RIPE
Rural Investment to Protect our Environment

# Methodology and Sources for Roofs and Covers - Dairy

| Ecosystem Service | $/Animal Unit/Year | Citation |
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| Methane emissions mitigation (at $51/tonne CO2e) | $61 | In "Ammonia and greenhouse gas emissions from slurry storage - A review," Kupper et al. (2020) find that uncovered dairy lagoons emit 8.3 kg methane per m3 per year. Assuming 46 m3 per animal unit, methane emissions total 381 kg per animal unit per year. Assuming a 13% reduction in methane emissions from implementing a cover,* as per Kupper et al., emissions reductions total 50 kg per AU per year. Converting to tonnes of CO2e yields a value of 1.2 tonnes CO2e per AU per year. At $51 per tonne CO2e, the value of implementing a cover is $61 per AU per year.<br><br>*Cover types for which there was available methane data: lid (wood or concrete), plastic fabrics, expanded clay, straw cover, and vegetable oil. |
| Carbon dioxide emissions mitigation (at $51/tonne CO2e) | $10 | Kupper et. al. (2020) find that an uncovered dairy lagoon emits 58 kg per m2 per year, which equals 2.26 tonnes CO2e per animal unit per year if assuming 39 m2 per animal unit. Assuming that a lagoon cover* reduces CO2 emissions by 9% (Kupper et. al. 2020), the cover will reduce CO2 emissions by an average of 0.2 tonnes CO2 per AU per year when standardized. The benefit, at $51 per tonne, totals $10 per AU per year.<br><br>*Cover types for which there was available CO2 data: plastic fabrics, expanded clay, straw cover, and vegetable oil. |

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| Air Quality/ Human Health Benefits | $1,018 | In "Ammonia and greenhouse gas emissions from slurry storage - A review," Kupper et. al. 2020 find that storage covers* on dairy waste lagoons tend to reduce ammonia emissions by an average of 75%. The average ammonia emissions from a dairy waste lagoon total 43 kg per animal unit per yr. A 75% reduction equals 71lbs per head per year. The public health cost of ammonia emissions in the United States is $54,900 per ton NH3 (Heo et al. 2016), resulting in a per-animal unit benefit of $1,917.<br><br>In "Measurement of Atmospheric Ammonia, Methane, and Nitrous Oxide at a Concentrated Dairy Production Facility in Southern Idaho Using Open-path Ftir Spectrometry," Bjorneberg et al. (2009) found that a waste lagoon on a dairy farm emitted 7.25kg of ammonia per day. When adjusted for an annual rate and divided by the herd size, emissions equal 3.7kg per head per year. At a 75% reduction rate from implementing a cover, the emissions reduce by 4.46lbs per AU per yr, creating a benefit of $120 per AU per yr.<br><br>The average of $1,917 per AU per year and $120 per AU per year equals $1,018 per AU per year.<br><br>*Cover types for which there was available ammonia data: lid (wood or concrete), tent covering, plastic film, plastic fabrics, expanded clay, plastic tiles, peat, straw cover, and vegetable oil. |
| **Total** | **$1,089** | |