

“Toxic Waters”: the hidden crisis of algal blooms in Australia



Seagull surrounded by red algae at St Kilda Beach September 2024. PHOTO: Muchu Yu.

If you're a tourist planning to visit Melbourne's St Kilda Beach this September you may be disappointed. When you arrive at the beach in a state of excitement, you may find it has lost its previous charm.

Instead of the sunshine and turquoise sea of online beach videos, you may find thick red algae stretching along the shoreline, releasing a strong, sour smell made worse by recent heavy rains.

Instead of the lively atmosphere you expected, the beach feels almost deserted. Only a few seagulls pick through the algae, and no other visitors are in sight. You take cover from the rain under a nearby shelter, glancing back at the beach, feeling disappointed and unsettled.

On your way back, you go online to find out more. You discover that this phenomenon is called an algal bloom, triggered by various environmental factors and appearing as green, blue-green, red, or brown patches in the water.

You also find that not all blooms are easy to see since their effects can be widespread and harmful. It's not just the unpleasant sights and smells—algal blooms sometimes [produce toxins](#) that pose serious risks to people, animals, and entire ecosystems.

A [report](#) titled *Synthesis of Blue Green Algae (Cyanobacteria) Bloom Knowledge & Analysis of Recent Trends in the MDB*, published in 2023, stated that an algae bloom can cause major issues for water quality, including oxygen depletion, [turbidity](#) (a measure of water clarity, which refers to the cloudiness or haziness of water), clogging of waterways, and the production of multiple toxic compounds.

But you might worry that the impact of an algae bloom goes beyond just the unpleasant sight and smell. The health of waterways is closely tied to your quality of life and could even [affect your physical health](#).

The Department of Health of Victoria State Government acknowledges that algae and cyanobacteria can sometimes [cause damage to people, animals, and the environment](#).

They explain that a buildup of certain algae, which can negatively influence people and animals, is called a harmful algal bloom. These algae can grow in both saltwater and freshwater environments.

Harmful algal blooms can impact every part of life for both people and nature. But what factors and sources are driving these blooms? And who is responsible for their rise?

Dr Adam Kessler, a lecturer at the School of Earth, Atmosphere and Environment at Monash University, said that human activity is closely linked to the rise of algae outbreaks.



Dr Adam Kessler, a lecturer at the School of Earth, Atmosphere and Environment at Monash University. PHOTO: Shiru Lai.

How bad can a harmful algae bloom be?



Scenes of red algae bloom at St Kilda Beach September 2024. PHOTO: Muchu Yu.

The image of St Kilda Beach reveals how algae outbreaks can directly impact tourism, transforming once inviting shorelines into algae-covered stretches that deter visitors.

The Commonwealth Environmental Water Holder of the Australian Government [confirms](#) that these outbreaks also disrupt recreational activities like swimming and boating, affecting locals and tourists alike.

But the impact goes further. Algal blooms can create [low-oxygen zones in the water](#), leading to the death of fish and other aquatic life. The toxic compounds produced by certain blooms pose additional threats, harming wildlife and livestock and making the situation both challenging and costly to manage.

Are dairy farms responsible for harmful algae outbreaks?

In February 2022, the EPA started to [publicly report](#) that some dairy farms and milk product plants, while operating within regulated limits, discharge effluent containing nutrients that can promote algal growth. Although these farms comply with legal requirements, the cumulative effect of nutrient discharge, even within regulation, can significantly contribute to the formation of harmful algal blooms.

In April 2022, the Curdies River was [exposed](#) to water quality problems and livestock deaths, which were suspected to be caused by the consumption of toxic blue-green algae.

Dr Adam Kessler said that the biggest problem with nitrogen pollution in coastal waters is that it triggers algal blooms, as nitrogen often serves as a nutrient for algae in water systems.

“If we're not feeding people or animals, then we're feeding whatever is left in the environment, such as bacteria and algae,” he said.

The investigative sources of nutrients in the Curdies River [report](#) from CERRF (Centre for Regional and Rural Futures) reveals that lakes and reservoirs are experiencing a surge in cyanobacterial (blue-green algae) blooms, driven by nutrient pollution from rivers and groundwater. Elevated nitrogen and phosphorus levels disrupt natural nutrient controls, resulting in more frequent and widespread algal outbreaks.

