

## Policy Imperatives for Sustainable Aquaculture Development in Asia: Lessons from Bangladesh, the Philippines and Thailand

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### 1. INTRODUCTION

Sustainable development of aquaculture is of major importance to many Asian countries as it is vital in bridging the widening gap between the demand and supply of fishery products, in the face of declining capture fisheries' production and a rapidly growing population in Asia. It is a key player in generating substantial foreign exchange earnings, which are crucial to national economies, and it is a major source of income and employment, instrumental to poverty alleviation in the region.

In recent years, remarkable progress in the generation of aquaculture technology has been achieved in many Asian countries. However, empirical evidence from the crop sector suggests that the final outcome of technological improvement depends equally on the policy and institutional environments within which it is introduced. To identify policy measures that are needed to promote sustainable broad-based aquaculture development, a clear understanding of the key issues is required. First, rapid and sustainable development of the aquaculture sector means the aquaculture system has to be able to expand output at a rate significantly higher than population's expansion rate and this growth in aquaculture has to be maintained over a relatively long period of time. Second, broad-based development means equitable development, implying that resultant benefits of the development process will be widely distributed. The types of policies needed to achieve these goals should be able to:

- Foster the efficient and sustainable use of resources, leading to a high level of output per unit of resource; and
- Promote growth-oriented, equitable aquaculture systems.

The main objective of this paper is to identify an appropriate policy framework for the development of aquaculture and its contribution to overall economic development. The second section of this paper examines the performance of aquaculture sector in Bangladesh, the Philippines and Thailand. These three countries represent diverse technological, socio-economic and institutional environments. The third section discusses aquaculture policy in these three countries whilst the fourth section attempts to identify policy measures needed for sustainable aquaculture growth in Asia. Concluding remarks are given in the final section.

### 2. AQUACULTURE IN BANGLADESH, THE PHILIPPINES AND THAILAND

#### 2.1 Production

Despite limited time-series production data, there is apparently exponential growth in fishery products from aquaculture in Bangladesh, the Philippines and Thailand. In Bangladesh, total production from ponds, baors (oxbow lakes) and shrimp farms registered an upward trend at a yearly growth rate of 9% from 1983/84 to 1992/93 (Table 1). Expansion in production came mainly from shrimp farms with yearly growth rates of 15%. Annual growth rates of 8% and 11% were recorded for ponds and baors, respectively. Bangladesh aquaculture could have achieved a higher growth rate if ponds had maintained their share of total production. This production declined from 92% in 1983/84 to 84% in 1992/93, whereas that of baors and shrimp farms increased from 0.7% to 0.9% and 7% to 15%, respectively. This implies that a new pattern of resource use in favor of shrimp

farming is emerging in Bangladesh as there has been a substantial growth of 20% in its share of total production, compared with only 2% for baors and a negative 0.8% for ponds. The coefficients of variation (C.V.) of volume of production from these sources are considered high (26% for ponds; 38% for baors; and 40% for shrimp farms), indicating relatively high production instabilities, especially for shrimp. Carps are the major species cultured in ponds. About 73% of pond production comes from the three major carp species i.e. rohu (*Labeo rohita*), catla (*Catla catla*) and mrigal (*Cirrhinus mrigala*) in 1992/93 (Choudhury, 1995).

Table 1. Annual production (tonnes) of fish from inland culture fisheries in Bangladesh, 1983/83-1992/93

Year	Ponds		Baors		Shrimp Farms		Total Quantity
	Quantity	%	Quantity	%	Quantity	%	
1983/84	107.9	92.24	0.9	0.74	8.2	7.02	117.0
1984/85	111.6	90.11	1.0	0.78	11.3	9.11	123.8
1985/86	123.8	85.55	1.0	0.67	20.0	13.79	144.7
1986/87	149.2	86.02	1.2	0.71	22.1	13.28	166.1
1987/88	149.4	84.94	1.3	0.71	25.2	14.35	175.9
1988/89	155.0	84.47	1.3	0.72	27.2	14.81	183.5
1989/90	163.7	85.01	1.4	0.7	27.5	14.28	192.6
1990/91	181.0	85.79	1.5	0.73	28.4	13.47	211.0
1991/92	190.0	85.24	1.9	0.85	31.0	13.91	222.9
1992/93	249.7	83.81	2.7	0.92	45.5	15.26	297.9
C.V. (%)	25.50	2.5	37.73	9.72	40.20	19.62	27.42
Growth Rate (%)	8.25	(0.77)	10.91	1.88	15.14	6.11	9.03

Source: Bangladesh Bureau of Statistics.

Total aquaculture production in the Philippines was 772,100 tonnes in 1993, mostly from brackishwater pond culture, freshwater cage, pond and pen culture and mariculture of seaweed and shellfish. This was valued at 30.5 billion Pesos (US\$1.2 billion) in 1993 (BFAR, 1994). Tilapia (*Oreochromis* spp.), milkfish (*Chanos chanos*) and penaeid shrimp are the country's major aquaculture commodities. These species together contributed only 43% to total aquaculture production in 1993, but their value amounted to 86% of the total. Nevertheless, while milkfish production registered an alarming yearly negative growth rate of 3% from 1981 to 1993, penaeid shrimp and tilapia recorded substantial growth rates of 28% and 17%, respectively (Table 2). If these production trends continue, only penaeid shrimp and tilapia will remain the major species for aquaculture in the Philippines.

Table 2. Annual production of selected fish species from aquaculture in the Philippines, 1981-1993.

Year	Tilapia		Milkfish		Prawn		Aquaculture Quantity
	Quantity	(%)	Quantity	(%)	Quantity	(%)	
1981	10.6	3.12	225.0	66.27	1.7	0.50	339.5
1982	11.3	2.88	239.8	61.13	1.8	0.46	392.3
1983	30.8	6.92	238.6	53.61	9.3	2.09	445.1
1984	32.0	6.70	237.7	49.74	26.4	5.52	477.9
1985	43.8	8.85	193.6	39.13	26.5	5.36	494.7
1986	55.8	11.85	179.4	38.10	28.0	5.95	470.9
1987	75.8	13.51	197.5	35.20	32.4	5.78	561.0
1988	75.0	12.51	187.9	31.34	41.5	6.92	599.6
1989	81.7	12.98	192.9	30.65	43.5	6.91	629.5
1990	76.1	11.34	200.9	29.94	47.6	7.09	671.0
1991	76.6	11.06	234.1	33.81	45.7	6.60	692.4
1992	91.2	12.38	171.2	23.25	76.0	10.32	736.4
1993	96.3	12.47	149.0	19.30	86.1	11.15	772.1
C. V. (%)	48.71	36.53	13.76	34.89	68.01	53.89	23.29
Growth Rate (%)	17.29	10.92	(2.58)	(8.95)	28.45	22.90	6.37

Source: Bureau of Fisheries and Aquatic Resources, Bureau of Agricultural Statistics, Manila, Philippines.

Lack of fry or fingerlings remains a perennial problem that constrains the expansion of milkfish production in the country. A reversal in the trend in milkfish production would probably occur if farmers had regular access to fry and fingerlings. A considerable increase in tilapia production is

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expected in the near future, with the Philippines as the leading world producer. Currently, tilapia farming is receiving substantial institutional research support (Pullin *et al.* 1994). Expanding entry into export markets and the high costs of feed and power are the major constraints to the expansion of penaeid shrimp production in the country.

Major aquaculture commodities in the Philippines have posted high production C.V. *i.e.* 14% for milkfish; 49% for tilapia; and 68% for penaeid shrimp. As in Bangladesh, penaeid shrimp production in the Philippines has recorded the highest production instability among its major aquaculture commodities. Nonetheless, total aquaculture production will continue to expand mainly based on its established high growth rate of 6% with a considerably manageable C.V. of 23% from an aquaculture activities perspective.

