



COMPOST: ENHANCING THE VALUE OF MANURE

An assessment of the environmental, economic, regulatory, and policy opportunities of increasing the market for manure compost

EXECUTIVE SUMMARY

MAY 2017

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California's dairy producers provide significant benefit to local, state, and national economies. They generate 20% of US milk (CDFA, 2016), \$9.4 billion in revenue, and 30,000 on-farm jobs (Sumner et al., 2015). 90% of California's dairy cows are located in the San Joaquin Valley (CDFA, 2016), and the milk produced by these cows generates substantial economic benefit to a region suffering from high unemployment and poverty (UC ANR Committee of Experts, 2006; US Census Bureau, 2016). At the same time, the manure generated by these more than 1.5 million cows produces significant environmental impacts to air, water, and climate. Thus, identifying and supporting economically viable solutions for improved manure management is essential to ensure the health of the environment, people, and economy in the San Joaquin Valley.

Findings

In this study, we have examined best-available information on the array of environmental impacts and benefits of manure compost and, more importantly, the interrelationship between those impacts. We found that dairy manure composting has the potential to reduce water quality impacts, improve soils, and reduce greenhouse gas emissions from dairies with comparatively minimal impacts to local air quality. Dairy manure compost's portability gives it the potential to disperse nutrient concentrations further distances than manure. While further research is needed to better quantify these impacts, California need not wait to take proactive steps to promote dairy compost when its benefits are clear. Specifically, production of compost for export of manure off dairies appears to be a clear win.

Several key barriers have hindered the production and sale of manure compost and need to be addressed so the practice can be widely adopted. The inconsistency, complexity, and lack of clarity of regulations has been one of the primary barriers to compost production. In some cases, permitting requirements are simply unclear. In other cases, the regulations are based on limited and/or incomplete data and could prohibit better environmental outcomes. In order to establish effective regulatory and incentive programs, there is a critical need to conduct California-based research on the magnitude of the impacts of manure compost relative to current manure management practices.

The current regulatory approach also does not appropriately consider the net impacts from composting dairy manure across water quality, air quality, and greenhouse gases. This siloed approach to managing pollutants on dairies results in lost opportunities to address the most pressing environmental impacts of manure and could actually lead to negative environmental outcomes at a regional scale.

Fortunately, achieving the environmental benefits of manure compost is within reach, as the market for manure compost seems ripe for growth. Demand for compost is robust and expected to increase, particularly in rural agricultural regions of the state where supply of

municipal compost can be scarce. Manure compost can help fill this supply-demand gap, but agricultural producers need their customers to support them using manure compost. There is also significant opportunity to increase the supply of manure compost. Dairies are increasingly interested in composting their manure, and producing manure compost seems economically viable for many dairies. However, they need regulations and permitting requirements that are supportive of manure compost production. Table 1 below summarizes our key report findings.

Conclusion and Recommendations

Based on our research, compost appears to be an economically viable option that enables dairies to reduce their most significant environmental risks. However, we have identified some barriers that are impeding the production and sale of compost. We believe that targeted, short-term efforts by state and local government agencies to address these barriers can enable the market to emerge and grow on its own. We recommend the following specific actions that can be taken by government and associated entities to improve the science, regulatory regime, and market for manure composting while supporting state policies to improve soils and reduce greenhouse gasses. Doing so will help catalyze the market for manure compost, resulting in multiple environmental, social, and economic benefits, many of which will be realized in the San Joaquin Valley.

1. Research: Initiate comprehensive California-based research comparing dairy manure composting to existing manure management practices in order to quantify the magnitude of impacts across environmental media.

The available research indicates that composting manure is environmentally beneficial overall. Composting generates significant benefits to water quality and methane – by far the two greatest environmental impacts of dairy manure management – and relatively minimal increase in air quality impacts, some of which can be easily mitigated. The research we found was primarily conducted outside of California and/or studied non-manure compost feedstocks. While the relative impacts seem clear for most pollutants (the exception being volatile organic compounds), it is not possible to make definitive conclusions about the magnitude of the impacts due to the lack of comprehensive California-based research.

Therefore, we advocate for field-scale research in the Central Valley to quantify the magnitude of environmental impacts and tradeoffs of production and application of manure compost. This research must be comprehensive, including all of the following: (1) it must compare dairy manure composting to existing manure management practices; (2) it must look across multiple air, water, and greenhouse gas pollutants; and (3) it must measure the full life cycle, e.g. collection, storage/processing, and use (typically land application). The results of this research will help shape more science-based policy and may enable more cross-agency collaborative approaches to regulating environmental impacts – both of which would lead to better environmental outcomes.

