

Fighting Pollution with Pollution

White Paper

About Me

Growing up surrounded by greenery throughout my life has impacted my personality and my strong feelings towards the injustice being done towards the environment. In Mumbai, a concrete jungle, it is a rare sight to be surrounded by trees and fresh air. I was fortunate to grow up in a more privileged area with a large garden, but I still could not escape the high pollution levels in Mumbai. Monsoon, one of the longer and more prominent seasons in Mumbai, lasted three months, and a recurring event was acid rain. This event occurs because Mumbai is a metropolitan city with highly congested roads and many industries emitting pollutants into the air. I remember from a young age. I would always dread the monsoon as the frequent acid rain in Mumbai would have high sulphur dioxide and nitrogen oxide levels, seeping into the ground and dissolving nutrients, such as magnesium and calcium, that trees need to be healthy, destroying the garden around my house. Only at a 1-hour distance from where I lived were the Panje-Dongri wetlands. I remember that the summer season was scorching just before the monsoon, and temperatures would rise to 40 degrees. The summer is aggravated by the large amounts of methane emitted from the wetland, making the sweltering summer heat even more unbearable. Through my product, I will combine these two

problems, acid rain and large amounts of methane emitted by landfills, to create a solution.

An Abstract View

There are many fascinating ways in which different environmental issues can interact with each other. Acid Rain and methane emissions can be connected? Wetlands are a significant contributor to methane levels, while acid rain comprises sulphur dioxide and nitrogen oxides. When these two factors are intermixed, exciting things can happen. Acid rain can help solve the problem of methane emissions by reducing the number of methane-producing microbes in wetland areas. This happens because sulphur-eating bacteria in wetland areas out-compete methane-emitting microbes when sulphur compounds are deposited from acid rain. In fact, it is estimated that acid rain can reduce methane production by up to 30 per cent! Of course, it is essential to be careful when using acid rain to reduce methane emissions. After all, we don't want to cause further harm to the wetlands by introducing too much acid rain! One way to avoid this problem is to use smaller doses of acid rain, timed according to when there is a higher methane emission in the wetlands. By doing this, we can reduce methane levels without further damaging the wetlands. Research shows that wetlands emit more methane when conditions are warm and wet, but by this process of sprinklers slowly dosing the wetlands with artificial acid rain, methane emissions will reduce, and so will the temperature as methane traps more heat than the average carbon dioxide molecule and can have a more significant effect on increasing global warming.

Keywords

1. **Acid Rain:** rainfall made sufficiently acidic by atmospheric pollution that it causes environmental harm.
2. **Wetlands:** distinct ecosystem that is flooded or saturated by water, either permanently or seasonally.
3. **Methane:** Methane is a greenhouse gas that significantly contributes to global warming
4. **Emissions:** the production and discharge of something, especially gas or radiation.
5. **Sulphur dioxide:** A gas found in acid rain.
6. **Nitrogen oxides:** A gas found in Acid Rain
7. **Microbes:** an organism of microscopic size
8. **Bacteria:** A large group of single-cell microorganisms

Materials required.

1. Harvested Rainwater
2. Sulphuric acid
3. pH meter
4. SBS-CH₄: Methane Gas Detector
5. Polyvinyl (PVC) pipe or polyethylene pipe.
6. Control valves.
7. Risers.
8. Sprinkler heads.
9. Automatic timer.

10. Pipe cutter.
11. Underground water storage system

Product/Literature Review

- Natural wetlands are responsible for approximately 30% of global methane (CH₄) emissions. Wetland flooded soils are ideal for producing methane, an important greenhouse gas, and the pattern and intensity of these emissions may change as the planet warms. Methane is the leading cause of ozone, a dangerous air pollutant and greenhouse gas on earth, whose exposure causes the premature deaths of one million people yearly. Methane is also a potent greenhouse gas which will have 80 times more impact than carbon dioxide on global warming over 20 years. Dr Vincent Gauci of Open University and his colleagues conducted a study to investigate the interactions between acid rain and methane in wetlands. They went to the field in the U.S., Britain, and Sweden to observe the effects of low sulphate levels on methane emissions in wetlands. By applying various amounts of sulphate, like those found in acid rain, they determined that these low sulphate doses suppressed methane emissions by 30-40 per cent. The results were obtained over a period of several years.

