

Chapter 2

Carp Production in Asia: Past Trends and Present Status¹

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2.1 Introduction

Of the total world carp production, 95 per cent was from Asia in 2001. In this region, there are more than 20 main native carp species, contributing about 80 per cent of the total freshwater fish production. China, India, Bangladesh and Indonesia accounted for most of the carp production in Asia: 80 per cent, 12 per cent, 3 per cent, and 1 per cent, respectively. Altogether, they contributed 95 per cent of the world carp production. Low-income people favor carps because of their low price and good taste. In many areas in Asia, carps are the major source of animal protein for the poor.

This chapter focuses on the status and future of carp production in Bangladesh, China, India, Indonesia, Thailand and Vietnam. The analysis is largely based on primary data collected through surveys of 2 025 carp fish farmers conducted during 1998-99. In addition to the primary data, databases compiled by the Food and Agriculture Organization of the United Nations (FAO) and unpublished reports from Asian countries were also used.

The chapter is composed of five sections. Following the introduction, the second section describes recent trends and the current production of carp in the region. The third section discusses the status of the carp industry in the six countries. This includes, among others, recent trends (growth) and the current production of carp species, species-wise production analysis and

contribution of carp production to the total aquaculture and freshwater fish production in each country. Section 4 deals with the results of the producer survey conducted by the WorldFish Center and its partner institutions. This includes a description of the profile of carp producers including socioeconomic demography of carp farmers, characteristics of carp farmers and carp farming, stocking characteristics, producers' preference ranking of carp species and traits and their reasons for such preference. The future outlook on carp farming is also discussed in the section. Finally, concluding remarks follow this.

2.2 Recent trends and current production

Carp production is growing rapidly in Asia, increasing from 5.537 million t in 1990 to 16.313 million t in 2001, an annual growth rate of 11 per cent (Table 2.1). Among all the species of carps, Chinese carps i.e. silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*), common carp (*Cyprinus carpio*) and bighead carp (*Aristichthys nobilis*) are the major species, accounting for 23 per cent, 22 per cent, 16 per cent and 11 per cent, respectively, of the total Asian carp production in 2001. Indian major carps i.e. rohu (*Labeo rohita*), catla (*Catla catla*), mrigal (*Cirrhinus cirrhosus*) accounted for 5 per cent, 4 per cent and 4 per cent, respectively, in the same period. *H. molitrix*, *C. idella*, *C. carpio*, *A. nobilis* and crucian carp (*Carassius carassius*) are in the top position because of the influence of China, the main world producer of these species.

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Table 2.1. Carp Production from aquaculture of the selected countries, Asia and World (in metric tonnes)

Year	Bangladesh	China	India	Indonesia	Philippines	Thailand	Asia	World
1990		4 093 124 (91.79)	628 157 (63.96)	131 725 (61.89)	4 780 (5.89)	18 945 (19.40)	5 069 717 (77.19)	5 627 775 (73.80)
1991		4 169 740 (90.14)	765 581 (64.59)	113 948 (58.63)	4 897 (5.57)	21 106 (17.17)	5 270 986 (75.61)	5 636 589 (71.62)
1992		4 817 666 (90.25)	894 801 (66.35)	125 018 (58.71)	7 474 (6.42)	28 930 (20.43)	6 076 646 (76.83)	6 433 814 (72.61)
1993		5 731 191 (88.55)	1 037 987 (76.62)	164 548 (67.14)	80 (0.07)	29 958 (18.53)	7 183 165 (78.43)	7 490 870 (74.37)
1994		6 980 027 (88.39)	1 067 280 (74.29)	174 764 (68.45)	4 249 (3.54)	32 954 (18.54)	8 496 347 (78.13)	8 767 159 (74.58)
1995		8 261 854 (87.82)	1 211 033 (76.22)	192 397 (68.75)	2 842 (2.91)	33 601 (16.74)	9 934 215 (78.62)	10 197 660 (75.36)
1996		9 517 916 (86.61)	1 459 506 (86.45)	230 124 (70.00)	2 004 (2.20)	45 174 (19.70)	11 475 070 (79.39)	11 744 451 (76.26)
1997	329 000 (94.76)	10 580 210 (85.56)	1 560 020 (86.86)	181 413 (62.07)	1 865 (1.77)	43 747 (18.22)	12 940 002 (80.98)	13 221 798 (77.82)
1998	381 000 (90.68)	11 228 999 (84.95)	1 551 437 (85.06)	143 822 (52.10)	4 755 (5.47)	50 105 (22.08)	13 604 766 (80.59)	13 916 887 (77.68)
1999	450 000 (87.87)	11 948 233 (84.03)	1 712 193 (83.32)	208 977 (62.55)	10 574 (10.03)	50 570 (20.02)	14 628 684 (79.56)	14 997 943 (76.79)
2000	504 000 (88.25)	12 380 911 (81.62)	1 703 357 (92.36)	224 868 (61.93)	10 682 (9.53)	54 482 (20.10)	15 137 148 (78.48)	15 524 966 (75.85)
2001	530 000 (88.55)	12 892 221 (80.83)	1 964 287 (93.61)	236 363 (58.94)	19 568 (15.82)	60 199 (20.78)	16 003 387 (78.06)	16 427 626 (75.54)

