AQUACULTURE IN BATTICALOA

WHY AQUACULTURE ?

- Capture Fisheries declining
- World demand for Sea Food Increasing
- High Economic Benefit per unit Land Area
- Increased income generation
- Direct and Indirect Employment Creation
- Utilization of Available Resources
- Adding New Economic Activity

RESOURCES REQUIRED FOR AQUACULTURE

- Land
- Fresh Water for Inland Aquaculture
- Sea Water & Brackish Water for Coastal Aquaculture
- Fish or Shrimp Fry
- Feed
- Power/Electricity
- Skilled and Unskilled Workers

ARE THE ALL RESOURCES AVAILABLE IN BATTICALOA ?

YES

THEN WHY NOT SUPPORT ?

- The People are still believing the traditional Agricultural Farming
- Not willing to Change
- Wrong or Bad news from other districts
- Unwanted Fear Created by Various Groups
- Social Barriers
- Shortage of Technical People
- Awareness of the Economic Benefits are less

COMPLAINTS?

- Paddy Farmers – Salt Water will spoil their cultivation
- Fishermen – Their fishing activity can be disturbed.
- Society- The drinking water can get contaminated, grazing land is exploited and outsiders coming to their area thus affecting the traditional cultural values.

SALINATION OF PADDY LAND

- Due to the silting of lagoon, the salt water penetration to the paddy land area increasing year by year.
- Over Extraction of fresh water from the wells also bring the salt water to the paddy lands.
- There are no flood prevention bunds are constructed in most of the Areas.

How to Mitigate?

- **Salt water prevention bunds with proper sluice Gate System can be constructed to safeguard the paddy lands get contaminated with salt water during floods. This will also helps to reduce the siltation of lagoon**
- **Proper drainage systems – A BUFFER CANAL can be designed between Shrimp Farms and the Flood prevention bunds to drain the salt water back to the lagoon**

How to Mitigate?

- Allocate the land which are not suitable for any form of Agricultural Activities with proper buffer zones.
- Allocate necessary pathways and landing areas for fishing activities

HOW TO IMPROVE PRODUCTIVITY OF PADDY LAND?

- Cultivate High Yielding Saline Paddy varieties
- Using Paddy Land as grazing area for Cattle during the off season
- Paddy Farming with Shrimp and Fish as Indian Model – Pokkali Farming

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Shrimp, fish and paddy cultivation in same field is lucrative

M. J. PRABU

POKKALI FARMING SYSTEM

Pokkali farming is a system in which paddy and shrimp are grown alternately in the same field.

POKKALI

- A TRADITIONAL VARIETY OF PADDY
- CONSIDERED AS ORGANIC PADDY
- ORGANIC FERTILIZERS ARE USED
- NO NEED OF ARTIFICIAL FERTILIZER
- USED AS MEDICIANAL RICE
- GOVERNMENT PURCHASE AT RS 70.00 PER BU UNDER THE SPECIAL SCHEME
- GROWING IN HIGH SALINE AREA

POPULAR VARIETIES OF PADDY

VARIETIES	AGE (MONTHS)	AVERAGE YIELD (Bu/Ac)	COST OF PRODUCTION (RS)	SELLING PRICE (RS)	GROSS INCOME (RS)
BG 352	3.5	100 -120	35000 -40000	28	57000-68000
BG 94 -1	3.5	100 -120	35000 -40000	28	57000-68000
BG 300	3.0	100 - 120	35000 -40000	28	57000-68000
BG 369 (SALT TOLERANT)	3.5	100 - 120	35000 -40000	28	57000-68000
AT 354 (SALT TOLERANT)	3.5	80 - 100	35000 -40000	28	57000-68000
POKKALI (SALT TOLERANT)	4.0	40 -50	25000-35000	50-70	45000-60000

SUSTAINABLE AQUACULTURE

- Hi Tech Aquaculture Practices have been introduced for Sustainable Aquaculture.
- New Environmental Mitigation methods are introduced in Aquaculture to Safeguard other Sectors.
- Puttalam Shrimp Farming has been Re organized by NAQDA with the Collaboration of SLADA (Sri Lanka Aquaculture Development Alliance) An Aquaculture Industry Association formed by the various stake holders of the Industry.

