Fox River Valley
Organic Recycling
Project

Phase I Final Report
Feasibility of Cooperative Acquisition and Processing Of Diverse Organic Waste Streams in Wisconsin's Fox River Valley

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Executive Summary

Feasibility of Cooperative Acquisition and Processing of Diverse Organic Waste Streams in Wisconsin's Fox River Valley

Northeast Wisconsin, particularly the Fox River Valley, is faced with increasing obstacles to land spreading or landfilling of organic wastes. The region is home to food processors, municipal wastewater treatment and solid waste facilities, paper mills, wood manufacturers and livestock producers. The region also represents one of the fastest growing urbanizing populations in Wisconsin. Increasing competition and restrictions on land spreading areas, rising landfill costs and loss of agricultural land to urban development have led farmers and industries to seek alternatives to direct land spreading and/or landfilling of raw wastes.

The Fox River Valley Organic Recycling (FRVOR) project was initiated to evaluate the economic, technical, organizational and regulatory feasibility of centrally processing organic wastes to produce soil amendments. This feasibility study included 1) development of an organic "waste shed" for the region; 2) economic evaluation of collective processing and product production; 3) evaluation of suitable processing technologies for production of soil amendments and organic fertilizers 4) assessment of potential markets for finished products; 5) comparison of organizational and business models and 6) examination of regulatory changes needed to promote collective waste processing. The project should have a beneficial economic and environmental impact in the region by creating new employment, and by converting benign organic wastes into marketable soil resources.

Significant potential exists in the Fox River Valley for a collaborative waste processing enterprise. This preliminary analysis finds that an equity investment of approximately $1 million could result in annual revenues of $5.4 million after five years, create 13 new jobs and a $1.2 million cash flow beginning in year 5.

Key Words: organic by-products, centralized processing, composting, anaerobic digestion, organic soil amendments

Acknowledgements

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Introduction

Feasibility of Cooperative Acquisition and Processing of Diverse Organic Waste Streams in Wisconsin's Fox River Valley

The By-Product as Waste Paradigm

Many of the obstacles to expansion of beneficial use of by-products arise from current modes of dealing with by-products. Walker *et al.* (1997) indicate that the existing paradigm for by-products management characterizes by-products as "wastes" and assumes insurmountable environmental problems will result from land use of by-products. This perspective is derived partly from an industrialized societal disdain for reuse of materials that historically have been dumped or landfilled. It is also a legitimate response to the legacy of toxic wastes generated by many manufacturing industries in the industrialized world. State and federal regulatory programs for solid waste recovery and reuse reflect the "by-product as waste" paradigm. In a recent Biocycle "State of Garbage in America" review, Glenn (1998) observed that 45 US states have legislated waste reduction goals over the past ten years (25-50% diversion from landfills). However, very few states are close to realizing those reduction-reuse goals. Glenn attributes such shortcomings to 1) lack of incentives or consequences if goals are not achieved (no enforcement or withholding permits, if they exist), 2) disproportionate reliance on yearly appropriations from state legislatures to keep waste programs going and 3) insufficient funds for market development and public education. He concludes that the legislative climate of 1983-93 that led to landfill bans and reduction mandates is no longer present. Nonetheless, the current driving forces of water quality, topsoil loss and waste exportation may actually be creating favorable conditions for improved organics recovery.

Call for a Paradigm Shift

Walker *et al.* (1997) call for a "paradigm shift" from by-products as waste to one that considers by-products as valuable feedstocks for agricultural and non-agricultural purposes. McDonough and Braungart (1998) advocate an "eco-effectiveness" approach to waste generation and reuse that is regenerative rather than depletive or detrimental. Eco-effective manufacturing systems funnel "biological" nutrients back into organic cycles; i.e., cycles in which soil microorganisms degrade organic by-products. These new paradigms reject the notion that the soil is merely a receptacle for by-products, regardless of their nature. They open the door for processing by-products to maximize their beneficial use potential. Blending organic residues from agricultural, industrial and municipal sources represents a model of integrated waste management that might maximize beneficial use.

Other Critical Issues

However, there are critical issues to consider if an integrated by-product management model is to be successful: State regulations regarding by-product blending and reuse, landfill tipping fees, transportation costs, site management for odor, runoff and leachate control, minimizing environmental risks from new by-product blends and market development. Proximity of the processing facility to major by-product sources is pivotal to keeping transportation costs reasonable. A study of the economics of composting cost effectiveness relative to landfill tipping fees found that current landfill tipping fees were substantially lower than costs for composting ($45 vs. $75 for landfills and composting respectively); however, landfill tipping fees are often subsidized by the state or by-product generators (Criner *et al.,* 1995). In Central Iowa, the Metro Waste Authority and Artistic Waste Services have initiated a pilot project to collect organic residuals from the greater metropolitan area of Des Moines and compost them at a centralized facility (Block, 1998). Participating by-product generators pay 30% lower tipping fees than what they would be charged at the landfill. Although in its infancy, other key components of the pilot project's success include waste generator commitment to source separation and residuals collection using a dedicated organics vehicle.

Processed Organic By-Product Markets

The market value of processed by-products will be dictated by specific end uses and related to end user value recognition (e.g. demand for soil organic matter in the case of compost), availability and price of competing products, product homogeneity and consistency and effectiveness of the marketing strategy. For example, the city of San Diego, California's yard debris composting facility developed a diversified marketing plan for their composts and mulches when product generation began to outgrow existing markets (Grealy *et al.,* 1998). The plan identified potential end users including the City Park and Recreation Department, neighboring cities, the military, CA Highway Transportation Dept., avocado and citrus growers, nurseries, developers, landscapers, topsoil manufacturers, schools and local prisons. A key to their marketing success was the cost effectiveness of spreading the mulch.

Market diversification and meeting customer needs appear to be the most critical factors to successful use of processed by-products (Tyler, 1994). In general, end uses can be divided into two categories: high value (dollar) and volume (large quantity, low value) markets. Dollar markets include turf, horticulture, topsoil blending and landscaping. Volume markets include silviculture, sod production, agriculture, mine reclamation, landfill cover and state agency (DOT, DNR, Parks Dept.) uses. Successful by-product processors usually develop the dollar value markets first in proximity to the processing facility. While this strategy maximizes economic returns, it is also the most competitive. As such, successful marketing for high-end users requires product diversification to meet specific physical, chemical and biological requirements. Examples include 1) developing a line of organic mulches with different particle sizes for weed control, field nursery crop establishment, perennial crop fertility (e.g., mulch banding in tree crop beds or vineyards) or homeowner landscaping and 2) chemical alterations of by-products for container nursery production, greenhouse use or turf establishment.

The Fox River Valley's Dwindling Land Base

Northeast Wisconsin, particularly the Fox River Valley, is faced with increasing obstacles to land spreading or landfilling of organic wastes. The region is home to food processors (canneries, cheese manufacturers, kraut manufacturers), municipal wastewater treatment and solid waste facilities (biosolids and yard debris), paper mills, wood manufacturers and livestock producers. Dairy herd expansion in NE Wisconsin is progressing at one of the highest rates in the state. In addition, the region represents one of the fastest growing urbanizing populations in Wisconsin. Because food processors, paper mills, lumber mills, livestock producers, municipal wastewater and solid waste treatment facilities are located in close proximity, they are competing with each other for open, agricultural or silvicultural lands on which to spread their organic wastes. Available land is at a premium, and burgeoning urban/suburban development reduces land acreage annually. Several towns in the Fox Valley have adopted ordinances that restrict the movement and land spreading of manure and biosolids. In addition, landfill costs are rising and landfills are beginning to place restrictions on the amounts and types of organic wastes they will accept (state ban on yard waste for example). Moreover, state and federal regulations are moving toward phosphorus-based application rates of animal manures and possibly municipal biosolids; these regulations would increase by a factor of three the land base needed for land spreading. All of these factors:

1) Increased competition for land
2) Rising landfill costs,
3) Increasingly restrictive regulations on spreading of organic wastes and
4) Loss of agricultural land to urban/suburban development

have led farmers and industries in the Fox River Valley to seek alternatives to direct land spreading and/or landfilling of raw wastes. If these farms and industries can create options for processing organic wastes and generate revenue from the sale of soil amendment products, they will reduce their dependence on land spreading and landfilling as their sole waste management tools. Creation and sale of a line of soil amendment products to non-agricultural markets would improve distribution of organic matter and nutrients across the landscape. This would alleviate many of the non-point pollution problems associated with over applying nutrient-rich animal manures and biosolids to agricultural lands. In the intermediate to long term, centralized organic waste acquisition and processing should reduce waste handling costs for most of the industries, farms and municipal agencies participating in the project. In the short term (1-3 years), it may alleviate regulatory oversight and lower liability costs associated with waste handling and disposal. It should also facilitate industry compliance with ISO 14000 environmental management standards and permit such industries to obtain market advantage through an ISO 14001 certification label.

The principle objective of the Fox River Valley Organic Recycling (FRVOR) project is to evaluate the economic, technical, organizational and regulatory feasibility of bringing public and private interests together to cooperatively process organic wastes, produce, and market soil amendments. A new public/private arrangement would be formed to collect organic wastes, process them into soil amendments using appropriate technologies (anaerobic digestion, composting, dehydration, pelletizing, nutrient fortification) and market the finished products (fertilizers, composts, soil blends) to landscapers, horticultural enterprises, state departments of transportation, private and public golf courses and green spaces, land reclamation projects, and other similar uses.

FRVOR Project Operations

The FRVOR project received a grant from the University of Wisconsin's *University-Industry Relations* Program to fund a feasibility study of organic waste management in the Fox River Valley. The project was conceived and managed by Dr. Leslie Cooperband, a UW Soil Scientist. Greg Lawless, with the UW Center for Cooperatives served as a project consultant. The funding was used to hire Phil Wells, the project coordinator, to purchase materials, and to pay for travel and other project activities. The feasibility study will serve as a collaborator decision making tool and possibly as a supporting document for securing project funding for a pilot-scale waste processing, marketing, and distribution facility to be constructed in the Fox River Valley.

The project coordinator was hired in June, 2000 and the first project planning session with the University of Wisconsin's Center for Cooperatives was held later that month. FRVOR staff identified several Fox River Valley "waste generators" (industries, livestock farmers, municipalities) and waste "integrators" (public sector agency or private sector company or entrepreneur, responsible for waste collection, processing and marketing/distribution) with interest in participating in the feasibility study and possible pilot-scale processing facility (Table 1).

FRVOR Steering Committee and Advisory Groups

FRVOR staff contacted interested collaborators in the Fox River Valley area and convened the first FRVOR project meeting in July, 2000. The project steering committee and advisory group were formed from interested public and private sector institutions following the first meeting. The steering committee consists of representatives with a strong interest in guiding the feasibility study and perhaps investing in a jointly-owned processing facility. The advisory group membership consists of individuals who are willing to provide feasibility study advice and feedback, but are uncertain about investment. The members of the advisory group who are "waste generators" expressed interest in supplying materials as feedstocks, but were not interested in processing or marketing finished products. In contrast with members of the steering committee, they see the project mainly as an opportunity for alternative waste disposal. The steering committee meets bimonthly and the advisory group meets quarterly. The steering committee members agreed to provide and process feedstocks for research, and to participate in product demonstration sites. Over the project year, steering committee and advisory group members have come to understand and embrace the concept of collectively processing the region's organic wastes for the manufacture of organic soil amendments.

Table 1 FRVOR Steering Committee Members and Advisory Group Participants

Steering Committee
Vince Michalski, Agriliance (marketer /distributor of fertilizers, agricultural inputs)
Janeen Dhein, American Foods (Meat processor)
Pierre Grienier, City of Appleton, Wastewater (Biosolids)
David Wiegman, Bio-Resource Products, LLC, (Composter)
Carl Theunis, Tinedale Farms (Dairy)

Advisory Group
Dave Schwahn, Agrilink Foods (Vegetable processor)
Wendy Lodholz, City of Appleton, Public Works (Yard debris)
Shane Brooks, City of Appleton, Wastewater (Biosolids)
Lee Bruce, Bruce Company (Landscape Contractor/Retailer/ Golf Course Developer)
Vern Newhouse, Neighborhood Dairy
Jill Haygood, Outagamie County Recycling
Kevin Jarek, Zen Miller, UW County Extension Agents
Dr. John Katers UW-Green Bay
Mary Kohrell, UW-Extension, Solid and Hazardous Waste Education Center
Charlie Verhoeven, Jerry Rodenberg, Wisconsin Department of Natural Resources
Eric Booth, Hillshire Farms (Meat processor)
Tom Kromm, Vegetable producer, Oshkosh

Organizational Model Development

Project staff facilitated steering committee and advisory group meetings to develop an organizational model for FRVOR. Several organizational models were developed that included feedstock suppliers, location and scope of processing, location and scope of marketing and distribution channels and market outlets. The project committees evaluated the positive and negative aspects of each model and where they would place themselves in each. They then voted for the models that best fit the group's needs. The two chosen models included a completely integrated model (Model 1) where centralized processing, product refinement and marketing/distributing took place in one location and a model with two primary processing locations and a single location/entity for product refinement and marketing/distributing (shown on following page).

