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Aquaponics and algae farms will help change Australia's food industry



By Geoff Wilson

Be well prepared in 2013 to recognize the early signs of massive changes in the \$100 billion a year (retail value) Australian food industry. It is now moving strongly towards urban-based aquaponics and algae farming related to aquaponics.

Early signs include:

- Considerable new Australian investment into large-scale and home-scale urban and peri-urban aquaponics for production of more valuable, organic, fresh healthy foods such as fish, crustaceans, molluscs, many vegetables, most herbs, plus some fruits.
- Pioneering new investment into urban and peri-urban algae-growing industry – to provide important food additives such as essential oils and high quality food proteins, feed proteins plus petroleum-competitive local transport fuels.

Food production is integral to Australia's economic and social prosperity. It consistently accounts for around 20 per

cent of manufacturing sales and service income and means non-farm employment for about 227,000 Australians. The overwhelming majority of food sold in Australia is grown and supplied by Australia's 190,000 farmers. About half of Australia's food produced is exported, but a massive 98 per cent of fresh food consumed (fruit, vegetables, meat, milk and eggs) is grown in Australia.

It is the expanding fresh food sector that is a major focus for new Australian investment in aquaponics and algae farming.

Australian efforts are part of new global investment that will help provide the world's massively-expanding human population with important new urban alternatives to rural-based food supply.

Indeed, rural industry is now being questioned on its ability under climate change threats, to feed the nine billion people predicted to be populating the world's 190 or more countries by 2050. Australia's new-style food industry now under development is thus likely to be one of the leading agencies in the global changes ahead.

At least four new Australian companies are currently being brought into play by a coterie of well-informed food industry investors.

Expect important announcements over the next three to six months.

Unwitting aid to such new Australian investment will probably come from well-informed researchers and academics in Australia's medical and nutrition industries.

They are finding strong new voices about key human health issues that could seriously disrupt or re-align much traditional agribusiness in Australia.

They can also be expected to challenge current nutritional dogmas proffering second-rate human nutrition and serious misinformation (or lack of information) about human food needs.

Consider this against the current Australian and global "obesity epidemic" -- mostly based on over-emphasis on too many processed foods containing too much salt, sugar, fats and poor carbohydrates or proteins.

Physicians and nutritionists are starting to speak out most strongly on ways to combat this health-decline "epidemic" based on very shallow food marketing principles that follow public "wants" ~~rather~~ rather than "needs" that reflects woeful ignorance by most people about their own best interests in food consumption. Key aspects will be:

- Wider support of the importance of correcting the imbalance of the omega-3 and omega-6 essential oil ratios in world livestock industry fats, and in correcting dietary deficiencies in protein, folate, natural vitamins and vegetable oils.
- Wider recognition of the important age differences in dietary needs – especially for the rapidly-increasing over-65-year age group – which will require a new diet of less food but with much higher nutritional value.
- Greater emphasis on healthier fresh foods that eliminate the big problems of food processing in supplying either too much of the "bad things" such as salt, sugar, trans fats and excessively-refined carbohydrate, or too little of the "absolutely necessary things" such as omega 3 essential oil, folate, vitamin D and antioxidants and anti-cancer compounds

Our national political leaders facing an election year in 2013 should well note these changes under way for the local and global food industries.

New legislation (or enlightened updating of old legislation) will soon become necessary for sound changes in food production technology.

In the last 200 years world food consumption by humans has not always been related to good nutritional sense.

It has been far too dominated by profit-making distortions of trade and marketing rather than sound medical and nutritional advice based on solid research and development.

My observation is that the global medical and nutritional industries now have most of the proven information keys ready to unlock much of humanity from the severe burden of poor nutrition or avoidable deficiencies. Economists also have the keys to more efficient use of fresh foods.

The following observations (focused mostly on Australian experience) outline some of what's currently happening of importance in aquaponics and algae farming.

- **Energy changes will be important:**

Be alert to the new "localized" options in energy use, especially variations of the solar, wind, geothermal, biogas and "water movement" options.

Coal-fired and nuclear power sources are shaping up as much more expensive or dangerous for efficient, long-term, urban food engineering now in train – especially in cost-saving integrations in new ways to handle biological processes.

Of particular importance to food production based on new kinds of algae-farming is likely to be wise use of energy-production systems with multiple benefits beyond production of electrical power.

For example, a relatively inexpensive CSIRO-led gas-fired energy source can now provide an urban algae farmer with three usable items – electrical power, useful heat and carbon dioxide gas for better growing the algae.

