



# Microalgae for valorization of industrial & municipal wastewater

An effective, sustainable, and revenue-  
generating process technology

Environalgae

# Problem Statement

- ❑ The UN General Assembly in 2017 approved the global indicator monitoring framework developed by the Inter-Agency and Expert Group on Sustainable Development Goal Indicators (IAEG-SDG), and for the first time put wastewater on the global development agenda. [1]
  - SDG 6 is about ensuring the availability and sustainability of water and sanitation for all by 2030 and addresses the entire sanitation chain [1]
  
- ❑ Globally, ~400 billion m<sup>3</sup>/year of wastewater is produced, expected to increase by 25% and 50% by 2030 and 2050, respectively [2].
  - 80% of all wastewater is discharged untreated, creating a serious sanitation crisis for 4.5 billion people [2]
  
- ❑ Wastewater systems contribute to greenhouse-gas emissions (GHG) both directly through breakdown of organic matter discharged into the environment or during treatment processes, and indirectly through the energy required for treatment steps.
  - Account for 3% of global electricity consumption & degradation of organic matter contributes ~1.57% of global GHG emissions [3].
  
- ❑ Removal of major nutrients (C, N & P) is essential for environmental protection but through sustainable & circular routes [4]
  - Integration of microalgae-based wastewater treatment can help recover nutrients & reduce cost of aeration by providing oxygen through photosynthesis [4]

[1] UN Habitat and WHO, 2021. Progress on wastewater treatment – Global status and acceleration needs for SDG indicator 6.3.1. United Nations Human Settlements Programme (UN-Habitat) and World Health Organization (WHO), Geneva

[2] Pathways to a net-zero-carbon water sector through energy extracting wastewater technologies. npj Clean Water (2022) 5:49; <https://doi.org/10.1038/s41545-022-00197-8>

[3] Sustainable sanitation and gaps in global climate policy and financing. npj Clean Water (2020) 3:24; <https://doi.org/10.1038/s41545-020-0072-8>

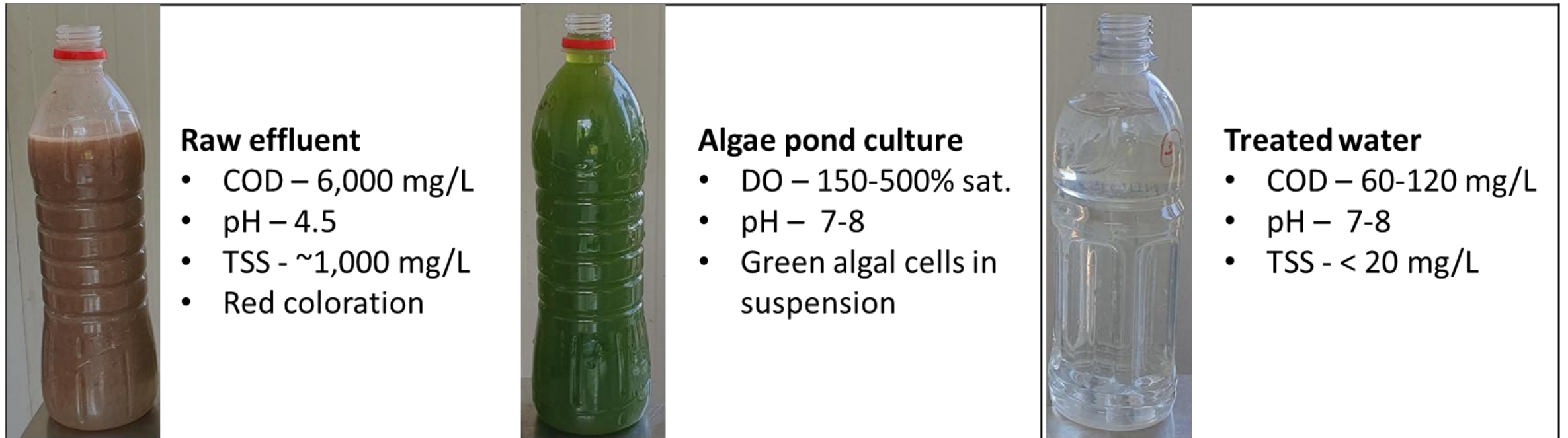
[4] Transitioning Wastewater Treatment Plants toward Circular Economy and Energy Sustainability. ACS Omega 2021, 6, 11794–11803

# The Need....and the opportunity

- Impact of *Climate Change* is well known and gets discussed in perhaps every important international convention of developed and developing nations.
- Our Nation has taken up ambitious NET ZERO goals.
- In the conventional effluent treatment processes, *Scope 1* and *Scope 2* emissions are usually significant. Hence, switching to more sustainable wastewater mitigation technologies will soon be a need of the hour
- (NEED) An ideal sustainable option for wastewater treatment should:
  - Utilize less energy
  - Result in very low carbon emissions
  - Produce clean water, and
  - Provide a co-product opportunity to improve the circularity quotient of carbon!
- (OPPORTUNITY) Microalgae-based wastewater treatment technology
  - Relies on sunlight as a source of energy; suitable weather conditions and ample sunlight availability throughout the year over here!
  - Consumes carbon and ammonia while it emits oxygen
  - Generates clean and compliant water suitable for discharge/ re-use
  - Produces microalgae-biomass for various end-use applications, thus recycling the carbon and nutrients from domestic wastewater streams

# An Exciting Clean-Tech for wastewater treatment....

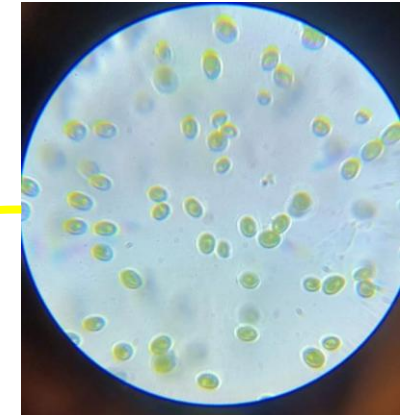
- **Sustainable** - Sunlight, the primary source of energy for our process, is free of cost, non-polluting and plentiful
- **Environment friendly\*** - O<sub>2</sub> released by algae, improves overall air and water quality in the environment
- **Effective** (field data collected from one of our pilot-plant sites for treatment of manufacturing effluent streams)



\* While the COD of this effluent is ~6,000 mg/L, our process can treat CODs of over 100,000 mg/L; what changes is the effluent volume treated per unit area

# 1 MLD plant operational at Sahyadri Farms

Full-scale microalgae ponds where the effluent gets treated  
**\*Drone-shot** of plant executed by us



Microalgae cells love it!!



