

The background of the slide is a photograph of a field of tall, green grasses, possibly a cover crop, under a bright blue sky with scattered white clouds. The grass is dense and reaches up to the top of the frame. In the distance, there are some palm trees and other vegetation. The overall scene is bright and sunny.

# EcoMulch

A Biodegradable Mulch

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# Problem

- **Food security** is the biggest issue we face today. From empty plates to broken systems, we have **climate change** and **unsustainable** farming. We have rising costs putting farmers in **debt** and **inadequate access to subsidies** creating **higher mental health issues** between these agriculturalists. Worse still, it is cyclical. **A farmer failing is a nation starving.** Here are a few issues we observe today in the field of agriculture:
- Infertile soil limits farming areas, **lowering crop yields** and **worsening global hunger** and **malnutrition**. In India, **46% depend on agriculture**, yet it contributes just **18% to GDP**. Farmers face **high irrigation costs, hidden input expenses, little government aid, and rising debt.**



**733 million**

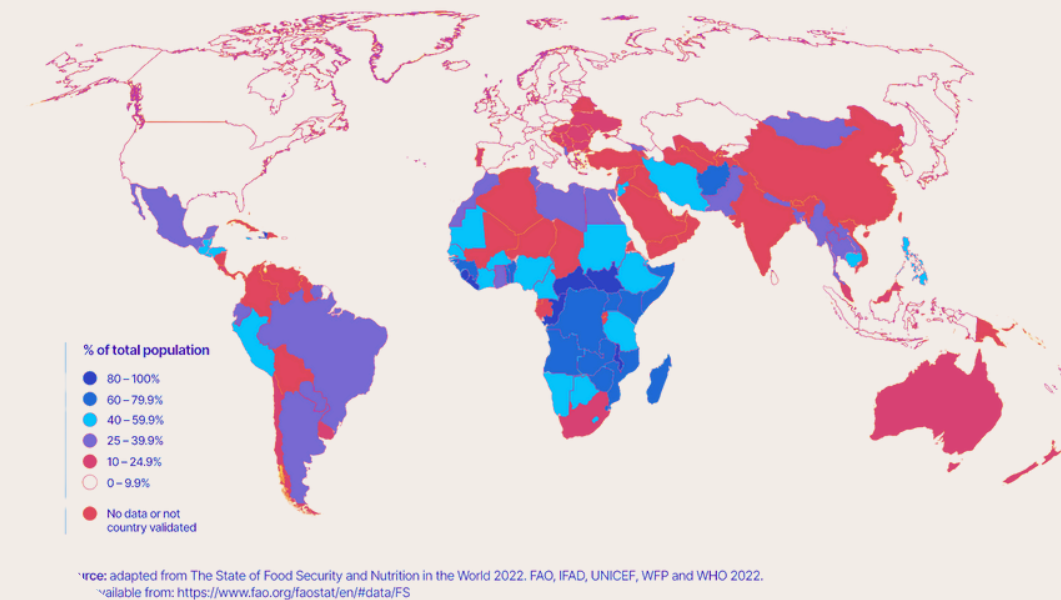
People suffer every year from starvation due to poor supply of food



**11,290 SUICIDES**

By Indian farmers in 2022 due to increasing costs and difficulty in paying back loans

Food Insecurity



- Plastic mulch\*, though common in farming, is **costly and environmentally harmful**. It incorporates the use of plastic sheets to cover the area where the compost is applied. It is used to capture water that has been evaporated from the soil so that the same water can be taken up by the plant. **It causes microplastic pollution, reduces soil fertility, increases soil acidity due to hydrolysis of plastic polymer when reacting with acid rain, and leads to infertile patches and lower yields** - worsening hunger and malnutrition globally. Nearby organisms may **ingest plastic, and this can cause them to die**, affecting the **biodiversity**. Decomposition of these organisms **raises CO<sub>2</sub> levels** due to constant respiration from decomposers, contributing to **climate change**. This not only asserts an environmental impact but also has a mental impact on the farmers.



