise consumer prices initially. Cost avoidance will be a driving force. Disposable diapers was mentioned several times as an example of the need for careful study. They represent a significant landfill volume and do not decay readily. They are a major use of recycled paper. Diaper services are few and far between. Arkansas is studying the costs of diaper services compared to disposable diapers.

* Legislation to require use of recycled paper may drive some business out of state because many paper mills are not equipped to manufacture from recycled materials.

* Application of organic solid wastes from municipalities and industry to farm and forest land can utilize traditional Extension experience with soil tests, fertilizer recommendations and land and crop analysis.

* Composting of leaves, sewage sludge, food processing wastes and livestock/poultry production wastes may produce usable soil amendments. Sales will be difficult as markets will be glutted. Agricultural and forest land may be eventual recycling sites.

* Bottle bills are difficult to enact and develop but can be very effective in reducing waste volumes. Tires are being recycled as fuel sources for boilers, as athletic track surfaces and as drip irrigation hose. One state reported shredding of tires and stock piling for future use.

Summary:

Increasing landfills costs will force municipalities and industries to upgrade solid waste management. Recycling, waste minimization, packaging redesign, composting and waste to energy projects will become more feasible as cost avoidance measures. Traditional and non-traditional audiences are available and will find a source of educational programming. Teaching materials are available as illustrated by Dr. Warner's document.

ROUNDTABLE DISCUSSIONS: AN INTRODUCTION

Horace Hudson, Head
Community Development, Georgia Cooperative Extension Service

At the conclusion of the concurrent sessions, facilitators asked the participants to identify priorities for Extension programming in water. The Nominal Group Technique (NGT) process was used. This group process technique allows the group leader to handle a diverse group in generating creative ideas and encourages all members in the group to participate. The NGT obtains input from every individual and eliminates unbalanced participation caused by peer pressure, dominant group members, or members who are experts in the area.

Participants were given paper and asked to answer the following question: "In your opinion, what are the issues or concerns that should be addressed by Extension Services in the Southern Region in order to meet current needs in water programming?" These needs were written on newsprint and posted along the wall. Attendees were asked to identify on a note card their personal selection of the top five concerns.

The NGT includes a process for weighing each item and summarizing for the entire group. Using the process, facilitators identified 12 top concerns. Using a common set of questions to facilitate discussion, this list was used as topics for roundtable discussions.

Safe Use of Agricultural Chemicals
Solid Waste Disposal and Management
Public Policy Education
Increase Public Awareness and Support
Extension Resources to Address Water Programming
Coordination and Networking with Other Agencies
Educational Programs for Policy Makers
Consumer Options to Reduce Waste
Disposal of Toxic Household Waste
Animal Waste Utilization
Youth Public Policy Education on Water Quality
Reduction of Public Fear About the Mass of Information Supplied to Farmers

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ROUNDTABLE DISCUSSION
Safe Use of Agricultural Chemicals

Mac Horton, Facilitator

Group discussion included:

Training of users, dealers and applicators
Fate of pesticides and nutrients in soil

Recommendations:

* Include brief commercial message on agricultural chemical management and water quality in all Extension meetings.

* Get concerned industries to acknowledge their roles and responsibilities in community water quality and safety information. Use these groups in Extension program efforts.

* Develop a regional approach for soil/site/crop/specific chemical recommendations. There is concern over potential conflict between Cooperative Extension Service and Soil Conservation over chemical recommendations for specific sites.

* Reinforce the Integrated Pest Management (IPM) concept and program. Encourage more research funding to develop new programs. Increase Extension resources to IPM program to include water, nutrient and pest management.

* Increase funding and emphasis on pesticide education (not just pesticide applicator training).

* Commend Southern Rural Development Center for assisting in this meeting. Highly recommend that the Southern Directors provide for future regional meetings on this subject.

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ROUNDTABLE DISCUSSION
Solid Waste Disposal and Management

Waldon Kerns, Facilitator

Group discussion included:

What is needed?

* Extension must be informed about developments in solid waste regulations

* Extension should be involved with clientele and regulators in development and modification of regulations.

* Extension should be involved in informing clientele (producers, processors, communities) about solid waste regulations and options.

* Extension needs information to support the above efforts.

