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Special Assistant to the Under Secretary
For Research, Education and Extension
United States Department of Agriculture
Jamie L. Whitten Building
1400 Independence Avenue, SW.,
Washington, DC 20250

Request for Public Input on USDA's Climate Change Strategic Planning Priorities and Goals for Research, Education and Extension

Dear Ms. Rollings:

The Center for Food Safety (CFS) and its Cool Foods Campaign submits the following comments in conjunction with the "Request for Public Input on USDA's Climate Change Strategic Planning Priorities and Goals for Research, Education and Extension" under the United States Department of Agriculture. 73 Fed. Reg. 45693 (March 7, 2008).

CFS is a non-profit public interest and environmental advocacy membership organization established in 1997, working to protect human health and the environment from potentially harmful food production technologies and promoting sustainable alternatives. CFS combines multiple tools and strategies in pursuing its goals, including litigation and legal petitions for rulemaking, policy and research, as well as public education.

The Cool Foods Campaign of the Center for Food Safety is a public advocacy education campaign to inform the public about the impact of greenhouse gas (GHG) emissions from agriculture and the food system on global warming. The Campaign has conducted extensive scientific data analyses of greenhouse gas emissions from all aspects of the U.S. food system. The aim of the Campaign is to educate people about the impact of their food choices across the entire food system and create lifestyle and legislative changes to reduce global warming. Our campaign seeks solutions to the problem of global warming, and focuses on agricultural practices and food choices that can reduce and reverse this trend.

We have a number of ideas for ways in which the USDA can conduct research, education and extension with regards to climate change and agricultural issues that we discuss below.

BACKGROUND

In the August 6, 2008 Federal Register, the United States Department of Agriculture (USDA) requested public input on the USDA's Climate Change Strategic Planning Priorities and Goals for Research, Education, and Extension. Recently, the USDA prepared a major scientific assessment of the effects of climate change on agriculture, land resources, water resources and biodiversity in the United States for the Climate Change Science Program (CCSP). As part of the planning process, the USDA has established four draft goals including: 1) Understand the effects of climate change on natural and managed ecosystems; 2) Develop knowledge and tools to enable adaptation to climate change and improve the resilience of natural and managed ecosystems; 3) Develop knowledge and tools to reduce the contributions of agriculture, forestry, and other land management practices to the bui9ld up of greenhouse gases in the atmosphere; and 4) Deliver climate change science and technology to USDA agencies, stakeholders and collaborators for improved decision making. In an effort to prepare a Strategic Plan to be published on the USDA website, the USDA seeks public comment on potential planning priorities and goals for research, education and extension.

The Center for Food Safety and the Cool Foods Campaign have numerous ideas for each of the four draft goals, as well as additional initiatives, in conjunction with the Strategic Plan to best assess climate change and necessary prevention, adaptation, and mitigation in the future.

CENTER FOR FOOD SAFETY COMMENTS

Summary

The potential impacts of climate change are now well documented and climate change effects will be felt throughout the world in various sectors. While significant focus for climate change mitigation has examined the transportation and energy sectors, relatively few initiatives exist to consider the GHG emissions from agriculture, livestock production and the food system. It is estimated that our food system uses close to 20% of the energy in our country[1] and produces up to ¼ of all GHG emissions. With such a significant contribution, the USDA is timely to consider significant research to best understand the ways in which agriculture and livestock production contributes to climate change, needs to adapt to it, and can help mitigate it.

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[1] Pimentel D, Williamson S, Alexander CE, Gonzalex-Pagan O, Kontak C, Mulkey SE (2008) *Reducing Energy Inputs in the US Food System.* Hum Ecol. 36:459-471.

While some research already exists to demonstrate that organic and no-till production systems produce fewer GHG emissions, the USDA should conduct thorough and extensive life cycle assessments of four production systems- organic, conventional, organic no-till and conventional no-till in addition to research on grass-fed pastoral systems to best understand the ways that our agricultural system can cope with changing climate conditions and potentially help reduce GHG emissions in the United States. To best conduct this research the USDA should consider pre-farm, on-farm and post-farm emissions from the various systems including such factors as: production, packaging, transportation and application of synthetic and organic fertilizers and pesticides; seed production, cleaning and transport; on-farm energy use; enteric fermentation; land-use changes; manure management; food transportation; processing; and packaging. As research becomes more available, the USDA should establish a website and dissemination system to give the public, and especially farmers, full access to research and conclusions to facilitate transitions to more efficient and climate-friendly systems like organic and grass-fed.