Figure 1. Model 1

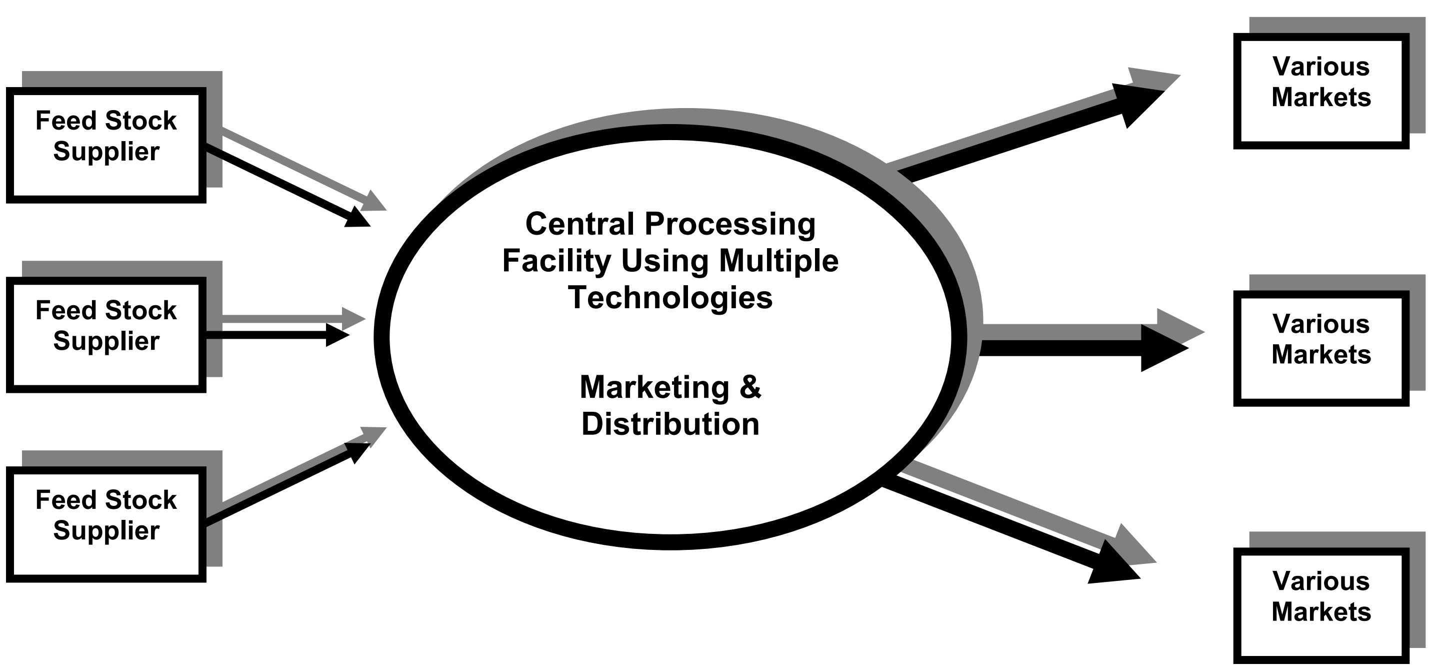
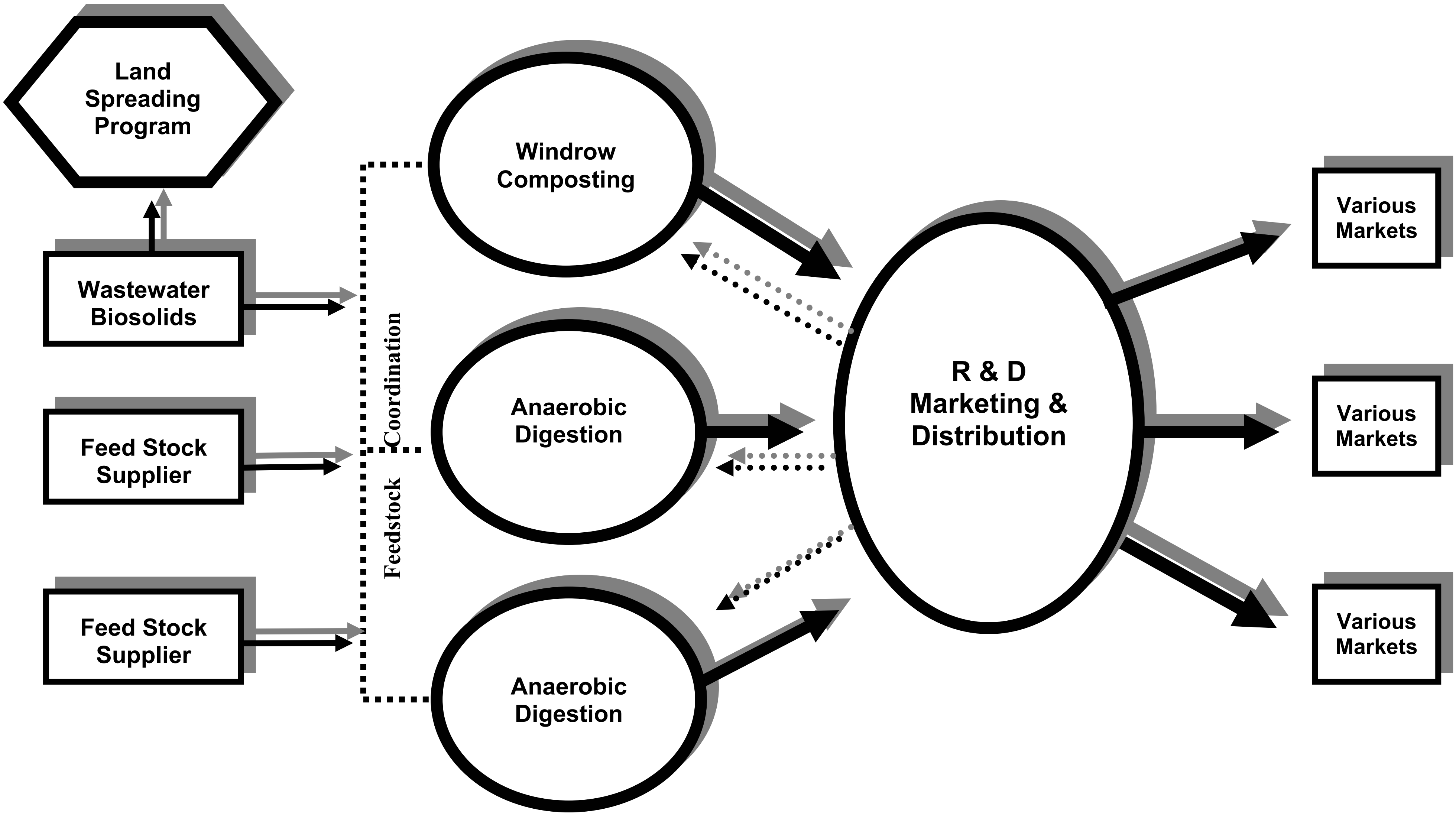


Figure 2. Model 3



The group decided that Model 3 best fit the group's current needs because three of the key players (a dairy farmer, a landscape contractor with a composting operation, and municipal wastewater treatment facility) already had investments in primary processing technologies. The dairy producer, Tinedale Farms, had begun construction of an anaerobic digester for producing methane gas. The gas will power a generator that will provide a renewable source of electricity to be sold by Wisconsin Electric to their customers. The digested solids will be dried and used as either animal bedding or a soil amendment. The composter, Bio-Resource Products, LLC, will take semisolid and solid wastes from local waste generators (City of Appleton yard debris, food processing wastes, manure) and produce compost.

Organic By-Product Data Collection

The project participants provided amounts of by-products generated annually and their current fates. From the five sources reported, they generate approximately 33,442 dry tons of organic residues per year. Some of these waste streams are seasonal (the cannery's wastes are generated from June-November only, and City of Appleton yard waste from October through December), while others are fairly constant throughout the year. The combined annual waste handling and disposal costs are nearly $1.4 million. It is important to recognize that these represent a small percentage of organic wastes in the region, and that many other waste generators will likely be interested in participating.

FRVOR Vision

Presently, the collaborative processing scenario is envisioned as a core of "entrepreneurs" including the dairy producer, the composter and the meat packing company who would share costs, revenues, and infrastructure with the City of Appleton Wastewater Treatment Division. Agriliance (the national input dealer) is able to provide expertise in marketing and distribution, particularly for the line of fertilizer products. Each processor would make available a portion of their processed materials to manufacture custom soil amendment blends. The dairy producer would provide digested solids from his methane digester, Appleton waste water would also provide digested solids and the composter would provide finished compost. A portion of these materials would go to a centralized refinement plant where they would be blended or further processed to produce higher value soil amendments. The plant would also take responsibility for product development and marketing, distribution, billing, and customer service.

Feasibility Study Development and Content

FRVOR staff developed the feasibility study plan and coordinated project activities with input from the steering committee and advisory group. The study includes the following sections

- *Case study examples* of cooperative processing of organic wastes, and successful marketing stories.

- *A collaborator feedstock survey or "waste shed" inventory* that identified large organic waste streams in the Fox River Valley region (approximately 50-mile radius from Appleton, WI) and assessed waste demographics (location, amounts produced, timing, current fates, handling costs) and waste biophysical characteristics (chemical, physical and biological traits). The target waste streams include food processing wastes (vegetables, fruit, cheese), meat packing wastes (paunch manure), municipal biosolids and yard debris, paper mill residuals, lumber mill residuals and large livestock farm wastes (manure). If additional funding is acquired for continued FRVOR work, FRVOR staff plans to enter this information into a geo-referenced database that will be used to generate maps by feedstock type. The planned database will be Internet accessible and interactive to facilitate information updates.

- *An organic feedstock technical analysis* to evaluate scenarios that blend the different feedstocks in a technically feasible and environmentally sound manner. The analysis focused on primary processing and refinement technologies, either alone or in combination. Primary processing includes anaerobic digestion and solids dehydration and composting; refinement technologies include pelletizing, nutrient fortification and granulation and product blending. This section compares each option in terms of 1) technical requirements, operational scenarios, regulatory cost and challenges, potential partners, startup and operational costs, logistical issues (transportation, facility siting, permits) and value of end product. In addition, the team considered issues associated with timing of waste generation and processing.

- *A market survey* to identify the potential regional market for specific types of organic soil amendments including composts, compost blends and fertilizers. The market area encompasses the metropolitan areas of Appleton, Green Bay, and Oshkosh, and Brown, Calumet, Outagamie, and Winnebago counties in Wisconsin.

- *An agricultural market attitudinal survey* to identify current use of organic soil amendments, perceptions about composts or organically-derived soil amendments and barriers to use of organic soil amendments.

- *An analysis of the institutional setting and regulatory framework* to assess current regulations related to all organic wastes and state agencies responsible for solid waste handling, disposal, processing and distributing, and an examination of regulatory changes needed to promote collective waste processing. The analysis includes a case study of the California Integrated Waste Management Board, and other state regulatory environments that promote innovative organic waste handling and processing.

- *An organizational and financial analysis* that identifies and discusses alternative business structures (private, public and public-private), and presents preliminary Pro Forma financial statements for a processing, marketing and distribution facility.

Case Studies

The research team identified and studied other organic waste processing projects to provide insights and perspectives gained by others with similar interests. This section provides an overview of these operations.

Pheasant Run Recycling and Disposal Facility

Composted Materials and Products:

Father Dom's Duck Doo**,** Pressed cranberry pulp wastes, duck litter/droppings, rice hulls, vanilla bean wastes, and wood shavings.

WisCompost**,** Yardwaste.

Best Blend**,** Horse manure bedding and yardwaste. Considering a name change to Father Dom's Pony Express

Background:

The manufacture and sale of Father Dom's Duck Doo and WisCompost, two high quality soil amendments, is made possible through a unique partnership of public and private interests united by a common goal of reducing organic waste deposited in landfills. Parties involved include the Pheasant Run Recycling and Disposal Facility in west central Kenosha County, Wisconsin, operated by Waste Management, Inc., Ocean Spray Corporation, the largest cranberry processor in the world, Maple Leaf Duck Farm, and Kenosha in Neighborhoods (KINWorks), a not for profit community organization, founded in 1986 by Father Dominic Roscioli. In 1987, Father Dominic initiated a leaf collection and composting program in the city of Kenosha to help support KINWorks neighborhood revitalization mission and to respond to a Wisconsin law that would ban organic materials from landfills in 1995. In 1989, Father Dominic began planning the manufacture of a cranberry/duck litter blend with the assistance of Pheasant Run and University of Wisconsin-Extension staff. Composting operations began in the spring of 1990 with the support of 10 acres of land and equipment donated by Waste Management, Inc. It was the first food processing compost site in Wisconsin permitted by the WDNR. All proceeds from sales of Father Dom's Duck's Doo Compost are used to revitalize Kenosha's inner city neighborhoods. The operation earned a Governor's Recycling Award in 1993, and a Wisconsin Electric Environmental Vision award in 2000.

Composting Site and Processes

The Pheasant Run waste disposal site, professionally managed by Waste Management, Inc has 700 acres with 80 acres permitted for landfilling. The composting site, originally 10 acres, has been expanded to 15 acres. The site is carefully managed to ensure they do not create noise, odor, or environmental problems for their neighbors. Access to the site is limited to one entrance and exit to ensure safety and provide security. The composting area pad has 1 foot of gravel and BT fabric to ensure year round access. Compost is processed in open-air windrows. Extensive product testing is performed to manage product liability. Windrow pile temperatures are continuously monitored. After windrow pile temperature reaches 150 to 160°F, piles are turned to control odors. After dropping to 100°F for a week or two, samples are sent to the lab for evaluation. Father Dom's

Duck Doo is screened, and screen spoils are used under new piles. They wanted to make a product that is consistent, and high quality. The characteristics of the duck manure product they manufacture are:

- Consistent, being made from a specific blend of materials and standardized processing procedures. Since the blend and processing procedures are consistent, the end product is consistent.

