From Bubbles to Productivity Boosts

The Unsung Benefits of Oxygenated Water

HYDRO 2050 | HYDRO

Table of contents

1.

Where it starts: Our water sources

Water, in its elemental form, is the foundation of life. It nourishes plants, sustains ecological systems, and ensures societies thrive.
Water quality plays a pivotal role in food safety, environmental stability, and our collective future. This whitepaper examines the vital relationship between water quality, emphasising the benefits of high oxygen levels and its effect on productivity.

Where it starts:
Our water sources

Our irrigation water comes from diverse sources, including underground reservoirs, surface bodies, and municipal supplies. Each source presents unique challenges regarding both quality and quantity. Effective irrigation involves more than merely soaking the soil; it requires delivering water of the right quality in the appropriate amounts. Ensuring a consistent supply of high-quality water is essential for food safety, and crops require specific water quantities tailored to their needs.

Low-quality, contaminated water can have devastating effects on crops. It can stunt crop growth and, in extreme cases, be fatal to plants. Excessive soluble salts can damage roots, impairing their water and nutrient absorption abilities. Over time, these salts and contaminants may accumulate on the plant's leaves, impacting crop productivity and quality.

Polluted water's negative effects extend beyond plants. Aquatic ecosystems, from fish to microorganisms, are also at risk. In aquaculture farms where pristine water is essential, contamination can be dangerous, making our seafood sources potential health threats.

Water quality is about more than agriculture; it concerns the intricate web of life that depends on this precious resource. We'll delve deeper into this relationship and discuss how to ensure a sustainable future for all.

2.

Problems
we face today

Water's role in food production and cultivation is paramount. However, harmful single-cell organisms in our water sources, such as toxic algae in lakes or bacteria in irrigation ponds, pose significant challenges.

These contaminants disrupt ecological balance and result in billions in annual treatment costs. Moreover, they jeopardise food safety by impacting both crop yield and quality.

Problems we face today

Traditionally, chlorine, copper and hydrogen peroxide have been a popular treatment to neutralise toxins, ensuring irrigation water remains pure. However, while these added chemicals can tackle immediate microbial threats, use can adversely affect long-term water quality. Over time, residual chlorine might affect the taste and safety of our produce.

With the increasing concern about the use of “synthetic” additives in food and the impact of chlorination, some countries have forbidden the use of chlorine due to the potential to form hazardous byproducts that are potentially cytotoxic to mammalian cells, genotoxic with the potential for DNA damage, mutagenic and persistent in the environment.

Water quality directly impacts crop health and productivity in farming.

Using contaminated water introduces unwanted elements, such as salts and heavy metals, into our food sources.

Additionally, pathogens in the water can introduce diseases to crops, affecting yield and produce quality. Poor water quality can also cause mechanical issues in advanced irrigation systems, like clogged sprinklers or drip emitters, hampering crop growth and productivity.

1. Harmful microorganisms

Organic waste, including manure or decaying plant matter, contains various microorganisms. While some are benign, others are potentially harmful, endangering both animals and humans. And water can unwittingly courier these pathogens. For instance, shellfish beds contaminated by pathogens become inedible, while crops can absorb these harmful bacteria, entering our food. Although many of these microorganisms cannot survive sunlight exposure, some resilient strains can persist in soils for years, cycling between plants, soil, and animals.

2. Metals

Metals like arsenic, cadmium, and copper can easily contaminate water. At high concentrations, they can enter crops, rendering them unsafe for consumption. Sources of metal contamination include manure, fertilisers, and waste oil. Complicating matters, substances like wood waste leachate can expedite metal release from soils. Plants grown on these soils exhibit diminished growth and lower yield.

3. Oxygen Levels

Materials such as manure or decaying fruits and vegetables possess a 'high oxygen demand.' Simply put, they consume the water's dissolved oxygen as they decompose. So, an overabundance of these can drastically reduce water's oxygen content, making it uninhabitable for aquatic life and less useful for irrigation.