GRADING OF PRAWN FARMERS IN TO THREE FARMING SYSTEMS –NWP

- GRADE A – CLOSED SYSTEM
- GRADE B – SEMI CLOSED SYSTEM
- GRADE C – OPEN SYSTEM

PRAWN FARM OPERATIONAL ZONES – NWP

ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
NEGOMBO TO CHILAW	CHILAW TO UDAPPUWA	UDAPPUWA TO PALAVIYA	PALAVIYA TO KALPITIYA	PUTTALAM TO WANATHAWI
Negombo/Waik	Bangadeniya	Poonaip/Wattaw	Karambe	Sevantivu
Thalwilla	Kusala/Kottage	Kotantivu	Mampuri/Ethala	Manativu
Madampe	Wairankattuwa	Mangalaeliya	Puwarasakuda	Annakutti/Malay
Thoduwawa/Irra	Bohawitiya	Madurank South		Mee Oya
Kakkapalliya	Naguleliya	Madurank/Semb		Wadathamu/Sam
Ambakkandawila	Muthupanthiya	Pulithiwayal		Wanathawilluwa
Marawilla/Sudu	Pinkattiya	Palaviya		
Wattakalliya/Jaya	Pulichakulam			
	Udappuwa			

PRAWN FARM OPERATIONAL PROGRAM - NWP

PERIOD	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
JANUARY					
FEBRUARY					
MARCH					
APRIL					
MAY					
JUNE					
JULY					
AUGUST					
SEPTEMBER					
OCTOBER					
NOVEMBER					
DECEMBER					