- Screened, to eliminate any undesirable litter or material.

- Free of weed seeds, as there are none in the feedstock material, and composting processes break down any that may have contaminated the feedstock materials.

- Well below allowable levels of heavy metals due to monitoring and management of feedstock materials, and

- Consistent pH and other chemical properties important to plant growers through extensive monitoring and chemical analyses.

Father Dom's Duck Doo compost is bagged by developmentally disabled workers at the KINWorks plant in Kenosha using a simple materials hopper and manually operated bagging equipment. They are considering moving the bagging operation to Pheasant Run to reduce product transportation costs. KINWorks estimates they could fill approximately 50,000 bags per year using their existing personnel and equipment.

Quantities:

Pheasant run processes approximately 30,000 tons of grass, leaves and brush, and 5,000 - 6,000 tons of the materials for duck manure compost per year.

Financial Arrangements:

Waste Management pays Maple Leaf for the duck manure, charges a tipping fee for other materials, and charges Father Dominic a modest processing fee. Ocean spray pays Waste Management to truck materials from the plant to the landfill site. Father Dom's organization holds the marketing rights to the finished products.

Marketing & Distribution:

The first several years were devoted primarily to processing, and product development and experimentation. Products were initially sold in bulk or bag through the Earth Store in Kenosha. Interested parties can also purchase compost directly in bulk from Pheasant Run. The available materials greatly exceed developed markets for the product. Excess compost manufactured is currently being stockpiled or used as landfill cover. Pheasant Run does not give away any of their compost, other than to a few community gardening programs. Pheasant Run has devoted little effort to compost marketing, but provides community educational programs on compost use, and sponsors a local "Compost Fest". During the first year of operations they sold 1,000, the second, 2,000 and in the third, 3,700 bags of compost with sales volumes increasing each year, to about 12,000/year in the 2000 growing season, primarily due to the work of Father Dominic. Sales of the other products have been much lower. The product was initially sold in 5 gallon plastic buckets, and later transparent plastic bags with a simple label. In 2000, Father Dominic's operation was selling bulk yardwaste compost at his retail outlet in Kenosha for $14/ cubic yard. No records for bulk sales were available.

Father Dominic advised that the potential exists to manufacture 1 million 22-qt bags of duck manure compost per year. Father Dominic became interested in selling more of the products to help fund his neighborhood revitalization initiatives, and began uncovering compost user perceptions and needs by working with local landscapers, nurseries and gardeners. He pursued and obtained assistance from the Paul Newman companies in early 2000 for designing a colorful and attractive compost bag that tells the duck manure product story and presents product characteristics and benefits. Newman also provided a grant to purchase bagging equipment.

With the new bagged product, he established distributor relations in the Chicago area and has begun pursuing retail outlet relations as far as Florida and the east coast using fundraisers and the rose industry as development channels. During the current and highest sales year, they doubled the previous years' sales and sold approximately 25,000 bags. The product retails for $3.50 to $4.00/22-qt bag locally, and $5.00 to $6.00/qt bag in larger metropolitan areas. Gross margins are currently $1/bag and $9/CY bulk for the duck manure, and $7/CY bulk for the yard waste compost. Efforts are underway to establish more sophisticated cost accounting procedures. The operation has received extensive media coverage due to Father Dominic's public relations efforts, which has helped to establish brand recognition and boost sales.

Lessons Learned

Even though sales have been modest, and limited by the time available from Father Dominic, the operation demonstrates that a quality process coupled with creative marketing provides a good return on materials once managed as waste.

Massachusetts Center for Ecological Technology: On-Farm Composting Of Food Residuals, Municipal Yard Waste and On-Farm Wastes

Background

The MA Center for Ecological Technology (CET) conducted an On-Farm Composting Project from fall 1996-Spring 2000. CET served as liaison between farmers interested in composting, waste haulers and waste generators in Western Massachusetts to cultivate connections between them. Their assistance included identifying potential collaborators and designing and implementing appropriate technologies for waste storage, collection and processing. They created a market-based, decentralized infrastructure, building on-farm composting competency. They identified the potential benefits to each category of project participant so that it was clear what farmers, waste haulers and waste generators would get out collaboration. To date, over 70 businesses (supermarkets, restaurants, etc) have diverted 22,000 tons of organic residuals to seven farms using six waste haulers. This activity will continue as a regular "way of doing business" in the area.

Early on in the project's development, CET identified three main barriers/obstacles to project success:

1) Lack of established infrastructure

2) Lack of "critical mass" of participants

3) Need for quality control and consistency in waste handling and composting.

To overcome some of these shortcomings, CET worked with the University of Massachusetts Cooperative Extension to provide "free" testing of compost for farmers. They also developed guidelines for using compost in the greens industry (landscaping, ornamental horticulture, turf and grounds—the publication is available at their website for a cost of $8—www.cetonline.org). CET also helped food waste generators design and develop organic waste separation, storage and collection systems to facilitate consistency and hauling. They also tracked diversion savings for these businesses to assess how much money was saved by sending their residuals to be composted.

Lessons Learned

A. Project participants were motivated by factors like environmental stewardship or improving public and/or government relations; HOWEVER, they would not have participated in the project without some economic incentive.

B. The Project development, implementation and maintenance required significant outreach and technical assistance. Having a third party serve in this role (CET) was important for participant confidence.

C. Farmers most likely to become composters are those who either have a need for the finished product or need to manage their own organic wastes more effectively (e.g. livestock farmers).

D. Direct contacts (phone and site visits) were more effective than workshops for getting participation from a broader group of individuals.

E. It was a lot easier to get waste hauler participation if waste generators had already signed on to the idea.

F. They also acknowledged that project success was partly related to a "progressive" regulatory climate. For example, regulators removed significant regulatory barriers to co-composting on-farm and non-farm wastes. They also cited rising land fill costs and land fill closures in the area as stimulants for bringing project partners together.

A-1 Organics, Inc., Colorado

Background

A-1 Organics, Inc., in Colorado, began as a manure composting facility 25 years ago and has evolved into management of six composting facilities throughout the state (Johnson, 1998; A1 Organics Website, 2001; www.a1organics.com). Each facility serves a variety of municipal, commercial and agricultural (livestock) waste generators. Their feedstocks include yard trimmings, wood, biosolids, agricultural by-products, manure, brewery by-products, shredded money from the Denver Federal Reserve, construction debris and food residuals. The compost mixes depend on proximity to various waste streams. During 1999 alone, A1 Organics diverted approximately 6,300,000 gallons and 270,000 tons of materials from traditional disposal options to environmentally friendly recycling via composting and compost related activities.

They do not operate the composting operations as a separate function of another business, such as a dairy or turkey farm operation. They consider compost as a value-added product, not a waste product. Currently, their six major operations along the Front Range produce 250,000 cubic yards of finished compost per year. In the last two years they have invested over three million dollars in handling, turning and screening equipment. The company has its own line of 25 different bagged soil amendment products ranging from $2.50-5.50 per 40 lb. bag. The target market is largely landscaping, shipped throughout Colorado's Front Range, western and southern Colorado, and into Wyoming. They also niche market compost from the Denver Zoo called “Zoop” for $10/ 2-lb. bag. In addition to processing organics and making soil amendments, A-1 provides services like custom grinding, hauling, bagging, marketing, waste stream auditing, site permitting, and compost consultation. The key to their success is a very diversified strategy for by-product collection, processing and product generation.

This year (2001) they implemented their own certified quality program. They have a quality seal that ensures each product is EPA-compliant, consistent and weed, pathogen, odor and chemical pollutant free. They also provide a “general product specifications sheet for several products they market (see Appendix I for a list of their marketed products and a sample specification sheet). Chemical analyses are performed by an independent laboratory.

Lessons Learned

A. A1 Organics has a product-oriented, market approach to organic waste recycling. Moreover, they have taken a regional approach to processing organic residuals. A-1 maximizes the economic viability of producing compost by using locally available organic wastes.

B. A1 Organics fits the processor model; they are not a waste generator, rather having chosen to focus their business on serving as “waste integrators” for manufacturers, farmers and municipalities.

C. A1 Organics is probably the first commercial composter in the US who has developed a compost quality seal along with their products.

D. Their market strategy of producing and distributing a diverse line of products and services probably contributes greatly to their economic success.

The Tillamook Oregon Methane and Energy Agricultural Development (MEAD) Cooperative Project

Background

The Methane and Energy Agricultural Development Cooperative (MEADCO) was organized almost ten years ago to support the development of improved environmental management of dairy manure in Tillamook County (western) Oregon. Tillamook, located on the Pacific coast, is Oregon's premier dairy producing region with 150 dairy farms maintaining more than 35,000 cows producing 2 million pounds of manure daily. The coastal region is also one of the wettest areas in the state (Tillamook Co. receives approx. 95" of rain from October-May). The combination of high land application rates of dairy manure coupled with high precipitation resulted in elevated nutrient and pathogen (fecal colliform) loading to streams and rivers emptying into Tillamook Bay. As a result, the bay was closed to commercial oyster harvesting for an average of 100 days per year.

The MEAD Project was initiated as an intergovernmental effort between the Tillamook County Soil and Water Conservation District (SWCD) and the Tillamook People's Utility District (PUD). It also included participation from dairy farmers, the Tillamook Co. Creamery Assoc. (a cheese and milk product cooperative) and the Port of Tillamook Bay. The basic concept was to collectively process dairy manure from numerous farms and food processing wastes at a single location utilizing anaerobic digestion. Anaerobic digestion would generate methane that would be converted into energy, the energy would be sold to the Creamery to run it's cheese and milk product manufacturing facility and the digested solids would be blended with compost made from wood residuals to make potting mixes. The liquid effluent from the digester would be returned to dairy farms to be used as liquid fertilizer on their pastures. The endeavor was initially billed as a community economic development project and also included plans for meatpacking and fertilizer plants.

In the early 1990's Oregon State University and an engineering firm (Unisyn Biowaste Technology) conducted a study to determine the technical, social and economic feasibility of collectively processing dairy manure and food processing waste (waste to energy plant). The team concluded that large-scale anaerobic digestion could be economical based on revenues generated from energy, organic fertilizers and potting soil sales. The project received over $1.5 million funding from the Oregon Department of Energy and the US EPA. They used part of the money to set up a revolving loan fund for water quality projects, and remaining funds to construct a pilot scale anaerobic digester on a 1000 cow dairy. The team also formed a manure cooperative (MEADCO) with 45 dairy farms signing up to send their manure to the collective processing facility. The farmers were promised 3-5 yr. contracts and a flat rate, $2/wet ton "tipping fee." The business structure of the manure cooperative was easy for farmers to understand. It included some percentage of the profits going to farmers from sales of the potting mixes (proportional to their initial investment), a single contract between the manure cooperative and the waste processor, and members were given the right to buy out other investors after 10 years.

Although there was ample enthusiasm and adequate funding for the project, things began to unravel after several unsuccessful attempts to get a contractor to build the centralized anaerobic digestion facility. After the second contractor could not come up with sufficient financing for the project (mid 1990's; approx. five years after the project was conceived), the Tillamook Creamery Assoc. decided to pull out of the project. According to the MEACO Chairman of the Board (a dairy farmer), the Creamery management and board were never unanimous in their support of the project. The project was suspended after the 1000-cow dairy farm with the pilot-scale digester went out of business and the fourth contractor (Duke Engineering) tried to raise the tipping fee for manure so that the project could be financially solvent based solely on tipping fees (1996-98).

To date no large-scale anaerobic digester has been built to process dairy manure and food processing wastes. However, elements of the project have received renewed vigor as a composting venture. Pro-Gro Mixes and Materials, Inc. (a growing media supplier in Tillamook Co.) has initiated a composting facility at the Port of Tillamook Bay (Swanson and Charlton, 2001). Pro-grow composts dairy manure and wood residuals (sawdust and bark). The firm spent a year pilot testing compost recipes and improving compost process management. Most recently, they applied for a permit to receive other wastes including fish residuals and livestock mortalities. The composts will be used to make several container mixes. At present, the facility should be producing 200-400 cubic yards of compost per day with a projected capacity of 600-800 cubic yards/day (Swanson and Charlton 2001).

Lessons Learned

A. Several project participants felt it was critical to obtain financing for the project (including infrastructure costs) before trying to sell the idea to project participants, particularly farmers.

B. Although the initial project interests among farmers and the Creamery were high, the delays in project execution led to loss of interest and participation among key stakeholders.

C. Strong local support was critical for project success. If they had received strong endorsement from only 25% of the farmers and the Creamery, they could have attracted investors (MEADCO Board Chair, personal communication).

D. The land grant university, Oregon State Univ., took little initiative to back the project, even though they had conducted the feasibility study.

E. Even though the project was billed as a community economic development initiative, they continued to seek outside contractors to finance and implement the project. The outside contractors never fully grasped the local community needs. To highlight this point, the only component salvaged from this multimillion-dollar venture was the composting activity, and that was initiated by a local, family-owned company.