Dissolved oxygen serves as our measurement standard, and if it drops too low due to contamination, aquatic species, ranging from fish to microorganisms, are adversely affected leading to reduced growth rates, weakened immune systems, and increased susceptibility to disease and mortality. Bacteria in the soil also rely on the oxygen in irrigation water to grow to help increase nutrient availability for the crops.

4. Eutrophication:

While high nutrient levels in water might seem beneficial, the reality can be detrimental to aquatic ecosystems. Be it direct manure disposal, water runoff from fertilised fields, or erosion of nutrient-rich soil, the results are often similar: rampant algae blooms and significant drops in oxygen levels. And not all algae are benign; for instance, blue-green algae in large amounts can be toxic to livestock and marine life.

5. Irrigation Issues:

Water quality holds significant ramifications for crop farmers. Imagine facing liability for illnesses or damage traced back to your produce because of subpar water quality. From a practical standpoint, a common issue many farmers face is blocked irrigation systems. This could result from mineral accumulation over time or biofilm buildup, also harbouring potential pathogens.

3.

A groundbreaking **Solution**

The global challenge is identifying long-term strategies to ensure a continuous supply of pure, healthy water. As demands for water efficiency and reuse intensify, our need for safe and healthy water increases.

Historically, the approach to treating contaminated water was by adding potentially harmful chemicals, such as chlorine or copper-based solutions. These not only pose risks to plant and aquatic life but also leave lasting residues in water sources. Emerging evidence suggests that such chemical treatments can inadvertently foster the growth of drug and antibiotic resistance.

A Disruptive Technology with Proven Results:

Enter Hydro2050, which uses revolutionary advanced oxidation technology, leveraging the combined power of oxygen, ozone, and ultrafine bubbles to neutralise bacteria and pathogens, manage algae blooms, and enhance water's oxygen levels for food cultivation. The method eliminates the need for chemicals and their associated risks, simultaneously enabling water purification, sterilisation, and oxygenation.

180x stronger than **UV light**

2,000x stronger than **Ozone**

Environmentally friendly

50x stronger than **Chlorine**

Environmentally friendly

Chlorine: Present Sterilizer

Damage to Ecosystem
Unhealthy for Humans

Hydroxyl OH Radicals vs. Other Water Treatments

A groundbreaking Solution

Hydro's unique water treatment solution uses Hydroxyl (OH) radicals, the most potent oxidising molecules that safely target organic and some inorganic water contaminants. The unique technology generates a spectrum of over 95% of ultrafine bubbles smaller than 5 microns in diameter through cavitation, thus providing a greater capacity to carry oxygen and ozone in your water.

When the minuscule oxygen and ozone bubbles collapse under water pressure, they unleash highly reactive hydroxyl radicals. The sonic energy released as these bubbles collapse with the hydroxyl radicals present attacks and safely degrade pathogens and other potentially harmful impurities in the water.

Due to their short-lived nature and rapid action in water purification, hydroxyl radicals are not harmful and pose zero threats to humans, animals, or plants.

4.

Benefits: Driving business growth with healthy water

Agriculture

- Improved Soil Health
- Faster Plant Growth
- Reduce Production Cost
- Healthier Animals

Aquaculture

- Improve Fish Health
- Greater Fish Growth
- Disinfection
- Improved Energy Efficiency

Agriculture

Extensive studies by US government agencies and independent labs (such as NOAA, National Park Service, Microbac, and Babcock Laboratories) have confirmed that the patented Naias technology outperforms traditional contamination and water treatment systems. Research outcomes indicate an impressive removal efficiency rate of over 95% for bio-toxin algae (in contrast to the 15-20% efficiency of prevalent methods).

Contaminated Water Test – March 2016
Peter Moeller, Ph. D., Toxicologist

Dominant Species	Before Treatment	After Naias Treatment
Closterium	Yes	No
Eaudorina	Yes	No
Scenedesmus	Yes	No
Unidentified diatom	Yes	No
Nitzschia	Yes	No
Scenedsmus	Yes	No
Synechocystis	Yes	No
Rotifer	Yes	No
Cylindrospermopsis	Yes	No

Many of these organisms **have hard theca (cell walls)** that often make them **resistant to other algacideal chemicals**.

Because of Hydroxyl Radicals, **all are destroyed** with **No Chemical – 100% Natural**, Eco Friendly Solution.

