Management-Intensive Grazing

Initiative Summary: This initiative would create incentives and provide support for farmers wishing to transition their livestock operations from grain-intensive practices (which usually requiring the importing of grain/nutrients into the region) to continuous MiG, which by contrast takes advantage of more local resources and increases sequestered carbon in pasturelands.

In addition to the implementation of MiG on farms, the initiative would help in marketing Pennsylvania-grown, pasture-based products to Pennsylvanians. A strategy of "Eating the View" would emphasize the need for consumers to choose products that help to maintain the bucolic pasturelands for which Pennsylvania is famous, while also improving their own nutrition and the health of the planet by sequestering more carbon through intensive grass production.

Goals: Double the number of acres under management-intensive grazing (MiG) by 2020.

Implementation Period: The implementation of this option will proceed with a linear increase in additional MiG acres between 2013 and 2020.

Implementation Steps: Provide incentives for farmers/grazers/ranchers to transition to MiG.

Estimated GHG Reductions and Net Costs or Cost Savings

GHG Reductions from MiG

The goal is to double the number of acres with MiG in Pennsylvania by 2020. The number of MiG farms in Pennsylvania as of 2007 was 10,871.[1] This was divided by the total number of dairy and cattle farms in the state in 2007 (42,749) to calculate the percentage of farms already utilizing MiG practices (25.4%). When this number is multiplied by the total pastureland acreage in Pennsylvania (1,279,590 acres), we can estimate the number of acres with MiG practices, just over 325,000. This is used as our baseline, and under the policy, this number will double to over 650,000 acres of MiG pastureland by 2020.

The GHG savings of MiG come primarily from two areas: soil carbon sequestration and reduced methane emissions. Land that is intensely grazed or that is being used to produce crops (such as corn) to be fed to cattle typically has minimal soil carbon sequestration. MiG allows greater carbon sequestration than traditional grazing methods, probably due to increased carbon inputs either from greater above-ground inputs (greater productivity or manure inputs), increased root

[1] USDA. Census of Agriculture, 2007. Volume 1, Chapter 2: County Level Data (Pennsylvania). http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_2_County_Level/Pennsylvania/index.asp

turnover, or a combination of the two.[2] For the purpose of this quantification, no GHG savings were attributed to increased root volume. GHG savings are estimated to be 14.3 metric tons of carbon dioxide equivalent (tCO_2e)/acre (3.9 metric tons of carbon/acre) under MiG.[3] These savings are assumed to occur all in one year, although they actually build up for about 10 years. The GHG savings of MiG are shown in Table 1.

Table 1. Carbon Sequestration from Management-Intensive Grazing

Year	Implementation Path	Total Additional Acres of Beef/Dairy Cattle	Additional Sequestration ($MMtCO_2e$)
2013	0%	0	0
2014	15%	48,810	0.70
2015	30%	97,619	0.70
2016	45%	146,429	0.70
2017	60%	195,239	0.70
2018	75%	244,048	0.70
2019	90%	292,858	0.70
2020	100%	325,398	0.47
Total			**4.65**

There are also GHG savings that result from reduced methane emissions. Cattle digest grass through a natural process called enteric fermentation. Enteric fermentation results in methane emissions, which can vary depending on the amount and type of feed given to the cattle. MiG practices reduce the overall amount of feed and generally result in a diet that is easier to digest than the diet given to cattle in confined feeding operations.[4] While methane emission reductions

[2] Conant, Richard and Paustian, Keith. "The Effects of Grazing Management on Soil Carbon (Carbon Sequestration)". National Renewable Energy Laboratory. 2002. http://www.nrel.colostate.edu/projects/agecosys/people/files/rtc/pres/2000/lv00/glci00.pdf

[3] Ibid.

[4] DeRamus, H.A. Clement, T.C., Giampola, D.D., and Dickinson, Peter. "Methane Emissions of Beef Cattle on Forages: Efficiency of Grazing Management Systems". Journal of Environmental Quality. 2003. http://jeq.scijournals.org/cgi/reprint/32/1/269.pdf

can vary based on other factors, an average reduction of 22% was found when MiG practices were implemented.[5] These are applied to all animals in this analysis, as shown in Table 2.