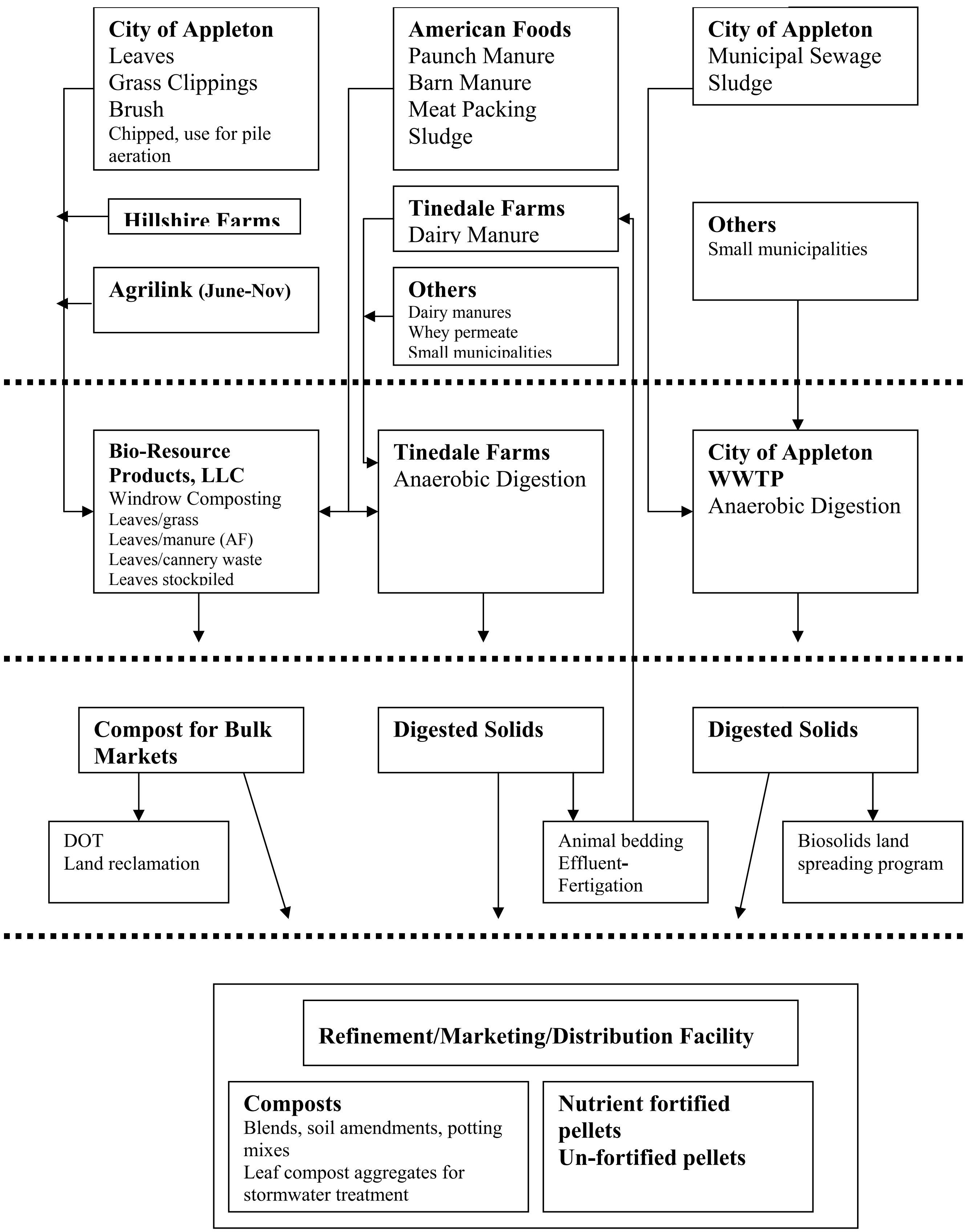
F. Large grants do not always ensure project success, particularly when a project has economic, social and technical complexity.

Collaborator Survey and Supply

Present/Potential Collaborators and Organizational Structure

Current FRVOR participants include food processors (American Foods, Agrilink Foods, Hillshire Farms), dairy farmers (Tinedale Farms, Neighborhood Dairy), a fertilizer dealer (Agriliance), a Landscape Company (Green Acres Landscaping's Subdivision Bio-Resource Products, LLC) and the city of Appleton (both Wastewater and Public Works Divisions). Future participants could include cheese manufacturers, other vegetable or meat processors, lumber mills (or wood product manufacturers with wood wastes) and paper mills. An outline of the proposed general organizational structure including feedstock suppliers, primary processors and refinement processes along with material flows from their points of generation to their inclusion in several soil amendment or fertilizer products is on the following page (Figure 3). We have selected appropriate primary processing technologies including composting and anaerobic digestion. We decided to take advantage of infrastructure for composting and anaerobic digestion at three locations: Bio-Resource Products, LLC, Tinedale Farms and Appleton Wastewater Division. Products from these three locations would eventually undergo refinement processing at a single facility. Refinement processing technologies under consideration include product screening and blending, pelletizing (or granulation), nutrient fortification and compost aggregation.

Figure 3. Organizational structure, material flows, processes and final products



Primary Processing Alternatives, Costs, Technical & Regulatory Issues

The FRVOR planning team quickly focused on composting and anaerobic digestion as the principal means of primary processing of organic wastes to capitalize on existing efforts within the FRVOR steering committee. Each of the primary processing facilities has (or will be) investing in infrastructure, equipment and personnel to generate feedstocks for refinement. Bio-Resource Products, LLC has purchased composting equipment, and will be modifying his site to maximize process efficiency and hiring a compost operator to manage composting operations. Tinedale Farms has invested significant capital in the construction of a two-stage anaerobic digester to generate methane gas and produce digested solids. They will likely hire several individuals to manage and operate the digester and process the solids. Appleton Wastewater will be modifying their solids separation process to facilitate nutrient fortification of their biosolids. In general, regulatory issues that will need to be addressed in FRVOR Phase II include blending of organic wastes with different regulatory designations, site improvements at the compost facility and siting requirements for the refinement facility and issues of liability between waste generators and waste processors.

Bio-Resource Products, LLC

Bio-Resource Products, LLC, in Greenville, WI initiated composting of municipal yard debris in April 2001. They hold a contract with the city of Appleton, Division of Public Works to receive approximately 20,000 cubic yards of yard waste (leaves, grass clippings, brush) per year. Bio-Resource Products has a 20-acre site devoted to windrow composting (using a tractor-pulled SCAT turner). In Phase II of the FRVOR team will develop and test compost recipes at the composting site combining yard debris with meat processing wastes (paunch manure, processing sludge and barn manure), cannery wastes (vegetable peelings, culls) and animal manures (See tables 2, 3 and 4 on the following pages for representative compost recipes and the feedstock characteristics used to generate recipes).

Tinedale Farms and Ag Environmental Solutions

Tinedale Farms and Ag Environmental Solutions, LLC (AES) have constructed a two-stage anaerobic digester on their farm in Wrightstown, WI. The system is a Temperature-Phased Anaerobic Digestion (TPAD) design that utilizes thermophilic (first stage; >130^{o}F) and mesophilic (second stage; 90-130^{o}F) temperatures to digest dilute (<12% solids) organic wastes. The waste is processed in the thermophilic stage for five days, and then cooled to 100^{o}F before entering the mesophilic stage for ten days. Two tube-type heat exchangers are used to a) recirculate heat from the 375-KW electric generators to the thermophilic stage and b) decrease the temperature of the waste as it passes from the thermophilic to the mesophilic stages of the digester. The high temperature phase destroys pathogens and increases methane output for energy generation. This is the first time this technology has been applied to treat dairy farm wastes. While their initial focus will be on maximizing methane generation for energy production, they expect to be producing a consistent output of digested solids by July 2001. In Phase II of the project, the FRVOR team will take and analyze monthly samples of digested solids for bulk density, biological activity, complete elemental composition (C, N, P, K, Ca, Mg, Al, Fe, and heavy metals), moisture content, ash content, available nutrients, soluble salts and pH.

City of Appleton Wastewater Treatment Facility

The City of Appleton Wastewater Treatment Facility is an activated sludge plant that uses mesophilic anaerobic digestion to reduce the volatile solids during the digestion process. Anaerobic digestion is classified as a Process to Significantly Reduce Pathogens (PSRP). The biosolids produced at the plant are classified as Class B (see regulations report for definition). The biosolids are applied to agriculture lands as a fertilizer and soil amendment. Appleton is investigating technologies that could lead to a heat dried and nutrient fortified product. Heat drying the biosolids would kill pathogens to levels consistent with a class A designation (see regulations report for definition). Appleton Wastewater Treatment Plant produces a relatively consistent biosolids and has long-term data on nutrient and other physical characteristics. As such, in Phase II, we will take samples of their biosolids only for the tests that the city does not routinely perform.

Table 2. Compost recipes using only two feedstocks

Feedstocks	**Mix ratios**	**Volume (cu yd)/batch**	**Est. Mix C:N**	**Est. Mix % Moisture**
Yard waste: grass clippings	1:1	7.7	33:1	53
Yard waste: Meat packer sludge	1:1	4.9	30:1	50
Yard waste: Meat packer barn manure	1:1	5.2	36:1	52
Yard waste: Meat processor sludge	1:1	4.9	25:1	50
Unbedded dairy manure: yard waste	1:1	4.0	32:1	54
Dairy manure: leaves	2:1	9.4	29:1	68

Table 3. Compost recipes with more than two feedstocks

Feedstocks	Mix ratios	Volume (cu yd)/batch	Est. Mix C:N	Est. Mix % Moisture
Dairy manure: leaves: yard waste	2:1:1	12.1	34:1	57
Leaves: Paunch: MP Sludge	1:1:1	10.3	32:1	63
Leaves: Paunch: Yard Waste: MP Sludge: MP Barn Manure	1:1:1:1:1	15.4	34:1	58
Leaves: Cannery Waste: Yard waste: MP sludge	1:1:1:2	17.2	31	60
Grass clippings: leaves: MP Paunch: yard waste	2:1:1:1	20.7	34:1	60
Grass clippings: leaves: yard waste: MPr sludge	1:1:1:1	16.6	31:1	55

MP= meat packer; MPr= meat processor

Table 4. General feedstock characteristics (some values are estimates from *Compost Recipe Maker* program

Feedstock	Bulk Density (lbs/cy	C:N ratio	% N	% Moisture
Unbedded dairy manure	1460	13	3.5	83
Leaves	300	60	1.0	38
Yard waste	750	50	0.8	25
Grass clippings	400	17	3.4	82
Paunch manure	1460	25	1.8	75
Meat Packer Sludge	900	15	3.2	75
Meat Packer Barn Manure	800	20	2.4	78
Cannery waste	585	19	2.7	87
Meat Processor Sludge	900	12	4.4	75

FRVOR Collaborator Feedstocks

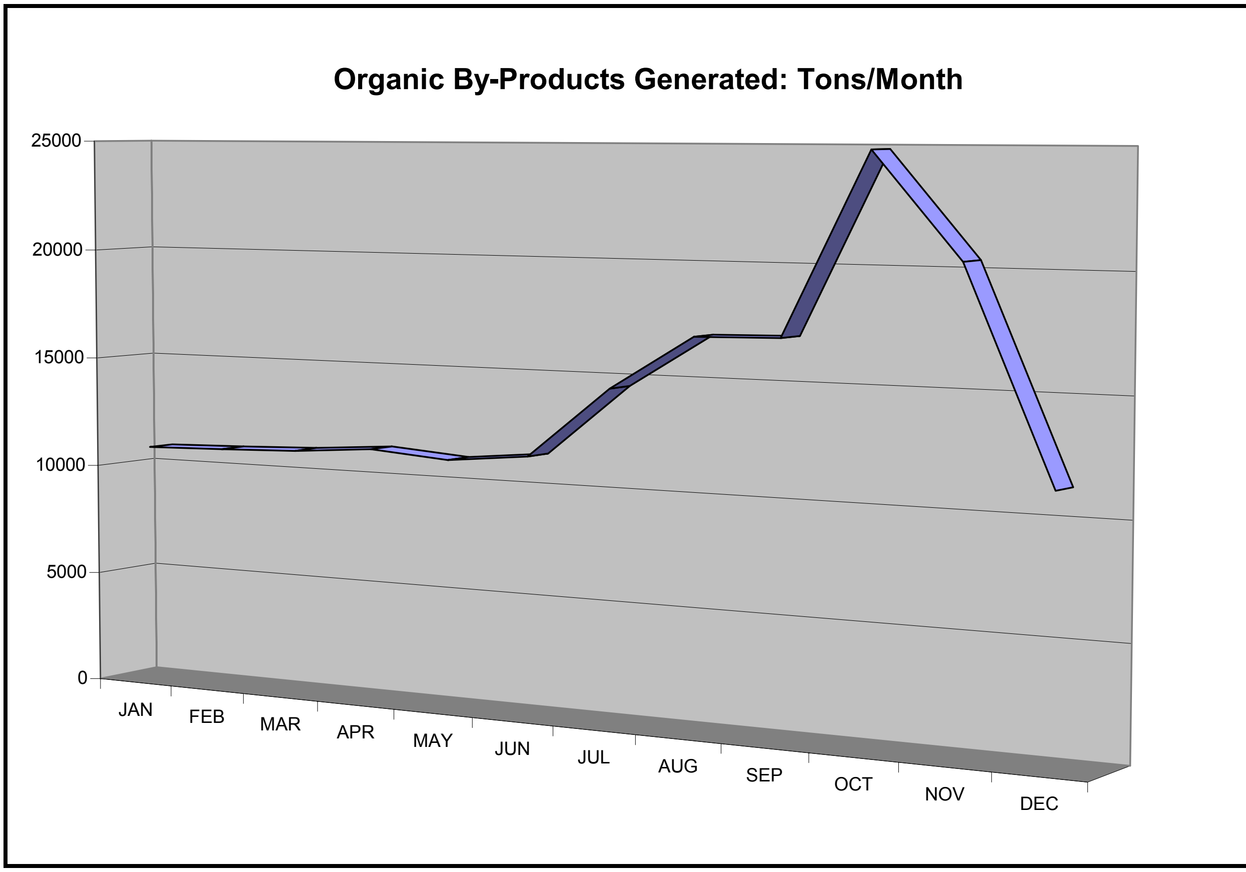
Quantities, Chemical-physical Characteristics, Availability, Management, and Costs

FRVOR staff conducted a survey of FRVOR participants (both on the steering committee and advisory group) to determine what organic by-products they generated, how much and during what times of year (seasonality), current fates (land fill, landspread, animal feed, incineration, etc) and disposal costs. Each "waste generator" provided us with monthly data on amounts generated and percent solids so that we could express the data either on a wet or dry tons basis. FRVOR staff tabulated the data into annual wet tons, annual costs and costs/ton (Table 5 and found that the majority of the organic wastes are produced in mid to late fall (October-November; Figure 4).

