



The No.1 Aquaponics magazine  
for the backyard enthusiast.

**Issue 6**

Third Quarter 2009

Bringing Food Production Home

# Backyard Aquaponics



*Westfield Primary School*  
Aquaponic education starts young

**Commercial Aquaponic production**

**Edible flowers** – not just pretty but tasty too!

# Welcome



It seems like life is revolving around shows and field days at the moment, we've just finished with a display at Dowerin Field Day, and now we're getting ready for the Perth Royal Show. These shows offer us an ideal opportunity to display aquaponics to a range of people who would possibly not normally get to see aquaponics. We've become quite proficient at these shows now and we provide a large display of information for people to browse so that they can learn about the processes of aquaponics.

The Perth Royal Show will be interesting, the show receives over 400 000 visitors over the 8 days that it's open and this year they're showcasing aquaculture. A whole pavilion within the showgrounds has been designated as display area for aquaculture exhibits. The displays will include industry representatives from all areas of aquaculture, from

ornamental fish growers for the pond and aquarium trade through to huge ocean cage culture of fish destined for dinner tables. Of course Backyard Aquaponics are going to be there, we have a large area where we'll have working aquaponic systems, there will be display boards filled with information and an educational video playing throughout the day as well as friendly staff to answer enquiries. Faye will also be participating in cooking demonstrations every day. In the next issue we'll include an article about the aquaculture exhibition at the show with details of all the highlights. ●

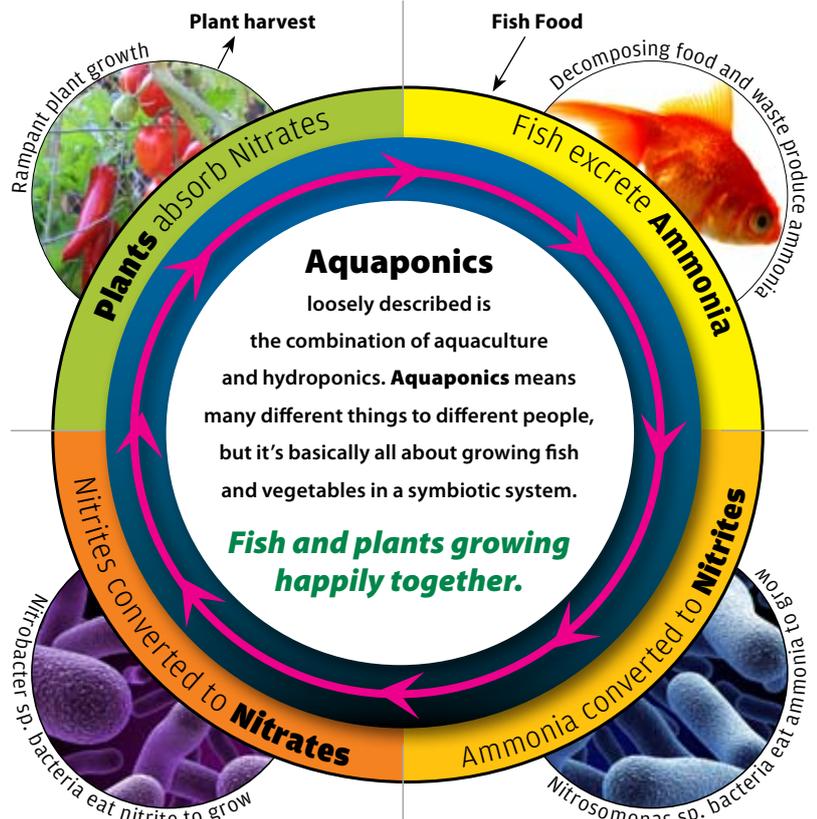
*Joel Malcolm, Editor*

## Backyard Aquaponics on the tube

There is a whole range of aquaponics videos that you can view on youtube, visit the link below and see us in action! <http://www.youtube.com/user/backyardaquaponics>



## The Nitrogen Cycle



# Backyard Aquaponics



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## Backyard Aquaponics Magazine

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## Contents

### Our Favourite Tanks

Aquaponics at Westfield Primary School ..... 4

Commercial Aquaponic production ..... 10

### By the Barbeque

Spicy Coconut Fish Curry ..... 8

Pizza with pizzaz ..... 14

### In the Garden

Silverbeet ..... 9

The beauty of Bees ..... 22

Edible Flowers – Not just pretty but tasty too! ..... 28

### By the Pool

Silverbeet ..... 9

Blue Tilapia ..... 16

### In the Garage

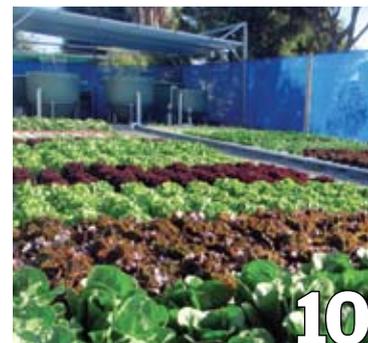
Airlift Bio Filter (ABF) ..... 26

### Over the Back Fence

Aquaponics – from alternative to mainstream agriculture ..... 18

Simplicity and planning ..... 31

The role of Aquaponics in uplifting the rural poor in developing countries ..... 33



10



08



16

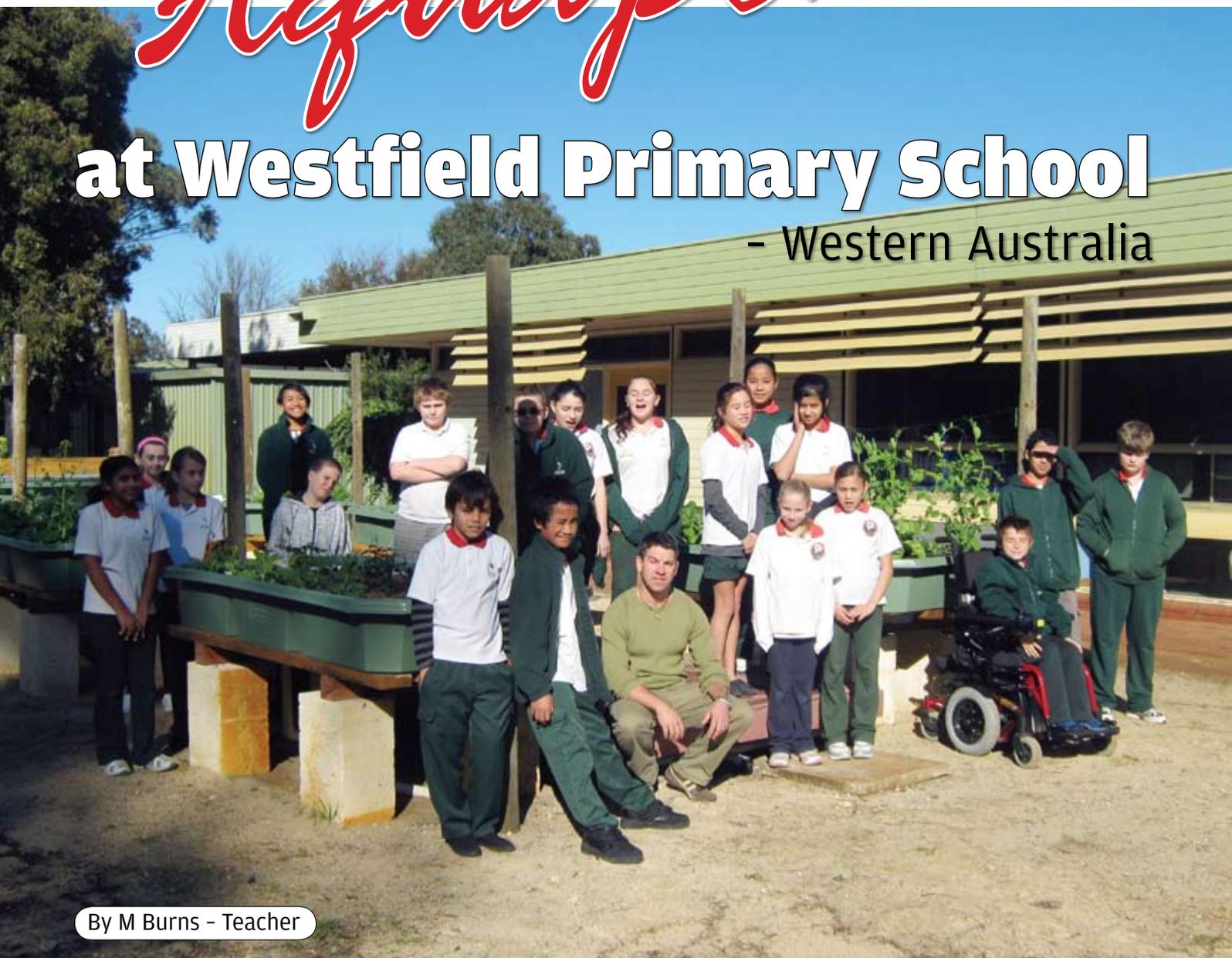


28



# Aquaponics

## at Westfield Primary School - Western Australia



By M Burns - Teacher

The first question we are usually faced with by visitors to our school is, "What's that?" And now we love to hear someone ask one of our students this very question as it is rewarding to hear a ten-year-old launch into their own spiel about what aquaponics is. Hopefully, and more often than not, the answer is something like this. *'Aquaponics is a closed system combining aquaculture and hydroponics where the waste products produced by fish in a tank are converted by bacteria into nutrients that plants, grown in soil-less beds, can use.'* Invariably, though, the students find a more 'kid friendly' way of explaining it.



