

Beef Barriers

Introduction:

Historically on livestock farms, such as beef cattle farms, animals were given access to open water sources. A concern that farmers have is the management of nutrients and manure that are applied to crops or created by livestock and the ways in which these might affect the ecosystem at and near their farm. As manure is produced by cattle in an area, there is the potential for algae to develop in a water source. When large amounts of algae appearing rapidly together in a group, it is known as an algal bloom. While there are many natural causes, runoff from farms and other sources can cause algae issues in local waterways as fertilizers spread on field crops can be washed away by rain and irrigation.

Algal blooms can have short- or long-lasting impacts on water ecosystems. Figure 1 below shows Brookmill Park Lake in Britain. Over 11 months, the lake experienced an explosive growth of algae.



Brookmill Park Lake, Britain, when there was no algal problem.

Sources/Usage: Public Domain.

Credit: Mike Quinn via Geograph U.K.



Brookmill Park Lake, Britain, when there was a severe algal problem.

Sources/Usage: Public Domain.

Credit: Mike Quinn via Geograph U.K.

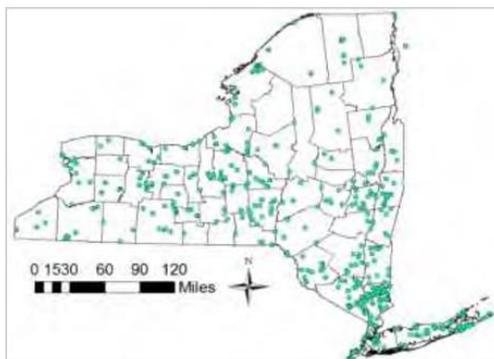
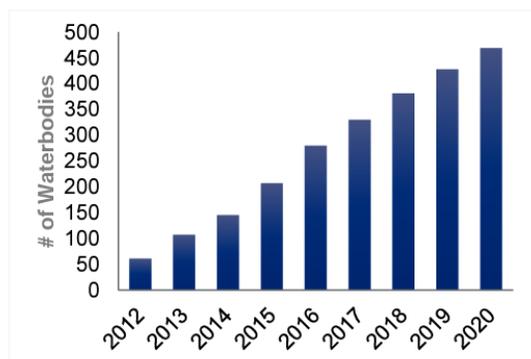
Figure 1. Brookmill Park Lake¹

Prompt 1:

There are similar environmental issues in waterways throughout New York. Graph 1 below shows the number of waterbodies affected by harmful algal blooms (HABs) from 2012-2020.

¹ From: Water Q&A, Lab Exchange

<https://www.labxchange.org/library/pathway/lx-pathway:69980a09-42bf-418d-9679-f8756f2bcc6a/items/lx-pb:69980a09-42bf-418d-9679-f8756f2bcc6a.html:7bcac1df>



Graph 1. (at left) Cumulative number of waterbodies in NYS with documented HABs

Graph 2. (at right) Cumulative map of locations of waterbodies in NYS with documented HABs, 2012-2020

From: https://www.dec.ny.gov/docs/water_pdf/researchguide.pdf

Q1.

Using Graph 1 from above, describe how waterbodies in New York have been impacted by algae since 2012.

Q2.

Using Graph 2 from above, describe any observations you notice about the locations of algal blooms in waterbodies in New York.

Algal blooms can be a problem on beef cattle farms and the open water that livestock drink from, which can have a negative impact on many connected waterways. For this reason, many beef cattle farms have fencing around open water sources. When a physical fence is not possible, farmers will often block access to water for their livestock with a barrier, grass buffer, or line of trees. Examples are shown in Figures 2 and 3.

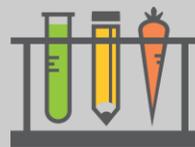


Figure 2. (at left) Fencing around stream. (Photo courtesy of USDA NRCS)



Figure 3. (at right) Trees lining a farm stream

From: https://www.morningagclips.com/wp-content/uploads/2019/04/28774453358_37389bee19_z.jpg

Sources of water that do not have fencing and allow beef cattle free access to the water can easily develop algae, shown below in Figure 4.



Figure 4. Algae covered farm pond.

Q3.

In what ways might a physical barrier help to prevent algal blooms in water sources on beef cattle farms?

Beef cattle farmers can help to improve water quality in their communities by managing their farms effectively.



Watch the video, [Water Supply for Over 9 Million - YouTube](#)².

Q4.

Why is it important for beef cattle farmers to help protect the quality of the water supply?

Prompt 2A:

Before we explore what beef cattle farmers do on their land, we need to understand why clean water is important. Use Figure 5 to answer the questions that follow.

