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Trialing Dietary Interventions to Mitigate Enteric Methane Emissions in Dairy Cattle

IFEEDER® Institute for Feed Education & Research

INNOVATION CENTER FOR U.S. DAIRY
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The Nature Conservancy

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CONTENTS

PROJECT SUMMARY

While existing and emerging feed management practices have the potential to provide a multitude of benefits to the US dairy value chain, those practices have not been widely adopted, or all benefits have not been realized. Similarly, the use of NRCS feed management practice standard (Conservation Practice Standard (CPS) 592), a tool to implement feed management practices on US dairy farms, has been limited. Therefore, The Nature Conservancy teamed up with Dairy Management, Inc. and the Institute for Feed Education and Research (IFEEDER) to draw on insights from on-farm trials, expert advisor surveys, and a network of relevant stakeholders to understand barriers to adoption of feed management practices and use of CPS 592, which can inform NRCS to support enhanced adoption. The on-farm trials conducted in the current project confirmed that adoption of feed management practices such as feed additives or supplements could provide production and environmental benefits without compromising animal health, creating an opportunity for additional revenue generation for US dairy farmers. However, high variability in production benefits suggests that there should be financial incentives or other financial mechanism available to dairy producers to derisk the adoption of feed management practices. In addition, this high variation in production benefits and the cost of practice implementation should be considered while setting incentive payment rates. Preferred sources of financial support among farmers and feed advisors were NRCS, companies selling dairy products, and consumers. In addition to the uncertainty regarding economic benefit of these practices, lack of publicly available evidence on the effectiveness of feed management practices, impact on animal health, and lack of access to technical support have been identified as barriers to adoption. Therefore, there must be increased investment in offering financial and technical assistance, conducting more research and generating scientific evidence. Awareness about CPS 592 could be raised by providing training and education opportunities for farmers and feed advisors. A simple feed management plan template that is tailored to a specific objective was created in this project, which might encourage increased adoption of feed management standard among feed advisors. In addition, a Conservation Stewardship Program (CSP) enhancement was developed in the current project, which could be seen as an opportunity to generate additional income for dairy farmers, leading to enhanced adoption of the feed management standard and practices.

PROJECT GOAL AND OBJECTIVES

Innovative feed management practices including feed additives and supplements have significant potential to improve performance in dairy cows and some of them could reduce enteric methane emissions from US dairy herds. Within USDA, Conservation Practice Standard (CPS) 592 for Feed Management has not been widely used in NRCS EQIP cost-share program, and no enhancement currently exists for its use within the NRCS Conservation Stewardship Program. **The long-term goal** of this project was to generate evidence and create resources that could be leveraged by NRCS and dairy stakeholders to enhance the adoption of CPS 592 on dairy operations of all sizes, which could improve performance of US dairy herds while reducing greenhouse gas (GHG) emissions and improving air quality. The **immediate goal** was to evaluate environmental and economic impacts of feed management practices to inform and

educate stakeholders and NRCS programs. The project aimed to draw on insights from on-farm trials, expert advisor surveys, and other resources to understand barriers to adoption of feed management practices and CPS 592. By sharing this information with NRCS, we hope that related programming and guidance might be updated to support enhanced adoption. This project achieved the goal by fulfilling the following **objectives**:

1) Conducting an on-farm assessment of implementing feed management practices on US dairy farms,
2) Developing feed management insights using the knowledge and experience of a relevant expert and stakeholder network along the dairy value chain,
3) Informing targeted stakeholders on project results to support their decision-making regarding feed management practice adoption,
4) Informing NRCS programs and policies based on project results.

PROJECT BACKGROUND

Improved feeding and other management practices made US dairy herds more efficient over the past several decades, minimizing stress on natural resources and reducing GHG emissions per unit of milk produced. However, feed management practices have not been routinely used to achieve multiple benefits including improved performance, reduced water pollution, improved air quality, and reduced GHG emissions. Conservation Practice Standard (CPS) 592 - Feed Management was initially introduced by NRCS to reduce water quality impacts of manure nutrients, which was later updated to include practices that could reduce air pollution and GHG emissions. However, a decade since CPS 592 was updated, there is still relatively little information available related to the role of this standard in achieving widespread adoption of innovative feed management practices targeting production benefits, water quality impact, and reduced GHG emissions.

