Aquaculture for the Future

By Dr. Richard D. Braley , November 2007.

Aquaculture currently provides about 25% of the aquatic products consumed, while 75% comes from catch or wild fisheries. However, as the wild fisheries cannot supply more than about 100 million tonnes, increased demand will have to come from improved aquaculture. Aquaculture is also now at a critical stage where it must address the issue of the growing public view that large-scale aquaculture is damaging the environment through habitat destruction, nutrient pollution, disease epidemics, and genetic dilution. Often, the claims of wrong doings are made up from information about mass prawn culture with poor controls. All forms of aquaculture cannot be judged by mistakes made in culturing one type of organism. However, when the damage is done and the wrong perception is prevalent, the only way is for proposed aquaculture ventures to cover each of these areas of contention in submissions before any ponds are dug or before any steps are taken to make changes to the site. Likewise, governments must make guidelines for the use of aquatic resources and the monitoring of this so that aquaculture can progress without conflict.

Let us briefly examine penaeid prawn farming, the worst offender as far as creating this growing negative perception of aquaculture by the public. The perception by investors that prawn (or, shrimp, if you prefer) farming will return quick profits has only some truth in it. Unfortunately, there are those investors who do not take all the factors into consideration when working with live organisms, and as a result they will eventually fail. Profits may be good for a short time and then natural disasters or aquaculture-induced disasters (disease epidemics such as the white spot disease that has affected wide-ranging areas, e.g. Taiwan, Bangladesh) occur. Often, this has been a result of poor design of the ponds, whereby inlet water and outlet water become intermixed between various ponds. New designs are being trialed in Thailand and other countries which include recirculation of the farm's water (Figures 1 & 2). As most of the rivers, estuaries or coastal areas are considered to carry the disease organisms the recirculation farm is a good idea, though obviously more costly for the initial capital investment. Below is a hypothetical design of my own (Figure 3) which I believe would be an easily controlled recirculation farm for prawns and other organisms. There is a high circular berm around the outer circumference of the entire farm. The supply canal (5) with fresh particle and biofiltered water is at the highest point just inside of the outer circular berm. There are outlet pipes or canals to each of the ponds (either the smaller nursery ponds, 3, or the growout

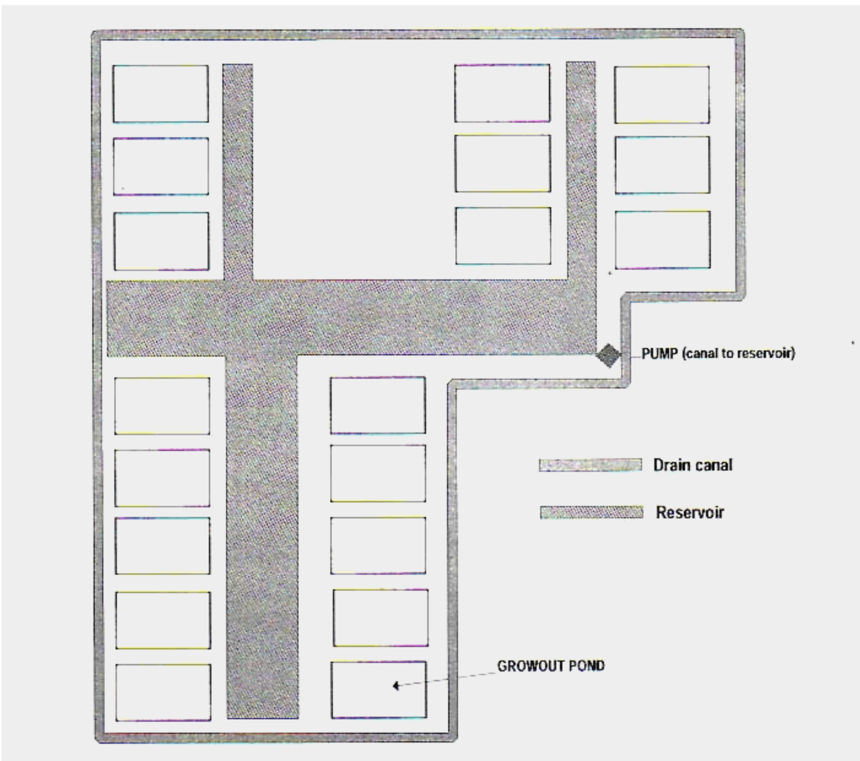


Figure 1: Recirculation shrimp farm in Thailand, where the drain canal and reservoir [treatment area] equals the growout pond area. After Robertson, 2001, Figure 5.