Up to 1,000 m<sup>3</sup>/day of manufacturing effluent streams including Process effluents, biogas digestate effluent & Condensate from ketch-up manufacturing



Microalgae for Aquafeed & Crop Growth Stimulant



Centrifugation



Microfiltration

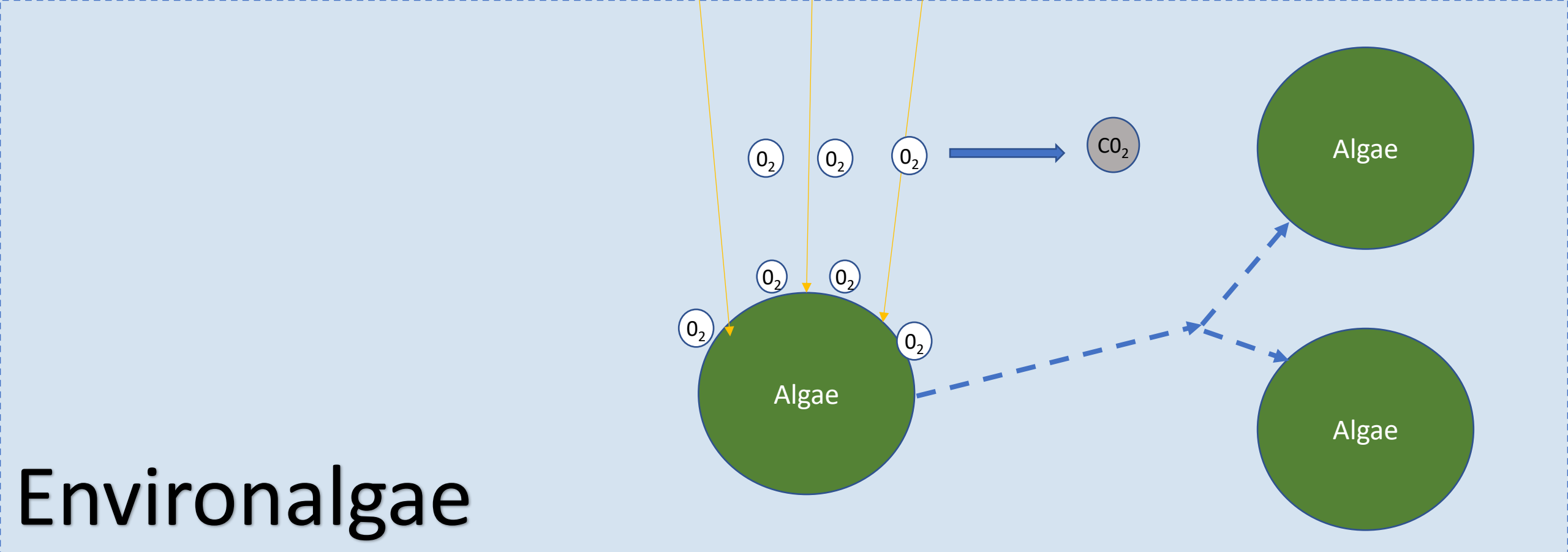
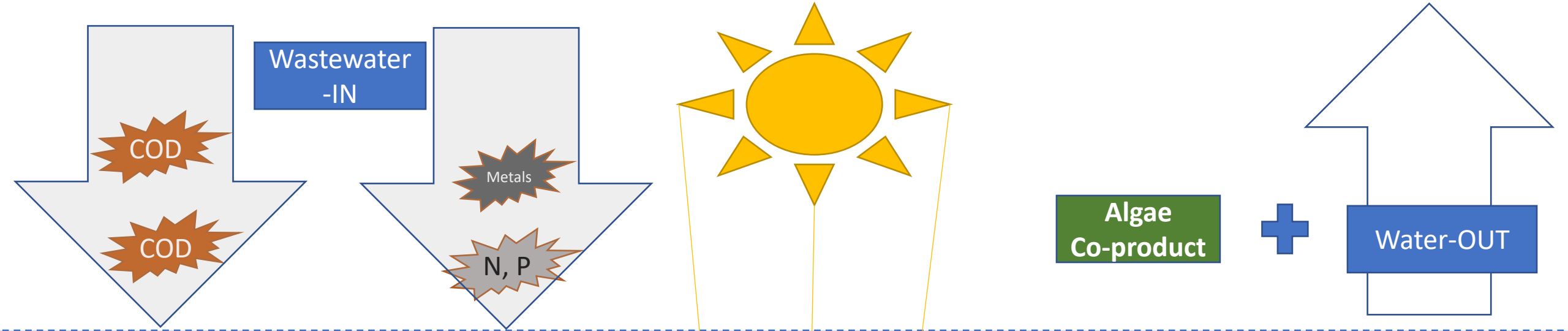


