

# Stubble Decomposing & Irrigation Spray System

Second Sun Systems and IIT Ropar research initiative

Stubble is **VALUABLE RESOURCE** for **IMPROVING SOIL FERTILITY**

*Problem: Described in Poetry*



[https://youtu.be/3fPmZ5hf\\_6g](https://youtu.be/3fPmZ5hf_6g)

Mother Nature has provided us **CROPS RESIDUE** for regenerating **SOIL WEALTH**; it must not be burnt; neither in **FIELDS** nor in **BOILERS**. Our aim is to empower farmers with such a simple **In-Situ** solution that they find burning cumbersome and adopt **REGENERATIVE AGRICULTURE** for enriching organic carbon in soil and **CARBON SEQUESTRATION** to combat climate change and boost microbial Biodiversity in Rhizosphere.

*Solution: Stubble Decomposing & Irrigation Spray System*



# The team

Sukhbir Singh Sokhi: **Mechanical Engineer; US10455775B2**

He is having 25 years of experience with diverse exposure in various disciplines of Mechanical Engineering. He would oversee assembly plant as proposed in phase 1 and aluminum sheet manufacturing plant in Phase 2.

Raj Nidhi Sharma: **(FIE, M.S- BITS Pilani, B.Tech-HBTI Kanpur, PG. Diploma (Industrial Management –IIT, Roorkee, HOD Industry interface-Sharda University.**

He is mentor Growth and Planning;a man of vast experience who would help us to scale overseas market.

Dr. Amit Sehgal: **B.E., M. Tech, Ph. D. (Electronics Engineering)**

He Advisor Fundraising, serving as Startup Mentor of Change for incubators of Atal Innovation Mission, Govt. of India and for Atal Tinkering Labs.

Namit Sharma: **(Chartered Accountant)** Oversee company financial matters.

Munish Aggarwal : **(Civil Engineer)** Oversee Local Marketing.

# Problem statement

1. Stubble burning is big environmental problem for North India in particular and South East Asia as a whole. NASA has captured the image of this menace from space. Indian state of Punjab, Haryana and Uttar Pradesh are among major rice producing states. 20 million MT of paddy straw is generated in Punjab only. the burning of one metric tons (2,204.6 pounds) of straw releases 3 kilograms (kg) of PM, 60 kg of CO, 1,460 kg of CO<sub>2</sub>, 199 kg of ash, and 2 kg of SO<sub>2</sub>, causing significant global warming and acid rain. The major problems faced by the local people are eye irritation, dryness of eyes, lung diseases, and chest congestion.
2. Soil is depleted due to continuous agriculture. Organic Carbon should be 1.1% which is 0.5% in State of Punjab. Whole of India has similar patterns. As per the study conducted by Department of Soils, PAU, Ludhiana in 2010, the soil loses 6-7 kg nitrogen per tonne, 1-1.7 kg phosphorus, 14-25 kg potassium and 1.2-1.5 kg sulphur due to stubble burning. This leads to an additional expenditure of Rs. 150 crore (US\$20 Million) per year to replenish the soil.
3. Carbon Sequestration is required to regenerate Soil Wealth while Regenerative Agriculture is required for CO<sub>2</sub> drawdown from climate. None of prior arts have these solutions. The loss of fertility leads to loss of one quintal extra yield of wheat crop and that could be obtained if the farmer ploughs back the paddy straw into the fields. So, the monetary losses attributed to this practice have been estimated at around Rs. 500 crore (US\$70 million) per annum in terms of loss of fertility, additional nutrients and loss of yield due to stubble burning. Burning of wheat/paddy straw raises the temperature of the soil in the top 3 inches to such high degree that the equilibrium of carbon: Nitrogen ratio (11:1), the percent bacteria (4:1), and the percent fungi (9:1) are rapidly changed.
4. Problem of stubble burning is related to **Ease of Doing**. Farmers don't have time to wait for slow spraying of bio-waste decomposer or slow and labor consuming stubble collecting while he always faces shortage of labor especially post harvest. Spraying/collecting of 2 hectare would take 8-10 days for 1 person with cost of INR 4500-5000 (US\$70) which is big ask for small farmer. (64% farmers in Punjab are small farmers having 2 hectares of land). Thus to empty field for wheat crop farmer choose only fast and economical way to burn it.