Recent research and development activities have identified innovative feed management practices, particularly feed additives and ingredients that can provide a multitude of benefits mentioned above. However, there are challenges to widespread adoption of these emerging innovative solutions. The challenges include insufficient publicly available evidence regarding their short and long-term effectiveness and impact on animal production and health. Most solutions have been evaluated in controlled experimental conditions or in privately funded studies, which generated some useful information, but didn’t bridge the knowledge gap in terms of logistics and implications of adopting these solutions on commercial dairy operations. Solutions that are commercially available face additional challenges to adoption. The cost-benefit case of feed management practices can vary substantially based on various factors including the cost of implementation, magnitude, extent, and persistency of impact on production and health. Consequently, there is a relatively low uptake of the relevant Practice Standards developed by NRCS. Therefore, this project was explicitly designed to address these issues through a combined strategy of on-farm trials and demonstrations, engagement with farmers and relevant stakeholders, and targeted feedback to NRCS.

PROJECT METHODS

On-farm animal trials were conducted on five dairy farms in two US states (three in Michigan and two in Wisconsin) to gain insight into the implementation of feed management practices on commercial dairy farms in the US. Based on the results of a feasibility analysis, the project goal was revised from an initial goal of evaluating feed management practices for their enteric methane mitigation efficacy using direct measurement. In addition to the criteria required by NRCS, multiple considerations (including farmers' willingness, ability to administer practices, certain number of cows, willingness to collect samples, ability to collect and share relevant data, and participate in surveys/interviews) were used to select and recruit dairy farms to this project.

Upon project initiation, an expert panel consisting of industry, academic and non-government organization representatives was established (see the *appendix*). The expert panel served as consultants for experimental design and result review throughout the effort.

The trials were conducted on commercial dairy farms and with input from the expert panel, the resulting trials were designed to be scientifically robust without disrupting the daily routine of a commercial dairy farm. Samples and data were collected from each farm to determine the impact of implemented feed management practices on milk production, calculate enteric methane emissions, and conduct **an economic analysis**. The economic analysis was conducted using a simple principle where the cost of an intervention was considered the only cost and additional revenue from increased milk production was calculated using the milk price for a specific state. The profit or loss was calculated as a difference between the cost and additional revenue and was extrapolated to non-participant states based on the milk production and milk price for individual states. The Participants were asked to complete a **post-trial survey** to evaluate trial experiences and attitudes toward the feed management practices.

The scope of on-farm trials was revisited and changed based on **a survey involving feed advisors across multiple states in the US**. The revised scope of the trials was to generate information to address barriers to implementing feed management practices on commercial dairy farms. The survey was administered online using the project partner's networks to evaluate the feed advisor attitudes toward feed management practices and CPS 592 and to gather insight on barriers to adoption of both practices and the standard.

National conferences and meetings attended by relevant stakeholders including dairy producers, feed advisors, and NRCS conservation district staffs were used to raise awareness of feed management practices and CPS 592 by sharing project details and findings. Local events such as field days or farm visits and meetings with local NRCS staff were leveraged as additional outreach opportunities.

A network of animal nutritionists and NRCS staff was consulted to understand the major barriers to feed management plan (FMP: required for CPS 592) adoption and identify improvements to the FMP to enhance adoption. In addition, the expert panel for this project and other stakeholders were consulted to develop a CSP enhancement for NRCS, which could accelerate adoption of the feed management standard and practices.

PROJECT RESULTS

On-farm assessment to gain insight into the implementation of feed management practices on US dairy farms:

On-farm trials were conducted to demonstrate implementation of feed management practices on commercial dairy farms and to assess the economic and environmental benefits generated as a result of practice implementation. The feed management practices used in this project were a feed additive and a feed ingredient (fatty acid ingredient). Lessons learned during farm selection for on-farm trials and designing and conducting trials were valuable for successful feed management practice utilization to achieve intended impact. Engagement with the farm's feed advisor or nutritionist was important for selecting the feed management practice to trial at each location. Early engagement with feed advisors and farmers to discuss various logistical factors was critical for successful implementation of feed management practices. Some key factors to address include dose of an additive, mixing the additive in a ration, any known interactions with ingredients or nutrients in a ration, feeding method, and product stability during transport or storage.