² Video Link: <https://www.youtube.com/embed/HSoHkG7bbJE?feature=oembed>



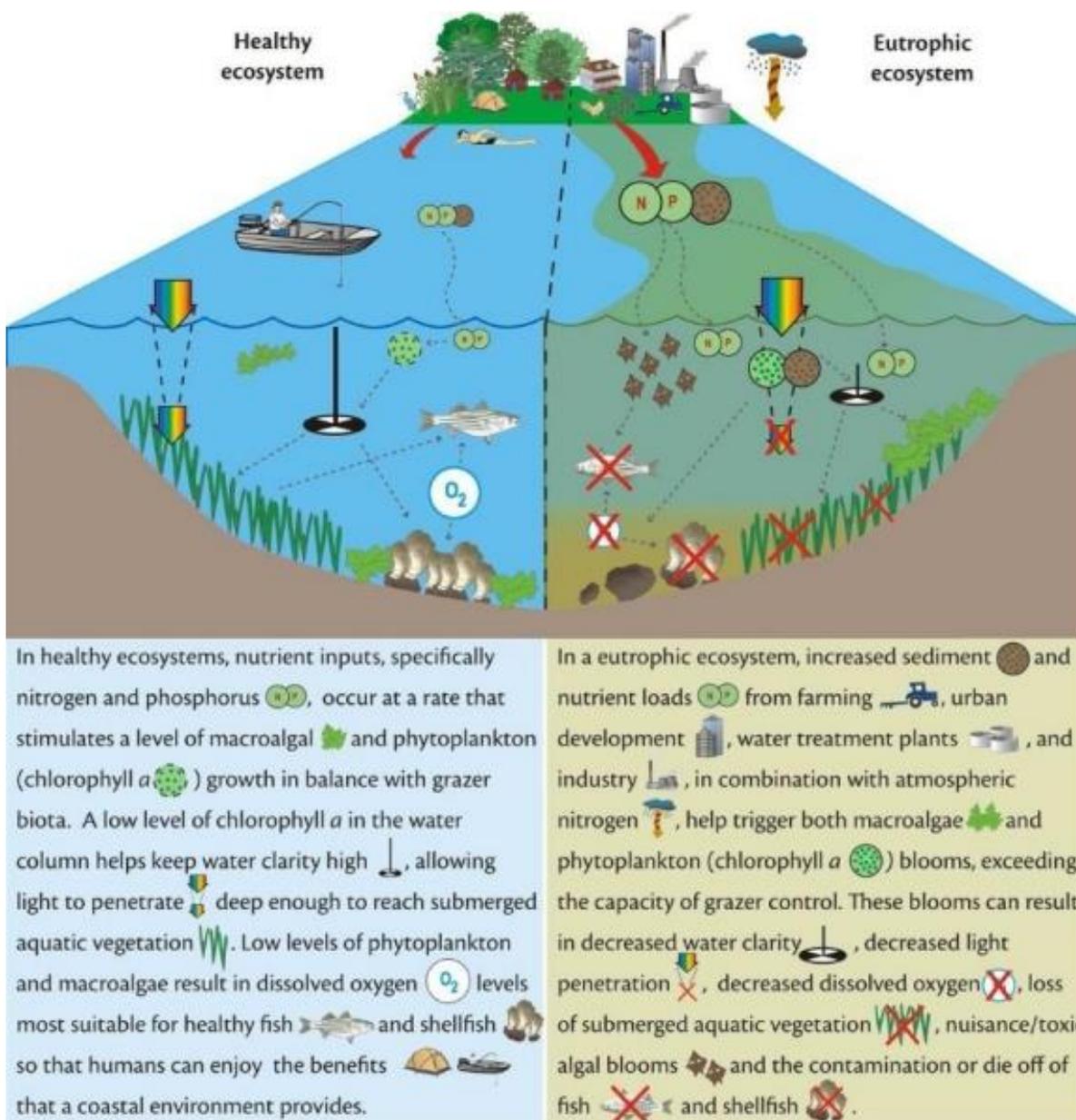


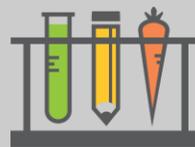
Figure 5. Conceptual diagram comparing a balanced ecosystem with one receiving excess nutrients.

From: Phosphorous in aquatic ecosystems, Chapter 1³

Q5.

What are some visible indicators of a healthy water ecosystem?

³ <https://www.canada.ca/en/environment-climate-change/services/freshwater-quality-monitoring/publications/phosphorus-aquatic-ecosystems/chapter-1.html>



Q6.

A eutrophic water ecosystem is unhealthy. What makes a water ecosystem unhealthy?

Q7.

How can beef cattle farming impact the health of a water ecosystem?

Prompt 2B:

High amounts of nutrients like nitrogen, phosphorous, and potassium can cause algal bloom in a water ecosystem⁴. In

⁴ <https://newyork.agclassroom.org/matrix/lesson/802/>





Data Set 1, shown below, are the results of an experiment that a student did comparing different amounts of fertilizer and seeing how much algae grew over 4 days.