# Problem Statement

5. One prior art relates to make fuel of paddy straw and send it to Power generating plants to burn in boilers. This solution is tough to scale up as it requires a huge plant and in huge numbers. A plant is required after every 300 acres of land otherwise high transport cost makes it unviable. Huge spaces are required to store stubble for whole year of plant functioning. 20 million MT stubble is produced in just 20 days so to store such huge quantity would be a challenge itself. Too much resources are required to implement this solution only in state of Punjab. Moreover this prior art has no solution for 3-4 inches stem and root. Farmer still would be forced to burn it.

**6. Other prior art relates to spraying machines which are inefficient to spray vast fields in 1-2 days. While tractor driven machines are cumbersome to operate and costly machine would only be used for few days in year for farmer which is reason farmers are not using these machines. Non availability of farm labor post harvest for stubble management also forces farmers to burn it.**

7. Though bio waste decomposer is available but it has limited reach due to inability of farmers to spray it in fields as quickly as required. It is also nearly impossible for farmers to collect rice residue by employing big numbers of labor or dump stubble at one place and spray waste decomposer on it. Bio waste decomposer has now been developed by PUSA Institute and earlier by National Centre for Organic farming, Gaziabad to effectively decompose all residues in situ which require our system for effective use.

8. Stubble must not be left in fields to decay itself as itself decay of stubble would produce huge amounts of GHGs Methane and Carbon dioxide. Farmers still require our solution to spray bio-waste decomposer to get rid of these gases.

9. Down fall in water table is 33-50 cm/year in Punjab. Thus danger of fertile land of Punjab; to be converted in desert is looming large.

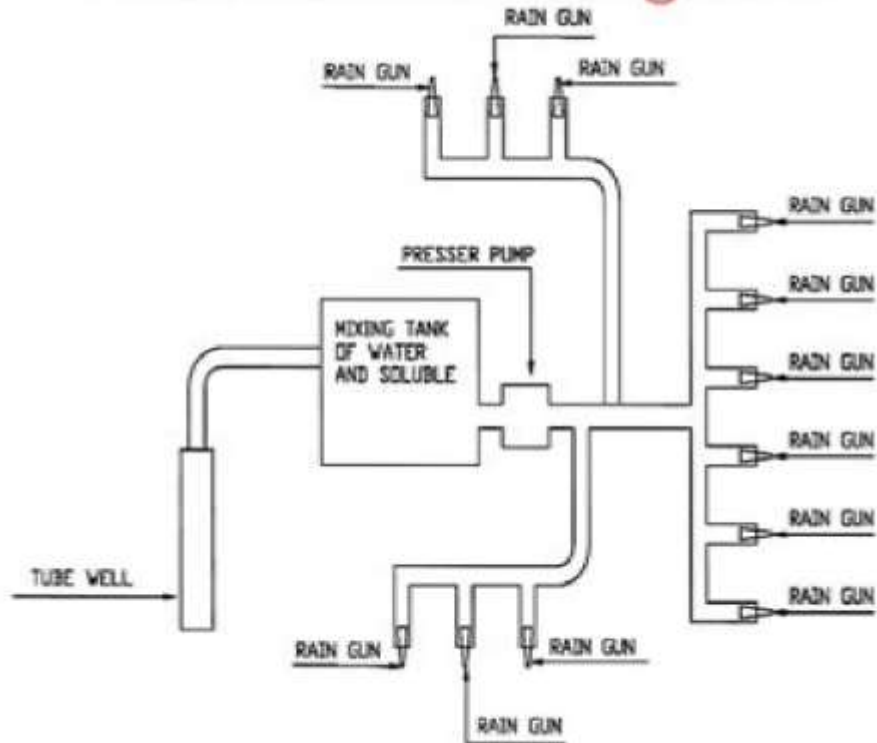
<https://www.researchgate.net/publication/318588145>

10. About 50-80% irrigated water is percolated in soil with chemicals which are used in fields for paddy production. It causes both groundwater pollution and soil pollution.