How to do it

* Develop a regional publication and training materials under contract to a state or through regional task force. Coordinate programs across state lines recognizing differences in regulations or between states.

Resources available

* Utilize existing programs from other states as inventoried by regional task force.

Where are the gaps?

* Expertise

* Communicating Extension capability to agencies and associations dealing with solid waste. Be sure to include professional associations such as AWRA, WPCF, etc. who have never heard of Extension

ROUNDTABLE DISCUSSION
Public Policy Education

Roy Carriker, Facilitator

Group discussion included:

What is needed?

* We need better competence and knowledge of government's role in water quality and of public policy education.

* Need seminars and workshops for Extension specialists and county agents on:
  government's role in water quality protection
  concepts and techniques on education for public decision

How to do it

* Will require state level commitment and leadership with extensive follow through

Regional coordination

* Water quality specialists and public policy education specialists could be pooled on a regional basis to do in-state training. May consider bi-state or tri-state training, but state differences may be such as to require state-by-state approval

Resources and materials available

* Should make use of "Education For Public Decisions," a module developed with Kellogg funds. Each state Extension director was provided a copy. It includes a 50-page source book, numerous fact sheets and nine videotapes. Contact Verne House, Clemson University.

* Also use materials developed by Kellogg-funded "Groundwater Policy Education Project." These will be available in 1990. Contact Charles Abdalla, Pennsylvania State University or Roy Carriker, University of Florida.

Where are the gaps?

* The biggest gap is in the general lack of accurate knowledge on the part of most Extension professionals about the role of government in water quality and about the role of an educator in the context of public policy decisions. Attitudes are often much too casual, superficial or misinformed.

* Appoint a select committee to design a specific project or approach to achieve all of the above. Be sure to draw on people with a well developed concept of "public policy education" and with knowledge of government's role in water quality protection. Let's not "reinvent the wheel" on public policy education.

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ROUNDTABLE DISCUSSION
Increase Public Awareness and Support

Charles Privette, Facilitator

Group discussion included:

* Grass roots support for water programming
  Develop monetary support as well as moral support
  Provide support for the educational component of dealing with water issues

* Bring groups together to define roles
  Invite agencies to meet together to develop understanding and trust

* Facilitate bringing together interested groups
  Example: Water-Wise Atlanta
  Can result in monetary support from industry and other interested parties, example: Green Industry, Water Suppliers, etc.

* Increase public awareness
  Use well-known personalities to publicize issues
  Keep issues before the public when the crisis is over

* What can Extension do to increase public awareness?
  The best type of Extension media support varies from one area to another
  Radio programs can be a good way to disseminate timely information
  Interactive video can be used effectively
  Involve state school officials to incorporate the issues into public school curricula to create changes in attitudes among youth - place more emphasis on water in 4-H programs
  Changes in adult behavior are often tied to economics (Hit them in the pocket book!)

* Develop a regional newsletter
  This will help maintain awareness among Extension personnel and keep them informed about other programs and materials, example: North Carolina State has a newsletter which might be expanded, suggested that the planning committee explore this possibility

* Challenge for some states:
  Better publicize what is being done
  Concern was expressed among the group that most states didn't send communications people to this meeting

* Use demonstration projects
  Demonstration projects can be highly visible, especially when done in concert with existing well-known groups, example: Southface Water Conservation Project in Atlanta

* Utilize volunteers to publicize programs
  Example: Master gardeners to disseminate information on xeroscaping

* Change attitudes
  It is hard to change attitudes which result in changes in behavior. It is a long term process. Plastic cups on the conference tables are an example of the difficulty of changing behavior.

* Make consumer groups aware of environmental issues, and let them put pressure on industries
  This could be risky and could get us in trouble with industry and commodity groups.

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ROUNDTABLE DISCUSSION
Extension Resources to Address Water Programming

Bill Yates, Facilitator

Group discussion included:

* Regional planning across state lines

* Additional funding resources are needed, some funds shared from other agencies

* Other Extension programs will suffer as water quality programs are developed

* District supervision and middle management need to be supportive and involved in all water quality programs

* Intensive in-house training is a must for the water quality appointee at county levels and for specialists involved

* Some training could be accomplished on a regional basis

* Catalog resources state-by-state

* Help local and area agents experience some successes with administrative support for program credibility, to promote system interest and support

* Administrative support (from directors' offices) for personnel involved in water quality programs needed

* Clientele need to be brought into the program sooner than usual

* Administrative support for intensive programs where youth and home economics personnel are involved

* Other campus resources need coordinating into the overall program

* Coordination between extension and research personnel needed in planning the programs involved in water quality

* Southern regional information exchange groups on water quality progress are needed to integrate extension and research planning

* Discourage as many administrative requirements, reports, etc., for agents, specialists and middle management (Consideration of administrative requirements)

ROUNDTABLE DISCUSSION
Coordination and Networking with Other Agencies

Michael Smolen, Facilitator

Group discussion included:

What is needed?