It is a simple power unit that makes a local agribusiness or algal food production company almost completely independent and without carbon dioxide emissions.

- **Water supply options:**

Adequate, low-cost supply of fresh water supply is crucial for sound urban agriculture – but fresh water supply seems to be less of a problem for some urban agribusinesses as engineers develop:

- 1. Solar-powered air moisture harvesting.**

- 2. Recycling of water within food production and energy systems.**

Re-use of energy and water in aquaponics (integrated fish-and-plant growing systems) and in algal farming systems using aquaponics as a nutrient-base, appears to be making the physical supply of fresh water less of a problem.

In fact, in one new fresh food system the actual water loss will be mostly in the produce itself, rather in the water-wasting processes of past systems of food production.

Also of growing importance to urban and peri-urban food production is sustainable freshwater supply using “natural water movement energy” – such as from river flows, and from waves, tides and deep ocean currents.

A company has been set up in Brisbane to harvest water movement energy, and many others are studying what can now be done with river or sea flows.

Use of “water flow systems” offers less expensive desalination of salt waters. Also important, perhaps, is the discovery by Victoria University in Melbourne that water desalination can be made much more efficient using industrial waste heat in a membrane-technology process.

At least four Australian salt-water desalination plants could be made economic if “water movement energy” was quickly tapped and waste heat better utilized (as might well be announced for both in 2013).

- **Nutrient recycling:**

Aquaponics and algae farming technologies are fine for recycling organic nutrients in urban or rural wastes.

Such recycling can be much less costly than utilizing artificial fertilizers now rising in cost. Instead of depending on declining reserves of plant or animal nutrients (as rural agriculture and rural and urban hydroponics does) aquaponics and algae farming uses fish wastes.

Providing fish are fed good nutrients the plants produced from the fish wastes thrive, through the emulation of “Mother Nature”.

But other organic wastes can be processed for “organic” plant or animal feeds using worms or insects (such as soldier-fly larvae).

There’s a global movement progressing in these nutrient recycling fields. It promises to become an important sector of the world’s future food industry – saving much pollution of fresh-water waterways, seas and oceans.

- **LED-lit growing of plants**

One of the most important advances being made in “integrated” aquaponics and algae-farming lies in Light-Emitting Diode (LED) technology.

Most plants take up two narrow spectrums of sun-light – part of the blue shift and part of the red shift.

Scientists in Australia, New Zealand, Canada, Australia and Europe are now developing LED technology so that almost day-length growing of plants is easy in controlled conditions.

It means that high-volume urban and peri-urban growing of plants can occur closer to both a source of power (eg solar, wind, geothermal or water movement energies) and closer to the local customer. High-cost equipment can thus have big costs amortised over large-scale production of top-quality, fresh food plant produce – **with little transport cost.**

Also, necessary essential oils and high-value proteins can be supplied in both human food additives and in animal feeds (especially for likely urban-based animals such as fish and poultry).

- **Emphasis on “organic” and “local” fresh foods:**

An important part of “integration” of urban growing of food lies in two words – “organic” and “local”.

“Organic” is a label for food produced without artificial fertilisers and chemicals to control pests and diseases. It is currently perceived as being worth at least an extra 10% to 20% or more in retail price value, so is a very worthwhile objective for urban aquaponic and algae growers. Providing the major nutrient input is “organic” (via fish feed), the fish, crustaceans, vegetables herbs or algae plant produce is “organic” too.

“Local” has more importance for the aquaponic or algae grower. It means much reduced transport cost which, for weighty fresh produce, is a significant saving. “Local” for home growers of aquaponic produce could be only a few metres to their kitchens. Or it could mean only the travelling distance of a suburb width for a large-scale operator.

So far the best effort I know by a local urban plant food grower (in Auckland, New Zealand), has been a record of only about 10 minutes from picking to supermarket purchase a few blocks away. Same-day freshness is an easy guarantee – with significant increases in fresh food flavor enjoyment as a result. It means that the fresh, organic food gets to be consumed almost immediately, compared with a wait of up to three or four days in current best times between rural harvest and city consumption. This is a significant marketing advantage for future urban growers.

- **Aquaponics advances for supermarkets:**

Urban aquaponics is of great future supply and profit significance to supermarket chains throughout the world.

Two companies are currently leading a global field that can be expected to provide

“organic” local fresh food to supermarkets without using much of the high-cost central warehousing system that has served supermarkets reasonably well over the last 40 or more years. It is now under great strain as supermarkets highlight fresh food.