The factors mentioned above, either individually or in combination, could greatly influence the direction as well as magnitude of the impact expected from the implementation of feed management practices on a commercial dairy farm. For example, the average milk production across farms in the current project increased by a little over 2% and approximately 1%, respectively, when the feed additive and the fatty acid were fed to milking cows, but the impact on milk production ranged from -2.25 to 5.57% and -1.35 to 3.15%, respectively. One factor potentially contributing to the variation in milk production through fatty acid supplementation could be that at least one farm didn't have enough capacity in the ration to add an amount of fatty acid that has been considered optimum for improving production and reducing GHG emissions (*i.e.*, underdosing). **This high variation in the direction and magnitude of impact on milk production when the same practice was implemented on more than one farm in the current study confirms the perceived risk associated with the adoption of new feed management practices.** As with the adoption of other on-farm practices, **access to financial incentives or other financial mechanisms is critical for derisking the adoption of feed management practices** - even for those considered to provide production benefits in addition to reducing water pollution, air pollution, and GHG emissions.

There was also some variation in milk composition, but it wasn't considered significant enough for farmers to gain economic benefit from it or to be concerned. Participant farms didn't share any concern regarding the quality of milk from cows fed the feed additive or the fatty acid in the current project. Implementation of two different feed management practices in the current project didn't lead to any animal health consequences. The feed additive and the fatty acid used in the current project are commercially available and have been approved for their intended use in cattle by FDA. Neither milk quality nor animal safety were a concern but **generating enough evidence from trials like this on commercial dairy farms advances the confidence of consumers, producers, and other stakeholders along the dairy value chain**.

Efficacy evaluation and comparison of the feed additive and fatty acid were not on-farm trial objectives, therefore impact of these feed management practices on enteric methane emissions was calculated instead of being directly measured from individual cows. The methods used to calculate the impact on enteric methane emissions are accepted by the scientific community and have been incorporated into EPA and USDA NRCS guidance documents. In the current project, estimated reduction in enteric methane emissions ranged from 15 to 20 g per cow per day.

Generating evidence on efficacy, safety (to animal and human health), and production benefit of feed management practices using on-farm trials is considered a critical step towards scaling adoption of those practices on dairy farms. However, it is equally **important to understand dairy producer knowledge and perceptions about feed management practices** that could provide water and air quality benefits and reduce GHG emissions as secondary or co-benefits. Participant dairy farmers in the current project shared a mixed response regarding their intention to continue the practice they tried during on-farm trial. Farmers who tried the feed additive in the current project wanted to continue its use regardless of the results (impact of milk production) from the current project, but the farmers who added the fatty acid to their rations wanted to try other feed management practices, primarily because they were not convinced there would be long-term economic benefits for continuing the practice. Concerns about fatty acid expense were identified because the production benefit was highly variable. Therefore, it is aligned with the recommendation above **that there should always be some financial mechanisms to derisk the adoption of feed management practices** that could provide a multitude of benefit including minimized water and air pollution potential and reduced GHG emissions.

Similarly, dairy producers participated in this project indicated the need for continuous financial support to enable adoption and continuous use of feed management practices. Additionally, they mentioned NRCS cost-share programs such as EQIP as a key source of financial incentives. Other key stakeholders along the dairy value chain who dairy producers think should provide financial incentives include brand marketers, consumers (via premium for labeled product), and co-ops.

Importantly, participant dairy producers were interested in and willing to explore more options and would like to obtain more information about feed management practices so that they can make informed decisions. Additional information sources identified by the producers include nutritionists, farm advisors, co-ops, university extension specialists, peer groups, other industry experts, farm magazines and newsletters. However, easy access or updated information from these resources might not always be available, so a concerted effort should be made by key stakeholders along the dairy value chain to create adequate, easily available resources.