The hydroxyl radicals generated are effective against a wide spectrum of single-celled organisms, leaving behind nothing but enhanced oxygen levels in the water.

Agriculture

• Improved Soil Health

Increasing the soil oxygen level improves water use efficiency (WUE), plant yield and produce quality.

Beneficial soil organisms require oxygen to survive and grow, and the proliferation of organisms such as arbuscular mycorrhizal fungi (AMF) can improve the host plant's resilience to stress such as salinity, drought, heat and waterlogging.

The Advanced water treatment kills, removes, and keeps clear biofilm in irrigation lines to ensure clean and accurate delivery of water to every plant and avoid secondary infection; and reduce labor costs for cleaning.

Regular Water

(Approx. 7ppm of DO)

High Oxygen Water

(Approx. 21ppm of DO)
More volume, Healthier

Agriculture

• Faster Plant Growth

Plants irrigated with oxygenated water tend to show better root health, faster growth, more vibrant colour and better produce quality. In addition to improving the biological growth processes within the plant, the utilisation of added nutrients is improved, leading to greater yields (25%-64%). Most plants achieve optimum growth with water at a dissolved oxygen level of 21 ppm, 3 times more than tap water.

TOMATO EXAMPLE

15% less fertilizer

11% bigger size;

14% heavier

Brix (sweet) index increase

Larger Roots

Longer shelf life

Better lustrous appearance

• Reduce Production Cost

Better germination, faster growth, improved fertiliser utilisation for higher crop yields, reduced plant cycle time, reduced losses, less chemicals and lower fungicide requirement increase business efficiency while lowering operational costs.

Agriculture

• Healthier Animals

Clean, healthy, oxygenated water also benefits animals promoting faster growth rates and healthier animals. Controlling pathogens present in drinking water and removing biofilm reduces the risk to animal health, and improves gut health, leading to productivity benefits.

• Reduced Methane Production

Ruminant Methane production is notoriously one of the largest contributing factors toward greenhouse gas (GHG) emissions, accounting for 50% of emissions from the agricultural sector in Australia, and 7% to total Australian GHG emissions. A recent Australian study has shown Ozone decreased Methane production by 20% in a Rumen fermentation system which provides an effective pathway for reducing GHG emissions in the Agriculture sector.

• Removing Metals in Water

Metals in water are deleterious to animals and plants. Adding Ozone which is highly oxidative to water via ultrafine bubbles, allows metals present in the water to be oxidised out of solution and simply filtered out before use, improving the health and quality of the water.

Aquaculture

This avant-garde technology offers numerous benefits in aquaculture settings, such as healthier fish, reduced fish mortality, accelerated growth, and eliminating chemical usage. For instance, Aqua Blue Waters conducted tests on prawns in 2013, revealing a mortality drop from 24% to 9% when employing Naias technology.

• Improved Fish Health

Maintaining optimum oxygen levels improve fish resilience, fish growth and general health. The Hydro process adds dissolved oxygen via ultrafine bubble technology, so that oxygen is held in the water column. Ultrafine bubbles have unique characteristics – they don't float and burst at the surface like normal bubbles and they spread throughout the water column eliminating oxygen stratification.

Oxygen addition through ultrafine bubbles is more energy efficient compared to conventional aeration methods and far more effective in delivering oxygen into water.

Maintaining optimum oxygen levels positively impacts pond ecology and microflora for species such as shrimp and fin fish. Combining with Ozone, is a safe and effective method for killing pathological bacteria in the water without harming the fish, eliminating chemical usage and leaving no chemical residue.

Aquaculture

• Greater Fish Growth

The ability to maintain optimum oxygen levels improves fish growth rates and can counteract the reduction in DO levels caused by increasing water temperature or operations such as feeding. Improved fish health and improved oxygen levels can also lead to improved conversion of food.

• Disinfection

The combined effect of nanobubbles and ozone creating hydroxyl radicals is a strong disinfectant that can kill a wide range of harmful micro-organisms, including bacteria, algae, viruses, and parasites, without leaving any harmful residues in the water. This can help prevent disease outbreaks and improve the overall health of the fish. The improved water quality and enhanced immune system can lead to higher survival rates in aquafarms, which can improve the overall productivity of the aquaculture system.