Table 5 Wasteshed Inventory, FRVOR Participants

Source	Type of By-Product	Annual Total (wet tons)	% Solids	Means of Disposal	Annual Cost	Cost/ton
Cannery	Vegetable Peelings	12000	20	Landspread on DNR approved fields	$130,000	$10.83
	Vegetable by-products	15000	20	Hauled to local farms for cattle feed	$90,000	$6.00
Dairy Farm	Cow Manure/bedding	90000	12	Haul & landspread	$200,000	$2.22
Municipality	Brush	3090	85			
	Grass	97	15			
	Yard Waste	657	80			
	Leaves	10749	77	Stock piled	$263,470	$18.05
	Biosolids[3]	19990	28	Haul and landspread	$387,500	$19.38
Meat Packing Facility	Paunch Manure	10625	24	Land spread		
	Barn	3492	25	Land spread		
	Waste Water Sludge	6152	28	Land spread	$321,360	$52.24
		20269				
Meat Processing Facility	Waste water sludge	3551	25	Land spread	$59,258	$16.69
	casings	562	35	Land filled	$8,711	$15.50
	Totals	**196,234**			**$1,460,299**	

Figure 4. Seasonal distribution of all organic wastes from FRVOR participants

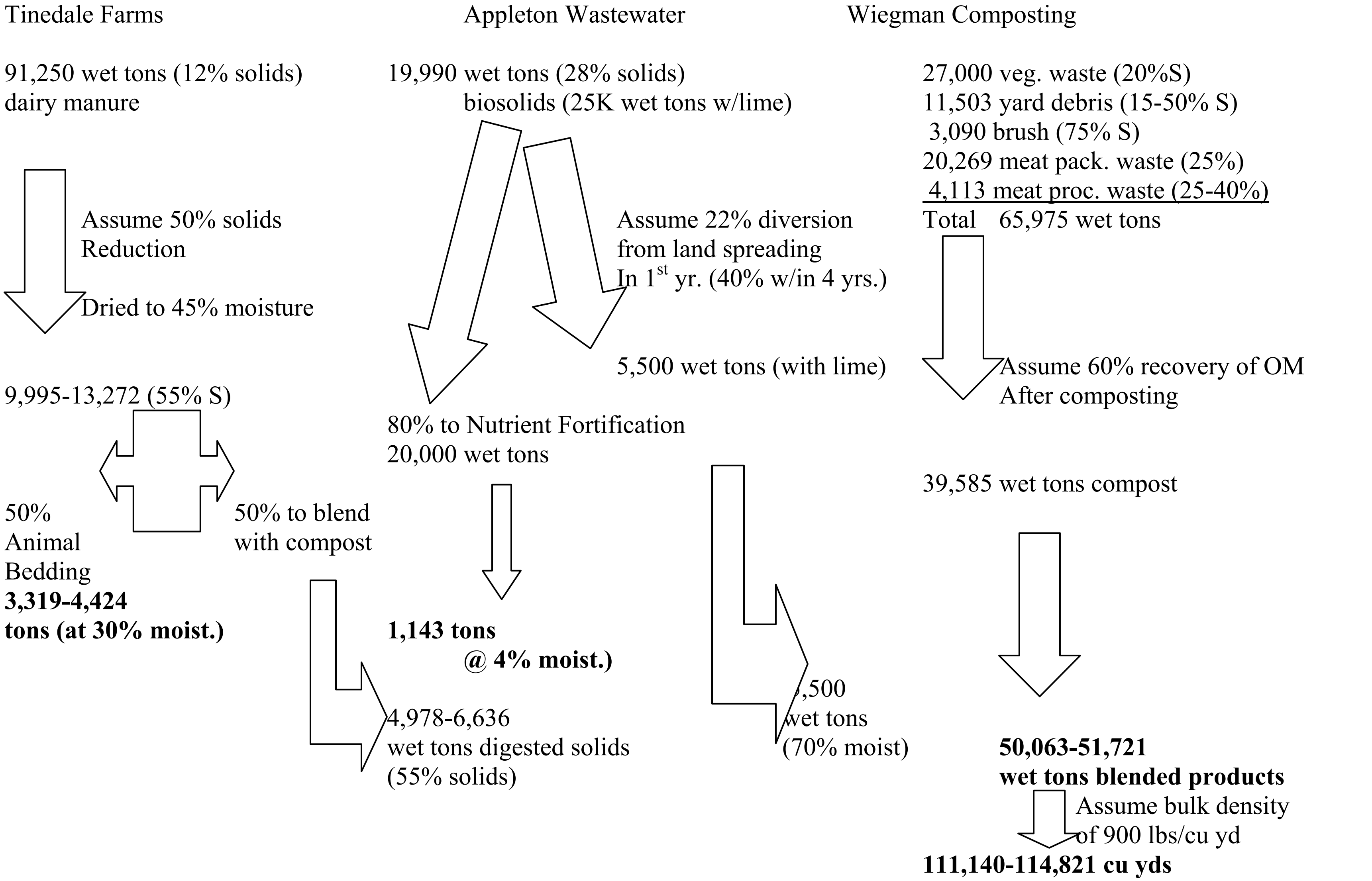


Some of the wastes are seasonal (cannery wastes, grass clippings, leaves, brush), while others are produced consistently throughout the year (dairy manure, biosolids, meat processing wastes). In total, four private enterprises and two municipal divisions produce over 196,000 wet tons (approximately 33,500 dry tons) of organic wastes per year. Handling and disposal costs are close to $1.5 million. Costs range from $2-52 per ton. Most of the FRVOR waste generators currently land spread their organic wastes; one sells part of their waste as animal feed and another landfills a portion of their waste stream. In terms of chemical, physical and biological characterization of these wastes, only preliminary data on pH (6.3-8.0), ash contents (1-70%), particle size (fine to 4"), bulk density (300-1500 lbs/cu yd), total N (0.9->4%) and organic matter (23-84%) have been acquired. FRVOR staff will be collecting samples in FRVOR Phase II to complete the data for these measurements and to determine total minerals, potential contaminants (heavy metals, organic pollutants), pathogens, biological activity (BOD5, volatile solids content), electrical conductivity (salts) and carbonates.

From the wasteshed inventory, FRVOR staff developed material flows from waste generators to primary producers to determine how much of each primary product would be available for refinement processing (Figure 5 on next page).

At this time, we assume that Bio-Resource Products will receive and compost all cannery, meat packing and meat processing wastes in combination with yard debris from the City of Appleton. After composting, these materials will generate approximately 40,000 wet tons of compost. Tinedale Farms will likely process its own manure for the next two years and then may take additional wastes (cheese whey, meat packing wastes, cannery wastes, and small municipal sewage). Some of their digested solids will be used for the production of animal bedding. The remainder will be available for blending with compost (5,000-7,000 wet tons). Appleton wastewater will continue to process municipal sewage. They estimate approximately 20% diversion of biosolids from landspreading that could be used for refinement processing (approx. 5,000 wet tons). Eventually, The City would like to divert as much as 40% for refinement blending and up to 60% of their total biosolids generated to be dried, pelletized and sold as nutrient fortified fertilizer. FRVOR staff used these assumptions and estimates to calculate the amounts of each refinement product the enterprise could produce in subsequent years (see Market Analysis, Preliminary Product lines section).

Figure 5 FRVOR Project Annual amounts (wet tons) of Raw Feedstocks, Primary Processing Products and Finished Products

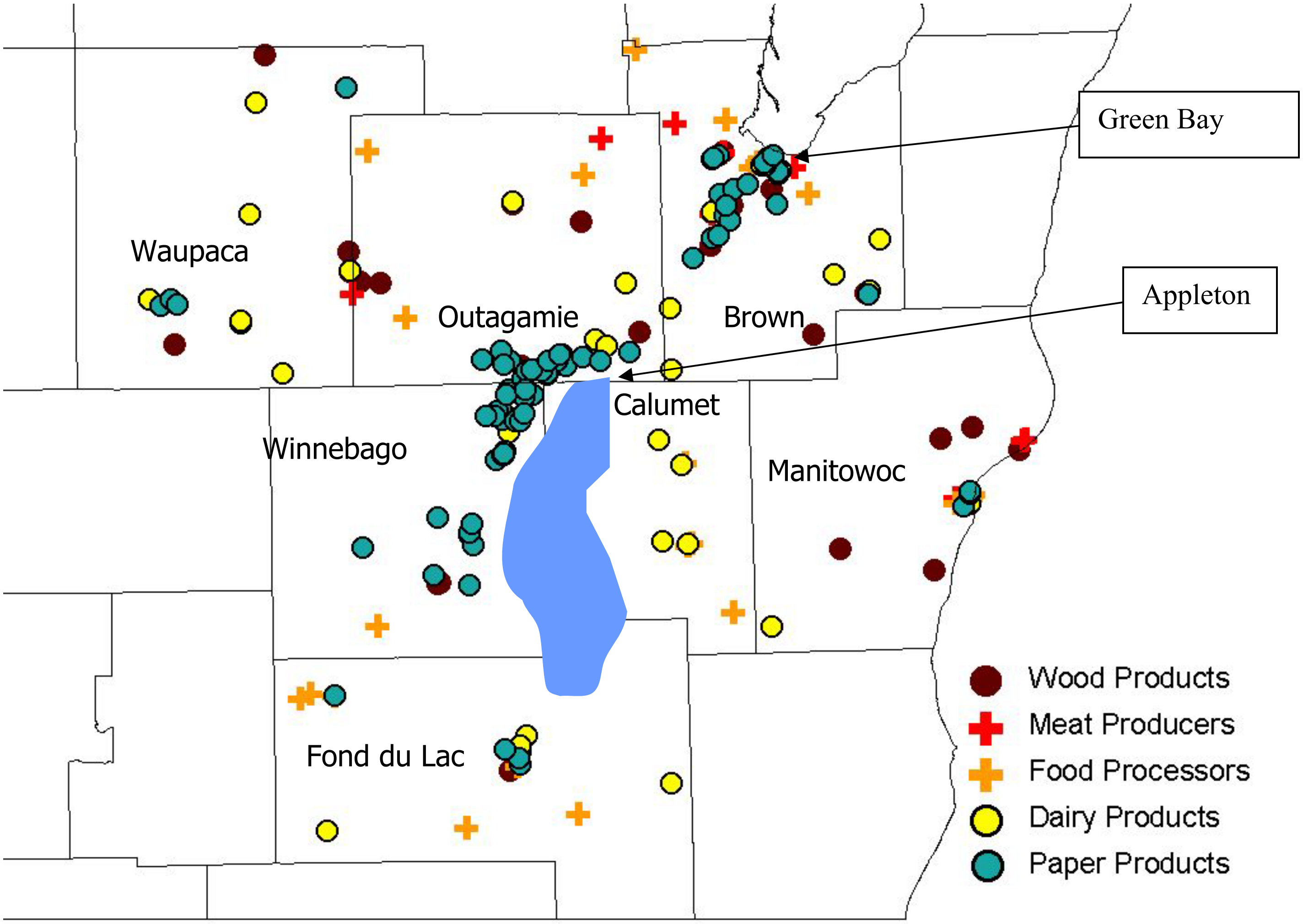


FRVOR staff has begun working on a more complete "waste shed" inventory of the Fox River Valley region. Counties include Outagamie, Brown, Winnebago, Calumet, Fond du Lac and Manitowoc. Using SIC code information about specific manufacturers from the Harris Info Database, staff generated a map of the region showing locations of wood product manufacturers, meat and food processors, cheese plants (dairy producers) and paper producers (Figure 6). Data was also collected on organic waste types, amounts generated annually, disposal methods, locations and costs (Table 6). This very preliminary dataset suggests that many of these manufacturers generate large quantities of organic wastes annually (100-56,000 wet tons), pay between $5,000-300,000 to dispose of these wastes and transport them great distances for disposal (up 1,400 miles in one case). As with the FRVOR participants, most landspread their waste or use them as livestock feed; however, a number were land filling their wastes.