In Thailand, shrimp culture, mollusc culture and fish culture accounted for 76%, 23% and 1%, respectively, of the total coastal aquaculture production: 295,600 tonnes in 1993. Tilapia (*Oreochromis niloticus*), silver barb (*Puntius gonionotus*), catfish (*Clarias spp.*), catfish (sawai) (*Pangasius sutchi*), sepat siam (*Trichogaster pectoralis*), giant freshwater prawn (*Macrobrachium rosenbergii*) and other fish species accounted for 31, 17, 17, 10, 9, 7, and 9%, respectively, of the freshwater aquaculture production of 142,105 tonnes in 1992 (DOF, 1993). These data indicate that penaeid shrimp, catfish, tilapia and silver barb farming are becoming the major aquaculture activities in Thailand. It is expected that resource use will follow these farming activities unless there is an emergence of new and relatively ecologically friendly species with higher profit potential. There has been a recent inclusion of environmental criteria for the selection of species to culture in Thailand. This may drastically alter the roles of existing species in total aquaculture production. Existing data, however, reveal that Thailand may not yet be ready to alter the relative share of shrimps, catfish, tilapias and silver barb to total aquaculture production.

Table 3. Annual production of selected fish species from aquaculture in Thailand, 1981-1992.

Year	Tilapia	Catfish	Shrimp
1981	5.5	6.1	10.7
1982	7.1	3.5	10.1
1983	12.1	3.0	11.6
1984	7.9	4.6	13.0
1985	15.1	6.4	15.8
1986	18.4	15.8	17.9
1987	17.0	13.9	23.6
1988	18.8	12.6	55.6
1989	21.1	12.4	93.5
1990	22.8	17.9	118.2
1991	28.1	29.1	162.1
1992	43.9	23.8	162.7
C.V. (%)	55.72	63.93	99.68
Growth Rate (%)	15.79	18.87	29.75

Source: Department of Fisheries, Ministry of Agriculture and Co-operatives, Bangkok, Thailand.

Shrimp, catfish, tilapia and silver barb showed considerably high annual growth rates of 30, 19, 16 and 16% from 1981 to 1992, respectively (Table 3). Shrimp, catfish, tilapia and silver barb production had a high C.V. of 100, 64, 56 and 54%, respectively. Although shrimp production has expanded substantially, its production plateaued in 1992 and has posted the highest C.V. (production instability) as in Bangladesh and the Philippines. It is estimated that production of cultured shrimp is now at its maximum level and will not exceed 200,000 tonnes annually (FAO/NACA 1995). Among the major species cultured in Thailand, tilapia and silver barb are the most promising. Tilapia (56%) and silver barb (46%) registered much higher percentage change in production compared to shrimps (only 0.4%) and catfish (a reduction of 18%) from 1991 to 1992.

For Bangladesh, the Philippines and Thailand, although shrimps dominate aquaculture production in these countries, it is an unstable source of growth and development of their aquaculture sector. Shrimp production has registered high C.V. in all countries indicating high production instability and

it is approaching a limit wherein further expansion could result in serious environmental repercussions, threatening even its own sustainability.

## 2.2 Costs and Returns

The profitability of major aquaculture commodities varies within and among Bangladesh, the Philippines and Thailand. These differences can be attributed to variations in: soil and water quality; seed quality; management practices; input use levels; and factor and market prices *vis-à-vis* consumers' preference. In Bangladesh, polyculture of carp species, mostly of the Indian major carps (*Labeo rohita*, *Cirrhinus mrigala* and *Catla catla*) and, to a lesser extent, exotic carps (*Hypophthalmichthys molitrix*, *Ctenopharyngodon idellus* and *Cyprinus carpio*), is the most common freshwater fish culture system. Nile tilapia and silver barb are the major species being cultured in seasonal freshwater ponds while shrimp is cultured in brackishwater ponds. Net profits over variable cost per production cycle per 100 m<sup>2</sup>, as a measure of profitability, shows that carp polyculture ranked first at US\$17; Nile tilapia monoculture, second at US\$13; shrimp farming, third at US\$7; and silver barb (*Puntius gonionotus*), last at US\$6 (Table 4).

Table 4. Costs and returns of selected aquaculture species per 100 m<sup>2</sup> in Bangladesh, 1991/1992.

Item	Carp Polyculture*	Nile Tilapia Monoculture*	Silver Barb Monoculture*	Shrimp Farming**
<b>Return</b>				
Production (kg)	81.69	40.50	38.67	
Value (US \$)	21.08	16.41	10.96	10.06
<b>Cash Costs (US \$)</b>	<b>2.84</b>	<b>1.70</b>	<b>3.68</b>	<b>2.63</b>
Fingerlings	1.61	1.11	2.64	1.29
Lime	0.28	0.34	0.37	-
Inorganic Fertilizer	0.34	0.21	0.30	-
Rice Bran	0.05	-	0.08	-
Oil Cake	0.33	-	0.12	-
Pesticide	0.01	-	0.01	-
Harvesting/ Labor	0.22	0.04	0.16	1.34
<b>Non-Cash Cost (US \$)</b>	<b>0.90</b>	<b>2.12</b>	<b>1.34</b>	<b>-</b>
Cattle Manure	0.46	0.44	0.39	-
Poultry Manure	0.02	0.05	0.02	-
Rice Bran	0.43	1.63	0.93	-
<b>Total Variable Cost (US \$)</b>	<b>3.74</b>	<b>3.82</b>	<b>5.02</b>	<b>2.63</b>
<b>Net Profit Over Variable Cost (US \$)</b>	<b>17.34</b>	<b>12.60</b>	<b>5.94</b>	<b>7.43</b>
Cash Cost / kg Fish (\$/kg)	0.03	0.04	0.10	-
<b>Total Variable Cost / kg Fish (\$/kg)</b>	<b>0.05</b>	<b>0.09</b>	<b>0.13</b>	<b>-</b>

Sources: \*Ahmed *et al.* (1994); \*\*Rahman *et al.* (1994)

Silver barb monoculture had the highest cash cost requirement per 100 m<sup>2</sup> at US\$4 compared with only US\$3, 3 and 2 for carp polyculture, shrimp farming and Nile tilapia monoculture, respectively. A high percentage of cash costs were accounted for by the cost of fry or fingerlings alone across these aquaculture activities. Cost of fry or fingerlings to total cash cost in carp polyculture, Nile tilapia monoculture, silver barb monoculture and shrimp farming amounted to 57, 65, 72 and 49% of the total cash cost, respectively. The share of the feed component (rice bran) to total cash cost was relatively low compared to the cost of fry or fingerlings across these farming activities, however, its share to total variable cost was substantially higher (13% for carp polyculture; 43% for Nile tilapia monoculture; and 20% for silver barb monoculture) if the non-cash cost of the feed component were considered in the analysis.

Manure and rice bran comprised the non-cash cost. These results indicate that those engaged in carp polyculture, Nile tilapia monoculture, silver barb monoculture and shrimp culture in Bangladesh are extensive in terms of low stocking densities and inputs. Apparently, production costs and aquaculture production expansions depend mainly on the availability and price movement of fry and

\* Exchange rate US\$1 = 38 Taka.

fingerlings in Bangladesh. To produce a kilogram of fish under carp polyculture, Nile tilapia monoculture and silver barb monoculture, the fish farmers would incur a cash cost of at least US\$0.03, 0.04 and 0.10 and a total variable cost of US\$0.05, 0.09 and 0.13, respectively. Though capital requirement in extensive shrimp farming is minimal (about US\$3 per 100 m<sup>2</sup>), the costs of semi-intensive shrimp farming are rather high. Fish farmers engaged in semi-intensive shrimp farming have more cash requirements than those in carp polyculture and Nile tilapia monoculture farming.

In the Philippines, tilapia production comes mainly from freshwater culture in ponds and in cages while milkfish and penaeid shrimp are mainly from brackishwater culture in ponds. These commodities are now cultured in semi-intensive mode, except for tilapia in cages, which is cultured in intensive mode. Feed costs were the single major cash cost component of these aquaculture farming activities (Table 5). It amounted to 61% of the total cash cost for tilapia cage and milkfish culture, 46% for tilapia pond culture and 59% for penaeid shrimp culture. The use of commercial feeds is generally supplemented by the growing use of natural food through fertilizer applications. In the Philippines, a fish farmer had to spend US\$0.45, 0.68, 1.58, and 3.52 as cash cost and US\$0.49, 0.75, 1.66, and 3.69 as total variable cost to produce a kilogram of fish from the culture of tilapia in cage and pond, milkfish and penaeid shrimp, respectively. Although shrimp farming is very promising in the purest economic sense, being capital intensive and considered major ecological pollutants, those interested outside the circle of existing fish farmers will have considerable difficulty in gaining entry unless they have substantial capital.