Dr Kessler said “fertilisers” are the primary industrial source of nutrient pollution, while “sewage” is the main contributor from domestic sources.

The [report](#) also investigated the high concentrations of nutrients in the Curdies River below the confluence with Scotts Creek, as well as in Scotts Creek itself. The report found that nutrient levels increase with water flow, indicating that the nutrients come from diffuse sources, leading to greater pollution.

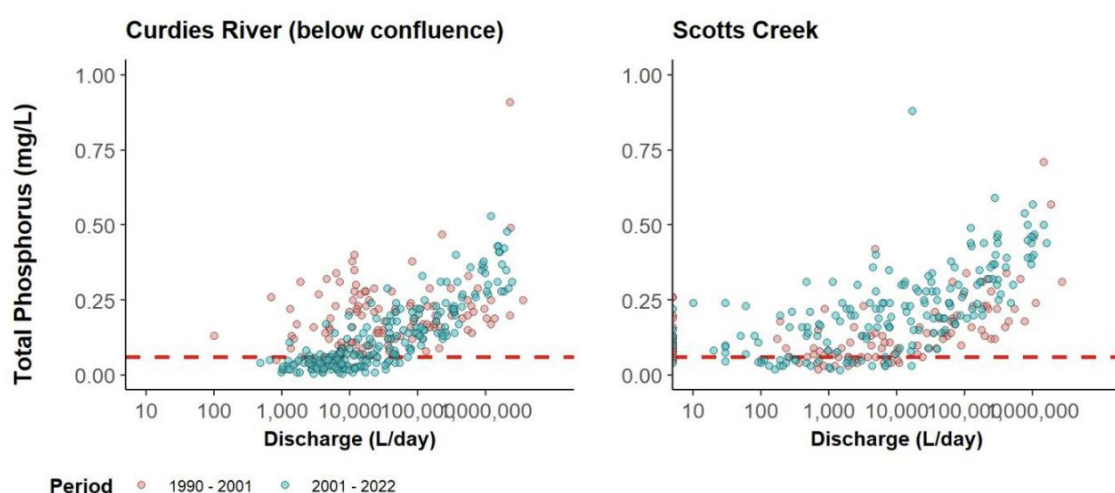
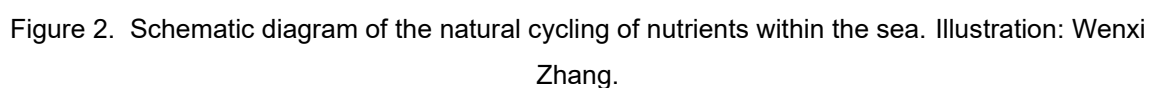


Figure 1. Comparison of discharge volume and substance content in two [rivers](#) before and after monitoring of factory

In 2001, the level of phosphorus in the river was monitored and visibly reduced following the improved regulation and control of factory effluents. As shown in Figure 3, the anthropogenic control of discharges is feasible, because the levels of pollutants in the two rivers monitored decreased significantly.

The [report](#) outlined short-term strategies like removing blooms, using algaecides such as copper sulphate, and using barriers. However, these methods are costly, potentially harmful to the environment, and not long-term solutions.

Nutrients stimulate rapid algae growth, and the nutrients within the algae then enter the ocean's natural self-purification system.



Nutrients like nitrogen and phosphorus, found in algae, are naturally [recycled and metabolised](#) within the ocean's ecosystem.

As shown in Figure 2, when nutrients from algae enter the ocean, some are carried by surface currents, while others settle gradually into the sediment or are absorbed by seafloor plants. During this process, existing marine life—such as fish, shrimp, shellfish, and aquatic plants—absorbs part of these nutrients for biological functions, naturally breaking down and metabolising them.

Additionally, a small portion of nutrients is recycled within the ecosystem, such as fish waste promoting algae growth. The remaining nutrients are further diluted by currents and sunlight, reducing their concentration over time. This self-purifying system allows the marine environment to balance nutrient levels effectively.

