

Booming Inland salt
water aquaculture
will require
infrastructure help

By Geoff Wilson *

Specialised infrastructure will
be required for development of
new fish farming businesses, farm
sideline businesses and the processing
and marketing of an expanding
quantity of fish, crustaceans and
molluscs from fish farms.

Governments around Australia are becoming very excited about salty waters on or
under inland farms.

The salty waters are now being regarded as a potential asset for a huge inland
aquaculture industry possible within 10 years --- instead of these waters being
a current farming liability in their destruction of productive farm land and
fresh water streams that often run saltier than the Dead Sea!

This turnaround promises to trigger a new rural investment push in at least
five Australian states, predicated on expectations of a massive export market
for aquaculture products as well as a booming home market for healthier food.
Predictions by the Food and Agriculture Organisation (FAO) of the
United Nations that, by the year 2020, around 50% of the world's seafood will
come from farmed fish, crustaceans and molluscs, are starting to register with
investors and strategic planners in government and industry.

Profitable new fish farming enterprises for many of Australia's 100,000 or
fully professional farmers, are forecast.

So is a new fish feed industry based on Australian grains, rather than mostly
imported fish meals. This augurs well for Australia's 40,000 or so serious grain
producers -- and future producers of pulse crops (legumes) being encouraged more
widely in Australia by State governments.

The "boom", now being predicted within three years by insiders, is likely to
rapidly expand or better utilise Australia's aquaculture education, consultancy,
employment and investment on both production facilities and in processing and
marketing.

Fortunately for farmers much of the infrastructure for a easy adoption of inland
fish farming is in place. But there are specialised services that do need
infrastructure development.

Educational institutions and consultancy services are in place. R&D by
governments is expanding, with new staff recruitments.

Dairy, meat and vegetable processing companies are ideally set up to well
service future inland aquaculture on a low-cost basis compared with greenfield
start-ups.

But they will require governmental infrastructure help to adapt to aquaculture
that well paces itself against expanding farm output.

Minimum additional infrastructure is required on farms in irrigation areas --
where doubling or trebling enterprises using the same water is in prospect.

The potential for relatively low-cost aquacultural development will certainly
well underpin current moves in government to expand both aquaculture research
and development, plus the information extension services fully justified by the
new opportunity.

Australian fisheries scientists have found that many fish, crustaceans and
molluscs can thrive in salty farm waters from:

- * Irrigation drainage.
- * Dryland salting from over-clearing of trees.
- * Deep aquifers containing ancient sea water.

More than 25 years of investment in aquaculture research and development by various Australian governments is now paying off -- handsomely. So is some unique development of probiotics by private interests in Australia. Opportunities now exist in five Australian States (see the accompanying saline waters "resources" map) for farmers and investors who may back them. Most of inland New South Wales and Victoria is involved, with big areas of salted land in South Australia and Western Australia. Queensland has a particularly good opportunity on its southern border.

Profits clearer

The money-making opportunity for serious aquaculture on inland salty water is now much clearer thanks to research just being completed in NSW and Victoria. A sideline salt water pond of 10,000 litres on a hectare can now yield fish worth up to \$50,000 a year according to fisheries economists.

The salt-tolerant fish species most favoured for commercial inland fish farms are barramundi, Atlantic salmon, snapper, silver perch, rainbow trout, mulloway, black bream and prawns.

But further research is expected to identify other species suited to inland farming, as some little-known Queensland native fish are tested on inland saline waters in farm ponds.

The most recent breakthrough was in December, 1999. NSW Fisheries scientists involved in the Co-operative Research Centre for Aquaculture, announced that its team had cracked the secret of farming salt-water snapper. It is the first Australian sea fish to be grown using inland salt water.

Stewart Fielder, the NSW Fisheries scientist at the forefront of both snapper and other inland aquaculture research, foresees a "booming" inland saline waters industry ahead, with significant development beginning within three years.

"Snapper are just a start. Barramundi, prawns, mulloway, silver perch and salmon are all candidates for aquaculture in these dams. If it works for snapper, the sky's the limit," he said.

About five tonnes of snapper can be produced each year on a hectare of salt-water pond. The fish is in keen demand at around \$10 to \$14 a kilogram wholesale.

