Independent Investigation Lab Report

Word Count: 2250

Title: The effect of incremental amounts of fish meal fertilizer on dissolved oxygen levels in a mock pond

Personal Engagement:

Chemical fertilizers, especially nitrogen and phosphorous based, are commonly used to grow crops. However, these fertilizers are susceptible as runoff, so the nutrients flow into nearby water sources. It can mean the deterioration of aquatic environments, as well as their demise into dead zones. As long as chemical fertilizers remain an industrial standard, then the process of nutrient runoffs will only extend the effects of eutrophication. As such, it's important to investigate new possible forms of organic fertilizer, so that there can be novel insight into preventing the effects of eutrophication while maintaining efficient crop cultivation.

Exploration

Research Question:

My research question explores how different concentrations of fish meal affect dissolved oxygen levels of samples of slightly eutrophic pond water.

Environmental Issue Addressed:

The environmental issue my research question inquires is eutrophication, as it occurs on both a global and local level wherever bodies of water naturally occur near societies.

Background Information - Literature Review:

The widespread ecological phenomenon, known as eutrophication, impacts the water quality for an aquatic ecosystem (Diaz, 2010). Eutrophication is when excess nutrients enter an aquatic ecosystem, rapidly increasing algae growth. Consequently, algal blooms form, blocking sunlight and depleting dissolved oxygen levels, as a cycle occurs with the death and decomposition, by bacterial activity, of algae that releases more nutrients. Soon, the ecosystem is left with dead algae blooms and hypoxia, effectively killing all organisms and turning into a dead zone (Davis & Nagle). Chemical fertilizers are prime influencers of eutrophication, for nitrogen and phosphorus-based fertilizers are common in agricultural practice; thus, over enrich aquatic ecosystems when runoff occurs (Nixon, 1995). However, there has been investigations to turn organic matter, such as fish waste, into fertilizer that is environmentally friendly and efficient (López-Mosquera et al.,2011). As such, fish meal is a possible alternative to conventional fertilizers that is minimally damaging to aquatic systems.

My dependent variable is dissolved oxygen (DO for this report) levels, the small amounts of oxygen dissolved in water, which aquatic organisms require to survive. It's an important parameter for measuring water quality (Perlman, 2017). For my experiment, I will use a DO meter, fitted with a sensor probe, to measure its levels in mg/L in each of my trials. However, DO saturation can be affected by temperature and salinity levels. Additionally, the probe must be correctly calibrated to lessen measurement errors (WaterAtlas, n.d). I'll also be measuring in a span of 5 days, so that eutrophication occurs as time passes.

My independent variable is different concentrations of fish meal fertilizer, a dry fertilizer processed from bycatch fish by heating, pressing, and drying (Barlow & McCurran, 2015). I will make the concentrations by percent mass solutions with a constant amount of water. Each concentration will be put into "mock ponds," which pond water is put into small cups. Thus, nutrients are added at smaller scale. I chose this condition for differentiation of how quickly the pond water will reach low DO levels. As such, the formulated condition resembles the issue of open fertilizer run-off seeps into unprotected bodies of water, thereby increasing eutrophication.

If increasing concentrations of fish meal fertilizer are added to a mock pond then the DO levels should drop incrementally as there are slightly higher nutrient concentrations. Additionally, measuring DO levels in a confined volume, compared to a large body of water, should mean quicker eutrophication formation in a span of a few days, especially since pond water is slightly eutrophic by nature with the presence of organisms.

Variables - Experimental Design:

Variable	**Identification** Include units	**Measurement:** Explain how it is measured, including units and equipment
Independent Variable: *Fish Meal Fertilizer Concentrations*	**IV Levels:** 1. Control- 125.0 mL with no fish meal fertilizer 2. 1st trial- 5% mass percent solution of 25 mL 3. 2nd trial- 10% percent mass solution of 25 mL 4. 3rd trial- 15% percent mass solution of 25 mL 5. 4th trial- 20% mass solution of 25 mL 6. 5th trial- 25% mass percent solution of 25 mL	• Balance (used to measure the fish meal fertilizer in grams) • Distilled water • Graduated cylinder (100 mL)
Dependent Variable: *Dissolved Oxygen levels*	**Quantitative measurement:** I will record the dissolved oxygen levels of the mock ponds by using a dissolved oxygen meter fitted with a sensor probe.	• Lab Quest fitted with Dissolved oxygen probe (calibrated in mg/L)
	Qualitative measurement: I will be observing the reaction as it happens. I will note occurrences that happen such as bubbles or change in color solution	• Laptop with premade qualitative data tables