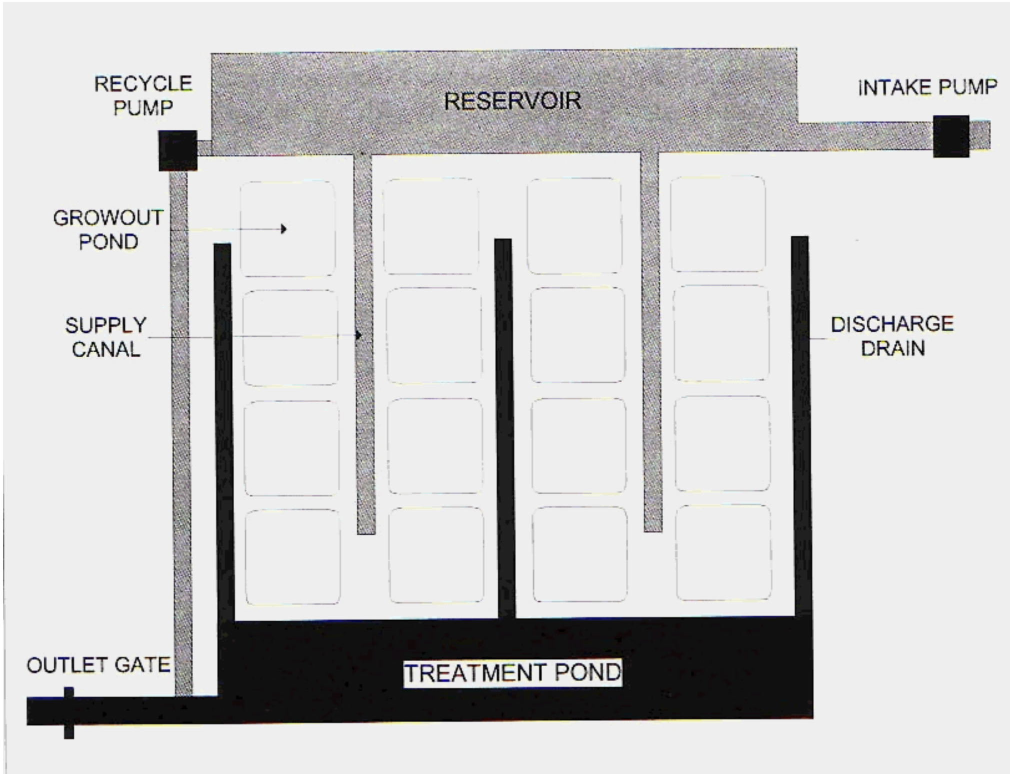
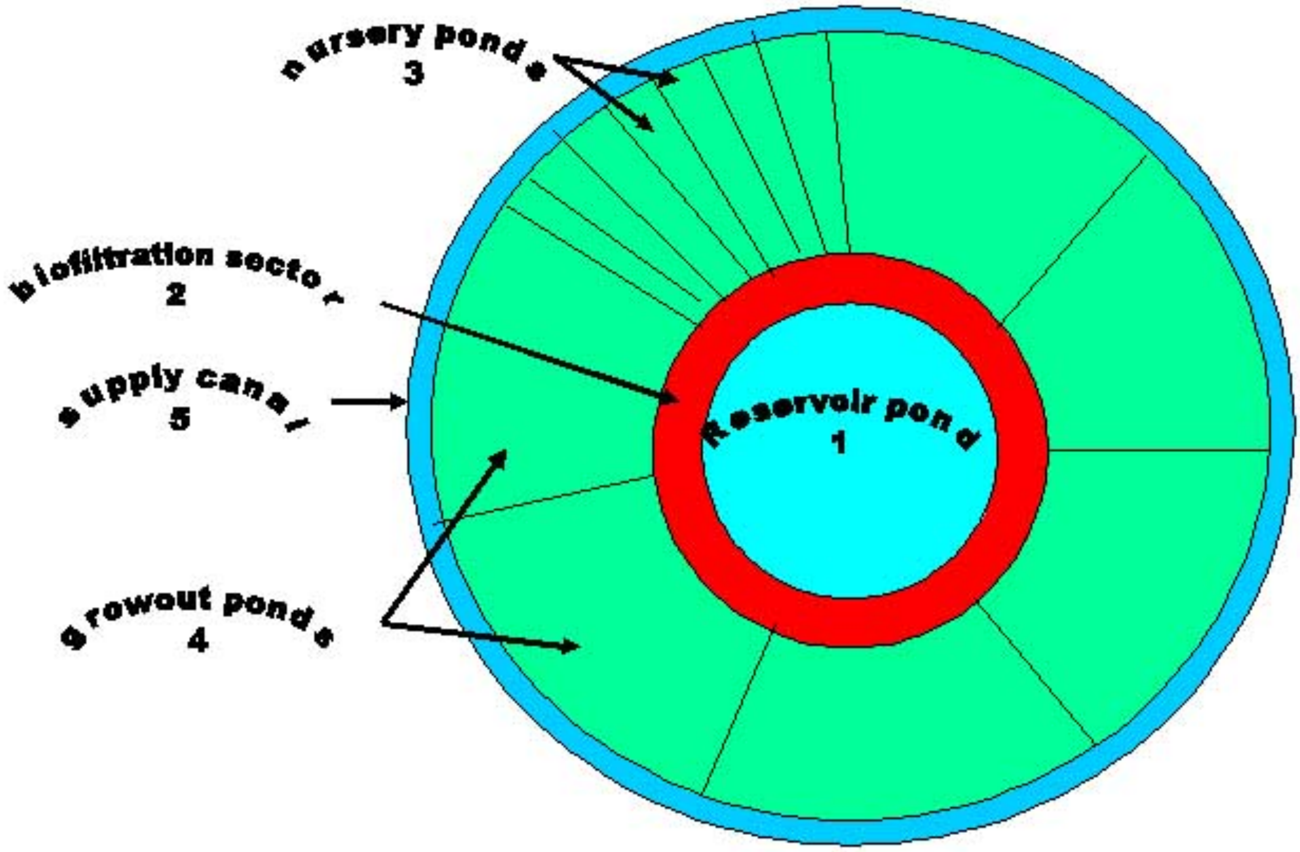