Table 5. Cost and return of selected aquaculture species per 100 m<sup>2</sup> in the Philippines, 1994.

Item	Tilapia Monoculture *		Milkfish	Shrimp
	Cage	Pond	Semi-int. monoculture **	Semi-int. monoculture **
<b>Return</b>				
Production (kg)	189.40	10.50	16.52	15.00
Value (US \$ <sup>10</sup> )	333.57	18.09	36.22	80.77
<b>Cash Costs (US \$)</b>	<b>84.43</b>	<b>7.14</b>	<b>26.06</b>	<b>52.80</b>
Labor	6.33	0.71	0.55	4.21
Fry/Fingerlings	24.90	2.41	6.92	5.77
Fertilizer	-	0.25	1.10	0.73
Feed	51.24	3.30	15.78	31.15
Fuel/ Electricity	0.99	0.12	0.58	4.03
Lime/ Miscellaneous	0.98	0.35	1.13	6.91
<b>Non-Cash Costs (US \$)</b>	<b>7.76</b>	<b>0.71</b>	<b>1.44</b>	<b>2.60</b>
Family Labor	7.76	0.48	1.44	2.60
Fry/ Fingerlings	-	0.23	-	-
<b>Total Variable Cost (US \$)</b>	<b>92.19</b>	<b>7.85</b>	<b>27.51</b>	<b>55.40</b>
<b>Net Profit Over Variable Cost (US \$)</b>	<b>241.38</b>	<b>10.25</b>	<b>8.71</b>	<b>25.37</b>
<b>Cash Cost / kg Fish (US \$/kg)</b>	<b>0.45</b>	<b>0.68</b>	<b>1.58</b>	<b>3.52</b>
<b>Total Variable Cost/ kg Fish (US \$/kg)</b>	<b>0.49</b>	<b>0.75</b>	<b>1.66</b>	<b>3.69</b>

Source: \* BAS-ICLARM Field Survey, 1994; \*\* Aquaculture Division, BFAR, 1995.

In Thailand, net profit over variable cost per 100 m<sup>2</sup> per production cycle of shrimp farming at US\$102, was substantially higher than that of catfish (US\$48) and of tilapia (US\$14) (Table 6). However, shrimp farming cash requirements were also higher at US\$126, compared to catfish at US\$105 and tilapia at US\$10. As in the Philippines, feed cost was the most important expense for these activities in Thailand. Cost of the feed component alone was 54, 72 and 38% of the total cash cost for shrimp, catfish and tilapia farming, respectively. The second major cash expense was cost of fry or fingerling. The labor component, including its non-cash side, was lower than the cost of fry or fingerlings in the production of these commodities. These results imply that shrimp and catfish farmers are already in the intensive farming mode. Clearly, although shrimp farming is the most profitable, it is also more capital intensive than catfish and tilapia farming. Shrimp, catfish and

<sup>10</sup> Exchange rate US\$1 = 26 Pesos;

tilapia farmers had to spend US\$3.05, 0.53 and 0.17 as cash cost and US\$3.12, 0.56, 0.20 as total variable cost, respectively, to produce a kg of fish.

Table 6. Costs and returns of selected aquaculture species cultured in ponds per 100 m<sup>2</sup> in Thailand, 1992.

Item	Tilapia	Catfish	Shrimp
<b>Return</b>			
Production (kg)	55.60	199.50	41.19
Value (US \$ <sup>11</sup> )	24.99	158.43	230.22
<b>Cash Cost (US\$)</b>	<b>9.50</b>	<b>105.30</b>	<b>125.69</b>
Fry/ Fingerlings	2.91	19.54	23.15
Feed	3.64	76.07	68.36
Labor	1.42	3.94	3.44
Drug/Lime/Other Chemicals	0.15	1.03	8.21
Fuel	0.78	3.20	11.48
Maintenance	0.22	0.75	10.74
Others	0.37	0.79	0.31
<b>Non Cash Cost (US\$)</b>	<b>1.92</b>	<b>5.74</b>	<b>6.01</b>
Interest/ Opportunity Cost	0.14	0.22	3.21
Fry/ Fingerlings	0.11	-	-
Feed	0.56	1.64	-
Labor	1.11	3.89	2.80
<b>Total Variable Cost (US\$)</b>	<b>11.42</b>	<b>111.04</b>	<b>131.69</b>
<b>Net Profit Over Variable Cost (US\$)</b>	<b>13.57</b>	<b>47.39</b>	<b>98.53</b>
<b>Cash Cost / kg Fish (\$/kg)</b>	<b>0.17</b>	<b>0.53</b>	<b>3.05</b>
<b>Total Variable Cost/ kg Fish (\$/kg)</b>	<b>0.21</b>	<b>0.56</b>	<b>3.20</b>

Source: Office of Agricultural Economics, Ministry of Agriculture and Co-operative, Bangkok, Thailand.

Silver barb is mainly cultured in Thailand under either extensive or semi-intensive polyculture systems with other carps (mainly common carp and rohu) and non-carp species (catfish and tilapia). Carp polyculture, with silver barb as the principal species, is also a less capital intensive but profitable aquaculture activity. It is even less capital intensive than tilapia monoculture. In 1994, carp farmers had to spend only US\$0.13 and US\$0.18 as cash cost and total variable cost to produce a kilogram of fish, respectively, and earned a profit of about US\$30 per 100 m<sup>2</sup> (Tavarutmaneekul and Tookwinas, 1995). Unlike other major aquaculture activities, the cost of hired labor is the most important cash cost component in carp culture, comprising about 54% of the total cost. Other major cash expense items for carp culture in Thailand were cost of fry or fingerling (15%) and feed costs (10%).

Across these three Asian countries, only shrimp and tilapia farming are comparable in terms of cost and return data. In summary, fish farmers net profit over total variable cost from tilapia pond culture in Thailand (US\$14) per production cycle per 100 m<sup>2</sup> was higher than that of Bangladesh (US\$13) and the Philippines (US\$10). Also, Thai fish farmers have higher net profits from shrimp farming (US\$102) than those of their counterparts in the Philippines (US\$25) and Bangladesh (US\$7). Apparently, Thailand has comparative advantage in producing tilapia and shrimps over Bangladesh and the Philippines, which could possibly be attributed to their superior production technologies and favorable socio-economic and policy environments.

Shrimp farming is generally more capital intensive than other aquaculture activities in these countries that favor only the exploitation and entry of the 'rich' or those with access on capital. Cultivation of carnivorous species like shrimp through intensive systems requires scarce animal feed ingredients in large quantities, which may deplete the supply of marine protein for direct human consumption. Results show that semi-intensive tilapia and carp/barb farming in Bangladesh and Thailand, and semi-intensive tilapia farming in all these countries, are more promising and sustainable than shrimp farming: it encourages wider participation and 'new entrants' with its low capital requirement but with better incomes.

<sup>11</sup> Exchange Rate US\$1 = 25.5 Baht

## 2.3 Export

Relative to the total value of fishery exports, shrimp is a major commodity for Bangladesh; Thailand has shrimp, canned tuna and cephalopod; and the Philippines has shrimp, tuna, cephalopod and seaweed. Thus, the discussion of exports of these countries is focused only on shrimp due to its significant share to total value of fishery exports. For the Philippines, seaweed is included as there has been a resurgence of interest to culture it on a commercial scale.

Export of shrimp, which constituted about 69% (based on a 5-year average, 1988-1992) of its production, is very significant to the fishery economy of Bangladesh. It contributed 91% to its total fishery exports valued at US\$138 million in 1992 (Table 7). Although, shrimps share of the total value of fishery export posted a marginal yearly growth rate of 0.03% from 1983 to 1992, its export value registered a robust growth rate of 10%.