Treated effluent

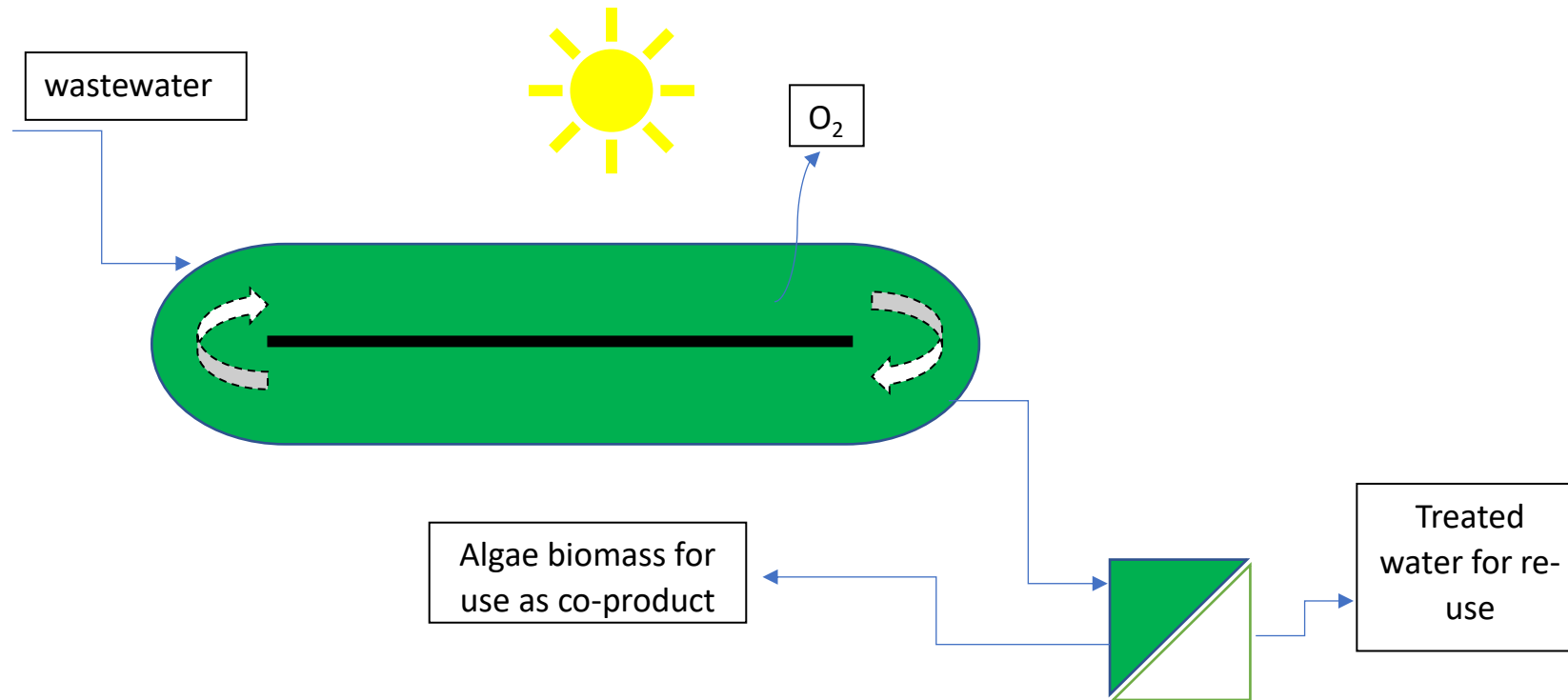
# How does our process work?

A short schematics-based animation to illustrate the process of pollutant abatement by photosynthetic microalgae.

PS – You will need to click multiple times on the next slide for the animation to execute



# Typical block-diagram for microalgae-based wastewater treatment



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# Algae versus conventional option

Parameter	Conventional effluent treatment	Microalgae
<b>Oxidizing agents</b>	<ul style="list-style-type: none"> <li>Need to be added at high mixing energy costs</li> </ul>	<ul style="list-style-type: none"> <li>Generated by microalgae through photosynthesis using sunlight</li> </ul>
<b>Ammonia etc.</b>	<ul style="list-style-type: none"> <li>Difficult/ expensive to remove, it generally degases out of the system</li> </ul>	<ul style="list-style-type: none"> <li>Decisive advantage through rapid metabolism of ammonia into proteins and amino acids</li> </ul>
<b>Operational exposure risks</b>	<ul style="list-style-type: none"> <li>Foul smell, exposure to pathogens</li> </ul>	<ul style="list-style-type: none"> <li>Shallow (&lt;30 cm deep) water bodies that emit oxygen!</li> </ul>
<b>Carbon emissions</b>	<ul style="list-style-type: none"> <li>Generated and released into the atmosphere</li> </ul>	<ul style="list-style-type: none"> <li>Utilized by microalgae to produce more algal biomass and oxygen</li> </ul>
<b>Generated bio-sludge</b>	<ul style="list-style-type: none"> <li>Needs to be disposed</li> </ul>	<ul style="list-style-type: none"> <li>Platform feedstock for fertilizer, feed and biochemicals</li> </ul>
<b>Carbon capture</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>Huge potential to integrate carbon capture with effluent treatment</li> </ul>

# How would the end-user benefit by deploying this technology?

## ❑ Effective abatement of pollutants under broad conditions

- A process technology that can be customised based on the nature of effluent streams generated at customer site
- A process that is effective at low pH and high salt concentrations
- A process that can not only remove COD & BOD (carbon), but also remove Ammoniacal nitrogen, phosphorus and other nutrients. And hence help avoid Nitrous Oxide emissions; which is otherwise >265 times more potent at global warming than Carbon-dioxide

## ❑ Sustainable

- Uses sunlight as the primary source of energy and generates oxygen and hence reduces energy requirement for aeration-mixing
- Explore the potential of Carbon Emissions Reduction (CER) credits.