Table 2. Reduced Methane Emissions and Total GHG Reductions

Year	Additional Beef/Dairy Cattle in MiG	Enteric Fermentation Emissions ($MMtCO_2e$)	Emissions Reduction ($MMtCO_2e$)	Total Emissions Reduction ($MMtCO_2e$)
2013	0	2.77	0.000	0.00
2014	61,381	2.76	0.023	0.72
2015	122,761	2.75	0.046	0.74
2016	184,142	2.75	0.070	0.77
2017	245,522	2.73	0.093	0.79
2018	306,903	2.72	0.116	0.81
2019	368,283	2.71	0.139	0.84
2020	409,203	2.69	0.154	0.62
		Total	**0.641**	**5.29**

Costs of Management-Intensive Grazing

MiG often results in decreased production from the dairy herd, because animals have less feed available. However, costs are often significantly lower, which typically counterbalances this loss in revenue.[6] The switch from centralized feeding to managed grazing can be made relatively inexpensively. According to Kriegel and McNair, "transitioning from a traditional dairy farm to a managed grazing operation requires very little additional investment."[7] The primary cost of implementing MiG practices is fencing, which is estimated to be between $30 and $70 dollars

[5] DeRamus, H.A. Clement, T.C., Giampola, D.D., and Dickinson, Peter. "Methane Emissions of Beef Cattle on Forages: Efficiency of Grazing Management Systems". Journal of Environmental Quality. 2003. http://jeq.scijournals.org/cgi/reprint/32/1/269.pdf

[6] Kriegel, Tom and McNair, Ruth. "Pastures of Plenty: Financial Performance of Wisconsin Grazing Dairy Farms". University of Wisconsin-Madison. 2005. http://www.cias.wisc.edu/wp-content/uploads/2008/07/pastplenty607.pdf

[7] Ibid.

per acre. The higher cost is used to account for the cost of constructing livestock lanes.[8] This is discounted forward to reflect 2010 dollars, and applied to the first year MiG practices are implemented, as shown in Table 3.

There are also associated costs and cost savings that come from maintaining MiG practices. Costs come primarily in the form of reduced yield (beef sold or milk produced), and costs savings come from reduced inputs, such as corn to be fed to the cattle. A survey of profitability of different farm types over seven years found that net farm income for dairy operators was higher for managed grazing ($524/head) than for traditional confinement ($245/head) or large-scale confinement practices ($131/head).[9] These costs are also shown in Table 3. Final costs are discounted to 2010 dollars using a 5% discount rate. Additional information on the cost-effectiveness of MIG practices in Pennsylvania, if available, would improve this analysis and reduce the underlying uncertainty.

Table 3-3. Costs and Cost Savings of Management Intensive Grazing Practices

Year	Additional Acres of Beef/Dairy Cattle	Additional Cost of Fencing ($MM)	Cost Savings from MiG Practices Compared with Traditional Confinement ($MM)	Net Costs ($MM)	Discounted Net Costs ($MM)
2013	0	$0.0	$0	$0	$0
2014	48,810	$4.8	$18	-$13	-$11
2015	97,619	$4.8	$36	-$31	-$24
2016	146,429	$4.8	$54	-$49	-$37
2017	195,239	$4.8	$72	-$67	-$48
2018	244,048	$4.8	$90	-$85	-$58
2019	292,858	$4.8	$108	-$103	-$67
2020	325,398	$3.2	$120	-$117	-$72
			Total	**-$467**	**-$316**

[8] Undersander et al, "Pastures for Profit, A guide to rotational grazing". University of Wisconsin Extension Service. 2002. http://learningstore.uwex.edu/pdf/A3529.pdf

[9] Kriegel, Tom and McNair, Ruth. "Pastures of Plenty: Financial Performance of Wisconsin Grazing Dairy Farms". University of Wisconsin-Madison. 2005. http://www.cias.wisc.edu/wp-content/uploads/2008/07/pastplenty607.pdf

Key Assumptions:

It is assumed that underutilized land is available in PA to allow for expanded MiG.

