# Dairy Compost Utilization Program
# Marketing Composted Manure to Public Entities

Texas Cooperative Extension
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# INTRODUCTION

Approximately 75 dairies with an estimated 38,000 cows operate in the Bosque River watershed. Previous studies have demonstrated that excessive applications of manure to land areas in the immediate proximity of the dairies have contributed to water quality problems in the basin (McFarland and Hauck 1999). In a joint effort to address water quality concerns, TCEQ and TSSWCB developed the TMDL Implementation Plan and within that plan, interest and support developed for the production of composted dairy manure as a means for encouraging transport of dairy animal manure out of the watershed. Both agencies worked to create programs supporting a sustainable composting industry. These programs included incentive payments to support the transport of manure from dairies to compost facilities, incentive payments for public entities to purchase dairy compost to gain experience with its use and an educational effort to expand knowledge and market development regarding use of dairy manure compost.

It was the latter that sparked development of the Dairy Compost Utilization Program. This program, funded by the TCEQ through a Section 319(h) Clean Water Act Grant from the US EPA, was administered by the Texas Water Resources Institute (TWRI) and conducted by Texas Cooperative Extension (TCE) and Texas Agricultural Experiment Station (TAES). Ron Alexander and Associates (RAA) were contracted through the project to conduct marketing activities. The Dairy Compost Utilization Program tasked TWRI and TCE with:

1) Providing assistance to composters in production practices and achieving product consistency;
2) Assessing compost quality and working to improve the material produced;
3) Expanding public knowledge of composted dairy manure through educational programs, publications and demonstrations;
4) Expanding local governmental purchasing and use of dairy manure compost; and
5) Assisting TCEQ in creating a sustainable dairy manure composting program.

The Dairy Compost Utilization Project officially began in July 2002. In the past three years, significant changes and impacts have occurred as a result of the project.

*Provide assistance to composters in production practices and achieve product consistency.*

Dairy compost producer knowledge of sound production practices, record keeping and testing has vastly increased. Only a few facilities existed before the Dairy Manure Export Support (DMES) Program began and therefore, several of the compost facilities that went into business following the DMES Program were managed by former nursery producers, dairy farmers and commercial transportation operators. Thus, at project onset, many of the compost producers had little knowledge concerning compost production. Through workshops, site visits and personal communication, compost facility operators gained considerable knowledge on compost production.

*Assess compost quality and work to improve the material produced.*

With the training of the compost producers, the quality and consistency of composted material have improved substantially through the life of the project. Five of the six dairy compost producers in the watershed have joined the Seal of Testing Assurance Program and have established standard protocols for material sampling and assessment. Through the project, the compost producers learned the value of a regularly scheduled testing regime.

*Expand public knowledge of composted dairy manure through educational programs, publications and demonstrations.*

TCE agents and specialists gained considerable knowledge on the use and application of dairy manure compost. This information was conveyed to the public through demonstrations, fact sheets, news articles, presentations, and other communications. In addition, this information will continue to be utilized by compost producers, agency personnel and end users as valuable guidance in proper use and management of this resource.

*Expand local governmental purchase and use of dairy manure compost.*

Use of dairy manure compost also has increased in several markets. Prior to the project, use of composted dairy manure primarily was limited to only TxDOT, a few agricultural applications and organic farmers. The City of Waco was the only city that participated in the purchase and use of the compost for an annual public compost sale.

Through Project efforts, however, the compost producers have each found expanded and niche markets for distribution of their compost. Namely, the small nursery operators and landscape farms have begun purchasing and selling the compost material for bulk distribution or as a bagged product. Also, several school districts have utilized the material as a topdress for athletic fields. The Leon Bosque Resource Conservation and Development worked to promote the application of a compost/sand blend (50/50) to athletic fields in the surrounding area. Despite efforts to market the compost to local cities, very few of the municipalities purchased the material on their own accord. Partnerships with the project were formed and demonstrations occurred on city property, yet continued use of the material by cities has not occurred. Limited budgets and lack of adequate experience with compost use in the small cities within the Bosque and Leon River Watersheds were perhaps primary reasons for the lack of adoption of compost use.

*Assist TCEQ in creating a sustainable dairy manure composting program.*

While market development has not occurred to the extent desired within the timeline of the project, the market effectively is still very young and indications are that it will continue to grow with time. Unfortunately, time and related constraints of the project did not allow for stronger market development. Namely, the composted material was atypical compost, which caused some of the project's efforts to focus on determining the nature and cause of the atypical characteristcs, improving quality and identifying a best fit market for this type of material. Secondly, lack of participation by compost producers hindered market development. Next, the amount of true 'on the ground' marketing was limited because Texas Cooperative Extension is not in the position to be a marketing agency as its role is to provide unbiased information to the public. Finally, time was also an issue. Research shows that a typical successful market development project requires at least 2.5 years of a pure market push excluding background market assessment prior to development. In the Dairy Compost Utilization Project, however, the first 2 years were devoted to assessment of compost production, its consistency and quality and the proper use of the material. Nevertheless, substantial progress made through these project efforts and the marketing aspect during the last year established the potential for the dairy compost program to achieve success.

# RESULTS BY TOPIC

Given that the end goal of the Dairy Manure Compost Utilization Project was to develop a sustainable compost market through the expanded use of compost by the public and private sectors, it was imperative for initial efforts to strategically assess compost material, production methods and potential markets, identify priority product improvements and market development goals, develop necessary strategies to obtain these goals and adapt the strategies as the project progressed and more knowledge was made available.

First, the Dairy Compost Utilization Project assessed the composition and characteristics of the compost material and current and potential compost markets. Subsequently, efforts were made to 1) educate compost producers on proper production techniques, 2) improve manure feedstock and compost quality, 3) evaluate appropriate uses of dairy manure compost so sound recommendations could be made through public outreach, and 4) demonstrate the use of compost and educate the public on dairy manure compost availability and use.

## Compost Market Assessment

At project inception, the potential dairy compost market was evaluated in specified geographical areas. TCE conducted a telephone survey of municipalities and other public entities within a 17 county area grouped by population. Results were tabulated and summarized in the "Dairy Compost Use and Production Survey Results" Report (**Appendix E**).

Of the 102 public entities identified within watershed, TCEQ identified 40 entities total to be surveyed and TCE received responses from 70% of the contacted entities. Of the positive responses received by TCE, 63% use some type of organic material in their management practices. Consequently, 38% do not currently use any organic materials in their land and plant management programs.

Of the 63% that do use organics, approximately half produce their own product and of those, a majority produce a mulch product rather than a compost product. Generally, entities that produce their own product do so to conserve landfill space and money. Input costs for this production are low as entities receive materials from their citizens in the form of green waste from lawn and yard trimmings. Therefore, it is more economical for entities to produce a mulch type product rather than a compost type product. For the remaining half who use compost, but do not produce their own, TCE discovered that these entities purchase or receive their organic material from a variety of sources. A majority of the entities who produce compost or a mulch product give or sell the product to their citizens or another entity (i.e. TxDOT). Only 3 of the contacted entities stated they used a compost or mulch product in their land management needs such as city parks, football fields and local schools.

The 32% who do not currently use or produce compost provided several reasons behind their disinterest. The majority lacked the funds, personnel and public demand to warrant the production or the purchase of compost. Furthermore, given funding, entities admitted that compost was not their most significant priority.

Given the findings, TCE determined that significant interest in purchase and use of dairy compost did not exist among the surveyed public entities. In addition, project personnel discovered many barriers facing the dairy compost market. There were already well developed organic markets in the large metropolitan areas and the dairy compost would have to compete with free organic sources typically provided by cities that produce them. Concerns about compost quality also existed as the market was new and poorly understood. Compost producers lacked experience and knowledge to produce quality compost. The public was generally misinformed about composted dairy manure and its proper use. Finally, most public entities had limited budgets to utilize compost.

Project personnel were subsequently tasked to address these barriers (**Table 1**).

To address compost quality concerns and to improve the knowledge of compost producers, dairy compost production and marketing consultants assisted compost producers within the watershed to ensure production techniques were consistent with those necessary to produce a quality

product, and project personnel worked with compost producers to test their composted material and establish a regular testing regime.

To address limited compost use knowledge, TCE worked with TAES to establish field verification studies and demonstration plots in the project area to determine and ensure environmentally sound application and use techniques. As a result, more efficient and sustainable uses of compost by public entities were demonstrated and appropriate literature was developed.

To address cost issues, TCE worked to promote the Composted Manure Incentive Program administered by TCEQ. Through participation in the incentive program, use of compost became more economical for public entities. In addition, TCE faced the challenge of highlighting the economic benefits of compost that do not necessarily have a set value. For example, application of dairy compost can improve soil tilth, water holding capacity, cation exchange capacity and porosity in addition to providing plant nutrients. An inorganic fertilizer, however, can only provide plant nutrients. Yet, economic comparisons with inorganic fertilizers are typically based on nutrient costs alone. Therefore, TCE worked to showcase the non-nutrient benefits of compost in its use demonstrations and publications. Specifically, the Economics of Compost Use fact sheet educates the public on the benefits of compost in addition to nutrient costs.