While financial incentives and access to resources required for practice implementation are critical for the adoption of a feed management practice and its scaling, continuous and sustained adoption cannot be expected if there is no economic gain for dairy producers. In addition, a net economic loss incurred from the adoption of practices is generally the most critical barrier to the adoption of practices on a farm. Therefore, an economic analysis of the adoption of two feed management practices used in the current project was conducted. Assuming that the cost of purchasing the feed additive or fatty acid was the only implementation cost in the current project,

potential revenue ($ per cow per year) from increased milk production was calculated for participant states (Michigan or Wisconsin) using a USDA dataset on state-level milk production and milk price, which was then extrapolated to 24 dairy states in the US. In the current project, additional revenue generation per state from feeding feed additive and the fatty acid ranged from $96.5 to $121 and $46 to $50 per cow per year, respectively. However, when the cost of feeding feed additive and the fatty acid was considered, it appeared that farmers could experience net loss or net profit depending on the impact on milk production and the cost of implementing the practice. The net loss or profit range was wide and varied due to many factors including practice implementation cost, farm-level impact on milk production, state-level variation in milk production and price (*see Tables A1 and A2 in appendix*). **The data on economic loss or profit from the implementation of certain feed management practices along with the factors contributing to the variation in net loss or profit should be considered while setting up incentive payment rates for individual feed management practices**. In addition, local context (at least state level context) should be considered meaning incentive payment rate for the same feed management practice might vary by state.

Developing feed management insights using the knowledge and experience of a network of relevant experts and stakeholders along the dairy value chain:

In the current project a survey was conducted to understand attitudes toward adoption of feed management standard (CPS 592) and feed management practices on US dairy farms among various professionals, including animal nutritionists, dairy consultants, educators, veterinarians, feed mill staff, cooperative staff, and NRCS staff. There were 42 respondents, but the working territory of survey respondents represented most US dairy states except the Southeast. (use this link for more details on the survey results)

Less than a third of feed advisors were familiar with NRCS conservation practice standard 592 and among those familiar, only a small percentage recommended it to dairy producers. **There is a need to increase awareness and education about NRCS conservation practice standard 592 among dairy consultants and nutritionists. This could involve targeted training sessions and informational campaigns to highlight the benefits and implementation strategies of CPS 592.**

Majority of participant feed advisors were aware of at least one feed additive that could provide production or environmental benefits and among them, two-thirds recommended a feed additive to their client dairy producers. **Feed advisors considered various factors including cost of practice implementation, effectiveness of the practice, impact on animal production and health, and ease of use while selecting and recommending a feed management practice (*e.g.*, feed additives)**. In addition, feed advisors considered responses or attitude of their client dairy producers in their decision-making process, confirming the need for an early conversation with both producers and their feed advisors to facilitate the adoption of feed management practices.

However, **many feed advisors shared that they didn't feel confident enough to recommend the adoption of feed additives or supplements particularly because they thought it was too**

expensive to implement those practices and there was a lack of certainty about an economic return. In addition, they were not aware of any easy access to financial incentives to derisk the adoption feed management practices including feed additives and supplements that could provide production and environmental benefits. Since the cost of implementing feed management practices such as feed additives or supplements was a significant concern for many respondents, **it is recommended to NRCS that financial incentives should be made available for specific practices via cost share programs such as EQIP. Furthermore, additional funding options and subsidies should be explored to make these practices more affordable for dairy producers**. This could include financial subsidies, tax breaks, or recognition programs from federal agencies like USDA NRCS for those who implement sustainable practices.

Among other sources of financial incentives included brand marketers and consumers. Since consumers were seen as one of the most likely groups to pay for these practices, it is important to engage them in the process. This could involve marketing campaigns to raise awareness about the benefits of these additives and encouraging consumers to support sustainable practices through premium pricing. However, the applicability and timing of this approach should be assessed carefully to make sure that raising awareness does not backfire by having consumers reject the practices than having them pay a premium for it. Additionally, feed advisors should conduct cost-benefit analyses using simple principles similar to what has been done in the current project, which could help in demonstrating the economic advantages of using these practices.

Furthermore, lack of sufficient publicly available evidence that supports the claimed impact of feed additives and supplements has been identified as an adoption barrier. The survey conducted in **the current project highlighted the need for unbiased proven economic benefits, scientifically proven efficacy, and education**. Therefore, it is crucial to conduct more research and make robust efficacy data publicly available. **Federal agencies like USDA NRCS should collaborate with research institutions, NGOs, and private sector and conduct field trials to gather reliable data and build confidence among professionals**.

Most respondents who recommended feed additives or supplements to their client dairy producers believed there should be record-keeping requirements. However, there has been a lack of record keeping or lack of consistency in record keeping and therefore, **it is advisable to establish standardized record-keeping practices for producers who are using feed management practices, which could help in monitoring usage, assessing effectiveness, and ensuring compliance with current or future regulations**.