Table 7. Export of shrimp and prawn from Bangladesh and Thailand compared with total exports of fishery products.

Year	Bangladesh			Thailand		
	Shrimp/Prawn		Export	Shrimp/Prawn		Export
	Value (million \$)	%	Value (million \$)	Value (million \$)	%	Value (million \$)
1983	62.5	91.96	67.95	148.5	27.26	544.9
1984	69.2	86.39	80.1	133.7	21.1	632.9
1985	78.05	94.82	82.3	140.1	20.75	675.1
1986	98.95	83.75	118.2	184.7	18.25	1,011.9
1987	125.1	85.18	146.9	252.9	20.06	1,261.1
1988	139.2	87.03	160.0	385.4	23.63	1,630.9
1989	146.4	90.15	162.4	630.5	32.18	1,959.4
1990	145.9	90.44	161.3	806.6	35.61	2,264.9
1991	140.3	87.69	159.9	1,054.5	36.35	2,901.4
1992	138.0	91.27	151.2	1,252.5	40.78	3,071.8
C. V. (%)	28.03	3.66	28.27	78.80	27.69	55.34
Growth Rate (%)	9.99	0.03	9.97	28.18	7.27	20.92

Source: FAO.

Table 8. Export of selected fishery products from the Philippines, 1981-1993.

Year	Shrimp/Prawn		Seaweed		Export Value (million \$)
	Value (million \$)	%	Value (million \$)	%	
1981	21.8	13.75	7.3	4.64	158.3
1982	32.5	24.75	9.4	7.15	131.1
1983	30.8	21.5	10.1	7.03	143.4
1984	32.4	24.86	4.9	3.78	130.5
1985	63.5	33.78	20.9	11.15	187.9
1986	105.2	44.11	22.9	9.6	238.5
1987	154.9	49.45	23.7	7.57	313.3
1988	250.0	54.95	26.7	5.87	455.0
1989	233.6	49.2	37.2	7.84	474.9
1990	222.6	46.9	49.9	10.52	474.29
1991	272.9	53.11	21.55	4.19	513.9
1992	211.4	48.24	18.9	4.32	438.3
1993	224.7	43.41	18.5	3.57	517.7
C.V. (%)	65.54	33.55	57.01	37.06	48.04
Growth Rate (%)	22.72	9.19	11.19	(2.34)	13.53

Source: Bureau of Fisheries and Aquatic Resources, Bureau of Agricultural Statistics, Manila, Philippines.

Penaeid shrimp and seaweed are the major aquaculture exports of the Philippines. Altogether, they contributed 47% to the country's total value of fishery exports of US\$518 million in 1993 (Table 8). The share of shrimp in total value of fishery export, which comprised about 51% (based on a 5-year average, 1988-1992) of its production, has been increasing at the rate of 9% annually, while that of seaweed has been declining at the rate of 2% from 1981 to 1993. Nevertheless, export values of these commodities has been growing at an annual rate of 23% for penaeid shrimp and 11% for seaweed, but an examination of yearly export data revealed a deteriorating situation for seaweed.

The export value of seaweed peaked in 1990 at US\$50 million and nose-dived to only US\$18 million due to high product standards set by the US buyers. The recent acceptance by the US market of the quality standards of the Philippine seaweed exports and the Philippine government's provision of technical and financial support to growers, however, may reverse this trend.

In Thailand, the export of fishery products is considered a major source of foreign exchange earnings. Export of shrimp, which constituted about 80% of its production (based on a 5-year average, 1988-1992), accounted 41% of Thailand's total fishery exports valued at US\$3.07 billion in 1992 (Table 9). The export value of shrimp has been growing rapidly at a rate of 28% and its share of total fishery exports has been expanding at the rate of 7% yearly. Despite these impressive growth rates, shrimp export contribution to total fishery exports is expected to be marginal as existing growing areas have reached their maximum productive capacity (FAO/NACA 1995).

Although Bangladesh and Thailand both posted high export value C.V. of shrimp at 28%, their high C.V.'s do not indicate boom and bust cycles as in the Philippines (with relatively higher C.V. of 66%). As a high percentage of shrimp production from these countries (Bangladesh, 69%; the Philippines, 51%; and Thailand, 80%) is exported, sustainability of shrimp production is highly vulnerable to movement of supply and prices in the world market. This also implies that resources are being directed to satisfy luxury export markets but not basic food needs.

Table 9. Export and wholesale prices of shrimp and prawns in the Philippines and Thailand.

Year	Philippines*		Thailand**	
	Export (US\$/kg)	Wholesale (US\$/kg)	Export (US\$/kg)	Wholesale (US\$/kg)
1981	7.51	5.28	5.08	2.45
1982	7.22	6.86	5.07	3.04
1983	6.37	5.97	6.28	3.29
1984	4.76	6.13	5.63	3.15
1985	7.47	6.55	4.95	3.40
1986	8.94	6.16	5.46	3.89
1987	9.96	7.26	4.15	5.85
1988	10.29	8.45	7.53	5.68
1989	8.73	6.60	8.38	4.74
1990	8.83	5.69	9.41	4.86
1991	8.96	5.41	8.63	4.86
1992	8.95	6.40	8.89	5.20
1993	9.88	5.26	-	-
C.V. (%)	18.2	13.55	26.54	25.87
Growth Rate (%)	3.51	(0.36)	5.86	6.72

Sources: \* FAO, BFAR & BAS; \*\* FAO, INFOFISH

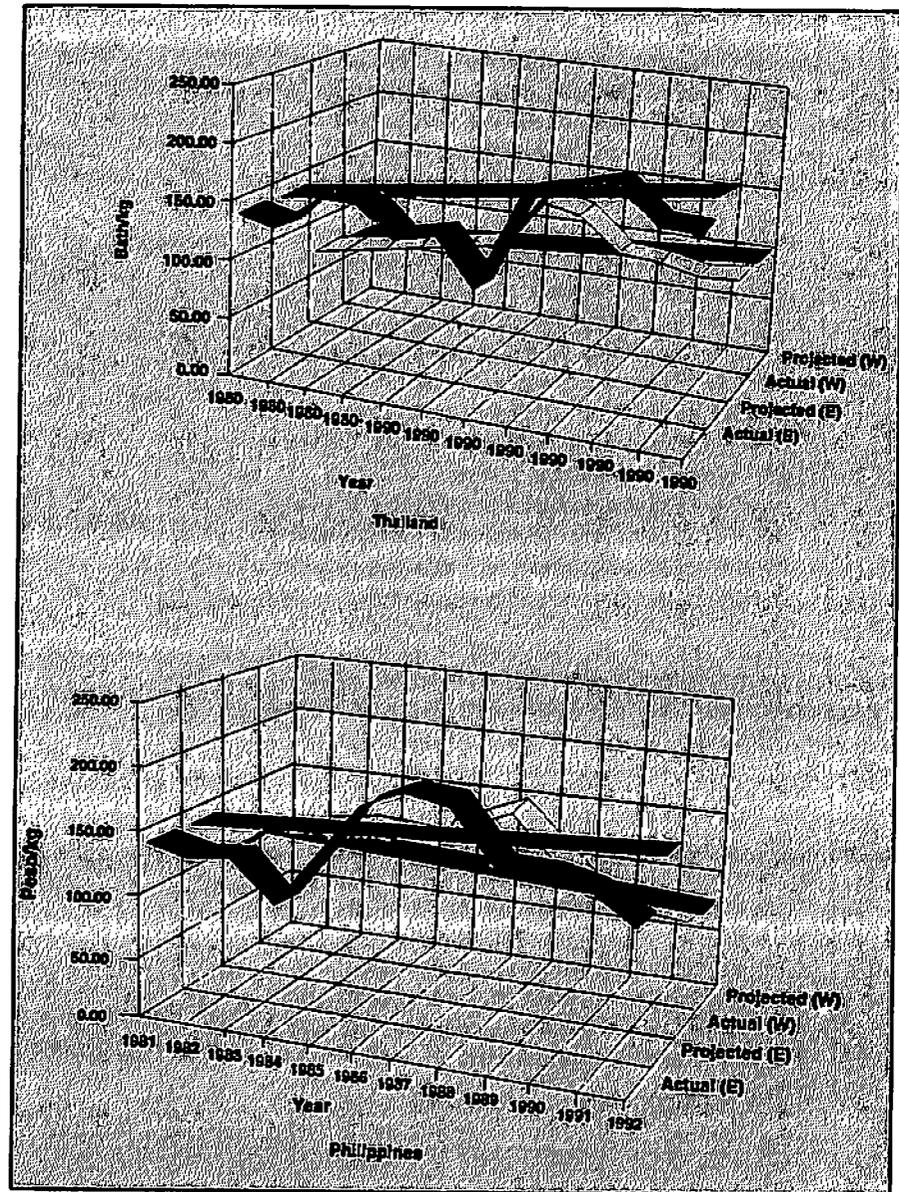


Fig. 1. Export and wholesale prices of shrimps and prawns in the Philippines and Thailand, 1982-1993.