The first company is setting up in Canada, but is tipped to expand rapidly from its first \$55 million alternative energy-production/aquaponics supply business into five big supply hubs of similar large-scale, around the United States.

If successful I predict it will trigger similar investments by most of the world’s supermarket conglomerates - seeking a better supply of “same-day, local, organic” fresh produce for stores.

Seasonal factors will probably become less important, as 24-hour, more efficient, organic local operations can greatly reduce transport costs and offer fresher produce.

In Australia **Urban Ecological Systems Australia Pty Ltd** (UES) is the company to watch.

It is developing Australia’s first large-scale aquaculture-horticulture food production facility.

Here’s what UES says about itself on its website:

“Two of the fastest growing food sectors are organic food and fresh seafood, but both sectors have come under increasing pressure.

“Organically- produced food is recognised as being not only healthier for consumers, but also more sustainable for the environment. However, the added costs to organic farmers of ‘going the extra mile’ for the environment often means losing many of the efficiencies of conventional ‘industrialized’ agriculture.

“The additional costs of organic agriculture raise shelf prices beyond the reach of mainstream customers, holding back the organic industry from delivering significant environmental and health benefits to a waiting world. Large volume buyers require a consistent supply of quality produce at a commercially viable price, which organic producers presently struggle to deliver

mainly because the organic supply chain has a limited array of tools to counter unpredictable weather and pests, and often has a broken cold chain, or requires multiple handling.

"At the same time many of the world's great ocean fisheries are collapsing under the relentless pressure of over-fishing. Aquaculture, long heralded as a solution to the fall in wild-catch, has also run into limitations, in particular due to problems caused by the enormous quantities of effluent that such operations release into the environment every day.

"UES's solution to these challenges is a state-of-the-art, combined aquaculture-horticulture system.

"One of the fundamental principles of organic farming is to manage the nutrients cycling with-in the farm system; wherever possible, making the waste stream from one process the feedstock for another.

"By taking the effluent from aquaculture and safely processing it to create an allowable input to organic food production, UES turns a waste stream into a revenue stream.

"UES's propriety patent-pending technology not only solves aquaculture effluent problems, but also brings a range of previously unattainable cost-savings to organic production.

"Clever science has been used to bring commercial efficiencies to the natural processes of organic food production delivering major savings in energy, water, labour and production costs.

"Based on an accredited organic compost and other allowable inputs, UES's (certifiable) organic farming system is being combined with leading aquaculture and greenhouse production systems, housed within a state-of-the-art climate-controlled greenhouse."

Many are keenly awaiting to the opening of UES's first operational facility.

Based on publicly-available information here's the large-scale urban/peri-urban aquaponics process UES is preparing to use:

- 1. Fish are housed in multiple tanks where they grow to harvestable size.*
- 2. Wastes from the fish are processed by a UES' patent-pending bio-converter, turning*

an effluent that would otherwise be toxic to the environment into an allowable input for certifiable organic production of food plants. This is used to irrigate the plant crops in large (15,000 square metres or more) greenhouses.

3. Food plants are grown in a novel compost system n organic compost plug and are supplemented by the flow of organic nutrients from a bio-converter.

4. Clean water flows back to the fish – nutrients in the water being taken up by the plants.

It is thus a significant upgrade on the classical aquaponics pioneered from the late 1970s by university researchers in the United States. They took ages-old, simple practice of past civilisations around the world – the Chinese, the Aztecs, the Khmers and perhaps the Egyptians – and brought it up to a modern speed.

- **Algae farming for food and additives:**

One of Australia's emerging companies in algae farming for omega-3 oil for humans, and for high-quality human food proteins and animal feed proteins, is **Qponics Limited**.

Queensland-based, Qponics is currently about 18 to 24 months off commercial production.

The company previously announced a collaboration with **Urban Ecological Systems Australia Pty Ltd**, to access nutrient-rich aquaculture effluent as feed stock to fertilise the growth of algae.

Qponics has also previously announced that it has signed agreements to produce algal-strains in a project with the **University of Queensland**, and signed a Memorandum of Understanding to form a mutually-beneficial marketing collaboration with Melbourne-based **Nutrition Care Pty Ltd**.

Of note is that an international company named Martek, has adopted a similar fresh-water algae approach to Qponics.