**Plastic Mulch**

\*Mulch is a material applied to soil to retain moisture and suppress weeds



**Without healthy soil and efficient water use, food security collapses - EcoMulch tackles both at the root.**

EcoMulch is a potentially revolutionary biodegradable mulch - **a scalable, cost-effective alternative** to traditional mulch, designed to address both the **economic and environmental challenges** farmers face today.

Made from agricultural waste and natural materials like clay, turmeric, and margosa leaf extract, EcoMulch is not only affordable but also **sustainable and highly effective.**

The clay in EcoMulch has an inherent **high moisture retention capacity**, which slows down water evaporation and **reduces irrigation needs** - a crucial advantage in **water-scarce regions**. We tested this in our **PROTOTYPE**

**Turmeric** is naturally **antimicrobial and antifungal**, helping to **prevent plant diseases and fungal growth**, while **margosa** adds an additional layer of protection by acting as a **natural pesticide**, keeping harmful insects at bay and promoting **healthier crops**.

EcoMulch was designed in a flat pyramid shape to optimize the **surface area** for **better soil coverage** and **improved air circulation**, reducing the **risk of plant rot and improves root health**. This unique design also helps **suppress weed growth** by blocking sunlight, all without the need for harmful chemicals.

As EcoMulch breaks down, it naturally enriches the soil, enhancing **microbial activity** and **improving soil fertility**. Unlike plastic alternatives which degrade the soil over time, EcoMulch improves long-term soil health, ensuring continued productivity without the environmental cost.

EcoMulch also helps **prevent the loss of topsoil** during heavy rains and winds - a major cause of declining soil fertility. By acting as a protective layer, it keeps the topsoil in place and preserves the soil's ability to **retain nutrients**.

EcoMulch is a scientifically-backed solution addressing multiple agricultural problems simultaneously: **reducing input costs, improving crop yields**, and helping farmers adopt more **sustainable** practices that benefit both their bottom line and the environment.

## THE SOLUTION

# Strengths

- 1. **5.3 times cheaper** than plastic mulch, so more affordable
- 2. Fully decomposes into nutrients improving **soil fertility**
- 3. **Prevents fungal infections** and **repels pests**, improving crop quality
- 4. Blocks sunlight reaching the seeds of weeds, reducing competition for the crop by **reducing weed density**
- 5. **Better crop yield**
- 6. **Retains moisture**, so the need for irrigation is lower. This helps combat the issue of **water scarcity**
- 7. **Cost savings** for farmers because of the **reduced need for irrigation, fertilizer and pest control.**

# Opportunities

- 1. Farming sectors in major developing/underdeveloped countries require **affordable** solutions that are also **sustainable.**
- 2. Different proportions of ingredients for different crops would help **improve growth.**
- 3. **Acquire green certifications to attract investors and consumers**
- 4. Makes use of AI to predict when to change EcoMulch. AI is a booming industry hence may receive more funding.

## Market Potential in India

Market analysts predict the Indian mulch film section will expand remarkably throughout the next several years. Market analysts predict that the Indian mulch film market will expand to USD 653.1 million in 2030 through an annual growth rate of 11.1% starting from 2025. The demand for sustainable agricultural methods together with environmental concerns about plastic mulch multiply the market growth of biodegradable mulch films.

# Weaknesses

- 1. Greater **time** to prepare: it needs to be dried and cured unlike plastic mulch



# Threats

- 1. Other biodegradable mulches (**competitors**). To name a few:
  - a. HealthiStraw
  - b. BASF SE
  - c. SuperMoss Coco Mulch (23261)

COMPETITOR	SOLUTION	COSTING	LIMITATIONS of Competitor Mulch
HealthiStraw	Non-GMO wheat straw	\$633 per hectare	1. Residual seeds may cause unwanted growth 2. May contain dust and impurities 3. Expensive.
BASF SE	Remains in soil and can be ploughed post-harvest	\$1625 per hectare	1. CO <sub>2</sub> as by-product 2. Expensive 3. Weaker mechanical properties 4. Uncontrolled degradation
SuperMoss Coco Mulch	Long-lasting, and better-quality plants	\$625 per hectare	1. High salt content affects sensitive plants 2. Low nutrient content 3. Requires rehydration