2. **Regulatory: Amend air quality, water quality, and waste regulations so that they are clear, science-based, and reflect the net environmental impacts of composting dairy manure.**
 - a. The San Joaquin Valley Air Pollution Control District should create clear and science-based Best Available Control Technology Guidelines for new or expanded composting on dairies.
 - b. The Central Valley Regional Water Quality Control Board should consider compliance with the existing requirements of the Dairy General Order as constituting compliance with the siting requirements of the new Compost General Order.
 - c. CalRecycle should provide clear guidance to ensure Local Enforcement Agencies are consistent in how they interpret and assess compliance with the notification tiers of the Agricultural Material Composting Operations and Green Material Composting Operations.
 - d. The California Department of Food and Agriculture, the Administration, and the Legislature should identify funding pools other than the Greenhouse Gas Reduction Funds in order to fund needed research and market development for dairy manure compost.

3. **Market: Support outreach and education to encourage manure compost production and research and demonstrations to bolster demand for manure compost.**
 - a. Provide funding to California Department of Food and Agriculture to build producers' knowledge of compost production regulatory requirements and best management practices.
 - b. Fund research to compare the soil health benefits and contamination risks of dairy manure compost, green waste compost and food waste compost.
 - c. Fund demonstration projects to study and prove economic feasibility of dairy manure composting in the San Joaquin Valley.

4. **Policy: Implement AB 1045, the Healthy Soils Initiative, the Alternative Manure Management Program, and SB 1383 in a manner that promotes beneficial dairy manure composting and encourages coordination across state agencies.**
 - a. Address permitting challenges for dairy manure composting through AB 1045.
 - b. Recognize and support the role of dairy manure compost in meeting goals of the Healthy Soils Initiative and the Alternative Manure Management Program.
 - c. Ensure that the Short Lived Climate Pollutant Strategy fully incorporates the composting of dairy manure in its policy and economic provisions addressing manure methane emissions and the need for new composting facilities.
 - d. Encourage agency staffs responsible for implementing AB 1045, the Healthy Soils Initiative, the Alternative Manure Management Program, and SB 1383 to coordinate closely to achieve an integrated multi-agency strategy that maximizes the benefits derived from dairy manure compost.