- The methane emission levels of wetlands are an issue that still needs to be researched and solved. My product design is a fresh new perspective on this issue besides mine. There is only one other solution to this. Coastal wetlands help fight climate change by absorbing and storing carbon. Saline wetlands are especially good at reducing methane emissions. But building roads and coastal defences can

hurt these ecosystems by blocking tidal flow. This can lead to changes in the wetlands, like less salt, different water levels, and different plants. This work aimed to understand better what factors control methane emissions in this invasive vegetation type that dominates impounded coastal wetlands. The research team used 12-foot-tall chambers to enclose Phragmites vegetation and assess how much methane and carbon dioxide move in and out of the ecosystem across the salinity gradient. Salinisation (increasing the salt content) with tidal restoration could dramatically reduce methane emissions in impounded wetlands dominated by Phragmites. They also used an eddy covariance tower consisting of high-speed gas analysers mounted high above the vegetation canopy to monitor the continuous release and absorption of methane and carbon dioxide for an entire year from the impounded wetland at the Herring River.

- This product has many similarities and differences between my products. These products aim to lessen methane emissions from wetlands by adding something that will inadvertently cut off the methane produced. In the above development, there is an aim that by increasing the amount of salinity in the coastal wetlands, the phragmites will decrease. At the same time, my product aims to lessen methane gas by lowering the number of methane-producing microbes and replacing them with more sulphur-eating bacteria. Using methane detectors of different sorts, these products aim to know when the period is in which the most methane is emitted and aims to target releasing either acid rain or saline to target cutting larger emission quantities.

- After carefully researching these products, I have concluded that the salinisation of wetlands will not be a better solution as the increase in the salt content will, in the end, only degrade wetland sites by killing less salt-tolerant species and only leaving ghost forests in their wake which means wetlands with only standing dead trees. Instead of increasing the salt content, I plan to gradually dos the wetlands with small amounts of sulphur until the total pH level of sulphur in the wetlands is at 5, which will only out-compete methane microbes but not degrade the wetlands but help the environment by reducing methane emissions with no further consequences. Another advantage is that my product is mainly an underground water system with only a few sprinklers disguised in the form of rocks in the place of a large unstable tower which is clearly out of place and will affect the aesthetics of the wetlands. Nature is unpredictable; therefore, it is necessary to control the amount of artificial acid rain going into the wetlands and manufacture it myself. If diluted to the perfect amount, it will possess colour or odour, which will not disrupt the aesthetic of the wetland.