## TACKLING SDGs

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ZERO HUNGER

- greater yields of crop
- less soil infertility
- more land available to grow crops

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CLEAN WATER AND SANITATION

- less irrigation needed
- less runoff (less fertilizer used)
- better water infiltration

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SUSTAINABLE CITIES AND COMMUNITIES

- reduced agricultural plastic pollution
- urban farming is encouraged
- better resilience of communities against water shortages and food insecurity

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RESPONSIBLE CONSUMPTION AND PRODUCTION

- makes use of agricultural waste
- Fully biodegradable
- No plastic used
- Less dependence on fertilizers

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CLIMATE ACTION

- Reduces carbon footprint (cutting down on plastic)
- Improves soil carbon retention, increasing crop yield resilience to climate shocks.
- Conserves water

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LIFE ON LAND

- Improves soil biodiversity
- Controls weeds naturally (less reliance on herbicides - these harm nearby plants and insects)
- Prevents soil degradation.



# Algorithm

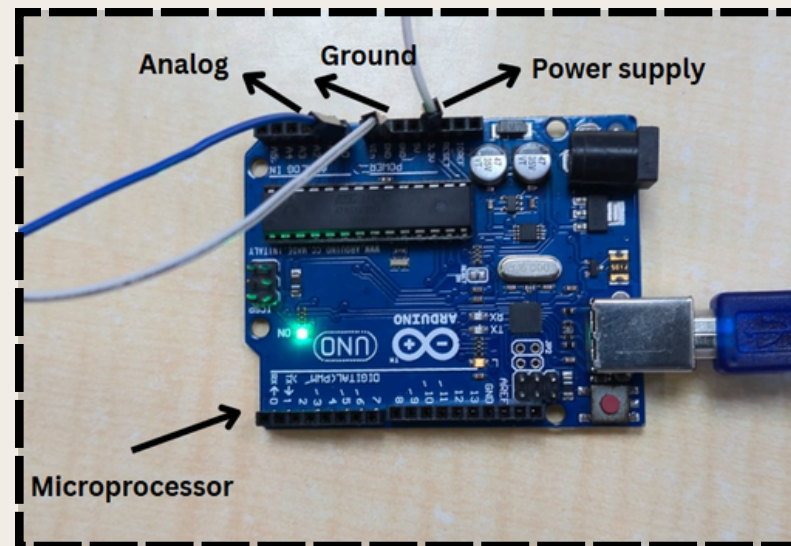
Key abiotic soil factors being tested:

CO<sub>2</sub> levels (microbial activity and respiration)

Moisture (water availability)

Temperature (soil microclimate, growth conditions)

Humidity (evaporate, moisture retention)



## Equipment, Setup & Experimental Process

The container with the setup was covered with a plastic bag preventing gases from escaping, reducing any uncertainty to the readings we record. The sensors were embedded within the soil for continuous tracking, allowing the measurements of any changes in gases without external factors affecting it.

4 setups were created:

- 1: Covered with EcoMulch,
- 2: Covered with plastic mulch,
- 3: Plants with EcoMulch
- 4: Plants with plastic mulch.

```
Moisture_Sensor.ino
1  int Moisture=A0;
2  unsigned long startTime;
3
4
5
6
7  void setup() {
8    // put your setup code here, to run once:
9    Serial.begin(9600);
10   startTime = millis();
11   pinMode(LED_BUILTIN, OUTPUT);
12 }
13
14 void loop() {
15   // put your main code here, to run repeatedly:
16   int MValue=analogRead(Moisture);
17   Serial.print("The Moisture Level is: ");
18   Serial.println(MValue);
19   delay(1000);
20
21   unsigned long currentTime = millis();
22   unsigned long elapsedTime = currentTime - startTime;
23
24   Serial.print("Time elapsed: ");
25   Serial.print(elapsedTime / 1000); // Convert milliseconds to seconds
26   Serial.println(" seconds");
27   delay(1000); // Update every second
28
29   digitalWrite(LED_BUILTIN, HIGH);
30   delay(1000);
31   digitalWrite(LED_BUILTIN, LOW);
32   delay(1000);
33 }
```



## Data Collection:

Real-time soil condition updates were observed on the serial monitor of the Arduino Uno application, ensuring precise tracking.