* Coordination and cooperation within Extension and university system

* Directory of contacts for resource information in other agencies

* Cooperation between agencies on recommendations to agricultural producers concerning water quality, pesticides, wetlands, etc.

* Cooperation between county offices of ES, SCS, ASCS and conservation districts

* Cooperation with agricultural chemical associations on water quality issues

What are the requirements?

* Permission and incentives for interdisciplinary projects

* Authority from Extension leadership to work on interagency activities (establish priority and recognition)

* Take initiative to form informal and formal networks

* Joint training and meetings between county level employees in different agencies (ASCS, SCS, conservation districts, ES, FMA, health, all with water and health responsibilities)

* Conduct professional training on reimbursable basis or tuition basis to support regulatory areas such as sediment control, storm water management, etc.

Where are the gaps?

* Sharing material/programs/training between agencies

* Differences between public perceptions and reality

Where do we go from here?

* Need Extension efforts to promote teamwork between agencies (Extension take lead)

* List of what is happening and who is doing what inside Extension

* Put together a list of cooperating agencies on water quality; use the Food & Ag Council, National Wildlife Federation list

* Focus on local-level networking

* Develop appropriate groups of resource people and participants based on specific objectives; do not restrict to agriculture

* Review state Non Point Source programs--become an active part

* Draw in agricultural industries (poultry, fertilizer, chemicals); lead them to a future where chemical inputs are reduced and wastes are recycled or managed.

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ROUNDTABLE DISCUSSION
Education Programs for Policy Makers

Ruth Morgan, Facilitator

Group discussion included:

Who are our policymakers?

* County officials
* State officials
* Congressmen

What is needed?

* True facts to educate ourselves and then our policymakers
* Cause - Effects

How do we reach these people?

* Personal contacts
* Seminars
* Advisory councils

How to do it

* Put on programs, tours, etc., for policy makers; use them on committees, councils, etc.
* Interact with them one-on-one

Regional Coordination

* Should be at the administrative level to bring network together

Where are the gaps?

* Water quality plan has been put together for all states, but has not been shared; in order to educate ourselves as to what it states the issues are, the plan must be widely disseminated.
* State, federal and local leadership should structure strategy to fill in the gaps in areas such as setting policies, what the policies are, and who enforces policy.

ROUNDTABLE DISCUSSION
Consumer Opinions to Reduce Waste

Joyce Christenbury, Facilitator

Group discussion included:

What is needed?

Education related to:

* Choices related to purchasing
* Wise utilization after purchase
* Dollar (savings) or costs of reducing waste or not reducing waste

Wise use of water in the home

* Composting
* Use of product for what it is designed for - or give it to someone who can use it
* Recycling
* Agent training

How do we program?

* Display in grocery stores
* TV, news
* Radio, talk shows
* 4-H
* Youth, in public school classes
* Other youth groups, example: Boy Scouts
* Teaming up with other clubs interested in the same topic
* Dollar costs to whatever audience reached
* Extension Homemaker Clubs

* Incorporate into other programs and subject matter such as foods, nutrition and clothing

What type assistance

* Southern regional publications such as slide sets and video tapes

* Research

* Regular sharing of existing educational materials

* Information from ES, USDA communicated to all home economics specialists; act as liaison

* Generic information and provision for specific information added at beginning or end of publications

* List of organizations and addresses that have resources available

What are available resources?

* We don't really know

* Only some states have materials

* Other organizations, example: League of Women

Where are the gaps?

* Not enough is known about existing resources to identify the gaps

* This issue overlaps with disposal of toxic waste, household waste and waste management

Where we go from here?