HIGH RISK PERIOD

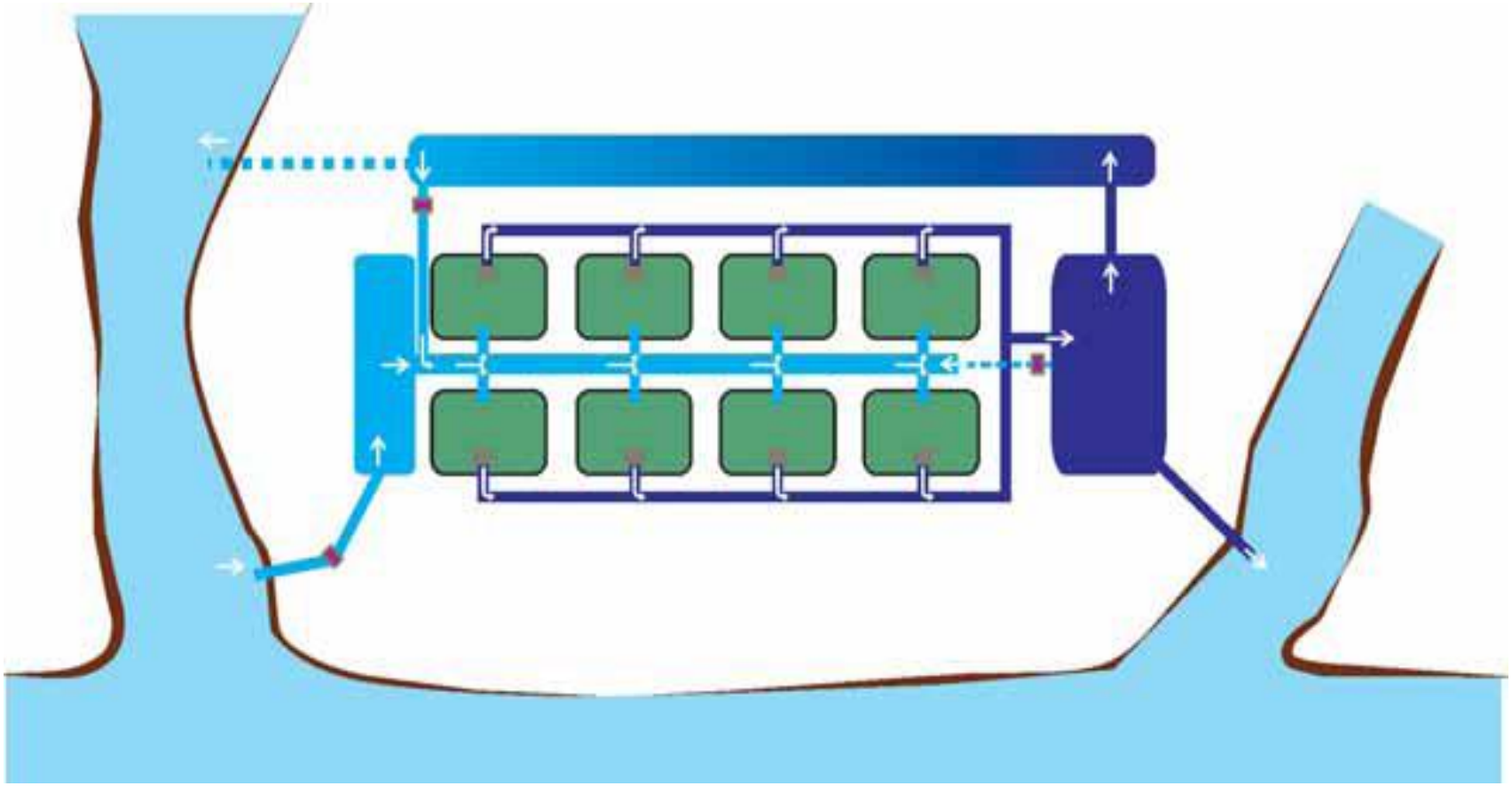
RISK PERIOD

FAVORABLE PERIOD

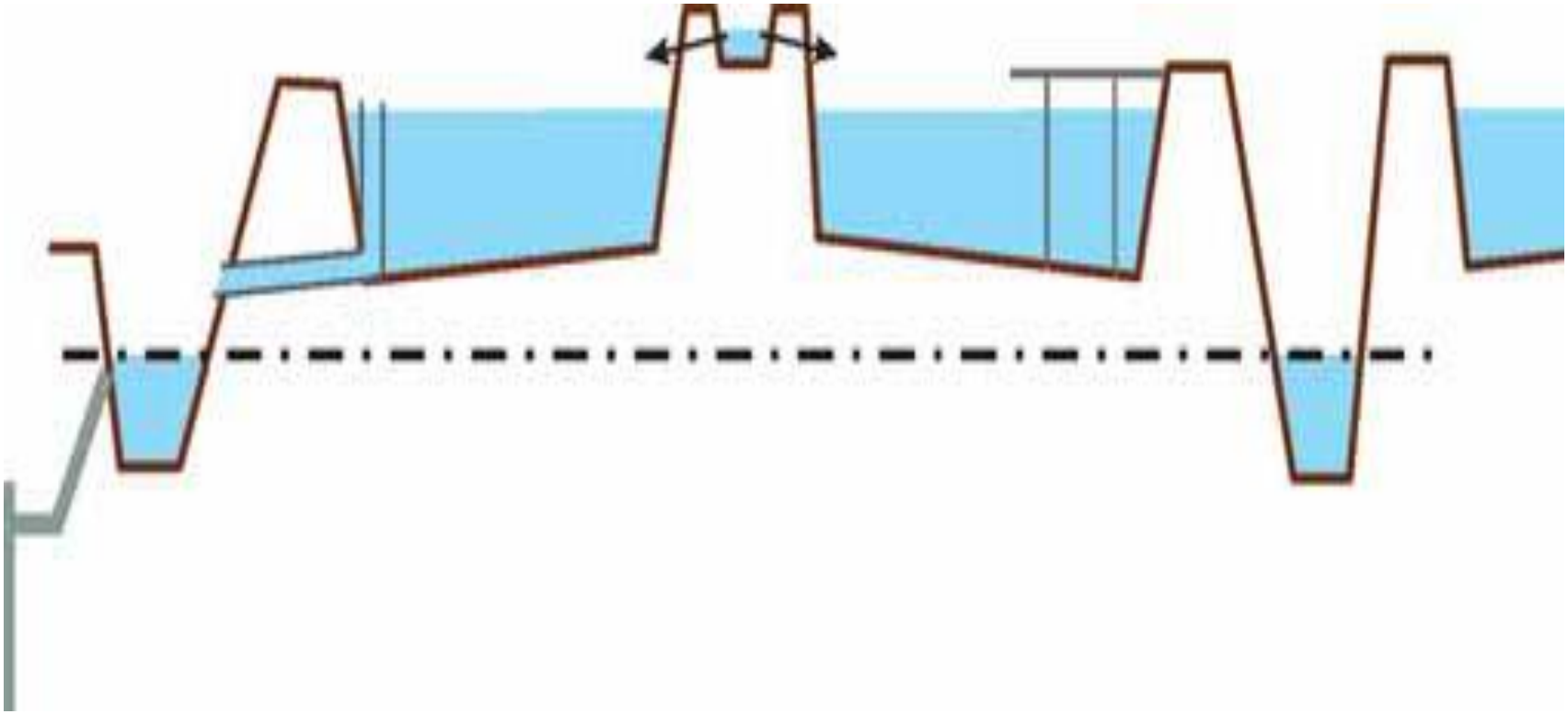
NWP - ZONAL INFORMATION FOR ONE YEAR

PERIOD	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	PL'S (Mn)	PRODN (MT)
JANUARY						30	300
FEBRUARY						40	450
MARCH						35	400
APRIL						10	320
MAY						20	400
JUNE						20	650
JULY						15	550
AUGUST						10	350
SEPTEMBER						14	350
OCTOBER						25	350
NOVEMBER						43	250
DECEMBER						25	100
					TOTAL	287	4470

20 ACRE PRAWN FARM DESIGN



CROSS SECTION OF THE PRAWN FARM



ECONOMICS
OF
FIVE(5) ACRE
SHRIMP FARM

FARM DESIGN & OPERATION ASSUMPTIONS

DETAILS	UNIT	
Farm Land	Acres	5
Average Grow out Pond Area	Sq M	3000
Storage Pond	Sq M	3000
Sedimentation Pond	Sq M	2000
Grow out Ponds	Nos	3
Storage Pond	Nos	1
Sedimentation Pond	Nos	1
6" Submersible Water Pumps with Accessories	Nos	1
1 Hp Paddle Wheel Aerators with Accessories	Nos	6
30 KVA Power Generator	Nos	1
30 Amp Main Power Supply	Nos	1
Administrative and Stores Building	Nos	1
Staff Quarters	Nos	1
Generator Building	Nos	1
Internal and Access Roads	Nos	1

TECHNICAL/MANAGEMENT ASSUMPTIONS

DETAILS	UNIT	QUANTITY