	Identification	**Important/Significance explained**
Control Group	The control is 5 samples of mock ponds not mixed with any fish bone meal fertilizer	I chose this as my control, for the untouched mock ponds are a natural baseline for the depleting DO levels with the other IV trials.
Experimental Groups	1. 5% mass solution of 25 mL 2. 10% mass solution of 25 mL 3. 15% mass solution of 25 mL	These are my experimental groups, for the collected DO levels will be compared to the different concentrations of fish bone meal fertilizer

	4. 20% mass solution of 25 mL 5. 25% mass solution of 25 mL	
Sampling Method	N/A	N/A
Risk Assessment and Ethical Considerations	When collecting the pond water, it's important to avoid capturing any organisms.	

Constants	Importance to keep constant	How each is measured/maintained
Type of fish meal fertilizer	Using the same brand of fish meal fertilizer is important to have consistent levels of nitrogen and phosphorus used when making my fertilizer concentrations. Otherwise, different fertilizers can accelerate eutrophication with higher nutrient levels than needed	I'll use the same fertilizer when making my concentrations for each IV level
Source of pond water	The water will be collected from the same pond because the ecosystems of different ponds can be different, which present biological processes	I'll collect my pond water on the same day from the same pond
Dissolved Oxygen Probe	Using the same dissolved oxygen probe is important to ensure the same measurement tool for measuring DO. Using a different dissolved oxygen probe can result in different in different readings, especially if it's calibrated different or a different type of dissolved oxygen sensor	I will use the same dissolved oxygen probe and rinse with each measure. Measurements will be in mg/L
Graduated Cylinder	Using the same graduated keeps consistency in my measurements. Using a different graduated cylinder can have different measurements, not be suitable to use, and it can affect my experiment through contamination.	I will use the same graduated cylinders to measure the constant amount of water for fertilizer concentrations
UV Grow Light	The same UV Grow Light will	All of the trials will be under the

	be used to continue the natural processes within the pond water, so that there are no discrepancies in dissolved oxygen levels between all trials	same UV Grow Light and kept there for 5 days

Methodology - Materials and Apparatus List:

- 2 Empty 2 Liter Bottles
- Down to Earth Fish meal fertilizer (ASIN: B00F9FVON8)
- 30 red plastic cups 532 mL
- Vernier Optical Dissolved Oxygen Probe
- Plastic pipette
- 2 Beakers 250 mL
- Gallon of distilled water
- Small plastic cup
- Graduated Cylinder 100 mL
- UV Grow Light (School provided)
- Balance
- Metal evaporating dish
- Spatula
- PC with *Microsoft Word* software
- Paper towels
- Empty gallon of water container
- Funnel
- Tape
- Marker
- Goggles
- Apron

Methodology - Procedures:

Set-Up Procedures

1. Travel to a nearby pond in a local neighborhood
2. Submerge the 2 Liter bottle and cap it once the bottle is filled
3. Ensure the cap is tight and tape around the cap to minimize air escape
4. Head to the school lab area and put on goggles and apron
5. Use marker and tape to label each red cup, based on if it's a control group or IV level, (i.e. the first 5 cups are the control group) and the trial number
6. Measure 125 mL of the collected pond water in a 250 mL beaker for each cup
7. Measure 25 mL of distilled water with a 100 mL graduated cylinder and pour it in the same 250 mL beaker
8. Place the metal evaporating dish on a balance and zero it
9. Calculate the mass required for a 5% mass solution of 25 mL (1st IV level) and measure the calculated mass of fish meal fertilizer with a spatula on the metal evaporating dish
10. Thoroughly mix the fertilizer into the beaker with the 25 mL of distilled water
11. Pour the concentration of fertilizer into the 1st designated trial of the 1st IV level set of cups
12. Repeat steps 7-11 for the rest of the trials in for the 1st IV level
13. Repeat steps 7-12, but measure the mass required for each concentration level from calculating the % mass solution for the designated IV level and its trials
14. Turn on the UV Grow Light, and place all the cups into grouped placements by IV level underneath it

15. Create premade qualitative and quantitative data tables in *Microsoft word* that includes separate 5 days for all trials ("Days 1 - 5")
16. Set the Vernier Dissolved Oxygen probe near the samples and calibrate as needed
17. Place another 250 mL beaker filled with distilled water and a small plastic cup placed near the probe