**Table 1.** Identified dairy compost market barriers, strategies developed to address the barriers and resulting activities to implemented strategies.

| Challenge or Barrier | Strategy | Activities or Results |
|---|---|---|
| Manure feedstock quality | Educate dairy producers on development of manure pack and manure collection procedures | Educated dairy producers (DOPA) to improve manure collection techniques |
| | Educate compost producers on accepting high quality manure | Composters sought manure from dairies that provided better quality material. Composters learned it was acceptable to refuse manure due to poor quality |
| Compost production techniques | Direct assistance to compost producers | Improved compost consistency and quality |
| | Assessment of compost facilities and provide recommendations for improvements | Improvements in compost facilities and production practices (better temperature and processing records). |
| | Compost production workshop | Provided workshop to compost producers on proper production techniques |
| Compost material assessment | Train producers on proper sampling techniques | Provided a compost sampling publication and provided one-on-one assistance in sample collection. Assisted compost producers in joining the STA program – six of the seven are STA members |
| Compost not meeting standards | Improve organic matter content and reduce pH | Conducted the 'Modification of Low Quality Dairy Manure Study' |
| Unachievable standards | Educate TxDOT Regional Engineers on typical characteristics of dairy compost (low organic matter and high pH) | RAA had numerous discussions with TxDOT encouraging the use of dairy manure compost as its use showed no detrimental effects to roadsides |
| Excessive transportation costs | Add carbon source to reduce bulk density | Worked with DOT to allow use of woodchips to decrease density |
| | Reduce amount of inorganic material collected thru manure collection process | Educated dairy producers (DOPA) to improve manure collection techniques |
| Lack of marketing by compost producer | Provide direct assistance to composters in making sales calls; | RAA directly assisted compost producers in making sales calls |
| | Compost Marketing Workshop | Provided sales and marketing training workshop to compost producers |
| Lack of customer service by compost producer | Provide sales literature or use literature for composters to provide to customers | Provided project literature to compost producers as well as offered product specific literature for their own |
| Lack of application equipment (large and small scale applications) | Encourage composters to create a 'bundled' price – compost purchase and application | Compiled list of application services in the area and shared list with compost producers to set up a joint effort |
| | Given no small scale application equipment existed, project purchased a turftiger to apply compost to athletic fields or parks | Used Turftiger for demonstrations conducted at schools/parks. Allowed compost producers to use applicator if necessary for small applications |
| Misconception of composted dairy manure | Provide unbiased information about compost characteristics, specifically dairy compost | News releases, public demonstrations, fact sheets |
| Limited compost use knowledge especially with atypical dairy compost | Implement verification studies in the surrounding area focusing on compost use in various venues; | Field days showcasing verification studies; fact sheets outlining data collected; presentations to citizens, agencies and professional colleagues |
| | Organics Training Workshop | Provided training on a variety of compost use techniques, rates and application methods to County Extension Faculty, thereby reaching general public |
| Budget constraints of potential compost users | Utilize the Composted Manure Incentive Program to promote the use of compost on a trial basis and economically | Several school districts took advantage of incentive payment to apply compost to athletic fields. Upper Leon Soil and Water Conservation District Compost Rebate Program allowed several distributors/wholesalers access to the material |
| | Showcase the additional economic benefits of compost (benefits in addition to nutrients) | Developed Economic of Compost Use fact sheet and demonstrated non-nutrient benefits in compost use demonstrations |

**Compost Education, Demonstration and Marketing Activities**

TCE and RAA worked to expand public markets in addition to TxDOT through education and demonstration activities. Given the variety of organic materials available, it was important to promote the use, incentives and benefits of dairy manure compost.

To kick-off awareness of the Dairy Compost Utilization Program, TWRI developed an informative project brochure. Over 1,500 printed copies were broadly distributed to all project participants (County Extension Offices, dairy manure compost facilities, SWCDs, TSSWCB, BRA, TCEQ, TIAER, TxDOT, and COGs) to further promote the Program.

In follow up to the brochure, RAA and TCE then trained the trainer. In an effort to take advantage of the local Extension network, RAA and TCE provided education to County Extension Faculty on the use of compost. Finally, to address the general public, state-funded entities and the private sector, RAA and TCE implemented a three-fold approach. First, personnel attended trade shows and speaking events. Second, personnel conducted and provided information at compost use demonstrations in conjunction with County Extension educational events. And third, news and magazine articles as well as project fact sheets were developed and distributed.

Training the Trainers: To ensure a knowledgeable staff and a consistent message, a two-day organics training workshop was one of the first events conducted through the Program. County Extension Faculty, District Extension Administrators, Researchers and RAA participated in the training. Participants received educational materials for their own use and distribution at the county level. Presentations at the workshop addressed the use and benefits of dairy compost so that county personnel would be better informed during future outreach and education efforts. The two-day workshop concluded with a demonstration of a top-dress application of compost and a tour of a local compost facility. Through this workshop, local knowledge of dairy compost substantially improved laying the groundwork for a successful project.

Trade Shows and Speaking Events: The Dairy Compost Utilization Program was promoted to public entities at the following trade shows. Information presented at trade shows focused on proper use of compost and the Composted Manure Incentive Payment available to public entities through TCEQ.

- Texas Public Works Association annual meeting in San Antonio
- Texas Nursery and Landscape Association Trade Show in Dallas
- Dairy Compost Seminar hosted by TIBH in Fort Worth (cities present included Carrollton, Farmers Branch, Arlington, Fort Worth and Coppell)
- Texas Section of the American Society of Landscape Architects Conference in Dallas.
- City of Waco hosted a one day discussion to utilize compost as their landfill cover and to establish vegetation around landfill areas
- North Central Texas COG Compost Workshop – Using compost on public right-of-ways and Successful community compost events

- North Central Texas COG Compost Roundtable Discussion at Tierra Verde Golf Club
- Central Texas COG compost workshops in Temple and Cameron (cities present included Cameron, Rockdale, Temple, Killeen, Belton)
- Austin Organic Growers Association in January 2005

Demonstrations: At least ten compost use demonstrations were conducted throughout the project. Many of these demonstrations occurred on public land and the public entity was directly involved in the decision to utilize dairy manure compost as well as the purchase and application of the material. Two types of compost use demonstrations occurred through this project: 1) demonstrations initiated by a city or a partnering agency and 2) demonstrations initiated and conducted in cooperation with County Extension faculty.

TCE actively participated in the compost use demonstrations promoted by cities and partnering agencies by providing fact sheets, information on compost incentive payments and technical expertise on the use and characteristics of composted dairy manure. Photos from some of the demonstrations listed below are posted on the project Web site at http://compost.tamu.edu/photo_gallery.php.

- Compost Use Demonstration at Mary Head Carter Park in Carrollton
- Stormwater BMPs demonstration conducted at Sawyer Ranch development West of Austin
- North Central Texas Council of Government Compost Use Demonstration on Road Right-of-Ways (cities present included Arlington, Mansfield, Plano, Haltom City, North Richland Hills)
- Compost application demonstration at Plano in fall of 2003
- Topdress application demonstration at City of Carrollton
- Use of compost to establish landscapes at the annual Turf/Ornamental Field Day in 2003, 2004, 2005

County Extension Agents worked with various entities in their individual counties to demonstrate and promote the use of dairy manure compost to the public during 2004 and 2005. These county-level marketing and education efforts were conducted both inside and adjacent to the Bosque River Watershed and included County and City Courthouse lawns and landscape areas, city owned gardens, athletic field complexes, public school grounds and greenhouse or nursery operations. **Figure 1** lists demonstration sites by county and type. In many of these demonstrations, photographic data and some visual assessments were collected and posted on the project Website at http://compost.tamu.edu/research.php. Reports for individual demonstrations where data and/or information were collected are included in **Appendix F**.

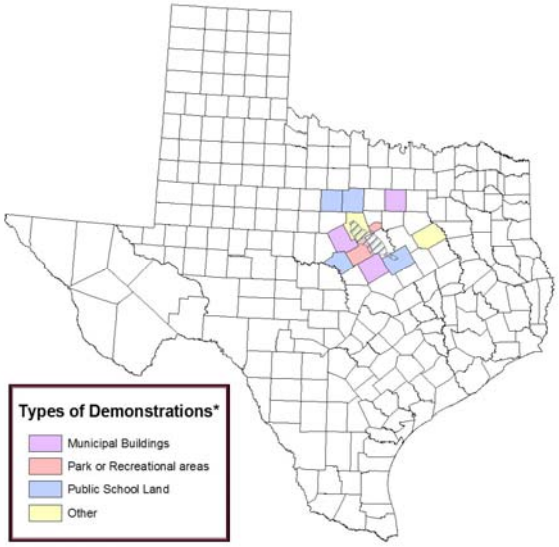


**Figure 1.** Type and location of compost use demonstrations conducted at the county-level.

News Articles and Fact Sheets: Various communication outlets were utilized during the Dairy Compost Utilization Project. RAA distributed articles and literature to professional organizations while TCE distributed similar material to newspapers, local government offices, such as the NRCS, as well as through all appropriate County Extension Offices.

Project related literature was included in the fall 2003 newsletter of the Texas Chapter of American Society of Landscape Architects. The article provided information on the benefits and various uses of compost and addressed the type of compost a Landscape Architect should specify for various uses (**Appendix G**). RAA also provided a 6 article series to the Texas Nursery and Landscape Association monthly magazine (**Appendix H**). This series provided information on (1) compost and its benefits; (2) the STA Program; (3) the DMES Program; (4) compost use in landscaping; (5) compost use by professional growers; and (6) selling compost through landscape suppliers.

TCE utilized numerous local outlets to promote the Dairy Compost Utilization Project. News releases focused on the general use of compost, its availability and the incentive payments available to both public and private entities. Three news releases were produced on the incentive payments throughout the project. Key articles are provided in **Appendix I**.

Many newspapers prefer to develop their own articles, but need leads provided in brief summaries or "story tips" (see example in **Appendix J**). These information pieces developed through the Dairy Compost Utilization Project also were provided to the TCE Agricultural Communications Department, which lists such tips on AgNMore, a daily listserv distributed to approximately 250 daily newspapers in Texas

Five compost demonstrations and uses evaluated as case studies were publicized in a news release format. This format allowed project personnel to send these highlighted compost uses to key newspapers publicizing a local compost use, the overall Dairy Compost Utilization Program and its beneficial incentive payments. Each selected case study showcases a different compost use and typically showcases a different compost user. The following 5 case studies were selected and are included in **Appendix K**.