### 2.3.1 Export vs. Domestic Price

A country has an incentive to export a commodity if its freight on board (F.O.B.) price at the export or world market is higher than its domestic price. Since the domestic price of shrimp in Bangladesh was not available, only those of Thailand and the Philippines are analyzed to detect the presence or absence of such incentives. Their export and domestic wholesale prices of penaeid shrimp are expressed in US\$ nominal terms and real local currency to remove the effects of inflation on price movements in the latter.

The Philippines has a weak domestic market for penaeid shrimp. While the Philippine export price (in US\$) for shrimp moderately increased at a yearly rate of 4%, the domestic wholesale price marginally increased at 0.33% (Table 10). In real local currency, export price posted considerably slower growth at 1% while the domestic price declined faster at 2%. The Philippines had highly fluctuating prices with CV's ranging from 18% to 19% for export price and 13% to 18% for wholesale price of penaeid shrimp. The Philippines experienced in 1984 an all-time low in shrimp export price of US\$55/kg for the 12-year period under consideration due to Japan's economic recession. A substantial increase in shrimp production during that year aggravated the situation. It must be noted that Japan is the major export market for Philippine shrimp. Even now, a recession of 1984 magnitude in Japan is sufficient to depress the Philippine export price of shrimp. Eventually, the export price recovered, peaking in 1988 at US\$10/kg, and stabilizing at US\$9/kg in 1992. In local real currency equivalent, the export price of shrimp peaked at Pesos 205/kg in 1987 (rather than in 1988) and declined substantially to Pesos 127/kg in 1992.

At a glance, there was a seemingly declining export price of shrimp in terms of local real currency and a recovering export price in terms of US\$ currency. This apparent discrepancy is traceable to the strengthening of a US dollar (\$) against the local currency and a higher Philippine inflation rate against the US. As exporters exchanged the dollar price rate received into local currency, its Peso equivalent was reduced substantially in real terms due to an over-valued exchange rate and a higher inflation rate.

The Philippines has tremendous incentives to export shrimp. Its real export price of Pesos 127/kg was substantially higher than its real domestic wholesale price of Pesos 91/kg in 1992. In the 12-year period, the wholesale price was higher than export price in only one year (1984). Moreover, the government of the Philippines had successfully intervened, mainly by the imposition of lower tariff rates on feed, in making shrimp competitive in the export markets. Nevertheless, the Philippines has to find new export markets other than Japan, develop the domestic markets and produce value added products *vis-à-vis* increasing production if it has to expand and sustain the growth and development of shrimp farming.

Table 10. Export and wholesale prices of shrimps and prawns in the Philippines and Thailand, 1981-1992.

Year	Philippines*		Thailand**	
	Export (Peso/kg)	Wholesale (Peso/kg)	Export (Baht/kg)	Wholesale (Baht/kg)
	Actual	Projected	Actual	Projected
1981	139.2	139.2	97.9	97.9
1982	131.4	141.2	124.8	96.1
1983	137.0	143.2	128.3	94.3
1984	102.4	145.2	131.8	92.6
1985	145.4	147.3	127.5	90.88
1986	189.3	149.3	130.4	89.2
1987	205.0	151.4	149.4	87.6
1988	199.7	153.6	164.0	85.9
1989	155.5	155.8	117.6	84.4
1990	154.1	157.9	99.3	82.8
1991	148.9	160.2	89.9	81.3
1992	126.8	162.4	90.6	79.8
C. V. (%)	19.29	18.29	18.2	22.0
Growth Rate (%)	1.41	(1.84)	3.16	4.02

Sources: \* FAO, BFAK & BAS; \*\* FAO, INFOFISH

In Thailand, export and wholesale prices (in US\$) of shrimp posted a modest yearly growth rate of 6% and 7% from 1981 to 1992, respectively (Table 10). In real local currency, however, the export price grew only at a rate of 3% while domestic wholesale price expanded at a rate of 4% for the same period. There were considerable fluctuations in export and wholesale prices as reflected by their respective high CVs (both at 26%) but with comparatively lower CVs if expressed in real terms. These results imply that those engaged in shrimp farming and exporting face a high degree of price instabilities both in the domestic and export markets. In the 12-year period (1981-92), 1987 was a relevant year to see how the government succeeded in assisting those engaged in shrimp farming in Thailand. The export price dipped to an all-time low of US\$4/kg, due to a phenomenal increase in production relative to previous years, but the domestic wholesale price increased substantially to US\$6, because the government, in anticipation to downward pressure of oversupply on export and domestic prices, set in place a subsidy programme and promoted successfully domestic consumption of shrimp.

### 3. AQUACULTURE POLICIES IN BANGLADESH, THE PHILIPPINES AND THAILAND

#### 3.1 Sectoral Policies

Like most market-oriented developing countries, the governments of Bangladesh, the Philippines and Thailand intervene in the aquaculture sector through various sector-specific policies on feed, fertilizer, trade, investment and research. These policies play crucial roles in defining the economic boundaries for the sustainability of aquaculture development in these developing countries of Asia.

##### 3.1.1 Feed Policy

Feeds for aquaculture, despite recognition in these countries of their pivotal role in determining economic success or failure, are treated peripherally through the issuance of circulars or memorandum orders. The feed cost component accounts for most of the cash requirements of semi-intensive and intensive aquaculture. The Philippines and Thailand have been following an import substitution policy supposedly using local ingredients to reduce the cost of feeds. Because their governments have not been successful in totally eliminating foreign ingredients in locally formulated feeds, feed costs still comprise about 70% of the production cost. Bangladesh, where most aquaculture is still extensive, is pursuing a production policy of gradually intensifying aquaculture.

The Philippines and Thailand have also resorted to reactionary measures against feed supply shortages rather than drawing up guidelines for and implementing a comprehensive feed policy framework. In the case of Thailand, when black tiger prawn farming was hard hit by the collapse of its export price in 1989, the government of Thailand offered no specific guidelines for farmers to claim an automatic subsidy for expenditure on feeds. The government, instead, negotiated directly with feed manufacturers resulting a 12.5% discount on shrimp feed prices and for another 10% discount on bulk purchases, provided that each purchase was in cash and not less than one ton. It also required manufacturers to affix price tags on every feed package to prevent the price from escalating without notice (Nambiar, 1991a). In the Philippines, it is obligatory on the part of feed manufacturers not only to affix price tag on every bag of feed on sale but also a label describing the feed components.

Tariff on feeds, feed ingredients and feed import quotas was available only in the Philippines. To improve the competitiveness of shrimps in the export markets, tariffs on feeds and feed ingredients have been lowered from a high of 30 and 10% to 10 and 3%, respectively. This would reduce the prices of both local and imported feeds. Feed imports are not subject to quantitative restrictions. The government has not completely eliminated such tariffs because: (1) local feed millers need protection for the continuance of their operations, within acceptable profitability levels, from adverse movement of prices; (2) local feed millers can supply the feed requirements of the prawn growers, given appropriate incentives; and (3) production of local feeds should be encouraged as imported feeds carry risks of oxidative rancidity which is implicated in red and blue diseases. Red disease can

completely destroy farm output, whereas blue disease lowers the quality and hence reduces the price of shrimps (Clarete and Cortes, 1992).