Data Collection Procedures

18. Within the same day of preparing the samples, measure the DO levels of the 1st trial of the control group and wait until readings have stopped fluctuating substantially
19. Record the measurements in the quantitative data table and record observations for the trial sample in the qualitative data set for "Day 1" within the data table
20. Fill a pipette from the beaker of distilled water (refill as needed) and rinse the probe as needed underneath the plastic cup (discard into sink as it nears capacity)
21. Dry the sensor of the probe with paper towels and place the cup back underneath the UV Grow Light
22. Repeat steps 18-21 for all the trials in the control group and IV levels
23. Repeat steps 18-22 for each day that passes ("Day 2, 3 etc.")

Clean-Up/Disposal Procedures

24. On day 5, place a funnel on an empty water gallon and pour all the pond water from each trial
25. Rinse any leftover fertilizer with water in the cup and pour into the empty water gallon (obtain another empty water gallon if necessary)
26. Label the empty water gallon(s) as "Pond water contaminated with fish meal fertilizer" and give to chemical supervisor for proper disposal
27. Discard the cups into a nearby trash can
28. Empty out the beaker of distilled water and plastic cup into the sink
29. Recap the DO probe and store it back

***Data* - Data Table**

Days	Control Group No Fish meal fertilizer added				
	Trial #01	Trial #02	Trial #03	Trial #04	Trial #05
1	8.78	8.81	8.76	8.87	8.82
2	10.06	10.14	10.32	10.38	10.28
3	11.84	11.93	11.77	11.95	11.87
4	11.45	11.38	11.32	11.52	11.43
5	11.04	10.83	10.52	10.77	10.90
	Dissolved Oxygen Levels mg/L (± 0.01)				

Days	Control Group No Fish meal Fertilizer added				
	Trial #1	Trial #2	Trial #3	Trial #4	Trial #5
1	Water is clear and contains little wood pieces floating	Water is clear and contains little wood pieces floating	Water is clear and contains little wood pieces floating	Water is clear and contains little wood pieces floating	Water is clear and contains little wood pieces floating
2-5	Water is darkened against the background of the inside of the cup; little wood pieces floating	Water is darkened against the background of the inside of the cup; little wood pieces floating	Water is darkened against the background of the inside of the cup; little wood pieces floating	Water is darkened against the background of the inside of the cup; little wood pieces floating	Water is darkened against the background of the inside of the cup; little wood pieces floating
	Qualitative Data/Observations				

Days	Concentration of Fertilizer IV 1: 5% Fish meal fertilizer of 25 mL				
	Trial #06	Trial #07	Trial #08	Trial #09	Trial #10
1	8.89	8.68	8.94	8.63	8.72
2	0.61	0.62	0.57	0.64	0.59
3	0.87	0.78	0.74	0.72	0.71
4	0.85	0.75	0.71	0.71	0.70
5	0.79	0.72	0.70	0.69	0.67
	Dissolved Oxygen Levels mg/L (± 0.01)				

Days	Concentration of Fertilizer IV 1: 5% Fish meal fertilizer of 25 mL				
	Trial #6	Trial #7	Trial #8	Trial #9	Trial #10
1	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color
2-5	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.
	Qualitative Data/Observations				

Days	Concentration of Fertilizer IV 2: 10% Fish meal fertilizer of 25 mL				
	Trial #11	Trial #12	Trial #13	Trial #14	Trial #15
1	8.82	8.90	8.67	8.74	8.89
2	0.60	0.60	0.63	0.64	0.67
3	0.71	0.70	0.72	0.72	0.71
4	0.68	0.69	0.69	0.69	0.70
5	0.65	0.65	0.64	0.65	0.65
	Dissolved Oxygen Levels mg/L (± 0.01)				

Days	Concentration of Fertilizer IV 2: 10% Fish meal fertilizer of 25 mL				
	Trial #11	Trial #12	Trial #13	Trial #14	Trial #15
1	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color
2-5	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.
	Qualitative Data/Observations				

Days	Concentration of Fertilizer IV 3: 15% Fish meal fertilizer of 25 mL				
	Trial #16	Trial #17	Trial #18	Trial #19	Trial #20
1	8.75	8.82	8.69	8.73	8.92
2	0.65	0.66	0.66	0.66	0.67
3	0.71	0.70	0.73	0.73	0.71
4	0.69	0.69	0.68	0.68	0.70
5	0.65	0.65	0.65	0.64	0.65
	Dissolved Oxygen Levels mg/L (± 0.01)				