“As is true for so many students practical and hands-on activities provide **motivating learning experiences**”

**Our story so far...**

In mid-2008 we identified a school vegetable garden as a project that would both fit with our school ethos of ‘Share Care and Learn’ and hopefully engage our students and parent body. Following this we established a permaculture based garden with our senior students. This was a hit with the students and the learning opportunities that it opened up were boundless. As we were discussing further developing this project, an opportunity presented to apply for a Stephanie Alexander Kitchen Garden Grant.

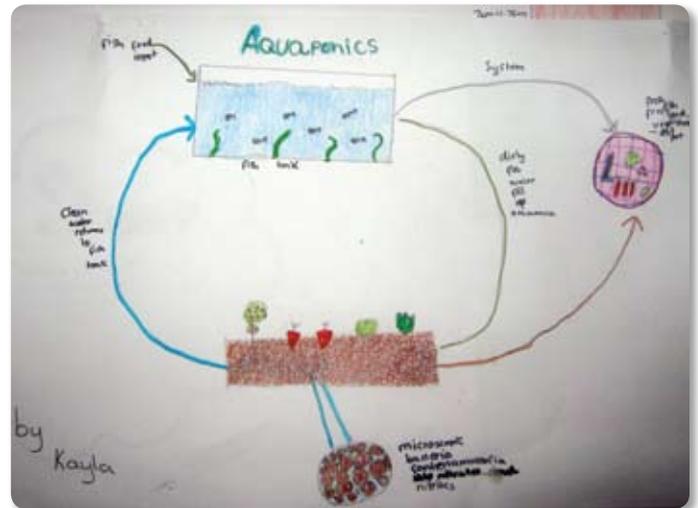
While researching and putting together the application for the grant, (up to \$60 000), passion and ideas grew. As is true for so many students, particularly those in the lower socio-economic areas such as ours, practical and hands-on activities provide motivating learning experiences. With my background in environmental biology and landscape design and construction; aquaculture and growing primary produce

was a concept of great interest. Luckily our Principal’s own love of fish and aquariums made aquaponics the perfect fit.

By the end of 2008, the aquaponics system had taken on a life of its own, independent of our application for the Stephanie Alexander Kitchen Garden grant. We were eventually successful in obtaining this grant which will enable us to convert a classroom into a kitchen and build further vegetable gardens around the school – but that’s a separate story.

Within a short period of time a draft plan had been drawn up and costed, taking into account the safety issues associated

with having a 5 000 litre tank of fish on site at school and the needs of a system that would have little fingers constantly poking at it. Then of course came the ‘F’ word – funding. At the end of the year we scraped together unspent funds and used this money to purchase the BYAP tanks, growbeds and pumps required to set up the system.



**The educational aspect of aquaponics is evident**



## Our Favourite Tanks

Over the Christmas break I did a lot of reading and visited the BYAP shop a few times to look at how their systems were set up. My aim was to ensure that our system could be open to the students at recess and lunch without any need for specific supervision or fencing. To achieve this, the design included the following

- a **sunken sump** covered with tread mesh
- a **reinforced weld mesh fish tank cover** that could be easily removed or lifted (to achieve this the lid was made in quarters and hinged from a central beam)
- the use of ball valves that had **removable handles**
- **lockable** electrical box
- **strong and stable**, yet aesthetically pleasing grow bed stands
- a **raised decking** that would allow smaller children to look into the fish tank and reach the grow beds with ease
- **pipework tucked away** and secured, yet still able to be accessed for maintenance when required

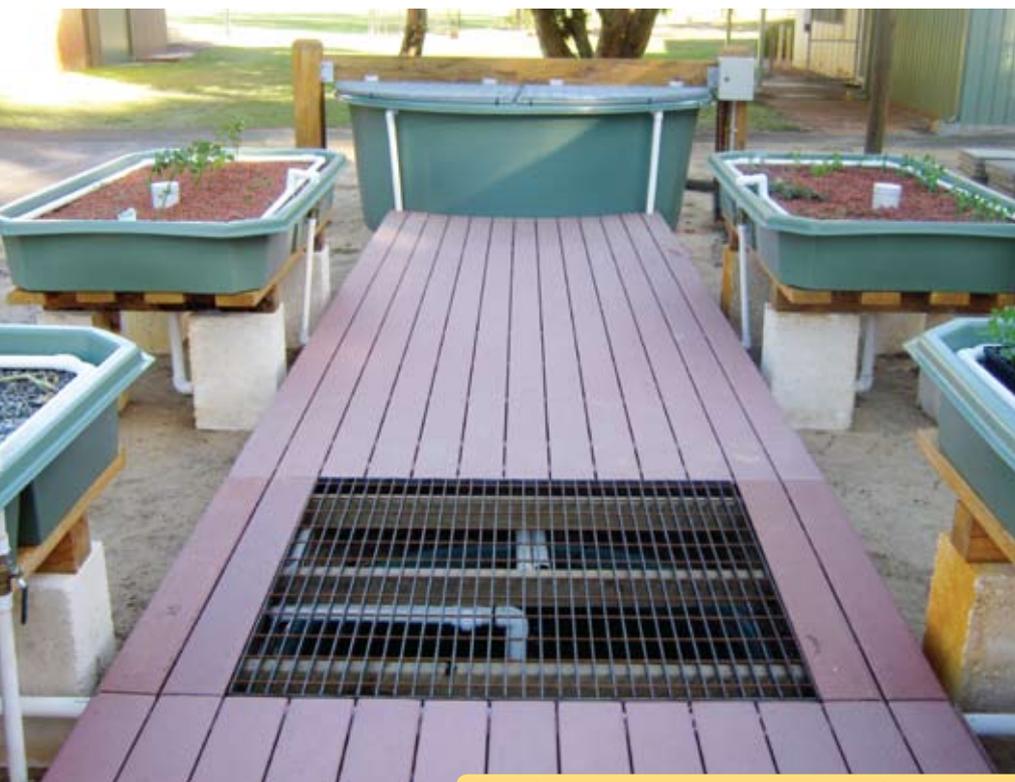


**Reinforced weld mesh cover for the fish tank**

- stocking densities that were conservative so as to ensure a **very stable system** that would require nothing more than daily fish feeding over weekends and holiday breaks

On return to school in 2009, work started immediately on construction. Various businesses were contacted to provide quotes for materials and many donated materials due to the benefit they felt the project would bring to the school community. With about \$3 500 allocated from our 2009 budget, \$1 500 from a Health Department grant and the generosity of local businesses, final funding was sorted.

By the start of May we had the system sufficiently complete that we introduced our first season of table fish; 100 rainbow trout went into the system along with the 14 koi (in the sump) that will become long-term school pets. The grow beds were planted out with seasonal vegetable seedlings and other seeds



**The raised deck and sunken sump covered with tread mesh**

“My aim was to ensure that our system **could be open to the students** without any need for specific supervision or fencing”

were planted directly into the beds. To date we are enjoying impressive plant and fish growth and we hope that in October we should be able to harvest our first season of trout. The students will then prepare a gourmet meal for the whole school in our (yet to be built) kitchen and we will enjoy a major school celebration. Then the barramundi can go in over summer, along with seasonal summer vegies.

Of course, the above is just about the fun part, the planning, building and fish feeding; but as a school, we need to make sure aquaponics is about more than that. So from our point of view, what is it really about? What learning can it provide for our students? So far, we have looked at the obvious learning such as suitable aquatic species and lifecycles, plants, seeding and harvest times, water filtration and the nitrogen cycle. To me this is just the tip of the iceberg and aquaponics is merely a conduit that focuses children's naturally inquisitive minds and causes them to question the choices they and those around them make.

Our learning to date has always directed the children toward the why of growing fresh produce at home in an aquaponic system (or dirt garden). There are always the standard yet somewhat naive answers of 'it's fresher, healthier and cheaper', but is that all it's

about? If you ask around our Year 6/7 class, hopefully you would be enlightened about the true costs, both economic and environmental, that are associated with the foods we eat. You will hear talk of food miles, processing wastes, the effects of excess packaging, garbage, recycling and tyre manufacture and disposal – all from the starting point of aquaponics.

So what are our senior students currently investigating? Bottled water versus tap water, of course, the myths behind the advertising and the economic and environmental costs of the daily choices we make. A long way from aquaponics I hear you say, but is it? In the context of creating more environmentally aware children, who are able to make informed decisions about our future, not really.

To me, aquaponics is a fantastic learning tool, limited only by a teacher's ability to contextualise the ideals and values that many readers of this magazine value. Think about this from your own perspective and make sure you share the real reasons why you love aquaponics with your children and grandchildren. ●

**Further Reading:**

<http://members.iinet.net.au/~westps/kg/kg.html>  
<http://www.kitchengardenfoundation.org.au/>



Students helping with construction



By the Barbeque



# Spicy Coconut Fish Curry

Very easy to put together but always a taste-bud tantaliser

## *Fish curry ingredients*

- 500g white fish fillets*
- 2 tablespoons red curry paste*
- ½ red onion*
- 400ml coconut milk*
- ½ red capsicum*
- Snow peas*
- Small bunch of spring onions*
- 1 teaspoon grated ginger*
- 3 kaffir lime leaves*
- Coriander*
- Red chilli (optional)*



## *Method*

- Roughly chop fish into 2 cm cubes and place in wok or large frypan
- Fry with red curry paste and a little of the coconut milk for about 2 minutes.
- Add sliced onion and cook for a further 3 minutes.
- Add coconut milk and stir well.
- Add sliced capsicum, spring onions, sliced snow peas, ginger and whole lime leaves.
- Stir all together and place lid on for 5 minutes.
- For those who like it really hot try adding fresh chilli before serving.
- Serve with steamed rice and garnish with sprigs of coriander. Serves 4.