### 3.1.2 Fertilizer Policy

In the early 1970s, most Asian governments controlled the fertilizer sector and provided incentives for increased agricultural production through subsidies. The following measures were implemented: government monopolies on procurement and distribution of fertilizer through parastatal institutions; direct fertilizer subsidy programmes; regulatory mechanisms for private trade; and controls on input and output pricing. Acknowledging the increasingly high fiscal cost of such programmes, most Asian governments have taken steps, since the late 1970s, to reduce their involvement in the fertilizer sector. An overview of some deregulation and privatization policies is presented in Table 11. Although substantial progress has been made, some barriers that distort the free play of market forces still continue in the form of: setting prices of fertilizers produced in factories under government controls; supply of raw materials to factories at subsidized prices; licensing of companies permitted to participate in foreign trade; allocation of foreign exchange to import fertilizers; lengthy import procedures; and inadequate port, warehouse and transportation facilities, etc. As a result, localized shortages of fertilizer and fluctuations in prices at critical times of fertilizer demand are still common in many Asian countries.

Table 11. Overview of policy changes in the fertilizer sector of certain Asian countries.

Country	Year of policy changes	Restrictions in fertilizer trade	Production capacity - govt. owned (%)	Fertilizer trade operated by govt. (%)	Pricing Policy	Subsidies
Bangladesh	1978	Import controlled by state designated trading companies	100	0	Ex-factory price set by Govt.	None since 1973
Thailand	1990	No restrictions	0	0	No intervention	None
Philippines	1986	5% Excise Duty on Fertilizer Manuf.	77	50	No intervention	None since 1992

Source: FADINAP, 1994.

Table 12. Domestic retail prices of fertilizers compared to world prices

Market	Price of Fertilizer (US \$/ton)				Domestic Production of Fertilizer as % of Consumption (1990-1991)		
	Urea	TSP	DAP	Muriate of Potash	Nitrogen	Phosphate	Potash
<b>International Market</b>							
FOB	129	150	145	108	-	-	-
C & F	163	178	190	132	-	-	-
<b>Domestic Market</b>							
Bangladesh	103	195	-	163	107	24	0
Thailand	202	-	-	-	0	0	0
Philippines	187	-	267	196	48	190	0

The impact of policy changes regarding de-control of fertilizer markets and privatization, would be reflected in the difference in prices paid by farmers compared to the world market prices under competitive markets. Table 12 provides information on world prices of major fertilizers and the retail trade in selected Asian countries. For phosphate and potash, which are mostly imported, domestic prices are now closer to world market prices. For urea, however, the domestic prices in Bangladesh are lower than the world market prices. With further reforms towards competitive markets, the price of urea is expected to increase in Bangladesh. This will depress fertilizer consumption in the country.

### 3.1.3 Aquaculture Trade Policy

Aquaculture trade policies are focused mainly on promoting and protecting tradable export commodities: shrimps for Bangladesh and Thailand; seaweed and shrimps for the Philippines. These countries are net exporters of fishery products and their trade policies are considered outward-

looking; *i.e.*, higher priority given to improving foreign exchange earnings than increasing the availability of produce for domestic consumption. But Thailand, after experiencing a drastic fall in export prices especially when the Japanese shrimp market crashed in 1989 (Nambiar, 1991a), started to promote domestic consumption of shrimp by setting up market places for farmers to sell directly to consumers; the holding of a Shrimp Fair to showcase various styles of cooking; and negotiating with potential shrimp importing countries to expand the export markets for penaeid Thai shrimps.

All these countries have open trade policies, with no quantitative restrictions for those willing to engage in the export, import and local trade of aquaculture commodities. Entry is also non-restrictive for as long as all legal requirements are met. In the process of trading, taxes and duties are applied to every business transaction. In all these countries, however, favorable incentives are given to exporters, whereas importers are penalized by high tariff rates. In the Philippines, a licensed exporter has only to pay an export tax of 0.5% of an FOB value of the commodity plus P120/transaction (US\$5) to cover the permit application and gathering fees. The government has a "one-stop-shop" to process all requirements of the exporter: transactions are facilitated and costs reduced. A Philippine importer, however, has to pay a tariff of at least 30% for an imported aquaculture commodity. At present, the government is still debating the mode of import valuation; whether to shift from the current Home Consumption Value (HCV) scheme to a transaction value (TV) or export scheme with the purpose of protecting the interests of local producers. In the HCV scheme, import value is computed based on the domestic wholesale price of the products in the country of origin, whereas the TV scheme valuation is based on actual export prices of the products brought into the country.

#### *3.1.4 Aquaculture Investment Policy*

Bangladesh, the Philippines and Thailand, with their open-entry investment policies, are encouraging local and foreign investors to engage in a wide range of aquaculture activities to sustain and to enlarge the sector's contribution to national economies. These policies are embodied in the countries' respective programmes, projects and incentives for the development of their aquaculture sectors.

Bangladesh is investing heavily in the development of shrimp culture areas and the improvement of shrimp culture techniques and practices in its effort to increase production of shrimp for export. In a scenario of increasing production, investment is anticipated to flow towards modernizing existing processing plants and machinery for product diversification, packaging and marketing. Bangladesh is exporting semi-processed raw materials. Further processing and packaging for distribution has high costs that leads to substantial value addition (Nambiar, 1991b). It is important for Bangladesh to capture part of such a value addition process, for which its low income labor force and acute unemployment problems are relevant. The Foreign Private Investment Act, 1980 continues to be the framework for the promotion and protection of foreign investment in Bangladesh.

For the Philippines, the Board of Investment (BIO) of the Department of Trade and Industry (DTI) is the government agency that promulgates and administers incentives for the aquaculture sector. The Bureau of Export and Trade Promotion of the DTI is responsible for export promotion, together with various overseas commercial offices. The Central Bank, Securities and Exchange Commission and the Department of Tourism also extend assistance in promoting investment in aquaculture. Under Book 1 of the Omnibus Investment Code, an investor may enjoy certain benefits and incentives, provided that the investment is in preferred areas detailed in the Investment Priorities Plan (IPP). An enterprise not listed in the IPP may still be entitled to incentives for Filipino owned enterprises with at least 50% of the production is for exports; and for an enterprise with more than 40% foreign equity, at least 70% of the production is for exports. Hence, the government is giving attractive incentives for investors in aquaculture activities that can generate foreign exchange earnings.

In Thailand, investment incentives in general are covered by the Investment Promotion Act, 2520 (1977) and implemented by the Board of Investment. Some of these investment incentives are intended to strengthen the position of Thailand's aquaculture products in the world market and to contribute substantial foreign exchange earnings to its economy, as summarized in Table 13.

Table 13. Fisheries balance of trade in Bangladesh, Philippines and Thailand, 1983-1992

Year	Bangladesh (million US \$)*			Philippines (million US \$)**			Thailand (million US \$)*		
	Export	Import	Balance	Export	Import	Balance	Export	Import	Balance
1983	68.0	-	68.0	143.4	10.0	133.4	544.9	42.8	502.1
1984	80.1	-	80.1	130.5	3.0	127.5	632.9	85.8	547.1
1985	82.3	-	82.3	187.9	6.3	181.5	675.1	138.3	536.8
1986	118.2	0.001	118.2	238.5	18.9	219.6	1,011.9	283.7	728.2
1987	146.9	0.006	146.9	313.3	31.0	282.3	1,261.1	267.1	993.9
1988	160.0	0.014	160.0	455.0	62.2	392.8	1,630.9	537.9	1,093.0
1989	162.4	0.029	162.4	474.9	65.4	409.4	1,959.4	726.8	1,232.6
1990	161.3	0.002	161.3	474.3	75.1	399.2	2,264.9	794.4	1,470.5
1991	160.0	0.052	160.0	513.9	84.7	429.3	2,901.4	1,052.9	1,848.4
1992	151.2	0.060	151.2	438.3	95.2	343.1	3,071.8	942.1	2,129.7
C. V. (%)	28.27	95.98	28.27	42.59	73.65	38.57	55.34	72.61	48.63
Growth Rate (%)	9.96	52.34	9.96	16.19	36.62	14.02	20.91	34.92	17.11

Source: \* FAO; \*\* BFAR/BAS.