Informing targeted stakeholders on project results tailored to supporting their decision-making regarding feed management practice adoption:

Apart from NRCS, the key stakeholders were farmers as end users of the feed management standard and practices and feed advisors who can influence the decision on a dairy farm regarding adoption of feed management practices. Key resources developed and information

generated in the current project have been mentioned throughout this report, but some key ones include 1) evidence from on-farm trials that adoption of feed management practices on dairy farms could provide production and environmental benefits, 2) confirmation that farms should seek for financial support to derisk the adoption of feed management practices, 3) development of a simple feed management plan tailored to achieving a specific objective, and 4) development of a CSP enhancement tailored to achieving additional environmental benefits when specific feed management practices are considered in a feed management plan.

A network of project partners was engaged to inform key stakeholders on project results via partner websites, project overview documents, conferences and meetings, and podcast (see 'Project Outputs' section for more details). In addition, there were various phone calls with state NRCS contacts and partner dairy cooperatives over the course of the project to share intermediate project results.

Informing NRCS programs based on project results:

We had been sharing project deliverables with some insights periodically via semi-annual progress reporting throughout the project life. In addition, we have shared some key deliverables and data generated in the current project as an appendix to this report. Furthermore, we had regular engagements with the NRCS technical lead for the current project and state conservation district staff. In addition to the recommendations and insights shared above, there are two deliverables that could help NRCS modify feed management practice standards or program such that it leads to enhanced adoption of the standard as well as feed management practices with production and environmental benefits.

In the current project, a network of project partners was leveraged to gather insights from feed advisors regarding adoption of the feed management standard. Since the launch of the 592 feed management standard by NRCS, the feed management plan (FMP) has been an integral part of the standard, however, the FMP has not been widely used by US dairy farmers. One of the challenges has been that the FMP was initially developed to address only water quality concerns associated with dairy production and requests data input not required for the use of 592 standard to reduce GHG emissions in dairy cows. Therefore, a simplified FMP template, tailored to specific practices (*i.e.*, enteric methane mitigation) or their expected impact, has been developed in the current project, which has been shared with NRCS in a progress report (*see the appendix*).

When feed management practice standard (CPS 592) was launched by NRCS, the initial focus was on addressing water quality concern associated with excess amount of nutrient excretion by dairy cows. The scope of the standard was expanded to consider additional issues such as air quality and GHG emissions. Even though feed management practices were recommended as part of this standard, the underlying concept was that dietary manipulation could reduce nutrient excretion in manure, leading to reduced water and air quality impact and GHG emission reduction. However, many current and emerging feed management practices can affect the way feed is digested, and nutrients are used by dairy cows, leading to relatively high GHG emission reduction from dairy cows. These practices have not been widely adopted by US dairy producers for various reasons with lack of sufficient information on the implementation of these practices and limited access and availability of financial support being a couple of major challenges.

Therefore, a CSP enhancement (*see the appendix*) was developed in the current project, which is tailored to the adoption of practices that could go above and beyond the basic feed management standard and provide a secondary benefit of GHG emission reduction (*i.e.*, enteric methane emission reduction) in addition to the primary benefit of improved feed efficiency. Adopting specific practices listed in the CSP enhancement will allow farmers not only to achieve both primary and secondary benefits mentioned above but also will make them eligible to apply for additional financial incentives, which would improve the value proposition of feed management practices along with the feed management standard, leading to a win-win situation for all stakeholders along the US dairy value chain.

PROJECT OUTPUTS

Media and publications:

- We created a press release at the launch of the project, which was shared publicly by all project partners.
- We created a one-page overview document for general project communications. This document was also translated into a Spanish version. This document has been on our TNC website since the first year of the project.
- We created both MI and WI recruitment flyers which were used by our partners (MMPA, Foremost Farms, CAC) to recruit participant farms that met the project requirements.
- We shared with NRCS a Feed Management Plan (FMP) template that Dr. Partha Ray and Dr. Juan Tricarico collaborated on. We believe this FMP can be useful not only for our CIG project, but more broadly as an NRCS resource.
- Dr. Partha Ray (TNC) recorded an episode of the Dairy Stream podcast highlighting our CIG project, which aired October 2023. This podcast is co-produced by the Dairy Business Association and Edge Dairy Farmer Cooperative.