I. Draft Goal One

Draft Goal One as stated in supplementary information is: "Understand the effects of climate change on natural and managed ecosystems."[2] At 73 Fed Reg 45693, the USDA lists a variety of areas for emphasis and CFS is grateful for the agency's recognition of such diverse issues. Specifically, the attention given to the impact of climate change on grazing lands and croplands is of particular interest to CFS. Climate change will affect these systems differently and may affect various types of livestock and agricultural production systems in diverse and various ways. It is crucial to understand the ways in which climate change will impact on both grazing lands and croplands to ensure that the American food supply remains abundant and safe. To this end, CFS recommends additional research requests based on Goal One of the Strategic Plan.

The Effect of Climate Change on Various Production Systems

While Draft Goal One recognizes the significant impact that climate change could have on croplands, it will remain crucially important to fully research the various ways that climate change will affect all types of croplands and production systems. Agricultural methods and farming systems are unique in that they can both offer the potential to mitigate GHG emissions, but may also be major contributors of GHGs as well. At the same time, climate change could affect organic systems differently than conventional industrial systems. Research has demonstrated that organic and no-till production systems are better able to retain water and may be able to withstand drought and other weather events more than conventional cropping systems.[34] Similarly, organic systems may be better suited to handle unpredictable and widespread pest infestations through the use of intercropping, cover crops and integrated pest management. Research has also shown that organic systems have the potential to decrease incidences of certain types of plant diseases.[5]

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[2] 73 Fed. Reg. 73 No. 152 (August 6, 2008).

[3] Bescansa P, Imaz MJ, Virto I, Enrique A, Hoogmoed W.B. (2006) Soil water retention as affected by tillage and residue management in semiarid Spain. *Soil & Tillage Research*. 87:19-27.

[4] Pimentel D, Hepperly P, Hanson J, Douds D, Seidel R, (2005) environmental, Energetic, and Economic Comparisons of Organic and Conventional Farming Systems. *Bioscience*. 55:573-582.

[5] Leon MCC, Stone A, Dick RP (2006). Organic soil amendments: Impacts on snap bean common root rot (Aphanomyes euteiches) and soil quality. *Applied Soil Ecology*. 31:199-210.

Conclusive research on all of these topics, as well as other events and issues that may arise as a result of climate change impacts on agricultural cropland, are needed to best understand the ways in which American farmers can transition their production methods to best adapt to climate change. If it becomes apparent that certain production systems are less affected by climate change than others it would be prudent for USDA and other government agencies to implement systems to transition farmers into different types of crop production systems. To this end, CFS recommends that USDA research the effect of climate change and related weather and pest events on four types of production systems: certified organic, conventional, organic no-till, and conventional no-till. A thorough analysis of the effect of climate change on these four systems will provide extremely timely and important research for farmers, government agencies and the American public to be best able to withstand climate change impacts.

The Effect of Climate Change on Grazing Lands and Animals

The USDA notes that climate change may have real impacts on grazing lands in particular. Certainly, long and short-term changes in climate, weather, pests and other related events will have an effect on grazing lands and should be studied extensively. USDA should especially consider the effect of temperature changes on grassland vitality and the potential for depletion and creation of new grasslands. As temperatures shift, grasslands may be adversely affected but could also shift further north with warming climates. In addition, changes in precipitation may have drastic effects on grassland. Limited precipitation may cause desertification of current grasslands; similarly, increased rates of precipitation could transition grasslands into forests, wetlands or other landscapes. USDA should thoroughly examine the ways in which all potential climate change impacts will change the physical composition of grassland regions and their ability to support grazing animals.

It is also imperative to research the effect of climate change on livestock and other food animals, in addition to understanding their habitats. While negative impacts on grazing lands could harm the livestock industry, physiological impacts on food animals as a result of climate change events could also have untold effects. To date, very little research has been conducted on the effect of changing climate on animal health, reproduction and well-being. Livestock and other grazing and food animals are highly sensitive to changes in heat, water and food. As climate change may cause widespread changes in grazing techniques, available food and water, and weather, it is vital to examine the impacts this may cause on animals.

In particular, research has demonstrated that changes in ruminant diets can have an important effect on bacteria survival, especially of *E. coli*, and can cause changes in methane emissions. The digestive tract of cattle is ideally suited for a high fiber diet, such as grass and other forage. But when cattle are fed fiber-deficient grains, like corn, digestive mechanisms become disrupted which can lead to a number of serious health complications[6] that require energy-intensive treatments. Of notable concern is the development of *E. coli* O157:H7, which is triggered by a high grain (low fiber) diet, and often treated with an assortment of antimicrobials. Studies have shown that cattle fed high grass diets had lower rates of *E. coli*

[6] Such as tissue degradation and liver abscesses, hoof loss, "feedlot bloat", and suffocation.

