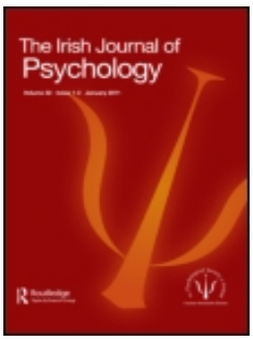

The Irish Journal of Psychology

ISSN: 0303-3910 (Print) 2158-0812 (Online) Journal homepage: http://www.tandfonline.com/loi/riri20

Integrated approaches to waste disposal and resource. management

Robert J. P. Gale

To cite this article: Robert J. P. Gale (1996) Integrated approaches to waste disposal and resource. management, The Irish Journal of Psychology, 17:4, 348-360, DOI: 10.1080/03033910.1996.10558121

To link to this article: http://dx.doi.org/10.1080/03033910.1996.10558121

The Irish Journal of Psychology, 1996, 17, 4, 348-360

Integrated approaches to waste disposal and resource management

Robert J. P. Gale
Royal Roads University, Victoria, British Columbia

Research concerning the motivational factors that contribute to environmentally responsible behaviour is briefly reviewed. While compliance with waste management and other laws motivate many individuals, corporations and institutions, there are limits to government's ability to regulate. Other policy instruments are becoming increasingly important and require careful consideration. Attention is drawn to the need for an integrated approach to the two overarching issues associated with waste, those of waste disposal and resource management. Management options for policy makers are discussed.

There is a growing and compelling interest in environmental protection at the municipal level. This interest is expressed in the development of programmes and institutional arrangements that foster corporate and community based environmental management (Gale & Lee, 1992; Maclaren, 1991; Roseland, 1992). It is also expressed in the generic questions being raised by environmentalists and community leaders. For example, is it prudent and rational to discard products that could still have a practical use? Are we individually and collectively responsible for conserving resources and protecting the environment? Will current landfill sites pose a threat to future generations?

One problem area receiving considerable attention is urban waste management, specifically waste reduction, reuse, and recycling (Blumberg & Gottlieb, 1989; Denison & Ruston, 1990; Kharbanda & Stallworthy, 1990; Maclaren, 1991). The increase in waste accompanying the growth of consumer societies has lead to a number of waste management initiatives. Unlike many natural resources, waste when considered as a resource, has been increasing. Maclaren (1991, p.28) thus notes that the goal of waste management is "to reduce rather than to increase or sustain the resource base." To this end, the obligation of local governments to develop programmes that change attitudes and behaviour towards resource use and

Correspondence address: Robert Gale, Environmental Programs, Royal Roads University, 2005 Soake Road, Victoria, British Columbia, Canada, V98 5Y2.

disposal represents a pressing challenge. This obligation arises because governments have traditionally assumed responsibility for the wastes generated by society.

An integrated approach to waste and resource management is an essential response to this challenge. Integrated waste management concerns waste generation, composition and disposal practices, as well as policy and institutional changes. It involves a rational approach to waste reduction, reuse and recycling and the assignment of responsibility for waste to its generators and distributors. Educational and advocacy programmes for attitudinal and behavioural change are an essential component.

Attitudes and behaviour

Most of the garbage we generate in our daily lives ends up in landfill sites. Globally, these sites tend to be rudimentary dumps rather than environmentally sound disposal facilities. The use of such dumps for products that could still benefit humans and the environment raises important questions about resource use, waste disposal and conservation. For example, what are the full costs of existing practices? What are the economic, social and environmental impacts? Is there evidence of a waste management and resource misuse problem?

The need to tackle such questions from the perspective of natural resource management and environmental protection is generating interest in alternative approaches that reduce, reuse or recycle waste. This interest is evident in the European Community as well as in Canada and the United States (Commission of the European Communities, 1992; Government of Canada, 1991; Franklin Associates, 1992). Apart from the technical issues concerned, the interest in alternative solutions represents a fundamental challenge to the attitudes and behaviour of individuals, corporations and institutions towards the environment. An understanding of motivational factors that contribute to environmentally responsible behaviour is thus important. Are our professed attitudes towards waste disposal and conservation consistent with our behaviour?