- Breckenridge ISD demonstrates Dairy Manure Compost on Football Field
- City of Waco sells Dairy Manure Compost to Citizens
- Lovell Lawn and Landscape raises Live Oaks in Dairy Compost
- Santo ISD Utilizes Dairy Manure Compost in Sports Field Management
- Citizens and Compost Beautify Tarrant County Courthouse

Finally, in addition to utilizing media outlets, TCE also developed five fact sheets and education materials throughout the project. Initially, a series of fact sheets was developed to address basic compost uses in horticulture and turf, compost as an erosion control treatment, compost sampling techniques and incentive programs; these publications filled significant voids in the literature. All fact sheets were distributed at trade shows, workshops, various speaking events and compost use demonstrations, and were sent to all agency and county offices for local distribution. Copies of these project fact sheets are presented in **Appendix L** and available on the project website.

New fact sheets were developed and existing fact sheets revised, as necessary (**Appendix M**). These educational materials will support dairy compost producers in their future marketing efforts. However, on numerous occasions, RAA offered to assist compost producers in developing sales literature, product labels or compost use guidance. Unfortunately, no compost producers accepted RAA's offer of assistance and therefore, no compost producer specific marketing tools were developed.

<u>Additional Marketing Efforts:</u> A specific effort dedicated to fact sheet distribution and to compost marketing was a joint Texas sales call effort of TCE and RAA. TCE provided RAA with a list of municipalities within the project region and RAA staff phoned individual contacts on the list to communicate the following: 1) the Dairy Compost Utilization Project; 2) the benefits of compost use within their own land management plans; 3) the incentive payments currently available; and 4) the economic and environmental benefits of compost use. RAA determined interest levels in the use of compost such as specific needs or upcoming projects and denoted these entities as potential leads. Finally, the sales calls also allowed TCE to distribute educational material to the municipalities. A full report of contacts, literature received and potential sales (highlighted in yellow) is included in **Appendix N**.

As a result of these sales calls, over 600 fact sheets were distributed to public entities to promote potential sales. Of the 120 contacted entities, 37 were identified as leads. These leads on potential compost use or projects were communicated directly to the compost producers and the composters were urged to contact the individuals to finalize the compost sale. As a result, it is estimated that over 8,000 CY of composted dairy manure were sold to public entities in follow up to the sales call effort. (TCE did not have direct access to compost sales data. Therefore estimates are based on data provided by TCEQ of compost sales through 2004)

Extensive efforts were also conducted to sustain the TxDOT market as it had become the primary market for dairy compost producers. However, with the introduction of the new standards, most of the producers were not able to successfully bid as many projects and their sales consequently suffered. To assist the compost producers, RAA and TCE worked with TxDOT engineers/inspectors as well as some of the contractors to educate them on typical dairy compost characteristics and its use on roadsides. Specifically, the high pH and low organic matter content of the dairy compost did not negatively affect the performance of the compost in controlling erosion and/or establishing vegetation.

Finally, the individual sales assistance provided by RAA introduced a variety of markets to the compost producers. The following are examples of sales completed as a result of this assistance.

- Cities of Dallas (Parks), Mansfield (Parks), Farmers Branch, Hurst, N. Richland Hills, Waco, Carrollton (erosion control and vegetation establishment)
- City of Carrollton also developed compost use specifications for their city parks
- Dallas Community College
- Elmont Independent School District
- Valley Mills Independent School District
- One compost facility sold 10,000 CY for a sports complex development in Cleburne

Upper Leon Soil and Water Conservation District Compost Rebate Program: In addition to the above efforts to promote the use of compost to public entities, TCE saw major advantages in the use of composted dairy manure on private agricultural lands. First, the dairy compost facilities are located in an area dominated by agricultural production. Second, the high cost of transportation limited distance the compost could economically be transported and therefore, establishment of a local market would be ideal. Third, with costs for inorganic fertilizers increasing dramatically the potential for compost as an economical nutrient source was significant.

However, even with all of these incentives, four issues limited widespread compost use by agriculture.

*Economics*

First, use of dairy compost or any organic amendment may not be economical when compared to inorganic fertilizers within the first year. Rather, to adequately compare the economics and benefits, cost and effects must be considered over at least a 3-year period. Unfortunately, most agricultural producers cannot and do not base decisions on a 3-year economic outlook. The difficulty of quantifying the additional benefits of compost also was a factor. While compost does provide physical, chemical and biological benefits to the soil and plants, these benefits do not have a set value and therefore, typical economic comparisons between compost and inorganic fertilizer were based on nutrient costs alone.

*Behavioral Change*

Second, the use of dairy compost in agricultural applications, particularly on a large scale, was a behavior change for most individuals. Factors such as the environment, weather, and cropping and production scheme all must be considered with any amendments in agricultural

production. Given application is often not included with purchase of compost and a nutrient management plan is recommended, even more planning is required to apply compost on agricultural land. Thus, producers must allow more time and effort to utilize composted dairy manure in their production scheme.

*Raw manure was easily accessible and inexpensive*

Third, given the large number of dairies in the area and the youth of the composting program, agricultural producers, who did apply organic amendments, generally utilized raw manure supplied by local dairies due to lower cost.

*Lack of application equipment*

Finally, compost applications on agricultural land require specialized equipment and little or no equipment was available in the area. Further, inorganic fertilizer, could be purchased and applied with a single order. Despite encouragement by project personnel, very few compost producers provided application services with the purchase of the composted dairy manure.

To address the issue of economics, TCE, in collaboration with the Texas State Soil and Water Conservation Board (TSSWCB) and the local Soil and Water Conservation Districts (SWCD), established a private producer incentive payment. It was anticipated that by reducing the cost of compost, agricultural producers would be more likely to utilize the material on a trial basis. This would then lead to behavior change and more compost use, creating incentives for development of compost application services. The program utilized the local SWCDs as compost purchasers for the general public. Specifically, the three SWCDs involved in the program included the Upper Leon, Cross Timbers and the Hamilton-Coryell Districts. By utilizing the SWCD, a compost producer was able to sell composted dairy manure to private producers at a reduced price. The Upper Leon SWCD was responsible for the program, which became known as the ULSWCD Compost Rebate Program.

Requirements for the program followed the Composted Manure Incentive Payment program. Additional requirements included: 1) limiting the amount of compost purchased by a single buyer through the program to 4,000 CY, 2) applications of the compost had be made outside of the Bosque River Watershed to support implementation of the TMDL manure export target, and 3) agricultural producers had to obtain a TSSWCB Certified Water Quality Management Plan before applying the compost. Unfortunately, little to no activity occurred through the program during its first year. While much interest was expressed, the complexity of the program and time limitations hindered program advancement. Therefore, program requirements were revisited in August, 2005 and the ULSWCD Compost Rebate Program was revised to include compost distributors, baggers, etc. and agricultural applications only required a TSSWCB Certified Nutrient Management Plan.

The ULSWCD shared all transactions with TCE through April 30, 2006. A summary and a complete list of purchases are provided in **Figure 2 and Table 3**, respectively.