O157:H7 in their stomachs[7] and such research is significant to consider in the context of climate change. If grazing lands are to be adversely affected by climate change, this may cause a shift in dietary patterns of livestock and other animals. With the potential decreased access to pasture and increased use of grain inputs in livestock diets, there could be a vast impact on the health and safety of our nation's food supply. To continue to ensure a safe and adequate food system, the USDA should research the effect of diet changes that may result in food animals because of climate change. Specifically, the USDA should examine whether diets consisting of grains, especially corn, rather than forage increase the prevalence of *E.coli* O157:H7 or other diseases and bacteria among cattle and other food animals.

The Use of Distiller Grains as a Feed for Animals

As the USDA and other government agencies consider alternative fuel sources, there has been a rapid increase in ethanol production. Production doubled from 3 billion barrels in 2003 to 6 billion barrels in 2007, and is expected to double again to 12 billion barrels by 2010.[8] Estimates for 2008-2009 field crop use of corn by the USDA concludes that ethanol and its coproducts (including distillers grains) make up almost 30% of total corn supply.[9] The production of ethanol as a means to address climate change still remains controversial and inconclusive, since studies demonstrate that ethanol production is in fact not reducing greenhouse gas emissions[10]. As production continues to increase, the impacts of ethanol production are being felt far and wide throughout the United States. Already one of the by-products of ethanol is having significant impacts on animal production. Recent increases in the production of ethanol have led to a substantial increase in distillers grains- a byproduct of ethanol production. In 2004 alone, ethanol plants produced approximately 7.3 million tons of distillers grains[11], which has increased as ethanol production has rapidly scaled up to meet political mandates. Ethanol production continues unabated and distillers grains are becoming common animal feed.

USDA should examine the dietary and health impacts of feeding distillers grains to cattle and other animals, especially since there is an increase in the by-product as a result of biofuel production. Preliminary research has indicated that feeding distillers grains to cattle increases the ability of *E.coli* O157:H7 to survive and flourish in cattle stomachs.[12][13] Such persistence can and will have drastic effects on the American meat supply and could potential sicken vast numbers of people. *E.Coli* O157:H7 is a deadly strain of bacteria that

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[7] Russell, James B.; Rychlik, Jennifer, L. (2001). Factors that alter rumen microbial ecology. *Science*. 292: 1119-1122.

[8] USDA ERS. Agricultural Baseline Projections: U.S. Crops, 2008-2017 http://www.ers.usda.gov/Briefing/Baseline/crops.htm

[9] USDA ERS. Field Crop 2008-2009 Corn Estimates. http://www.ncga.com/PDFs/CORNSTATS.pdf

[10] Searchinger T, Heimlich R, Houghton R.A., Dong F, Elobeid A, Fabiosa J, Tokgoz S, Hayes D, Yu T.H. (2008). Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change. *Science*. 319: 1238-1240.

[11] National Corn Growers Association. Distillers Grains Feeding Recommendations. http://www.ncga.com/ethanol/DistillersGrains/index.asp

[12] Jacob M.E.,Fox J.T., Drouillard J.S., Renter D.G., Nagaraja T.G. (2008). Effect of Dried Distillers' Grain on Fecal Prevalence and Growth of *Escherichia coli* O157 in Batch Culture Fermentations from Cattle. *Applied and Environmental Microbiology*. 74:38-43.

[13] Varel V.H., Wells J.E., Berry E.D., Spiehs M.J. Miller D.N., Ferrell C.L., Shackelford S.D., Koohmaraie M. (2008) Odorant production and persistence of Escherichia coli in manure slurries from cattle fed 0,20,40, or 60% wet distillers grains with solubles. *J Anim Sci.* Published Online August 1, 2008.

can contaminate a large portion of the food chain as food animals are slaughtered and redistributed throughout foods. In addition, research also shows that feeding cattle diets high in distillers grains increases the emission rates of nitrous oxide, hydrogen sulfide and methane[14]—all potent greenhouse gases themselves. As the USDA is trying to examine ways in which to decrease climate change impacts and greenhouse gas emissions, it is imperative that they fully understand the impact of ruminant diets. If feeding distillers grains to cattle will increase not only food-borne illnesses and threaten our food supply, but also increase the very greenhouse gas emissions the Federal Government is working to decrease, it is irresponsible to continue such widespread use of distillers grains in cattle feed.