## ❑ Clean-tech

- Generates clean water that can be re-cycled and re-used; over 90% of the treated water can be *viably* recycled through Reverse Osmosis
- Releases oxygen into the atmosphere and hence cleaning the air

## ❑ Profitable

- Microalgae biomass generated from the process has huge potential as feedstock in the Feed, Fertilizer & Biofuels industries

## ❑ Improved Brand-value

- Deployment of low-carbon & circular solutions for effluent treatment can help improve brand value and reduce Scope 3 emissions for their customers
- Positive socio-economic impact on Agricultural economy through production of bio-stimulants & live feed for Farming & Aquaculture, respectively

# Why this technology makes more sense now?

- Microalgae-based wastewater treatment can positively contribute towards mitigation of ill-effects from *Climate Change* by the virtue of being *Sustainable, Circular, and Clean*.
  - By primarily relying on natural sunlight for photosynthesis-mediated degradation of pollutants from the wastewater, this process scores high on *Sustainability*.
  - By converting the waste organic carbon, nitrogen, phosphorus, and other nutrients, present in the effluent into nutritious, high-protein algal biomass with potential for use in the Agriculture & Aquaculture industry, this process also scores high on *Circularity*.
  - Finally, by generating clean water and releasing pure oxygen to the environment, this is essentially a *Clean technology* option for wastewater treatment.

# About Environalgae

- ❑ Company website - <https://environalgae.com>
  - Email: [ninadg@gmail.com](mailto:ninadg@gmail.com) or [ninad@environalgae.com](mailto:ninad@environalgae.com)
  - Phone: +91-8600140949
  - Address: Environalgae, 1101 Millennium Empire, Plot 47 Sector 15, Near D-Mart, Kharghar, 410210 Maharashtra, India
- ❑ We have now commissioned what is one of the largest microalgae-based end-to-end effluent treatment plants ever built. Its a novel, microalgae-based process that converts nutrients present in effluent from their agro-processing unit to high-value algal biomass for use as high-value feed for the aquaculture industry. Treated water generated from this plant meet the discharge specifications of the pollution control board.
- ❑ Links to videos on our lab, pilot plants and full-scale plant set-up by us:

Content	Google Drive Links
<b>Environalgae lab</b>	➤ <a href="https://drive.google.com/file/d/1I5MLLbTSestZk6fXQrWyot9uCabjPdsl/view?usp=drive_link">https://drive.google.com/file/d/1I5MLLbTSestZk6fXQrWyot9uCabjPdsl/view?usp=drive_link</a>
<b>Environalgae pilot-test-bed facility</b>	➤ <a href="https://drive.google.com/file/d/1-wR0E2DOFm1Ti8gyzXQIUGA8X3_yiwdt/view?usp=drive_link">https://drive.google.com/file/d/1-wR0E2DOFm1Ti8gyzXQIUGA8X3_yiwdt/view?usp=drive_link</a>
<b>Pilot-process set-up at customer site</b>	➤ <a href="https://drive.google.com/file/d/1vl2Ghuwv4R5BaQ3N-yigcR3ddtpuh40t/view?usp=drive_link">https://drive.google.com/file/d/1vl2Ghuwv4R5BaQ3N-yigcR3ddtpuh40t/view?usp=drive_link</a>
<b>Full-scale process set-up at customer site</b>	➤ <a href="https://drive.google.com/file/d/1PHArZ1_oXJr2etdRPC1DAG7KLKIIpQp/view?usp=drive_link">https://drive.google.com/file/d/1PHArZ1_oXJr2etdRPC1DAG7KLKIIpQp/view?usp=drive_link</a> ➤ <a href="https://drive.google.com/file/d/1Uf2zO3YMF24cR0UpHgOyKvWNVjKS_VYO/view?usp=drive_link">https://drive.google.com/file/d/1Uf2zO3YMF24cR0UpHgOyKvWNVjKS_VYO/view?usp=drive_link</a>

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# About Environalgae

Team with an ideal of youth and experience

- **Ninad Gujarathi, PhD (Proprietor and Founder)**
  - Leadership experience in R&D, Techno-commercial, Manufacturing and Business roles, with proven track record of evaluating, conceptualizing, innovating, developing, scaling-up, delivering process & business solutions, and business growth.
  - Experience in conceptualizing, designing, executing, commissioning and operating some of the world's first and largest algae-based carbon capture and process effluent treatment plants.
- **Rahul Patel, PhD (Chief Technologist)**
  - Experience in developing cultivation biology process schemes, executing, commissioning and operating one of the world's first and largest algae-based carbon capture and process effluent treatment plants.
- **A team of FIVE Biologists, FOUR Engineers and ONE supervisor** to help our customers with research, development, designing, executing, and commissioning this emerging technology



Best Technology Solutions Provider  
at the Annual IGCW Awards 2023

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# Why Environalgae?

- As a team, we are among the very few across the world to have experience in developing, demonstrating and executing microalgae-based effluent abatement projects
- Significant experience in managing large and multi-national microalgae projects across the world
- Top management of the team are experienced R&D, technology & business leaders with illustrious corporate careers prior to establishing Environalgae
- We develop & provide customized process technology solutions for your effluent treatment needs
- We follow a *phase-gate* approach with focus on developing and **demonstrating value-addition** at each stage of the project, prior to presenting a business case for further investment by customer
- We are passionate about the environment and also about the potential of microalgae for meaningfully contributing towards resolution of some of the greatest climate challenges that mankind has ever faced

# Our Phase-gate approach....

Phase	Phase description	Remarks
SCIENTIFIC FEASIBILITY ASSESSMENT	Algal bioassays at Environalgae lab	One month of studies at low cost
TECHNICAL FEASIBILITY ASSESSMENT	Process development at Environalgae lab	One and a half months paid project
VALIDATION STUDIES	Pilot-scale demonstration-validation studies at Environalgae pilot-plant facility	One month paid project
DESIGN	Design of the full-size ETP plant	Two months paid project
EXECUTION & COMMISSIONING	Execution and Commissioning of the full-size ETP plant	Three-Four months paid execution work