Days	Concentration of Fertilizer IV 3: 15% Fish meal fertilizer of 25 mL				
	Trial #16	Trial #17	Trial #18	Trial #19	Trial #20
1	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color
2-5	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.
	Qualitative Data/Observations				

Days	Concentration of Fertilizer IV 4: 20% Fish meal fertilizer of 25 mL				
	Trial #21	Trial #22	Trial #23	Trial #24	Trial #25
1	8.70	8.91	8.66	8.84	8.82
2	0.67	0.70	0.69	0.69	0.76
3	0.70	0.71	0.72	0.72	0.71
4	0.70	0.71	0.70	0.72	0.71
5	0.65	0.66	0.64	0.65	0.64
	Dissolved Oxygen Levels mg/L (± 0.01)				

Days	Concentration of Fertilizer IV 4: 20% Fish meal fertilizer of 25 mL				
	Trial #21	Trial #22	Trial #23	Trial #24	Trial #25
1	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color
2-5	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.
	Qualitative Data/Observations				

Days	Concentration of Fertilizer IV 5: 25% Fish meal fertilizer of 25 mL				
	Trial #26	Trial #27	Trial #28	Trial #29	Trial #30
1	8.72	8.83	8.89	8.67	8.69
2	0.71	0.72	0.74	0.74	.85
3	0.71	0.70	0.73	0.71	0.72
4	0.70	0.71	0.72	0.70	0.70
5	0.68	0.67	0.69	0.69	0.66
	Dissolved Oxygen Levels mg/L (± 0.01)				

Days	Concentration of Fertilizer IV 5: 25% Fish meal fertilizer of 25 mL				
	Trial #26	Trial #27	Trial #28	Trial #29	Trial #30
1	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color	The fertilizer is brown with little particles settled in the water. Water has an opaque, brown color
2-5	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.	Fertilizer is rested in cup upon initial look. White matter is rested atop of the water.
	Qualitative Data/Observations				

***Data* - Calculations/Data Processing**

Days	Control Group No Fish meal fertilizer added		
	Mean	Range	Standard Deviation
1	8.81	0.11	0.038
2	10.24	0.32	0.118
3	11.87	0.16	0.065
4	11.42	0.20	0.067
5	10.81	0.52	0.172
	Dissolved Oxygen Levels mg/L		

Days	Concentration of Fertilizer IV 1: 5% Fish meal fertilizer of 25 mL		
	Mean	Range	Standard Deviation
1	8.77	0.31	0.121
2	0.61	0.07	0.024
3	0.76	0.16	0.058
4	0.74	0.15	0.056
5	0.71	0.12	0.041
	Dissolved Oxygen Levels mg/L		

Days	Concentration of Fertilizer IV 2: 10% Fish meal fertilizer of 25 mL		
	Mean	Range	Standard Deviation
1	8.80	0.23	0.088
2	0.63	0.07	0.026
3	0.71	0.02	0.007
4	0.69	0.02	0.006
5	0.65	0.01	0.004
	Dissolved Oxygen Levels mg/L		

Days	Concentration of Fertilizer IV 3: 15% Fish meal fertilizer of 25 mL		
	Mean	Range	Standard Deviation
1	8.78	0.23	0.081
2	0.66	0.02	0.006
3	0.72	0.03	0.012
4	0.69	0.02	0.007
5	0.65	0.01	0.004
	Dissolved Oxygen Levels mg/L		