Table 6. Preliminary Waste shed Inventory data from non-FRVOR Industries

Source	**By-product**	**Wet Tons/yr.**	**% Solids**	**Disposal method**	**Distance**	**Disposal Costs ($)**
Cannery	1) Corn silage 2) Pea waste	56,000	20-21	Cattle Feed (6-10,000 tons/year) Landspread (50,000-46,000 tons/year)	30-40 up to 150 miles	~$275,000
Paper Mill	Recycled pulp rejects	15,330	40-42	Landfill	Ridgeview landfill 41 miles	$216,000-$288,000
Paper Mill	Sludge from paper fiber	5,300-6,300	30	47% Landfill cover 63% Re-use as paperboard	115 miles & < 30 miles	$138,830 to $162,473
Cheese plant	Concentrated Whey Permeate	18,200	50	Cattle feed Landspread as last resort	New Mexico 1,400 miles	~$145,000
Jams, Jellies, Preserves	Food waste	96	60	Horse feed	265 miles (MN)	$4,968

Figure 6. Locations of waste generators in the Fox River Valley Region



Market Analysis

This section provides an estimate of the potential regional market for specific types of organic soil amendments including composts, compost blends and fertilizers. The survey area encompasses the metropolitan areas of Appleton, Green Bay, and Oshkosh, Wisconsin. Potential purchasers include greenhouses, landscaping companies, topsoil vendors, yard and garden retail centers, golf courses, cemeteries, parks, sod producers, land developers, Wisconsin Department of Transportation, landscape nurseries, and schools. The survey identifies competing products and possibilities for product substitution, current quantity of soil amendment purchases of bulked and bagged products and quality expectations for products and services. Using this information, FRVOR staff developed a preliminary list of desirable products and considered marketing and distribution options.

FRVOR Market Identification and Characterization

A small number of compost market analyses have been conducted nationally and in several other states, but little is known about the potential compost markets in Wisconsin or in the Fox River Valley (Iowa DNR 1998; Tyler 1996 US Composting Council 2000). As part of this project, FRVOR staff carried out a preliminary analysis of potential compost markets in the major metropolitan areas in the FRVOR region. The analysis includes the metropolitan statistical areas of Green Bay, and Appleton-Oshkosh-Neenah located in Brown, Calumet, Outagamie, and Winnebago Counties. In 2000, the four-county population was estimated to be 584,143, or 10.9% of the state's total population (Wisconsin Census 2000). The purpose of the market analysis was to estimate the potential dollar value and quantities of compost that might be purchased in the Fox River Valley region, and to identify other information helpful for compost market development. Because the compost market is undeveloped, the market research was designed to quantify and characterize compost product substitutes being sold and used in the region, including mulches, topsoils, and soil amendments. The market analysis was conducted to:

- Estimate the quantity of bulk and bagged soil amendment purchases
- Identify product quality and service expectations
- Identify competing products currently in use and opportunities for substituting compost
- Evaluate regional marketing & distribution optionsSeveral tools were developed by FRVOR staff to identify and characterize the potential compost markets: a wholesale market mail survey questionnaire, telephone interviews with soil amendment wholesalers, an on-site retail price survey, an agricultural user attitudinal survey on organic materials use, WI Department of Transportation (WIDOT) data queries and in-person interviews. The survey questionnaires are included in Appendix II of this report. The agricultural market attitudinal survey instrument was designed, but only tested with a small number of vegetable farmers (Wisconsin Potato Vegetable Growers Association Annual Meeting). All survey respondents were promised confidentiality and their identities and individual responses are not included in this report. Tabulated survey results are included in Appendix II.

Potential Compost Markets

The major markets for compost and mulch have traditionally been horticulture, bulk suppliers, agriculture, land reclamation and public agencies. Horticulture includes landscape contractors, retail garden centers, nurseries and green houses, sod farms, and golf courses. Bulk suppliers market or produce supplies to the "green industry". They include topsoil blenders and dealers, compost and mulch brokers, and bulk materials suppliers. Agriculture includes fruit and vegetable production, and feed and grain crops. Land reclamation includes the use of compost for remediation of contaminated soils, disturbed soils in urban areas, surface mines and gravel pits, erosion control and as a final landfill cover. Public agencies use of compost include parks and recreation, roads and highway, buildings and grounds, public works and sanitation, schools and athletic fields, and airports. Other potential uses include reforestation, wetland construction, and wildlife rehabilitation. (EPA 1997, TNRCC 1994, Tyler 1996) This market survey did not address the potential for agriculture or land reclamation except for erosion control for Wisconsin Department of Transportation projects in the FRVOR four-county region. Other market studies have identified significant potential for agricultural use of compost, but have also found that extensive education, promotion, research and field trials will be required to develop these markets (Tyler 1996, TNRCC 1994). A study completed in the adjacent state of Iowa predicted a significant and growing potential for use of compost on Iowa organic farms, which are increasing by approximately 22% per year, where 38% presently use compost (Iowa DNR 1998). Irrigated vegetable production in Wisconsin's Central Sands as well as the FRVOR region's greenhouse vegetable production represent other market opportunities, but were not analyzed in Phase I of the FRVOR project. An evaluation of markets not included in this study, and more rigorous analysis of identified markets is planned for FRVOR Phase II.

FRVOR Regional Market

Locally Available Compost Products, Quality, and Processors

From the wholesale mail marketing survey (14 responses out of 77 mailed), retail survey (42 stores), and interviews with soil amendment retailers, greenhouse/nursery operators, and landscape contractors (14), FRVOR staff learned that the market for compost in the Fox Valley is practically untapped. Only 14% of the wholesale/retail survey respondents purchase or use compost in bulk, and 36% stock or use compost in bags. There are no compost operations in the region producing a commercial line of compost, and compost products were under represented in mass merchandiser outlets. Stores surveyed generally carried only one variety of clearly labeled compost-derived products, which were from other states and almost always poor quality, inexpensively priced "composted" cattle manure. The compost products stocked in retail garden centers were derived from duck or cattle manure. One retail garden center stocked composted mushroom growing medium. Two respondents indicated they sometimes purchased bulk yard waste compost from a small local compost operation, but that the compost was of poor quality, and usually not available when needed. 71% of the respondents indicated compost was unavailable, and 60% reported that when available, it was of poor quality. 73% potential compost purchasers were concerned about compost's erratic or inconsistent supply. Most frequent quality concerns included the presence of chemical contaminants, weed seeds and physical contaminants. Other tabulated results from the mail survey are in Appendix III of this report.

According to a survey conducted by the University of Wisconsin-Extension Solid and Hazardous Waste Education Center (SHWEC 2000), seventeen licensed composting facilities are operating in the Fox River Valley Region, but none of them produce a commercial product. Only 1 of them reported selling their compost, with 8 indicating they gave it away for free. Five of the sites reported that their compost was used for municipal projects. There are two composting operations in Southeast Wisconsin producing commercial products, but only one was being sold in one of the surveyed outlets. Some landscapers use some of the free compost, but most landscapers in the FRVOR surveys or interviews do not frequently use it.

Compost Pricing

The FRVOR wholesale/retail survey and interviews identified that $16.71/CY was the average wholesale price currently being paid for bulk compost and 71% indicated that a wholesale bulk price of $16 to $20 was reasonable for good quality compost. Compost prices in bags varied widely depending on bag size, type of material, and quality. Competing products such as potting soils and peat in bags had wholesale prices ranging from $31/CY for peat to $269/CY for specialized potting soils.

Potential Compost Users and Markets

The number and type of potential compost users are identified in Table 7 on the following page. The potential market categories, and estimated compost amounts purchased and values for the FRVOR region are shown in Table 8, and displayed graphically in Figures 7 and 8 on the following pages. Note that this survey was not exhaustive, and other potential compost sellers exist, such as grocery and hardware stores, where other market studies have identified significant potential (Enviros RIS 2001, Iowa DNR 1998, Tyler 1996,).

Compost Market Estimates

Compost amounts and dollar values were estimated by establishing average uses and purchase prices per market sector and multiplying the average by the number of organizations identified in each sector. The average compost use figures were developed by using the data acquired from the surveys, other compost market studies, and compost end use data. Since the compost market is undeveloped, it was assumed that compost could replace percentages of some peats, mulches, or other organic materials currently being sold. Basic assumptions for each sector are provided in Appendix IV of this report. The compost market estimates in this report should be considered preliminary and not accurate enough for budget level planning, but provide a reasonable estimate of the market potential. More extensive market research will be carried out in Phase II of this project to confirm or amend the figures in this report, and well-planned and executed marketing, promotion, and education programs must be employed to break into these potential markets.

Table 7. Number and Type of Potential Compost Users

	Number in Metropolitan Area			
Type	**Appleton**	**Green Bay**	**Oshkosh**	**Total**
Retail Fruit & Vegetable	3	7	1	11
Retail Garden Centers/Greenhouses	22	21	5	48
Landscape Architects	5	10	0	15
Landscape Contractors	46	45	24	115
Lawn Maintenance	22	25	8	55
Nurseries	4	7	8	19
Topsoil Dealers	13	10	4	27
Wholesale Plant Operations	1	1	1	3
Sod Dealers	2	1	0	3
Mass Merchandisers	10	11	6	27
			Total	**323**
Golf Courses	**Brown**	**Calumet**	**Outagamie**	**Winnebago**
Type	**Number**			
9 Hole	3	2	2	1
18 Hole	8	3	7	9
27 Hole	3	0	0	0
			Total	**38**
Ag Cooperatives	**Brown**	**Calumet**	**Outagamie**	**Winnebago**
	3	2	3	2
			Total	**10**

Table 8. Potential Market Categories, Compost Amounts and Values

Market	Cubic Yards/Year	Dollars/Year
Retail Garden Centers/Greenhouses	21,550	$ 872,775
Landscape Architects/Contractors	130,000	$ 1,560,000
Lawn Maintenance	36,850	$ 442,200
Lawn Establishment	93,610	$ 1,123,325
Nurseries	133,000	$ 1,596,000
Topsoil Dealers	40,500	$ 324,000
Wholesale Plant Operations	30,000	$ 360,000
Sod Dealers	60,000	$ 480,000
Mass Merchandisers	108,000	$ 4,374,000
Golf Courses	41,752	$ 501,027
WI DOT FRVOR Counties	214,338	$ 2,143,375
Total	**909,600**	**$13,776,703**