According to Wikipedia, **Martek Biosciences Corporation**, based in Colombia, Maryland, United States, is now

integrated into **Royal DSM NV**. DSM announced its acquisition of Martek for \$1.1 billion US Dollars in December 2010.

Martek Biosciences produces nutritional supplements from fermentation-cultivated microalgae.

The company's products include the omega-3 fatty acid docosahexaenoic acid (DHA) and arachidonic acid (ARA), an omega-6 fatty acid. DHA is used in foods, beverages, infant formula, and supplements. The ARA is used in infant formulas.

Martek Biosciences also produces and markets fluorescent algal proteins for use in life science research applications.

This business unit was spun off to form Columbia Biosciences in July of 2007.

In early 2010, Martek announced that it is purchasing **Amerifit Brands**, a consumer health and wellness product company. In the northern hemisphere spring of 2010, Martek joined with the not-for-profit **National Center for Creative Aging**, to develop a campaign called "Beautiful Minds: Finding Your Lifelong Potential." The campaign is designed to inspire baby boomers to be more proactive about their brain health.

Similar joint efforts have been flagged for Australia by local medicos and nutritionists, and a likely collaboration between business, universities and other researchers is a distinct possibility.

It is expected to be necessary to convince both politicians and consumers in Australia that their best interests are served by the adoption of many new rules about fresh food production, marketing and consumption.

Background on North America's considerable commercial effort behind algal oils and proteins demonstrates the logic of the Qponics Limited approach in Australia – dedicated as it is to local production of nutritionally-essential food additives from local resources.

- **Algae farming for transport energy plus animal fodder:**

North Queensland's City of Townsville is the location for a significant algae farm that will supply a biodiesel plant, and provide a soybean meal replacement to be used as livestock fodder. The project is being jointly developed by:

- A private company - Melbourne-based **MBD Energy**, which is involved in multi-million-dollar algae farms to sequester carbon dioxide emissions from coal-fired power stations and
- Scientists at **James Cook University** in Townsville.

The project has received a grant from the **Queensland Government** to assist in the development of a pilot plant. It's major achievement so far has been a 5000sq m test facility at James Cook University that has produced 14,000 litres of oil and 25,000kg of algal meal from every 100 tonnes of carbon dioxide consumed.

The algae farm runs on inputs of sunlight, water and nutrients. One third of the produce from algae is oil for biodiesel for local use.

Two thirds is a protein rich feed for other local use. It can be used as a drought-proof feed stock for beef, chicken, fish farms, and prawn farms.

The algae farm concept now being tested is expected to have a production of 700,000 tonnes a year of algae.

This means 250,000 tonnes of algal oil, will convert into 290 million litres of diesel fuel. That's an estimated one week's supply of diesel for the whole of Australia." Algal cake as a soybean feed replacement. In the current market, it would follow existing prices of fodder.

Townsville's algal farm expects to maintain profitability even if imported crude oil prices fell to between \$US60 to \$US80 per barrel.

- **Aquaponics advances for small-scale growers:**

As yet the potential market for small-scale (home-based or community-oriented) aquaponics is under-appreciated in Australia.

Most home growers are not “statistically visible” because government agencies in food, agriculture or statistical collections are mostly unaware of their growing strength.

Yet if you ask for estimates from Australia’s handful of suppliers of aquaponic equipment or knowledge, their combined views lead to the conclusion that some 10,000 or so Australians have been at least considering home-based aquaponics. This estimate reflects sales of promotional CDs.

My personal “guesstimate” is that between 400 to 500 Australian families are currently practicing aquaponics of some kind for home production of both fish and vegetables. Six or more Australian high schools have aquaponics teaching units and five commercial aquaponics operations are now visible.

The burgeoning home based and community aquaponics Australia now needs to be well-supported by two streams of activity:

- By government information services based on sound information now coming from medicos, nutritionists and aquaponics experts.
- By encouragement of commercial firms to service highly-specialised needs of home based or community-oriented aquaponic growers.

My view is that considerable scope now exists for companies with expertise in horticulture and aquaculture to provide expert services to best set up new aquaponics growers, and to service them regularly with sound technical advice and practical help.

Home owners need this kind of service to help provide economical outcomes for a very local supply of fresh, organic food

from a facility only metres away from a home kitchen.

It is only a matter of time, in my view, that such services will be commercially viable for home owners and community groups.

Home-based aquaponics and algae farming in Australia clearly has not yet achieved much in the way of lower cost and more valuable fresh foods for humans. But in five to 10 years time that can be expected to change – perhaps massively.