## FABRICATION OF EcoMulch

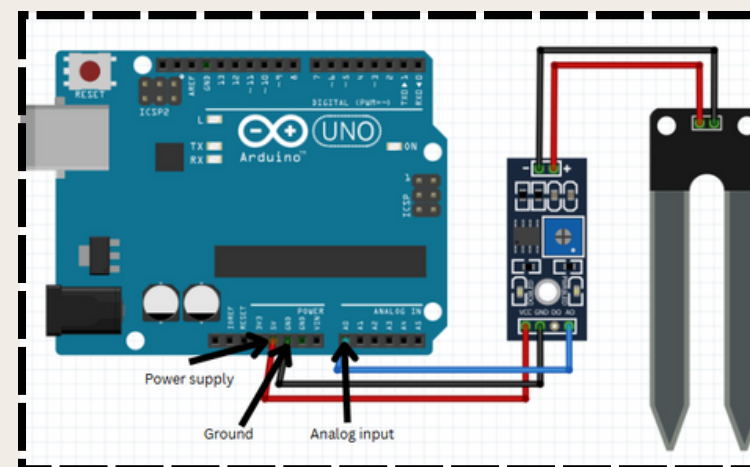
### Materials needed:

Sand, Clay, Turmeric, Neem Extract

### Procedure:

1. Add sand, clay and turmeric in a ratio of 200g:10g:10g and stir gently with 50ml water until it's a uniform mixture.
2. Pour the neem extract while kneading, but ensure the consistency does not get too thin.
3. Add some water to prevent any lumps and dry patches.
4. Spread the mixture in a thin layer, allowing it to set and dry.
5. Once it is slightly hardened, crumble it directly onto the soil around the plant.

The experiment comprised of comparing and contrasting abiotic factors. The Arduino Uno microprocessor was used to make a simple circuit which continuously relay readings in the soil on the serial monitor of the Arduino Uno application.





# Analyzing Results from Experiments

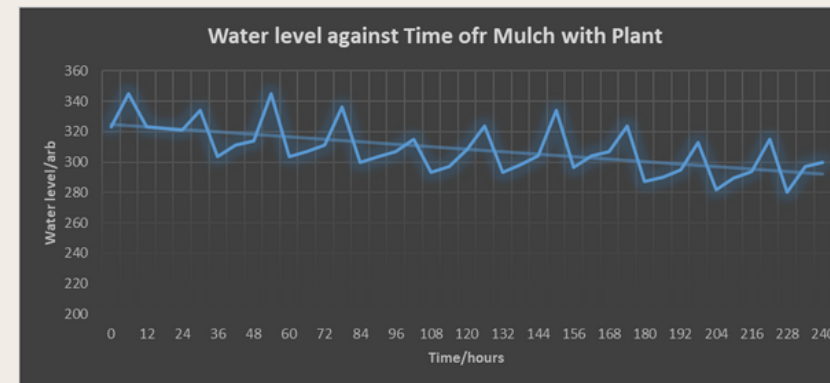
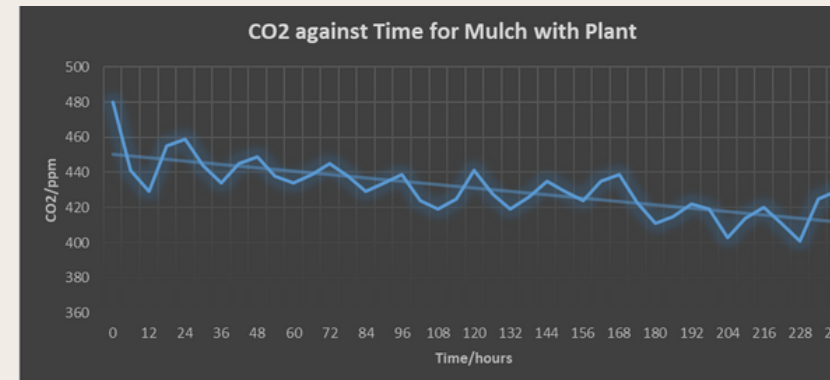
## **Soil with EcoMulch and plant**