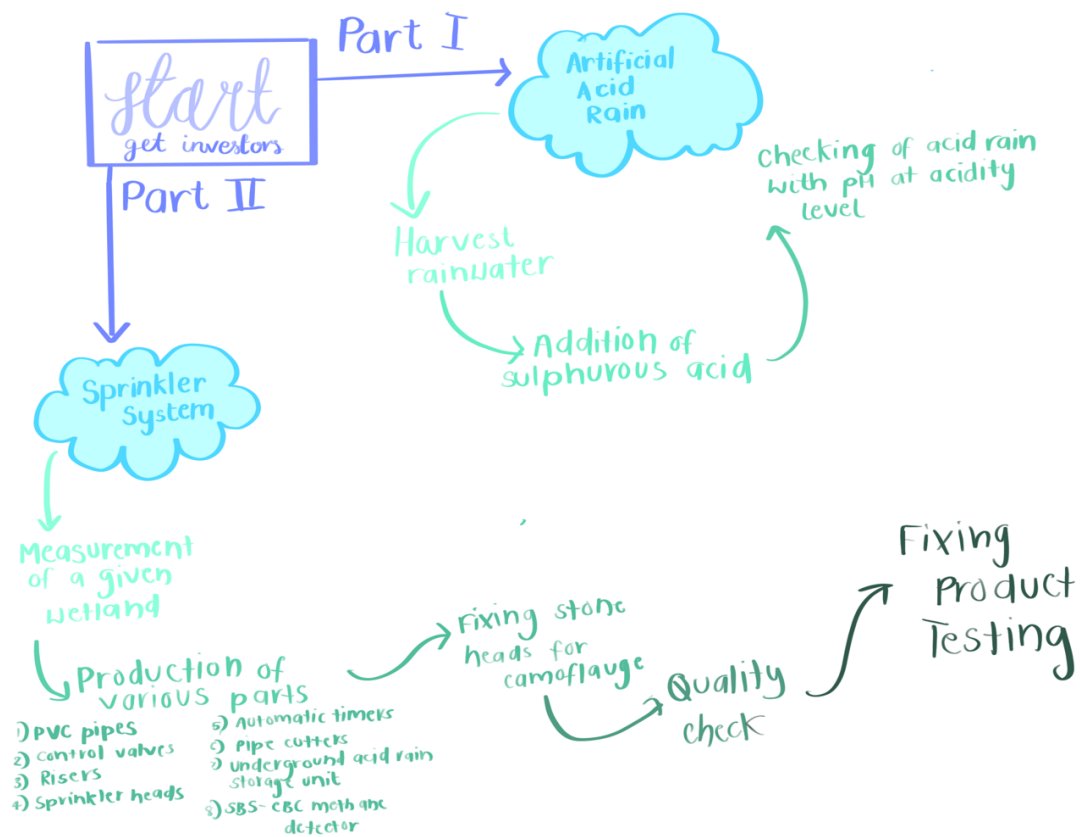
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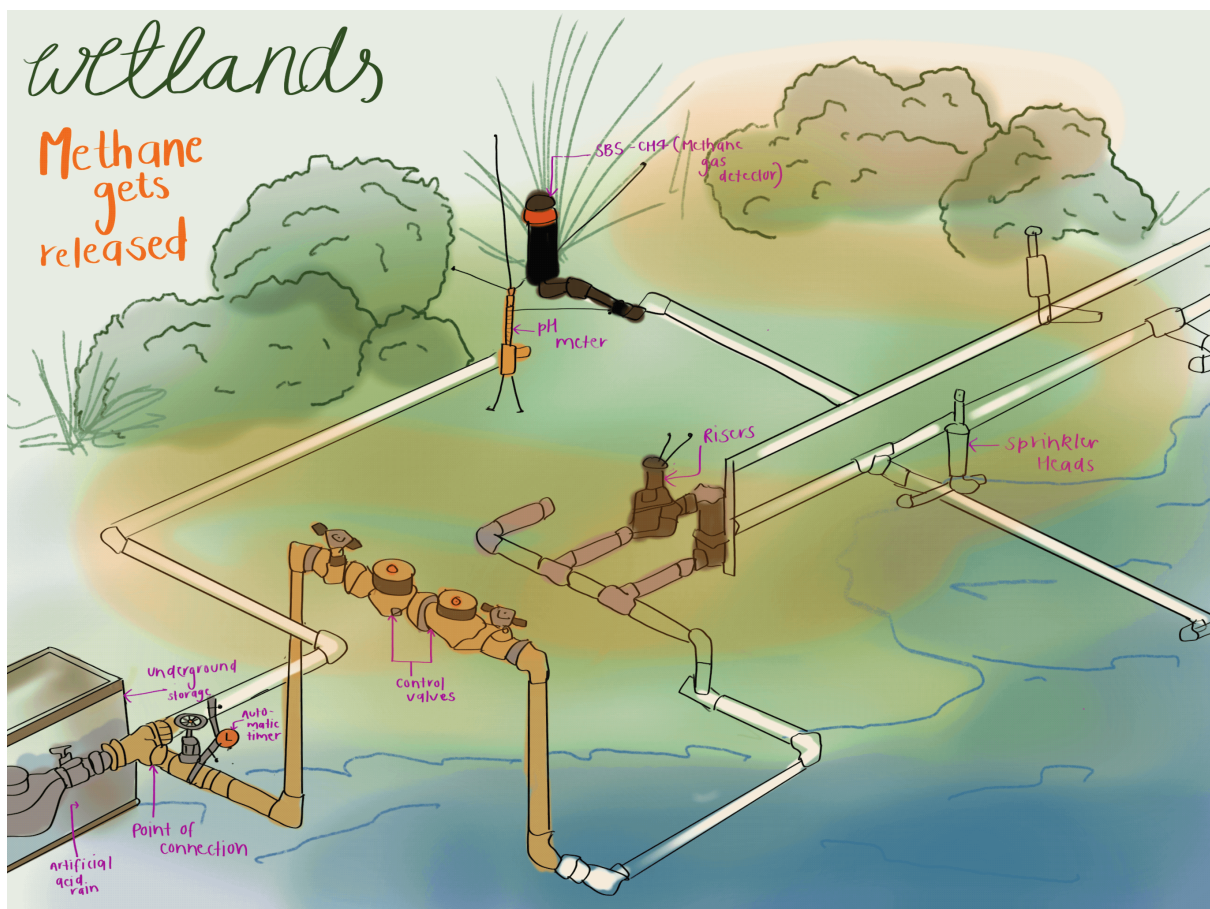
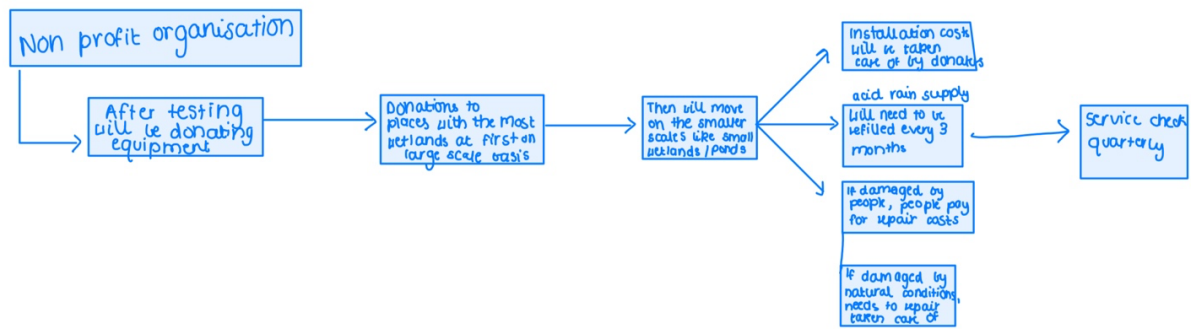
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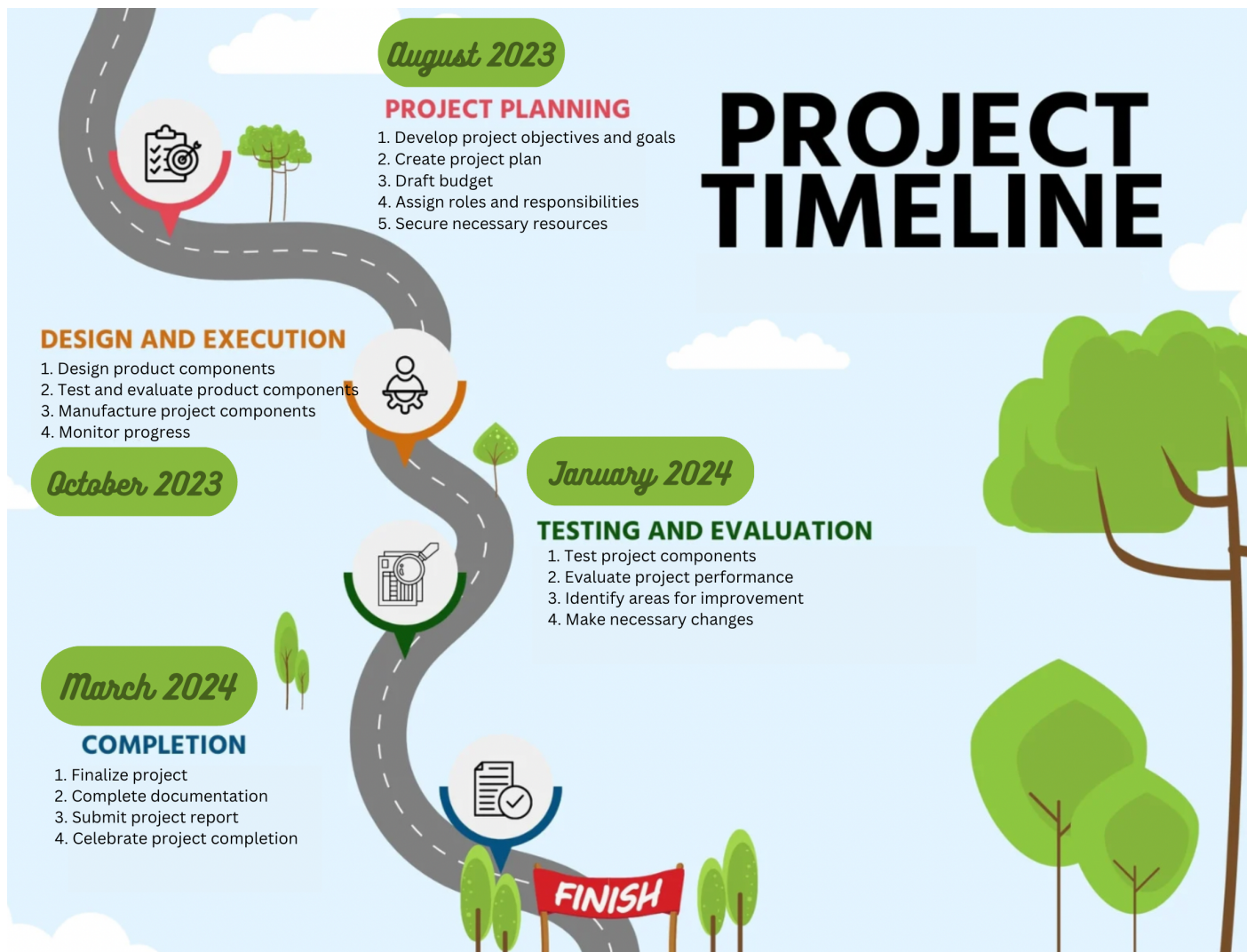
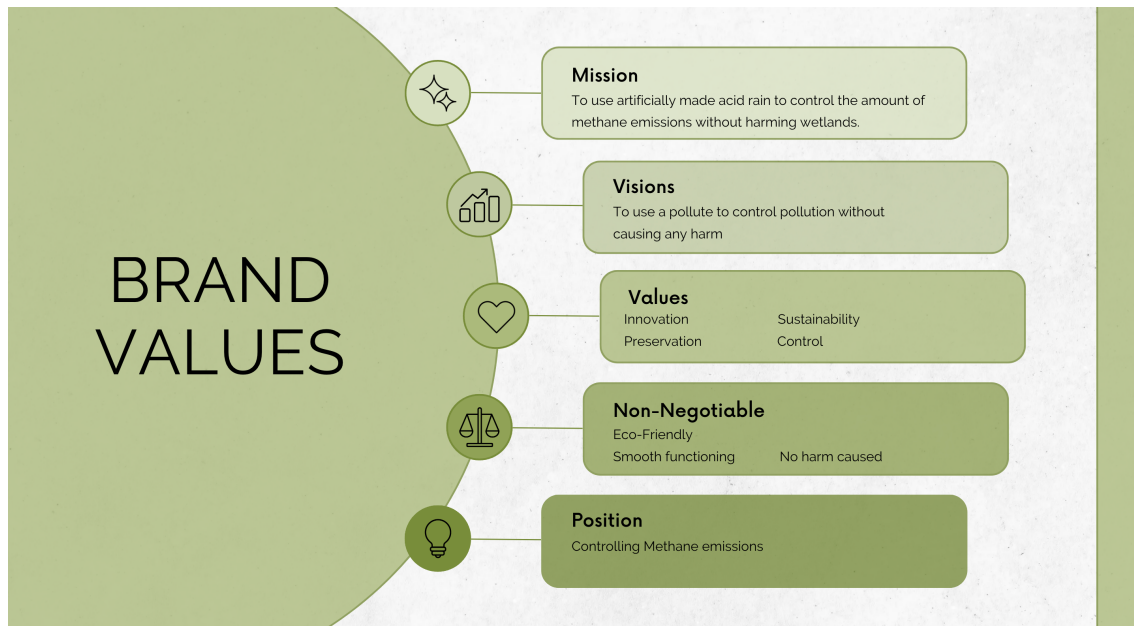
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Consumer/Customer Experience flowchart





Conclusion

Growing up in a privileged area with a large garden in Mumbai, I have experienced high pollution levels and frequent acid rain. The city's urban environment, with congested roads and industries emitting pollutants, led to the dissolution of nutrients like magnesium and calcium needed for healthy trees. The Panje-Dongri wetlands, located just a 1-hour distance away, were a significant contributor to methane levels. Acid rain can help reduce methane emissions by reducing the number of methane-producing microbes in wetland areas. However, it is crucial to use smaller doses of acid rain, timed according to the highest methane emission in the wetlands only until the pH meter reaches a level of 5 acidity. Research shows that salinizing wetlands is not a better solution as it degrades sites and leaves ghost forests. Instead, a gradual sulphur-based system with small sprinklers will outcompete methane microbes and reduce methane emissions without degrading the wetlands. This approach reduces methane levels by 30% as the 160 million tonnes of methane will reduce alarmingly, without further damaging the wetlands. The use of artificial acid rain can also help reduce global warming, as methane traps more heat than the average carbon dioxide molecule and have 80 times more impact than carbon dioxide on global warming over 20 years.