Figure 7. Potential FRVOR Compost Market/Year

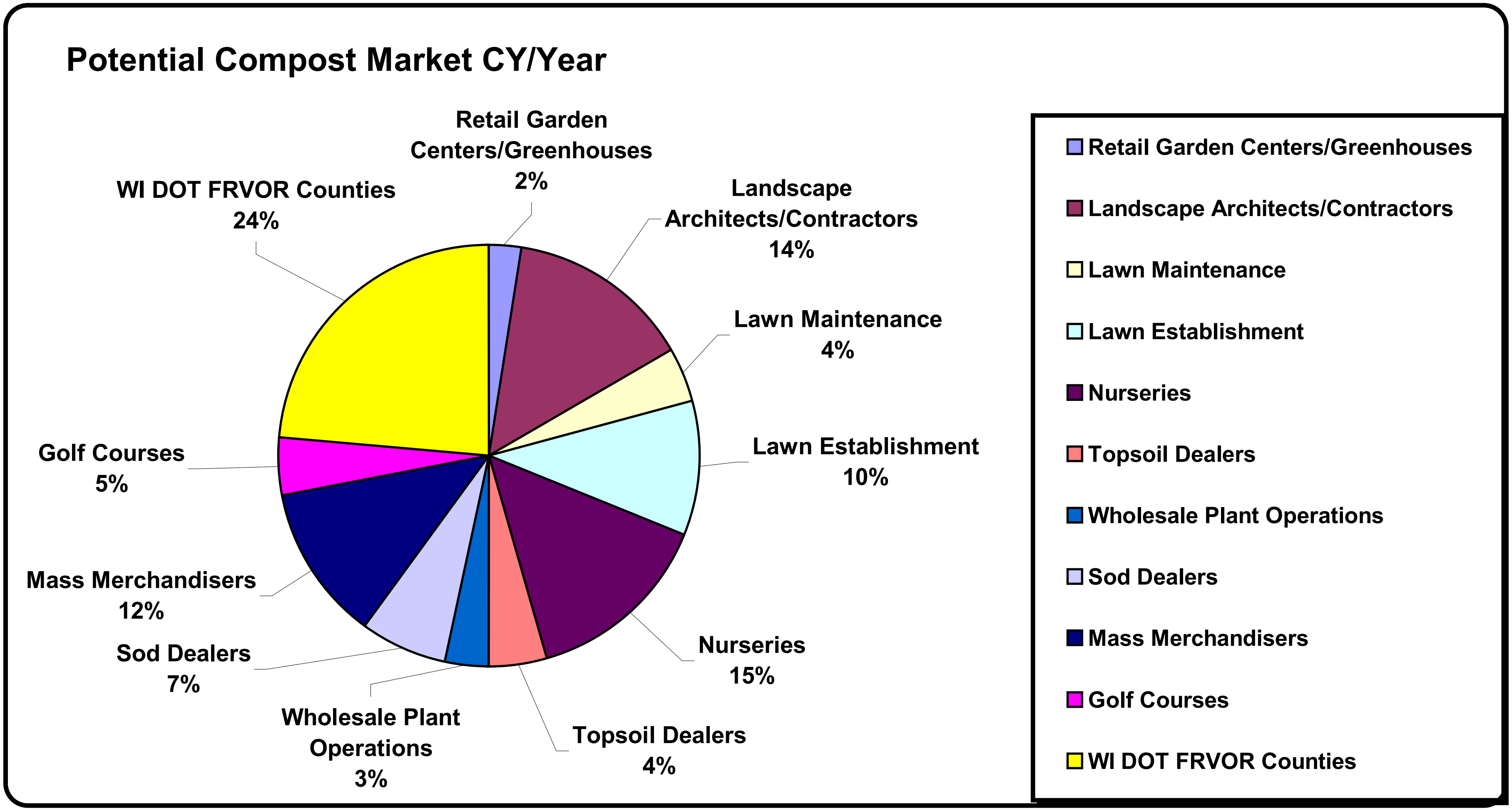
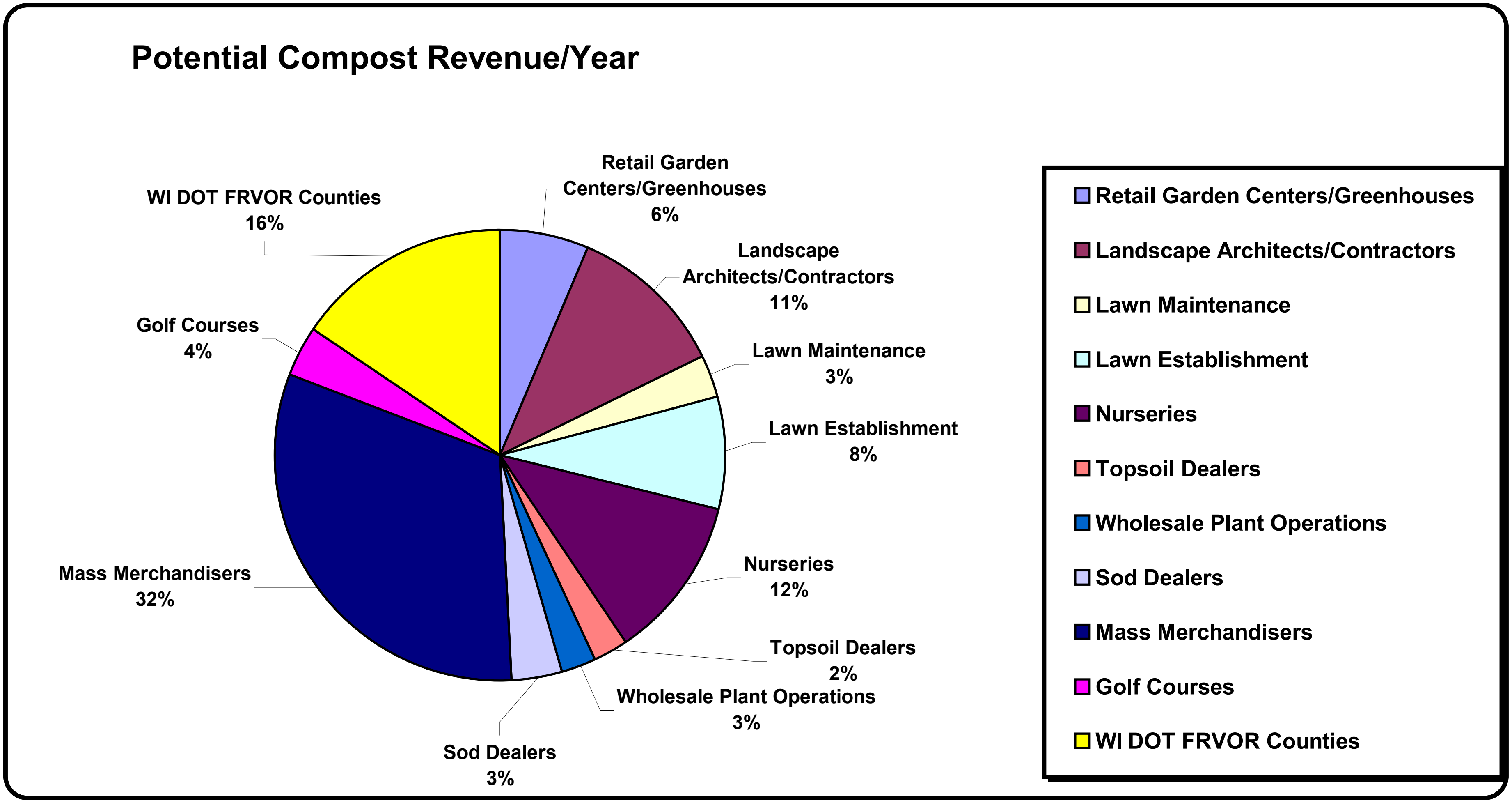


Figure 8. Potential Compost Revenue/Year



Regulatory Framework and Institutional Setting

Regulatory Climate

The regulatory climate can have a large influence on promotion and implementation of alternative by-product processing and end use strategies. In the early 1990's, the Australia-New Zealand Environmental and Conservation Council conducted an inquiry into existing waste management practices. The outcome was a mandate for 50% reduction in wastes to landfills by the year 2000. They introduced policies and legislation to minimize waste including financial support for innovative waste minimization programs and development of standards and quality control criteria for recycled organic materials (Rochfort 1998). The state of California underwent a similar process in 1990 with 50% waste diversion goal by the year 2000 and the creation of the California Integrated Waste Management Board (CIWMB). All jurisdictions in California were required to collect data on local waste streams and develop solid waste management plans. The CIWMB fosters market development for recyclable materials and provides education/outreach on waste reduction programs. Like California, the Washington state legislature created the "Clean Washington Center"(CWC) in 1991. The CWC has worked in partnership with business, industry and local governments to develop markets for recycled materials. They provide technical assistance in business development, recycling technology, product marketing and policy research and analysis. The common denominators of these state and federal initiatives include commitment to divert significant waste streams from land fills, creation of waste management boards to tackle issues at the community level and economic incentives for development of by-product processing facilities and markets for end products.

State And Federal Regulations Governing Land Use of By-Products

One of the major components to achieving success for the FRVOR project will be to examine the existing state and federal regulations and identify opportunities for regulatory updating. Wisconsin's solid waste management regulations are landfill oriented and have not yet considered the beneficial blending and processing of agricultural, municipal and industrial organic by-products. A recent report entitled " A study of the future of solid waste management: A report to the Wisconsin Legislature (WI DNR and UWEX Solid and Hazardous Waste Education Center, January, 2001), highlighted Wisconsin's lack of "coordinated planning, development and delivery of comprehensive waste management services." It acknowledged that land filling is the predominant disposal method in the state (60% of MSW) and that composting has the potential to recycle as much as 50% of all solid wastes generated in Wisconsin. The report recommended development of a set of financial mechanisms (tax incentives for recycling, credits for technologies that reduce or eliminate waste generation and solid waste disposal fees) to encourage waste reduction, recycling and reuse and discourage waste disposal. It also advocated development of community-level incentives to examine coordination of solid waste management activities to achieve cost savings and increase efficiencies. The Wisconsin Department of Natural Resources (WDNR) has shown an interest and willingness to cooperate with FRVOR participants in an effort to reevaluate the state's regulations on by-product handling/processing to promote by-product blending.

Soil Amendment Standards

Another need for promoting the widespread use of processed organic by-products is to develop state standards for soil amendments. For example, there are no standards for compost use in Wisconsin, and the WI DOT has no specifications outlining compost use for erosion control or establishing vegetation. FRVOR staff has begun to work with the WI DOT and WDNR to address both of these areas.

Refined Product Deregulation

Deregulation of refined products (like class A biosolids) will improve FRVOR's chances for moving FRVOR products into the market place. We have begun working with a business sector specialist in the DNR's newly created Cooperative Environmental Assistance (CEA) Bureau. This Bureau was created to work with businesses and supports "innovative, non-regulatory incentives to promote environmental protection." Jerry Rodenberg will be FRVOR's CEA liaison person. He has 25 years of experience working with the food processing industry and supports the FRVOR project goals. Jerry has already provided an example of a paper mill receiving permission to publicly distribute their paper mill sludge.

Regulatory Authorities and Jurisdictions

Applicable Wisconsin Regulations

NR 214 applies to landspreading of "industrial sludges and by-product solids." Sludges and solids from industrial, commercial and agricultural facilities including those that are temporarily applied to land and contain primarily organic matter with low concentrations of metals and organic pollutants (See Appendix VI for DNR synopsis of the rule). These sludges and by-product solids must be designated as "beneficial" for use as a soil conditioner or fertilizer in accordance with NR 518.14 Wis. Administrative Code, Landspreading of Solid Waste. Facilities that generate these types of wastes include: food processors (fruit, vegetables, dairy products, meat, fish, poultry), mink raising facilities, aquaculture operations and other operations with similar wastes that have "no detrimental effects on ground water, soil, vegetation or surface waters" Sludges not covered under this rule are those that don't have beneficial properties as a soil conditioner or fertilizer OR those that contain toxic or hazardous substances (metals, solvents, lubricants, biocides, dioxin, PCBs, phenolics, pesticides and bioaccumulative toxins). Paper mill sludge was originally designated as a "solid waste" (i.e., not permitted to be landspread), but received beneficial use status within the past few years. It now falls within the NR 214 guidelines. By-product solids include paunch manure and vegetable waste materials like leaves, cuttings, peelings and sweet corn silage.

Potential constraints

A permittee must amend his/her management plan every time a new sludge (or solid waste) is added or lost during the term of the permit. Whenever the permittee proposes to add a new source of sludge for land applying under this permit, they must amend the management plan and obtain DNR approval prior to land application.

NR 500, 502 and 518 WI Administrative Code

NR 500, 502 and 518 WI Administrative Code that applies to composting and landspreading of yard waste, clean chipped wood, vegetable food waste and agricultural wastes including crop residues, manure and animal carcasses. Definitions for composting and compost are provided.

Facilities composting 20,000 cubic yards or less " total materials on site at one time" are exempt from plan submittal requirements, but must have an initial site inspection, provide minimum operation and design standards, obtain an operating license and land spread compost in compliance with NR 518.14. Facilities composting greater than 20,000 cu yds must have additional operational and design standards (including runoff collection and presence of a low permeability pad), submit a detailed plan for their operation and monitor and report quality of finished compost and leachate characteristics. Wastes exempt from NR518 Landspreading include those materials used as a soil conditioner or fertilizer and applied using sound agricultural practices, and agricultural wastes applied to farmland. Manure generated from a designated "Concentrated Animal Feeding Operation" or CAFO (currently defined as livestock facilities with 1000 animal units or greater) will have to be spread according to a nutrient management plan.

NR 204 Domestic Sewage Sludge Management

NR 204 Domestic sewage sludge management (sludge management standards for Wisconsin come directly from the Federal, US EPA Part 503 Regulations from the Clean Water Act). This rule has detailed guidelines for allowable sludge characteristics and management practices for land application of municipal sewage sludge or biosolids. There are heavy metal and pathogen limits (see table in Regulations Appendix VI). The designation of Class "A" or "B" relates to pathogen limits: Class A sludge must be treated to reduce pathogens to 1000 MPN/g TS for fecal coliforms and 3 MPN/ 4g TS for Salmonella; Class B sludge can contain up to 2,000,000 MPN or CFU/ g TS. Process options for Class A include composting, heat treatment/drying, beta and gamma ray irradiation, pasteurization and some PFRP (Process for Reducing Pathogens) process. Class B processes include aerobic and anaerobic digestion, air-drying, composting and alkaline stabilization. Both sludges must meet "vector attraction reduction criteria as well (See Appendix VI).

Potential Constraints

Alternative uses of sewage sludge including land application on sod farms, nurseries, Christmas tree plantations, mine reclamation sites, restoration of construction sites, highway right-of-ways (e.g., DOT applications), etc. may not be conducted unless DNR approval is obtained.

Potential constraint to feedstock blending: Laws passed in the 1980's gave DNR broad authority to approve waste reuse on a case-by-case basis. The case-by-case basis proved to be tedious and unfairly applied. In 1995, the WI legislature directed DNR to develop specific reuse options and testing requirements. They developed NR 538, "Beneficial Reuse of Industrial By-Products" in 1997. Although this rule relieved some of the regulatory hurdles to beneficial use of organic solid wastes, there is a new concern about the presence of persistent bioaccumulative toxins (PBTs). These substances can be present in very small quantities but potentially harm people and the environment. The DNR has taken a stance against by-product blending for fear that blending will reduce regulatory status by contaminant dilution. This mindset may have adverse consequences for projects attempting to blend organic by-products. We recommend testing for potential PBTs in any of the feedstocks to be used in either primary or refinement processing within the FRVOR project.

Marketing, Distribution, & Secondary Processing Facility

Upgraded Composting Site and Permit

Bio-Resource Products, LLC is currently operating a compost site permitted for yard waste and leaves in Greenville, WI. This permit allows a maximum of 20,000 cubic yards of unprocessed material at any given time. A new permit will be required to expand the compost operation to include materials other than yard waste and leaves, as well as many site improvements and operating conditions, not required under their existing permit. These regulations require a plan submittal and review by the WDNR, detailed information concerning materials to be received, their management and processing, potential product markets, transport means and methods, and estimated facility closure costs. Mandatory site improvements include a low permeability pad that meets certain standards, and management of run-off as a leachate into a collection basin or tank. Additional site improvements such as berms to conceal the site, and fencing for security and safety will also be needed. An investigation to use lime stabilization as an alternative to asphalt, concrete, or compacted clay is expected to be underway soon. If this material meets the approval of the WDNR, it will substantially reduce site improvement costs. We assumed that lime stabilization would be accepted as an improved alternative and was used to estimate site improvement costs in the financial analysis conducted for this study.