The investigation of variables that account for environmental attitudes is an ongoing pursuit in the social and behavioural sciences (see, for example, Bruvold, 1972, 1973; Bowman, 1977; Constantini & Hanf, 1972; Gale, 1991a, 1992; Hines, Hunderford & Tomera, 1986; Newhouse, 1990; Sewell, 1972). Hines et al. (1986) show how difficult it is to predict responsible environmental behaviour on the basis of any one variable or set of variables. Their findings demonstrate that knowledge of issues, knowledge of action strategies, locus of control, attitudes, verbal commitment, and an individual's sense of responsibility, may all be variously associated

with responsible environmental behaviour. Even given these variables, the pragmatic question O'Riordan posed in 1971 (p.100) about the nature of evidence in attitude and behaviour studies is no less relevant today: Can individual preferences be interpreted and expressed as meaningful operational guidelines?

Given the difficulty in implementing innovative waste management programmes and changing attitudes and behaviour, governments often adopt regulatory mechanisms to achieve change. This is especially true when national governments are targeting private corporations or local authorities. Compliance with the law is clearly an important motivational factor for waste generators and distributors.

Waste generation, composition and disposal

Landfills and, in many countries, incinerators are the backbone of many local government waste disposal practices. Changing public attitudes towards these practices is a critical step in the evaluation of alternatives. Public concern about the longer-term health, environmental and economic costs of landfilling and incineration, is an important factor in this evaluative process. Concerns range from fears of surface or groundwater contamination, to the waste of resources - including the newspapers, plastic bottles, glass jars, and aluminum cans, buried at a landfill - to the conversion of land otherwise available for housing, recreation, or wildlife. Each concern raises questions about the true efficiency and economy of waste disposal practices.

Municipal hazardous wastes (MHW) and municipal solid wastes (MSW) are the usual focus of integrated waste management[1]. Local goverments manage MSW through a system comprising the collection, transportation and disposal of solid wastes within designated areas. Hazardous wastes, such as batteries, paints, cleaners and fire alarms, constitute a relatively new category of waste at the local level requiring special care. These wastes often contaminate the environment when incinerated or buried in landfill sites. Mercury in batteries, for example, is extremely poisonous. Paints and solvents are also contaminants of ground and surface water. Fire alarms contain a radioactive device to detect smoke. Given the range of wastes that can exist in a community, it is important for local governments to determine the composition of waste generated in their community before disposal and remedial options are designed.

Waste generation

There has been an overall increase in waste generation in developed countries since World War II. Empirical studies show that waste generation has increased in the U.S., for example, from 1.2 kg/person/day to 1.6 kg/

person/day between 1960 and 1985 (Franklin Associates, 1988). More recent U.S. Environmental Protection Agency estimates project waste to increase from 1.8 kg/person/day in 1988 to 2.03 kg/person/day by 2000 (Kaufman, 1993, p.422). In Canada, the amount of waste in Ontario is increasing on a per capita basis (Ontario Ministry of the Environment, 1990) at that same time that landfill capacity is declining in major urban centres (McRobert, 1993). The estimated amount of waste created by Canadians in 1988 is 1.8 kilograms per person. Reducing this figure by fifty percent by 2000 is now a major, yet still somewhat modest national goal[2].

In Ireland, the estimate of the amount of waste generation requiring landfill disposal is 1.97 million tonnes (Denison, 1996; Environmental Resources Ltd. and the Environmental Institute (hereinafter ERL), 1993, p.12). Of this, household and commercial waste streams comprise 62 percent and 38 percent of the total, respectively. On a per capita basis, Dennison's estimates indicate that waste generation has increased from 0.67 kg/person/day in 1979 to 0.96 kg/person/day in 1990.