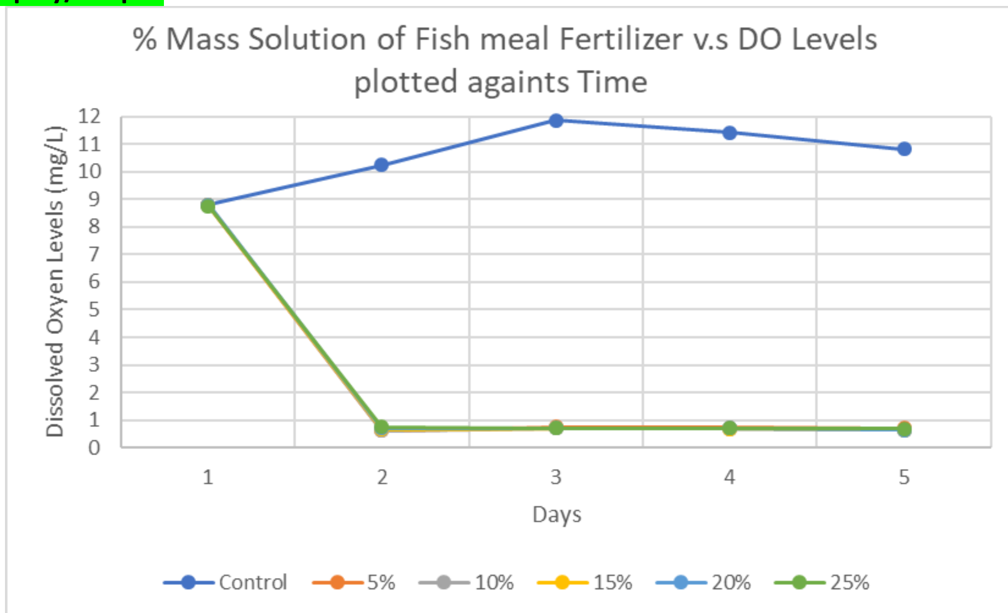
Days	Concentration of Fertilizer IV 4: 20% Fish meal fertilizer of 25 mL		
	Mean	Range	Standard Deviation
1	8.79	0.25	0.092
2	0.70	0.09	0.031
3	0.71	0.02	0.007
4	0.71	0.02	0.007
5	0.65	0.02	0.007
	Dissolved Oxygen Levels mg/L		

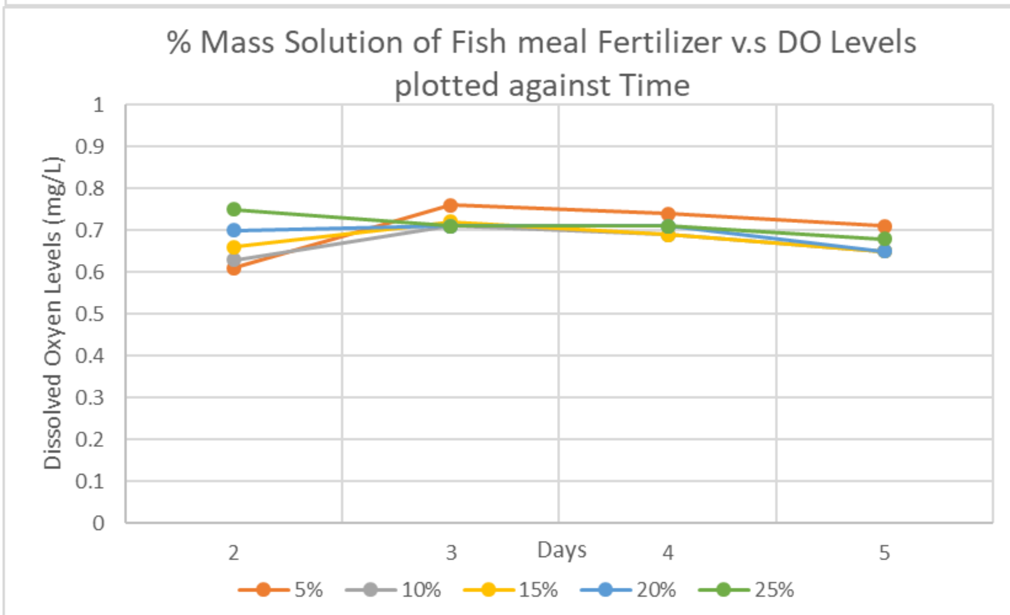
Days	Concentration of Fertilizer IV 5: 25% Fish meal fertilizer of 25 mL		
	Mean	Range	Standard Deviation
1	8.76	0.22	0.085
2	0.75	0.14	0.050
3	0.71	0.03	0.010
4	0.71	0.02	0.008
5	0.68	0.03	0.012
	Dissolved Oxygen Levels mg/L		