# Silverbeet

(*Beta vulgaris var. cicla*)

By Joel Malcolm



**S**ilverbeet is also known as Swiss chard, chard, rainbow chard, mangold or perpetual spinach.

This ancestor of the sea beet (*Beta vulgaris* ssp. *maritima* L.) is often underrated and overlooked in many modern vegetable gardens but it performs beautifully in an aquaponic system, and makes a tasty and nutritious addition to your diet

Silverbeet comes in a range of colours and forms from the fardhook giant variety that has deep green glossy leaves and a wide flat stem, through to the more colourful varieties that often have a thinner rounded stalk and come in a rainbow of colours from deep burgundy reds through a range of pinks, oranges, yellows and whites. The bright colour variations in silverbeet, almost lends itself to being grown in an ornamental flower garden for its stalks and leaves. I would grow silverbeet in my systems even if it wasn't edible, just for the array and intensity of the colours.

This underrated plant is not only beautiful but it's also high in nutrients, very easy to grow, will grow under a wide range of conditions and temperatures, and is highly resistant to pests and diseases. Leaves can be harvested as required, leaving the plant to continue growing and producing, young leaves can be

used fresh in salads while older leaves are best steamed, sautéed or boiled as required. And best of all, silverbeet grows exceptionally well in aquaponic systems.

## CULTIVATION

Silverbeet can be grown year round in mild climates and is capable of withstanding temperatures from 0°C through to temperatures over 40°C. Silverbeet can grow in partial shade situations very well, especially in the warmer weather. From planting, you can expect to begin harvesting leaves within 30 days with many varieties, though some varieties may take up 50 days when conditions aren't ideal.

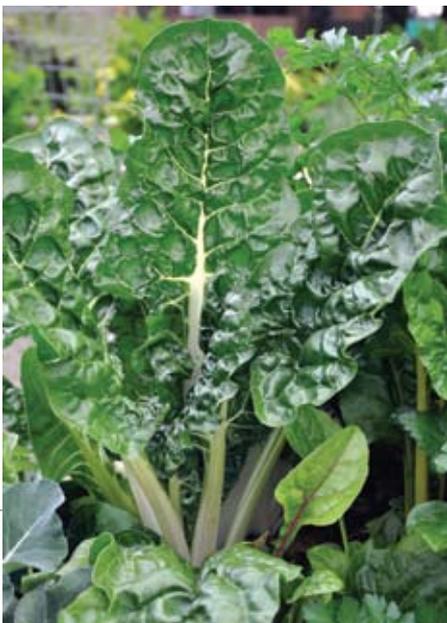
It's strongly recommended that you harvest only what is required from the outer leaves of your plants for cooking, or just harvest a few of the younger leaves from each plant for salads. This allows your plants to keep

producing month after month, year round. I have had some plants continue to produce for over two years. In tropical areas plants may be shorter lived.

## VARIETIES

There are many varieties of silverbeet available as seedlings from nurseries or as seed from seed suppliers. The most commonly found seedlings are generally a straight green and white variety, often 'fardhook giant' or a colourful mix called 'rainbow chard'. Rainbow chard seedlings are generally a mix of many varieties providing a wide spectrum of colours. Some seed suppliers will have a range of varieties available some of the more common ones are fardhook giant, vulcan red, long dark green, ruby red, lucullus and golden sunrise. Personally I like to plant rainbow chard which is a mixture of varieties, this allows for a wide variety of growth rates, forms, and colours.

It's very easy to save seed from silverbeet and I strongly recommend you give it a go for a few reasons. The great thing about seed saving with silverbeet is that you can leave the plant growing and ripening seed while still harvesting leaves from the plant, the small leaves on the sides of the main flower stalk are great in salads. With a mix of varieties like rainbow chard you can pick a plant whose colour or productivity you liked and keep the seed. You will possibly get cross-pollination with other varieties but this is half the fun. Silverbeet comes in as one of my top ten plants for aquaponics and I will always have more than one plant growing in my systems. ●

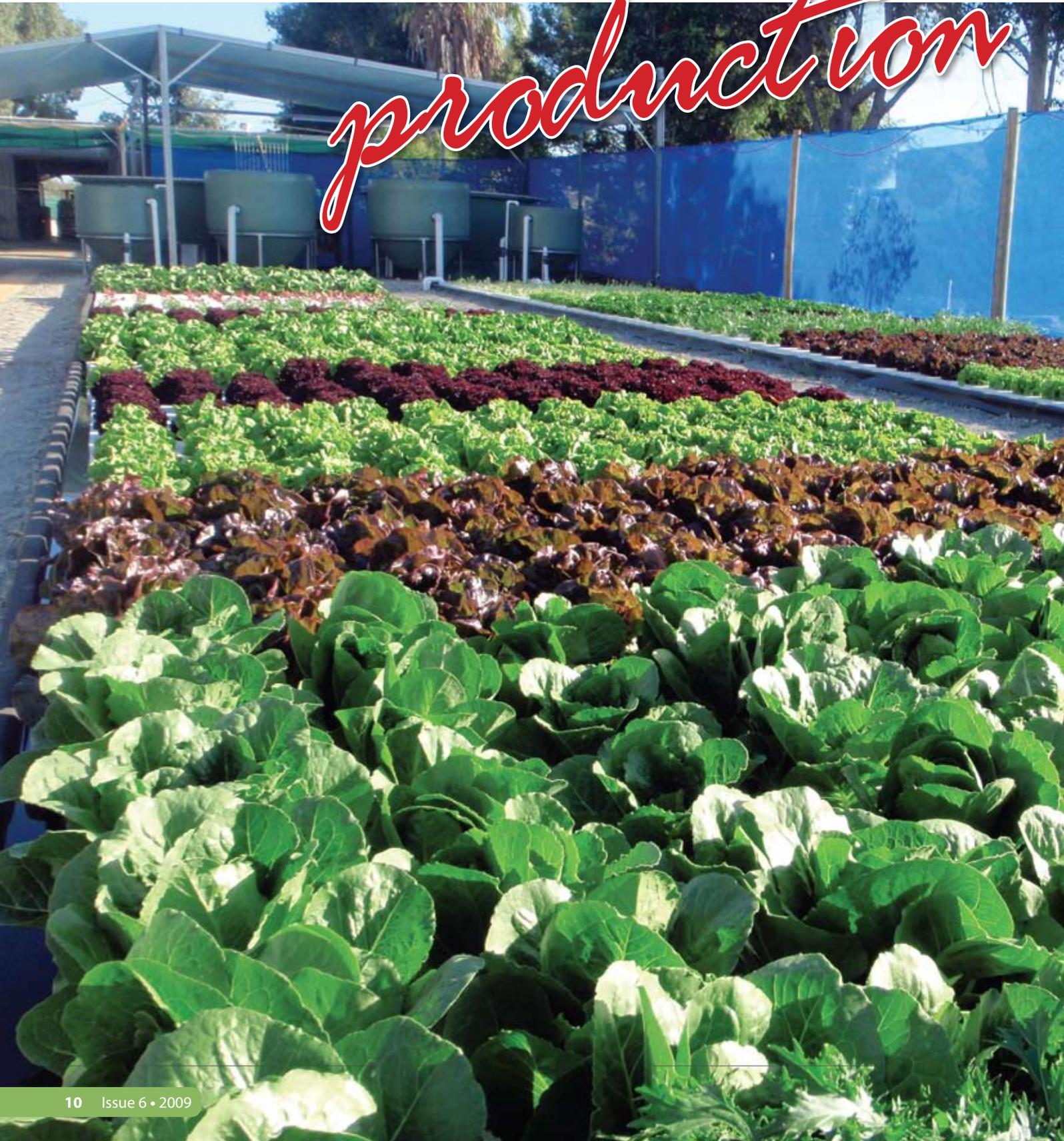




Our Favourite Tanks

# Commercial A

*production*



# quaponic

By Joel Malcolm



A

quaponics, in a commercial sense within Australia, is still in its infancy - you can

count the number of commercial

operations on one hand. The number of commercial operations that turn a profit purely from production of an aquaponic system is probably zero in Australia at the moment with most commercial operations requiring other forms of income to be viable. Other income streams include consulting services, farm tours, sales of informational products and value adding of produce. Aquaponics is often considered a small part of a larger farming venture. Personally I don't consider this to mean that commercial aquaponic production is not viable, I feel we just need to look at it as a different model to what most people consider viable primary production models. Aquaponics in a commercial sense is well suited to small scale production, it's highly intensive, uses very little space and it's extremely productive.

Over time as research and trials continue I expect that viable large scale aquaponic models will become more feasible, however for the moment commercial aquaponic production is currently at a level of what most would concede to be small scale production systems. There are a few commercial aquaponic systems in the United States, one of the more recent systems by Friendly Aquaponics in Hawaii where they have achieved organic certification for their salad greens and vegetables this allows them to receive premium prices within the organic market helping to make the system more economically viable. The family now make a living from their aquaponic systems though with some additional income from courses, workshops and sales of manuals.

I began researching the commercial floating raft or deep water culture (DWC) style of system many years ago. The University of Virgin Islands (UVI) have been researching this style of system for decades pioneering the use of floating rafts on raceways filled with the nutrient rich effluent water from fish tanks. Their model has been replicated numerous times throughout the United States as well as other countries around the world quite successfully. Although their system suited their local environment quite well, here in Western Australia we had a totally different set of variables to deal with, our climate is much cooler and more variable over summer and winter, while they have reasonable constant temperature year round. Dr Savidov from the

“Aquaponics in a commercial sense is well suited to **small scale production**, it's highly intensive, uses very little space and it's extremely productive.”



## Our Favourite Tanks

Crops Diversification Research Centre in Canada has been doing some extensive trial work in aquaponic production experimenting with different ideas and methods, while Friendly Aquaponics in Hawaii have also been expanding and making some changes to the commonly implemented UVI system.