Additional equipment and personnel will be required to manage the much greater quantities and variety of materials identified in this report. The *preliminary* capital cost for site improvements is estimated to be approximately $1.1 million, and the first year annual cost for management, marketing and production personnel and operating costs is estimated to be $116 thousand. During the first year of expanded operation, an additional $100 thousand may be needed to purchase equipment for mixing, blending and bagging the value-added product lines. These processes would be conducted at the composting site until construction of the Secondary Processing Plant/Marketing & Distribution Facility.

Secondary Processing Plant/ Marketing & Distribution Facility

Construction of a secondary processing plant is expected to be needed by 2005 to increase production efficiency and to add equipment to process an aggregated leaf compost product for storm water treatment, and a heat dried, granulated and fortified biosolids organic based fertilizer product. The plant is estimated to cost approximately $4.3 million to build, and approximately $365 thousand to staff and operate at full capacity. Many of the operations and services previously done at the composting site would be transferred to this facility by the beginning of 2006. This facility could house raw materials procurement and coordination, value added production, customer service, research and development, marketing, distribution, and accounting. Consideration could also be given to functioning as a broker/distributor for soil amendments manufactured by others. A comprehensive property search and location analysis should be conducted to select the optimum location to minimize property purchase price and transportation costs between by-product producers, the composting site and the new plant/marketing and distribution facility. Preliminary capital and operating cost estimates for 2002 through 2006 are in Appendix VII of this report.

Organizational Analysis

The various components of this proposed project, including anaerobic digestion, composting, new product development, advanced refining, marketing, etc., could ultimately require a somewhat complex "organizational structure". For instance, the operation could involve combinations of business forms (co-op, LLC, sole proprietorships), bound together by a host of contractual relationships. The involvement of the City of Appleton (COA) also raises some public-private complexities. Despite greater complexity, public/private cooperation can have many benefits. Through public private ventures, the advantages of the private sector—innovation, timely access to finance, knowledge of technologies, managerial efficiency, and entrepreneurial sprit—can be combined with the social responsibility, environmental awareness, and local knowledge of the public sector. In such joint ventures, both the public and private sector partners have invested in the enterprise and therefore both have a strong interest in making it work (Bennett et al. 2000). Information concerning various business structures including cooperatives, limited liability corporations and S-corporations are included in Appendix VIII of this report.

Two functional areas can be considered for joint public/private ownership or operation among FRVOR participants. First is the financing, ownership and operation of a compost site permitted to process mixed waste sources. Second would be financing, ownership or operation of a central processing marketing, and distribution facility. The central processing facility would blend or further process materials from Bio-Resource Products, LLC compost operation, the City of Appleton Biosolids, Tinedale Farms digested manure solids, and possibly other materials such as sand and bark, to produce higher value soil amendments and container mixes. The plant would also take responsibility for product development and marketing, distribution, billing, and customer service. Advantages of a centralized facility include the ability to develop more sophisticated product lines to serve various markets, and economies of scale that would permit the purchase of efficient processing and packaging equipment, professional management and marketing staff, and possibly, access to national soil amendment markets.

Since the project can progress in stages over several years, a few relatively simple options are viable for consideration during the early years of development.

Stage One: Composting Leaves and Yardwaste, Testing Product blends

It is not expected or recommended that the project participants leap into a multi-million dollar investment for mixed waste processing or a secondary refinery. Rather, the first couple of years should only involve yardwaste composting plus pilot scale composting of other waste streams, such as the feedstocks available from Agrilink, American Foods, and Hillshire Farms. The first couple of years would also evaluate test batches of compost-digested manure solids and compost-biosolids blends. Activities for Stage One would include (a) ironing out understandings with the DNR, (b) Testing various compost recipes and perfecting compost products and compost blends and (c) developing markets for those products. Proceeding beyond the pilot scale will require significant composting site improvements, and a new DNR permit. Approximate costs for this investment are expected to be in the range of $1 to $1.5 million dollars. Additional information concerning compost site upgrading is included in Appendix VIII of this report. Two organizational options for Stage One have been identified.

Option One:

Each feedstock supplier would contract independently with Bio-Resource Products to accept their waste in exchange for a receiving fee, and in some cases, Bio-Resource Products would pay for the waste stream. Bio-Resource Products would independently develop composted products, market them under their own label, and hopefully earn a profit. Composting site improvements would be borne by Bio-Resource Products. Financing these improvements would require long-term waste processing contracts, and an aggressive marketing program.

Advantage for everyone: simplicity.

Option Two:

Feedstock suppliers could form a simple co-op (minimal assets, possibly one employee). The co-op would negotiate a contract with Bio-Resource Products for waste processing.

Disadvantage: more complex.

Advantages: Feedstock suppliers could possibly achieve a short-term advantage if they were able to negotiate lower waste management costs through collective bargaining. Other advantages could serve all parties, especially if further refining and additional investment were pursued as the enterprise grows. Potential advantages to forming a co-op now could include:

- Establishing a cooperative culture early among feedstock suppliers would make it easier to cooperate at later stages, when cooperation could become more essential.
- A co-op employee could serve a coordinating and oversight function that would serve all feedstock suppliers.
- A co-op employee might also alleviate Bio-Resource Products of some responsibilities (record keeping, product development, marketing, etc.) although Bio-Resource Products in turn might charge lower receiving fees in exchange for these services.
- The DNR might favor having an intermediary entity (the co-op) take responsibility for waste products once they are combined.
- There could be public relations value associated with a community cooperative effort (resulting in greater support from the City of Appleton, for example).
- Some grant dollars and loan programs are targeted to co-ops.

Stage Two: Further Refining

The preliminary market research implies that proceeding beyond yard waste compost derived products may be profitable and possibly reduce waste management costs. Given that potential, it is worthwhile to consider what organizational arrangements would enable FRVOR to expand their product line to include processing of other wastes.

Investment Needed

The key issue with Stage Two is that far more money would be needed to develop and operate a central marketing, distribution and processing facility. FRVOR staff obtained or prepared ballpark estimates of $4.5 million for the plant construction, equipment, and land.

The City of Appleton must determine if it could become a co-owner in a private enterprise, or if this would be advisable, however the city could contribute to the project in other ways, as through municipal project bonding or a favorable land lease arrangement. Using $5 million as an example, the City might consider issuing a bond and providing $1 million in financing (and does not contribute land.) That would leave $4 million to be raised by other means. If half of that were covered by a conventional bank loan, $2 million more could be contributed as equity capital.

Limited Liability Company (LLC)

It is conceivable that one of the participating FRVOR organizations might be willing and able to make that $2 million investment, and, that again, would certainly simplify coordination and operations. However, if multiple investors were needed to finance the project, or if the feedstock suppliers desire an ownership share themselves, then a "multiple entity" business form would be required.

An LLC offers limited liability to all owners, while avoiding corporate level taxation. Without eliminating other options, such as the new Wyoming cooperative statute (WY H.B. 21 SN 2001), we can conclude at this point that a Wisconsin LLC would be an appropriate means to accommodate multiple investors. LLC members can include individuals, other LLCs, and/or corporate entities, including cooperatives.

The complications (as well as certain advantages) arise if the feedstock suppliers choose to join the LLC as a collective group. Under this scenario, the LLC members could include Bio-Resource Products, the feedstock suppliers' co-op, and other individuals/companies as needed. A feedstock supplier, such as American Foods, could have an ownership share of the LLC as a co-op member and also as a direct investor in the LLC. Clearly, a major disadvantage to this approach would be its complexity, which must be outweighed by its advantages if FRVOR follows this option.

Advantages to a Combined Co-Op/LLC

Some of the advantages of a combined Co-Op/LLC would benefit the feedstock suppliers. First, they could receive a share of the LLC's profits through membership in the co-op. Second, they would have access to the LLC's records and practices (i.e., an oversight privilege) which could alleviate their regulatory concerns and also give them some assurance that their waste processing fees are reasonably priced.

Further, a combined structure giving feedstock suppliers a stake in the business should give them an added incentive (beyond contractual obligations) to provide quality feedstock that results in the best end products—something that should be good for all investors.

Recommendations

The following recommendations are offered as a starting point for further discussion and negotiations. The first suggestion is that feedstock suppliers consider forming a cooperative to implement Stage One Composting. The DNR should be consulted to explore if such an "intermediary" facilitates or complicates their regulatory function. All suppliers could be required to join the co-op, for a modest investment. Suppliers would pay processing fees to the co-op. The co-op could take "ownership" or responsibility for the wastes, though physically they would be delivered to Bio-Resource Products, who would compost them under contract for a negotiated compensation. The difference between what the co-op collects in processing fees, and what it pays Bio-Resource Products, could be retained as savings to invest in Stage Two.

If Stage Two Blending and Refining is pursued, we recommend that an LLC be formed, with the feedstock suppliers' co-op taking an ownership share of that LLC. Feedstock suppliers who want a larger or more direct share of ownership could also invest independently in the LLC.

Conceivably, the co-op could negotiate for a share of ownership in the LLC that is larger than the amount of cash it invests. The contracts that the co-op establishes with its member-suppliers would have a certain value in and of themselves. However, the co-op's share of the LLC should not be so large that other LLC investors do not earn a satisfactory return on their own investment.

See Appendix IX for an analysis of the potential FRVOR enterprise that was graciously donated by the Lindquist & Vennum law firm.

Conclusions & Recommendations for Continued FRVOR Activities

The authors of this feasibility study have concluded that:

1. A significant potential for compost and digested solids derived soil amendments is present in the Fox River Valley and within other potentially available market areas.

2. The organic wastes or by-products available from present FRVOR participants have value as raw materials for the manufacture of soil amendments, representing a significant cost savings in current and projected waste management alternatives.

3. An enterprise based in the Fox River Valley that would receive locally available organic by products, process them into *high-quality* soil amendment products and market and distribute the products appears to be potentially profitable.

4. The soil amendment enterprise presents a viable, environmentally responsible, long-term solution to the region's organic waste stream problem.

Recommended Phase II Activities

1. FRVOR participants should carefully consider the information presented in this report, and communicate thoughts and concerns with each other and FRVOR staff.

2. Detailed discussion and analysis of organizational alternatives should be investigated individually and collectively by interested FRVOR collaborators.

3. Preliminary agreements and letters of intent should be prepared among all FRVOR collaborators so that all clearly understand their roles, responsibilities and expectations.

4. Conditional, long-term contracts for supplying by-products to the waste processing entity (assumed to be by Bio-Resource Products at this time, and could also include Tinedale Farms) should be executed as soon as possible so that processing site improvements and DNR approvals can proceed.

5. FRVOR staff should continue as planned with additional market research, product development and testing.

References Cited

Abelson, P.H. (1994). Minimizing wastes (editorial). Science 265:11.

Bennet, Elizabeth, Peter Grohmann, and Brad Gentry 2000. Public-Private Cooperation in the Delivery of Urban Infrastructure Services (Options and Issues). PPUE Background Paper, UNDP/Yale Collaborative Programme.

Block, D. (1998). Capturing commercial organics in Des Moines. Biocycle 39(8):33-35.

Criner, G.K., A.S. Kezis, G.K. White and J.P. O'Connor. (1995). Regional composting of residential waste: an economic analysis. Comp. Sci. Util. 3:31-39.

Enviros RIS (2001). Toronto Compost Markets Study, Toronto, Canada.

EPA (1997). *Innovative Uses of Compost*. US Environmental Protection Agency. EPA530-F-97-046

Glenn, J. (1998). The state of garbage in America. Biocycle 39(10):32-43.

Graedel, T.E. and B.R. Allenby. (1995). Industrial Ecology. Prentice Hall, Englewood Cliffs. N.J.

Grealy, S., J. Theroux, S. Stowell and K. Sturdevan. (1998). Managing and marketing urban greenery. Biocycle 39(10): 37-42.

Iowa DNR (1998). Iowa Statewide Compost Market Assessment, Iowa Department of Natural Resources.

Johnson, K.W. (1998). Balancing markets with compost production. Biocycle 39(6):48-50.

McDonough, W. and M. Braungart. (1998). The next industrial revolution. The Atlantic Monthly 202:82-92.

Rochfort, C. (1998). An Australian perspective on recycling organic materials. Biocycle 39 (4): 74-75.

Swanson, L. and W. Charlton. (2001). Targeting composted manure for nursery mixes. Biocycle 42 (2):51-52.

TNRCC (1994). *Texas Municipal Compost Marketing Manual*, Texas Natural Resource Conservation Commission.

Tyler, R. (1994). Fine-tuning compost markets. *Biocycle* 35(8): 41-48.

Tyler, Rod 1996. Winning the Organics Game: The Compost Marketer's Handbook, ASHS Press.

Walker, J.M., Southworth, R.M. and A.B. Rubin. (1997). U.S. Environmental Protection Agency regulations and other stakeholder activities affecting the agricultural use of by-products and wastes. *In* J.E. Rechcigl and H.C. MacKinnon (eds.) Agricultural uses of by-products and wastes. ACS Symposium Series 668. Washington, D.C., p. 28-47.

WY H.B. 21 SN (2001). 2001 Wyoming House Bill No. 21, Wyoming 56th Wyoming Legislature.

Appendices

Appendix I A-1 Organics Product Specifications

Appendix II Survey Questionnaires

Appendix III Tabulated Survey Results

Appendix IV Basic Market Assumptions and Calculations

Appendix V Solvita Standards

Appendix VI DNR Rule Synopsis

Appendix VII Compost Site Upgrades and Refining Facility Capital & Operating Costs

Appendix VIII Business Structure Comparisons

Appendix IX Lindquist & Vennum FRVOR Business Structure Letter

Appendix X Financial Data