* Identify existing resources and work toward regional coordination within the Southern region

* Designate water quality coordinator for each state

* Specialists whose subject matter relates to water quality have release time

* County staff needs release time to work on water quality

* Allocate funds for training for county staff

ROUNDTABLE DISCUSSION
Disposal of Toxic Household Waste

Dale Dorman, Facilitator

Group discussion included:

Recommendations

* Portion of water resources initiative funding should be set aside as a line item for the development of educational programming in disposal of household hazardous waste

* Interdisciplinary committee should be formed to review and compile research based information from teaching and research branches of the university, other agencies and organizations and private industry

* Through a regional ECOP workshop approach, training should be provided forspecialists on subject matter and public policy issues

* Workshop time also is needed to develop a regional:
  plan of work
  curriculum
  appropriate educational support materials
  an evaluation tool

* Educational programming is needed for adult and youth programming

* Develop a communications network to facilitate the sharing of information. Network should cut across discipline and program lines

ROUNDTABLE DISCUSSION
Animal Waste Utilization

Frank Humenik, Facilitator

Group discussion included:

What is needed?

* Factual research data on alternatives
* Regional exchange of research data, Extension publications and educational programs
* Better communication in Extension at all levels and between states
* Better recognition of achievements

How to do it

* On-site nutrient balances for all wastes, i.e. aquaculture, crops, animal and municipal waste water and sludges
* State multidisciplinary leadership team to help solve specific needs
* More effective cooperation within Extension and outside agencies
* Regional teleconference training

Regional coordination

* Better information on what is happening and/or help available throughout the region
* Regular regional workshops

Resources available

* Inservice training
* Regional teleconference capabilities
* Better access and utilization of available material

Where are the gaps?

* Incentive funding

* Increase in base support

* Data to define environmental impact

* Redefine priorities

* Awareness of resources and help available

Future

* Prepare for exemption removal

* Increase public understanding

* Regional clearing house for relevant information, resources, materials, etc.

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ROUNDTABLE DISCUSSIONS
Youth Public Policy Education on Water Quality

Michele Cooper, Facilitator

Group discussion included:

What is needed?

* A scope of "what is being done"
* Issues identified for youth
* Clearing house of resources; there is too much duplication with no regional coordination
* Network for distribution of resources and ideas
* Regional Plan; a four-year plan of work by regions for better publicity out to public policy makers, etc. to present a unified front
* Regional workshop for teaching teams of youth and volunteers
* Newsletter; there is a question of effectiveness because of time and delivery system

Examples of issues:

* Water Quality--recreation, water cycle, drinking water quality, etc.
* Short term water activities--adopt-a-stream, beach, highway, etc.; clean- up campaigns; beach sweep

How to do it

* Grant proposals
* Clean up campaign activities
* Conservation workshops--hands on approach
* Recycling programs
* Continuation of listing of resources and contacts

Where are the gaps?

* Networking--need someone from ES-USDA for coordination newsletter

Where do we go from here?

* Get commitment from the top administrators

* Reporting--getting the message out

* Training--grant proposals

* Prodding--keep up enthusiasm; don't let all this drop or get cold

* Use donors for funding. For problem companies, could be good publicity

ROUNDTABLE DISCUSSION
Reduction of Public Fear About the Mass Of Information Supplied to Farmers

Art Hornsby, Facilitator

Group discussion included:

There is an irrational perception on the part of the public about information being supplied to farmers.

What is needed?

* Effective connection to mass media

* Extension personnel sitting-in with environmental organizations

* Extension programming to make public aware that information glut to farmers is also relevant to homeowners (urban & rural)

* Better and more effective educational program on health effects, risk assessment and risk management (relative risks)

* Extension must maintain image of unbiased and factual informational source, and perspective that quality food for people includes pesticide use

* Educate the farming community about the validity of public concerns about uses of agricultural chemicals (misperceptions or not)

How to do it

* Facilitate discussions about water quality concerns between farming community and the general public (Involve prominent farmers in this process)

* Work with media to get more exposure to resolve this issue at a more favorable time to reach urban audience (TV programming), and develop relationship with local agriculture editors

* Work with Extension communication specialists to develop materials for media.

Regional Coordination

* Regional workshops to address current water quality issues (communicate both problems and successes)

* Information specialists should be a part of these regional activities

* Share information and "model programs" across states

* Semiannual or quarterly newsletter for Southern region to keep ourselves informed.