After my years of experience with media based systems and the research into DWC systems I had a few ideas of my own that I wanted to implement in some trial systems. One of my main problems with the commonly practiced principles in DWC systems being implemented around the world was the waste of nutrient within the system. Common to almost every one of these systems was the removal of solid fish wastes from the system, these solids then had to be disposed of. In all of the economic modelling for these aquaponic systems the majority of profits are returned from the plant crop while only very small returns are realised from the fish crops. The majority of expenses for inputs into the system are from fish feed and power for extra aeration to keep the fish at optimum levels while at high stocking levels. By my reasoning, if one of the major input costs are from fish feed, why would you then remove the fish solid wastes from the system before the plants can take advantage of it and treat it as waste from the system, especially when the fish were not the major income

earner from the system. If you could feasibly break down these solids and use them within the system, then for the same plant production levels you would have less input costs in the way of fish feed. As well, you might expect that you would need lower stocking levels of fish, meaning lower pumping requirements of air and water. Lower power and feed costs mean more potential profit for a smaller investment.

One of the main concepts behind aquaponics that I find most attractive is the fact that there can be no waste streams. If there is a waste or bi-product of the system that needs to be disposed of, then it's being looked at the wrong way. Any waste can be considered useful if you just find a way to use it. OK, even in the commercial UVI style of system they use the fish solids to fertilize crops grown in the ground so as such it is not going to waste, but it is not as efficient to remove it from the aquaponic system and use it in a separate production system.

With these concepts in mind, when it came to designing a small commercial system I wanted to keep the solids within the system and break them down. For fish health it's certainly advantageous to remove the solids from the system, so my idea was to remove solids from the main stream of waterflow and digest them, breaking them





down in an aerobic environment where their mineralization can then aid the growth of the plants without inhibiting the health of the fish. This was going to be reasonably simple to achieve. I figured the simplest way to achieve this was to; remove the heavier solids from the water flow using conventional means like a swirl separator. Smaller particles and suspended solids I felt were not such an issue because I had already read details of trials in Hawaii by Friendly Aquaponics. There they had built and run a DWC system with a reasonable amount of success that had no solids removal at all, neither larger particles, or finer suspended particles, the whole lot was pumped into the DWC raceway where the plants are cultured and this had been very successful so far.

I decided to take some other steps away from conventional DWC aquaponic system designs to cut the cost of setting up and to make more efficient use of space. Most DWC aquaponic systems are based around raceways that are 1.2m wide, the width of a standard polystyrene sheet (1.2m x 2.4m). I decided that rather than having multiple raceways that were narrow we could double the width of the raceway allowing for the standard polystyrene sheets to be

“ One of the main concepts behind aquaponics is the fact that there can be **no waste streams** ”

## Our Favourite Tanks



used sideways. So for the same growing area we almost halved the amount of framework required for building the raceways. Another plan for this system was to half bury the plant growing raceways, for a few reasons. Firstly, the construction of the sidewalls of the raceway would only need to be half as high if we dug the other half below ground. Secondly, keeping the water volume partly buried would aid in keeping the water temperature in the system more stable. The only downsides to having the raceways buried is that the floating rafts are lower to the ground, so harvesting the plants would require some more bending to lift the rafts out. However we had already designed a two person raft lifter so lifting the rafts wasn't a major issue.

The area where the systems were to be set up was 30m x 8m, initially I planned to have one large system but after some consideration I decided to build two discrete smaller systems. The reasoning behind two separate systems rather than the larger one is for safety. If something goes wrong with the system, you lose the lot. But with two separate systems, if there is component failure, then only one system suffers while the other system continues to operate as normal. ●

In the next edition of the magazine we'll look at the building and operating of these systems.

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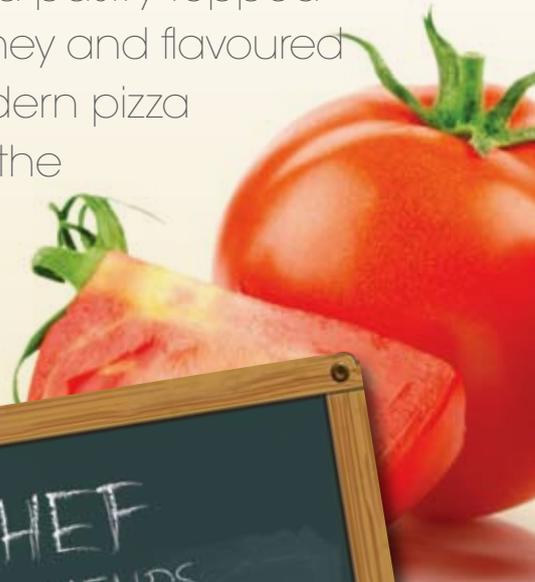


By the Barbeque



# Pizza with pizzaz

The Ancient Greeks covered their bread with olive oil, herbs, and cheese. The Romans developed a pastry topped with cheese and honey and flavoured with bay leaves. Modern pizza originated in Italy as the Neapolitan pie with tomato. In 1889 cheese was added.



### Scone dough base

- 1 cup plain flour
- 1 cup self raising flour
- 1/2 - 3/4 cup water

### Topping choices

- Tomato paste or pizza sauce
- 1/2 - 1 cup grated cheese
- Spring onions
- Yabbies, mussels, anchovies
- 1/2 red onion, sliced or chopped
- Capsicum, sliced
- Pepperoni, ham, salami
- Mushrooms, finely cut
- Fresh herbs such as basil, chives, parsley, thyme

## Method

### Option 1.

- Using a non-stick cook pan. Put dry mix into pan with any optional extras (eg. salt, herbs and cheese).
- Slowly add the water while stirring. Use the back of a spoon to spread the mix evenly around the base of the pan.
- Add extra water gradually if required. Mix should be sticky but not sloppy.
- Top with pizza sauce, variety of toppings followed by cheese and a sprinkling of fresh herbs.
- Place on a hotplate, on medium heat, with vent closed until lid is hot. Open vent, turn to low heat and finish cooking. Approx 20 minutes in total. Decorate with sprigs of fresh herbs.

### Option 2.

- Combine both flours evenly, adding any optional extras including salt, mixed dried italian herbs and parmesan cheese.
- Add water and/or oil if desired and mix to form a dough.
- Turn out on to a floured board and roll with a rolling pin or bottle until the required thickness is achieved. Place on a pizza tray.
  - Spread with pizza sauce, top with your choice of toppings followed by cheese.
  - Cook in oven at 180 degrees around 15-20 minutes until cheese has melted and base is slightly browned.

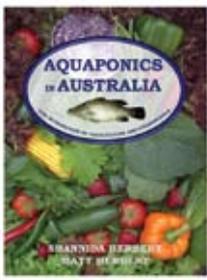
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# Blue Tilapia

*Oreochromis aureus*

**Family:** Cichlidae (cichlids), subfamily: Pseudocrenilabrinae

**Order:** Perciformes (perch-likes)

**Class:** Actinopterygii (ray-finned fishes)



By Aleece B. Landis

**T**ilapia are an important aquaculture fish. They can grow fast given good conditions, are forgiving of poor water quality compared to many other aquaculture species and can survive relatively low levels of dissolved oxygen in their water. They are also adaptable to a wide variety of feed. While they can live in both fresh and brackish water, they do require warm water. They can survive temperatures ranging from 8-30°C and can even tolerate a water temperature up to 41°C. A minimum temperature of 20-22°C along with a long photo period

seems necessary for breeding. I have been told that water temperatures below 10°C may permanently compromise the immune systems of the fish.

Tilapia are prolific breeders and can start breeding while they are still quite small. Excessive breeding activity tends to reduce growth rates and cause crowding. Most commercial tilapia growers use all-male stock to get more consistent growth, the males grow faster. Getting all male tilapia can be done in a variety of ways: by manually checking the fish for gender

(though this is prone to error and is labor intensive), by feeding the fry hormone-laced food to cause all the fry to develop as males, or to cross breed those fish that will produce only male offspring.

Tilapia are mouth brooders, to breed the female will lay eggs, the male fertilizes them and then the female will pick the eggs back up and brood them in her mouth. I have been keeping tilapia in a cage within my fish tank to keep them from breeding. As long as they cannot access a bottom surface, they cannot complete the breeding process.



Male tilapia seeking to breed and female tilapia getting ready to release their young can be very aggressive.

Young tilapia have an extreme protein hunger and will happily eat their smaller siblings. High protein feed is recommended for tilapia fry and fingerlings if you are seeking fast growth. Adult tilapia can filter feed and pond culture often uses algae blooms to feed tilapia. Tilapia will take to pellet feed as well as leafy greens, vegetables, worms and bugs.

I have had my tilapia (blue tilapia) for over a year. They are a mixed gender batch that I got in May 2008. We had some tilapia big enough to eat by October 2008 but many were still small. Over the cooler months my tilapia did survive however I had to add warm water on a few of the cooler nights to keep the water temperature above 10°C, the temperature at which I've been told that their immune systems rarely recover. The tilapia hardly ate for months and definitely were not growing. Personally I don't recommend growing tilapia unless 20°C is the coolest the water is likely to get and 32°C is the normal water temperature range.

There are several information sources that tout tilapia as being wonder fish for aquaculture and aquaponics. I don't think these ravings are very realistic since many of the people hearing them or reading them take it to mean that even under the worst of conditions, tilapia will still produce these high harvest weights in minimal time. The truth is the harvest weights and times are only close to accurate for the best of water quality, temperature, and feed conditions. I've had my tilapia for over a year and probably only half of them are over a pound

in weight. So why are my fish that have been in a system with high water quality, good feed and restricted breeding still so small? Because my water temperatures have only been up over 20°C for part of the time. When the water gets up into the mid 30°C (and stays there) the fish eat and grow

very fast but my water only gets and stays that warm for part of the year.

Now that my system water has warmed up, the tilapia eat well. I moved some into my duckweed tank and they have been breeding prolifically. I was never successful breeding the tilapia in an aquarium but by putting them in a large tank with access to the bottom and plenty of duckweed to eat I now have a tank with a dozen adult tilapia and probably thousands of babies.