Post Larvae (Fry) Stocking Density	Pls/Sq. M	20
Survival rate at Harvest	%	75
Feed Conversion Ratio (FCR)		1.5
Lime/Dolomite/Pond/Crop	Kg	2000
Fertilizers/Pond/Crop	Kg	30
Water Exchanges	%/Day	10
Culture Period	Days	130
Pond Preparation/Drying Period	Days	60
Average Size at Harvest	g	30
Farm Supervisor	Nos	1
Skilled Workers	Nos	2
Unskilled Workers	Nos	2

FINANCIAL ASSUMPTIONS

DETAILS	UNIT	VALUE (RS)
Market Price for 30 g Prawns	Kg	900.00
Post Larvae (Prawn Fry)	Nos	0.75
Prawn Feeds	Kg	240.00
Lime/Dolomite	Kg	10.00
Fertilizer	Kg	100.00
Salary - Supervisor	Per Month	20,000.00
Salary - Skilled Worker	Per Month	18,000.00
Salary - Unskilled Worker	Per Month	15,000.00
Staff Welfare per Staff	Per Month	3,000.00
Electricity/Fuel per Pond	Per Crop	50,000.00
Pond Preparation Expenses per Pond	Per Crop	30,000.00
Repairs and Maintenance per Pond	Per Crop	10,000.00
Transport Expenses per Pond	Per Crop	5,000.00
Harvest Expenses per Pond	Per Crop	20,000.00
Bio Security Measures Per Pond	Per Crop	15,000.00
Probiotic Bacterial Cultures per Pond	Per Crop	20,000.00
Land lease Rental per Acre	Per Year	5,000.00
Licenses & Approvals per Acre	Per Year	2,000.00
Misc. Expenses per Pond	Per Crop	5,000.00