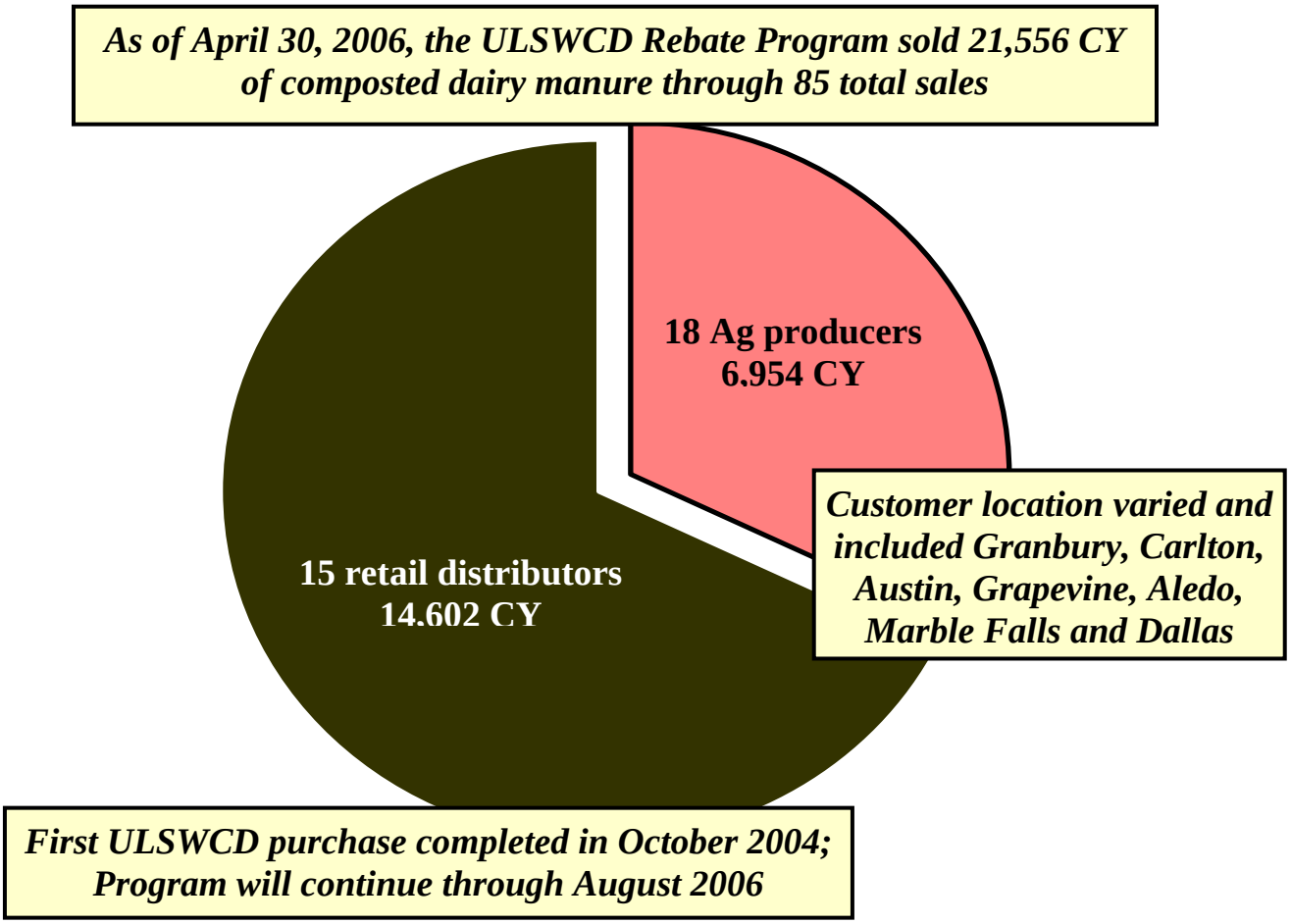


**Figure 2.** Summary of ULSWCD Compost Rebate Program purchases.

**Table 2.** Total purchases completed through the ULSWCD Compost Rebate Program.

| Customer | CY | Customer Type | Compost Use | Location |
|---|---|---|---|---|
| Accent Rock & Landscape Material | 35 | Distributor | Retail | Granbury |
| Adolf Gebert | 100 | Producer | Land application | Carlton |
| Backbone Valley Nursery | 130 | Distributor | Wholesale/Landscape | Marble Falls |
| Circle J Backhoe | 1267 | Producer | Land application | Stephenville |
| Clark Gardens | 65 | Distributor | Retail | Weatherford |
| Clear Fork Materials | 2027 | Distributor | Bagged distribution | Aledo |
| Dunbrokus Ranch | 280 | Producer | Winter Pasture | Carlton |
| Ed Pare | 350 | Distributor | Retail | De Leon |
| Eddie Kimmel | 250 | Distributor | Retail | Comanche |
| Geo Growers Inc | 4000 | Distributor | Retail | Austin |
| Gerald Burns | 100 | Distributor | Retail | Comanche |
| Greg Mitchell | 100 | Producer | Land application | Comanche |
| Growers Select | 195 | Producer | Land application (Ryan, OK) | Mission |
| Joe Paul McCullough | 2460 | Producer | Land application | Comanche |
| John Moore | 80 | Producer | Land application | NA |
| Jr. Jones | 50 | Producer | Land application | Gustine |
| Jr. Stephens | 400 | Producer | Land application | Gustine |
| Karan Kirk | 126.8 | Producer | Land application | Gorman |
| Larry Adams | 350 | Producer | Land application | NA |
| Lilly Day Gardens | 50 | Distributor | Retail | Burnett |
| Lindsey Landscaping | 50 | Distributor | Retail | China Springs |
| Mark McCullough | 200 | Producer | Land application | Gustine |
| Natural Gardener | 2300 | Distributor | Bulk Distribution | Austin |
| Nicholson Farms | 235 | Producer | Land application | Gustine |
| Pat Bays Construction | 50 | Producer | Land application | Dublin |
| Ronnie Lamb | 50 | Producer | Land application | Gustine |
| Scotts Company | 4000 | Distributor | Bagged distribution | Cresson |
| Sid Waynick | 550 | Producer | Land application | Carbon |
| Soil Building Systems | 776 | Distributor | Retail | Dallas |
| Steve Turknett | 324 | Producer | Hay & Pecans | Grapevine |
| Todd Denman | 200 | Producer | Land application | Carlton |
| Tomlinson Ball Field | 220 | Distributor | Sportsfield application | Granbury |
| Wolfe Landscape | 185 | Distributor | Bagged distribution & topsoil | Waco |

The Dairy Compost Utilization Web site was a major marketing and educational tool developed and utilized in the project. All fact sheets, practice verification studies information and results, compost demonstrations information and results, PowerPoint presentations and useful publications or links from other projects were posted on the Project Web site for public access. Many of these documents were posted in Adobe Portable Document Format so they could be easily downloaded, simplifying and expanding availability.

In May of 2004, user statistic software was added to the project Web site to track usage. The number of unique users per month steadily increased throughout the project. **Figure 3** graphically displays the increase in number of unique visitors from May 2004 through December 2005. Another advantage of the user statistic software was the ability to determine which Web pages were most utilized and downloaded. **Figures 4** and **5** display the unique hits per page-type for 2004 and 2005, respectively. Data for 2006, although not presented here as it is still in progress, is similar to the 2005 data. The photo gallery remains the most visited page. In second in number of visits for 2006 are the fact sheets with the practice verification studies in a close third.

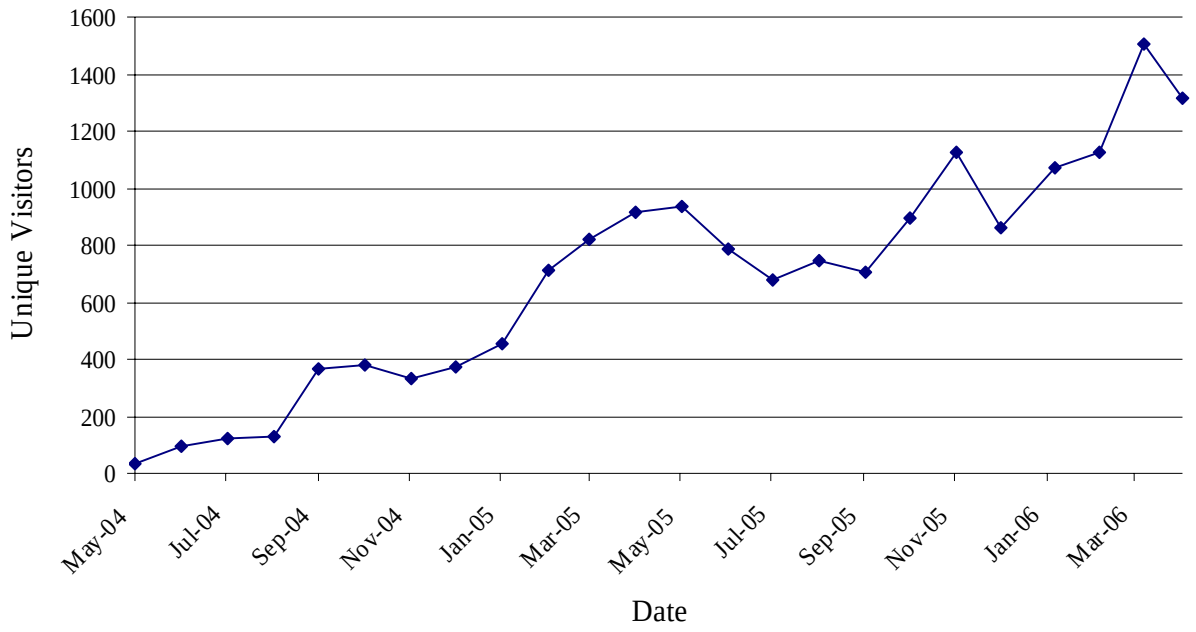


**Figure 3.** Number of unique visitors to project Web site from May 2004 to April 2006.

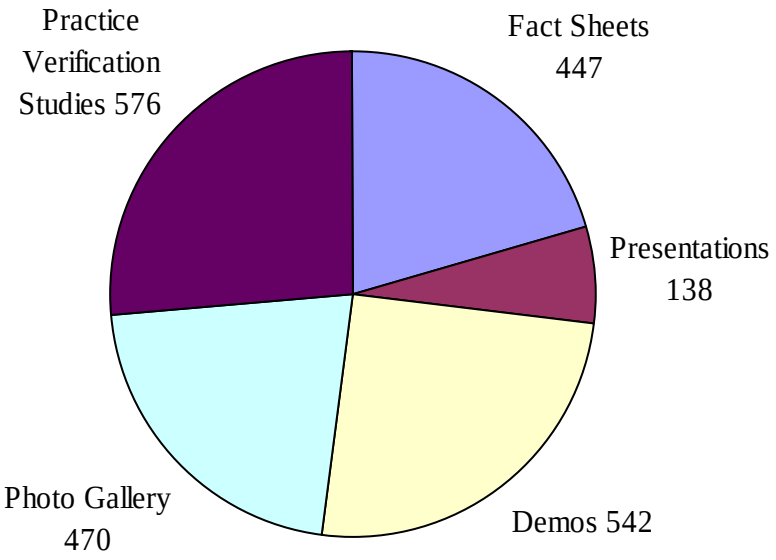


**Figure 4.** Type and number of sites accessed in 2004 on the Project Web site.

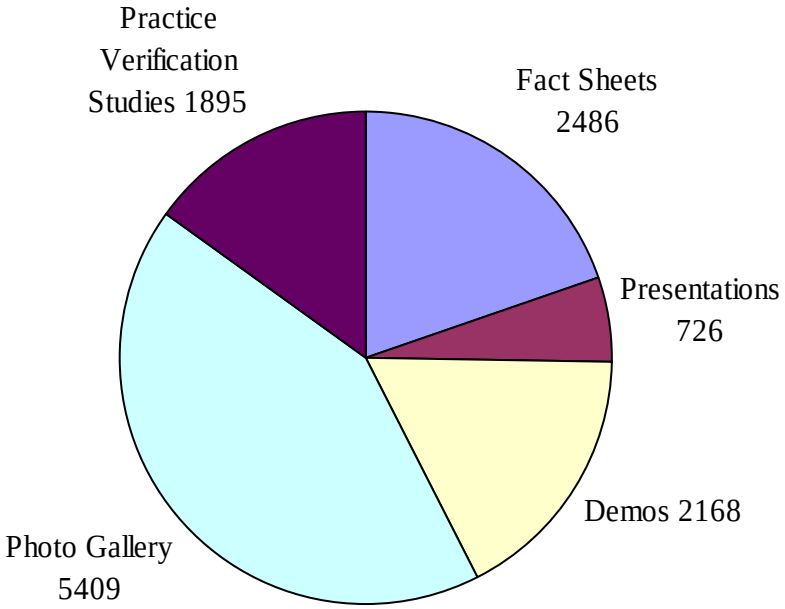


**Figure 5.** Type and number of sites accessed in 2005 on the Project Web site.

## Compost Producer Education and Assistance

Each compost facility in the project area was evaluated and reviewed in an on-site visit conducted soon after initiation of the project. Following the evaluation, composters were provided an assessment of their facility, production practices and market plans. This first step also introduced the compost producers to the project, which opened lines of communication for all involved.