### TREND IN CARBON DIOXIDE:

- The carbon dioxide concentration within the closed environment decreased as the plant began to take CO<sub>2</sub> for photosynthesis.
- Turmeric encourages growth of soil microbes that enhance carbon fixation
- Turmeric kills bacteria and fungi so they do not respire causing a drop in carbon dioxide

### TRENDS IN WATER

- At first the water levels increased as water came into contact with the surface of the sensor.
- After a short while the water level started to decrease as rate of photosynthesis increased by the plant. The plant was watered every 24 hours at 6 am. There was an overall decrease in the water level.



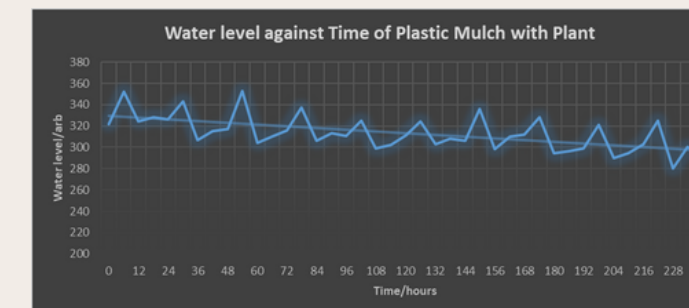
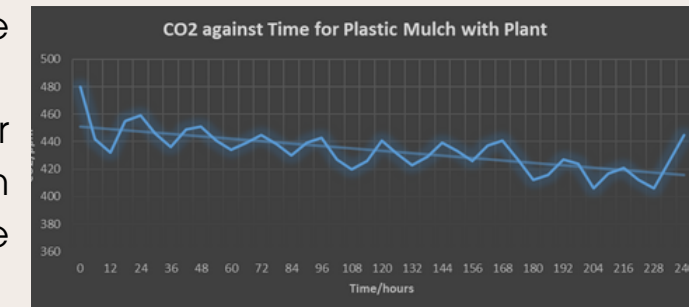
## **Soil with plastic mulch and plant**

### TREND IN CARBON DIOXIDE:

- The carbon dioxide concentration saw the same trend but also had a decreased rate.
- Since the plastic mulch has weaker water retention capabilities, more water was lost from the soil which would explain all the variation we observed in this particular experiment.

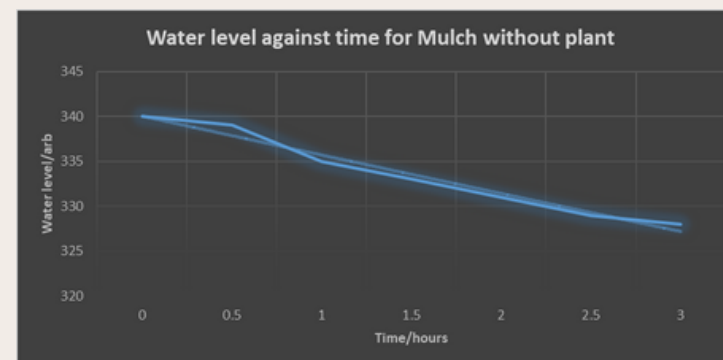
### TRENDS IN WATER

- The same trend was observed with this apparatus as well, but the water level decreased at a significant rate.
- Similarly, the observed trend of the humidity levels was same except the levels increased with a significant rate. The high humidity levels help maintain a very low concentration gradient, which means that the plant with mulch is less prone to lose water due to transpiration.