II. **Draft Goal Two**

Draft Goal Two as stated in supplementary information is: "Developing knowledge and tools to enable adaptation to climate change and improve the resilience of natural and managed ecosystems."[15] As the potential impacts of climate change become more apparent daily, it is crucial for the USDA to assess the ways in which existing and future agricultural and grazing lands can adapt to climate change. Certainly, it is also important for USDA to assess the agricultural systems that produce the least amount of GHG emissions as a means for not only adapting to climate change, but reversing the impacts of it altogether.

Assessing Alternative Agricultural Systems for Climate Change Adaptation
As indicated under comments for Draft Goal One, organic agriculture has demonstrated its ability to better adapt to weather events including drought, flood and pest invasions. The higher content of organic matter in soil in organic production systems can assist in retaining moisture that can be utilized during droughts, and also keep topsoil in place during floods. As the USDA considers the ways in which climate change will affect certain agricultural systems, as suggested above, they should also investigate alternative production systems as tools for climate change adaptation. In addition to organic production systems, no-till agriculture, especially organic no-till, may provide similar benefits by encouraging soil growth, retention and health. CFS strongly recommends that the USDA recognize and further research the ability of organic and no-till systems to provide better means for climate change adaptation in agriculture. Particularly, CFS recommends that the USDA especially note the impacts of drought, floods, and increased pests on organic and no-till systems, compared with conventional systems.

Researching the Economic Costs to Adapt to Climate Change
Under the elements of Draft Goal 2, USDA has noted that it is significant to examine the "economic costs, benefits, and feasibility of adaptation at the producer through the macroeconomic scale." Adaptation costs for climate change have the potential to be costly and far-reaching. Yet, many of the expensive agricultural inputs conventional agriculture has come to rely on, including chemical pesticides, fertilizers, genetically-engineered seeds, and widespread use of tractors for tilling, are not necessary for high-yielding productive systems. As the USDA considers the economic feasibility of adaptation, they should specifically look at low-input production systems like organic and no-till organic, which have fewer economic costs to begin with. As high cost inputs become more expensive with increasing fuel costs,

[14] Varel, Id.
[15] Federal Register, supra, note 2.

such as the recent rise in fertilizer costs, it is becoming increasingly apparent that conventional agricultural costs will continue to rise. Given the added pressure of potential climate change impacts, the USDA should strongly examine ways that organic and no-till production can be better utilized by farmers concerned with rising economic costs of farming. As part of this analysis the USDA should also examine the barriers to farmers who wish to convert to organic and no-till methods and examine ways to increase the economic viability of organic certification and transition to such methods.

III. Draft Goal Three

In the Strategic Plan, Draft Goal Three is listed as: "Develop knowledge and tools to reduce the contributions of agriculture, forestry, and other land management practices to the build up of greenhouse gases in the atmosphere."[16] Agriculture and animal production are significant producers of greenhouse gas emissions. Research has shown that agriculture could contribute as much as 32% of all global GHG emissions.[17] Yet, research has also demonstrated that organic systems use less fossil-fuels overall, and thus create fewer greenhouse gas emissions.[18] As the United States examines the ways in which it can reduce its global GHG emissions, agriculture and animal production will certainly play a vital role in the discussion. It is crucial for the USDA to research and investigate ways in which the agricultural sector can reduce its GHG emissions and also potentially mitigate emissions as well.

Life Cycle Analyses to Analyze GHG Emissions in Various Production Systems

To better understand the ways and means in which organic, conventional and no-till (conventional and organic) agricultural production contributes GHG emissions to the atmosphere, the USDA should conduct life cycle assessments (LCAs) of all four systems. Only through adequate and thorough LCAs will the USDA be able to understand the greatest ways in which agriculture contributes GHGs, and through what types of production systems. CFS recommends that LCAs must examine all aspects food production beginning with pre-farm inputs such as synthetic fertilizers and pesticides, and ending with post-farm factors including transportation, processing and packaging of foods.

Pre-Farm Emissions Analysis

Greenhouse gas emissions in agricultural systems begin before seeds are even planted in the ground. A variety of inputs are typically used in conventional agriculture that requires significant amounts of energy and fossil fuels to produce. Current conventional industrial agricultural production is heavily reliant on synthetic pesticides and fertilizers which are contributing significant amounts of GHG emissions to the atmosphere. CFS recommends that the USDA specifically undertake significant research to compare the GHG emissions from the production, packaging, transportation, application and volatization of synthetic pesticides and fertilizers. Every year the U.S. food system uses nearly 40 billion pounds of

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16 Federal Register, supra, note 2.