Websites:

- We launched a webpage, nature.org/USdairy, where we communicate on this project. We will update this page with final project results when ready. From mid-March 2023 through mid-April 2025, the page received over **3,100 visits.**

Conference attendance:

1. Ricardo Costa (TNC) and Lara Moody (iFeeder) presented on this project at the Soil and Water Conservation Society (SWCS) annual meeting, which took place July 31-Aug 3, 2022 in Denver, CO.
2. Alisha Staggs (TNC), Lara Moody (iFeeder), Partha Ray (TNC), and Juan Tricarico (DMI) presented on this project to a standing room only audience of very interested participants at the Sustainable Agriculture Summit in Phoenix, AZ on Nov 17, 2022.
3. Ricardo Costa (TNC) presented on our progress at the 79th SWCS International Annual Conference, July 21-24, 2024, in Myrtle Beach, SC. The focus was on the farmer advisor survey results (see the abstract on page 201 and poster for more details).

4. We are confirmed for an oral presentation on our final results at the SWCS 2025 annual meeting, which will take place August 3-6 in Costa Mesa, California. It will likely be Dr. Juan Tricarico joining in person to present.

PROJECT IMPACTS

The goal of this project was to gain insight into the implementation of feed management practices on commercial dairy farms. In addition, resources and information were generated that would help NRCS update or modify the feed management standard and cost-share programs such as EQIP. Therefore, it was not expected that a large number of dairy farms, acres or animals would be impacted during the lifetime of this project. However, there were five dairy farms in the current project that conducted feed management planning and implemented feed management practices with the intention of improving milk production and reducing environmental impact. A total of 405 milking cows received a feed additive or fatty acid, leading to a net increase in milk production and net reduction in GHG (enteric methane) emissions across all farms.

By implementing innovative feed management practices, including feed additives, the project has demonstrated the potential to improve performance in dairy cows while reducing GHG emissions. Additionally, the project has provided valuable insights into the barriers to adoption of these practices and informed NRCS programs to support enhanced adoption of the feed management standard and practices. Overall, the project has contributed to a better understanding of feed management practices and their role in achieving sustainable dairy production in the US.

Participation of 42 feed advisors representing major US dairy states (except the Southeast) in a survey conducted as part of this project likely helped to raise the awareness of the topic of feed management standard and practices among feed advisors. In addition, the project lead and partners, including dairy cooperatives and feed additive manufacturers will use the resources generated in the current project to help raise awareness regarding the feed management standard and enhance the adoption of feed management practices.

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APPENDIX

Expert Panel

Affiliation	Title*
AgNext, Colorado State University	Associate Professor
American Feed Industry Association	Director of Animal Food Safety
Cornell University	Associate Professor
Dairy Management Inc.	VP-Sustainability Research
Elanco	Dairy Technical Consultant
IFEEDER	Executive Director
Michigan Milk Producers Association	Director, Member Services & Farm Sustainability Manager
The Nature Conservancy	Livestock Sustainability Scientist
TNC/ University of Maryland	Applied Social Scientist/Regenerative Ag Fellow
NRCS	Animal Husbandry Specialist
UC Davis	Professor

*The titles of panel members were true when the project started and mostly through the project life.

Economic analysis

Table A1: Net profit or loss (the difference between the cost of implementing a practice and the revenue generated because of change in milk production) when a feed additive is used on dairy farms

State	Farm 1	Farm 2	Farm 3	Avg.
	Net profit, $/AU*/year	Net profit, $/AU*/year	Net profit, $/AU*/year	Net profit, $/AU*/year
WA	100	182	-87.7	64.7
OR	94.7	172	-83.7	60.9
CA	91.5	166	-81.5	58.8
ID	101	183	-88.2	65.3
UT	90.7	165	-80.9	58.2
AZ	94.7	172	-83.7	60.9
CO	106	191	-91.5	68.5
NM	87.7	160	-78.8	56.2
SD	89.8	163	-80.3	57.6
KS	86.9	158	-78.2	55.6
TX	102	184	-88.8	65.9
MN	85.8	156	-77.5	54.9
IA	89.7	163	-80.2	57.5
WI	94.3	171	-83.5	60.7
IL	84.7	154	-76.7	54.2
MI	108	195	-92.9	69.8
IN	98.1	178	-86.1	63.3
OH	92.3	168	-82.0	59.3
GA	105	190	-91.1	68.1
FL	97.7	177	-85.8	62.9
VT	91.4	166	-81.4	58.7
NY	109	197	-93.7	70.6
PA	86.7	158	-78.1	55.5
VA	97.5	177	-85.7	62.9