CAPITAL INVESTMENTS FOR 5 ACRE SHRIMP FARM

DETAILS	UNIT	UNIT VALUE(RS)	TOTAL VALUE (RS)
Land Clearance and Approvals	1	30,000.00	30,000.00
Grow out Pond Construction	3	150,000.00	450,000.00
Storage Pond Construction	1	150,000.00	150,000.00
Sedimentation Pond Construction	1	100,000.00	100,000.00
Water Supply &Drainage Systems	1	150,000.00	150,000.00
Inlet/Outlet Structures	5	100,000.00	500,000.00
6" Submersible Pumps with Accessories	1	150,000.00	150,000.00
1 Hp Paddle Wheel Aerators with Accessories	6	80,000.00	480,000.00
30 KVA Power Generators	1	200,000.00	200,000.00
30 Amp Main Power Supply	1	100,000.00	100,000.00
Internal Electrical Wiring and Accessories	1	100,000.00	100,000.00
Other Equipment	1	25,000.00	25,000.00
Administration and Stores Building (Semi Permanently)	1	50,000.00	50,000.00
Staff Quarters (Semi Permanent)	1	50,000.00	50,000.00
Generator Building	1	25,000.00	25,000.00
Internal and Access Roads	1	25,000.00	25,000.00
TOTAL CAPITAL INVESTMENTS			**2,585,000.00**

WORKING CAPITAL FOR 5 ACRE PRAWN FARM

DETAILS	UNIT	UNIT VALUE(RS)	TOTAL VALUE (RS)
Pond Preparation	3	30,000.00	90,000.00
Post Larvae Prawn Fry)	180000	0.75	135,000.00
Prawn Feeds (180000*0.75*30g*1.5)	6075	240.00	1,458,000.00
Lime/Dolomite	6000	10.00	60,000.00
Fertilizers	90	100.00	9,000.00
Salary - Supervisor	6	20,000.00	120,000.00
Salary - Skilled Worker	12	18,000.00	216,000.00
Salary - Unskilled Worker	12	15,000.00	180,000.00
Staff Welfare	30	3,000.00	90,000.00
Electricity/Fuel	3	50,000.00	150,000.00
Repairs & Maintenance	3	10,000.00	30,000.00
Transport Expenses	3	5,000.00	15,000.00
Harvest Expenses	3	20,000.00	60,000.00
Biosecurity Measures	3	15,000.00	45,000.00
Probiotic Bacterial Cultures	3	20,000.00	60,000.00
Land Lease Rental	5	5,000.00	25,000.00
Licenses & Approvals	5	2,000.00	10,000.00
Misc. Expenses	3	5,000.00	15,000.00
TOTAL WORKING CAPITAL REQUIREMENTS			**2,768,000.00**

PROFITABILITY FOR ONE CROP

Shrimp Harvest Income:	**Rs 3,645,000.00**
Operational Expenses:	Rs 2,768,000.00
Profit from one Crop:	**Rs 877,000.00**

INVESTMENT SUMMARY

Capital Investments:	**Rs 2,585,000.00**
Working Capital:	**Rs 2,768,000.00**
Total Investments:	**Rs 5,353,000.00**
Profit for One Year: (Two Crops per Year)	**Rs 1,754,000.00**
Return on Investment:	**33%**
Pay back Period:	**03 Years**

05 ACRES LAND – OUTCOME FOR ONE YEAR?

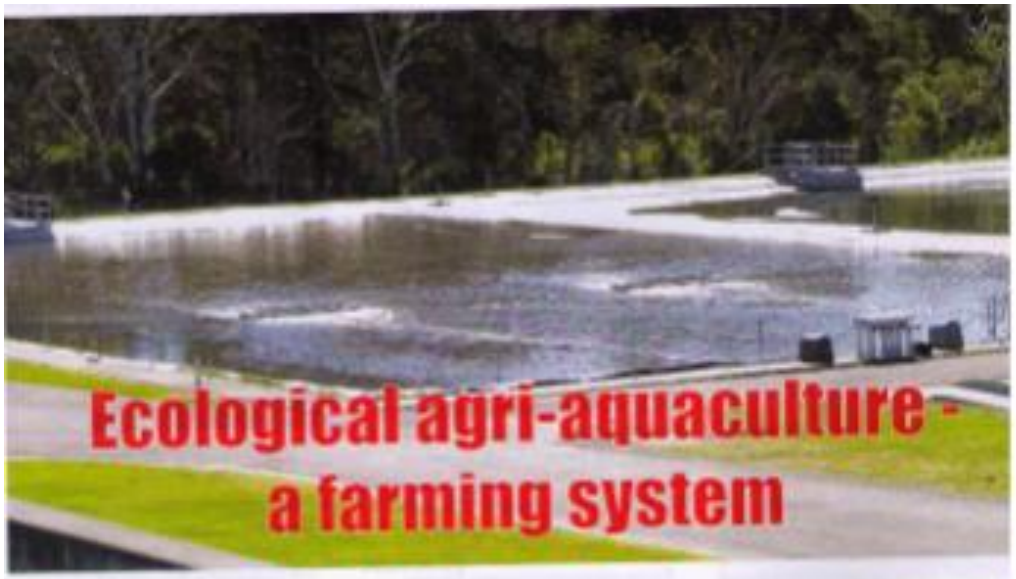
INDICATORS	PADDY FARMING	SHRIMP FARMING
GROSS INCOME	RS 300,000.00	RS 7,290,000.00
NET PROFIT	RS 100,000.00	RS 1,754,000.00
MONEY CIRCULATION IN THE AREA	RS 150,000.00	RS 4,500,000.00
FOREIGN EXCHAGE EARNING	NO	YES
FULL TIME EMPLOYMENT	1	5
DIRECT EMPLOYMENTS FOR GRADUATES	NO	YES

