Assessing Possible U.S. Feedlot Adoption of Methane Reducing Feed Additive 3-Nitrooxypropanol (3-NOP): Overview of a Recent Research Project

Jaime R. Luke (jrluke@ksu.edu) & Glynn T. Tonsor (gtonsor@ksu.edu)
Kansas State University Department of Agricultural Economics
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Background

Beef cattle are ruminant livestock that emit enteric methane (CH_4) emissions as a byproduct of their digestive process. Approximately 2% of total U.S. greenhouse gas (GHG) emissions come from enteric methane from beef production. Beef producers are receiving pressure to reduce these emissions in the wake of climate change concerns. The U.S. Roundtable for Sustainable Beef (USRSB) has set a target for the feedlot sector to reduce emissions by 10% per pound of beef by 2030 as compared to 2020 levels.

Several strategies are being developed to reduce emissions. Among these is the synthetic feed additive 3-Nitrooxypropanol (3-NOP). 3-NOP reduces enteric methane emission yields from cattle in feedlots by about 20%.[1] It is not yet approved for use in U.S. beef production but has been approved in other major beef producing countries, including Canada, Brazil, and the European Union. Currently, no widespread economic incentive exists in the marketplace to spur producers to adopt the additive. The objective of our study is to estimate the needed incentives for U.S. feedlot producers to adopt 3-NOP to achieve the 10% emissions reduction target. As objective analysts, our goal is for these novel estimates to positively contribute to societal discussions while also encouraging additional research as the marketplace situation evolves.

Feedlot Producer Survey

From November 2023 through January 2024, a survey of U.S. feedlot producers was conducted. The survey was distributed via *FEEDLOT Magazine* as well as through livestock producer organizations in Colorado, Iowa, Kansas, Nebraska, and Texas. These efforts garnered 65 usable observations.

Producers were presented with information on 3-NOP and asked if they would adopt the additive given a specific scenario. Producers were randomly assigned to different scenarios that varied on the following elements: (1) cost of 3-NOP {10¢/head/day, 25¢/head/day, *or* 40¢/head/day}, (2) incentive amount {$2/cwt, $5/cwt, *or* $10/cwt}, (3) incentive source {premium from the processor *or* subsidy from the government}, and (4) information {net profit calculations included *or* net profit calculations not included}.

If producers chose not to adopt the additive at the presented amount, they were asked a follow-up question that doubled the incentive. On the other hand, if producers did choose to adopt the additive at the first amount, they were asked a follow-up question that halved the incentive. From this series of two questions, we determine the interval where each producer would be willing to adopt 3-NOP. These intervals are used to estimate incentives necessary for 3-NOP adoption in the U.S. feedlot sector. The complete survey and estimation methodology is available by following the 'Full Study' link at the end of this document.

[1] Alemu, A. W., Pekrul, L. K. D., Shreck, A. L., Booker, C. W., McGinn, S. M., Kindermann, M., & Beauchemin, K. A. (2021). 3-Nitrooxypropanol Decreased Enteric Methane Production from Growing Beef Cattle in a Commercial Feedlot: Implications for Sustainable Beef Cattle Production. *Frontiers in Animal Science*, *2*, 641590. https://doi.org/10.3389/fanim.2021.641590

Results

We subset our data into small producers (<2000 head sold in past year) and large producers (2000+ head sold in past year). Table 1 summarizes the minimum incentives necessary for the average producer to adopt 3-NOP. The government subsidy required for the average small producer and the average large producer to adopt 3-NOP would be at least $6.39/cwt and at least $2.36/cwt, respectively, assuming the cost of the additive is zero. Thus, on average, large producers are willing to adopt the additive for less. At a cost of 25¢/head/day, the incentive would have to increase by at least $3.50/cwt for the average small producer to adopt (0.14 × 25¢/head/day) but only by at least $2.25/cwt for the average large producer to adopt (0.09 × 25¢/head/day). If the incentive is offered in the form of a premium from the processor, the average small producer would adopt 3-NOP for $2.31/cwt less as compared to the government subsidy. The average large producer would require $1.27/cwt less from a processor premium, revealing both small and large producers prefer processor premiums as compared to government subsidies. Finally, the average small producer would require $4.54/cwt less if net profit calculations are included in the messaging as compared to when they are not. That figure is $1.15/cwt for the average large producer, suggesting enhanced messaging could have a greater impact on small producers.

Table 1. Minimum incentives necessary to spur average U.S. feedlot producer adoption of 3-NOP ($/cwt)

	Small (<2000 head)	Large (2000+ head)
Government subsidy when 3-NOP available at no cost:	6.39	2.36
If 3-NOP cost increases by 1¢/head/day:	0.14	0.09
If processor premium vs. government subsidy:	–2.31	–1.27
If net profit calculations included vs. not included:	–4.54	–1.15