*1 AU = 1,000 lbs mature cow

Table A2: Net profit or loss (the difference between the cost of implementing a practice and the revenue generated because of change in milk production) when a fatty acid ingredient is used on dairy farms

State	Farm 1	Farm 2	Avg.
	Net profit, $/AU*/year	Net profit, $/AU*/year	Net profit, $/AU*/year
WA	-148	6.71	-70.7
OR	-146	1.19	-72.3
CA	-144	-1.96	-73.2
ID	-148	7.46	-70.5
UT	-144	-2.73	-73.4
AZ	-146	1.16	-72.3
CO	-150	12.1	-69.1
NM	-143	-5.64	-74.2
SD	-144	-3.57	-73.6
KS	-142	-6.49	-74.5
TX	-149	8.31	-70.2
MN	-142	-7.53	-74.8
IA	-144	-3.73	-73.7
WI	-146	0.84	-72.4
IL	-142	-8.60	-75.1
MI	-151	14.1	-68.6
IN	-147	4.57	-71.3
OH	-145	-1.18	-72.9
GA	-150	11.5	-69.3
FL	-147	4.11	-71.4
VT	-144	-2.00	-73.2
NY	-152	15.2	-68.3
PA	-142	-6.60	-74.5
VA	-147	4.00	-71.5

*1 AU = 1,000 lbs mature cow

Feed Management Plan (FMP) template

Objective: Dietary manipulation (*e.g.*, feeding a feed additive or supplement or changing ration composition) to achieve environmental benefit without compromising milk production and animal health

Month: _____ Year: _____

Recommended intervention (e.g., feed additive or other changes)

Name	
Dose, g/cow or heifer/day	
How to deliver (mix in TMR or premix or top-dress, etc.)	
How many days to feed	
Other dietary changes	

Animal information

Cow/heifer group/pen/ milking string										
Rolling Herd Avg. (RHA)										
Type of cows/heifers										
No. of cows/heifers										
Avg. daily milk yield/cow										
Avg. milk true protein, %										
Avg. milk fat, %										
Use DairyComp and DHI test report to provide information in this section and share the reports.										

Current ration information (indicate whether dry matter or wet weight basis)

Cow/heifer group/pen										
Ration ID										
Feeding method (TMR, forage and grain separately, top-dressing, etc.)										
DM or wet										
Feed intake/cow or heifer										

If feed intake is not known, provide the amount of feed offered										
Attach/include a report or screenshot from feed mgmt. software such as that has feed intake or feed offered amount.										
Availability of forage report (YES/NO)										
If yes, attach/include the report from last 2 months (e.g., NDS).										
Availability of nutrient profile report of current diet (YES/NO)										
If yes, attach/include the report from last 2 months (e.g., NDS).										

Proposed ration information (indicate whether dry matter or wet weight basis) [if dietary intervention is only inclusion of a feed additive and no ration reformulation is required, skip this section]

Cow/heifer group/pen										
Ration ID										
Feeding method (TMR, forage and grain separately, top-dressing, etc.)										
DM or wet										
Feed intake/cow or heifer										
If feed intake is not known, provide the amount of feed offered/will be offered										
Attach/include a report or screenshot from feed mgmt. software such as that has feed intake or feed offered amount.										
Availability of forage report (YES/NO)										
If yes, attach/include the report from last 2 months (e.g., NDS).										
Availability of nutrient profile report of proposed diet (YES/NO)										
If yes, attach/include the report (*e.g.*, NDS).										

Manure nutrient excretion [if dietary intervention is only inclusion of a feed additive and/or ration reformulation is not such that manure nutrient excretion will change, skip this section]

Cow/heifer group/pen										
Pre-intervention N excretion, g/animal/day										
Pre-intervention P excretion, g/animal/day										
Post-intervention N excretion, g/animal/day										
Post-intervention P excretion, g/animal/day										

Enteric methane emission

Cow/heifer group/pen										
Estimated emission before any intervention, g/cow/day										
Use an accepted equation (see below) to calculate baseline emissions.										
Intervention applied to this group/pen, YES/NO										
Estimated emission post-intervention, g/cow/day										
Use literature values to calculate potential reduction in emissions.										