# What we are offering: Microalgae-based treatment plant process for.....

Segment	Sweet-spot	Remarks
Small ETPs (10-100 KLD)	<ul style="list-style-type: none"> <li>High TDS or Ammonia containing effluent</li> <li>Superior sustainability impact over conventional processes</li> <li>Attractive ROI</li> </ul>	<ul style="list-style-type: none"> <li>Unique and unparalleled experience in scaling up microalgal processes from lab-scale to very large algal facilities (dozens of acres in size)</li> <li>We offer end-to-end services starting with process technology package development, pilot testing to plant commissioning and handover</li> </ul>
Large ETPs (100-3,000 KLD)		
CETPs (2,000+ KLD)		<ul style="list-style-type: none"> <li><b>Option A:</b> Process Technology, Process Design, Process Technology package, pilot testing to full-scale STP commissioning and handover</li> <li><b>Option B:</b> Pilot/ Demo systems for validation of feasibility &amp; viability at existing CETP units.</li> <li><b>Option C:</b> Dedicated end-to-end concise sub-plant at existing CETP units for abating specific problem effluent streams (high TDS, high Ammonia, high Chloride, high COD etc.)</li> <li><b>Option D:</b> Segregated end-to-end ETP for individual member industries that have effluent streams which are out of specifications for the CETP design (high TDS, high Ammonia, high Chloride, high COD etc.)</li> </ul>
Small common STPs (1-10 MLD)		<ul style="list-style-type: none"> <li>Unique and unparalleled experience in scaling up microalgal processes from lab-scale to very large algal facilities (dozens of acres in size)</li> <li>We offer end-to-end services starting with process technology package development, pilot testing to plant commissioning and handover</li> </ul>
Large common STPs (10-150+ MLD)		

#Microalgae-based STPs smaller than 1 MLD are not commercially attractive in terms of ROI or payback period as compared to conventional STPs



# Microalgae-based Effluent & Sewage-water treatment

## *Sustainability benefits & Revenue potential*

Capacity of plant	30 KLD ETP	300 KLD ETP	3,000 KLD CETP	10 MLD STP	150 MLD STP
COD assumed, mg/L	4,500	4,500	4,500	750	750
Ammoniacal-N assumed, mg/L	100	100	100	40	40
Land required, acres	0.33	2.8	28	19	278
Algae <sup>#</sup> generation, MT/year	134	928	9,281	6,118	92,813
Payback on CAPEX, years	4.3	2.5	0.9	0.7	0.5
Min. RO water generated KLD	17	184	1841	8,500	127,000
CO <sub>2</sub> Eq. Reduction MT/year	888	9,517	95,169	62,996	944,933
O <sub>2</sub> released MT/year	78	653	6,535	4,357	65,350

<sup>#</sup> Algae wet cake at 10% solids concentration sold at ₹60/Liter; <sup>\*</sup> After accounting for interest on CAPEX @8% and depreciation of CAPEX over 10 years

# Typical composition of fresh-wet microalgal slurry

Typical composition of algal biomass (on wet-cake basis; 10% solids) CENTRIFUGED FRESH SLURRY		
COMPONENT	CONTENT	REMARKS
Water	90.0%	Over half of this is water present inside the algal cells
Proteins	5.0%	Attractive amino acid profiles
Fats	1.5%	High MUFA & PUFA content, no trans fats
Carbohydrates	1.5%	Fiber content
Minerals	1.5%	Mg, Ca etc.
High-value phytochemicals	0.5%	Antioxidants and pigments

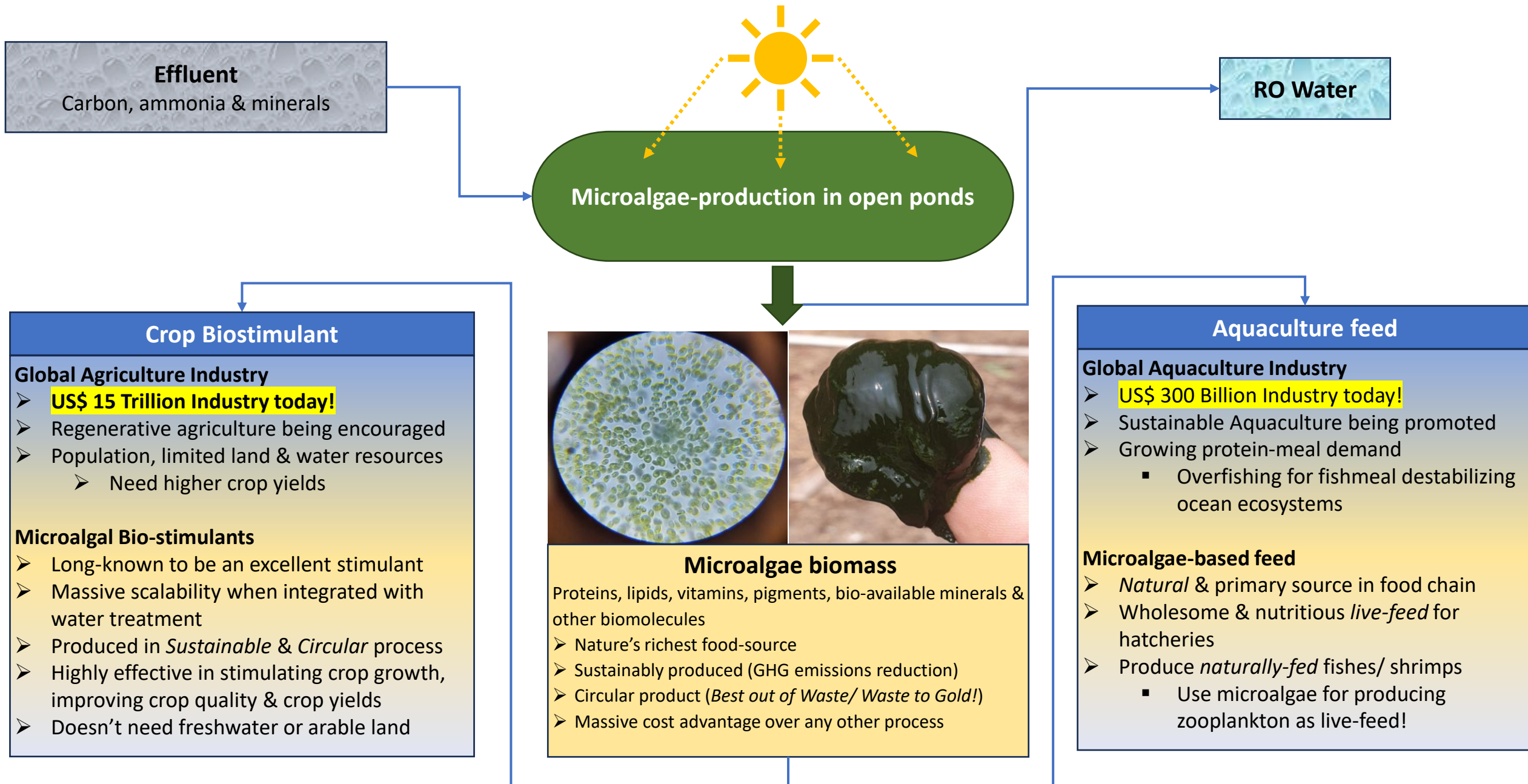
**Tremendous potential as a feedstock for Feed/ Fertilizers/ Biochemicals/ Food**