* Mechanism for sharing water quality in-service training across state lines

* Mechanism for sharing other water quality related meetings across state lines

* Water quality concerns integrated into PAT (pesticide applicator training)

Resources available

* There is limited material available to address this issue

* Materials are needed to educate educators and to educate the public

Where are the gaps?

* Support from administration (county, state and extension)

* Lack of support from traditional supporters to address this issue

Where do we go from here?

* Individual states must develop appropriate approaches to address this issue

* Conduct water quality workshops with USDA sister agencies, USGS, USEPA

* Develop liaisons at the county level with relevant water quality agencies

ACTIONS FOR WORKING TOGETHER

Ted L. Jones, Director
University of Arkansas Cooperative Extension Service

I'm very pleased to be the "wrap up" presenter at the Southern Extension Water Training Workshop. First, I want to commend Director Wayne Jordan, the Southern Rural Development Center and the planning committee members for planning and conducting a successful workshop. A non-technical workshop to provide training for individuals in all four program areas on any subject is a challenge. The subject matter and program process had to be exceptionally sound and well conceived in order to maintain the interest of the participants and to encourage the planning and conducting of strong educational programs after returning to their home states. I imagine most of the states are represented by a multi-disciplinary state water implementation team who were sent to the workshop with the understanding that there was a big job to be done upon their return.

I am pleased to be here for another reason. An Extension Director's job is always interesting, but it is not always enjoyable. Having the opportunity to present a few thoughts on "Actions for Working Together" in conducting educational programs related to water quality and quantity is enjoyable. I enjoyed the shots taken at Extension administration that I heard during the concurrent sessions yesterday. Some of the points showed a great deal of insight to Extension administration. Some of you better be careful or you may blame an Extension director.

This important workshop is recognition that the Southern Extension Directors believe the Cooperative Extension System is well suited for conducting educational, informational and technology-transfer programs concerning water. Extension educators from the land-grant universities with our network of committed faculty in most of the 3,150 counties is evidence that we are on the scene and available to plan, conduct, and facilitate programs. The Cooperative Extension System has credibility--credibility at all levels in our society including county, district, state and national. Further, the knowledge of local staff regarding the water quality and quantity challenges in their communities will strengthen our educational efforts. There is not just one right way of solving the water problem across this country, because we have many different water problems to solve.

The Cooperative Extension System has a strong track record of utilizing scientific and technological advances in problem-solving. In this sense the water program is not unique. Our staffs are prepared and will integrate research results from agricultural experiment stations and other research organizations as we search for solutions to the water initiative.

The Cooperative Extension System's reputation and 75-year record of helping concerned citizens successfully solve problems in many subject matter areas, including agricultural productivity and competitiveness, nutrition, diet and health, revitalizing rural communities, youth at risk and other critical issues, clearly shows the system has great strength, diversity and sustainability.

The nationwide initiative--Water Quality--which is high upon the public agenda and has been shown many times to be considered the most important issue facing American citizens, can be entrusted to our organization. I often say in Arkansas that the Cooperative Extension Service is an educational, informational and technology-transfer organization that conducts programs in agriculture and natural resources, home economics, community development and 4-H youth development to help people help themselves. In addition, our organizational and people skills enable us to recruit volunteers and local leaders who are so essential to many of our programs, including water quality.

I believe the Extension System has accepted th challenge of meeting the national problem of improving water quality throughout the nation. However, we need the support and cooperation of many other state and federal agencie: to accomplish this task. It is too big and too complex for CES to handle alone.

It is clear that we are not starting a new effort in a vacuum. Water management and conservation programs have been ongoing for many years. I know that each of you could think of examples of programs with which you have been involved that related directly or indirectly to water quality, water rights, supply, management. septic tank installation, irrigation, non-point source pollution, or point-source pollution. Many of you are experts in specialized areas related to the water program. One of the challenges that you face as member of your state water implementation team is working constructively with the other multidisciplinary members on your team. Here we are talking family, but as you know, it is more difficult to have a truly interdisciplinary program with common objectives than to have a multidisciplinary program where each of you teaches your area of expertise and presents your usual program. The challenge is first to adequately plan a strong program within our organization. including in-service training and development of educational resources.