Figure 2: Recirculation prawn farm design, after Robertson, 2001, Figure 2.

A


nursery ponds
3
biofiltration sector
2
supply canal
5
growout ponds
4
Reservoir pond
1

B

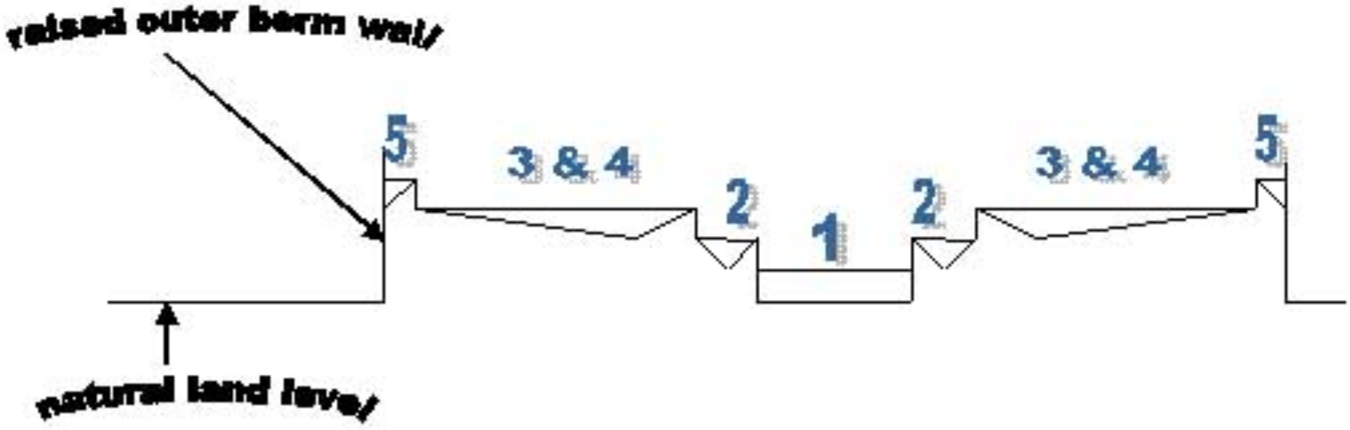

raised outer berm wall
5
3 & 4
2
1
2
3 & 4
5
natural land level

Figure 3: A. Overhead view of diagram showing integrated recirculation farm. B. Side view of integrated recirculation farm.