*Figures in parentheses indicate carp production as a percentage of freshwater aquaculture production in that country. Source: FAO, 2003. Fisheries Statistics [Online] Available: <http://www.fao.org/fi/statist/FISOPT/FISHPUS.asp> [2003, June].

A large increase in the total carp production in Asia has taken place mainly due to the very high annual growth rate (12 per cent) in carp aquaculture in the region over the last decade. During 1989-90, carp aquaculture contributed 91 per cent of the total production in Asia, which rose to 96 per cent during 1999-2000. At the same time, carp production from capture fisheries decreased at an average rate of 1 per cent annually.

2.3 Carp aquaculture in Asia

Bangladesh

Carp production accounted for 89 per cent of the total freshwater fish production in the country in 2001 (Table 2.1). Carps are by far the most important species in pond culture operations. *L. rohita*, *C. catla*, *C. cirrhosus* and *H. molitrix* together account for more than 78 per cent of (pond) production. About 88 per cent of all fish produced in ponds are carps. Polyculture of carps in ponds is most widely practiced in Bangladesh. Other culture systems include the integration of carp culture with rice farming and with poultry in the ponds. Carp culture in oxbow lakes (i.e. culture-based fisheries) is also practiced. As far as the intensity of polyculture of fish is concerned, pond culture may be rated as traditional to modified extensive¹⁰ (high fingerling stocking rate and low use of feed and fertilizers). However, there are some commercial ponds that are practicing semi-intensive technology.

China

In 2001 China accounted for 79 per cent and 76 per cent of the total carp production of Asia and the world, respectively. Carps are widely cultured, despite the introduction of numerous exotic freshwater species. Eight of the 10 major carp species being cultured are of national economic importance, including black carp (*Mylopharyngodon piceus*), *C. idella*, *C. carpio*, *H. molitrix*, *A. nobilis*, *C. carassius* and Chinese bream (*Megalobrama amblycephala* and *Parabramis pekinesis*). Production of these eight species reached nearly 12 million tonnes in 2001 and together accounted for about 73 per cent of the total freshwater aquaculture production. *H. molitrix*, *C. idella*, *C. carpio*, *A. nobilis* and

¹⁰ Aquaculture can be broadly classified as extensive, having no feed or fertilizer; semi-intensive, having some fertilizer and/or feed inputs; and intensive, largely reliant on feed inputs (Edwards et al. 1988; Edwards 1993; Molnar et al. 1996; Pullin 1993). As these systems are conceptual stages in a continuum and in actual practice modified to suit farm conditions, they are often categorized as "modified extensive", "modified semi-intensive", "modified intensive", "super intensive", etc. (Pillay 1997).

C. carassius accounted for 93 per cent of the total carp production. However, the share of carp production in the total aquaculture production was decreasing despite the fact that carp production was growing annually by 13 per cent. In 1990, the share was 92 per cent, which declined to 81 per cent in 2001. Growth in production of important species was 9.1 per cent for *C. idella*, 1.5 per cent for *H. molitrix*, 6.4 per cent for *C. carpio*, 19.7 per cent for *C. carassius*, 13.5 per cent for *M. piceus* and 39.5 per cent for *M. amblycephala* and *P. pekinensis*.

Currently, carps are grown in a polyculture system, but carp monoculture is also becoming popular for intensive culture in cages, ponds and running water systems. Culture environments include ponds, lakes, brooks, reservoirs and paddy fields, in a total area of 4 955 000 ha which comprises 1 994 000 ha in ponds, 880 000 ha in lakes, 1 568 000 ha in brooks, 371 000 ha in reservoirs, 1 586 000 ha in rice and paddy fields and 142 000 ha in other freshwater bodies. The highest production comes from ponds (4 474 kg/ha), followed by brooks (1 623 kg/ha), lakes (921 kg/ha) and reservoirs (743 kg/ha). Culture in China is very intensive with relatively high stocking and good use of feed and fertilizers. Carp culture takes place on state owned, collective, family-owned and private commercial farms.