Waste composition

Comprehensive studies of the composition of a waste stream are a recent development. Typically, the largest category of municipal solid waste is paper and paperboard. In Canada, the U.S. and Ireland it constitutes about one-third of the waste stream (ERL, 1993, p.12; Government of Canada, 1991, p.25-6). Food and garden waste such as leaves, grass and hedge clippings make up the second largest category, at 31 percent, 25 percent and 25 percent respectively (ERL, 1993, p.12; Franklin Associates, 1992; Government of Canada, 1991, p.25-6). Figures can vary according to the definition of waste or year of estimate. The actual composition of waste given by the Government of Canada (1990) in the Green Plan is as follows:

Waste Stream	Percentage
Paper Products	36.4
Food and Garden	33.7
Metals	6.6
Glass	6.6
Plastics	4.6
Wood	4.2
Textiles	4.3
Other	3.5

Waste disposal: Landfills and incinerators

Virtually all of the estimated 2 million tonnes of MSW generated in Ireland is landfilled (Denison, 1996). In the United States some 93 percent of MSW

was landfilled in the 1960s and 1970s (Franklin Associates, 1988, p.S-4). This has been reduced to 72 percent in 1992 despite an overall increase in the amount of solid waste generated throughout the country (Steuteville & Goldstein, 1993, p.42). The number of landfills has declined from 8,000 in 1988 to 5,386 in 1992 providing further incentives to source reduction and recycling. This trend will continue with the implementation of new provisions of the Resource Conservation and Recovery Act.

Landfills can pose a number of environmental problems. If the leachate produced from rainwater percolating through the buried garbage is not recovered, it can pollute the groundwater and adjacent streams. A leachate with a high heavy metal concentration, say of lead and cadmium, may represent a risk to human health and the environment. In the United States groundwater and surface water contamination is a widespread concern (Denison & Ruston, 1990, p.5). The odours, dust, litter, rodents and scavenging birds associated with landfills may also represent a problem for adjacent or down-wind communities. In some landfills, methane gas produced by the anaerobic breakdown of organic matter may cause local air pollution. It is also an explosive when mixed with air. In most modern landfills, however, the risk of a methane explosion is not a major problem.

Once wastes are buried, the absence of air slows the process of biodegradation considerably, leading to the preservation of bulky, albeit biodegradable products (Rathje, 1991). Newspapers can exist unspoiled for at least 40 years. Given that 73 percent of U.S. municipal solid wastes are buried in landfills (Kaufman, 1993, p.425 after EPA), and that paper makes up the largest component of municipal waste, the volume of space occupied by paper reduces the capacity of the facility to handle additional wastes. In effect, the landfill becomes a storage site for many products that would otherwise be biodegradable. Other products may take up less room than commonly thought. Rathje (1991) provides evidence that plastics, disposable diapers and fast-food packaging are a relatively minor component of a landfill compared to paper wastes. His studies conclude that plastics account for less than 5 percent of the average landfill's contents by weight, 12 percent by volume; disposable diapers make up 1 to 2 percent by weight and fast-food packaging makes up 0.1 percent by weight.

Incinerators generally represent a more controversial option than landfill sites. For some waste managers, incineration represents an advantage because it reduces the volume of waste by 80 to 90 percent. For others, incineration is a waste processing technology, not a waste disposal method (Denison & Ruston, 1990: 9). Because the burning of waste creates soot and large airborne particles that may be contaminated with toxic chemicals such as dioxins, furans, and polyaromatic hydrocarbons (PAHs), incineration is often deemed a public health risk. The residual ash is also problem-

atic and requires special disposal provisions because of the likelihood of heavy metal contamination.

In the United States 11 percent of municipal solid wastes are burned or incinerated (Steuteville & Goldstein, 1990, p.42). The high costs of incineration, as much as U.S. $562 million for a proposed plant in New York (see Denison & Ruston, 1990, p.8), has led to concerns about its economic viability. Perhaps more significantly, concerns about health risks have lead to the banning of this option in some jurisdictions. The State of Rhode Island, for example, has recently banned incineration and adopted a 70 percent waste diversion goal (Steuteville, Goldstein & Grotz, 1993, p.32). In Canada, the Province of Ontario has prohibited the construction of new incinerators for municipal waste.

Facility siting

Landfills take up land that may be valuable for other purposes, including housing, recreation, agriculture or wildlife. They may infringe on community values and lead to community opposition and conflict by way of the NIMBY syndrome ('Not-In-My-Back-Yard'). Although recognising the need for the facility in the abstract, its adverse impacts lead to community opposition. The community may argue, for example, that a landfill or incineration facility may contaminate the immediate or downwind environment, affect property values, increase the amount of heavy vehicles in the area, or cause psychosocial effects such as stress and life-style disruption.