Important triggers will be:

- (a) Desires by people to counter the supermarket food supply system (which sells about 70% of Australian food via two companies), and
- (b) More knowledge available about what fresh foods can be grown inexpensively via aquaponics at home or nearby.

- **Algae.Tec triggers a new world pace**

Of great significance in early January 2013 is that **Algae.Tec**, a Perth-based producer of algal oils used to make clean biofuel, announced plans to sell \$US200 million (A\$190 million) of bonds in Europe to fund expansion in the Americas.

The company intends to complete the offering by mid-year, to finance new factories in Texas and Brazil that will produce algae for biofuels.

Algae.Tec is expanding rapidly after the U.S. approved a \$US1.01-a-gallon tax credit for producers of algal fuels. That followed a decision by the US Environmental Protection Agency last September to raise the requirement for biodiesel in refined products.

Importantly, a year ago U.S. regulators allowed airlines to fly passenger jets using a biofuel blend.

Algae.Tec already has an algal biofuel site near Nowra, NSW. It plans to construct several major biofuel plants within 12 months.

Algae.Tec's technology can also trap carbon emissions released from industrial plants, which it can then use to feed algae production. In Texas, United States, Algae.Tec is working with a "large power group" to reduce its emissions, while in Brazil it plans to team up with a food manufacturer.

This has implications for Australian investment in food aquaponics and algal farming for food additives. Algae.Tec and its competitors will be interested in the servicing the huge global food market.

Last September Algae Tec said it planned to build as many as six factories by 2015 at a cost of about \$US100 million each.

The same month it agreed to work with **Deutsche Lufthansa AG** to build a European plant that uses algae to make jet fuel. Several sites have now been identified, including in Spain.

Early in December 2012 **Dr Mike Kelly**, Australia's Parliamentary Secretary for Defence, toured Algae.Tec's "Shoalhaven One" showcase facility. He was briefed on the process and potential applications of their products. This visit may lead Algae.Tec into an important collaboration.

What does this mean for Australian aquaponics and algae farming ?

The simple answer is that a number of food industry linked algae production systems will flow from Algae Tec's initiatives- as they also will from competing petroleum-replacement and rural-replacement technologies.

This flow can be expected to make large-scale urban and peri-urban food and energy production much more efficient for local supply of fresh produce and for local supply of all-important transport fuels.

Intense interest in the favourable economics of this fresh food production change will spur many supermarkets to either:

- Seek contract-supply arrangements with urban growers, or
- Invest in aquaponics and algae-farming themselves (especially in

joint ventures, as in Canada, where a jointly-owned company is combining production expertise with super-marketing savvy).

Adjustment problems could be immense in Australia -- at least in the short term of the next five years. After that I believe that economic sense will prevail. I also believe that wide-spread, home-based growing of food via aquaponics will become an important new market segment of the food industry. It could have great political clout.

An overwhelming political argument in favour of aquaponics and algae farming will be the clear need to alter the world's food production systems in accord with evidence-based food production practices. That evidence is becoming much clearer, as I propose to point out in the February 2013 newsletter.

It is in accord with what humanity now needs to do to protect itself from a major issue of climate change – the acute problem of a sustainable food supply.

- *DISCLOSURE: Geoff Wilson is a major shareholder in Qponics Limited, and he prepares the company's newsletter. Before retirement he was a globally-operating journalist in agribusiness.*

International Aquaponics Conference in June 2013

The International Aquaponics Conference: Aquaponics and Global Food Security

will bring together individuals having and wanting to have an impact on food quality, security and sustainability using aquaponic methods. Industry experts will share experience and knowledge in a fun and informative conference setting, providing participants a wealth of information on the rapidly growing aquaponics industry. Dates: June 19 to 21, 2013, University of Wisconsin-Stevens Point. Visit the Conference Website: www.uwsp.edu/aquaponicsconference





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Founding members of ANA:

Aquaponics Network Australia (ANA) is a not-for-profit organisation that currently comprises these eight volunteers:

Geoff Wilson, retired journalist in agribusiness.

Steven Nisbet, retired university mathematics lecturer.

Dr Paul Parkinson, retired university science lecturer.

John Stevens, university lecturer in valuing.

Susan Kennedy Smith, primary school science education officer.

Adam Richmond, high school science teacher.

Michelle Prior, consultant in policy development and strategic planning.

Dr Mike Nichols, retired university lecturer in hydroponics and consultant in hydroponics and aquaponics.