17 Bellarby J, Foereid B, Hastings A, Smith P (2008) *Cool Farming: Climate impacts of agriculture and mitigation potential.* Greenpeace International.
http://www.greenpeace.org/raw/content/international/press/reports/cool-farming-full-report.pdf

18 Pimentel, supra, note 4 at page 575.

synthetic fertilizers and more than one billion pounds of synthetic pesticides.[19] [20] [21] By contrast, organic agriculture is not permitted to use synthetic pesticides or fertilizers. Research has shown that organic farming thus uses about half the energy of conventional systems, based solely on pesticide use.[22] To best understand the impact of pesticides and fertilizers on GHG emissions from agriculture, CFS also recommends that the USDA conduct LCAs on approved organic pesticides and fertilizers, including compost, as well. Conclusions about the impact of both synthetic and organic pesticides and fertilizers will demonstrate ways in which farmers can change their use of inputs to reduce GHGs in agriculture.

Pre-farm emissions also occur from a variety of other sources. The creation of genetically-engineered seeds and the transport of seeds is another way in which greenhouse gas emissions may be produced prior to planting. CFS recommends that the USDA examine the energy usage and thus emissions from the creation of genetically-engineered seeds, seed cleaning, and the resulting emissions from transporting seeds. Seed transportation may be a factor in both organic and conventional systems, but would be certain in systems using genetically-engineered seeds, since the seeds can not be saved each year.

On Farm GHG Emissions

GHG emissions on-farm are the result of a variety of sources including on-farm energy use, manure management, enteric fermentation, land-use changes and soil management. Many of these systems are complex and require thorough analysis and significant research. In an effort to produce the best LCAs possible of organic, conventional, no-till organic, and no-till conventional, the USDA should consider all of the aforementioned areas in which GHGs may produced on-farm. With regards to manure management and enteric fermentation, earlier recommendations on examining diet changes would also be applicable here. Manure management should also be strongly examined. The USDA should examine manure management extensively to compare organic, conventional and pastoral systems, including on-farm collection methods like lagoons and pits, as well as incorporation in fields directly which is common in grass-fed systems. USDA should also consider emissions beyond methane, including ammonia and hydrogen sulfide, which have the ability to produce greenhouse gas emissions.

Methane Digesters

Recent interest in methane digesters on farms may offer some mitigation opportunities, but also poses many challenges. There are many factors with methane digesters that may in fact not result in overall reductions in greenhouse gas emissions. Research has estimated that methane digesters could potentially only provide about .0002% of the energy currently consumed in the U.S.[23] As well, the compression of methane gas requires significant

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[19] General Accounting Office (GAO) (2001). Agricultural Pesticides: Management Improvements Needed to Further Promote Integrated Pest Management. GAO-01-815.

[20] Food and Agriculture Organization of the United Nations (FAO UN). Statistical Yearbook. Online at http://faostat.fao.org/site/339/default.aspx

[21] Federal Register, supra, note 2.

[22] Pimentel, supra, note 1.

[23] Saltzman, R. (2006). *An Analysis of the Benefits of Farm-Scale Anaerobic Digesters in the United States.* Sierra Club.

amounts of energy, which may offset any potential greenhouse reductions.[24] Transportation of methane gas may also present difficulties, as most large scale farms will be able to produce more gas than they can use on farm; yet, given the economic investment of digesters, only large farms are usually able to invest in this technology. USDA should examine the ways in which methane digesters and methane gas produced on farms can be utilized by local grid systems and for on-farm energy use. They should also research the amount of energy needed to compress biogas to a usable form, and consider the overall greenhouse gas emissions or mitigation by the process.

Research has also shown that the use of antibiotics, and their presence in manure, impedes the bacterial breakdown in methane digesters. It is estimated that 70% of all antimicrobials used in the United States are administered to animals.[25] Given the prevalence of antibiotic use in livestock throughout the country, the USDA should examine the impact that antibiotic use will have on methane digestion and biogas production. If antibiotic use decreases the effectiveness of methane digesters, the USDA should not offer financial assistance to farms wishing to build methane digesters, if they are using antibiotics.

