Discussion – Defining a Problem with the Five Whys Analysis

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Introduction

The Five Whys is a root-cause analysis technique that uses repeated questioning to move from an observed problem toward the conditions that produced it. The method is easy to remember, but it is often applied poorly. Asking “why?” five times does not guarantee that the final answer is the true cause, and the questions do not have to total exactly five. The analysis must follow a defensible causal chain supported by evidence.

The original discussion applies the method to aquatic dead zones but reverses several links in the chain. Fish deaths do not cause a dead zone; low dissolved oxygen causes fish and other organisms to die or leave. Algae do not make water “waterless”; nutrient enrichment stimulates algal growth, and decomposition of dead organic matter consumes oxygen. This essay reconstructs the Five Whys analysis for a nutrient-driven dead zone, evaluates the method’s strengths and weaknesses, and shows how it can support—rather than replace—scientific investigation.

Defining the Problem Precisely

A useful analysis begins with a specific problem statement. “The lake is polluted” is too broad. A better statement is: “During late summer, bottom-water dissolved oxygen in the lake falls below the level needed to support fish and benthic organisms, producing recurring hypoxic areas and fish kills.” This wording identifies the affected system, the measured condition, the timing, and the consequence.

Precision matters because different problems require different chains. A harmful algal bloom may produce toxins even when oxygen remains adequate. A naturally stratified lake may develop seasonal hypoxia without a recent pollution event. Fish may also die from temperature shock, disease, or a chemical spill. The Five Whys should therefore begin after the problem has been verified through observations and measurements.

A Correct Five Whys Chain for a Dead Zone

Why 1: Why are fish and bottom-dwelling organisms dying or leaving?

They are exposed to water with very low dissolved oxygen. NOAA describes a dead zone as an area of hypoxia in which oxygen is too depleted to sustain much aquatic life. Mobile fish may escape if a suitable route exists, while shellfish, bottom organisms, and trapped animals may die. The immediate cause is oxygen shortage, not the mere presence of dead organisms.

Why 2: Why has dissolved oxygen become depleted?

Bacteria are consuming oxygen while decomposing large quantities of dead algae and other organic matter. Oxygen also may not be replenished quickly because the water column is stratified. Warm or fresh surface water can remain above colder or saltier bottom water, limiting vertical mixing. The demand for oxygen then exceeds the supply.

Why 3: Why is there so much algal and organic growth?

The water contains excessive nutrients, mainly nitrogen and phosphorus. These nutrients act like fertilizer and stimulate rapid plant and algal growth, a process known as eutrophication. Some blooms block sunlight from submerged plants. When algae and plants die, their decomposition creates additional oxygen demand.

Why 4: Why are excessive nutrients entering the lake?

Likely sources include fertilizer and manure runoff from agriculture, discharge from wastewater systems, leaking septic systems, urban stormwater, industrial effluent containing relevant nutrients, atmospheric deposition, and erosion. The importance of each source must be measured rather than assumed. Agricultural areas may contribute heavily in one watershed, while wastewater or urban runoff may dominate another (National Oceanic and Atmospheric Administration, “What is eutrophication?”; National Oceanic and Atmospheric Administration, “Hypoxia”).

Why 5: Why are nutrient sources not being adequately controlled?

The root conditions may include weak wastewater treatment, overapplication of fertilizer, insufficient riparian buffers, poorly maintained septic systems, inadequate stormwater infrastructure, limited monitoring, fragmented responsibility across jurisdictions, or incentives that reward production without charging for downstream environmental damage. This fifth answer identifies management and system failures that can be changed (Ohno, 1988).

Evidence Needed for the Chain

The Five Whys produces a hypothesis, not proof. Water-quality investigators should measure dissolved oxygen at different depths and times, nutrient concentrations, chlorophyll, temperature, salinity, water flow, and algal composition. Land-use maps and discharge records help identify sources. Sampling before, during, and after rain can reveal runoff patterns (American Society for Quality).

Source attribution may require nitrogen or oxygen isotope analysis, watershed models, flow measurements, and inspection of wastewater or agricultural systems. Without evidence, the analyst may stop at the most visible source or blame a convenient stakeholder. The chain should be revised when data contradict it.

Why "Five" Is Not a Fixed Rule

The number five is a prompt to continue questioning beyond the first explanation. Some problems reach an actionable cause in three questions; others require eight or several branching chains. Stopping exactly at the fifth answer can create false confidence. The goal is to reach causes that are specific enough to address and sufficiently supported by evidence.