But perhaps a more important recent development is the funding by the Fisheries Research and Development Corporation of a study being conducted by NSW Fisheries.

It is investigating the fish farming potential for saline inland waters for new and widespread aquacultural investment.

The study will look at likely obstacles and limitations of commercial expansion of inland aquaculture based on saline water, and how such obstacles can be overcome.

A research and development plan is expected to be finalised by mid-1999, following industry and government consultation.

This will give investors (both farmers and those who wish to engage in processing and marketing) an important entry point for a whole new industry that can piggy-back on existing agriculture and existing fish marketing.

"Exciting"

It is one of the most exciting development in rural Australia at present, in its contribution to the rural and general economy and to employment," said Dr Geoff Allan, NSW Fisheries principal aquaculture scientist.

A driving force behind researchers and government planners has also been the realisation that one of the biggest problems faced by salt-water aquaculture investors is lack of suitable sites on Australian coastlines.

Inland sites offer:

- * Closeness to facilities such as power, roads and processing.
- * Easier control of environmental problems.
- * Lower setting up cost, especially if existing farm infrastructure is used.
- * Fewer problems with harsh weather.
- * Little or no impact on recreational waters in coastal recreation areas.

NSW aquaculture experts favour fully professional investment using inland saline waters.

But Victorian experts tend to be strong advocates of partnerships in aquaculture between farmers with salting problems and investors with marketing and processing expertise.

Queensland experts believe both views are valid and see a meshing of interests between agriculture and aquaculture in the Israeli-style "agri-aquacultural systems" with multiple uses of either fresh or salty water..

Farm Sidelines

Geoff Gooley, aquaculture project manager of the Marine and Freshwater Resources Institute (part of Fisheries Victoria), said:

"We foresee inland farmers with salt water resources on their farms being able to develop sideline fish farming businesses. The non-harvesting labour is not too onerous, and important contributions can be made by the farmer's families.

"We also foresee joint venture groups of farmers acting together with marketing and processing professionals. An individual dairy or beef farming family can produce one to two tonnes of fish each a year as a useful sideline for extra revenue," he said.

A group of collaborating farmers could produce 10 to 20 tonnes a year in a supply both consistent in quality and volume.

A full scale fish farm using saline water would need to produce at least 15 to 20 tonnes a year to be viable by itself. However, the favoured Victorian approach, especially in irrigation areas affected by salting, will encompass:

- * Comfortable sideline output using existing farm infrastructure.
- * Sensible rehabilitation of salted land currently out of production, using pumped saline groundwater.
- * Links with food processing and marketing experts, such as dairy or meat companies.
- * Shared use by farmer groups of solar evaporation ponds for saline aquaculture wastewaters.

Salt harvesting

Harvesting of industrial salt from fish farm wastewater is envisaged as a potentially important part of fish farming using saline waters.

This means that spread of fish disease, or parasite problems, can be minimised. The input salty water is pumped from aquifers close the surface in the flushing of salted soil, so is likely to be of adequate quality for fish farming.

Evaporation ponding by groups of fish farmers in one area, then raises the prospect of further industry in salt harvesting for world chemical industries. The economics of this is yet unclear, but it is certainly a proven concept in parts of Australia.

Land repair

One of the key points about inland salt water aquaculture is that it can be used to rehabilitate land degraded by salting.

A team led by Lachlan McKinnon of the Marine and Freshwater Resources Institute in Victoria, made a study of this concept.

It is currently finalising its report and recommendations on an integrated aquaculture project on a dairy farm at Undera, near Shepparton in Victoria's Goulburn Irrigation District.

Salty water was ponded from flushing of degraded land.

"The project showed that Atlantic salmon, Australian bass, rainbow trout and silver perch show the most potential in irrigation areas. Interestingly, the dairy farmer involved has become so enthused that he is now considering salt water aquaculture as a major sideline enterprise.

Fisheries economist, Peter Rawlinson, of Fisheries Victoria, analysed the gross returns available to farmers who diversify by using their saline groundwater for fish farming.