11. Manual urea-pesticide Spraying costs farmer INR 1000/ acre; that spray too is heterogeneous which lowers crop yield.

# Product

## Schematic Diagram



# Our solution and Novelty

Fastest spray. Multifunctional use: Rain guns are mostly used for irrigation purpose while **the Stubble decomposing and irrigation spray system** purposes spraying of Waste Decomposer, Fertilizers, Pesticides and herbicides and spray irrigation in a manner that 2 hectares can be **sprayed in just 45 minutes with just 1 push of button of starter**. Strategic locations are chosen for positioning of rain Guns which are attached with GI pipes laid at depth of so that they may not hamper tillage. These pipes are attached to a pressure pump of preferable capacity. The pressure pump is attached to a water tank having continuous stirring arrangement. System can be replicated for big sizes of farms.

Working Cycle: Fill tank with bio-waste decomposer and push the starter to run stirring arrangement and pressure pump. The pressure pump would supply solution to Rain Guns which would spray it on stubble. The water soluble spray and spraying in field; both are homogeneous as continuous stirring arrangement ensures homogeneous water soluble spray and high intensity spraying ensure homogeneous spraying action. The spray System is high intensity sprayer to spray up to 50- 300 feet. Another embodiment relates to smart system which can accommodate odd shapes of fields.

Rain Gun: Water enters rain gun pressure of 3 kg or more. It has various sizes of outlets as per requirement of distance to be covered. It has rocker arm with spring or gears. Rocker arm may act from side or top. Rocker arm oscillation with needle screw creates rain effect. Oscillation is made possible with help from kinetic energy of water and spring action. Rain guns can spray water from 50-300 feet. Some embodiments can cover more distances with help of more powerful water pumps. Rotatable head arrangement helps rain gun head to spray water like rain at an aperture of nearly 280 degree centigrade or 360 degree or any desired aperture.

# Bio waste Decomposer

It involves various types of enzymes & consortium of very effective microbial strains. This is a lyophilized, water soluble consortia of very high concentration bacteria & fungus, containing minimum  $1 \times 10^{12}$  per gm of the powder) of effective decomposing microbes. Therefore act very fast to decompose hard & soft parts of rice & wheat straw. This formulation is enriched with multiple strains of Bacillus, Pseudomonas, Rhodopseudomonas, Aspergillus, Trichoderma, Paecilomyces, Silicon solubilizers & enzymes to enhance molecular breakdown. Also blended with **methane loving methanotrophs Methylomicrobium sp. Which eats the methane & carbon dioxide produced during the process of decomposing to give carbon enriched biomass.** All the microbes have anti pathogen characteristics to check growth of harmful pests & diseases. It improves soil health in manifolds – better aeration of soil, better water holding capacity. The decomposed waste would raise yield of next crop by 4-7%. Prolonged use up to 3-5 years has witnessed yield increase upto 30%. Climate of North India favours these microbes as they require temperature range of 20-30 Degree centigrade for optimal effectiveness. North India has temperature of 20-30 degree Centigrade during paddy harvesting.

**Once sprayed microbes would penetrate into stubble and start decomposing.** After spraying, Plough by rotavator/superseeder and sow wheat which would not be affected Bio Waste Decomposer. Multiple spraying can be done to completely decompose stubble in 15-20 days. It would decompose paddy straw and would be beneficial for wheat crop.

Though bio waste decomposer is available as now manufactured Indian Agriculture Research Institute (PUSA Institute) New Delhi, and earlier by Centre for organic farming Gaziabad and some private manufactures like Shri Amrut-Pune; but it has limited reach due to inability of farmers to spray it in fields as quickly as required.