Note: No costs for leasing pastureland have been included in this quantification. It is assumed that farmers/ranchers would have the acreage they need to graze their cattle. The inclusion of leasing costs or opportunity costs for pastureland will make this option more expensive and less cost-effective.

Key Uncertainties

MiG is typically more land-intensive than centralized feeding operations. GHG impacts from land-use change are very difficult to fully account for. This is particularly difficult in the case of cattle, where land that goes toward grazing may not be usable for alternative agricultural production. In such a case, it is likely that the GHG impacts from expanded land requirements are negligible. However, if additional land going toward MiG is coming from valuable cropland or forestland (for example), then the GHG impacts of that change could be significant.

In addition, some subcommittee members expressed concern that MiG practices often result in increased nitrous oxide (N_2O) emissions. Given that N_2O emissions have a global warming potential of more than 300 times that of CO_2, an increase in these emissions could erode or even negate the GHG savings of this policy option. However, there was no information available regarding the true impact of MiG practices on N_2O emissions, so these impacts were not quantified. In addition, the plants being grazed can dramatically alter N_2O emissions, particularly if they are nitrogen-fixing crops, such as certain legumes.

The cost savings of MiG practices are from a Wisconsin study of dairy cattle. If this is not applicable to beef cattle or to Pennsylvania farms, the cost estimates may not be accurate.

Additional Benefits and Costs

Market demand is already high for milk and beef products, so there should be very little overall cost impact on farmers or communities.

MiG could have some corollary benefits in terms of revenue, such as tourism or aesthetic improvement.

Grazing without supplemental feed can result in more profitable dairy farms, in spite of decreased milk production. However, this may require additional land going toward agriculture to meet overall demand for milk.

It is possible that additional GHG savings can be achieved by growing nitrogen-fixing plants, such as legumes, in a managed area. This would serve to naturally reduce N_2O emissions from cattle manure. These emission reductions were not included because it is difficult to assess the overall effectiveness of this GHG reduction strategy, and no information could be found to detail the impacts of this practice.

Some studies have found nutritional benefits of grass-fed beef, compared to corn-fed beef. It is possible that expanding MiG practices will improve the nutritional value of Pennsylvania milk and beef.

References:

Conant, Richard and Paustian, Keith. "The Effects of Grazing Management on Soil Carbon (Carbon Sequestration)". National Renewable Energy Laboratory. 2002. http://www.nrel.colostate.edu/projects/agecosys/people/files/rtc/pres/2000/lv00/glci00.pdf

DeRamus, H.A. Clement, T.C., Giampola, D.D., and Dickinson, Peter. "Methane Emissions of Beef Cattle on Forages: Efficiency of Grazing Management Systems". Journal of Environmental Quality. 2003. http://jeq.scijournals.org/cgi/reprint/32/1/269.pdf

Kriegel, Tom and McNair, Ruth. "Pastures of Plenty: Financial Performance of Wisconsin Grazing Dairy Farms". University of Wisconsin-Madison. 2005. http://www.cias.wisc.edu/wp-content/uploads/2008/07/pastplenty607.pdf

Undersander et al, "Pastures for Profit, A guide to rotational grazing". University of Wisconsin Extension Service. 2002. http://learningstore.uwex.edu/pdf/A3529.pdf

USDA. Census of Agriculture, 2007. Volume 1, Chapter 2: County Level Data (Pennsylvania). http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_2_County_Level/Pennsylvania/index.asp

Potential Overlap: Potential overlap with other work plans that require land—such as for biofuel feedstock production or forestry preservation options.

Feasibility Issues:

The transition from confined feeding to MiG is often most cost-effective on small-scale farms. Given the sunk costs involved in centralized feeding operations (particularly large ones), it may be difficult to make this transition without significant loss of capital.