# Potential commercial applications of microalgal biomass

Application as	Minimum price for 10% solids wet slurry (₹/kg)	Remarks
Attractive high-value fertilizer application	60	<ul style="list-style-type: none"> <li>➤ Environalgae can work with the customer for developing off-take options for the microalgal biomass produced through the process</li> </ul>
<b>Live feed</b> - for producing “live/ fresh, naturally-fed” aquaculture feed	50	<ul style="list-style-type: none"> <li>➤ Will need to be distributed as “fresh algal slurry” just like milk</li> <li>➤ Can be tested by your acquaintances in the shrimp industry</li> <li>➤ <a href="#">Commercial live-frozen microalgae sells at over \$77/Liter</a></li> </ul>
<b>Supplement in aquaculture feed</b> – ingredient rich in proteins, antioxidants & essential fats	50	<ul style="list-style-type: none"> <li>➤ Can be tested in the aquaculture industry</li> <li>➤ Pricing potential will need to be established</li> </ul>

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# MICROALGAE FOR REGENERATIVE AGRICULTURE & SUSTAINABLE AQUACULTURE



# Opportunity for Microalgae-based Bio-stimulants (MBST)

## Need for Regenerative Agricultural practices to improve sustainability in Agriculture

- ❑ In 2018, world total agriculture and related land use emissions reached 9.3 billion tonnes of carbon dioxide equivalent (Gt CO<sub>2</sub>eq). In 2018, agriculture and related land use emissions accounted for 17% of global GHG emissions from all sectors. [5]
- ❑ Agriculture is a major contributor to global emissions of the GHGs that drive climate change. Action in this arena also makes good business sense. By addressing GHG emissions, companies (and producers) can identify opportunities to bolster their bottom line, reduce risk, and discover competitive advantages [6]

## Biostimulants

- ❑ As per a 2022 report by the Food and Agriculture Organization (FAO), United Nations [7]
  - Algae and plant extracts, chitosans, and other biopolymers are also used as biostimulants.
  - Some advantages of biostimulant application include:
    - i. Improvement of efficiency in the absorption and assimilation of nutrients,
    - ii. Tolerance to biotic or abiotic stresses, or improving any of their agronomic characteristics.
    - iii. They could complement, and in some cases substitute, chemical agro-products; that could improve plants metabolism and biochemical activities.

[5] Emissions due to agriculture Global, regional and country trends 2000–2018. Food and Agriculture Organization of the United Nations. SSN 2709-006X [Print] ISSN 2709-0078 [Online].

[6] GHG Protocol Agricultural Guidance Interpreting the Corporate Accounting and Reporting Standard for the agricultural sector. World Resources Institute. [Homepage](#) | [GHG Protocol](#)

[7] Soils for nutrition: state of the art. Food and Agriculture Organization of the United Nations Rome, 2022. FAO, 2022. Soils for nutrition: state of the art. Rome.

<https://doi.org/10.4060/cc0900en>

# Opportunity for Microalgae-based Bio-stimulants (MBST)

## Opportunity

- ❑ The current global market for plant growth promoters and bio-stimulants is valued at USD 3.2 billion and forecasted to reach USD 5.6 billion by the year 2026 [8].
- ❑ Price is a factor that could hinder the experimental research and adoption of biostimulants can be more expensive than certain type of fertilizers. [7]
- ❑ Therefore, any sustainable & circular product that significantly improves agriculture crop quality and crop yields has a massive market potential, if it is priced reasonably
- ❑ Global Agriculture market size is about \$15Trillion and is only expected to grow further
  - Even a 20% increase in crop productivity and yield, and given the positive impact on sustainability, can create a massive market for Microalgae-based Bio-stimulants (MBSTs).
  - The current cost of production for our process, as proven at scale, is at least ten times lower than the market prices of other bio-stimulants

[7] Soils for nutrition: state of the art. Food and Agriculture Organization of the United Nations Rome, 2022. FAO, 2022. Soils for nutrition: state of the art. Rome.