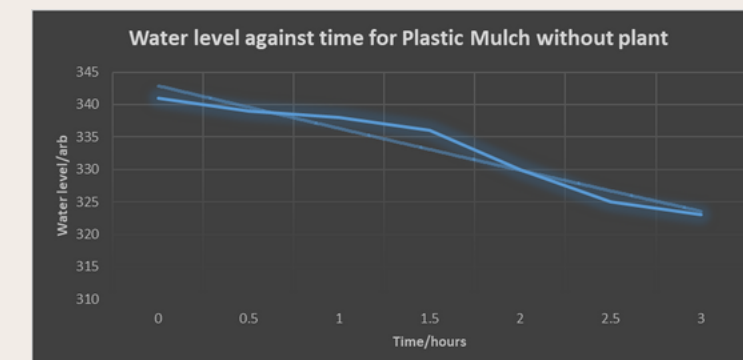
## **Soil with EcoMulch**

A setup was made and placed in the sun which had only EcoMulch and a moisture sensor placed inside to check how fast water was being evaporated



## **Soil with plastic mulch**

The same decreasing trend was seen with the water levels in plastic mulch. Water levels decreased at a significant rate as compared to that of the EcoMulch. This meant that the turmeric EcoMulch is composed of has better water retention qualities



## Citations:

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- Zhang, H., Wang, J., Liu, Y. and Li, X. (2020). Effect of mulch type and thickness on soil parameters and crop yield. Agricultural Water Management, 241, p.106353. Available at: <https://www.sciencedirect.com/> (Accessed 16 May 2025).
- AgriFarming. (n.d.). Plastic Mulch Cost, Usage & Alternatives in India. Available at: <https://www.agrifarming.in/plastic-mulch-cost-usage-alternatives-in-india> (Accessed 16 May 2025).

# Costs

## EcoMulch

INGREDIENTS	QUANTITY USED PER HECTARE	PRICE PER HECTARE (USD)
Clay	100 kg	\$8.94
Turmeric	15 kg	\$158.7
Margosa Leaf Extract	5 liters	\$11.76

TOTAL: \$179.4

EcoMulch costs just **\$179.4 per hectare**, compared to the market average of **\$946.8 for alternative mulch** making it **5.3x cheaper**. It's this affordable because we use waste materials like factory-discarded turmeric, construction-grade clay, and margosa water spray, cutting raw material costs without compromising effectiveness, with zero disposal costs and added soil benefits.

## Current Solutions

TYPE OF MULCH	PRICE PER HECTARE / USD
Polyethylene Mulch	\$479.40
Other Biodegradable Mulches	\$961.10
Biodegradable Plastic Mulch	\$1400.00

TOTAL (Average): \$946.8

This creates a massive market opportunity: with **180 million hectares of global cropland**, the total addressable mulch market (TAM) **exceeds \$100 billion**.

Our product also reduces irrigation by up to **1.5 million liters per hectare per year**, saving farmers \$45–75 annually. Combined with lower input and labour costs, farmers stand to **save over \$600 per hectare per year**.

**EVEN IF 1% OF THE AGRICULTURAL COMMUNITY UTILIZES EcoMulch, THERE IS A \$1 BILLION IMPACT**

TAM (total addressable market) - 45 billion dollars  
CAGR (compounded annual growth rate) - 12.5%

# Scalability, Feasibility and Distribution

## STEPS:

1. Setting up small factories to produce EcoMulch in places with low labour costs and where the raw materials are readily available (like Maharashtra, Kenya and Vietnam).
2. Selling through established markets which can reach farmers directly and at a large scale.
3. Making use of government schemes that can subsidize and help distribute EcoMulch through their lines to a large number of farmers.



## FEASIBILITY

- Raw materials are easily available in countries like **India, Vietnam and Kenya** where agriculture is a large part of the economy.
- Basic supply chains can be used.
- The composition of the mulch can be adapted based on **regional agri-waste** making it **cost-effective, locally sourced, and scalable across geographies.**

Eg. **corn husks** in Europe

**rice husks** in Asia

**sugarcane bagasse** in Brazil and India

**wheat straw** in North America

## REVENUE MODEL

We can earn from factory sales of EcoMulch, subscriptions of our app and licensing for industrial expansion

## SCALABILITY

Application provides an audiovisual user manual

Low skill manufacturing

Little infrastructure and training needed

No minimum or maximum land size