# Multipurpose uses and savings

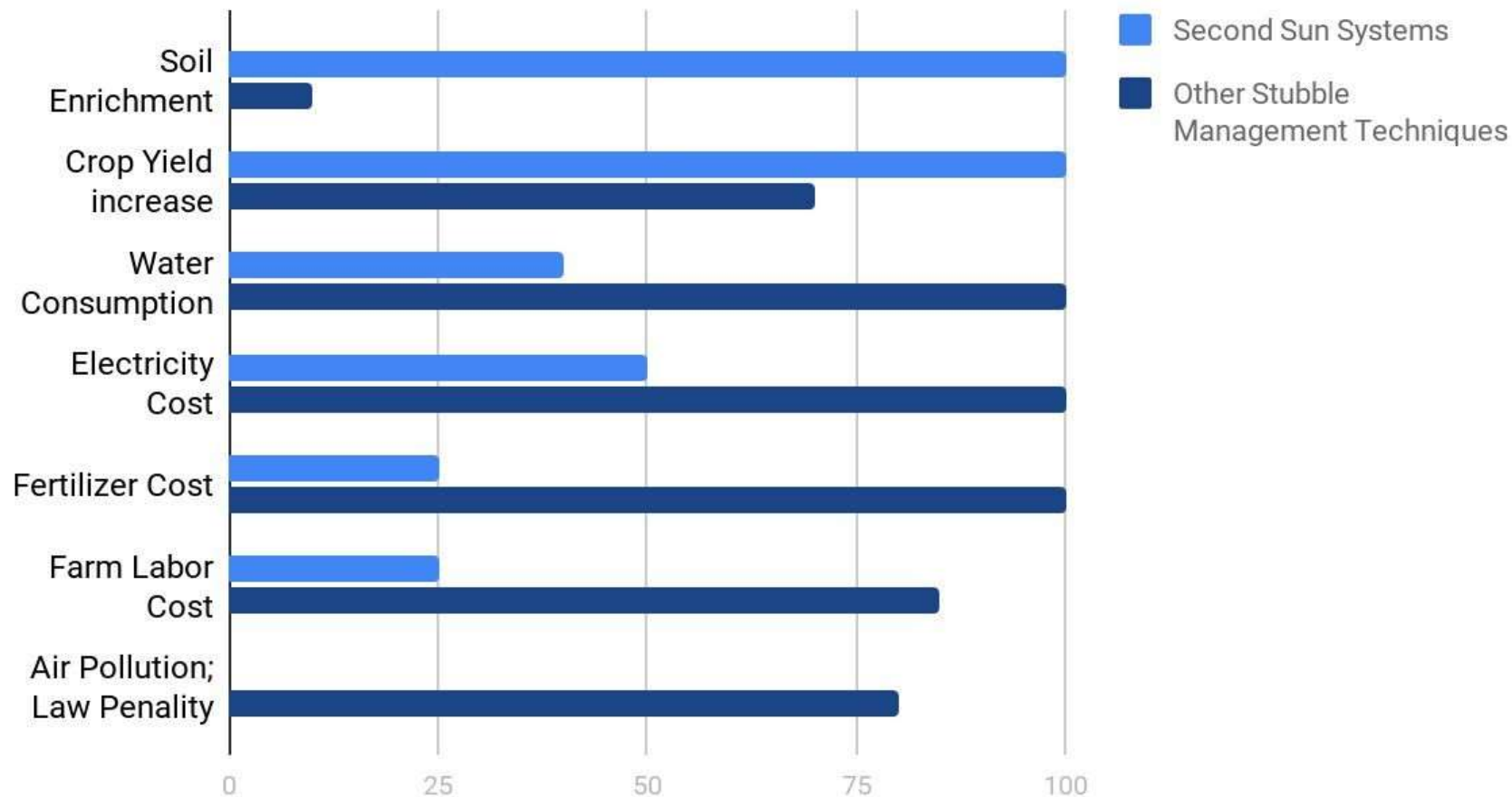
1. Stubble decomposer spray: Though waste decomposer is still present but mountainous task of spraying manually has barred farmers from using it. Our system can spray it effortlessly, effectively and economically to provide much needed carbon sequestration.
2. Carbon Sequestration- (To save Fertilizer cost): Cost of spraying of Stubble decomposer is approx. INR 500/-per 2 hectares. But According to some studies of various alternatives to the burning of stubble, incorporation of farm yield residues into the soil in the paddy and wheat cropping system seems to be the best strategy (Sood, 20155), as incorporation of the straw into the soil eventually enhances soil fertility. Stubble compost contains 1.7 to 2.1% of nitrogen, 1.5% phosphorous, and 1.4 to 1.6% potassium, which improve crop yield by 4 to 9% (Sood, 20155). All these microbes have anti pathogen characteristics to check growth of harmful pests & diseases. **Farmers can earn CARBON CREDITS by this technology.**
3. Air Pollution : PM 2.5, 10 and CO, CO<sub>2</sub>, SO<sub>2</sub>, SO<sub>2</sub> gases causing significant global warming and acid rain, SMOG gases are abolishable.
4. Soil wealth replenishment: Continuous use of Bio-waste decomposer boosts microbial Biodiversity in Rhizosphere to improve fertility of soil wealth which results in improved **Crop Yield**. 4 Mt of Carbon Sequestration per hectare with Intangible benefits are replenishing of other Minerals to give 4-7% increase in **Crop Yield**. This decomposed waste starts to give benefit to the next crop of same year like wheat followed by rice and vice versa.
5. Soil Pollution: Burning of straw damage soil, burn micronutrients, and kill friendly insect. These all would be saved with our technology.
6. Ease Of Doing : Our system enables farmers with fastest possible spray of Biowaste Decomposer. System is designed in a way that only 1 person can spray 2 hectares in just 45 minutes. Even larger area like 10 hectares can be sprayed in maximum 2 hours by 1 one person only. All needed is just 1 push of starter and spray is done.