India

Carps dominate aquaculture production in freshwater ponds, cages, pens and recirculating systems and production in inland fisheries. *C. catla*, *L. rohita* and *C. cirrhosus* accounted for 25 to 27 per cent each of the total aquaculture production in the country during 2001. These species together constituted about 85 per cent of the total freshwater aquaculture production during the same period. In freshwater aquaculture, only carp (pond) culture has reached commercial importance. About 93 per cent of the total carp production is coming from aquaculture with an average annual growth rate of 10 per cent during 1990-2001. On the other hand, production from capture fisheries has decreased by 7 per cent during the same period (Table 2.1).

The national productivity of carp culture in ponds more than doubled during the last one and a half decades, from less than 1 tonne/ha/year during the mid 1980s to more than 2 tonnes/ha/year in the early 2000s (Katiha 2000, Ayyappan and Jana 2003). Polyculture takes place in four systems,

extensive, improved extensive, semi-intensive or intensive. Polyculture in an improved extensive system forms the major practice all over the country (Wahab et al. 2001). In general, culture may be considered moderately semi-intensive as it is limited by low applications of feed and fertilizers.

Indonesia

Carps are the most important cultured species in Indonesia. Production of carps from aquaculture increased by 6 per cent per annum while capture fisheries decreased by 1 per cent during 1990-2001. The most important species are *C. carpio*, Java barb (*Barbonymus gonionotus*) and Nile carp (*Osteochilus hasseltii*). Indonesia is the world's third largest producer of *C. carpio* after China and the USSR. In 2001, *C. carpio* contributed about 90 per cent of the total carp production.

Cultured carps account for about 86 per cent of all carps produced in the country. Like China, although carp production has been on the increase, its share in the total aquaculture production eventually declined from 62 per cent in 1990 to 59 per cent in 2001.

Presently, carp culture largely takes place in three environments: ponds, floating cages and rice fields (Kontara and Maswardi 1999). The contributions from these systems to total aquaculture production in the country comprised 9.1 per cent from brackish water ponds, 4.1 per cent from freshwater ponds, 1.0 per cent from cages and 2.4 per cent from paddy fields. Production from culture grew by 8.4 per cent annually for brackish water ponds, 7.4 per cent for freshwater ponds and 2.4 per cent for paddy fields during 1987-96; the largest rise in production took place in cage culture, accounting for a 45.8 per cent annual growth during this period (DGF 1999).

Thailand

At present, fish culture in Thailand is one of the fastest growing industries in the region. Carp production from aquaculture had an average annual growth rate of 10 per cent during 1990-2001 where it accounted for about 20 per cent of the total aquaculture production and 56 per cent of the total carp production in the country. Overall carp production increased with an annual average growth rate of 8 per cent during the last decade.

B. gonionotus is the most important carp species in aquaculture (third among the freshwater species after tilapia and catfish) accounting for about 42 per cent of the total carp production in 2001. *C. carpio* accounted for 15 per cent during the same period.

Carp farming is carried out in ponds, paddy fields, ditches and cages. Polyculture in ponds is by far the most popular in terms of the number of farms and culture area. *H. molitrix*, *C. carpio*, *C. cirrhosus* and various species are normally cultured in polyculture together with other omnivorous species like Nile tilapia (*Oreochromis niloticus*). In addition carp culture is integrated with pig and poultry rearing and rice farming.

Vietnam

Rice farmers in Vietnam have practiced traditional carp culture in rice fields and village ponds for a long time. The main cultured species were *C. carpio* and other indigenous species. In the 1960s, with the introduction of *H. molitrix*, *A. nobilis* and *C. idella* together with induced breeding, freshwater fish culture entered into a new era. In spite of this, carp farming was not important to the rural economy of Vietnam until

the introduction of Indian carps *C. catla*, *L. rohita* and *C. cirrhosus*, in the early 1980s. In 1996, carp culture contributed about 29 per cent (0.40 million tonnes) to the total fish production (1.37 million tonnes). The Mekong River Delta plays a most important role in aquaculture, producing about 67 per cent of the total aquaculture production.