Another benefit of the compost facility visits was RAA and TCE became familiar with the specific areas where compost producers needed the most assistance. As a result, RAA and TCE hosted two workshops.

The first workshop conducted in the spring of 2003 addressed compost production. Specifically, compost producers were taught the value of a high quality manure feedstock and project personnel encouraged the compost producers to work with dairy producers to improve the quality of raw manure delivered to the compost facilities. Secondly, the workshop addressed sound record keeping skills, equipment needs, product sampling techniques, compost quality characteristics and various end use or application options.

The second workshop conducted in the fall of 2003 addressed compost sales and marketing. Compost producers received a Marketing Training Manual, which provided the basics of marketing an organic product and the potential markets in their area. In addition, compost producers were encouraged to jointly work together creating a stronger market for dairy compost.

Throughout the project, numerous contacts between TCE and the composters and between RAA and the composters occurred. Compost producers inquired about various issues including proper procedures to produce compost, information associated with acquiring and obtaining TCEQ permits requirements and the process surrounding the private and public rebate programs. TCE and RAA also served as the source of information about TxDOT specifications and participating in the TxDOT program. In addition, composters received assistance in developing their markets. RAA and TCE worked with the composters by participating in sales calls and providing the composters with sale leads. For example, two of the compost producers were able to secure a bid with TxDOT for a 27,000 CY job as a result of RAA's marketing assistance.

One of the most important long-term accomplishments of the Dairy Compost Utilization Project was facilitating participation of the composter producers in the Seal of Testing Assurance (STA) Program. TCE and RAA assisted composters in meeting the requirements of the STA Program and developed and distributed a fact sheet on STA sampling procedures (more information on Project Fact Sheets is provided in the Compost Education, Demonstration and Marketing Activities Section). Prior to the Project, none of the dairy compost producers were STA certified or even had a sound compost sampling protocol established. As a result, they did not have a clear understanding of product quality or appropriate markets or end uses for their products. Participation in the STA program provided composters with a better understanding and confidence in product characteristics, which enhanced their marketing and use strategies by enabling them to identify the most appropriate customer base. In addition, participation in the

STA Program also enabled composters to continue to pursue the TxDOT market as TxDOT adopted STA as its standard in 2003.

While the STA program ensures testing uniformity, the analytical costs are relatively expensive and quite often beyond a compost producer's means. In contrast, service laboratories, such as the TCE-SWFTL (Soil, Water, Forage Testing Laboratory located at Texas A&M University), are structured to process large numbers of samples and offer more "analytical packages" than specific analyses for individual samples. Test results are used to make research based recommendations relating to crop fertilization needs, forage and hay quality, suitability of water for irrigation, etc. Because of the high throughput, analytical costs are less expensive than those charged by labs adhering to strict (TMECC) procedures. The reduced analysis costs of a service type laboratory provide a means by which compost producers can assess their material on a more frequent and lower cost basis.

However, the question of how each laboratory's results compared did exist. And the organic matter improvement study provided the opportunity to evaluate the two laboratories and their analytical procedures. Within the organic matter improvement study, compost samples were analyzed through both a service laboratory (SWFTL) and a STA Certified Laboratory (Soil Control Laboratory). Both laboratories provided standard analyses on samples and sample results were statistically compared between the two laboratories. With the exception of organic matter, there were significant differences (at the 95% level) in the nutrient levels (N, P, Ca and Na), pH and soluble salts determined by the two laboratories. For organic matter, there were no significant differences between labs even though two distinct procedures were used to estimate organic carbon levels in the samples.

The results of this comparison indicate composters could effectively use data provided by SWFTL as management decision aids and in assessing the quality and potential applications of their products in less time. Service laboratories such as the TCE-SWFTL can provide good assessments of compost quality at a fraction of the cost. Through the Dairy Compost Utilization Project, these types of services were introduced to the compost producers and as a result, composters adopted a more frequent testing program and were able to assess and judiciously modify various production techniques and product amendments.

Near the end of the project, TCE and RAA conducted a final assessment of the compost facilities to document improvements in production practices, marketing and compost quality. A complete report of each facility's initial and final assessment was provided to the individual composters (**Appendix A**).

## Compost Quality Assessment

During initial compost facility site visits, TCE discovered that the dairy manure compost being produced was atypical for a compost product. This appeared to be due to a lack of consistency in production practices and problems with manure feedstock. The compost was denser, had high inorganic content and was very heterogeneous in nature. Therefore, project personnel visited dairy facilities within the watershed to evaluate manure collection practices. Todd Williams, an associate of RAA, visited Gustine Compost and associated contracted dairy facilities. Both groups determined that the primary source of inorganic contamination was related to dairy manure collection procedures, whether the manure was collected by mechanical scraping or through vacuuming. In an effort to reduce soil contamination during manure collection, TCE reinforced their education efforts (the Dairy Outreach Program Area and the Dairy Waste Management Handbook) to promote the development and maintenance of a manure pack. As a result, composters reported that the quality of manure received from dairies improved throughout this project.

These initial site visits also revealed that compost producers lacked experience in production practices and knowledge in methods for producing a consistent product. In addition, they had little or no knowledge of proper compost sampling procedures, means for obtaining a sample analysis, or the value of tracking material characteristics. Prior interest in product testing had been limited by the availability of a thorough sample analysis (i.e. the Solvita Maturity test was the only available test at project initiation). Although, the introduction of the STA Program provided compost producers with a means to obtain a complete sample analysis, the analysis costs exceeded their budgets. So, although compost producers and TCE were receiving inquiries as to the value, characteristics and proper use of dairy compost, this information was unknown. Therefore, knowledge of compost quality (sampling and analysis of compost) was required to determine a starting point and gauge the impacts of the project.

While TxDOT was shifting to TMECC as their standard methodology, the unique nature of this dairy compost precluded the assumption that standard methodology would provide adequate results. Specifically, temperatures utilized in the Loss on Ignition (LOI) method can cause clay minerals (like those in central Texas) to lose structural water, which will increase the total sample weight loss leading to an overestimation of organic matter content (Schumacher 2002). To possibly avoid over estimating organic matter content, the sample can be pre-treated (as noted in the TMECC methodology) using HCl. However, the use of HCI may dissolve part of the organic matter leading to an underestimation of the organic matter content and the potential need to use a correction factor. Interestingly, ASTM method D 2974 allows for ashing the sample at 750°C for peats and other organic soils, such as organic clays, silts, and mucks (ASTM, 2000) presumably based on the assumption that no carbonates and little to no mineral matter are present in the sample that could influence the resultant organic matter content. However, the dairy manure compost samples contained substantial mineral matter and thus, an assessment and modification of the LOI procedure was required.

The TCE Soil, Water and Forage Testing Laboratory (SWFTL) ran multiple analyses (**Table 2**) on dairy compost collected at various facilities to determine what modifications were needed to properly and correctly analyze the atypical dairy manure compost. Per observations by SWFTL,

the LOI method as written in the TMECC methodology failed to provide complete oxidation of the sample and thus over estimated organic matter content. The repeated modified analysis presented in **Table 2** varied in both temperature and time. Consistent results were finally obtained on 4/1/03 and 4/9/03 when samples were oxidized at 650° (Pitt et. al. 2003).

**Table 3.** Results of multiple analyses conducted on dairy compost samples at project initiation.

| Lab # | Organic Carbon Modified Methodology | | | | Loss on Ignition (%) |
|---|---|---|---|---|---|
| | 2/25/03 | 3/4/03 | 4/1/03 | 4/9/03 | 4/8/03 |
| 37385 | 9.38 | 16.2 | 9.91 | 10.04 | 24.26 |
| 37386 | 8.27 | 14.3 | 7.79 | 7.88 | 18.68 |
| 37387 | 7.98 | 13.8 | 10.77 | 10.74 | 23.95 |
| 37388 | 6.50 | 10.2 | 8.29 | 8.33 | 19.08 |
| 37389 | 6.71 | 11.6 | 6.84 | 6.83 | 16.08 |
| 37390 | 3.97 | 6.8 | 4.85 | 4.83 | 12.40 |

At this early point in the project, the applied research study QAPP was under development and so separate funding sources were used to support analysis costs. This enabled the project to continue to move forward by providing critical information regarding dairy compost product quality and characteristics.