# Multipurpose uses and savings

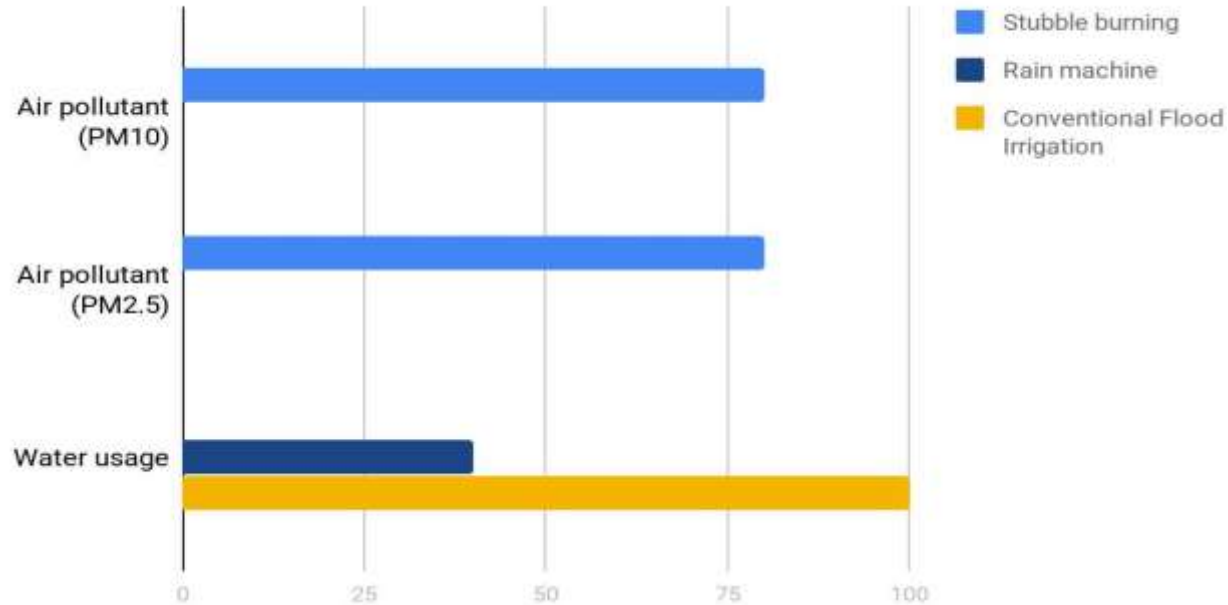
7. Irrigation: To irrigate fields replacing flood irrigation to save 60% water; precisely 216 cubic liters for 1 inch deep surface irrigation. Thus 60% saving electricity cost for farmers and nation. Saving water is of paramount importance for north Indian states where water table has drastically gone down. Down fall in water table is 33-50 cm/year in Punjab.
8. Water Pollution: The continues use of Bio-waste decomposer improves water holding capacity of soil which lower water seepage to ground. Thus saving drinking water stream from pollution.
9. Fertilizer spray: To spray fertilizer like urea to save labor cost and achieve homogeneous spray. Saving of Rs 2500 (US \$35) per hectare.
10. Pesticide spray: To spray pesticides and weedicides to save labor cost and achieve homogeneous spray as compared with manual spraying and small spraying equipment. Saving of Rs 2500 (US \$35) per hectare
11. Frost Biting: The system can save crops from fog-frost which is deposited on leaves to harm crops like potato in winter season. One push of starter enables farmers to spray water on 1 in 45 minutes on 2 hectares in chilly winter nights to ease out the job and improve Crop Yield.
12. Smart controls of machine can also accommodate square, rectangle or odd shapes of fields to irrigate or spray effectively in whole field.
13. More output from same piece of land as land consumed in water ways can also be used to for cultivation. The system would boost Crop Yield in fields as when would spray water on crops; water would wash leaves. Washed leaves would perform photosynthesis more effectively.
14. **Seed Germination:** The sprinkler system often ensures adequate seed germination with only one light application of water after seeding.
15. **Cooling of crops:** Temperatures above 35°C may cause blossom drop of yield up to 50 % in many crops. Sprinkler system will bring down the ambient air temperatures and leaf temperature by 5°C or more thus crop losses can be minimized.
16. Reduces pest and insects attack: Pests and insects get washed away during rain gun irrigation