Carps are mainly cultured in a polyculture system. The main species are *H. molitrix*, *C. idella*, *A. nobilis*, *L. rohita*, *C. cirrhosus* and local fish species (*Pangasius* sp, *C. carpio*). The culture system is primarily semi-intensive with the use of only minimal amounts of fertilizers, rice bran and other agricultural on-farm and off-farm by-products as feed. In addition, an integrated VAC system (V: garden, A: fish pond, C: livestock) is also common in the Red River Delta.

2.4 Profile of carp producers in Asia

This section discusses the results of the surveys of 2 025 carp producers undertaken by the WorldFish Center and its partner institutes during 1998-99.

Table 2.2. Socio-demographic characteristics of carp producers in Asia. Values shown are averages from each country

Items	Bangladesh	China	India	Indonesia		Thailand	Vietnam	
				RWS ^a	Cages		Northern	Southern
Sampled farm households	540.00	383	409.00	40.00	71.00	284.00	158.00	240.00
Age of farmers (years)	45.00		47.00	46.55	40.87	49.77	43.00	52.00
Gender (%)								
Male	100.00	100	87.00			95.10	43.90	51.40
Female			13.00			4.90	56.10	48.60
Education (years)	8.00	12	7.42	7.43	8.07	5.38	8.80	6.00
Illiterates (%)	11.00		32.70			1.80		4.35
Primary Occupation (%)								
Fish culture	9.00	100	43.70	92.50	94.40	20.10	2.00	7.90
Crop farming	65.00		41.10	2.50	1.40	60.60	87.40	44.60
Animal farming	2.00		2.20		4.20	7.00	10.60	0.80
Others	24.00		12.50	5.00		12.30		46.70
Experience in carp farming (yrs)	13.00	15	6.00	13.00	5.00		10.00	7.00
Gross per capita income (US dollars)	293.00	4 949 ^b	1 113.00			2 424.00	575.00	885.00
Income Sources (%)								
Fish culture	14.93	64.00	79.66			20.01	27.60	27.58
Crop farming	28.93	3.00	13.10			13.03	29.40	58.15
Animal farming	3.19	3.00	0.03			48.41	27.30	14.20
Hatchery and seed Production		20.00	6.35				6.20	
Business and salaries	32.55	6.00	0.55				7.40	
Others	20.00	4.00				18.55	0.10	0.08
Average household size (no.)	5.50	3.5	8.00	3.35	3.73	4.65	5.00	5.81

^a RWS = Running water system: fish are held in pens in small streams and irrigation systems.

^b The gross per capita income of China refers only to family-based farms. The average gross income of co-operative and state owned farms ranges from US\$ 53 179 to 149 135 per farm.

Source: WorldFish Center Field Survey (1998-99).

Socio-demography of carp farmers

The socio-demographic characteristics of the carp producers in Bangladesh, China, India, Indonesia, Thailand and Vietnam are described in Table 2.2 including details on age, gender, sources of income and occupation. The average age of the farmers ranged from 40-52 years. The male head of the family usually carried out carp farming. In Vietnam, the participation of women in aquaculture is as high as 50-56 per cent (for southern and northern Vietnam, respectively) indicating that carp farming is potentially gender neutral. The average educational level of the farmers varied from only five¹¹ years in Thailand to 12 years in China. The higher educational profile of farmers in China perhaps enhanced production. In India, 32.7 per cent of the farmers were illiterate, a factor which may explain this country's lower level of production. Except for China and Indonesia, fish farming is not the primary occupation of the majority of the fish farmers surveyed.

Experience in carp farming is an important factor influencing the production; carp producers in China were most experienced (15 years) with the least in India (6 years). The average annual gross per capita income of the farmers was as low as US\$ 293 in Bangladesh to as high as US\$ 4 949 in China. The values for other countries were US\$ 2 424 for Thailand, US\$ 1 113 for India, US\$ 575 for northern Vietnam and US\$ 885 for southern Vietnam. In general, the gross per capita income of the carp farmers was above the national average income. Fish culture contributed up to 80 per cent in India and as low as 15 per cent in Bangladesh to household income. The contribution of carp farming to household incomes in India varied among the states, e.g. from 15 per cent in Orissa to 95 per cent in Andhra Pradesh.

General characteristics of carp farmers and carp farming

General characteristics of the carp farms with pond systems in the six countries are shown in Table 2.3. Private owners usually operate the carp farms, except in China and northern Vietnam, where a large proportion of farms are owned by the state or by collectives. In India, the Irrigation Department owns about 30 per cent of the common water bodies, which are used by the Fisheries Department for stocking. Joint ownership is common in India, Thailand and Vietnam.