ponds, 4). The water then flows out of the pond to a lower level (2) where the particle filtration comes first, then the biofiltration. Finally, the clean water then overflows to the lowest level, the reservoir pond (1) and is ready to be pumped up again to the supply canal (5). If new water is needed in the system, it may be pumped from a nearby source to one of the growout ponds with its water flow turned off; there the water will be chlorinated and left to dechlorinate by sunlight and aeration before being flowed through in the closed system. Not all situations would require a closed system, and there may be modifications based on this idea which includes flow-through of outside water unless conditions deteriorate due to seasonal rain or high sediment loads. Fish culture in ponds would also be suited to this design. There is a wealth of information available today on aquatic recirculation systems, and this may vary from a simple system to highly technical systems for the fine control of the water quality.

Now, let us turn to another major group of aquacultured organisms: the bivalve molluscs. The voices of protest which stem mainly from crustacean culture have less to find wrong with bivalve culture, for bivalves filter phytoplankton from the water and turn it into quality edible protein. However, there are cases where the density of bivalves in the water column is too high and the faeces and pseudofaeces produced are prolific. If the site does not have sufficient water movement, then the bottom substrate can become anoxic from the continual rain of sediments down from the floating culture systems. When this is the case with pearl oyster culture the quality of the pearls produced can deteriorate. The simple rules of not allowing densities to be too high and rotational ‘crop’ movement of longlines or rafts similar to that in agriculture will help to maintain a healthier environment. There are special bivalve molluscs such as the giant clams which contain symbiotic dinoflagellate algae (zooxanthellae similar to corals) within their greatly expanded mantle tissue. Thus, they can be termed a Solar Animal. Although harvesting of cultured clams may require as many years as it takes to set up a tropical fruit tree farm, the production rate can be astounding. The largest species, Tridacna gigas, was found to produce 29 tonnes / ha of wet tissue (Barker et. al, 1988), and the second largest species, Tridacna derasa, produced 22 tonnes / ha of wet tissue (Heslinga and Watson, 1985) [see Figure 4]. This is a high production rate when compared with traditional cattle production on the land, and there is basically no feeding of these organisms. These giant clams may have a future as essential travelers with humans in a futuristic moon base (see further information on this at www.aquasearch.net.au).

Figure 4: Intertidal giant clam culture (Tridacna gigas) at James Cook University's Orpheus Island Research Station, north Queensland, Australia (above), and culture of Tridacna derasa on raised racks off the lagoon bottom at Aitutaki atoll, Cook Islands, South Pacific.

Where possible, polyculture of several species together will result in the greatest benefits. There is a reduced chance of disease epidemics compared with monoculture situations. Mid-water plankton feeders, herbivores, and detrital feeders all in one pond system will create a simple ecosystem to help maintain the water quality needed for the optimal growth of all species involved. Mullet and prawns may be suitable together, and the effluent water from the pond may run into an effluent canal which is stocked with oysters. The oysters filter microalgae from the water column, cleaning the effluent water before it goes to a settlement pond and then back to its origin (e.g. estuary, ocean).

A Code of Conduct for aquaculture has been produced by FAO (United Nations) to assist governments to help promote a safe and responsible sector for their nations. A Code of Best Practice is more specific than the Code of Conduct as it gives recommended procedures to use at the farm level for the purpose of industrial responsibility (Ackefors and White, 2002). As aquaculture boasts a great diversity of species and culture systems Codes of Best Practice will need to be prepared for each commercial operation. The future of aquaculture will be bright when everything is done right.

REFERENCES

Ackerfors, H., and P. White. 2002. A framework for developing best environmental practices for aquaculture. World Aquaculture 33(2):54-59.

Barker, J.B., Crawford, C.M., Shelley, C.C., Braley, R.D., Lucas, J.S., Nash, W.J., and S. Lindsay. 1988. Ocean-nursery technology and production data for the giant clam Tridacna gigas. pp. 225-228, In, Copland, J.W. and Lucas, J.S., eds. Giant Clams in Asia and the Pacific. Australian Centre for International Agricultural Research (ACIAR), Canberra, ACIAR Monograph No. 9, 274 pp.

Heslinga, G.A., and T.C. Watson. 1985. Recent advances in giant clam mariculture. Proceeding of the Fifth International Coral Reef Congress 5:531-537.

Robertson, C.C. 2001. International advances in prawn farm recirculation technology – design principles and efficiency of treatment systems. Department of Primary Industries, Queensland. Information Series QO01008, 76 pp.