Average Algae Growth Counts			
Day	Control	Low Amount of Fertilizer	High Amount of Fertilizer
1	1.3	4	4
2	3.3	5.6	6.6
3	5	15	18.7
4	8.7	16	24.3

Data Set 1. Average Algae Growth Compared to Amount of Fertilizer⁵

Adapted from:

Water Quality Ag in the Classroom Activity 1

Miller & Levine Biology: The Effect of Fertilizer on Algae Inquiry Lab

Observations from experiment:

After 4 days, the test tube that had the high amount of fertilizer was the darkest shade of green.

Q8.

Using evidence from the experiment, explain the impact of nutrients on the growth of algae.

Figure 6 below shows how nutrients are related to beef cattle.

⁵ https://assets.savvas.com/asset_mgr/current/202131/LabSamp_MLBio.pdf



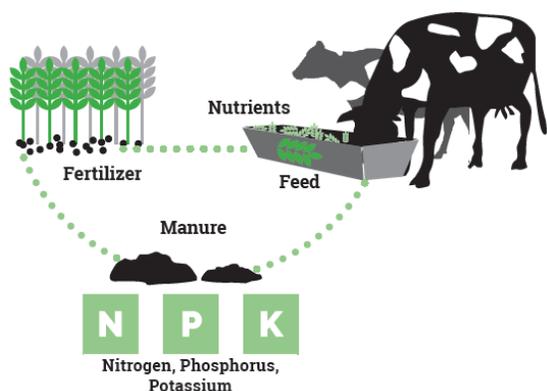


Figure 6. Manure nutrients⁶

Q9.

What is the connection of beef cattle to algae growth in open water sources on farms?

Prompt 3:

Solutions that limit the growth of algae in open water sources on the farm can impact the biodiversity of a water ecosystem for any water connected to it. Farmers throughout New York are part of conservation efforts to help make a positive impact. In the Chesapeake Bay region, conservation practices used by farmers in 2011 reduce the total nitrogen to rivers and streams by 44%. Phosphorous entering streams was reduced by 75% (Creech, 2021)⁷.

Table 2 below explains some potential solutions that beef cattle farmers are using.

⁶ From: Michigan EnviroImpact Tool
https://assets.savvas.com/asset_mgr/current/202131/LabSamp_MLBio.pdf

⁷ From: <https://www.usda.gov/media/blog/2017/12/13/farmers-keeping-nutrients-field-out-streams>



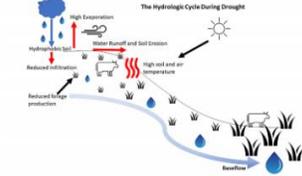
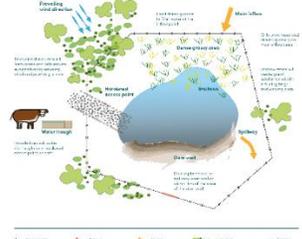
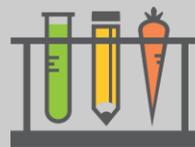
Conservation Practice	What is it? What does it do?	What does it look like?
Managing the beef lifecycle	Diet grazing in the pasture consists primarily of grass forages and crop residue from grain production. Cattle may spend 4-6 months in a feedlot, where 50-85% of their diet is grain from corn and by-products. This means that it takes less time to get from birth to harvest which decreases their environmental impact	 <p>Image source: https://www.canr.msu.edu/news/2022-msu-feedlot-educational-series</p>
Filter strips or vegetated / forested buffers	Buffers of trees or vegetation can mitigate nutrient pollution; remove sediment, organic matter, and pollutants from runoff and wastewater	 <p>Image source: https://extension.wsu.edu/animalag/content/protecting-the-water-on-your-small-farm/</p>
Managing grazing	Overgrazing can impact soil moisture, temperature, and evaporation rates. When there is little water in the soil, there is less water infiltration. This can lead to surface water runoff and increased soil loss.	 <p>Image source: https://extension.sdstate.edu/impacts-drought-soil-water-forage-and-livestock-grazing-systems</p>
Fenced farm dams	Improves water quality for livestock consumption, provides habitat for wildlife, and secures water during droughts; draws down greenhouse gases to mitigate effects of climate change	 <p>Image source: https://www.sustainablefarms.org.au/news/benefit-cost-analysis-lends-support-for-improved-farm-dam-management/</p>

Table 2. Beef Cattle Farm Water Quality Solutions

Q10.

Based on the evidence provided, which of the practices listed above has the greatest positive impact on biodiversity and water quality?





Prompt 4:

Consider what practices (or combinations of practices) should be implemented to improve water quality among New York water ecosystems.

Q11.

Develop a potential solution by creating a land management plan that is economically sound and considers the environmental impacts of the beef cattle industry.

Your answer should include:

A potential solution

3 pieces of evidence from the task for why this solution is best for biodiversity of the environment and water ecosystems.