But that balance is disrupted when algae blooms occur, often driven by human activities, such as wastewater from livestock farming. Imbalances caused by human activity require proactive intervention to restore ecological stability. A [report](#) on *Eutrophication of Marine Waters: Effects on Benthic Microbial Communities Range* emphasises that only through active human efforts can these disturbances be effectively managed.

What are dairy farm's sustainability measures?

[Consolidated Pastoral Company](#), a century-old farm with nine cattle ranches in Australia and two in Indonesia, has earned a strong reputation for its commitment to sustainable development.

Earlier this year, Meat and Livestock Australia recognized Consolidated Pastoral Company for its integrated [approach](#) to sustainability. The company highlights its dedication to environmental, social, and governance (ESG) [goals](#), making it clear that sustainability is a core part of its business values.

When asked about their approach to wastewater treatment, the Consolidated Pastoral Company team explained that they reduce the nutrient concentration in agricultural wastewater through multiple purification steps.

“We do have effluent ponds, and they go into the first pond to get clean, and a second pond to clear, and then the third pond to stick,” they said.

Through a three-step process of removing large impurities, precipitating secondary treatment and adsorbing excess material, farms systematically move wastewater to achieve effective [self-purification results](#).

Not only that, the Consolidated Pastoral Company team shared their water recycling and self-purification method, using an in-house system to process and reuse wastewater on their farms and ranches.

“We put it on the pad because it’s fertiliser and the cleared water is irrigation water,” they said.

[Fonterra Co-operative Group Limited](#) is a publicly traded, multinational dairy cooperative owned by thousands of farming families in New Zealand. It operates the largest dairy farm in Australia outside of New Zealand.

On their official website, Fonterra highlights their [commitment to sustainable development](#), emphasising that protecting natural resources is essential to safeguarding the environment and the future of the communities they rely on.

The Fonterra team explained that, while they don’t directly work on farms, they understand farm sewage treatment processes. Like Consolidated Pastoral Company, they highlighted the crucial role of sumps in managing farm wastewater.

“They have a pond where they treat the wastewater, the effluent pond,” they said.

Additionally, the Fonterra team shared their knowledge about the farm’s water self-purification process, which occurs after agricultural wastewater is treated in a sewage tank.

“Dairy farms, they spray that effluent onto the paddocks,” they said.

The team at [Lilydale, a dairy farm based in southwest Victoria](#), appeared at ease when asked whether treating the sewage was challenging.

In order to understand the details of the improvements in the Curdies River basin since the 2022 cyanobacteria outbreak, we tried to reach out to academic researchers from the Deakin University team that investigated and reported on the 2022 bloom in the Curdies River, but we have not yet received a response.

However, we still find the effective solutions they proposed in their report at that time. One possible solution is increased supervision and monitoring of nutrient discharge into the ocean. By closely tracking sources of nutrient pollution, regulatory bodies can better control the flow of excess nutrients into marine environments. Regular inspections, combined with stricter

enforcement of discharge limits, can help prevent the nutrient overload that leads to harmful algae blooms.

Forging a new green barrier to ocean health

An academic [report](#) of *an eco-environmental assessment of harmful algal bloom mitigation using modified clay* showed that modified clay is an effective and eco-friendly technology for controlling HABs.

The principle behind removing existing algal pollution with modified clay is that clay can adsorb algal cells, and the sedimentation caused by this process helps reduce algal blooms. This method differs from traditional physical, chemical and biological approaches, which may be costly, carry high ecological risk, be slow-acting, and difficult to implement on a large scale. Modified clay offers a more environmentally friendly alternative. The prototype of this technology was developed in the 1990s, but it was not widely used due to limited adsorption capacity and poor controllability.

However, nearly a decade of research into modifying clay with a substance called hydrotalc has led to significant breakthroughs in its effectiveness.

In addition to new technologies, Dr Adam Kessler from Monash University said that planting mangroves and creating the environment produced by salt marshes is a good sustainable restoration way to tackle algae bloom.

“We are getting better at rebuilding those,” he said.

Dr. Kessler shared a more sustainable approach to mitigating algal blooms, which focuses on preventing them at the source. He thought most farmers were not aware of how to discharge waste in an environmentally friendly way. There is a need for regulatory authorities to educate them and increase people’s environmental awareness to prevent nutrient pollution.