He found that one hectare of ponding of 10 megalitres of salty groundwater is capable of producing five tonnes of fish a year, currently wholesaling at about \$50,000.

Extraction of this 10 megalitres of saline water could rehabilitate 10 hectares of salt degraded land.

The consequent benefit to gross farm revenue was estimated at \$40,000 a year from the repaired pastures.

Thus, the sideline salt-water fish farm's total benefit was calculated to be \$90,000 a year.

It is this kind of information that is beginning to drive new fish farming policy planning.

Aquaforestry

Fish farming and agroforestry --- "aquaforestry" --- is now believed to be a technology team for property owners suffering dryland salting.

Dryland salinity in Australia has been accentuated by over-clearing of farm land, .

Cyclic salt that is carried from the sea to the soil by rainfall, seeps into streams that run in summer -- where before the tree cover encouraged a natural flushing in winter and spring.

Over-clearing of farm land has been excessive in Victoria and NSW, and is feared to be so in Queensland.

Summer seepages from over-cleared inland farms has led to some farm dams and streams being saltier than the Dead Sea.

Salty water from dryland salting is a vastly different "resource", and dryland farmers practising aquaculture will probably need quite different techniques to succeed in sideline ventures into aquaculture.

My view is that agroforestry solutions will be important to them -- perhaps in the little-known technique of "aquaforestry".

Australia's salt-tolerant casuarina trees are already proving invaluable in "aquaforestry" in Egypt, where tilapia fish are raised in the Nile estuary..

Not only do our casuarinas there provide cooling shade, shelter from hot winds, and repression of sand movement, but they also shed pollen into ponds in which tilapia fish are raised.

Tilapia is not a species suitable for Australian aquaculture. But high-protein casuarina pollen is a much-neglected natural fish food in our embryonic inland aquaculture industry.

Groundwater

Australia's natural saline groundwater is another kind of resource again.

Groundwater underlies about 60% of Australia. An estimated 20% (or some 14,375 gigalitres) is brackish or salty.

The salty, natural aquifer can be close to the surface, such as in Western Australia..

Here the Salt Water Inland Fin Fish Association (SWIFFA) probably leads the rest of Australia in salty water fish farming investment and ideas.

The association enjoys the keen support of Monty House, the WA Minister for Agriculture and Fisheries, a key factor in its success.

Salli Vaughan, one of the fish farming members of the association, said it had 170 members, 30 of them already investing in purpose-built farm lakes filled from a saline aquifer some three metres or so under the farm topsoil.

Black bream and ocean trout are grown, and the 30 farmers are finding that their fish in salty water are healthier, more productive and tastier than fish grown in fresh water.

The association's general plan is similar to that advocated for Victorian aquaculture using salty water.

It advocates that farmer members should be in a low-labour input role, with professionals harvesting, processing and marketing the fish.

The association has commissioned a marketing study and has tested buyer reactions before making any commercial sales. It has plans for its members to grow seaweed for sale as part of saltwater aquaculture enterprises.

Membership is being promoted to thousands of farmers in the WA wheat-belt who have saline water in abundance in dams, streams and underground. I predict that this organisation is a bellwether for farmers in other States of Australia.

For other investors, however, the deeper, artesian saline aquifers are a different aquaculture prospect.

They can be high-quality, ancient, seawater that is a pristine raw material for high-value farming of some warm-water fish species.

Deep saline waters tend to be warmer than surface waters, and this can be a problem with salmon or trout, but great for barramundi or Murray cod.

These variations in types of saline waters available are accentuated by differences in the levels of dissolved salts. Sometimes the salty water needs salts added for different fish species -- or shandied with fresh water, or abandoned if too salty.

Hence the importance of the current NSW Fisheries study of inland saline water for aquaculture. It is a vital first step for all investors.

Extension

It is also sensible as a sound information base for government extension services, including the setting up of special demonstration farms.

A most sensible proposal is that such farms should be run by publicly funded commercial farmers who are subsidised to set up commercial sidelines, or full-time enterprises, where regular public field days can be held for all kinds of investors.

Farmers participating in this way could be advised by research scientists in an extension system that could be both low cost and most effective.