If there is a good way of efficiently heating the system water or keeping the environment for the system at an optimal temperature range, then tilapia may be appropriate. They are definitely good for tropical climates. In my subtropical climate, with the use of flood and drain grow beds, it is difficult to keep the water temperature warm through the cold

winter nights. In a temperate climate, heating becomes necessary.

### COMMENTS ON OMEGA 3:

There have been all sorts of hype about proper levels of Omega 3 fatty acids and fish lately. Here in the US, channel catfish and tilapia are the most commonly farmed fish, especially in the south. It is interesting to note that the Omega 3 levels in farm-raised fish are not nearly as high as the levels in wild caught fish of the same type. This is due to the feed. Most commercial fish feed has large amounts of corn and soy with their less-than-desirable ratios of omega fatty acids. Fish fed these commercial fish feeds will therefore have similarly poor grades on the Omega 3/Omega 6 balance. The more varied and more 'wild' we can make the diets of our fish, the healthier they will be for us to eat. As things are now, tilapia raised on commercial fish feeds are not that bad for one to eat but they definitely don't have the good Omega 3 levels of the cold water fish. ●

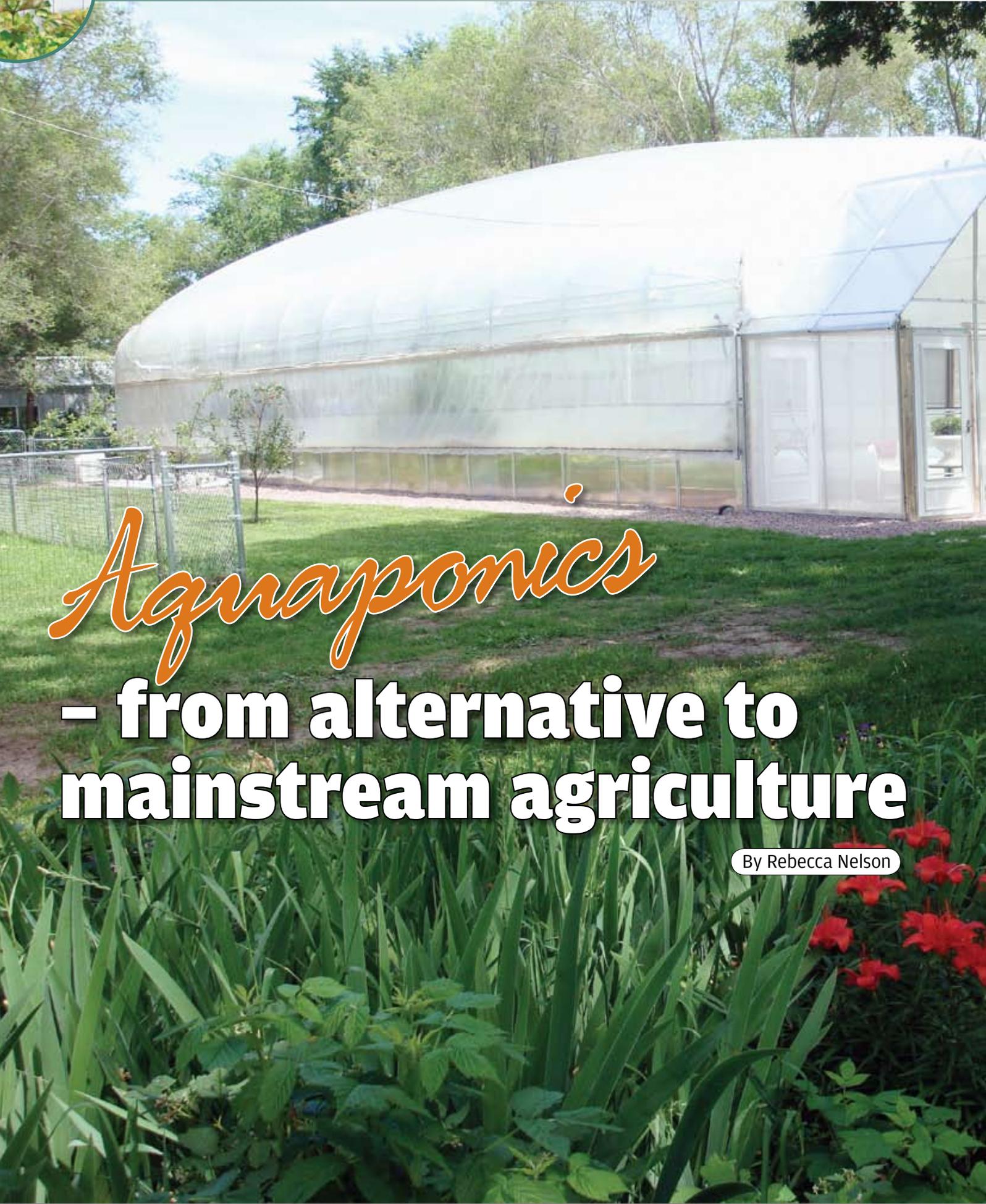


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*Aquaponics*  
- from alternative to  
mainstream agriculture

By Rebecca Nelson



**T**

The interest in aquaponics is growing exponentially around the world. The term aquaponics, something that even a few years ago was not known in most circles, is now being casually tossed into conversations related to sustainability, local food, feeding the hungry, business and food safety. It is also turning up in educational circles in discussions of hands-on learning and inter-disciplinary teaching. If you are reading this article in the BYAP magazine, the odds are good that you are aware of the many benefits and unique synergies that make aquaponics a new, fashionable topic of conversation.

When any new technology makes the progression from concept to real-world application, there are growing pains. Aquaponics can provide solutions to so many problems in our food production and food supply industries and this method is so natural and makes so much sense, there are people everywhere that want to be a part of it. This is great, because all of this interest will help the industry grow. But, to protect the industry, we all have to help correct misconceptions and inaccuracies that show up in articles, on the web and other places.

My partner, John Pade and I, have an extensive history in business, aquaponics, hydroponics and controlled environment agriculture. This past spring, we built a 185 square metre controlled environment

greenhouse that houses a variety of aquaponic growing systems at our location in Wisconsin, United States. It is a multi-purpose facility that demonstrates affordable technology in aquaponics and controlled environment agriculture, with an eye toward maximising production. Within the greenhouse, visitors see the application of both low-tech and high-tech methods, producing a very high volume of crops with minimal inputs. To reduce energy use, solar-powered roof vents, natural ventilation, insulation and other energy-saving methods are incorporated in the greenhouse design.

Research is one purpose of the greenhouse. We are providing space, funding and equipment to advance aquaponic technology. We have a variety of systems in the greenhouse and are developing new techniques and methods of growing that address current concerns in food safety, quality and commercial viability.

Another purpose of the greenhouse is to provide a place of learning for individuals who want to learn about aquaponics. We are now offering training workshops at our new greenhouse. Since the first course in May, individuals from 18 different states have participated in these workshops. The enthusiasm, interest and follow-up response by participants has been very high. Two additional workshops are scheduled for 2009, one in



## Over the Back Fence



September and one in November. Workshops will then resume in May of 2010. All of the workshop programs include both classroom and hands-on learning in the greenhouse.

Our intention is for someone leaving our course to be thoroughly informed on the skills to successfully operate an aquaponic greenhouse – from choosing the right design for their application, to water quality testing, calculating feed inputs and system ratios to seeding, transplanting and harvesting. In the afternoon greenhouse sessions, the students participate in all of these tasks, enforcing what they learned in the classroom sessions.

### Jennifer and Jason, from Wyoming, attendees at our May workshop commented:

*"Just wanted to drop you a quick line to thank you again for a wonderful training experience this past weekend. Jen and I thoroughly enjoyed the training, your honesty and insight and the opportunity to meet and network with other aquaponics newcomers. We came away from the weekend more excited and energized than ever to pursue our vision—thanks to you! Most importantly, we have found professionals that we can trust."*

It is very rewarding to provide information that helps people grow quality food in an environmentally-friendly way. Sharing information and teaching is not new to us. We offered workshops on hydroponics at our greenhouses in California throughout the late 1980's and early 1990's. In 1998, we offered our first aquaponics workshop in California. Since that time, we have relocated and are now very happy to again be sharing our passion and knowledge of aquaponics. Rather than patenting a system or claiming that we have "the secret" to aquaponics, we promote information sharing because we want aquaponic growers to be successful so the industry can grow in a positive and rewarding manner.

The systems that we have running are producing a myriad crops...tilapia, lettuces, herbs, tomatoes, cucumbers, squash and more. We are selling these crops locally at farmer's markets and retail outlets. I love spending time in the greenhouse but our other business endeavors (consulting, publishing and system sales) dictate that I cannot be in there full time. Therefore, we have hired a greenhouse manager, Sarah Sletten. Sarah is a dog trainer by profession. She trains all kinds of dogs but specializes in police and search and rescue dog training. Sarah's love of animals, order and

quality control make her an excellent choice for the greenhouse manager. She keeps the systems running smoothly, fish and plants healthy and fresh produce moving out the door. And, since our greenhouse doesn't provide full time work, she still has time to pursue dog training.

I believe that aquaponics – both the interest and application – is about to explode. From individuals setting up backyard systems to large corporate projects that will supply food for communities, this is just the very beginning.

We are at a point that aquaponics is commercially viable, but the technology will continue to evolve. Much university research has been done and now, as commercial projects develop, research will be taken on by the private sector. The systems that we know and use today will become more streamlined and more efficient. On the commercial side, at least in the United States, the emphasis is

**“When any new technology makes the progression from concept to real-world application, there are growing pains”**



on food safety. We are now incorporating equipment and methods into our systems that demonstrate good agricultural practices and ensure a healthy, quality product. On the hobby side, many companies are starting to sell kits and equipment to potential aquaponic growers.