For example, "weak waste management" is still broad. The team may need to ask why a wastewater plant releases too much nitrogen: Is its treatment technology inadequate, is flow above design capacity, are operators undertrained, is maintenance delayed, or are discharge limits insufficient? Each answer implies a different intervention.

Strengths of the Five Whys

Simplicity and Accessibility

The method requires no specialized software and can be used in a meeting, classroom, laboratory, factory, or field investigation. Its simplicity encourages people to move beyond blaming the final operator or treating symptoms as causes. In the dead-zone example, removing dead fish would address an outcome but not the oxygen depletion that killed them.

Focus on Causal Relationships

Repeated questioning forces the team to explain how one condition produces another. A good chain makes assumptions visible. Participants can then ask which link has evidence and which remains uncertain.

Action Orientation

The method can connect environmental symptoms with management decisions. “Fish are dying” does not identify a solution. “Nutrient loads exceed the lake’s capacity because wastewater treatment and agricultural controls are insufficient” points toward monitoring, treatment upgrades, nutrient-management plans, buffers, and enforcement.

Support for Cross-Functional Discussion

A dead-zone investigation benefits from ecologists, farmers, wastewater engineers, local residents, economists, and regulators. Each group sees different links. The Five Whys provides a shared structure for combining those perspectives.

Weaknesses of the Five Whys

Oversimplification of Complex Systems

Environmental problems rarely have one linear cause. Dead zones are influenced by nutrient loading, water temperature, stratification, residence time, weather, hydrology, and climate. A single chain may hide interactions and feedback loops. Several causal branches are often required.

Dependence on Team Knowledge

Participants cannot ask about factors they do not know exist. A team unfamiliar with hydrodynamics may focus entirely on nutrients and ignore stratification. A team drawn only from regulators may overlook economic incentives or local practices.

Confirmation Bias

Analysts may construct questions that lead toward a preferred explanation. If the team assumes agriculture is responsible, every “why” can be framed to confirm that belief. Evidence and dissenting views are essential safeguards.

Inconsistent Results

Different teams can reach different “root causes.” This variation is not always a flaw—complex systems genuinely have multiple causes—but it shows that the method does not generate an objective result by itself.

Confusion Between Root Cause and Contributing Factor

A condition can be important without being the sole root cause. Heavy rainfall may trigger nutrient runoff, but the deeper issue may be land management that allows nutrients to leave fields. Warm weather may intensify stratification, while nutrient loading provides the organic material that consumes oxygen. The analysis should distinguish trigger, contributing condition, and underlying system cause.

Improving the Method

The Five Whys works best when combined with a cause-and-effect diagram, process map, fault tree, or systems model. A fishbone diagram can organize possible causes under categories such as nutrients, hydrology, climate, infrastructure, land use, and governance. The team can then apply repeated questioning to each major branch.

The analysis should record evidence beside every link and label uncertain claims. It should also include the people who operate and experience the system. Farmers, plant operators, anglers, residents, and scientists may identify practical details that are invisible in official reports.

Finally, the team should test whether proposed actions affect the chain. If upgraded wastewater treatment lowers nitrogen loads but hypoxia remains unchanged, other sources or physical controls may be more important than expected.

Developing Corrective Actions

Actions should correspond to measured sources. Agricultural measures may include nutrient budgeting, timing fertilizer applications to crop demand, cover crops, controlled drainage, manure management, wetlands, and vegetated buffers. Wastewater measures may include biological nutrient removal, capacity upgrades, industrial pretreatment, and repair of sewer overflows. Urban measures include stormwater retention, green infrastructure, and septic-system maintenance.

Monitoring is part of the corrective action. Nutrient loads, dissolved oxygen, algal biomass, and biological recovery should be tracked over several seasons. Because weather varies, one improved year does not prove that the problem is solved. Management should use trends and models to separate intervention effects from natural variability.

Conclusion

A valid Five Whys analysis of a dead zone begins with low dissolved oxygen, traces oxygen loss to decomposition and limited mixing, links excessive organic growth to nitrogen and phosphorus, identifies the sources of those nutrients, and finally examines why controls have failed. Fish deaths and visible algae are consequences and indicators, not the deepest causes.

The method is valuable because it is simple, transparent, and action-oriented. It is weak when it is treated as proof, forced into one linear chain, or limited by the assumptions of a single investigator. Combined with measurement, diverse expertise, and systems analysis, the Five Whys can help transform an environmental symptom into a testable explanation and a practical nutrient-reduction strategy.

References

National Oceanic and Atmospheric Administration. What is eutrophication?

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American Society for Quality. Five Whys and Five Hows.

Ohno, T. (1988). *Toyota Production System: Beyond Large-Scale Production*. Productivity Press.