Cost to compost producers also led TCE to not utilize an STA laboratory in the beginning of the project. While project funds would have sufficiently funded STA analysis, the overall project goal was to create a sustainable program for dairy and compost producers. In evaluating and improving compost methodology at the SWFTL, the Laboratory was able to provide information to compost producers about the quality of their material on a more frequent basis and within their operational means. Further, because of the large quantities of composted dairy manure available, a targeted end use of the material at project initiation was for agronomic purposes (i.e. horticultural or agricultural applications). Agronomic laboratories, such as SWFTL, typically provide recommendations of application rates utilizing crop response data and specified yield goals. Thus, SWFTL was an ideal candidate to provide compost sample analysis at project onset. By expeditiously investigating and discovering major issues regarding compost quality, TCE was able to move forward with project activities and provide assistance to producers to address problems related to proper manure collection practices, agronomic application rates, proper production and monitoring practices and proper selection of feedstock and/or ratios of blends.

In contrast to a service laboratory, an environmental laboratory, such as Soil Control Laboratories, typically provides information about compost standards, the range in which a sample falls for meeting desired specifications and possible techniques to amend the production process or the sample, if necessary, to meet standards. In addition, an environmental laboratory will provide a general use recommendation; however, the recommendation is not typically based on crop response data or specified yield goals. As project efforts moved forward and compost standards such as the STA Program progressed and grew more prevalent within several of the

potential markets, the use of an environmental laboratory became necessary and beneficial to assess compost quality.

Thus, upon approval of the amended and revised QAPP in 2005, TCE conducted two additional compost sampling trips to assess compost quality through an STA Certified Laboratory, namely Soil Control Laboratory. TCE along with TCEQ personnel at some locations collected samples from Producers Compost, O'Neals Compost, Dairy Cow Compost and Organic Residual Reclamation in August, 2005 and from Bosque River Compost and Organic Residual Reclamation in September, 2005.

Results of compost assessment were shared with TCEQ both as "blind" samples (**Appendix B**) and as identified samples. Each compost facility received an official STA report of their sample along with a brief summary of the material description provided when the sample was collected. Further, as requested, the composters also received a complete set of results. Each sample was left unidentified in the full report to protect the privacy of each facility.

It should be noted that none of the samples met current TxDOT specifications. Samples failed due to the high pH, low percent organic matter, or both. Failure to meet TxDOT specifications was a common concern for compost producers in the region typically because of inherent problems in feedstock quality. Elevated inorganic material levels (primarily sand) decrease the organic matter content, increase bulk density, and contribute to an elevated pH. To produce quality material that meets the TxDOT specification, dairy composters have two feasible alternatives: 1) improve the quality of the manure feedstock or 2) add a carbon source to the compost.

*Improve quality of manure feedstock.*

Simultaneous collection of bedding material along with manure is the key issue in improving manure feedstock quality. At project onset, most dairy producers utilized sand as their bedding material due to availability and cost. Through the project, compost producers began encouraging dairy producers to utilize organic materials as bedding. While manure from dairies that bed on an organic material is preferred and even paid for in some cases, many dairy producers still utilize sand. However, project information and pressure from compost producers has motivated more dairies to begin use of organic bedding materials, such as cotton burrs, which will be highly beneficial as the composting program moves forward.

Another strategy for improving the dairy manure feedstock is to utilize only separated dairy manure. Unfortunately, only a small percentage of dairy producers have manure separation systems. Therefore, while this is a very reliable and confirmed method to increase organic matter content and decrease pH, it is not a feasible option for every compost producer in the watershed.

Through the project, TCE and RAA worked with compost producers to educate them in the selection of only high quality feedstock. Compost producers were encouraged to be in close communication with the dairies to 1) further educate the dairy producer on what type of material the composter required and 2) create a business relationship for future interactions, even offering payment for higher quality material.

*Add a carbon source to the compost.*

An alternative strategy for improving compost quality is to add a supplemental organic carbon material to the manure prior to composting or to the finished compost. By adding a carbon source, organic matter content may be increased (depending on rate of addition) and the final product typically becomes less dense. Lowering density reduces transportation costs per unit volume. Throughout the project, transportation costs were a major barrier to market development especially when competing for markets in larger urban centers situated more than 60 miles away. This second alternative led to the Compost Quality Improvement study conducted to assist compost producers in determining which carbon materials and rates of addition would enhance organic matter content in the compost to meet required standards. This study, conducted in 2004 and 2005, is discussed in detail in the next section.

Granted, meeting TxDOT standards was a primary focus in compost quality assessment due to the large market share available for compost producers. However, it was not the only objective of compost testing. The initial testing was a critical component in the project to develop and convey a basic understanding of the issues facing compost producers. It created the basis for change and improvement in production practices. The continued testing and assistance in improving production techniques to develop a consistent product led to introduction and sustained life of markets outside of TxDOT.

Over time participation in the TxDOT market depended more on availability of material and proximity to the job site, which led to fewer direct sales of dairy compost to the TxDOT. Therefore, dairy compost producers were encouraged to identify niche markets that each could fulfill on an individual basis. Specifically, some of the compost producers were able to provide a higher quality material for topdress applications on golf courses or sportsfields; yet, some of the compost material continued to contain greater levels of inorganic material, which were more appropriate for agricultural applications or compost manufactured topsoil. Overall, the transportation costs and the high inorganic material in the compost led project personnel and compost producers to identify a set of potential markets during the Dairy Compost Utilization Program. These markets were communicated to compost producers and each was encouraged to market their composted material as appropriate. The following is a list, although not a complete list, of markets identified, pursued or captured throughout the project.

*Topsoil and topsoil blends*

The high levels of soil inherently mixed with the dairy manure compost lend the material to be an ideal topsoil source for landscaping services and nurseries. Through the Upper Leon Soil and Water Conservation District Rebate Program, numerous gardening centers and bulk suppliers purchased dairy manure compost to distribute to consumers for this purpose. The dairy compost was sold in bulk and bagged as a stand-alone product or mixed with additional organic material.

*Topdress applications of golfcourses or sportsfields*

A common disadvantage of traditional dairy compost produced from lot dairy manure is the contamination of rocks or small pebbles found in the finished product. While these pebbles are typically considered inconsequential for most uses, they can create problems for superintendents of sportsfields and/or golfcourses. These landscapes are mowed frequently

and often with a reel type mower. Even the smallest pebbles can damage the blades of the mowers. Some specially processed compost, however, can be appropriate for such topdress applications. Specifically, one compost producer grinds the composted dairy manure to a fine powder. Another compost producer utilizes only separated manure as the feedstock, which leads to a fibrous, nitrogen-rich, material that is ideal for topdress applications.

*Sportsfield Construction*

As noted in the Project fact sheet, "Using Organic Matter to Improve Sportfields", the key to successful sportsfields is to establish a healthy soil when constructing the field. Through the Dairy Compost Utilization Project, the compost was marketed to the City of Hamilton in the construction of their City Recreational Facility. The city took advantage of the rebate offered by the Leon Bosque RC&D to purchase the dairy compost.

*Rangeland revegetation*

Increased troop numbers and reduced training land area caused increased erosion and sediment loss on the Fort Hood Military Training Base. The use of compost on these denuded lands provided much needed nutrients and topsoil to reestablish vegetation, thereby preventing erosion and sediment loss in runoff events. Through efforts associated with the Dairy Compost Utilization Program, various rates and timings of dairy compost applications were evaluated. Improvements in vegetation and soil health were demonstrated and therefore the use of dairy compost on Fort Hood became a viable market. In other revegetation activities, dairy compost can be applied to establish native grasses following brush control activities. For example, the Central Texas Cattleman's Association through the Leon River Restoration Project, worked with individual landowners to clear undesirable vegetation from the Leon River Watershed and improve habitat for endangered species. Both types of revegetation activities can benefit from applications of dairy manure compost.

*Nursery Potting Mixes*

Through a demonstration with the Lovell Lawn and Landscape Company, the use of dairy manure compost as potting soil mix proved to be beneficial in reducing water use and plant health over the traditional non-dairy compost mix. As a result, Lovell Lawn and Landscape continued to utilize the dairy manure compost as a potting mix and as bedding material for landscape projects. Dairy compost producers were encouraged to market their material as a potting mix to local nursery producers.

*Compost Manufactured Topsoil*

A specified product by the TxDOT is compost manufactured topsoil, which is typically blended at the job site. However, with the amount of soil material mixed with the dairy compost, it was possible for dairy compost producers to market their product as pre-blended manufactured topsoil for the TxDOT jobs.

*Agricultural applications*

Through verification studies performed at the Research and Extension Center in Stephenville, the use of dairy compost was demonstrated to yield similarly or better than inorganic fertilizers when applied to irrigated corn silage and coastal Bermudagrass. Given these data, the location of the dairy compost facilities (an area dominated by agricultural production),

the high cost of transportation (distance the compost could economically be transported was limited), it seemed ideal to promote and establish a strong market for agricultural applications of compost. And although the market did not flourish as personnel anticipated, the number of applications did increase over the project period and with this increase, it is anticipated more agricultural producers in the area will adopt the practice of dairy compost application in their management systems.

Most importantly, at project completion, dairy compost producers had learned the value of establishing a sound compost testing program as a quality control and marketing tool. The ideal strategy for compost producers to maintain high quality compost production involves 1) participating in the STA program and testing material through an STA Laboratory on the appropriate schedule and 2) intermittently utilizing a service laboratory, such as SWFTL to monitor compost quality on a more frequent basis. **A sound and successful market is based on a consistent product and knowledgeable sales people.** By utilizing both types of laboratories, composters are able to affirm the quality of the material being produced at their facility as well as provide information to consumers about the use of their product.