Land-Use Changes

As the production of ethanol has increased steadily, land-use has changed significantly. Subsidies for ethanol production have caused land previously held in reserve under the Conservation Reserve Program, to be taken out of conservation for corn production. In 2006, a chief economist for the USDA, Keith Collins, testified before the Senate about ethanol production. He noted, "The Conservation Reserve Program (CRP), which has 36 million acres set aside from crop production for environmental reasons, may provide a source of additional crop acreage…4.3 to 7.2 million acres currently enrolled in the CRP could be used to grow corn or soybeans."[26] As research published in early 2008 indicates, this type of ethanol production is not reducing overall GHG emissions.[27] USDA should conduct research on the impact of land-use changes of GHG emissions, specifically related to ethanol production and CRP land.

GHGs in Livestock Production

As the USDA considers the ways in which agriculture contribute GHGs to the atmosphere, they should also strongly note the role of animal production in climate change. The United Nations concluded in their 2006 report, "Livestock's Long Shadow" that animal production contributes 18% of all global GHG emissions.[28] Considering that the transportation sector contributes only 14% of GHGs, animal production should be a significant focus on reduction and mitigation strategies. In particular, LCAs to compare grass-fed, organic, and

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[24] Robbins, J.H. (2005). Understanding Alternative Technologies for Animal Waste Treatment: *A Citizen's Guide to Manure Treatment Technologies*, Chapter 6. Waterkeeper Alliance. Tarrytown, NY.

[25] Union of Concerned Scientists (UCS). (2001). *Hogging It!: Estimates of Antimicrobial Abuse in Livestock*. Online at http://www.ucsusa.org/food_and_environment/antibiotics_and_food/hogging-it-estimates-of-antimicrobial-abuse-in-livestock.html

[26] Statement of Keith Collins, Chief Economist- USDA, before the U.S. Senate Committee on Environment and Public Works. September 6, 2006.
http://www.usda.gov/oce/newsroom/archives/testimony/2006files/sentstbiofuels8-26-06_.doc

[27] Russell, supra, note 7.

[28] Steinfeld H, Gerber P, Wassenaar T, Castel V, Rosales M, de Haan, C (2006). *Livestock's Long Shadow-Environmental Issues and Options*. Food and Agriculture Organization of the United Nations.

conventional concentrated, grain-fed production systems are necessary to fully consider all of the complex inputs and differences in the three systems, which can be contributing GHGs in many ways.

Existing research on animal production, specifically ruminant livestock production, often focus on methane emissions. Yet, methane emissions are only one factor in the overall carbon footprint of meat and can not be considered exclusively. While some data suggests that grain-fed beef produces fewer methane[29] emissions than free range grass-fed beef, other studies demonstrate the opposite[30]. In fact, some research demonstrates that intensive or rotational grazing could increase soil carbon to offset GHG emissions by 15 to 30%.[31] Further research is needed on this topic, with a focus on diet-based emissions comparing grain fed cattle to grass fed cattle, as mentioned before. Once excreted however, manure may still produce significant amounts of GHGs. In pastoral grass-fed systems, manure is usually incorporated directly into the soil or collected for on-farm use. Organic production systems may use similar techniques. In contrast, animal waste in grain feedlots is often stored in "lagoons" or holding ponds that can contain up to 25 million gallons of manure and be as large as 20 acres and 15 feet deep.[32] [33] "During storage time the manure decomposes, and gaseous by-products are released."[34] "Toxic gases such as hydrogen sulfide (H_2S), carbon dioxide, ammonia and methane are present in every manure storage area."[35] It is increasingly important to understand the ways in which various manure management systems contribute to GHG emissions, and to thus shift manure management to systems that produce fewer emissions.

In addition to manure management, feed crops should also be considered a vital component of a thorough LCA of animal production. GHG emissions are prevalent in the growing of grain crops needed to feed cattle. In the United States, about half of the grain and oilseeds grown are fed to livestock.[36] [37] Growing crops like corn and soy conventionally to feed animals produces GHG emissions through the use of pesticides, fertilizers, machinery and transportation. Every year in the U.S., growing corn and soybeans – the main ingredients in animal feed – requires almost 270 million pounds of pesticides[38] [39] and more than 21 billion

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[29] Harper, L.A. et al. *Direct Measurements of Methane Emissions from Grazing and Feedlot Cattle*. J. Anim. Sci. 1999. 77:1392–1401.

[30] Koneswaran G, Nierenberg, D. (2008) *Global Farm Animal Production and Climate Change*. Env. Health Pers. 116:578-582.

[31] Phetteplace H, Johnson D, Seidl A, (2001). Greenhouse gas emissions from simulated beef and dairy livestock systems in the United States. *Nutrient Cycling in Agroecosystems*. 60:99-102.

[32] Marvin D. Factory Farms Cause Pollution Increases, *Johns Hopkins University Newsletter* 2004.

