WavAnchor
Team #4 Alternatives

Executive Summary: **WavAnchor,** our solution, is an innovative solar rod that utilizes **ultrasonic waves to stimulate acoustic flocculation and accelerate sedimentation** around mangrove roots so that the land on which the mangrove is growing, rises with the sea level.

Problem: When one of our group members went to the Philippines, he learned firsthand the crisis of **Mangrove trees**. Mangrove trees were dying. And as they died, coastal fisheries disappeared as well. Why? They are the **integral habitat for fish**. Usually, Mangroves trap sediment in their roots to raise land levels, occurring at a rate of **2mm** per year. However, global warming has increased the sea level rise to **4.4mm** a year. This causes their aerial roots to be **permanently underwater**, resulting in suffocation and land collapse. Data shows that roughly **50%** of global mangroves are no longer keeping up with relative sea level rise. Because of this, heavy economic damage is dealt to small-scale fishermen by disrupting their daily fishing operations with smaller fish catches, driving massive income instability. Despite existing efforts such as replanting and coastal barriers, these solutions do not address the root cause: Imbalance between sediment accumulation and the accelerating rise in sea level. We see a critical opportunity for an innovation that **directly enhances the sedimentation processes,** rather than replacing them.

Solution: That is why our team has created **WavAnchor**, a rod that uses **acoustic waves to attract sediment** around mangrove trees, preventing their roots from being submerged and allowing the mangroves to grow healthily. With a coverage radius of **8 meters**, one WavAnchor can protect over **200 square meters** of mangrove habitat. WavAnchor utilizes an internal ultrasonic transducer housed within a corrosion-resistant titanium casing, which is an efficient material for sound transfer in maritime environments *(Figure 1)*. The device emits a 28kHz frequency that triggers **acoustic flocculation**, utilizing the inverse piezoelectric effect *(Figure 2)*, where electrical energy is converted into mechanical motion. In acoustic flocculation, sound waves cause sediments to vibrate and collide more often, bonding into heavier sediments. These larger clusters precipitate out of the water and settle faster than normal sediment *(Figure 3)*, ensuring that the **ground accretes at a rate that can match or exceed sea level rise**. By delivering at a safe ultrasonic frequency, WavAnchor effectively clusters sediments while remaining **completely harmless to marine life** near the shore. To ensure environmental sustainability, the entire process is powered by a solar panel, providing a **self-sustaining energy source** that is both environmentally friendly and sustainable in the long term.

Comparative advantage/Sustainability: Governments often combat sea-level rise using artificial macro-infrastructure such as massive concrete groynes, which often cause down-drift erosion. WavAnchor stands out because it **actively enhances natural sedimentation**. Its design allows simple installation and low maintenance by local communities, which makes it **more accessible than large-scale engineering projects.** Additionally, the use of targeted **safe-acoustic flocculation** is a novel application in coastal ecosystems. We have demonstrated the feasibility through building a minimum viable product *(Figure 4)*.

Go-to Market: We will begin in the Philippines, partnering with **local cooperatives and NGOs** to allot WavAnchor directly into areas that need it most. Once we build credibility on these communities, we will scale into the B2B sector, selling to Philippine fish farms and eco-resorts that are currently losing millions to coastal erosion. By **2030,** we will expand across **Southeast Asia**, targeting the mangrove-dependent coasts of Indonesia/Vietnam. Our ultimate goal is to partner with government institutions to **integrate our rods into national climate defense** and achieve **global recognition**.

Market research: We identified the Philippines as the primary epicenter because it represents a **large and underserved market** of small-scale fishers who form the backbone of the region's economy. Mangroves are high-yield economic engines with a single hectare producing an estimated **$37,500** in economic value, meaning one rod generates $753.975 annually in economic value (8m^2*π*$37500/10000m). Our target customers, fishers and local fishing businesses, have an average monthly income of about **$275**, and with one WavAnchor protecting **$754** of economic value, there is a **strong economic incentive to buy.**

Revenue/Price Model: The WavAnchor achieves a manufacturing cost of just **$36**. By optimizing every factor from high-speed assembly to quality control, we have stripped the cost of traditional manufacturing. This lean structure allows us to offer a solution at a consumer price point **($40.99)**, making it **accessible to even individual fishers**. Our market strategy scales this accessibility into a powerhouse revenue model, reaping revenue from fishing communities, businesses, and governments. We project to have **$8.2 million** in revenue by **Year 10** with a net profit margin of **25.5%** *(Refer to the financial model in the video)*.