From our point of view, aquaponics is ready to move from being alternative agriculture to main-stream agriculture and we look forward to being a part of this transition. Best of luck in your growing! ●

For more information, please visit [www.aquaponics.com](http://www.aquaponics.com).  
Rebecca Nelson can be contacted via email at [nelson@aquaponics.com](mailto:nelson@aquaponics.com)

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# The Beauty of *Bees*

By Faye Arcaro

Photography Faye Arcaro



**B**ees exist all over the world and are an integral part of our ecosystem, they play a critical role in pollinating many of our flowering, fruiting and seed producing plants. They collect pollen on their body hairs and work all day transferring it from one flower to another, this term is often referred to as cross-pollination (fertilization). Bees have very long tongues which allow them to drink the nectar fluid from deep in the throat of the flower, providing the bee with protein from the nectar as well as energy.

Bees are responsible for the pollination of around 90% of flowers and fruit crops. You might ask, why is this so important? Well one in every three mouthfuls of food that we eat is directly related to the work of bees. If you take a look at the range of fruit and vegetables on display at the local grocery store you might get an idea of just how important the work of the bees are in ensuring each of those flowers had been pollinated, to produce crops. Can you imagine the work that would go into that, if it all had to be done by hand? Some fruits of course are self-pollinating while wind, other insects, birds, beetles and bats or marsupials may pollinate others. For the standard orchard it is most often the European honeybee that does this job. Also known as *Apis mellifera*, it was introduced to Australia in 1822.

There are thousands of bees worldwide including native bees, leaf cutting bees and honey bees. Some are solitary insects and live alone in the ground or holes of tree bark, while others are extremely social, living in colonies of many thousands.

Apiarists have become so familiar with the process that it is not hit and miss anymore and by understanding the cycles of weather, fruiting and flowering crops, hives

can be delivered to a farmer's orchard to do the work and ensure a bumper crop for sale. The other beautiful thing about this is the apiarist on return after helping out the farmer has the ability to collect and harvest a bountiful supply of honey for the market.

### THREATS TO BEES

Food security is a commonplace term nowadays and people are increasingly concerned with the environment and the future of their food. Over the past few years the United States lost 80% of their bee population.

Threats that face bees include the loss of habitat, viruses and diseases as well as the use of chemical pesticides. Recent threats have included Colony Collapse Disorder and the Varoa mite. The result can have devastating effects resulting in business failures.

Aquaponicists everywhere are gardening using organic principles and often relying on nature's own ecosystem to maintain its own balance without the use of chemical substances.

Sales and marketing strategies today often target people's worst fears. The thought of their beautiful garden being attacked by an army of insect pests sends them scurrying to the nearest hardware store with the offending leaf stalk and pest in hand, not satisfied unless they come away with a fast knockdown, sure-fire cure to eradicate the outbreak, and often unperturbed about the warnings on the label. Often these treatments can be unnecessary, costly, time consuming and ineffective to the home gardener. The reason for this is that if the instructions are not followed and the wrong dose is applied at the incorrect stage of the pest's cycle, the pest can build a resistance to the treatment and future generations may become immune. This allows the following



## In the Garden

generation to build up a resistance. Small pest numbers are not always a problem. As the population grows a predator will often prey on it as it is part of the natural food chain. Nature then maintains its own balance - the key is PATIENCE.

Pesticides, even organic ones, can be toxic to bees and other beneficial insects. To minimise the risk, avoid spraying when blossoms are open or when bees are present.

Although pyrethrum is classed as safe to use in organic gardens, used as a natural insecticide it has a low toxicity to animals and humans, but will kill some of the beneficial predators and it can be toxic to bees. To ensure against this use only in the evening as it remains toxic for a 12 hour period. It will breakdown in sunlight between two hours and two days depending on the conditions.

### THE LIFE CYCLE OF THE BEE

A colony consists of around 50 000 bees which will have one queen, drones (males) and many worker bees (sterile females). The queen is the largest in size, followed by the drones and the females are the smallest.

When a queen bee emerges from her cell her job is to mate with drones providing her with sperm that will last between two and three years, the term of her natural life. She will either return to the hive and take over as the queen or alternatively leave with some of the worker bees to start a new colony. She begins to lay eggs about 10 days after mating and will proceed to lay around 3000 eggs per day.

From each of the eggs laid, a grub or larva will hatch and then be placed in a cell. Young worker bees feed the larvae 'bee bread', which is a combination of nectar and pollen, while others will feed the queen and clean the cells. Slightly older workers will build

the comb, store the nectar and pollen as well as guard and ventilate the nest to maintain the temperature by fanning their wings. Worker bees aged 20-30 days will forage for nectar, pollen and water before returning to the hive. ●

### Interesting facts

- Honey found in the pyramids of Egypt can still be eaten after 2000 years
- Bees have five eyes but cannot see the colour red
- All the worker bees are female
- The sole purpose of the drones is to mate with the Queen bee. After they have served this purpose they will die. Their mouthparts are too short for collecting nectar, they have no sting so cannot defend the hive and they can't make beeswax
- Honey is made from the raw nectar which comes from flowers and is collected by the workers, they mix it with secretions from their glands (bee spit) and pass it onto another bee before it is deposited into the comb where it is capped and kept at a constant temperature before ripening into honey
- Bees communicate the location of the nectar or pollen source by performing what is called the 'waggle dance'. The speed of the waggle tells the distance to the flowers, the closer the source the quicker the waggle. If she flies in circles it means that the flowers are closer than 100 metres and the bees fly in ever-increasing circles until they reach the source. This song and dance theory was tested and proved in the late 1980s by using a robotic honeybee that could be sent in any direction and distance the scientist asked of it





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- **Pollen-food** or dietary supplement.
- **Propolis** pharmaceutical products with antibiotic and antifungal properties used to treat burns.
- **Bee venom** relieves arthritis and rheumatic pain.
- **Royal Jelly** a wonder tonic used for many ailments.



*Tips to attract bees to your garden*

- 1 Plant species that will **flower in succession**. It is a good idea to visit a nursery every month to purchase seasonal colour, as the plants grow and flower you can have bees year round.
- 2 **Favourable habitats** include remnant areas of bushland or even small areas of your garden with native vegetation that can be left to go wild. A few local species can ensure that honey bees, predators and native insects have a wildlife haven as well as providing a refuge for endemic marsupials.
- 3 Provide a source of **water and shelter**.
- 4 Observe and take note of the **plants that are attracting bees** in your area.



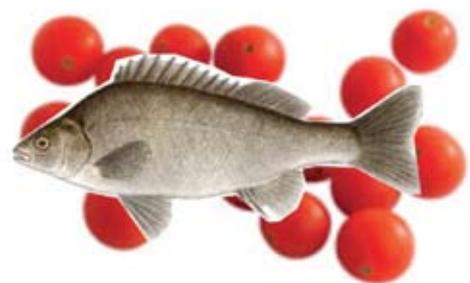
*Bee attracting plants for the aquaponic system*

- |          |           |        |             |
|----------|-----------|--------|-------------|
| Chives   | Marigolds | Onions |             |
| Mint     | Sage      | Basil  | Nasturtiums |
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# Airlift Bio Filter (ABF)

By Louis Kinstler

**A**

**Airlift Bio Filter** came about through a need to convert a large volume of water in a swimming pool for an aquaponics system. Airlift pumps had already received a lot of debate on their ineffectiveness in moving water to any head higher than zero. But at zero head an airlift pump



moves a tremendous amount of water and has the added benefit of allowing oxygen levels in the water to increase. With the pumping method determined it was only a matter of adding enough surface area for the bacteria to colonise.

My first ABF was 90mm of PVC running eight air stones below a section filled with bio balls. This worked well but slowly blocked after running for a few months. The second was similar in design but a little bigger. Using a section cut from a 200 litre drum holding 2000 bio balls I was able to drop the readings to zero in the pool for the first time. The system was still lightly stocked

and plant growth reflected this. Adding more grow beds allowed the system to remain stable as the bio balls would end up clogging in time.

The third time ended up the charm. As in most backyard aquaponics systems we like to use what ever is around to incorporate into a system. I used large PVC with hundreds of 5-10mm bits of 13mm black poly pipe. The air stones were placed below a mesh divider at the base and this was placed into a 380 litre fish tank that was connected to the main pool via a 500 litre grow bed running a 1000LPH pump. The media keeps the bacteria contained in the oxygen-rich area of the filter. Any bacteria that are knocked off the media will find a new home in the system water or another surface. A bacterium on the media is quickly replaced as the area inside the cut-off cannot be brushed up against another surface. Holes positioned close to surface height slowed the flow through the ABF to give the bacteria time to work. Water moved through the tanks based on the flood and drain cycle of the grow bed on continuous flow.

The ABF works on the same principle as wastewater treatment plants. They use a lot of aeration to create activated sludge. This is naturally-occurring bacteria that get super charged with a perfect environment - lots of food and oxygen. In the ABF the bacteria have a safe place to colonize inside the poly cut-offs. The air moves the water and media around macerating fish waste into finer particles allowing the filter to remain unblocked. With enough oxygen and bacteria the ABF works on converting ammonia and nitrite as well as breaking down solids in a similar way to compost tea. This is why they are also referred to as digesters.

Testing a system with 50 000 litre of water



“With enough oxygen and bacteria the ABF works on converting ammonia and nitrite as well as breaking down solids in a similar way to compost tea”

## In the Garage



and a ratio to grow bed media of 9:1 turned out to be difficult. 5450 litre of grow bed media and two ABF were able to quickly adapt to increases in bio load. Water tests would have to be taken from inlet and outlets to the ABF tanks.