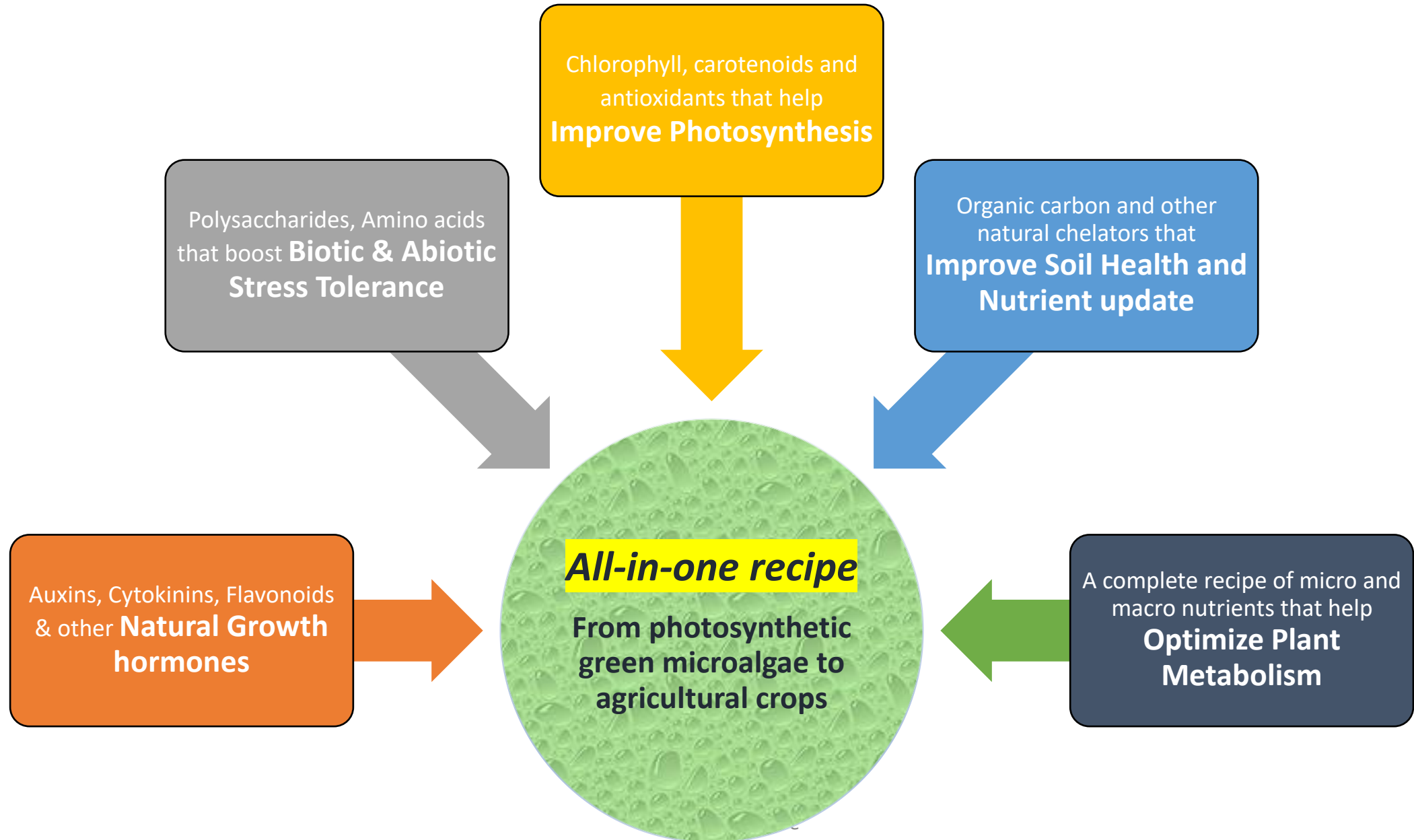
<https://doi.org/10.4060/cc0900en>

[8] <https://www.marketsandmarkets.com/Market-Reports/biostimulant-market-1081.html>

# Some examples of successful application of MBSTs

Crop	Microalgae sp.	Mode of application	Results	Reference
Wheat	Chlorella V.	Foliar spray	➤ <b>140% increase in wheat yield against control</b>	Shaaban, M. M. (2001a). Green microalgae water extract as foliar feeding to wheat plants. Pak J Biol. 4(6):628–32. doi: 10.3923/pjbs.2001.628.632
Onion	Scenedesmus subspicatus	Foliar	➤ <b>135% increase in onion yield against control</b>	Gemin, L. G., Mógor, Á.F., Amatussi, J., De Lara, G. B., and Mógor, G. (2022). Organic onion growth, yield and storage improved by foliar sprays of microalgae and fulvic acid as a natural biofertilizer. Bioscience J. 38 (e38045), 1981–3163. doi: 10.14393/BJv38n0a2022-58854
Black Gram	Chlorella V.	Foliar	➤ <b>119% increase in Black gram yield against control</b>	<a href="https://www.researchgate.net/publication/327896307_Prospective_of_Chlorella_vulgaris_to_Augment_Growth_and_Yield_Parameters_Along_with_Superior_Seed_Qualities_in_Black_Gram_Vigna_mungo_L">https://www.researchgate.net/publication/327896307_Prospective_of_Chlorella_vulgaris_to_Augment_Growth_and_Yield_Parameters_Along_with_Superior_Seed_Qualities_in_Black_Gram_Vigna_mungo_L</a>

# Why microalgae-based biostimulants (MBSTs) are highly effective





# Microalgae-based Biostimulants (MBSTs) tested in fields

- ❑ The name of this farmer is Mr. Yashpal Patil, and he is from Nandurbar district in Maharashtra, India.
- ❑ He had applied our microalgae-based Biostimulant as per the following schedule:
  1. 1 Liter/acre on day-4 via drenching
  2. 0.7 Liters/acre on day-12 via foliar sprays
  3. 0.7 Liters/acre on day-28 via foliar sprays
- ❑ On 19<sup>th</sup> of July, he was able to take his first harvest from the Crop. He typically takes 8-10 harvests over the crop cycle.
- ❑ His observations compared to last year are:
  1. Chilies are dark green and more vibrant in appearance
  2. The size of Chilies is bigger this time.
  3. **Yield has increased by 25% (5 quintals/acre as against 4 quintals/acre) in the first harvest**



# Microalgae-based Biostimulants (MBSTs) tested in fields

- ❑ The name of this farmer is Mr. Abhishek Jadhav, and he is from Nashik, Maharashtra (India).
- ❑ He has been applying the MBST in his field since the beginning of his tomato crop this year.
- ❑ He applies about 1-liter of it per acre per month
- ❑ His observations compared to last year are:
  1. Tomato size is bigger. Single tomato weighing ~45 gm, which was 30-35 gm last year.
  2. Tomatoes are very lustrous and are also going for export this time
  3. **The yield have gone up by twice compared to last year, while the pricing has been about 5-10 times of what he received last year because of the superior quality of the tomatoes**
  4. These tomatoes are sweet in taste too.