Formulas used

Name	**Formula**	**Sample Calculation**
Mean	Add up all the numbers in the set then divide by the number of entries	Ex. 2,4,6,8 Step 1. 2+4+6+8 Step 2. 20/4=5 Mean=5
Range	The difference between the largest and smallest value in a data set	Ex. 1,2,3,4,5 Step 1. 5-1=4 Range =4
Standard deviation	$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$	Ex. 2,4,6,8 Step 1. 2+4+6+8=22/4=5.5 Step2. 2-5.5=-3.5^2=12.25, 4-5.5=-1.5^2=2.25, 6-5.5=.5^2=.25, 8-5.5=2.5^2=6.25 Step 3. 12.25+2.25+.25+6.25/4=5.25 step 4. Square root of 5.25=2.29

Data - Data Display/Graphs





Data - Data Interpretation/conclusion as applied to your research question

My first graph shows the substantial drop in DO levels for the samples with concentrations of fish meal fertilizer after 1 day, while my control group remained relatively constant with minor fluctuations. However, the trends for the fertilizer samples are not easy to spot, so the second graph gives a closer look between Days 2-5. Within these days the DO levels remained between 0.60-0.75 mg/L after 1 day, and the all-around small values in standard deviation support how close overall the DO level readings were for all fertilizer samples.

Evaluation - Conclusion:

My data supports the broad conclusion that the fish meal fertilizer decreases DO levels initially, though it's inconclusive whether changes in concentration have any noticeable effects on DO levels after the substantial drop in DO levels. As such, this conclusion can be applied to the causes of eutrophication, as it starts with over nourishment, no matter the source of the nutrients. Thus, another strength of applying my results is the importance of monitoring DO levels in aquatic systems, as fertilizer is interconnected with the destruction of aquatic system when chemical fertilizers remain as common practice.

However, a limitation of my results is that my investigation isolates fertilizer as the main driver of DO levels, but salinity and temperature also play a part. As such, my results lack in the overall variability for DO levels, as bodies of water have natural fluctuations in these factors that also play a part in aquatic systems.

Evaluation - Strengths, Limitations, and Weaknesses

Limitations/Weaknesses	Explain how the limitation or weakness affected data collection or experimental results	Suggest ways to minimize or eliminate the limitations or weakness
Time discrepancy when measuring DO levels	When collecting my data, the DO meter would stop then decrease slowly at ambiguous times. Thus, I collect readings that aren't the true DO levels for the sample size.	I'll set a timer, such as 3 minutes, to allow the DO probe to get the DO levels with enough time for all samples in the same manner.
Range of Fertilizer concentrations	The significant drop in DO levels for all IV levels is attributed to the small volume of water mixed with sizeable masses of fish meal fertilizer. Thus, the measurement of DO levels isn't sustainable to test the effects of increasing concentrations.	I'll go with smaller percent mass solutions for fertilizer, preferably between 1-5%, as to avoid major drops in DO levels in order to study the incremental effects of fertilizer concentration.
Litter bottle delivery	When I collected the pond water, I used bottles that were clear plastic; therefore, photosynthesis still occurred from the time of transporting the pond water to the lab, decreasing DO levels until I could follow through with my experimentation	I'll use aluminum foil to wrap up the bottle, so that DO levels are increasingly preserved through blocking photosynthesis until the time I start DO measurements.

Future Studies

In a future study I'd investigate the DO levels at actual lakes in different locations, such as suburban and rural, to deduce if eutrophication is more impactful with fertilizers or with other wastes of human activity. I'd measure over a span of months to detect noticeable changes in DO levels.

Possible solution (or application) to the environmental issue:

Since the conclusion of my study reveals nutrients as the prime factor for eutrophication, a solution would be to implement agroforestry around the crops to decrease the chance of major run-off. Thus, a preventative measure is taken to stop nutrients from traveling freely in open farm fields.

Justification

The solution is appropriate because it involves change at the source of the nutrients, the farms. It's difficult to raise awareness of the harmful effects of eutrophication effects occur from nutrient transfer into the body of water. Thus, implementing agroforestry goes beyond the isolated blame of fertilizer use when farmers can be offered a chance to be more conscious of common agricultural practices and extend benefits of environmental protection and usage.

Evaluation

A strength is the functional benefit that agroforestry provides by being a buffer against major run-off with different plant matter in the way. Additionally, agroforestry provides better soil quality; therefore, the chance of run-of is decreased with healthier soil, protecting against soil erosion, to take in the nutrients more easily. However, a weakness with implementing agroforestry is the time and costs to structure and build the agroforest, which is an economic consideration that farmers weigh for changing agriculture practices. Another weakness is the major overhaul required to have an impactful change, as it requires the interconnected commitment of the farming industry to establish a new farming practice.

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