5.

The way Forward

Water, as the cornerstone of life on Earth, plays a paramount role not only in nurturing ecosystems but also in shaping the trajectory of our agricultural and food production endeavours. The quality and safety of this vital resource directly influence our environmental, health, and economic outcomes.

As outlined in this whitepaper, the challenges associated with maintaining water quality—be it pathogenic contaminants, metal pollutants, or issues with oxygen levels and eutrophication—present significant implications for both the environment and agriculture.

Furthermore, our traditional defences against these contaminants, such as reliance on chlorine, have revealed their own sets of challenges, including environmental residues and potential health impacts. These challenges underscore the pressing need for innovative solutions that are both sustainable and effective.

By leveraging cavitation technology and the potent oxidising power of Hydroxyl Radicals (OH), Hydro offers a solution that addresses the immediate threats to water quality and does so in an environmentally responsible manner.

The demonstrated efficacy of this technology, as validated by leading research institutions and its application in practical scenarios like aquaculture farms, signals a promising path forward.

As stakeholders—consumers, farmers, policymakers, or innovators—we all share the responsibility to champion and support solutions prioritising human and ecological well-being. Through collaborative endeavours and a commitment to sustainability, we can chart a course towards a future where clean water isn't just an aspiration but a guarantee for all.

6.

Research Papers - References

Ultrafine bubble water mitigates plant growth in damaged soil
1 Mineyuki Yokoyama ; Takatoshi Yamashita; Rumi Kaida,: Shigemi Seo,
2 Sadao Abe; 3 Kazuhiro Tanaka; 4 Masataka Nakano; Yoshiharu Fujii, and Kazuyuki Kuchitsu.
Bioscience, Biotechnology, and Biochemistry, 2021, Vol. 85, No. 12, 2466-2475

Oxygen in the root zone and its effect on plants
Mario de Jesús Moreno Roblero1; Joel Pineda Pineda2; Ma. Teresa Colinas León1; Jaime Sahagún Castellanos1
1 Horticulture Institute-Chapingo Autonomous University. Mexico-Texcoco highway km 38.5, Chapingo, Mexico. CP. 56230. (jaguar-moreno01@hotmail.com; lozcol@gmail.com);
2 Department of Soils-Chapingo Autonomous University. Mexico-Texcoco highway km 38.5, Chapingo, Mexico. CP. 56230.

Corresponding author: pinedapjoel@yahoo.com.mx.

Oxygen and Air Nanobubble Water Solution Promote the Growth of Plants, Fishes, and Mice

Kosuke Ebina1*, Kenrin Shi1, Makoto Hirao2, Jun Hashimoto3, Yoshitaka Kawato1, Shoichi Kaneshiro1, Tokimitsu Morimoto1, Kota Koizumi1, Hideki Yoshikawa1, Open Access Online
1 Department of Orthopaedic Surgery, Graduate School of Medicine, Osaka University, Suita, Osaka, Japan,
2 Department of Orthopaedic Surgery, National Hospital Organization, Osaka Minami Medical Center, Kawachinagano, Osaka, Japan,
3 Department of Immunology, National Hospital Organization, Osaka Minami Medical Center, Kawachinagano, Osaka, Japan

Impact of oxygation on soil respiration, yield and water use efficiency of three crop species

Xinming Chen1, Jay Dhungel2, Surya P. Bhattarai2,*, Manouchehr Torabi2, Lance Pendergast2 and David J. Midmore2
1 Key Laboratory of Agricultural Soil and Water Engineering in Arid and Semiarid Areas, Ministry of Education, Northwest
A & F University, Yangling, Shaanxi 712100, China
2 Centre for Plant and Water Science, Faculty of Science, Engineering and Health, CQUniversity, Rockhampton, Queensland 4702, Australia

Promotive or suppressive effects of ultrafine bubbles on crop growth depended on bubble concentration and crop species