Such enlightened government action on the Australia-wide salinity problem has breathtaking implications for rural investment in Australia -- to turn the major crisis of salting into a manageable and profitable opportunity.

Government extension services for inland aquaculture using Australia's vast resources of salty water is likely to see a merging of interests between fish farming experts and existing extension workers -- especially in dairy, beef, sheep and gains industries.

As with agroforestry (combining trees for profit with other rural enterprises) about 25 years ago, the needs of future extension will probably see graduate diplomas in aquaculture as add-on qualifications for traditional agriculturalists.

Grain feeds

Australian researchers are now developing locally-sourced fish foods for aquaculture in Australia and overseas.

This is a most important underpinning for Australian inland aquaculture about to develop both inland and around the coastline.

Import replacement for pelleted foods is desirable, otherwise aquaculture expansion could cost Australia dearly.

Pelleted fish and prawn feeds can cost more than \$1,000 a tonne, and they can represent up to 70% of total running costs of a fish farm.

Indeed, according to Dr Geoff Allan, principal aquaculture scientist of NSW Fisheries, the development of nutritionally-adequate, cost-effective diets for fish farms is one of the main factors limiting current expansion of Australian aquaculture.

The main protein ingredient in current use is fishmeal, which is only produced in small quantities in Australia. Global output of fishmeal is static or declining.

Yet demand is rising rapidly, especially for aquaculture. Dr Allan said replacement of fish meal in aquaculture feeds was a major world-wide priority. NSW Fisheries have now replaced fishmeal in the diets of farmed freshwater native silver perch, and is collaborating with other research organisations in barramundi, Atlantic salmon and prawns.

Ongoing research work on farmed fish and prawn feed is supported by the Fishing Research and Development Corporation, with help from meat and grains research funds. I expect that both meat and grains research support of aquaculture will burgeon from now on.

Also, a collaborative project by NSW Fisheries with the Thailand Department of Fisheries has been funded by the Australian Centre for International Agricultural Research (ACIAR). This is an important start point for the supply of Australian-grown and formulated aquaculture feeds to the whole of Asia. But our own inland aquaculture is expected to be a significant first market for a wide range of locally-produced grains and meat meals, especially as the feeding of fish is far superior in conversion of low-value foods into high value fish.

Export markets beckon for fish and prawn foods made in Australia. In general, from 1.2 to 1.5 kilograms of fish feed yields one kg of farmed inland fish or prawns that can wholesale from \$8 to \$15/a kilogram, depending on species.

Probiotics

Certain companies in Australia are currently becoming takeover targets as news spreads of the potential of inland aquaculture on salty water.

One the "white hot" areas on takeover interest is in probiotics. This is the practice of using beneficial bacteria to overwhelm pathogenic bacteria in the gut of animals.

In aquaculture, companies with patents and expertise in probiotics can solve the loss-making problems of at least three serious disease confronting aquaculture investment world-wide.

Also, probiotics are vital for the emerging aquaponics technology (hydroponics and aquaculture) in which fish excreta and other water wastes are converted into plant food for vegetable production in fresh water systems, and edible seaweed or algae in salt water systems.

Massive pollution of static aquaculture sites can be overcome in both the water column and the silt below it by using the probiotic microorganisms in high concentration, at the right time.

Another great benefit from probiotics is that it overcomes the need for fish farmers to risk using antibiotics. Although they are banned in Australian aquaculture, it is known that some Asian fish processors sending aquaculture products to Australia are in the habit of using antibiotics such as penicillin when disease threatens profits.

Superior Australian probiotic expertise and patented micro-organisms means that we have a head-start on the rest of the world in massive coastal aquaculture as well as "clean-green" inland aquaculture.

The good oil!

The recent CSIRO study of beneficial oils in Australian fish also favours investment in two species of farmed fish on inland saline water..

One is Atlantic salmon, an introduced fish. The other is Australia's native silver perch.

In 1998 CSIRO completed an analysis of some 200 Australian fish, crustacea and molluscs either farmed or caught in streams or at sea.