**Compost Quality Improvement Study**

Given the dairy manure compost produced in this region typically failed to meet the organic matter content standard of 25 percent and the pH standard of 8.5, a Compost Quality Improvement Study was proposed in 2004 to evaluate the addition of carbon sources to finished compost.

While the addition of carbon materials can improve compost quality, it also adds production cost. However, importance of the TxDOT market and the need to meet TxDOT specifications was a major concern for dairy composters.

As a first step, RAA completed the Organic Matter Improvement Survey, where potential sources of organic carbon were identified. Results were communicated to the composters who were encouraged to contact the entities with carbon sources to set up their own system. A full report and tabular results of the Organic Matter Improvement Survey can be found in **Appendix C**.

Three carbon sources, woodchips, sawdust and peanut hulls, identified as abundant and available in the area by the survey were obtained and tested for utilization in the organic matter mixing study. Several sources of dairy manure compost were then sampled and tested to determine their status in meeting the TxDOT specification. All compost samples and organic carbon samples were sent to an STA approved facility, the Soil Control Laboratory, in Watsonville, CA and to a service laboratory, the Soil, Water and Forage Testing Laboratory, in College Station, TX. All 4 compost sources initially failed the TxDOT specification based on percent organic matter and 3 of the 4 sources failed based on high pH. The 4 sources of compost material utilized in the mixing study included Gustine Compost, Producers Compost, O'Neals Compost and Dairy Cow Compost. Each carbon source was mixed with the composted dairy manure at 2 ratios, 10% and 30%, and then tested at 0, 30, and 60 days after mixing.

All data from the organic matter mixing study was entered in excel format, statically analyzed and interpreted (**Appendix D**). In this study, significant differences existed in organic matter contents, pH, total N and C:N ratios between the four compost sources tested, thereby, high degrees of variation existed within the data. Adding 10% and 30% (v/v basis) of three high carbon materials (peanut hulls, sawdust and wood chips) resulted in significantly higher organic matter levels when analyzed between the four compost sources but *only the higher (30%) rates of the amendments increased organic matter contents across compost sources.* While the physical mixing of high carbon amendments with low quality dairy manure composts can increase organic matter content and alter C:N ratios, it will have limited effects on pH, soluble salts and nutrients. With the exception of the 30% rate of peanut hulls (which significantly lowered pH and increased total N between compost sources), carbon sources had no significant impacts on the parameters tested between or across compost sources. When considered across all compost sources and high carbon amendments, adding 10 and 30% of the amendments to the composts increased the mean organic levels from approximately 9.8% to 11.3% and 14.6%, respectively. *On average, the blended materials met the modified (>10%) but not the base (25-65%) TxDOT specification for organic matter content.*

***Blending larger rates of high carbon amendments may be required to meet the TxDOT specification for organic matter content. However, if adding higher rates of the amendments are cost prohibitive, a better application of low quality composts may be their use in the preparation of CMTs or ECCs.*** Other studies have shown blending high carbon constituents with dairy manure prior to composting (Michel, et al, 2005) is also a viable option for improving compost quality.

By comparing the STA certified laboratory results obtained in the Compost Quality Improvement Study with the service laboratory results, the study also determined the value of the two types of laboratories for the dairy manure composting industry. Data comparisons in the study demonstrated that values for selected nutrients (total N, P, Ca and Na), pH and soluble salts differed significantly between the two laboratories, yet there were no differences in organic matter levels. Thus, service laboratories can be effectively used to provide compost facility operators with more frequent, low cost preliminary assessments of compost quality for use as management decision aids, particularly when modifying organic matter content. Because STA-TMECC results are often required and necessary to market compost products and provide compost users with information that equitably compares product qualities, determines use rates, etc., compost producers and retailers can rely on STA Laboratory results as a scheduled test to monitor production and product consistency.

## Practice Verification Studies

One of the most important and lasting accomplishments of the Dairy Compost Utilization Project was the development and completion of several practice verification studies utilizing dairy manure compost. Prior to the project, little or no scientific data existed regarding the effective use of dairy manure compost. This project supported efforts to evaluate the use of compost in horticultural, agricultural and roadside or construction applications. The 7 studies completed during the project included:

1. **Establishment of a Newly Constructed Landscape with Dairy Compost.** Construction of new homes and businesses is a continuous process in rapidly growing urban areas such as the Dallas metroplex. Large sections of land are quickly converted to residential homes, business offices, or strip malls. Post-construction landscaping is usually approached from only the plant-selection viewpoint. Little thought or effort is devoted to soil preparation prior to planting the landscape and unfortunately, the soil has usually been severely disturbed and compacted by vehicles and soil-moving machinery. Although ornamental plants and turfgrass planted in this disturbed soil may perform well in the short term due to abundant watering and fertilization, they frequently decline over time when heat and drought stress become prevalent. The effects of mixing low to high rates of compost with the soil prior to establishing the landscape were evaluated in the newly constructed landscape study at Dallas.
2. **Compost as a Bed Amendment under Shaded Conditions.** Many urban compost applications occur in already established planting beds. These beds typically coexist with mature trees and shrubs. Therefore, compost is applied directly in the bed under shady conditions and typically as a thick mat leading to abnormally high nutrient applications. Application of dairy compost under these conditions was evaluated in the shade study at Dallas.
3. **Establishment of Turfgrass on Compost Amended Soils.** Turfgrass establishment is a primary component of landscape development following the construction of a new home or business. Sports and recreation fields typically require even more intense management to sustain performance. Therefore, studies to evaluate the response of turfgrasses to dairy compost were conducted in conjunction with the newly constructed landscape study.
4. **Use of Compost on Coastal Bermudagrass.** Improved Bermudagrasses are a dominant agricultural crop throughout the region. These studies evaluated rates, timing and economics of compost use for forage Bermudagrass production.
5. **Compost use on Irrigated Corn Silage**. While produced on a limited number of acres in the region, corn silage requires significant amounts of plant nutrients. These studies evaluated rates of compost for optimum production of corn silage under irrigated conditions.
6. **Establishment of Jose Tall Wheatgrass with the use of Compost.** A wide variety of animal production systems in the project area utilize forages and range as their basis for animal nutrition. These include dairies, beef cattle, goats, sheep and wildlife. However, little or no information existed on the use of dairy manure compost in various forage systems.
7. **Evaluation of Soil and Water Quality following Compost Applications for Erosion Control.** Dairy compost is commonly used to help revegetate roadsides and construction areas and is applied as a supplement to erosion control mixtures. While these efforts

have largely been successful, questions exist regarding nutrient loads and runoff potential from these applications. To provide a scientific basis for decision making in the use of compost in these applications, studies were conducted at the Riverside Campus near Bryan-College Station.

All studies were conducted between 2003 and 2005. Study progress, data and photographs were posted on the Web site as the projects progressed. All presentations, posters, etc. related to these studies were posted on the Web site. Final reports for each study are included in **Appendix O**.

## Additional Projects

Supplemental projects that supported the efforts of the Dairy Compost Utilization Project also occurred during the project period. Some of these were supported by additional TCEQ funds, while others received funding from various sources, both state and federal. Results and information collected in these studies supported and enhanced the Dairy Compost Utilization Project. Several key examples are presented below.

Increased troop numbers and reduced training land area have caused increased erosion and sediment loss on Fort Hood. Many of the training landscapes have minimal vegetation and are almost void of quality top soil. Many areas will require multiple applications of compost and many years of management to completely reclaim the land. To evaluate the best practices for land reclamation, TWRI and personnel at the Blacklands Research and Extension Center in cooperation with NRCS have been utilizing dairy compost and other best management practices such as ripping and gully plugging to establish vegetation and reduce soil erosion and sedimentation. These activities, when used in combination, minimize soil loss and stabilize the landscapes for future activities.

TCEQ supported some of the compost application efforts on Fort Hood through supplemental project funds provided in 2004. A contract amendment to the Dairy Compost Utilization Project provided for the purchase, transportation and application of dairy compost along abandoned tank trails at Fort Hood. Six different dairy manure compost producers supplied material for these applications and vegetation was established along the tank trail. Comparison between types of material was not conducted as the study site conditions precluded development of a statistical plot layout. Regardless, site evaluations indicated that application of dairy compost was beneficial. The tank trails and compost were stable even during heavy rainfall immediately following application and all application areas established vegetation. Unfortunately, a common problem with any Fort Hood application, the cattle quickly found the fresh vegetation and compromised data collection on compost performance. Photo documentation was collected and a full report is included in **Appendix P**.

TWRI also met with Central Texas Cattleman's Association and the Rangeland Ecology and Management Department to discuss and expand the use of dairy manure compost in their project, the Leon River Restoration Project. This project, supported by federal, state and local funds, worked with individual landowners to clear undesirable vegetation from the Leon River Watershed and improve habitat for endangered species. Dairy manure compost was utilized on several of the project sites to establish native grasses and reduce erosion once the undesirable vegetation was cleared.

Texas Agricultural Experiment Station personnel in the Soil and Crop Sciences and Biological and Agricultural Engineering Departments received multiple sources of funds to evaluate the use of compost and manure to producer turfgrass sod. One hypothesis of this project is that excess phosphorus in the Bosque River Watershed could be exported in the form of sod produced with manure or compost. Researchers evaluated nutrient runoff and leaching from both compost and manure when used as a base for sod production. In addition, the researchers worked with local

sod producers to include this practice in their production schemes. **Appendix Q** includes a summary of the research evaluating compost use to sod production.