The size of culture ponds varies among the countries. The average area cultivated by a household is as high as 4.24 ha in India and as low as 1.04 ha in southern Vietnam. In China, the size of a family-based farm is 3.6 ha, on average. State-owned large-scale farms can be as large as 131 ha. The farm area allocated to fishponds was 31 per cent in northern Vietnam, 23.5 per cent in India and 26 per cent in Thailand. The average size of a fishpond in China was 1.70 ha, 1.21 ha in Thailand and 1.16 ha in northern Vietnam. The average size of a fishpond was only 0.20 ha in Bangladesh, where they are used for various purposes in addition to stocking with fish. The polyculture of fish in ponds is the main fish culture system in all these countries, except in Indonesia where monoculture in running water systems and cages are common. In southern Vietnam, 30 per cent of the farmers practiced monoculture. Integrated fish farming and rice fish farming constituted a major part of the aquaculture in Thailand and Vietnam.

Stocking Characteristics

Carp farming practices, including stocking density, species stocked, sources and size of fingerlings, are found in Table 2.4. The average stocking density in fishponds was highest in Thailand (6 7328 pieces/ha), followed by South Vietnam (2 8200/ha) and China (2 7867/ha). *C. catla*, *L. rohita* and *C. cirrhosus* accounted for the largest proportion of stocked fish in India and Bangladesh. *H. molitrix* and *B. gonionotus* were also very important in Bangladesh, accounting for about 20 per cent and 13 per cent of stocked fish, respectively. In China, *H. molitrix* (28 per cent) and *C. carpio* (22 per cent) predominate. In Thailand, *B. gonionotus* accounted for 40 per cent of stocked fish, followed by *O. niloticus* (37 per cent) and *C. carpio* (8 per cent) (this refers only to systems in which carps are produced). In northern Vietnam, *H. molitrix* and *L. rohita* are the dominant carp species stocked, while in southern Vietnam, *B. gonionotus* and *C. carpio* are the dominant carps stocked.

In all the surveyed countries, fingerlings were supplied by private and government hatcheries, except in China where the farmers produced the fingerlings themselves. In Thailand, private hatcheries provided 74 per cent of the total supply of fingerlings, followed by 61 per cent in India and 55 per cent in northern Vietnam.

¹¹ Although the general level of literacy is quite high in Thailand compared to many other Asian countries, the level of education for carp farmers is low. Commercial fish farmers from the Central Plains of Thailand have a much higher level of education.

Table 2.3. General characteristics of carp farming in Asia

Items	Bangladesh	China	India	Indonesia	Thailand	Vietnam		
				RWS	Cages	Northern	Southern	
Farm Area (ha)		3.59 ^a	4.24	2.29	2.87	3.98	3.67	1.04
Crop land (%)		8.55 ^b	24.76			50.80	43.30	80.69
Water spread area (%)		83.11	44.85			26.04	47.90	18.11
Fish-pond area (%)		17.95	23.51			25.63	31.60	7.94
Homestead area (%)			1.20			5.06	4.80	3.40
Animal farming						0.73		
Unutilized area			5.45				3.90	
Others			0.25			4.40		
Size of the fish pond (ha)	0.20	1.70	0.87			1.21	1.16	0.82
Fish farm area by tenure (%)								
Privately owned	100.00	41.10	62.60	100.00	100.00	90.10	35.00	95.70
State owned		29.60	29.30			0.70	45.00	0.57
Collective		29.30	2.20			8.50	17.80	
Leased /Rented			6.80			0.70		3.73
Others			1.20				2.20	
Type of operation (%)								
Single ownership	86.70	100.00	71.00	100.00	100.00	85.40	88.00	99.12
Joint ownership			26.90			14.60	22.00	0.88
Lease operated	13.30							
Culture period (months)	9-12	8-11	8-12	3-4	3-4	5-12	c	c
Culture type (%)								
Seasonal	26.30		13.00			8.50	8.10	41.42
Perennial	73.70	100.00	87.00	100.00	100.00	91.50	91.90	58.48
Pond system								
Monoculture		4.20				8.50	1.80	30.50
Polyculture	100.00	92.30	100.00			91.50	98.20	69.50
Mono+polyculture		3.50						
Cage culture								
Monoculture					100.00			33.33
Polyculture								66.67
Rice fish farming								
Monoculture						100.00		12.90
Polyculture								87.10
RWS								
Monoculture				100.00				

^a The average total area refers to small-scale farms. For large-scale state owned farms it is 131.80 ha.