The study focused on the beneficial oils in these fish -- oils which minimise heart disease, high blood pressure, rheumatoid arthritis and possibly cancer. Omega 3 oil was especially important, CSIRO said

The study found that Australian seafood contains more of these beneficial fatty acid oils than northern hemisphere fish -- and some 10 to 100 times more than the same fatty acids in beef, chicken and lamb.

Fish foods are much less fatty (except when deep fried) and offer a means to reduce the dietary fat intake of Australians.

These dietary advantages are important to the improvement of national health, and are well worth developing in marketing programs both in Australia and overseas.

The accompanying table shows the Omega-3 oil content of our top three fish, followed by some other fish species being considered for a big inland saltwater expansion of Australian aquaculture.

Fish species	Omega-3 oil content (mg/100 grams)
Sword fish	1,667 (not farmed)
Atlantic salmon	842
Silver perch	792
Rainbow trout	448
Eels (shortfin)	313
Barramundi (fresh water)	206
Barramundi (salt water)	150
Most others	100 to 200

This Omega 3 oil advantage is another reason why sensible investment is ripe in inland saltwater fish farming, particularly for Atlantic salmon and silver perch.

Atlantic salmon production is expected to have a seasonal tie in with the farming of the famed Murray cod, which has been mooted for Victorian irrigation farms with salt water resources.

Bright future:

The foregoing shows a very bright likely future for aquaculture in Australia in the next 10 years and beyond, based on inland salt water resources.

We are on the brink of a new expansion in aquaculture services and consumables to meet this opportunity, not the least of which will be the transmission of sound economic and practical information via education, consultancy, extension and technical media.

Government infrastructure in such technology transfer will be important in making new investment as economically sound as possible. Unfortunately the observable history of new primary industry development in Australia has mostly seen the pioneers and early responders "doing their dough" mostly through ignorance.

I am now well conditioned to hear from pioneers that they have spend double on their investment, compared with what it would cost on a duplicate set up five years after start-up.

That problem needs addressing early with adequate and enlightened farm extension infrastructure -- and possibly a financial investment infrastructure which encourages correct application of technology and business principles.

The latter point is just as important. All too often the business aspects of farming are badly neglected when new primary industries are in embryonic form -- as is inland aquaculture on salted land.

An important new industry:.

It is my belief, based on 42 years writing about Australian livestock industries, and 25 years as a agroforestry (farm trees) journalist, that we have in serious prospect a new industry that will be capable of eclipsing many others -- but which will be a vital additional revenue source for the many farmers in mainstream livestock and cropping..

The really important point about inland aquaculture based on Australia's extensive saline waters on or beneath farms, is the integration of agriculture and aquaculture. It can well integrate with:

- * Cropping (such as rice) in irrigation areas.
- * Livestock production in both irrigation and dryland areas.
- * Agroforestry and farm trees in plantations..
- * Reclamation of salted land in all these enterprises

To turn a salting liability into a revenue-earning asset is one by far the best option in a host of circumstances already well proved. Sensible infrastructure development must encourage many farmers to use aquaculture as a means of ridding themselves of the chronic grind of farming's cost-price squeeze, by enterprise diversification that uses existing farm resources and existing infrastructure on and off the farm as much as possible.

In this way the additional infrastructure required from government would probably be a t relatively small cost -- for massive benefit in new employment down the food chain.

That is the vision of many government scientists and administrators in all States of Australia. I share their vision.

World Aquaculture '99

An event that will trigger new investment interest in Australian aquaculture (both inland and around the coast) is the World Aquaculture '99 conference to be held in Sydney from April 26 to May 2. It is the annual international conference and exposition of the World Aquaculture Society, based in the United States. Like the Olympics, it has a different host nation each year. The principal sponsor in Australia is the Commonwealth Government's Fisheries Research and Development Corporation. Conference host in 1999 is NSW Fisheries. A trade display has attracted more than 120 participants.

Conference organisers are promoting day-attendance at two key sessions on:

- * Banking business opportunities in future aquaculture in Australia.
- * Sensible private investment in Australian aquaculture.

The conference is expected to also be a watershed in wider interest in production and consumption of fish foods from Australian aquaculture.

This map of likely areas for inland aquaculture investment using saline waters was prepared by Dr Stewart Fielder of NSW Fisheries at Port Stephens.

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