With 50 silver perch around 40cm and 50 catfish at 25cm I doubled their food. Fish were happy and readings stayed the same so 130 silver perch fingerlings were added and 20 small goldfish from another system. Plant growth improved without any spiking. A further 240 catfish fingerlings were added to the same 380 litre fish tank that was fed from the ABF tank.

Also added to the pool were 150 mouth-size yabbies and that finally increased the readings. Ammonia was now 0.25 in the main volume of water. The water leaving the fingerling tank was zero. The ABF

and grow bed were able to handle the ammonia coming from the pool and any that was produced by the 390 fingerlings that have remained in a 380 litre tank, some for almost a month. There have been no fish deaths to date in the system or any signs of stress.

On closer inspection of the filter, bio film is visible around the outlets. Also, the inside walls of the tanks are displaying an increase in bio film. This could be due to the increase in bacteria activity within the tanks that still have high dissolved oxygen from the ABF.

With most systems using air stones to help with dissolved oxygen in the water, adding this type of filter could help with bio load on a system. An increase of bacteria on the surfaces will also help in keeping systems stable. It will not replace grow bed media but seems to have made converting large volume pools over to aquaponics more viable. A larger filter is planned and its effects on water quality will be monitored, as more mineralization of solids have kept the water and grow beds clean. To try and determine the amount of bio load that the grow bed contributed I moved the inlet directly into the ABF tank. After several hours I re-tested and the ammonia tests still showed 0.25 input and zero output. Since testing, the system has now adjusted to the increase in bio load and remains at zero ammonia and nitrite. Plants are growing strongly as the weather cools. I need more fish. ●



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# Edible Flowers

## Not just pretty but *tasty* too!

By Rowena Mansfield

**F**lowers and leaves have been used over the years to decorate and flavour our food - from simple meals to highly decorated banquets. From ancient Romans through Chinese, Middle Eastern, Mediterranean, and Indian cultures, most cultures have consumed flowers as part of their diet in food and/or drink, or as medicines.

Elderberry flowers are used in wines and cordials; roses are used to produce rose water, an essential ingredient in Iranian and Middle Eastern cuisine, especially sweets, most commonly *lokum* (Turkish Delight). Squash blossoms are used in Mediterranean cuisine, generally battered and fried, and often stuffed, and chamomile flowers are used for chamomile tea. These are just a few of the more commonly known uses of flowers in food. Flowers are also used in stir fry dishes, they can be frozen in ice blocks for use in drinks, used in teas, vinegars, oils, jams and preserves, marinades and dressings. Growers with aquaponic systems will know of the abundant growth and profusion of flowers that are possible in an aquaponic set up.

It is always fun to taste and smell new things with traditional dishes, so here are just a few that we have grown and used to spice up our meals.





**Borage flowers**

### BORAGE FLOWERS

*(Borago officinalis)*

These flowers can be blue or white and are an ideal decoration in gin or other alcohol based drinks. They are said to be restorative and refreshing. The flowers can also be frozen in ice cubes to be added to drinks. Candied flowers are used for decorating cakes and puddings. The flowers and leaves are used in salads and as a garnish. The leaves have a mild cucumber taste.

### CALENDULA OR POT MARIGOLD

*(Calendula officinalis)*

Calendula is known as the poor man's saffron. The colourful flowers have a spicy peppery taste and can be used to add colouring to rice and other dishes. Chopped petals can be added to butters and cheeses. Flowers can be dried or

candied for later use. Calendula is not only edible but has many healing properties.

### COURGETTE OR ZUCCHINI FLOWERS

*(Cucurbita pepo)*

The young flowers are rinsed, patted dry and filled with cream cheese and herbs, dipped in batter and then deep-fried for a tasty appetiser. The flowers can also be finely sliced and added to salads, soups or a courgette risotto. Flowers can also be used for decoration of other dishes.

### NASTURTIUM FLOWERS

*(Tropaeolum majus)*

The flowers and leaves are used not only in salads but also with vegetable and fish dishes. They have a spicy peppery taste with a sweet aroma. They can also be used to decorate cold drinks or soups.

The young seeds can be eaten instead of capers and can be pickled in vinegar to preserve them for the winter. Chefs and others interested in food presentation buy our bags of nasturtium leaves and flowers – as many as we can provide.



**Nasturtium flowers**



**Courgette flowers**

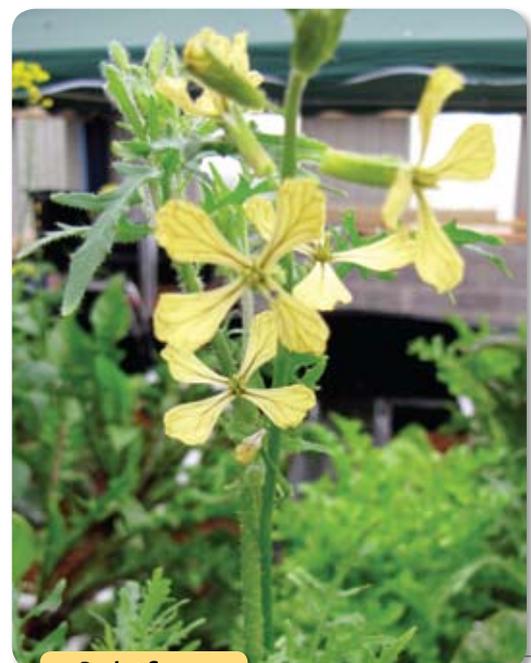
### ROCKET FLOWERS

*(Eruca sativa)*

Rocket leaves and flowers are used in salads and have a distinctive aromatic flavour. The leaves can also be cooked as a vegetable. A liquor with a peppery taste can be made



**Marigold flowers**



**Rocket flowers**



Rosemary flowers



Watercress flowers

but we have not tried this ourselves. Perhaps when we have some time we will try an old European recipe to make this strong drink.

### ROSEMARY FLOWERS

*(Rosmarinus officinalis)*

Rosemary has a very distinctive smell and taste. You either love it or hate it! The flowers can be eaten in green salads, also in fresh fruit salads. No barbecue should be without some rosemary burning on it. Rosemary flowers can be used to make a very aromatic herb jelly and the small attractive flowers can be candied for use as a breath freshener.

### WATERCRESS

*(Nasturtium officinale)*

Young watercress flowers make a tasty addition to any salad or light meal. Once the flowers get older they get quite bitter – so we use only the very young ones. The flowers and leaves are said to contain over 15 vitamins and minerals and are hailed nowadays as the *Great Natural Wonder Food*. Watercress can be used in many different ways from watercress salad, soups and sandwiches, dips, entrees and of course many vegetable dishes.

Finally, a word of warning – make sure of the identification of the plant and flowers that you are using and note that some people have allergic reactions to the pollen in some flowers.

We have eaten all the flowers and plants mentioned here and all the information is given in good faith. ●

*Bon appétit!*



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Rowena Mansfield

# Simplicity and planning

By Daniel Allen - East Texas

I remember visiting my grandparents as a young boy. I could never figure out where their food was stored. Yet, somehow at dinnertime there was a huge meal of steamed greens, mashed potatoes, green beans, fried chicken and gravy. Dinner was always a social event where everyone showed up, talked, ate, and laughed. It was simple, joyful. The "light bill" was literally the bill for four lights: two lights inside and two out.

As an adult, I regularly ate boxed and fast foods. That changed when my first daughter showed signs of food sensitivities. When I realised that there was no unsprayed food available, I decided to grow my own. Unfortunately, the soil where I live presented quite a challenge. It is red clay and rock - not at all fertile. After trying earth boxes, auto pots, and hydroponics, I discovered aquaponics.

Aquaponics made sense in every way. It is organic, easier than dirt gardening, efficient in water use, and very productive. We are pulling through

the learning curve and discovering how to grow and prepare meals without store-bought items. Getting meals together with very few purchased items like my grandparents did is a skill that requires planning. Being able to produce a large amount of food means hard work and a few challenges.

After discovering the BYAP forum, and reading for several days, I set out to design a system capable of producing 180

**The simplicity of Daniel's system is evident**

kilograms of fish each year and enough vegetables to feed four people. Using the slope of my land, I laid out the simplest system: a pond lower than the grow bed and a simple loop siphon to quickly return the water. The pond is 3.8 meters across and estimated to hold about 7 200 litres



**Daniel next to his system**



“Beyond nutrition, it has been a challenge to learn how and what to grow so that the system stays productive.”

filled to the top. The grow bed is 3.8 meters wide by 9.7 meters long, so it is a stocked size for a pond liner. It holds 10 000 litres of gravel and requires 4 100 litres of water. This works out to 18 litres per fish when it is full and 7.5 litres per fish during the flood cycle. The flood cycle takes 13 minutes and draining takes 30 minutes through a 38 mm pipe. It took hours of backbreaking work to shovel 10 cubic metres of heavy river gravel into the bed. Everything else

amount of food that can be eaten from the system in a season.

Similarly, vegetables can be chosen that mature or produce edible parts in fewer than 60 days. Other plant choices produce nonstop so that the system yields far more produce. Crops that have been a success for me include: basil, carrots, cayenne peppers, chives, corn, lettuce, green onions, green peas, mint, okra, radish, rock melons, squash, swiss chard, tomatoes and turnips. Several other crops are being tried including a grain crop with edible leaves. From March through July we have produced enough food to cook around 140 meals from aquaponic produce. The veggies are so full of flavour and grilled tilapia is a delight.

My grandparents were smarter than I gave them credit for. They really knew how to plan ahead and grow food. Planning, as well as knowing what to plant and how to plant it, is really the true key to productive aquaponics. Learning to plan ahead, plant ahead, and prepare the same things in different ways is making our aquaponics system productive. This has brought me full circle. I've arrived at a simpler lifestyle where sitting down to a family dinner whipped up from the garden "out of thin air" is a joyful highlight of my day.