There are at least two considerations to facility siting. First, regulatory requirements or public pressure has lead to the closure of a number of landfill sites or incinerators that pose unacceptable environmental risks in the United States. Second, this is occurring at the same time that the expansion of old landfill facilities or the siting of new ones is meeting stiff opposition. The decline of landfill capacity attributed to these two considerations suggests that disposal alone is inadequate. When waste generation levels are increasing on a per capita basis, landfill disposal is a particularly short-term solution. Once again, discarding resources that can benefit both humans and the environment raises questions about the circumstances that make them undervalued resources.

Management options

An integrated waste management system combines options for reducing or diverting waste with traditional landfill disposal. The "3Rs" waste management hierarchy, of reduce, reuse, and recycle, is essential to such a system. One of the difficulties in making an integrated waste management system operational is the disposable, non-repairable feature of many consumer products. Throw-away products make a proactive waste and resource

management strategy difficult to design. Since the costs of the throw-away approach to waste management are largely borne by local governments, and thus taxpayers, there is a need to develop consumer awareness programmes and to encourage manufacturers to design products with waste prevention as a key priority. Products would then be designed for "recyclability" and the prevention of chemical contamination (toxicity reduction). The reduction of waste at the source of production or sale is also a critical consideration.

The 3R's hierarchy represents the materials flow perspective. The choice of a management option from this hierarchy requires consideration of implementation costs to ensure a fair distribution of benefits and costs (ERL, 1993, p.5).

Reduction

Waste or source reduction (also called waste minimization), is the most important waste management strategy. This strategy involves waste avoidance and reducing the amount of waste at the source by not acquiring or producing something that will become worthless. It tries to make the businesses and individuals responsible for creating wastes accept the cost of future disposal. The rationale is very straightforward: the less waste generated, the less there is to manage and dispose. Waste avoidance and source reduction achieve savings in both the operating and capital costs of a waste management system by reducing the need for collecting, processing and disposing waste. In Canada, the National Round Table on the Environment and the Economy (NRTEE) states that source reduction is,

> ". . . the design, manufacture, purchase and/or use of products and materials in a manner that minimizes or eliminates the volume of the resulting waste requiring disposal. As the word "source" denotes, source reduction means waste reduction actions taken close to the source of waste generation, i.e., the point at which changed behaviour or direct action may reduce the volume of waste generated and ultimately disposed. Source reduction actions can be taken during the manufacturing of products, or applied further downstream, during the marketing, distribution, consumption, or re-use of those products."

Source reduction includes the following general measures (NRTEE, 1991: 15); reducing product volume, increasing product life, reducing product packaging, purchasing products selectively, promoting product re-use and decreasing product consumption.

Since paper and paperboard dominate the waste stream in most developed countries, plans to reduce the amount of paper products going to landfill are essential. Canada, for example, has introduced a National Packaging Protocol. Among other policy initiatives, the Protocol emphasises the importance of the waste management hierarchy in the management of packaging through source reduction, re-use and recycling. The Protocol will assist packers in managing resources as provinces continue to ban materials from landfill for which a recycling market exists. Banned materials go beyond packaging in some jurisdictions and may include batteries, thermometers, tires, drywall, wood, telephone books and garden trimmings. The Canadian Protocol is similar in intent to the proposed EC Directive on Packaging Waste that also sets targets for recycling packaging waste. In Canada, the diversion target for packaging is 50 percent of the 1988 level of 5.3 million tonnes by 2000 (National Task Force on Packaging, 1992).

Reuse

Reusing materials has a number of advantages. It reduces the area required for landfill, the amount of materials consumed by society, the rate of environmental degradation, the amount of litter, and the energy required to produce replacement products. Reusing materials can also provide entrepreneurs, families, the poor and the thrifty with inexpensive products. Unwanted materials such as cloths, books, furniture, and appliances, for example, can often be used by others. Reuseable materials also include packaging products such as cardboard boxes, grocery bags, and bottles, as well as construction materials from building sites and home renovations.

