

# NanoAqua Nanobubble Generator

## Technical Brief

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### Technology Summary

NanoAqua Nanobubble Generator is an advanced gas-to-liquid injection system that converts bulk oxygen or compressed air into nanobubbles (~80 nm). It achieves high oxygen transfer efficiency (75–80% OTE) to supersaturate water with dissolved oxygen (DO) without using chemicals, making it a sustainable solution for water treatment, agriculture, and aquaculture.

### Background

Low dissolved oxygen levels in water bodies and irrigation systems lead to poor plant growth, disease spread, and reduced aquaculture yields. Traditional aeration methods are inefficient in transferring oxygen and often require chemical additives. Nanobubble technology addresses these limitations by providing ultra-fine bubbles that stay in water longer, improving oxygen solubility and overall water quality.

### Technology Description

The NanoAqua Nanobubble Generator is an advanced gas-to-liquid injection system designed to efficiently convert bulk oxygen or compressed air into ultra-fine nanobubbles with an average size of approximately 80 nanometers. Utilizing a built-in oxygen concentrator delivering up to 95% pure oxygen, the system achieves a high oxygen transfer efficiency of 75–80%, enabling water to be supersaturated with dissolved oxygen without the use of any chemicals. This plug-and-play unit is engineered for easy installation and low maintenance, generating over  $1 \times 10^8$  nanobubbles per milliliter to ensure deep oxygen penetration in water. The technology's unique ability to enhance dissolved oxygen levels improves water quality, promotes root health and nutrient absorption in plants, suppresses harmful pathogens and algae, and supports healthier aquatic ecosystems. Available in multiple models with flow capacities ranging from 15 to 100 m<sup>3</sup>/hr, the NanoAqua series is versatile and scalable, making it suitable for agriculture, aquaculture, wastewater treatment, and environmental restoration applications.

### Market Potential / Proposed Deployment

#### Global Market Size:

- USD 33.4 B (2023) → USD 86 B (2031) | CAGR ~17%
- Alternate estimate: USD 81.2 M (2024) → USD 477 M (2034) | CAGR ~17.6%
- Ultra-fine segment: USD 390 M (2024) → USD 1.2 B (2033) | CAGR ~14.5%

#### Asia-Pacific (incl. India):

- Fastest-growing regional market with ~30%+ global share
- Driven by agriculture, aquaculture, and wastewater treatment demand
- India expected to contribute significantly due to irrigation and fishery applications

#### Key Drivers:

- Shift towards chemical-free water treatment
- Sustainable farming and climate-resilient aquaculture
- Government focus on water conservation and agri-tech
- CAGR Range: 10–18% globally, high double-digit growth in India/APAC

### Applications

- Agriculture & Horticulture: Enhances soil aeration, root health, and plant vigor.
- Aquaculture: Improves water quality, increases dissolved oxygen, and reduces disease risks.
- Wastewater Treatment: Enhances aerobic digestion and reduces chemical requirements.
- Environmental Restoration: Revitalizes stagnant lakes and ponds.

### Value Proposition

- Chemical-Free: Provides a sustainable and eco-friendly solution.
- High Efficiency: Achieves 75–80% oxygen transfer efficiency with low energy use.
- Versatile: Applicable across multiple sectors with easy scalability.
- Cost-Effective: Reduces input costs by improving water quality and crop/fish yields.

### Technology Status

- Development Stage: Commercially available and deployed in multiple sectors.
- Readiness Level: High TRL (Technology Readiness Level 8–9) with operational units in agriculture and aquaculture.
- Future Scope: Potential for integration with IoT-based water monitoring systems and scaling to large industrial applications.