ES-USDA and the Soil Conservation Service have been designated as the lead agencies in the water quality initiative within USDA. This is a commendable step and indicates that Extension can call upon large numbers of individuals in SCS to assist with many of the technical assistance aspects of the water program. Likewise, SCS can call upon our knowledge and abilities in conducting educational programs for which we have such a strong track record. However, there are many, many other actors in the water quality arena at all levels. Many of these organizations already have fixed positions and programs of their own They may not be searching for partners, but CES can convince them that jointly a stronger more effective program can be launched. But by far, the greatest number of people across this great country must be made aware of water quality concerns and shown alternatives as to how we can voluntarily maintain an adequate supply of high quality water for all of the many competing uses.

The program clearly recognizes that water is a very complex subject. Another of your challenges will be deciding what aspect of the water program should receive top priority in your county or state. If you look at your program outline for this workshop, you will note that the materials covered range from understanding the nature of the water resource, public policy and water quality, toxic substances, water supply and waste water management, and solid waste management. When you add risk assessment and management and relate those topics to surface water and groundwater, then consider all the competing uses for the water resources, setting program priorities emerges is an important task. The Cooperative Extension System has a long record which has proven that informed citizens make rational decisions when armed with hard data and when they understand the possible consequences of their actions. As an educational organization and not regulatory, the Cooperative Extension Service challenge is to provide unbiased, research-based information and educational programs with the belief that water users will voluntarily make decisions that are beneficial to themselves and to society. We must always keep in mind that there will be regulatory aspects to some phases of the water issue, but the Cooperative Extension Service will not be the regulatory agency. Water is an essential resource for all of us. We just expect that the water from the faucet will be high quality, have dependable supply, and be inexpensive. Further, we expect it to be available when we need it.

All of us are familiar with the Cooperative Extension System's nationwide initiatives of which water quality is one of nine. I find it interesting, and it helps me place in perspective the importance of water quality, when I consider water quality as viewed by Congress and the President. The President has a water quality initiative and Congress appears to be willing to appropriate scarce federal dollars to support water quality programs. Here, I am talking about support to the Cooperative Extension System as well as support for water programs in other agencies. During the last fiscal year, the Cooperative Extension System received only $1.5 million to support the water quality program. This year the House recommended $4 million and the Senate, $6.5 million for water quality programs. I understand the fixed appropriation is $5.25 million. These monies are indicative of the high priority Congress and the President are placing on the water program. The expectation is that additional federal dollars will be forthcoming for an undetermined amount of time. This is recognition that the water quality program is not a one-shot program or of a short duration, but of such significance that sustained integrated programming efforts from many organizations will be necessary.

We are now at the point in every program where we ask what's next. What's next in the sense of, "Have we only had two days of good fellowship, exchanging of information and ideas, and becoming better acquainted with our colleagues?" Those things are important but insufficient in meeting our challenge. The "Actions for Working Together" to conduct effective water programs in the final analysis will depend upon you and your organization. Each state represented has a multidisciplinary water implementation team, and I submit, several different water plans in your state. Extension, SCS, possibly the regulatory agency whether it's EPA or under some other name, .. will have water implementation plans speaking to some aspect of the water program. I challenge you, after returning to your home base, to meet with your team members, peers and personnel in related agencies to develop objectives, materials needed and a plan of action. I believe we have all the necessary ingredients for a successful program: (1) a nationwide initiative that is high upon the public agenda, (2) a qualified team of committed extension and research members; (3) some special funding to supplement ongoing programs; (4) many, non-Extension, local, state and federal agencies and organizations interested and willing to work with the Cooperative Extension Service on this program, (5) a program that has appeal and will impact a large percentage of our population, (6) a network in each county to assist and do much of the planning and teaching necessary to conduct the priority educational programs; and (7) recognition that this is a job that must be done and must be done in an effective manner on a voluntary basis that is acceptable to the general population. Otherwise, stringent regulatory options are a possibility in the future.

Most importantly, water quality is a challenge worthy of our organizations. Our water quality programs will make a difference in the quality of life. Our programs will impact upon participants, as well as non-participants. I repeat, this is a program uniquely suited to the Cooperative Extension System. Society will be improved because of your efforts. Each of you will have a sense of satisfaction because **you will be doing something important.** Good luck as you plan your work and work your plan!

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