# Microalgae-based Biostimulants (MBSTs) tested in fields

□ A farmer, Mr. Ritesh Patel from Akola, Maharashtra (India), tried our MBST on his soybean crop

□ His observations:

- Extensive vegetative growth, within 5 days
- Increased leaf size
- Better Flowering
- Lower flower-dropping
- Improved resilience to unseasonal rains
- **~50% higher soybean yields** vis-à-vis adjacent farms that didn't use MBST
  - 10 quintals of soybean/acre, despite of heavy rains in the late flowering stage



Before application of MBST



5 days after application of MBST



# Microalgae-based Biostimulants (MBSTs) tested in fields

- ❑ This was tested by a Farmer at Nandurbar, Maharashtra (India)
- ❑ Over a span of four months, he had applied our microalgae-based Biostimulant twice, once at 1-L per acre and the next time at ½-L per acre.
- ❑ Compared to a neighboring farm, his observations are:
  - a. Darker and larger leaves
  - b. Greater leaf coverage
  - c. Greater girth of stem
  - d. Early flowering and Early fruiting
  - e. Enhanced fruiting and consistent fruit bearing



Control vs Treatment three months back

The treated farm now!



# Microalgae-based Biostimulants (MBSTs) tested on other fruit crops

- Higher yields of Bananas & Chikoos
- Very large bunch sizes for bananas - ~50kg each!
- More sweetness in bananas and chikoos
- Superior taste
- Larger individual fruit sizes
- Better physical fruit appearance
- Longer shelf-lives after harvesting



# Microalgae-based Biostimulants (MBSTs) testing underway in Grapes

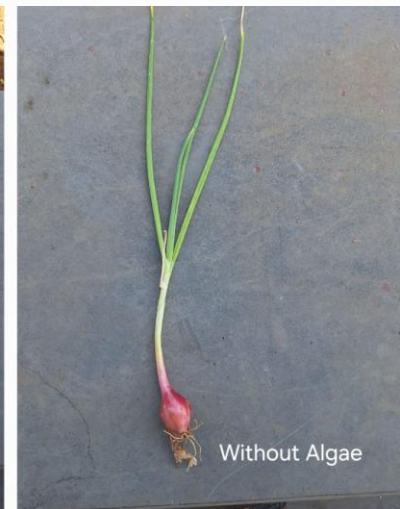
- Intense vegetative growth in the vineyards
- Very large leaves
- Very little yellowing of leaves
- Dark pigmentation in leaves
- Early and dense flowering
- Good fruiting
- Vineyards that had yellowing of fruit bunches improved within 4 days of MBST application (see the last picture)



# Microalgae-based Biostimulants (MBSTs) tested on vegetables

## □ Key observations

- a. Shorter crop cycles
- b. Darker leaves
- c. Higher yields
- d. Thicker grains
- e. Ability to grow well in extreme summer conditions
- f. Extended shelf-lives after harvest



# Microalgae-based Biostimulants (MBSTs) tested on leafy vegetables

## Key observations

- a. Shorter crop cycles
- b. Higher yields
- c. Brighter colour
- d. More intense flavours
- e. Tolerance to extreme weather conditions like high heat & heavy rainfall



Environalgae



# Background - Opportunity for live microalgae as primary & natural live-feed in Aquaculture

- ❑ The Aquaculture industry is almost \$300 billion globally. For the first time ever, this year, Aquaculture industry has overtaken the ocean/ river fishing industry as a market
- ❑ Aquaculture industry is facing three major challenges today:
  1. Product quality vis-à-vis wild-catch (nutritional value, antibiotics etc.)
  2. Impact of rising feed prices
  3. Sustainability impact of the sector – accounting for ~1% of global GHG emissions
- ❑ Green, live microalgae can alleviate some of these issues in Aquaculture farms by:
  1. Helping mimic wild aquatic ecosystems, by becoming the primary food source in aquaculture food-chain. This will help produce more “naturally-fed” fishes/ shrimps
    - i. Live microalgae as feed for hatchlings
    - ii. Live microalgae as a feed for zooplanktons (rotifers, copepods, daphnia etc.)
  2. Helping limit accumulation of organic matter and ammonia by converting them into more microalgal biomass. Thus reducing pathogens, improving oxygen levels & reducing toxicity.
  3. Reducing the carbon-footprint on account of reduced dependence on fishmeal
  4. Improving the efficiency ratios of supplemented feed, by reducing their consumption

# Opportunity for live microalgae as primary & natural live-feed in Aquaculture

- ❑ Enviroalgae has helped our customers instal very large microalgae projects wherein fresh, green microalgae biomass is generated at large-scale through nutrient recovery from food and agroprocessing operations of our customers
- ❑ Being a sunlight-driven process with nutrients being recovered from water treatment processes of the food industry, this microalgae biomass is expected to have a tremendous impact on sustainability (negative carbon foot-print).
- ❑ The microalgae is produced by consuming nutrients present in the agro-processing spent streams, and hence is very rich in its nutritional profile
- ❑ With water treatment credits and no costs for raw materials, the microalgae biomass produced from these processes will have tremendous pricing advantage over any other green microalgae biomass available in the market
  - By some estimates, the price of this live microalgae biomass (<\$1/Liter) is expected to be over an order of magnitude lower than the currently available biomass (>\$30/Liter) [9]
  - The availability from this one site is greater than 10,000 Liters per day and hence is a SCALABLE option

[9] [Commercial live-frozen microalgae sells at over \\$70/Liter](#)