Recycling

A number of materials constitute misplaced or unrealized resources that are recoverable from a municipal solid waste stream. They include aluminum cans, paper, cardboard, glass, plastics, tires, used oil, white goods (i.e., appliances such as refrigerators and stoves), and food and garden wastes. Apart from container deposit legislation (bottle bills) that require the consumer to pay a deposit on a beer or soft drink container, the most effective method of recovering relatively clean post-consumer waste products is through municipal kerbside collection. Ontario, for example, is implementing a mandatory and comprehensive recycling programme (a blue box programme) for municipalities with a population over 5000. The programme equips single family households with a blue plastic box for designated recyclable materials. Householders can then recycle materials for kerbside pick up each week. This programme is more effective than community drop-off or buy-back centres because it is convenient, covers a

range of materials, and requires less moral or economic motivation from participants. Kerbside recycling can be expensive and requires a high participation rate to offset costs as well as reasonable revenues from the sale of collected materials. The mandatory nature of the programme for municipalities ensures supplies of secondary materials for various markets and diversion from landfill. Market development is still a key concern, encouraged in part by regulatory preferences for recycled products in preference to virgin materials. For example, the City of Toronto can regulate the sale of newspapers in coin-operated vending boxes because it has jurisdiction over sidewalk vendors. As a requirement of their sale, newsprint must have a recycled content of no less than 15 percent. Pending further discussions with distributors, the standard will be 40 percent by 2000.

Both Canada and the United States are making progress in recycling and composting MSW. In the U.S. the recycling rate was 17 percent in 1992, up from 14 percent in 1991 (Steuteville and Goldstein, 1993, p.42). Six states reported recycling rates of 30 percent or more, and nationally kerbside recycling programs increased by 38 percent in 1992 to 5,404 programs serving some 78 million people (Steuteville & Goldstein, 1993, p. 43)[3]. In Canada, the City of Toronto diverted 19.3 percent of kerbside materials from landfill in 1992 (City of Toronto, 1993).

In Ireland, a joint study by Environmental Resources Ltd. and the Environmental Institute of University College Dublin (1993, p.13) estimates the absolute maximum quantity of potentially recyclable materials at 85 percent of total household and commercial waste. Although this is a theoretical upper level, it suggests the future rates of recycling can be very much higher than the average rate of 8.1 percent currently estimated. Since less than 1 percent of the household waste stream is presently recycled and the recycling rate for packaging waste is approximately 9 percent, there is tremendous scope for improvement. The recycling rate for glass from bottle banks is approximately 19 percent. This is considerably less than the average of 43 percent for seventeen European countries. The Netherlands has the highest recycling rate for glass of 66 percent.

The kerbside green box collection and recycling programme in Dublin involves a number of drop-off centres for bottles (bottle banks). As Denison and Ruston (1990, p.10) note "Most recyclable commodities are not enormously valuable, and few municipal programmes pay for themselves through sales alone. The real economic advantages of recycling stem from the disposal costs that recycling avoids."

In addition to kerbside recycling, backyard composting programmes, as well as municipal (centralised) composting programmes, are the topics of increasing attention in Canada and the United States. By composting kitchen and yard waste, homeowners can divert approximately 219 kg of

waste from landfill on an annual basis (Gale, 1991b). The savings to the municipality in terms of collection costs avoided and landfill capacity saved are enough to provide manufactured composting bins to householders on a subsidised basis. Approximately 25 percent of the 113,000 single-family households in the City of Toronto have composting bins giving Toronto "the largest backyard composting effort in North America" (Apotheker, 1992, p.37). One study estimates the pay back period to be about five years (Apotheker, 1992). Another demonstrates a high degree of householder satisfaction with a subsidised bin program (Gale, 1991c).

Integrated waste management systems

By themselves, landfill and incineration options are poor solutions to waste management problems because the strategic emphasis is placed on waste disposal. An emphasis on waste reduction and the recovery of "unrealized" resources from the waste stream would provide society with better overall benefits. Since this can only be achieved through planning and target setting, there is a need for an integrated systems approach, one that includes source reduction, material reuse, recycling, energy recovery, composting, and landfilling (Kaufman, 1993, p.437). A policy of integrated waste management is thus essential (Dennison, 1992, p.301). It would include the notion of waste stewardship, that is, the assignment of responsibility for waste to those who generate and distribute it (Fenton, 1993). These parties would be required to consider the impact of their products and marketing decisions on the waste stream.