ARE WE SHIFTING TO SHRIMP FARMING ONLY?

NO

WE HAVE TO DEVELOP SHRIMP FARMING AS AN ADDITIONAL ECONOMIC ACTIVITY IN AN AREA TO INCREASE THE INCOME FROM UNUTILIZED RESOURCES WITHOUT AFFECTING THE PRESENT INDUSTRIES

THANK YOU



Ecological agri-aquaculture - a farming system

The author, an experienced fishery professional, has designed a farming system that grows aquatic organisms without any waste. The modified approach for sustainable integration of different crops seems to be viable methods for mass production with fewer inputs.

Mong Heng So

Traditionally, aquaculture in developing countries is focused on growing high value products like shrimps and prawns mainly for export to earn the elusive foreign exchange. From time to time diseases, environmental, economic and social problems had made this industry ecologically unsustainable and economically vulnerable. It seems strange but true, conventional aquaculture producing exotic food is indirectly perpetuating several problems in developing countries. Thousands of hectares of farm land have been laid waste as a result of land salinization, diseases and ecological imbalance in their efforts to harvest more and more by indiscriminate use of these precious resources.

Future of land based aquaculture in developing countries?

The answer is in **ecological agri-aquaculture (EAA)**, an integration of agriculture and aquaculture to intensify food and nutrient production by using less land, water, energy and feed to produce more as marine fisheries and many aspects of conventional agriculture are reaching the plateau of productivity. Ecological agri-aquaculture has the potential to produce more aquatic meat, grains, vegetables, by-products and jobs with significantly less inputs than any conventional agriculture or aquaculture enterprises. It can produce enough food by using innovative aeration to integrate and intensify aquaculture and agriculture.

EAA is a variation of 'Integrated Multi-Trophic Aquaculture' (IMTA). Instead of poly-culture in the same habitat, the selected trophic organisms are cultivated in isolation in a series of separate small pond compartments (ecological niches) but contained in the same habitat. In place raceways, series of recirculating circu ponds are aerated and the water discharged continuously from one pon the other with an innovative aeration system that pumps, mixes, aerates, equalises and recirculates water with one low power machine. Diseases an pollution are isolated in each module. Different species of trophic organisms grown in separated pond compartmen assimilate the by-products and recycl water for further use.

EAA is centred on using an effectiv proprietary Aeralif aeration system to intensify the production system. Configuration of Aeralif aeration is bas

Case study

Feasibility of converting 5 ha of poor paddy land into eco-agri-aquaculture.

Site selection

- Easily adaptable to improve productivity of poor tropical paddy land.
- Must have good source of unpolluted water.
- Can also use flat unproductive land with reliable power supply.

Land utilisation

Main species-*Pangasius sutchi*	32 x 110 cum ponds at 1.0m depth	0.35 ha
Others-*M rosenbergii* and *Lemna* sp	32 x 110 cum ponds at 1.0m depth	0.35 ha
Agriculture	Rice/Arecha/ Coconut/Bamboo	3.0 ha
	M oleifera/vegetables	0.3 ha
Reservoir	100m x 100m lined pond at 1.0m depth	1.0 ha

Estimated per annum water consumption

1. Aquaculture	0.7 ML
2. Agriculture	6.3 ML

Estimated energy consumption whereas operation of this model could be achieved using conventional pumps and aeration equipment, the following costing assumptions are made using a new, proprietary technology that integrates pumping, aeration, mixing, aqualining and circulation into one unit. The Aeraliff aerator achieves measurably better performance in both moving and aerating water using significantly less energy than conventional methods. 12 Aeraliff aerators operating 24 hours per day, 365 days per year at US$ 0.25 per Kwhr equates to US$ 26 280 per annum.