Morio Iijimaa, Kaito Yamashitaa, Yoshihiro Hirooka 1, Yoshikatsu Uedab, Koji Yamanea and Chikashi Kamimurac
1Graduate School of Agricultural Sciences, Kindai University, Nara, Japan;
2Research Institute for Sustainable Humanosphere, Kyoto University, Kyoto, Japan; cEatech Co. Ltd, Kumamoto, Japan

Effects of nanobubble in subsurface drip irrigation on the yield, quality,

irrigation water use efficiency and nitrogen partial productivity of watermelon and muskmelon

Jing He1,2, Yanzheng Liu3*, Tianze Wang1, Weijie Chen1,2, Bin Liu1,2, Yunpeng Zhou1,2, and Yunkai Li2

1 College of Water Resources and Civil Engineering;

2 Engineering Research Centre for Agricultural Water-Saving and Water Resources, Ministry of Education; China Agricultural University, Beijing 100083, PR China;

3 College of Mechanical and Electrical Engineering, Beijing Vocational College of Agriculture, Beijing 102208, PR China

Mitigation of biofouling in agricultural water distribution systems with nanobubbles

Yang Xiaoa, Sunny C. Jiangb, Xiaoyao Wanga,c, Tahir Muhammada, Peng Songa, Bo Zhoua,d, Yunpeng Zhoua, Yunkai Lia,*

a College of Water Resources and Civil Engineering, China Agricultural University, Beijing 100083, China

b Department of Civil and Environmental Engineering, University of California, Irvine, CA 92617, United States

c College of Water and Architectural Engineering, Shihezi University, Shihezi 832000, Xinjiang, China

d Key Laboratory of Technologies and Models for Cyclic Utilization of Agricultural Resources, Ministry of Agriculture and Rural Affairs, Beijing 100125, China

Ozone Treatments for Preserving Fresh Vegetables Quality: A Critical Review

Citation: Sarron, E.; Gadonna-Widehem, P.; Aussenac, T.: Ozone Treatments for Preserving Fresh Vegetables Quality: A Critical Review. Foods 2021, 10, 605. https://doi.org/10.3390/ foods10030605

Evaluation of water oxygenation on milk production: milk composition and somatic cell concentration in milk

John E. Shirley, C. Galdamez, J. Estrada, Kansas Agricultural Experiment Station

Research Reports
Volume 0 Issue 2 Dairy Research (1984-2014)

Ozone Decreased Enteric Methane Production by 20% in an in vitro Rumen Fermentation System
Lucy Zhao1†, Eleonora Caro1,2†, Devin B. Holman3, Katherine E. Gzyl3, Peter J. Moate4, 5 and Alex V. Chaves6*
Frontiers in Microbiology, 2020,
1 Sydney School of Veterinary Science, Faculty of Science, The University of Sydney, Camperdown, NSW, Australia,
2 Department of Agricultural, Forest and Food Sciences, University of Turin, Turin, Italy, 3 Lacombe Research and Development Centre, Agriculture and Agri-Food Canada, Lacombe, AB, Canada, 4 Agriculture Victoria Research, Ellinbank, VIC, Australia, 5 Centre for Agricultural Innovation, School of Agriculture and Food, Faculty of Veterinary and Agricultural Sciences, The University of Melbourne, Melbourne, VIC, Australia, 6 School of Life and Environmental Sciences, Faculty of Science, The University of Sydney, Camperdown, NSW, Australia

Development of New Agriculture and Aquaculture Technology Using Fine Bubbles
T. Hata, Y. Nishiuchi, and H. Minagawa; Department of Social Design Engineering, National Institute of Technology, Kochi College, Japan Department of Mechanical Systems Engineering, The University of Shiga Prefecture, Japan

Effects of Nano-Aerators on Microbial Communities and Functions in the Water, Sediment, and Shrimp Intestine in Litopenaeus vannamei Aquaculture Ponds
Yingkai Xu , Lisong Li , Suo Lou , Jiashen Tian , Shuhao Sun , Xiaodong Li and Yingdong Li.

Welcome to the *future of farming*

HYDRO 2050 | HYDRO POWERED BY Naias

For scheduling a demo or for further inquiries,
contact us at:

0422 852 005
info@hydro2050.com