Equation to predict enteric methane emissions: [-126 + (11.3 × DMI) + (2.30 × NDF) + (28.8 × MF) + (0.148 × BW)]

DMI: Dry matter intake; NDF: dietary neutral detergent fiber concentration; MF: milk fat %; BW: body weight;

CSP Enhancement

CONSERVATION ENHANCEMENT ACTIVITY

E592A

Dietary manipulation to reduce enteric methane emissions in dairy cows

Conservation Practice 592: Feed Management

APPLICABLE LAND USE: Farmstead

RESOURCE CONCERN: Air

ENHANCEMENT LIFE SPAN: 1 year

Enhancement Description

Dietary manipulation is used on dairy farms to reduce excess nutrient excretion and to improve feed efficiency. However, dietary adjustments could be made by adding feed additives or supplements to dairy cow rations or by manipulating dietary composition (both ingredients and nutrients) to reduce enteric methane emissions from dairy cows.

Criteria

- Documentation of producer's record of feed management meeting NRCS Conservation Practice Standard Feed Management (CPS 592) criteria to minimize nutrient pollution of surface and groundwater and reduce greenhouse gas (GHG) emissions.
- Calculate baseline enteric methane emission using an approach accepted by the scientific community and/or recommended by NRCS.
- Calculate emission reduction by using an emission reduction factor from literature or using an approach accepted by the scientific community and/or recommended by NRCS.
- Use one or more of the following feed management practices or diet manipulation strategies to reduce enteric methane emissions, while maintaining the health, well-being, and productivity of dairy cows.
    - Use feed additives or supplements that are FDA-approved for use in the US. There must be scientific evidence to support that the products can reduce enteric methane emissions in dairy cows without compromising production, animal health and well-being as well as human health safety. Producers and/or feed advisors should be wary of any product that does not have credible scientific data to support the advertised benefit.
    - Producers should consult with a feed advisor while selecting and using a product that would work best and should pay attention to various factors including feed intake, composition of ration, physiological status of cows, product mixing into a ration and delivery, and product dose regime.
- Use highly digestible feed ingredients including forages to improve overall digestibility of dairy cow ration or improve feed efficiency, which will reduce enteric methane emission intensity (*i.e.*, emission per unit of milk produced).

Documentation and Implementation Requirements
Participant will:

- Prior to implementation, provide documentation for review by NRCS showing a record of implementing feed management meeting all applicable NRCS Conservation Practice Standard Feed Management (CPS 592) criteria to minimize nutrient pollution of surface and groundwater and reduce GHG emissions.
- Prior to implementation, consult with a feed advisor (*e.g.*, professional animal scientists, animal nutritionists, or other comparably qualified individuals) to develop a feed management plan tailored to reduce enteric methane emissions.
- Prior to implementation, consult with a feed advisor to select at least one feed management strategy that could reduce enteric methane emission.
- Prior to implementation, identify and select an approach that will be used to calculate baseline enteric methane emission and emission reduction following feed management strategy implementation.
- During implementation, keep records to document details of implemented feed management strategy including feed analyses and ration formulation (both pre- and post-implementation).
- After implementation, make documentation and records available for review by NRCS to verify implementation of the enhancement.

NRCS will:

- As needed, provide technical assistance to meet the criteria of the enhancement.
- Prior to implementation, review documentation to verify a record of implementing feed management meeting all NRCS Conservation Practice Standard Feed Management (CPS 592) criteria to minimize nutrient pollution of surface and groundwater and reduce GHG emissions.
- Prior to implementation, verify the selection of at least one feed management strategy and the development of a feed management plan tailored to achieving reduced enteric methane emission.
- After implementation, review documentation and records to verify implementation of the enhancement.

NRCS Documentation Review:

- I have reviewed all required participant documentation and have determined the participant has implemented the enhancement and met all criteria and requirements.

- Participant Name _____ Contract Number _____

- Total Amount Applied _____ Fiscal Year Completed _____

- NRCS Technical Adequacy Signature _____ Date_____