The priority investment areas for all these countries are: upgrading of production and hatchery systems; establishing additional feed mills and modernizing existing processing plants and machinery; strengthening infrastructure facilities such roads, transportation, communication, power, and ports; and improving skills and technological knowledge and hastening transfer of technologies through research and development.

### 3.1.5 Aquaculture Research Policy

Wide variations exist among Asian countries in terms of the contribution of aquaculture to employment, production and national economies. However, the tremendous potential of this sector is unquestionable. This potential can be harnessed only if resources are well managed and research and development (R&D) efforts are promoted vigorously to improve productivity. Research and development in crop sectors have made significant contributions to national economies in Asia (Evenson and Pray, 1990). The aquaculture sector is no different.

A traditional measure of the level of government support for aquaculture research is the research-intensity ratio that express levels of public research spending as a percentage of the value of the aquacultural product. Aquaculture research investment increased during the 1980s but it is still only around 0.3% of the sectoral value of production in Bangladesh, the Philippines and Thailand (Table 14). On the other hand, newly industrialized Asian countries like Taiwan spend about 1% of the sectoral value of aquaculture on research. By comparison, more developed countries spend about 2% of agricultural gross domestic product (AgGDP) on agriculture research (Pardey, 1992). Though there is no specific recommendation regarding "optimal" aquaculture research investment, a variety of operational guidelines concerning "desirable" research investment levels are available. The 1974 UN World Food Conference set a 1985 research investment target of 0.5% of AgGDP (UN, 1974), while the World Bank (WB) set a target for 1990 of 2% (World Bank, 1981). Ruttan suggested that "... a level of expenditure that would push rates of return to below 20% would be in the public interest (Ruttan, 1980). With the present low level of investment, however, the internal rate of return on investment in fisheries and aquaculture research is very high in Asia, more than 100% (Dey and Dele, 1990). The evidence in Table 14 makes it clear that Bangladesh, the Philippines and Thailand, and the donors continue to under-invest in aquaculture research, despite the likelihood of such high returns.

Aquaculture research, by its very nature, is a long-term undertaking. The level of investment in aquaculture research, thus, should not only be adequate but also sustained over a long period of time. The available data suggest that the level of funding of research varies widely year-to-year in Bangladesh, the Philippines and Thailand. The main determinants of this variability appear to be the high instability in foreign aid budgets for research. In countries like Bangladesh, funds are so short that after fixed expenses are covered, little is left for undertaking research.

In Bangladesh, the Philippines and Thailand, aquaculture research programmes are restricted almost entirely to the biological and technical dimensions of the sector; they fail to address the sector's equally (if not most) important issues, which are economic, sociological and environmental in nature. These research programmes generally do not reflect the need for adjustment in the distribution of research disciplines to keep up with changing priorities. In these countries, researchers' salaries and benefits are low, often lower than those they would receive in comparable administrative positions. Low wages make it difficult to retain staff or to recruit specialist (e.g. economists, computer programmers) in high demand in the private sector or in other non-fishery public sectors.

### 3.2 The Macro-economic Policy Environment

Incentives or disincentives for aquaculture development are influenced not only directly by commodity specific policies, but indirectly, by economy-wide policies that under (or over) value the exchange rate and distort the relative price to non-aquaculture goods. The available data reveal that the indirect effects of trade on macro-economics policies of developing countries implicitly tax their agricultural sector in general by 25 to 30% on the average (Krueger *et al.*, 1988). Due to the limitation of data, it has not been possible to estimate the impact of these economy-wide policies on aquaculture incentives. As an alternative we analyzed the trend on the real exchange rates in Bangladesh, the Philippines and Thailand as indicators of the changes in the relative incentives between aquaculture and non-aquaculture sectors.

The aquaculture sectors in Bangladesh, the Philippines and Thailand consist mainly of exportable, importable and potentially tradable commodities and the foreign exchange rates are crucial factors affecting the prices received by the farmers. An under (or over) valuation of the real exchange rate will increase (or decrease) the relative incentive of tradable to non-tradable sector.

Table 14. Actual aquaculture research expenditure (000 US\$) by regional and international institutes (RI), government research institutes (GRI) and universities (UNI).

Year	Country	RI	GRI	UNI	TOTAL
1980	Thailand	-	520.0	-	520.0
	Philippines	334.9	1,014.5	37.0	1,386.4
1986	Bangladesh	-	492.6	-	492.6
	Thailand	-	936.0	-	936.0
	Philippines	975.4	1,786.7	117.0	2,879.1
1987	Bangladesh	-	704.4	-	704.4
	Thailand	-	1,088.0	-	1,088.0
	Philippines	1,707.8	1,654.0	151.0	3,512.8
1988	Bangladesh	-	778.8	-	778.8
	Thailand	-	1,548.0	-	1,548.0
	Philippines	2,064.7	1,835.4	210.2	5,658.3

Source: Various published and unpublished documents.

Table 15. Average national research expenditures as a % of value of production, selected Asian countries.

Year	Country	Research expenditure compared with value of production (%)
1986	Bangladesh	0.26
	Thailand	0.33
	Philippines	0.47
1987	Bangladesh	0.29
	Thailand	0.38
	Philippines	0.39
1988	Bangladesh	0.24
	Thailand	0.36
	Philippines	0.36

Table 15 shows the trends in the nominal and real exchange rates of Bangladesh, the Philippines and Thailand. Real exchange rate was estimated by deflating nominal exchange rates with the ratio of the country-specific consumer price index (CPI) to the CPI in the US. The nominal value of the Bangladesh Taka and the Philippine Peso have been adjusted downward resulting in annual rates of depreciation of 6% and 11%, respectively. However, over the decade of the 80s as a whole, there has been virtually no depreciation of real exchange rates in Bangladesh and the Philippines. It is obvious that the substantial depreciation of the Taka and the Peso in nominal terms have been eroded by domestic inflation (relative to inflation in the US). Since 1990, the real exchange rate in the Philippines has in fact appreciated considerably, thus eroding the competitiveness of Philippine aquaculture exports. On the other hand, though the nominal exchange rate of the Baht did not change during the 1980s, it has recently depreciated to some extent against the US\$. The results thus suggest that economy-wide policies have provided incentives to aquaculture particularly for shrimp and other exportables, only in Thailand, but not in Bangladesh and the Philippines. In fact, these policies have penalized the tradable aquaculture sector in the Philippines.

#### 4. POLICY IMPERATIVES FOR SUSTAINABLE AQUACULTURE DEVELOPMENT IN ASIA

Government aquaculture policies should aim at ensuring an incentive structure that reflects the true social opportunity costs of resources and products. While a freely operating market economy would tend to generate that incentive structure, government interventions are necessary to "get the prices right" in the case of market failure, which occurs frequently in developing countries. The market fails to allocate resources efficiently in the aquaculture sector in the presence of externalities (pollution in aquatic environment), provision of public goods (e.g. research infrastructure) and in cases of lack of access to information and inputs (e.g. credit).

This section discusses sectoral and macro-economics policy environments that would foster the growth of the sustainable aquaculture. These policies relate to the use and management of natural resources, research, input and output pricing and marketing, credit, trade, investment and exchange rate.

##### 4.1 Use and management of natural resources policies

Most Asian countries are endowed with natural resources conducive for aquaculture, but what kind of aquaculture makes sense, particularly for the developing countries in Asia? The kinds of aquaculture which are socially equitable, environmentally compatible and have sufficient diversity and scope for change to adapt to changing circumstances (Pullin, 1993).