TWRI has cooperated with the Brazos River Authority in their efforts to administer the North Bosque Watershed Coordination Project and develop a Watershed Protection Plan for the Bosque River. Communication with the Leon-Bosque RC&D was also established to effectively market dairy compost for topdress application to sports fields. Another effort which involved local dairy cooperators and TIAER, worked to demonstrate the removal and/or reduction of phosphorus from dairy effluent resulting in less phosphorus applied to waste application fields.

Each effort, although individually implemented and sometimes geographically focused, is working to improve the water quality in the North Bosque River Watershed.

# ISSUES OR PROBLEMS

Complexity in required project processes and in development of project documents caused considerable delays in the Dairy Compost Utilization Project. In addition, compost markets did not develop as fully as anticipated due to a number of factors.

The State of Texas required bids for selection of a Compost Marketing Firm. The bid and approval process delayed the early planning and development of a strong marketing effort. The lack of background information regarding market potential and development also slowed and limited the Project's marketing efforts. As stated in the introduction, successful market development takes several years and typically feeds off self generated momentum. Unfortunately, due to delays in the bid process and contract approval with RAA, the marketing firm was not hired until 6 months into the project allowing for only 2 years of marketing efforts. The project needed more *on the ground*, market development efforts. For instance, obtaining additional trade show promotional booths, staffing an on-site salesperson (that the composters could have potentially hired after the project was over), or providing more *day-to-day* assistance. TWRI or TCE could not provide direct marketing such as an on-site salesperson because of their public structure; both are state agencies established to provide the public with unbiased information while not advocating one specific product over another. TCE and TWRI did provide education to the public about the use of compost and its benefits, but was not able to directly sell dairy compost.

By splitting the budget up by task for each individual involved, the project grew from a few manageable accounts to 38 separate accounts. In addition, the split budget further complicated project reporting and management. Much of the time utilized to manage the project was consumed by budget and administrative efforts.

Significant confusion affected timely development of the QAPP. Fortunately, these requirements were clarified at a discussion meeting between TCE and TCEQ, which allowed TCE to move forward with drafting necessary project documents. However, once drafts were submitted, the review and comment period was extensive, time consuming and numerous discussions and drafts were shared between TCE and TCEQ. Consequently, budget expenditures were less than expected which concerned TCEQ and thus, a budget meeting was scheduled to project future spending activities. The lack of a QAPP also delayed collection of field data. Background information and research data were imperative for project personnel to educate potential compost users and to develop marketing or educational materials.

TCE and RAA were continually contacted by composters regarding the compost quality needed to meet TxDOT specifications. In addition, TCE and RAA were heavily involved in assisting composters in both sales and product development activities related to TXDOT. Although not a responsibility of the project, it was very important to the composters, and TCE and RAA were the only individuals providing assistance in this area. Many of these issues arose with the introduction of a new TxDOT standard. The dairy manure composters were able to actively participate in the TxDOT market when the jobs were bid on the old specification. However, dairy compost sales began to plummet as jobs under the new specification were announced. Due

to the inherent nature of the soil and the manure collection practices, compost producers within the watershed likely will not be able to meet the specification without a significant addition of a carbon material such as wood wastes or yard clippings. While such amendments may improve quality, they will also add to the costs of producing the material, further limiting marketability. Compost facility location and transportation costs already pose a challenge to the compost producers when competing with other compost sources such as municipal composters. TCE and RAA, at the request of the composters within the Watershed, met with State Representative Sid Miller to discuss the ability of compost produced from dairy manure within the Bosque Watershed to meet TxDOT specifications. The meeting was a result of unsuccessful communications between the composters and TxDOT personnel. RAA attended as part of the contractual duties to assist the compost producers in their markets, while TCE attended to provide technical input regarding compost sample analysis. As a result of the meeting, RAA worked with TCEQ and TxDOT to develop suggested language for a temporary revised specification. While more sales were generated for the dairy composters through the revised specification, the market was only available for a short time as the modified specification ended when the compost incentive payment ended.

Numerous marketing challenges were faced by project personnel and the dairy compost producers. As previously noted, to produce a higher organic matter content and lower density material, supplemental carbon should be added during production. Unfortunately, such additions increase production costs. Given the location of these facilities, transportation costs also will continue to be a barrier especially when competing for a market in the larger urban centers situated more than 60 miles away. The variety of markets available to the compost producers is limited. It ultimately may be up to individual composters to identify niche markets to succeed.

Finally, the project goal was to provide compost producers with the tools necessary to effectively market their product and in doing so, establish markets which would be sustainable without government assistance. However, participation and active support of the marketing aspect of the project by compost producers was limited. This hindered the ability of the project to provide the type and level of service possible and necessary to build markets for their products.

# CONCLUSION

Multiple programs will be required to protect water quality in the Bosque River. Through the Dairy Compost Utilization Project, several agency partnerships were developed and a variety of projects working to reduce point and nonpoint source pollution continue in the Watershed today. While production and use of dairy manure compost is a viable part of a solution, it is not the only means towards water quality improvements. Efforts need to continue to enhance the dairy manure composting program so that it can be most effective. Finally, the Dairy Compost Utilization Project successfully established a greatly expanded Extension educational program dealing with compost that will continue within the watershed and will spread to other parts of the State.

Compost producers continue to rely on the TxDOT market and would prefer to keep the program alive (note: some compost producers wanted the variance to continue while others would like to see it eliminated). Also, it has been requested and is recommended that TxDOT engineers receive training about the characteristics of dairy manure compost compared to other composted materials.

Given the source of dairy manure in the area, most of the compost producers will continue to struggle with low organic matter content and high pH in their compost. Based on the results of the organic matter improvement study, composters can amend their material by obtaining bulking agents or supplemental carbon. Ideally, the composters could identify a supplement that they would be paid to manage and create a back haul program with the carbon supplier. However, even with a steady source of carbon material, the composted dairy manure may still fail to meet TxDOT specifications related to organic matter content and pH. Therefore, compost producers must reduce their sole dependency on TXDOT sales and take marketing activities more seriously.

While DFW is the largest and closest urban center, composters must expand their marketing efforts to other population bases in addition to DFW as this area already has several sources of organic material. With the limited geographical area and the unique nature of the material, compost producers must work to identify their own unique marketing strategy as individual as the product they produce. Creative marketing and niche market development will be the keys to success for sustaining the dairy compost market. Several facilities have already worked to establish their own specialty markets. Some have developed nursery mixes, others are bagging their material to transport and sell to urban markets, and at least one is offering application services and applying material to agricultural lands. Utilizing the new knowledge and information generated through the Dairy Compost Utilization Project, compost producers can move forward to establish a sound and sustainable compost market in the Bosque River Watershed.

The Composted Manure Incentive Program Model provided several benefits in developing and establishing a dairy compost industry. However, with each benefit or factor in the development of this market, a lesson was learned.

The partnership with TSSWCB and its incentive program to foster transportation of dairy manure from dairy operations to compost facilities successfully initiated the composting industry in the watershed. Without this cooperation and the DMES program, the composting industry would have struggled to begin.

One of the first lessons came early in the Programs. The initial lack of supervision during the first phases of the hauling incentive program and during the opening of some of the compost facilities created problems for the young composting industry. For example, compost producers were not judiciously accepting only high quality manure (i.e. fresh manure), which led to the stockpiling of poor-quality and old manure at several of the facilities. Both agencies worked expeditiously to rectify the problems and amend the programs to avoid such events in the future. Unfortunately, some of the damage was not reconcilable. The stockpiled lower quality material at the compost facilities continued to cause problems for the composting industry and the market throughout the Dairy Compost Utilization Program.

In review, the second lesson learned was the need for more upfront education. Stockpiling of old material potentially could have been avoided if dairy producers, trucking industry and compost producers were effectively educated on the benefits of selecting high quality fresh manure to produce quality compost. Education for compost facility operators on proper production techniques prior to either DMES or CMIP also could have facilitated more effective market development. If the initial composted dairy manure had been of higher quality and the compost producers more knowledgeable about their product, the market development process would have faced fewer hurdles.

The third lesson surfaced when addressing market potential. More background research regarding the composted product and its market was needed. The composted product that could be produced from all types of dairy manure available in the Bosque River Watershed should have been evaluated first. The DMES program was fully operational and efforts to develop the TxDOT and other public markets were already underway when the Dairy Compost Utilization Program first began; yet, it was this program that was tasked to assess dairy manure compost quality. A market can not be effectively evaluated or established until product characteristics and quality are known. By fully understanding their product, compost producers and RAA could have better focused their efforts in market development by identifying its best potential uses, competition and niche.

*In summary, more upfront efforts (prior to the Program) were needed, including education for all involved, assessment of current and potential product quality and an effective evaluation of market potential. The project also would have benefitted from more active involvement in the marketing process by the compost producers. Finally, give the unique and complex nature of this program, more time was needed to fully achieve the market desired.*

Given the circumstances present at the initiation of the Program and the time allotted, the Dairy Compost Utilization Program achieved its goals. Namely, *compost producers gained valuable knowledge* regarding compost production; *dairy manure compost quality improved*; the *base knowledge of compost use increased* substantially and this information was effectively conveyed

to the public; *purchases of composted dairy manure expanded*; and finally, *the development of a sustainable market* was substantially enhanced.

In looking ahead, the dairy compost market is still very young and has potential to grow and reach a sustainable level. However, given the geographic location and type of composted material produced, the market is unfortunately limited and will only bear a certain amount of production. Thus, the *development of niche markets by compost producers will be necessary for their long-term success*.

Ultimately, the compost industry is benefiting the region by providing an additional means to effectively manage livestock manure. However, manure composting is just one of the efforts that are helping achieve this goal. *Multiple programs are necessary and must complement one another to support a sustainable dairy industry and protect water quality in the North Bosque River Watershed.*

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