An integrated approach must be able to draw on a full range of policy instruments. Typically, these would include voluntary and regulatory instruments, government expenditures, and financial incentives. Evaluation of tipping fees, user charges, property taxes, and other sources of accounted or unaccounted revenues and costs as they affect resource conservation, recovery and disposal, must be an impartial consideration. Studies and evaluations of deposit charges (e.g., bottles), manufacturers "take back" provisions (e.g., car batteries), and advanced disposal fees (e.g., prepaid disposal charges on tires), provide options and incentives for efficient resource management. Market development in recyclable materials and green industry promotion are also critical considerations. The adoption of environmentally sound procurement practices on the part of governments and corporations is thus essential.

The transition costs to an integrated waste management system represent an obstacle to change for some. Without full cost accounting, landfill disposal may appear to be the least costly practice. It is thus important to recognise the economic externalities that arise from many existing practices. These include water pollution, air pollution, and the

export of clean-up costs to future generations. Including the previously unaccounted costs of resource consumption is thus essential. Too often the costs of landfill, funded by property taxes and other assessments, have received little public scrutiny. Alternative waste management programmes can thus appear expensive when introduced in incremental steps. This suggests the need for comprehensive and independent analysis of the full costs and impacts of landfill programmes versus those that emphasise the 3Rs. It also suggests the need for public education and culture development to foster attitudinal and behavioural changes supportive of integrated waste management.

ACKNOWLEDGMENTS

I would like to thank Wendy Simson-Lewis, Neville Ward, and Wayne Bond of Environment Canada, Don Young of the City of Toronto, and John Sinclair of the University of Manitoba, for providing me additional references and suggestions.

NOTES

[1] It is very difficult to do comparative analysis in waste management because baseline definitions vary enormously from one jurisdiction to another. The figures discussed here are those reported in the waste management literature and do not take into account differences, if any, in the definition of waste.

[2] The method of calculation has yet to be determined. This could be either a fifty percent reduction of waste based on 1987 figures or a calculation made on a per capita basis.

[3] The calculation of "recycling rate" estimates, that is, the amount of materials being diverted from landfill, may differ from one jurisdiction to another. Some calculations are based on residential waste only. The City of Toronto's calculation is for the entire MSW stream.

REFERENCES

Apotheker, S. (1992). Recycling in Canada's big cities. *Resource Recycling*, December.

Blumberg, L. & Gottlieb, R. (1989). *War on Waste: Can America Win Its Battle with Garbage?* Washington, D.C.: Island Press.

Bowman, J. S. (1977). Attitudes and orientations of environmentally-concerned citizens, *Environmental Conservation*, **4**, 259-269.

Bruvold, W. H. (1972). Consistency among attitudes, beliefs, and behavior. *The Journal of Social Psychology*, **86**, 127-134.

Bruvold, W. H. (1973). Belief and behavior as determinants of environmental attitudes. *Environment and Behavior*, **5**, 202- 218.

City of Toronto, 1993. *Status Report on Material Management - 1992.* Report of Commissioner of Public Works and the Environment to the City Services Committee (Reference c39csc93123:263). Toronto, Canada: City of Toronto.

Commission of the European Communities (1992). *European Community Environmental Legislation: Vol. 6 Waste.* Directorate-General XI, Environment, Nuclear Safety and Civil Protection.

Constantini, E. & K. Hanf. (1972). Environmental concern at Lake Tahoe: A study of elite perceptions, backgrounds and attitudes. *Environment and Behavior*, **4**, 209-241.

Denison, R. A. & Ruston, J. (Eds.) (1990). *Recycling and Incineration.* Washington, D.C.: Island Press.

Dennison, R.A. (1996). Environmental life-cycle comparisons of recycling, landfilling and incineration: A review of recent studies. *Annual Review of Energy and the Environment*, **21**, 191-232.

