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Good afternoon to you, the Honorable Eddie Bernice Johnson, Chairwoman, and members of the Committee; thank you for the opportunity to appear before you today to testify regarding "The impact of agriculture on water quality." My name is Jim Baker, recently retired from the faculty at Iowa State University, and currently working part-time for the Iowa Department of Agriculture and Land Stewardship. There I am involved with nutrient water quality issues related to both local fresh waters and hypoxia in the Gulf of Mexico. Today I want to present the six points listed below; I have also included a short written summary at the end of my written testimony.

- **Current nutrient water quality impairments in the Corn Belt are not mainly due to mismanagement of fertilizers and manures.**

    - Significant agricultural research in the last 35 years has led to a good understanding of nutrient crop uptake, versus the loss in surface runoff water and sediment and in subsurface ("tile") drainage.
    - Improved crop genetics and management have increased yields while limiting nitrogen inputs such that inputs are often less that outputs removed in grain plus losses, depending on the weather and crop rotation.
    - If the nitrogen balance is negative, soil organic matter is being mineralized, releasing carbon, reducing soil sustainability, and negatively impacting soil, air, and water quality.

- **The impairments are mainly due to the conversion from a prairie/wetland landscape to intensive grain crops with additional nutrient inputs, and installation of subsurface drainage where needed.**

    - Even with the best management practices, row-crops are leaky systems requiring significant amounts of soil nutrients be present for economic optimum growth, but which are susceptible to loss whenever excess water drains from the land
    - However, this historic land conversion by our forefathers has created a very productive system for growing food, feed, and fuel.

- **Reductions in impairments will come mainly through changes in cropping and/or implementation of off-site practices.**

    - More sod-based rotations could reduce nutrient losses significantly, but these management changes would likely lead to significant swings in the supplies of food, feed, and fuel.
    - Cover crops may have potential in the Midwest, but they are currently a "management nightmare" for producers.
    - Wetlands and vegetated filter/buffer strips, as off-site practices, require site-specific design and need to be strategically located in order to reduce field-to-stream transport of nitrogen and phosphorus, respectively.
    - But these different options are not "win-win" situations for the producers economically, and require incentives to encourage implementation.

- **Even with widespread adoption of the best available technologies, guidance federal nutrient criteria for standing and flowing water are not attainable in row-cropped areas of the Corn Belt.**

    - EPA's guidance criteria for nitrogen and phosphorus for the Corn Belt ecoregions are so low they are not always met by concentrations in today's rainwater.
    - Returning to pre-European settlement conditions of land cover is not realistic (former Iowa Secretary of Agriculture, Patty Judge, has said: "Not farming Iowa is not an option.").

- **Regulatory impediments are limiting the adoption and/or efficiency of off-site practices.**

    - Regulations requiring site-by-site assessment/permitting are not practical for landscape-scale application to the hundreds and thousands of sites that will be needed in each State.
    - Environmental regulatory frameworks that allow categorical and regional regulatory decisions are needed.
    - To be efficient, off-site practices must be allowed to be targeted to watersheds with the greatest need, and sited within those watersheds at locations where they can have the most impact.

- **What is needed for the future:**

    <u>Research funding</u>
    - To answer critical questions of soil fertility needed to assure future productivity and soil quality, develop new technologies on nutrient utilization for possibly new as well as existing crops, and evaluate potential and management needs of perennial and annual cover crops.

- For an Upper Mississippi River Nutrient Environmental Research Center being proposed at Iowa State University, engaging other land-grant universities across the Corn Belt.

Funding for States, Special Project Area Pilots, and Demonstrations

- To develop state water quality strategies, targeting on a local and regional basis tailored to the specific landscape and water quality issues.
- To engage existing local watershed management agencies, such as Iowa's 3000 drainage districts, in transforming agricultural landscapes to achieve water quality goals.

Regulatory frameworks

- To foster broad ecosystem and landscape-wide analyses and decision-making on a categorical basis for the large number of implementation sites needed for off-site management practices.

General Summary

Research in the Corn Belt over the last 35 years has quantified nutrient losses associated with crop production and the use of fertilizers and manures. Hydrology of the land, management practices and systems that affect land use and drainage, and weather play dominant roles in the transport of nonpoint pollutants in general, and different forms of nutrients in particular. The properties of the different forms, primarily in their adsorption/interaction with soil, also play a major role.

Drainage from agricultural lands dominates water flows in most parts of the Corn Belt because agriculture occupies a major portion of the land area. In tile-drained landscapes, nitrogen (N) losses, dominated by nitrate (NO_3) leaching, are of most concern and usually occur with sustained subsurface flows in spring and/or fall, at times with little row-crop water use/nutrient uptake. In contrast, in "rolling" landscapes with good surface drainage, phosphorus (P) losses with runoff water and sediment are of more concern, and occur with rainfall-runoff events that can happen year around, but that are generally greater in spring when the soil has less cover.

The most important "natural" factors affecting nutrient losses are soil properties and weather (the Corn Belt is fortunate to have fertile soils and generally ample precipitation, but both lead to nutrient losses). For N losses, the most important management factor is land use. The conversion to row crops, with installation of artificial subsurface drainage where needed, has created a productive system, but has also increased the potential for nutrient loss. For P, land use in conjunction with tillage is generally the most important management factor affecting hydrology and especially the erosion potential. The combination of rate, method, and timing of nutrient additions generally is of lesser importance (weather patterns often have more effect on

nutrient losses than nutrient management). One concern for N rates is that if they are too low, N must be supplied by the soil, depleting organic matter and causing soil, air, and water quality problems.

Because inorganic forms of N and P must be present in the soil at concentrations ample for crop production, whenever excess water moves over and/or through the soil, nutrient losses occur. Controlling these losses by a prescribed amount will be difficult for several reasons. The number of alternative systems available to producers is fairly limited due the lack of economically viable technologies; our ability to accurately predict the nutrient reduction expected for a given practice even under a standard set of homogenous conditions is limited; and the highly variable nature of weather, soil properties, and hydrological response times makes impact assessment of management change extremely difficult.

In terms of a "viable vision" for future water quality improvements, there are no easy answers and improvements will be incremental (but returning the Corn Belt to pre-settlement conditions is neither socially nor economically feasible, nor in the best interest of maintaining our nation's food, feed, and fuel production infrastructure). The potential and limitations of in-field and off-site management practices/systems need to be considered relative to their costs and acceptance for implementation. Off-site management systems that include structural practices will need to be implemented at a large number of sites to achieve landscape-level environmental improvement, and regulatory frameworks need to be compatible with this scale of implementation. Actions taken must be science-based; promotion of any wrong actions must be avoided.

In summary, emerging science indicates that current nutrient impairment problems are not mainly due to mismanagement of fertilizers and manures (certainly some improvement in management can and should be made). Overall, the majority of our nutrient impairments are due more to historic changes in land use and hydrology that came with the conversion of prairie and wetlands to cropland. In many areas this was done using artificial subsurface drainage; it should be noted that with the exception of NO_3-N leaching, the existence of subsurface drainage reduces the losses of other pollutants (i.e. those transported with surface runoff). Given this new perspective, and that these historic changes have created a very productive system critical to our country's food security, new, broader approaches to solving water quality problems will be needed. Further research is needed to design/refine new management practices and develop cropping system alternatives, possibly with more sod-based rotations. However, these new approaches must be sustainable with respect to both soil and water quality, and must also be economically feasible.