# Customer value preposition



# Climate Impact

Climate Impact



Total Co2 saving for beachhead market: 1,460 kg of CO<sub>2</sub>, 199 kg of ash and other pollutants per 1 MT Paddy Straw.  
Our System would use 60% less water to irrigate same field.

Source: <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/flood-irrigation>

# Market

	Segment A	Segment B	Segment C	Segment D	Segment E
Market Segment	Small Farmer Under 2 Hectares	Big Farmer Above 5 hectares	Mid Size Farmer Above 2 hectaces	Mid size "Supply Chain" Farmer Above 2 hectares	Government
Buyer?	1	2	4	5	5
Well Funded?	2	3	4	5	5
Buying Reason?	2	2	3	4	5
Accessible?	5	4	4	4	1
Cost of Consumer Acquisition?	1	3	2	2	5
Life time value?	3	4	4	4	5
Whole Product?	5	5	5	5	5
Competition?	3	3	3	2	2
Next Segment?	5	5	5	5	5
Founder's Dearm?	4	5	5	5	5
Like Customers?	3	3	5	5	5
Total	34	39	42	44	48

7.06 lakh (64,6%) farmers of Punjab hold land above 2 hectares are Mid Sized farmers

Source: <http://farmech.gov.in/FarmerGuide/PB/Introduction.htm#land>

# Objective Summary

**Carbon Farming**: Our technology would **reduce 14.9 MT CO2 per hectare from atmosphere** by **replenishing 4.13 MT Organic Carbon in soil**. The increased organic carbon in the soil favor microbial activities in rhizosphere. We would enable farmers to earn **Carbon Credits**.

**Rejuvenative Farming**: 1 hectare of land produces average 8.5MT of stubble which contains 48.7% organic carbon, 1.05% Nitrogen, 0.14% Sulphur, P, Potassium and various other minerals. Our technology would replenish all minerals in to soil to increase fertility of soil. The technology can be applied to other crops like wheat, corn, sugar cane, cotton etc.

## The Dream

- An effort to limit **Global Warming to 1.5°C** as per **Paris Agreement** and **IPCC guidelines** by **9.74 Million MT of CARBON SEQUESTRATION** in soil in State of Punjab. To draw down **35.064 Million MT of CO2** from atmosphere by **REGENERATIVE AGRICULTURE** which would improve nutritional profile and resilience of crops, Improves **microbial biodiversity** in rhizosphere and enhance fertility of **SOIL WEALTH** in State of Punjab. Our technology can be easily replicated to INDIA and SOUTH EAST ASIA for Carbon Sequestration and CO2 drawdown of much larger quantities to combat **CLIMATE CHANGE**.

- The Honourable Supreme Court has observed, **“Farmers are to be equipped; not punished”**. In line with The Honourable Supreme Court our endeavour is to provide such a convenient solution to the farmers so that they find it easy to use as compared to burning of stubble. Thus menace of stubble burning would eradicate without penalising already stressed farming community.

- To help farmers to conserve already diminishing precious potable water and save spraying labor cost.  
To achieve 500 crore ( US\$70 Million) turnover by end of 3 years.