- Capacity to withstand intensive culture, adverse grow-out conditions and disease infection.
- Impact on adjoining land.
- Low potential environmental impact, where fingerlings are prone to external predation.
- Even escapees will find it hard to survive, breed or invade the new environs.
- Easily planned for daily/weekly harvest to achieve excellent cash-flow.

Design for *P sutchi* and *M rosenbergii*

Pangasius matures within 2-3 years. A female weighing 4-5kg can produce up to 500 000 eggs per spawning. EAA system can simulate a flowing river system to induce *P sutchi* to spawn naturally without hormone induction. From the 3rd year onwards each farm can selectively domesticate its own brood stock to breed a better generation. Pangasius feeding behaviour is like eels but it needs a lower the intensity of production and oxygen requirement of the selected fish species. Placement of the Aeraliff system is very flexible to enable it to operate safely without causing physical damage to the fish with any moving parts. Energy, operating and maintenance costs are significantly lower. Business risk is mitigated through greater diversification.

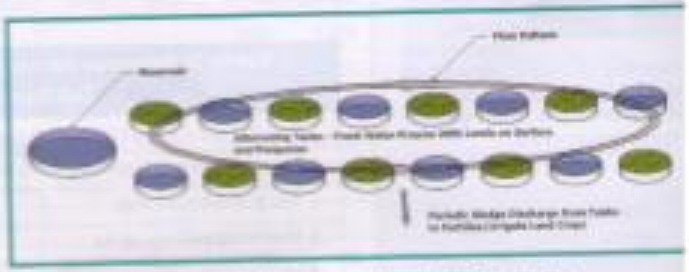
In the cited case study pangasius is chosen as main crop, to be fed with organic by-products derived from agriculture and marine fisheries industries. The entire used water is recycled to the second pond which is stocked with *M rosenbergii* (Freshwater Giant Prawn) to assimilate the uneaten and undigested feed. The metabolic wastes are absorbed by the Lemna plants floating on the surface. It also forms a shade to prevent excessive phytoplankton bloom. Lemna is also a feed resource. From time to time the effluent/sludge in these ponds will be discharged to fertilise and irrigate paddy, plantation and vegetable crops.

Pangasius is chosen from more than 200 domesticated freshwater fishes, from around the world, for the following characteristics:

- Good consumer preference - flesh is boneless; white meat for versatile cooking.
- High fecundity, fast growing and adaptable to tropical conditions.
- Can be bred naturally without hormones, using the EAA system to simulate river conditions.
- A voracious omnivore that could efficiently convert agri/fisheries

Table 1: Capital expenditure (CAPEX) [all figures in US$]

Particulars Year 1	Amount
1.Land lease@500/ha/x5	2 500
2.Construction of 4 modules x 16 above-ground ponds@2 000 each	124 000
3.Construction of 1ha lined reservoir	20 000
4.Aeration equipment	12 000
Total	**158 000**



A single model of above ground ponds in an EAA system.

protein diet that could be easily formulated on site to keep track of what organic food had been given to maintain feed traceability. The by-products and the leftover food are released into the next pond to feed the *M rosenbergii* thus reducing the organic bulk. Lemna (Duckweed) is grown to cover the surface of this pond to reduce metabolic toxicity and concurrently produce a fresh feed supplement for the Pangasius. A unique aeration system is provided to pump, mix, aerate, equalise and recirculate each pond alternately.