Intensive aquaculture is known to pose greater threats to the environment than does extensive or semi-intensive aquaculture. The rapid expansion of shrimp farming in Thailand and the Philippines, has caused serious local environmental impacts (FAO/NACA, 1995). These include the destruction of coastal mangroves, pollution of the aquatic environment and serious disease outbreaks. Bangladesh may encounter the same situation if it succeeds in its present campaign to intensify aquaculture production. However, there are some less intensive aquaculture systems that can also be non-sustainable (Pullin, 1993), in which environmental degradation was a contributing factor.

For the developing nations of Asia, small-scale hatchery and grow-out operations are socially and environmentally desirable (Pullin, 1993). Nevertheless, without productivity improvement small-scale aquaculture will not be able to improve the overall supply of food fish at the rate required to meet the growing demand. Affordable produce will have to be available to maintain the social fabric of developing countries.

The challenge lies in devising policies that would rationalize (within their carrying capacity) the present and future use and management of natural resources for aquaculture production consistent with development goals of the developing countries in Asia, which are mainly food security, poverty alleviation and employment generation. Policies should, therefore, promote the adoption of productivity- and sustainability-enhancing technology by farmers. The culture of omnivores and

herbivores species (e.g. carps, barbs and tilapias) with short production cycle under semi-intensive system and adoption of integrated aquaculture-agriculture systems should be encouraged (Williams, 1995). Policy measures should also be undertaken to ensure equitable access to land and water resources by various farmer groups.

#### 4.2 Aquaculture research policy

The primary focus in sustainable aquaculture development is the ability of the aquaculture system to expand output to meet the demand of the growing population. To meet the demand for output, research should aimed at increasing productivity and sustaining the productivity gains in the long term. The sustainability perspective in aquaculture research policy implies a need to identify potential future constraints to growth in the total output of the system and the rate of change of these constraints, *ex ante*. Aquaculture research must be anticipatory, across a wide array of ecosystems and the sources of constraint upon them. Due to the linkage to the other systems and sectors, aquaculture research should be targeted at improving and sustaining the productivity of not only the aquaculture sector, but also the integrated production systems (e.g. aquaculture-agriculture system).

Given the current capacity of the NARs in Asia, it is clearly not possible to carry out the entire gamut of research needed in a highly decentralized fashion. This implies that a system based on the network approach would be appropriate. Policies to foster collaboration among national, international and donor countries research centers have to formulated and nurtured. Collaboration between research centers, universities, non-government organizations and private sector must also be initiated.

One great lacuna in our information concerning aquaculture research is knowledge of what the private sector may or may not do in developing Asian countries. National governments must formulate policy guidelines regarding the participation of the private sector in research. They must seek to determine which activities require public support and which should be left to the private sector. However, there are a number of research areas that should attract significant private sector involvement, including: fish processing and marketing; and technology for high-value-aquaculture products.

If sustainable aquaculture/agriculture systems are to be adopted, they must be compatible with the incentives individuals face. Aquaculture research policy, thus, must reflect the present and future incentive structures that the farmer faces, and the linkages to other policies regarding taxes, subsidies, land tenure, pollution, *etc.*

Aquaculture research programmes should be able to integrate research from different disciplines. Research to develop aquaculture systems, or aquaculture-agriculture systems for that matter, will be effective only if the content and direction of research are in line with farmers' needs. This implies a need for on-station research that is aware of the adoption process, as well as more participatory on-farm research than is currently the case. This sensitivity to adoption implies in turn that more social science information is needed at the research planning and design stage.

Adequate financial and human resources have to be appropriately allocated among alternative research activities. The absolute level of research has to be increased substantially to push rates of return on research investment to below 20%. There is a need for external support for NARs, international research centers themselves, and not just for the project, so they can conduct long-term research. Continuity across specific donor-funded project in different institutes must be achieved. This would require strategic planning and budgeting.

#### 4.3 Input and output pricing, trade and marketing policies

The development of a competitive market system for both inputs and output, and the elimination of taxes levied through sectoral and other macro-economic policy measures, will result in decreased input costs and increased input use. As discussed earlier, the Philippines has reduced (but not completely eliminated) tariffs on feeds and feed ingredients, as a way of protecting its local feed millers. Elimination of the tariff is a matter of time. The removal of tariffs on feeds and feed ingredients could drastically reduce the cost of shrimp production in the Philippines and could

substantially improve competitiveness in world market. The efficient use of feed, fertilizer and other inputs can best be achieved by improving the product and input markets, infrastructure and institutions.

Trade taxes (for export and import) distort the relative production incentives. Most countries in Asia are imposing high tariffs for import of aquaculture products but low taxes for export products. The former restrict the flow of commodities, trigger prices to rise to the disadvantage of consumers, and allow the continuance of production inefficiency. The latter provide such high incentives to export rather than to trade domestically, that products are priced beyond the purchasing power of the consumers of the producing countries. Thailand's experience in developing domestic markets for shrimps when export prices declined substantially, is a good example of pursuing a balanced trade policy. In fact, it is even possible that the removal of tariff and non-tariff barriers to trade may result in a new pattern of resource use, which is more sustainable because it allows only the continuance of aquaculture systems with high production efficiencies. As output pricing either for export or domestic markets are determined largely by production and marketing costs, improving existing policies and instituting new ones that would reduce these costs would improve the environment for sustaining the development of aquaculture in Asia.

Opportunities exist for introducing new value-added aquaculture products that cater to specific markets segments in Asia. There are also marketing and processing opportunities for making more use of under-utilized species and for optimizing allocation of raw materials and supplies (Tietze, 1995). As the latter entails taking advantage of external supplies, special support measures are needed in the short- and medium-term, to protect employment: particularly for women in these traditional fish marketing and processing industries that cater to rural and urban populations with limited purchasing power.

#### 4.4 Other sectoral policies

Sectoral policies on credit and investment will play significant roles in the expansion of sustainable aquaculture in the developing countries of Asia. Credit is still needed to finance different aquaculture activities including production, processing, storage, transport, marketing, consumption, import and export. An appropriate credit programme that could serve all these functions has to be devised.

Considerable public investment in infrastructure, capability building and institutional strengthening is needed for sustainable development of aquaculture in the developing countries of Asia. Aquaculture investment policies of these countries need adjustment to reflect the true social cost and profitability as well as emerging new realities. Bureaucratic red tape remains a major problem that delays investment in aquaculture in the developing countries of Asia. In the Philippines, the establishment of a One Stop Action Center for foreign and local investors, which is vested with authority to act on all matters concerned with setting up of projects or the inflow of investments, is a good example in minimizing red tape.

#### 4.5 Exchange rate policy

Based on comparative analysis of exchange rates of Bangladesh, the Philippines and Thailand, many developing countries in Asia need to devalue/depreciate their currency to remain competitive in the export markets. A competitive exchange rate is crucial to sustaining the growth and expansion of the aquaculture sector in the region. Difficulty, however, lies in determining the magnitude of devaluation/depreciation needed to maintain competitiveness in export markets for most developing countries in Asia. Thus, in-depth country-specific studies of the effects and repercussions of devaluation/depreciation not only for the aquaculture sector but for the entire economy needs to be done.

### 5. CONCLUDING REMARKS

Appropriate technologies, policies and institutional support systems are equally important requisites for sustainable development of aquaculture in the developing countries of Asia. The following

policy measures have been identified to promote sustainable broad-based aquaculture development in the developing countries of Asia:

- Rationalizing the carrying capacity of the present and future use and management of natural resources for aquaculture production.
- Defining an anticipatory research policy targeted at the needs of present and future generations of farmers, to be implemented through an interdisciplinary systems approach.
- Developing competitive input and output markets, and instituting balanced trade and marketing policies.
- Promoting public investment in aquaculture infrastructure, capability building and institutional strengthening.
- Maintaining a competitive exchange rate.

To further sustain aquaculture development, the long-term prospects of domestic, regional, and world demand and supply must also be examined. Each country must explore both regional and world markets to estimate and expand the current and potential demand for its aquaculture products.

Sustained broad-based growth of aquaculture will increase the sector's contribution to the national economies of Asian countries. It will spur the demand for producer and consumer goods and services. Therefore, policies that promote these backward and forward linkages in the development of aquaculture will have a significant effect on employment, income and food security.

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