[33] Schlosser, Eric and Charles Wilson, Chew On This (New York, New York: Houghton Mifflin Company, 2006), 166.

[34] Park K. et al. Greenhouse gas emissions from stored liquid swine manure in a cold climate. *Atmospheric Environment* 40 (2006) 618-627.

[35] Cyr, Dawna and Steven Johnson. Barn and Manure Storage Safety Bulletin. University of Maine Cooperative Extension. http://www.umext.maine.edu/onlinepubs/htmpubs/2304.htm

[36] U.S. Department of Agriculture. *Feed Grains Database: Yearbook Tables*. Economic Research Service. http://www.ers.usda.gov/Data/Feedgrains/StandardReports/YBtable4.htm

[37] U.S. Department of Agriculture. *Oil Crops Yearbook*. Economic Research Service. http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1290

[38] USDA. (2006). *Agricultural Chemical Usage: 2005 Field Crops Summary*. National Agricultural Statistics Service.

[39] USDA. (2007). *Agricultural Chemical Usage: 2006 Field Crops Summary*. National Agricultural Statistics Service.

pounds of synthetic fertilizer[40][41] which produce vast amounts of GHG emissions in their production, transportation and application. On average, it requires 13 kilograms of grain to produce 1 kilogram of beef,[42] which requires significant amounts of energy.

In contrast, animals that are "grass-fed" or produced using organic methods produce significantly fewer GHG emissions than conventionally raised animals. These systems typically require less synthetic inputs and energy to operate than industrial facilities.[43][44] Grain-fed beef – animals raised in feedlots – requires twice as many energy inputs compared to grass-fed beef.[45] USDA-certified grass-fed animals cannot be fed grain or grain byproducts and must have continuous access to pasture during the growing season.[46] While some animals, like chickens or pigs, do not eat grass and may rely on feed crops, if raised organically the animals are fed 100% organic feed grown without synthetic pesticides and fertilizers. As a result, organic meat and dairy products result in significantly fewer GHG emissions than conventional meat and dairy.[47] The USDA should consider this research in their own analysis and undertake advanced LCAs to quantify this data. Such research will be necessary to conclude the types of animal production systems and methods which can reduce GHG emissions below their current levels.

Local and Regional Food Systems

Recent interest in local foods, has led to considerable questions about the GHG emissions from the transportation of food. While research indicates that the transportation of food is only 14% of total GHG emissions from the food system[48], there are certainly ways to reduce GHG emissions in food transportation. In addition, the way in which food has been transported also has considerable impact on the GHG emissions for that food. Air transport requires five times the energy of road transport, and more than 23 times the energy of rail transport.[49] While local systems will likely utilize mostly road transport, they may not be as efficient as possible, given economies of scale. To better understand the complexities of local and regional food systems, and to develop models to increase efficiency and reduce GHG emissions from food, CFS recommends that the USDA conduct LCAs of local, regional and national food transport systems.

IV. Draft Goal Four

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[40] USDA, supra, note 36.
[41] USDA, supra, note 37.
[42] Pimentel D, Pimentel M. *Sustainability of meat-based and plant-based diets and the environment.* World population, food, natural resources,and survival. World Futures 2003; 59:145–67.
[43] Steinfeld, supra, note 28.
[44] Heitschmidt RK, Vermeire LT, Grings EE (2004) *Is rangeland agriculture sustainable?* American Society of Animal Science. 82(E.Suppl) :E138-E146.
[45] Pimentel D, Pimentel M, (eds.) (2008). *Food, Energy, and Society: Third Edition.* CRC Press: Boca Raton.
[46] Steinfeld, supra, note 28.
[47] Pimentel, D (2004). *Livestock Production and Energy Use.* Encyclopedia of Energy.
[48] Heller, Martin C.; Keoleian, Gregory A. (2000). Life Cycle-Based Sustainability Indicators for Assessment of the U.S. Food System. Center for Sustainable Systems, University of Michigan. Report No. CSS00-04. December 6, 2000. Retrieved from: http://css.snre.umich.edu/css_doc/CSS00-04.pdf
[49] Whitlegg, J (1993) Transport for a Sustainable Future: The Case for Europe. Bellhaven Press, London.

The USDA Strategic Plan lists Draft Goal Four as, "Deliver climate change science and technology to USDA agencies, stakeholders and collaborators for improved decision making."[50] CFS supports the USDA in the efforts to roll out research and information to the "general public, the scientific community, land managers, producers, and policy makers about climate change and agriculture and forestry." As the USDA considers the ways in which they will best distribute information, they should also consider the means by which they can encourage conversion to systems that produce fewer GHG emissions.