Risk mitigation

- Breed fish naturally without hormonal induction,
- Use aeration instead of land and water

Table 2: Operating and management expenses (OMEX) [all figures in US$]

Particulars	Amount
1. Aqua farm maintenance-erosion, bund repairs	-
3. FW Prawn seed @30/m2 x110 x32 =105 600 pcs x2crops x0.03/juvenile	6 336
4. Fish / pangasius @30/m2 x110 x32 =105 600 pcs x2crops x0.06/fingerling	12 672
5. Agriculture: paddyx3ha	1 500
6. *M oleifera* @0.30 x5 000 plants	1 500
7. Poultry/ vegetables-subsistence	300
8. Coconut trees	300
9. Clump bamboo	300
10. Pangasius feed@211 (200kg x0.95/SR x2/FCRx0.35)	140 448
11. Power/fuel @12kw x24hrs x365 days x 0.25=26 280+3 720	30 000
12. Salaries/wages@5 workersx2 500 (1 supervisorx6 000)	18 500
13. Certification charges	-
14. Artificial fertilisers/ chemicals/ pesticides /antibiotics	-
15. Pond preparation, sludge removal/disposal/liming charges	-
16. Harvesting expenses-paddy	1 000
17. Contingencies	7 144
Total	**220 000**

Table 3: Revenue for eco agri-aquaculture farming [all figures in US$]

1. Pangasius @ 211 200 kg x SR (Survival ratio) 1:0.95 x 1.2 selling price	200 600	240 768
2. FW prawns @ 211 200 juveniles x SR 1:0.90 x 45 gm x 6.50	8 553	55 598
3. Rice @ 15 000 kg x 2 crops	30 000	18 000
4. *M oleifera* @ 4 000 kgs 1.0 / kg	4 000	4 000
Total		**318 366**

to intensify production,
- Use aeration to bio remediate ponds like rivers instead of chemical treatment to reduce pollution,
- The tanks are independent of soil conditions and their placement therefore can avoid using environmentally sensitive land to reduce exposure to cross-contamination
- Used water is recycled and purified ecologically
- Zero discharge of effluent and sludge to uncontrolled external environs and waterways,
- Phytoplankton bloom is reduced by more than 80 percent,
- Built in integrated pest management to exclude terrestrial and aerial pests,
- Easy to harvest, depurate and purify the products without associated 'geosmin' odour,
- Small grow-out ponds facilitate daily/weekly harvest instead of seasonal harvest meaning thereby better cash-flow.
- Diversification to reduce risk – Aquaculture: (1) Pangasius (2) Freshwater Prawn (3) Duckweed Agriculture: (1) Rice (2) Vegetables (3) Poultry–biological control (4) Plantation crops-coconut, drumstick, bamboo.

Table 4: Estimated profitability of eco-agri-aquaculture [all figures in US$]

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
CAPEX					
1. Lease, ponds, reservoir, equipment	158 000				
2. Pangasius hatchery, equipment			30 000		
Total	158 000		30 000		
OMEX					
1. Total variable costs	220 000	225 000	210 000	230 000	230 000
Annual production by weight (kg)					
1. Pangasius	200 000	210 000	220 000	220 000	220 000
2. FW Prawns	8 500	9 000	9 500	9 500	9 500
3. Rice	30 000	30 000	30 000	30 000	30 000
4. *M oleifera*	4 000	8 000	16 000	20 000	20 000
5. Coconut-by pieces	-	-	-	3 000	6 000
6. Pangsius fingerlings				500 000	500 000
Sales Revenue					
1. Pangasius	240 000	252 000	264 000	264 000	264 000
2. FW Prawns	55 000	58 000	62 000	62 000	62 000
3. Rice	18 000	18 000	18 000	18 000	18 000
4. *M oleifera*	4 000	8 000	16 000	20 000	20 000
5. Coconut				3 000	6 000
6. Pangasius fingerlings				30 000	30 000
Total	317 000	336 000	360 000	397 000	400 000
Less OMEX variable costs	220 000	225 000	210 000	230 000	230 000
Total gross profit	97 000	111 000	150 000	167 000	170 000
Less CAPEX	158 000		30 000		
Cumulative gross profit/cash-flow	***(61 000)***	***50 000***	***170 000***	***330 000***	***500 000***

Conclusion

Ecological agri-aquaculture like *permaculture* is a matter of emulating Natural Designs. It is so flexible to implement that similar designs can be used in land based marine aquaculture. Marine ecosystem can likewise be adapted for land based situations without polluting the oceans. Many organisms can be adapted for EAA. In this case the river flow system is brought into the farm yard where water is conserved and it's used optimised; and riverine species are intensively cultured. EAA is so incredibly efficient that in an aquatic area of about half a hectare more than 200 000 kgs of aquatic meat can be produced seemed out of this world but it is real.

Mr Mang Heng Soo has practiced aquaculture for around 40 years and now actively using the described system in his farm.