*2. Can you check if there is any information on what causes 11 site years to be so high, and write a short explanation in the sentence? (Or at least explain, are they all from one site, or one year, or one study? It just seems very high.)*

There are 11 site years with NO3-N loads greater than 60 kg/ha in the MANAGE database. 8 of them were originated from the studies in northern and southern parts of IA and MN, respectively, while 6 of them occurred within the same two years (1990 and 1991).

High N loads in all these case were largely attributed to unusual seasonal or annual precipitation patterns; in particular (a) wet years following the dry period with virtually no or very little tile flow, or (b) very wet spring conditions causing up to 80% of the NO3-N losses occurring by early June.

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **YEAR** | **SITE** | **LOAD** | **Researcher** | **Publication Name** | **State** | **Extract from The Publication** |  |
| 1989 | 120 | 72.5 | Kladivko | Nitrate leaching to subsurface drains as affected by drain spacing and changes in crop production system | IN | Loads were particularly high in 1989 after the low corn yield in the 1988 drought year. The higher residual nitrate that was probably remaining in the soil profile in autumn 1988, coupled with the high drain flow volumes in 1989, led to the highest nitrate N loads of the 15-yr study. |  |
| 1990 | 129 | 60.5 | Lawlor, Helmers | Nitrogen application rate effect on nitrate-nitrogen concentration and loss in subsurface drainage for a corn soybean rotation | IA |  | dry years followed by wet year |
| 1991 | 129 | 67 | Lawlor, Helmers | Nitrogen application rate effect on nitrate-nitrogen concentration and loss in subsurface drainage for a corn soybean rotation | IA |  |  |
| 2001 | 129 | 61.5 | Lawlor, Helmers | Nitrogen application rate effect on nitrate-nitrogen concentration and loss in subsurface drainage for a corn soybean rotation | IA | Approximately 80% of the NO3‐N losses that occurred in 2001 were prior to spring N application on 4 June and were likely derived from organic after N mineralization and previous spring applications made in a minimal drainage year (2000) |  |
| 2003 | 129 | 61.5 | Lawlor, Helmers | Nitrogen application rate effect on nitrate-nitrogen concentration and loss in subsurface drainage for a corn soybean rotation | IA |  |  |
| 1990 | 133 | 62.05 | Logan | Tillage, crop and climatic effects on runoff and tile drainage losses of nitrate and four herbicides | OH | Tile drainage, which previously averaged 40% of precipitation, was virtually zero in 1987 and 1988 and was 28% and 31% of precipitation in 1989 and 1990, respectively. 1990 was the wettest year. | dry years followed by very wet year |
| 1990 | 156 | 112.1 | Randall | Impact of long-term tillage systems for continuous corn on nitrate leaching to tile drainage | MN | Flow-weighted nitrate-nitrogen (NO-N) concentrations increased dramatically in the wet years (1990 and 1991) following the dry period of 1987 to 1989. During the wet 1990 to 1992 period, flow began each March and continued until November | wet spring + dry years before |
| 1991 | 156 | 125.9 | Randall | Impact of long-term tillage systems for continuous corn on nitrate leaching to tile drainage | MN | Flow-weighted nitrate-nitrogen (NO-N) concentrations increased dramatically in the wet years (1990 and 1991) following the dry period of 1987 to 1989. During the wet 1990 to 1992 period, flow began each March and continued until November | wet spring + dry years before |
| 1991 | 157 | 76.53 | Randall | Nitrate losses through subsurface tile drainage in conservation reserve program, alfalfa, and row crop systems | MN | No flow occurred in the dry years of 1988 and 1989. In 1990, a year of normal precipitation, tile lines in the row-crop systems flowed intermittently during a 26-d period from late May through June. In 1991 drainage occurred during a 102-d period (late March-early July) from the row crops. In 1993, when precipitation was >60% above normal, tile flow was abundant from all cropping systems during mid-March through mid-August. In 1993, drainage volume from the row and perennial crops closely paralleled monthly rainfall until July when ET from all cropping systems exceeded drainage. | wet year |
| 1993 | 157 | 81.63 | Randall | Nitrate losses through subsurface tile drainage in conservation reserve program, alfalfa, and row crop systems | MN | No flow occurred in the dry years of 1988 and 1989. In 1990, a year of normal precipitation, tile lines in the row-crop systems flowed intermittently during a 26-d period from late May through June. In 1991 drainage occurred during a 102-d period (late March-early July) from the row crops. In 1993, when precipitation was >60% above normal, tile flow was abundant from all cropping systems during mid-March through mid-August. In 1993, drainage volume from the row and perennial crops closely paralleled monthly rainfall until July when ET from all cropping systems exceeded drainage. | wet year |
| 2011 | 394 | 90.1 | Nelson | Reducing nitrogen loss in subsurface tile drainage water with managed drainage and polymer-coated urea in a river bottom soil | MO | high NO3-N loss in the tile drainage water over the 2011-2012 study year was likely due to **wet spring conditions** and carry-over N, which resulted in approximately 60 kg NO3-N ha−1 of loss for both FD and MD during the FD period from **9 May through 12 July,** 2011 | wet spring |

*4. Seeing how many years there are brings up the need for some text describing the MANAGE database, and specifically the free draining plots you are including. How many years are included, what is the geographic spread? If you would consider drafting some sentences on that it would be great.*

The Managed Annual Nutrient loads from AGricultural Environment (MANAGE) database is a readily-accessible database compiling measured field-scale annual nitrogen and phosphorus load data along with pertinent management and site characteristic metadata collected across the United States and Canada. Currently it contains 1279 site-years (*actually, plot-years*) of data from 91 studies on artificially drained agricultural lands, including both surface and subsurface drainage types.

Considering water quality sustainability criteria/metric defined earlier, for this analysis we only included studies conducted in “Corn Belt” states that partially or fully drain to Mississippi, hence to the Gulf of Mexico (in particular: IA, IL, IN, MO, MN, OH). Selected data was further reduced to include the results from the sites/plots with corn being part of their crop-rotation and having subsurface drainage with no inlets. Subsequently, derived dataset contained 677 site-years of data from 39 studies spanning from 1969 to 2012. Studies from Iowa made up the most of the data contributing about 60% of site-years, followed by Illinois and Minnesota with 16 and 14% respectively (Fig. X).