Key References:

- Yamamoto, Y. (2023). "Living under ecosystem degradation: Evidence from the mangrove–fishery linkage in Indonesia." Journal of Environmental Economics and Management. https://doi.org/10.1016/j.jeem.2023.102750
- Aburto-Oropeza, O., et al. (2008). "Mangroves in the Gulf of California increase fishery yields." PNAS. https://www.pnas.org/doi/10.1073/pnas.0706841105
- UNDP Indonesia (2025)https://www.undp.org/indonesia
- Philippine Statistics Authority (PSA)https://psa.gov.ph
- World Meteorological Organization (WMO). State of the Global Climate 2023/2024 https://public.wmo.int/en/resources/library/state-of-global-climate
- Lovelock, C. E., et al. (2015). "The vulnerability of Indo-Pacific mangrove forests to sea-level rise." Nature. https://www.nature.com/articles/nature15538

Figures and Diagrams:

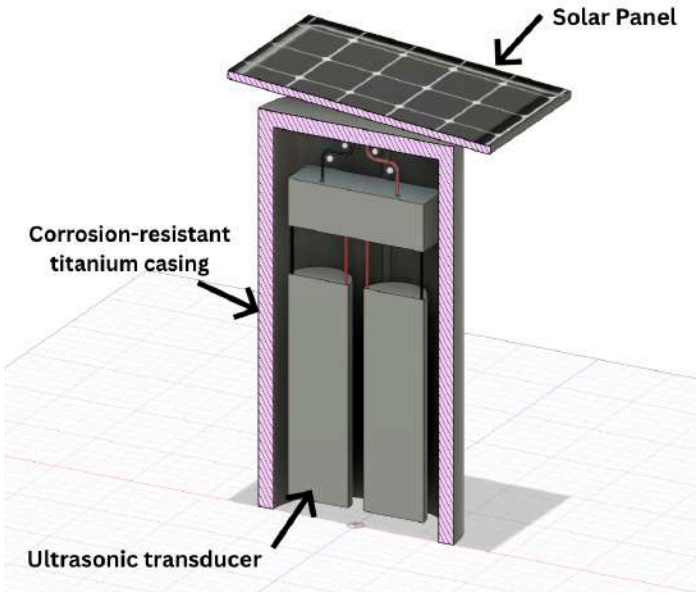

Figure 1
3-D Model of WavAnchor built in Fusion 360

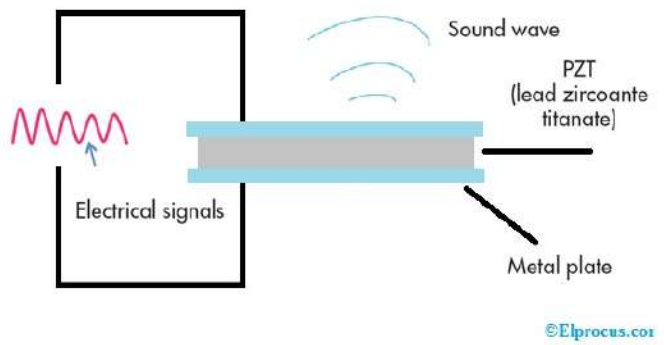

Figure 2
Concept illustration of Inverse Piezoelectric Effect

https://www.elprocus.com/what-is-the-piezoelectric-effect-working-and-its-applications/

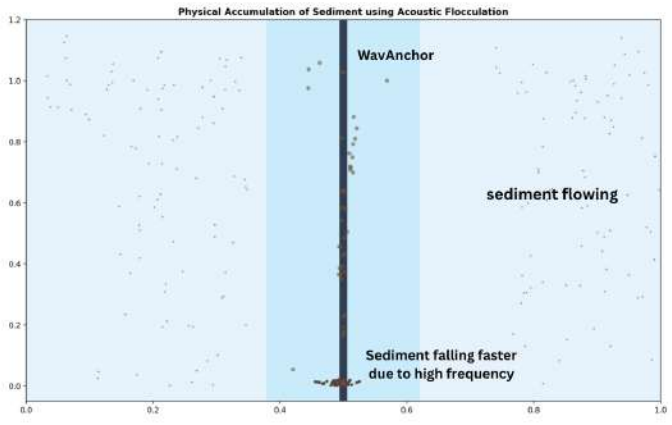

Figure 3
Animation of Acoustic Flocculation built using Python

Figure 4
Minimal Viable Product
using the vibration of a phone surrounded by sands