Table 1. Summary of Dairy Manure Compost Impacts, Barriers, and Opportunities

	Environmental Impacts	Regulations/Permitting	Policy	Overall Assessment
Water Quality	Composting is a clear solution to reducing dairy water quality impacts. It decreases leaching risk during both storage and land application as compared to uncomposted manure. It also provides solution for over-application of manure, which is responsible for 95%+ of nitrate leaching from dairies.	Classification of dairy manure as Tier II in the SWRCB's Compost General Order requires substantial mitigation measures. Lack of clarity about how the CVRWQCB's Dairy General Order could be modified to incorporate elements of the Compost General Order is a significant challenge. Dairy General Order modifications could disincentivize composting on dairies, which is one of the only economically viable options for dairies to export excess nutrients, as required by the Dairy General Order.	Composting manure provides a clear water quality benefit for dairy manure management. Composting is currently one of the only economically viable options for dairies to export excess manure nutrients. Disincentivizing compost could significantly impede meeting policy objectives of protecting surface and groundwater quality.	Manure compost provides a clear benefit to reducing the significant water quality impacts of dairy manure management. However, the current regulatory approach appears to be heading in a direction that indicates that composting manure is detrimental to water quality. Composting of dairy manure should be encouraged, not discouraged, in order to achieve better water quality outcomes, particularly as it relates to leaching of manure nutrients to groundwater.
Greenhouse Gases	Compost produces a net GHG benefit. Significant methane reductions more than compensate for potential slight increases in CO ₂ from equipment and N ₂ O.	N/A at this time. CARB is starting the process to establish regulations for methane emissions from dairy manure management soon. CARB can start regulating dairy methane as early as 2024.	Most of the focus for reduction of methane from dairy manure management has been on digesters. Compost is more practical methane reducing practice for a much larger percentage of California dairies. SB 1383 serves as a statutory requirement to include other methane-reducing practices, but it is unclear to what extent composting (as a standalone practice and as an "add on") will play a significant role in upcoming regulation and budgetary allocations.	Manure compost reduces methane emissions as well as overall CO ₂ eq as compared to solid manure stored in static piles. It is also more operationally and economically viable for a larger percentage of dairies as compared to other methane reducing practices. Composting should be considered by SB 1383 and related program as a key option – either as a standalone or as an "add on" practice – for achieving industry-wide methane reductions from manure management.
Air Quality	Compost produces a net increase in precursor emissions, although the magnitude of emissions and their impacts on regional air quality and health are unclear. Emissions of NH ₃ from manure compost are greater than uncomposted manure, but they are also easier to mitigate because they do not occur during land application. More research is needed to determine net VOC emissions.	Compost does appear to increase air quality emissions from manure, and permitting requirements reflect that. However, VOC emission factors for manure compost are based on research of co-compost, not pure manure compost. Additionally, lack of clarity of what VOC mitigation measures will be required is a major permitting issue. Current regulations do not consider net emissions.	Lack of research on emissions from manure in static piles compared to composting is a barrier to understanding if and how composting could improve air quality outcomes. Current approach of not considering net emissions or precursors' actual formation of criteria pollutants does not ensure improved air quality and health outcomes.	Composting appears to increase air quality impacts, but more directly-relevant research is needed to confirm this and to understand the magnitude of incremental impacts to air quality and health. Permitting requirements should be revised as needed to reflect the findings from this research. Additionally, SJVAPCD needs to provide more up-front clarity on BACT and potential mitigation measures for VOCs so producers can estimate economic feasibility prior to applying for a permit.
Soil Health	Manure and manure compost share many benefits for improving soil health, but manure compost enables soil health benefits to be achieved on significantly more acreage because it is easier to transport can be more readily applied to more crop types.	N/A	CDFA's Healthy Soils Initiative is a significant program to incentivize practices that improve soil health. Compost has received significant attention as part of this program's development and could be one of the major practices incentivized by the program.	Manure compost is widely understood to provide multiple soil health benefits. Recent policy initiatives focus on improving soil health and appropriately recognize and promote the use of compost as a practice to improve the health of our soils
Supply	Composting is one of the only economically viable ways for dairies to export excess manure nutrients, thereby protecting water quality. Composting can also reduce methane emissions from dairy manure management, particularly if coupled with practices that reduce the amount of solids entering anaerobic lagoons.	Lack of clarity on regulations and permitting requirements is the largest barrier to dairies producing compost. This is particularly true for air quality permits due to perception that VOC mitigation measures will be cost-prohibitive. This also true for water quality, as producers are unclear of permitting requirements now that the Composting General Order has been released. Increased permitting requirements for export of manure compost (vs. on-farm use) is a barrier to improved regional distribution of manure nutrients.	Past policy initiatives related to compost have focused on landfill diversion, largely ignoring California's substantial agricultural feedstocks. This has left a gap in funding for research and market development of manure compost. AB 1045 has the potential to significantly impact manure compost supply if it (1) incorporates agricultural feedstocks and on-farm composting into its mandate to streamline the compost permitting process and (2) addresses the major permitting barriers addressed in this report.	Lack of clarity on regulations and permitting requirements is the largest barrier to the production of manure compost. If this barrier is removed, the supply of manure compost is likely to increase substantially. Otherwise, it is unlikely that the supply of manure compost will increase even moderately.
Demand	Composted manure can be used by a much larger customer base than uncomposted manure. By using manure compost, these customers can benefit from increased soil organic matter, increased water holding capacity, decreased pathogens and weed seeds, and increased carbon sequestration, among others. Greater proportion of organic nitrogen can reduce leaching risk compared to use of uncomposted manure.	Existing food safety regulations place only minimal restrictions on the use of manure compost, appropriately reflecting best available science regarding pathogen risk.	Past policy initiatives related to compost have focused on landfill diversion, largely ignoring California's substantial agricultural feedstocks. This has left a gap in funding for research and market development of manure compost. CDFA's Healthy Soils Initiative is a positive step forward in incentivizing the use of compost, but it is funded by GGRF and so can't address most research and market development needs.	The demand for compost is strong and growing in California. For those interested in using compost, manure compost is typically viewed favorably, as long as salt concentrations are not too high. However, customer restrictions sometimes do not reflect best available science on pathogen risk and can limit a producer's ability to use manure compost.

Key			
Positive (Environmental Impacts) Incentivizes (Regulations & Policy)	Neutral / mixed (Environmental Impacts) Neutral / unclear (Regulations & Policy)	Negative (Environmental Impacts) Disincentivizes (Regulations & Policy)	N/A