Producing and Distributing Educational Materials

The research conducted by the USDA and the Economic Research Service already provides invaluable information to the public, academics, non-profit organizations, industry and politicians. As the USDA researches various issues surrounding climate change, agricultural and livestock production and mitigation techniques, they should prepare their research for public dissemination. In addition to establishing a significant portion of their website to climate change issues, the USDA should produce materials specific to farmers to distribute at extension services. A summary of research conducted, along with measures that farmers can take to reduce their GHG emissions should be given to all farmers who work with the extension service. Farmers play a vital role in mitigating and decreasing GHG emissions and in order to best facilitate this transition, they need to have a thorough understanding of the issues and ways in which they can assist.

Facilitating Transitions

As farmers begin to realize the ways in which they can reduce their GHG emissions pre-farm, on-farm and post-farm, they should be given the resources to do so. Based on the significant research already conducted which has demonstrated the ability of organic agriculture to produce fewer GHG emissions and also potentially mitigate additional GHGs, in addition to the likely increase in similar research from LCAs from the USDA, CFS recommends that the USDA consider the transition to organic production for producers as a solution to reducing GHG emissions. CFS also recommends the USDA establish similar transitional systems for farmers wishing to pursue grass-fed pastoral systems, since it is demonstrated that grass-based systems use about half as much energy as conventional livestock production systems.[51] To this end, the USDA should research ways they can distribute information about climate change impacts on organic production and the role of organic production in reducing GHG emissions in agriculture. The USDA should make organic conversion a priority and establish support systems and technical assistance to those producers interested in converting to organic production. USDA should also work to secure additional funding to allow for the subsidization of organic and grass-fed transition.

V. Conclusions

Climate change is one of the most pressing issues of our time and it will affect not only our environment, but our ability to produce food and our entire agricultural system. The many factors of climate change will impact on our daily lives, agriculture and food systems in untold and myriad ways and adequate research will allow for proper adaptation, mitigation

[50] Federal Register, supra, note 2.
[51] Pimentel, Id, note 42.

and conversion to systems with reduced GHG emissions. CFS welcomes the opportunity to offer suggestions for research to examine these many issues and commends the USDA for their pro-active approach to investigating climate change, food and agricultural systems. CFS has made numerous suggestions for research and other outreach activities in the 4 draft goals of the Climate Change Strategic Planning Priorities and Goals for Research, Education and Extension, as outlined below.

CFS concludes that the USDA should do the following:

Draft Goal One

- Examine the impact of climate change on four types of production systems: organic, conventional, organic no-till and conventional no-till.
- Examine the impact of climate change on grazing lands and animals
- Specifically research the impact of climate change on animal physiology, and the potential increase of *E.coli* from grain fed systems vs. grass-fed systems
- Research the effect of distillers grains on cattle diet, as distillers grains become more prevalent as a result of ethanol production. Research indicates that distillers grains have the ability to increase GHG emissions and *E.coli* prevalence.

Draft Goal Two

- Assessing the ways in which organic and no-till production systems can better adapt to climate change through soil and water retention
- Research the economic feasibility of climate change adaptation in climate change, specifically the availability of money for organic and no-till transition

Draft Goal Three

- Conduct extensive life cycle assessments (LCAs) for four production types- organic, conventional, organic no-till and conventional no-till.
- Specifically research LCAs of both conventional and organic fertilizers and pesticides, including the effect of their production, packaging, transportation, application and volatization on GHG emissions
- Examine the GHG emissions of seed production, cleaning and transportation for genetically-engineered, conventional and organic seeds.
- Research on-farm GHG emissions for all four systems including energy use, manure management, enteric fermentation, land-use changes and soil management
- Specifically research methane digesters as a mitigation technique, especially considering the economic vs. benefit analysis, the effect of antibiotics on biogas production and other challenges.
- Research the effect that land-use changes have on GHG emissions, particularly the removal of lands held in conservation to produce ethanol.
- LCA analysis of livestock production, comparing conventional, organic and grass-fed systems.
- Comparison of local, regional and national food systems, specifically the impact of transportation on GHG emissions, and ways to decrease GHG emissions from food transport either by distance or type of vehicle used.

Draft Goal Four

- Establish a climate change section on the USDA website to publish studies and research
- Produce a summary for farmers, including ways to reduce GHG emissions from farms, to be distributed through extension services
- Offer financial and technical assistance to farmers wishing to transition to organic, localized or grass-fed production systems.

Respectfully Submitted,

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