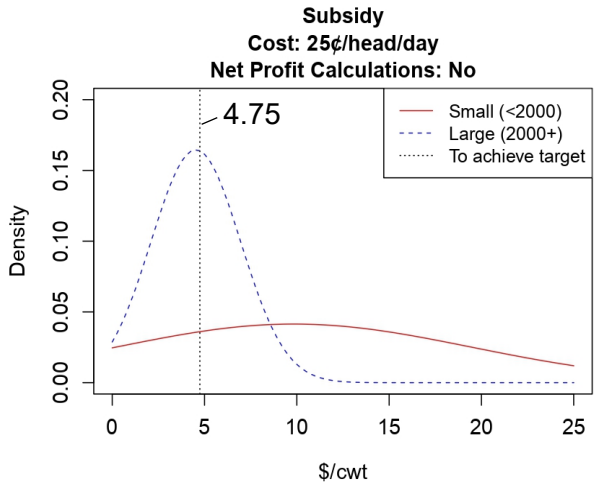
Key assumptions were made to complete the remainder of our analysis. According to 2023 USDA NASS data, the average small feedlot operation (as defined above) sold, on average, 159 head for slaughter. The average large feedlot operation sold, on average, 15,339 head for slaughter. We assume 3-NOP reduces methane emissions by 20%. Hence, one-half of all U.S. cattle on feed would have to be fed 3-NOP to reach the USRSB 10% reduction target assuming the feedlot sector exclusively uses 3-NOP to reduce emissions. Based on 2023 USDA NASS data for commercial slaughter, that equates to approximately 12.42 million head of fed cattle.

Potential 3-NOP Adoption Scenario

Numerous potential adoption scenarios can be explored using the survey results in Table 1. For the remainder of this document, we focus on the following scenario: A government subsidy with 3-NOP cost of 25¢/head/day and net profit calculations not included. For this scenario, the average small producer would need at least a $9.83/cwt to adopt 3-NOP; the average large producer would need at least $4.53/cwt. Figure 1 plots producer adoption curves.

As stated above, large producers sell far more fed cattle than small producers. Thus, a subsidy of $4.75/cwt would be necessary to reach the 12.42 million head target. As shown in Figure 1, this captures a much larger share of cattle from large producers versus small producers.

Figure 1. Estimated 3-NOP adoption by feedlot size



In fact, over half of large feedlot producers (54%) would adopt the additive at a $4.75/cwt subsidy level, resulting in 11.29 million cattle being fed 3-NOP as outlined in Table 2. The remaining 1.13 million head of cattle being fed 3-NOP would originate from small producers, meaning about 30% of total small producers would adopt the additive. Over 7 thousand operations would be needed to reach the 1.13 million head from small producers, whereas only 736 operations could provide the 11.29 million head from large producers. Consequently, small producers receive outlays of about $75 million, or about one-tenth of what large producers receive at over $746 million. On average in this scenario, each small producer who adopts 3-NOP would receive about $10 thousand, while each large producer would receive over $1 million.

Table 2. 3-NOP adoption outcomes at $4.75/cwt subsidy

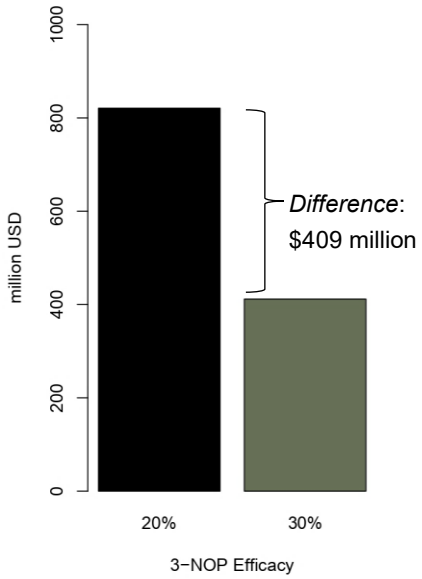
	Small (<2000 head)	Large (2000+ head)
% of operations adopt	30%	54%
# of head (millions)	1.13	11.29
Number of operations	7,092	736
Outlays (USD)	$74,584,553	$746,270,940
Average USD/producer	$10,517	$1,013,955

R&D Investment Discussion

Congressmembers in both the U.S. Senate and U.S. House of Representatives have recently proposed the Enteric Methane Innovation Tools for Lower Emissions and Sustainable Stock (EMIT LESS) Act. An aim of this legislation is to expand research for emission-reducing feed additives.

Consider the possibility of an investment in research and development (R&D) that improves the efficacy of 3-NOP from a 20% emissions reduction to a 30% emissions reduction. In this case, only one-third of U.S. cattle on feed would need to be fed 3-NOP to reach the 10% reduction target. Thus, rather than a subsidy of $4.75/cwt, a subsidy of only $3.57/cwt could achieve the target because the cost to subsidize 3-NOP for an additional steer or heifer in the feedlot increases with each animal. We find that outlays to reach the emissions reduction target total $821 million at a 20% efficacy level but only $419 million at a 30% efficacy level as illustrated in Figure 2. As such, an R&D investment could be less costly to taxpayers than subsidizing additional producers while achieving identical emissions reduction outcomes.

Figure 2. Total subsidy outlays



Key Takeaways

1. Producers prefer processor premiums over government subsidies to incentivize 3-NOP adoption.
2. The least expensive avenue to achieve emissions reduction targets could result in outlays per large producer nearly 100x greater than outlays per small producer.
3. Improving 3-NOP efficacy through R&D investments may be less costly to taxpayers as compared to incentivizing greater producer adoption via government subsidies.

Full Study: J.R. Luke and G.T. Tonsor. (2024). The enteric methane emission conundrum: U.S. beef cattle producer adoption of climate-focused technology. Forthcoming in *Sustainable Production and Consumption.* Available at https://doi.org/10.1016/j.spc.2024.08.011.

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K-State Agricultural Economics | 342 Waters Hall, Manhattan, KS 66506-4011 | (785) 532-1504 | Fax: (785) 532-6925