History of Limestone Use and Its Effects on Rivers: How We Transformed a Life-Giving Rock into a Pollutant

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Humankind has been the major agent transforming our planet for the past several millennia. Nowhere are our actions more important than those related to water. The very origin and evolution of humanity starting 4.4 million years ago is thought to be closely linked to rivers. From its inception, humanity has drunk, harvested, dammed, straightened, dredged, and polluted rivers.

I propose to compile an environmental history of limestone use in the twentieth-century US, examining the socioeconomic drivers and environmental and health implications of its use as related to rivers. I will explore the conundrum of how a rock that provided an essential nutrient of life, helped achieve food security, and mitigate acid rain also polluted our water and air.

One of the most common rocks on Earth, limestone has featured prominently in the folklore and traditional medicine of many cultures. Limestone has also been pivotal in the modernization of agriculture. Continuous crop and livestock harvest acidifies the soil by removing acid-neutralizing base cations. An example of limestone's contribution to the green revolution comes from the Brazilian savannah, once considered unfit for agriculture due to its acidic soils. Explosive productivity from liming the region in the 1960s helped transformed the country into one of the largest exporters of soybean and beef in the world. Agricultural liming is perhaps the most pervasive use of limestone today.

In the US, limestone was also used to counter the negative effects of acid rain on stream fauna and flora in the late 1900s. Alarmed by the quickly acidifying rivers, many state fisheries departments, and federal agencies rushed to lime the rivers. Essential for life in the primordial soup, the calcium in the limestone was a perfect solution for several modern environmental ills.

I hope to address the drivers and consequences of agricultural liming in the twentieth-century US. First, I will examine agricultural liming trends during 1910-2010 from the US Agricultural Census and the Minerals Yearbook. I will use reports from government agencies and agricultural extension centers to explain the drivers of these trends.

Second, I will compile from the scientific literature calcium's interactions with other nutrients and pollutants in rivers. Many have noted the unseen interconnectedness of pollutants: studies on soil have shown that excessive calcium mobilizes nitrate into groundwater, making it unsafe to drink. Calcium also binds with phosphorus in the soil, thus preventing plant uptake and necessitating fertilization of the major nutrient, which can lead to algal blooms in downstream lakes and rivers.

Last, I will examine in detail limestone's other constituent: carbonate. It is what makes our beverages fizz, what plants use to photosynthesize, and is the greenhouse gas that we have pumped into the atmosphere. As limestone dissolves in water, carbonate is released and made available for transformations. Whether riverine carbonates from liming degas as carbon dioxide and exacerbate climate change remains an unresolved research topic. Using state and federal long-term water quality databases, I will follow the fate of carbonate during its journey from croplands to the sea.