Environmental Resources Limited and the Environmental Institute, University College Dublin (1993). *Towards a Recycling Strategy for Ireland.* Department of the Environment: Custom House, Dublin.

Fenton, R. W. (1993). Pulling in the same direction: Private waste stewardship and municipal waste management planning. *Alternatives*, **19**, 24-30.

Franklin Associates (1988). *Characterization of Municipal Solid Waste in the United States, 1960to 2000 (Update 1988).* Washington, D.C.: United States Environmental Protection Agency, Office of Solid Waste.

Franklin Associates (1992). *Characterization of Municipal Solid Waste in the United States: 1992 Update.* Washington, D.C.: United States Environmental Protection Agency, Office of Solid Waste.

Gale, R. J. P. (1991a). Environment and development: Attitudinal impediments to policy integration. *Environmental Conservation*, **18**, 228-236.

Gale, R. J. P. (1991b). The waste diversion potential of backyard composting. *Journal of Environmental Systems*, **20**, 257-267.

Gale, R. J. P. (1991c). Home composting: It's popular and effective. *Resource Recycling*, **10**, 44 & 46-49.

Gale, R. J. P. (1992). Environment and economy: The policy models of development, *Environment and Behavior*, **6**, 723-737.

Gale, R. J. P. & Lee, J. (1992). Municipal environmental management: A public health perspective. *Optimum: The Journal of Public Sector Management*, **23**, 51-61.

Government of Canada (1990). *Canada's Green Plan.* Ottawa, Canada: Minister of Supply and Services.

Government of Canada. (1991). *The State of the Environment Report.* Ottawa, Canada: Supply and Services Canada.

Hines, J. M., Hungerford, H. R. & Tomera, A. N. (1986). Analysis and Synthesis of Research on Responsible Environmental Behavior: A Meta-Analysis. *Journal of Environmental Education*, **18**, 1-8.

Kaufman, D.G. & Franz, C.M. (1993). *Biosphere 2000: Protecting Our Global Environment.* New York, U.S.A.: Harper Collins College Publishers.

Kharbanda, O.P. & Stallworthy, E. A. (1990). *Waste Management: Toward a Sustainable Society.* New York, U.S.: Auburn House.

McRobert, D. (1993). Restructuring the economy: A look at the implications of the shift to recycled materials. *Alternatives*, **19**, 31-38.

Maclaren, V. (1991). Waste management: Current crises and future challenge. In B. Mitchell (Ed.), *Resource Management and Development: Addressing Conflict and Uncertainty*. Toronto: OxfordUniversity Press.

National Round Table on the Environment and the Economy (1991). *The National Waste Reduction Handbook*. Ottawa, Canada, KlN 7B7: National Round Table on the Environment and the Economy.

National Task Force on Packaging (NTFP). (1992). *National Packaging Protocol: 1988 Benchmark Estimates*. Report prepared for the Canadian Council of Ministers of the Environment, Office of Waste Management, Environment Canada. Ottawa, Canada: Environment Canada.

Newhouse, N. (1990). Implications of attitude and behavior research for environmental conservation. *Journal of Environmental Education*, **22**, 26-32.

Ontario Ministry of the Environment (1990). *Towards a Sustainable Waste Management System*. Toronto, Ontario: Ontario Ministry of the Environment.

O'Riordan, T. (1971). *Perspectives on Resource Management*. London, U.K.: Pion Limited.

Rathje, W. L. (1991). Once and future landfills. *National Geographic*, **179**, 116-134.

Roseland, M. (1992). *Toward Sustainable Communities: A Resource Book for Municipal and Local Governments*. National Round Table on the Environment and the Economy. Ottawa, Ontario, KlN 7B7: National Round Table on the Environment and the Economy.

Sewell, W. R. D. (1972). Environmental perceptions and attitudes of engineers and public health officials. *Environment and Behavior*, **3**, 23-59.

Steuteville, R., Goldstein, M and Grotz, K. (1993). Solid waste legislation - The state of garbage in America: Part I. *Biocycle*, **34**, 32-34.

Steuteville, R., Goldstein, N., & Grotz, K. (1993). *The state of garbage in America:* Part II. *Biocycle*, **35**, 30-36.