Improvements to the system since it was placed in operation have included an air pump, for the purpose of supplying oxygen throughout the water in the fish tank. This has greatly improved water clarity and the health of the fish.

If I had the chance to change anything now, I would change to a flood and drain style, aquaponic system. The only way to add value to an aquaponics system like this would be if I used expanded clay for uniform space in the grow bed, as well as to avoid so much intensive labour. I would also opt to use prefabricated aquaponic system components which would allow for portability, expandability and the option to resell elements of the system. ●

was a pleasure, especially the releasing of 1 000 bluegill fish.

In operating this system, I have faced three big issues: weather, nutrition, and learning what and how to plant. I live in East Texas, Zone 8, and while we have a good, long growing season, the transition between seasons can be a bit troublesome. Freezes and cold snaps, for example, seem unpredictable. Two months into spring - during April - we had a cold snap that dropped the water temp below 10°C. This was too cold for my new, bluegills, so all but a dozen fish died. I could have avoided this problem if I had turned off the pump over night.

The next challenge came when we released 100 tilapia into the fish tank, immediately they started mating and I had fingerlings and fry everywhere. When heavy spring rains fell for days, many of the babies were washed out of the system from the overflow. Two design issues came to light: overflows need to be screened and the grow bed needs a cover to keep from collecting too much rain and diluting nutrients. Once the rain season passed, the next weather related issue was East Texas heat. When temperatures rise above 38°C, it's very hard to start new plants. A shade cloth is needed to continue planting on a regular basis. In order to prevent algae in the tank, I added an air pump.

We all know that supplemental nutrients are required for healthy plants. I found all the nutrients my plants required, including iron, in 'SeaAgri' sea salt. Beyond nutrition, it has been a challenge to learn how and what to grow so that the system stays productive. Planting green onions or leeks, for example, instead of regular onions reduced the time from planting to harvest. This increases the





# The role of Aquaponics

## in uplifting the rural poor in developing countries

By Kevin Cuthbert - Knysna, South Africa

**E** specially in the African context, the rural areas are characterised by poverty, disease, drought and a pervading sense of hopelessness.

For most families on this continent, the only form of income is one or another government grant and the irregular remittances from family employed on the mines and in industry in the cities. The current recession has exacerbated this situation, with the recently jobless now streaming back to the 'homelands' with an uncertain future.

When jobs were plentiful in the cities and funds trickled back to families in the rural areas, subsistence farming began to decline. The effort of scraping a few paltry crops from the barren earth hardly seemed worthwhile compared to visiting the nearest store with a handful of banknotes. But as these funds dry up, many a rural family is looking again to the vegetable patch to provide much-needed food.

The big mining companies and other employers are not oblivious to the conditions that their staff will face when returning home, even with a redundancy package in hand, and are exploring ways of providing a more sustainable solution to this problem.

Aquaponics, especially in its simpler forms, could provide the solution. The question however, arises, "How will it be funded and implemented and what forms will it take?" I believe that it will be funded by government poverty alleviation schemes, the United Nations and employers, and

that it will be implemented by universities, agricultural extension officers and companies specialising in aquaponic design and implementation.

### BASIC TYPES

There are basically two design types that would be applicable here, and I will refer to them as "below ground" and "above ground" systems. "Below ground" systems would use existing earth ponds or dams to hold the fish and "above ground" systems would see the fish accommodated in plastic or concrete purpose-built tanks or runways, possibly even in greenhouse tunnels.

In its simplest form, a "below-ground" system would merely consist of a small earth pond with the banks down to the water's edge terraced and planted with vegetable crops. Water would be pumped from the dam to the top of the terraces and it would then slowly trickle back down into the pond. The terraces would be lined with plastic and the grow bed medium would be gravel. The ponds would be stocked with tilapia, catfish or other local aquatic species. Drainage is important, as is water retention, so insulation of the terraced grow beds is vital and innovative, yet low-tech drain designs will have to be found to continually flood and drain the system. The natural catchment of the pond should not be compromised by the grow

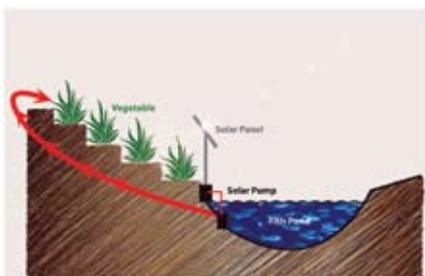


Photo: courtesy of Aquaculture Innovations

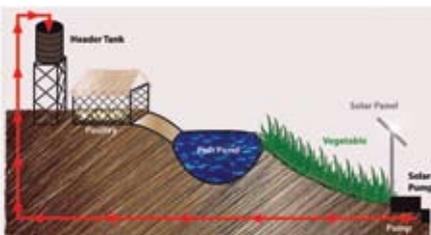


## Over the Back Fence

beds and the design would need to take into account possible flooding and overflow of the pond. The terraces would need to be easily accessible for maintenance and harvesting and the pond prepared and harvested identically to existing earth pond culture. Placement of the submersible pump would be vital and some sort of concrete sump would be necessary to prevent clogging. Stocking densities could presumably be far higher than pure pond culture because of the presence of massive biological filtration in the form of the grow beds and the nutrient needs of the vegetable crop. Some innovation is needed here to marry the best elements of pond culture and recirculating aquaculture systems (RAS).



A modification of the above system could incorporate chickens or other poultry and would also operate using gravity and a small pump. Poultry could be housed at the top of a hill and the concrete floor of the run hosed down daily, with the water running down a drain into a fishpond. This fishpond would overflow onto terraces planted with vegetables and the water would eventually collect in a sump at the lowest point and then be pumped back up to a header tank at the top of the hill.



The main challenge with both of these systems is the pump. In most cases, one can naturally assume that electricity will not be freely available, so solar pumps may be the only way to overcome this problem. There are many alternative, low-tech, means of pumping water, including playground equipment connected

to water pumps ([www.playpumps.org](http://www.playpumps.org)), but I am unconvinced that these methods would be reliable enough to ensure the precise flooding and draining cycles integral to aquaponics systems. One of the other challenges of implementing aquaponics into rural Africa is that in certain areas there isn't really a culture of eating fish. In other areas, it is widespread.



Photo: courtesy of Aquaculture Innovations

## LAND RE-DISTRIBUTION FACTORS

Right here in South Africa, there are massive tracts of very fertile and productive land currently being returned to previously dispossessed locals, who have neither the experience nor the capital to farm this land, resulting in real threats to our food security. What we should rather do, is persuade the authorities to leave these productive farms in the hands of those who have the know-how and capital, and look at aquaponic solutions for the emerging farmers on land that cannot be used for anything else.

It is in this area, that I think the "above ground" systems would be of real use. These systems could range from small IBC-based home systems right up to large tunnel-based aquaponic systems farming fish and vegetables commercially. Aquaponics would, in my opinion, be the best and most productive use of this type of land because of its small footprint and its frugal use of water.

The high initial capital cost of implementation may be a problem, but our government is spending billions implementing their land re-distribution policy anyway. Aquaponics would provide employment, transfer valuable skills and contribute positively towards food security.

## "ABOVE GROUND" SYSTEMS

Here are two "above ground" aquaponic systems to demonstrate what could easily be built in rural areas for home or small community systems. The first is an IBC container-based system, consisting of a tank, a small submersible pump, and a plastic half-barrel grow bed. Time to build – a couple of hours. Cost – a couple of dollars.



The second is a system consisting of four 3m diameter fishponds, a sump and about 100m of gravel grow bed space, all housed within a greenhouse tunnel. The footprint is small (300 square metres), and it uses very little water and electricity. The capital cost may be rather high for a poorer community to manage, so a system of this nature would probably have to be funded. Here is a floor plan of the system and what it looked like during construction. A year later it is producing a steady stream of tilapia and fresh vegetables for the local community.

What is needed to make systems like this happen in emerging countries is firstly the political will and secondly the funding, which will obviously have to come from aid agencies. With the continent littered with well-meant, but ultimately aborted projects (many of them aquaculture-based), aquaponics is unfortunately going to be a hard sell. Another very difficult aspect is how to measure a "return" on this investment. Normal business

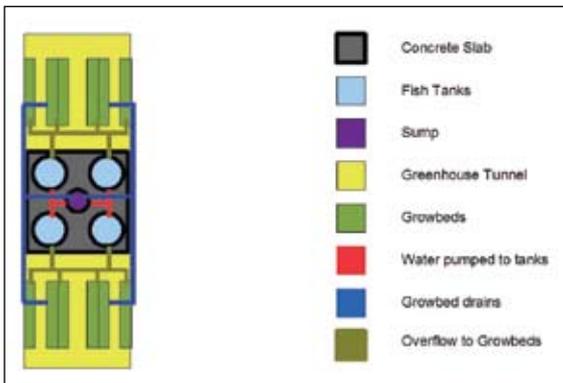


models are irrelevant here and the question should be, "How would the investment in designing and building an aquaponic system, and training a community to operate it, compare to merely giving them food in the form of food aid?"

Only time will tell, but if we are to break the chains of dependence, we really need to start

transferring skills, the most importance of which is to feed ourselves, our families and our communities, a skill that modern life has robbed most of us of.

Aquaponics is certainly not the "silver bullet" to alleviate poverty and provide food to needy communities, but it certainly offers a better than average chance of meeting these goals. ●



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**T**his edition of the magazine sees us take things forward another step with a printed version becoming available. The magazine will be available either as an electronic subscription, or in a printed format. For current subscribers who wish to receive printed editions, we will be sending out details of how to upgrade soon.

Work is well under way on the **seventh edition** of the magazine. We will continue to showcase systems belonging to members of the online discussion forum, there will be information on vegetables and plants well suited to aquaponics systems, plus lots of useful hints and tips.

*It's promising to be an exciting issue, packed full of information.*



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