^b The percentage of pond area refers to the water-spread area.

^c Not available.

Source: WorldFish Center Field Survey (1998-99).

In Indonesia, where only *C. carpio* were stocked in cages and running water systems, 48-55 per cent of the total supply of fingerlings came from government hatcheries. Middlemen played an important role in supplying fingerlings for cage culture in Indonesia.

Fingerling size at stocking influences the pond yield. Stocking size is expressed in different units among the countries. Stocking size varied between 1-5 cm with an average of 3 cm for Indian major carps in India and Bangladesh. In China, stocking sizes varied between 20-250 g for *H. molitrix* and up to 1 kg for black carps that represent the largest stocking size for Asia. Similarly, in northern Vietnam stocking sizes were large, ranging from 63 g for *H. molitrix* to 382 g for black carp. In southern Vietnam stocking sizes were smaller, ranging from 1.2 g for *L. rohita* to 5.3 g for *A. nobilis*. In Indonesia, the stocking size of

C. carpio for monoculture in cages and running water system varied between 25-100 g.

Producers' preference ranking for different species

Producers' preferences for stocking of various species are shown in Table 2.5. In Bangladesh, producers ranked *L. rohita* as the most preferred species followed by *H. molitrix*, *C. cirrhosus* and *C. catla*. In China, producers gave highest preference for *C. idella*, followed by *H. molitrix* and *C. carassius*. In India, *L. rohita*, *C. catla* and *C. carpio* were the most preferred. In Thailand, farmers primarily preferred *O. niloticus*, but among carps they preferred *B. gonionotus* and *C. carpio* most. In northern Vietnam, the first preference was for *C. idella* followed by *C. carpio*, *H. molitrix* and *L. rohita* each with equal ranking. In southern Vietnam, farmers preferred *Pangasius hypophthalmus* most, followed by *C. carpio* and *B. gonionotus*.

Table 2.4. Carp farming practices in Asia

Items	Bangladesh	China	India	Indonesia	Thailand	Vietnam		
				RWS	Cages	Northern	Southern	
Average stocking density*	10 261.00	27 867.00	18 408.00	56.50	136.56	67 328.00	5 432.00	28 200.00
Species composition (%)	24.10		31.00			4.93	22.90	0.11
<i>Labeo rohita</i>	16.13		26.06					0.01
<i>Catla catla</i>	16.45		17.77			4.47	7.40	2.68
<i>Cirrhinus cirrhosus</i>	4.49	21.90	6.44	100.00	100.00	8.37	4.90	17.30
<i>Cyprinus carpio</i>	2.80	20.90	4.18				8.70	1.54
<i>Ctenopharyngodon idella</i>	19.68	27.96	7.17				28.10	2.83
<i>Hypophthalmichthys molitrix</i>	13.04					39.88		20.00
<i>Barbonymus gonionotus</i>	0.55						2.30	4.33
<i>L.calbasu</i>		8.97						
<i>Aristichthys nobilis</i>		3.11						
<i>Mylopharyngodon amblycephala</i>		14.93						
<i>Carassius carassius</i>		0.69						
<i>M. piceus</i>						36.76		
Tilapia	2.74	2.23	6.85			4.26	25.70	51.20
Others								
Source of fingerlings (%)								
Own	5.00	90.00	0.54	2.50	5.72	4.03	23.60	2.00
Private hatchery	40.00		61.85	42.50	13.46	74.20	54.50	79.00
Government hatchery	20.00		25.00	55.00	48.08	21.77	7.90	11.00
Middlemen and others	35.00	10.00	13.00		32.09		13.80	8.00

*For Indonesia, stocking density is in kg/100 m², while the others are in number/ha. Source: WorldFish Center Field Survey (1998-99).

Table 2.5. Producers' preference for freshwater species in Asia. In Thailand and northern Vietnam, some species had tied rankings

Rank	Bangladesh	China	India	Thailand	Northern Vietnam	Southern Vietnam
1	<i>L. rohita</i>	<i>C. idella</i>	<i>L. rohita</i>	<i>O. niloticus</i>	<i>C. idella</i>	<i>P. hypophthalmus</i>
2	<i>H. molitrix</i>	<i>H. molitrix</i>	<i>C. catla</i>	<i>B. gonionotus</i>	<i>C. carpio</i> / <i>L. rohita</i> / <i>C. cirrhosus</i> / <i>H. molitrix</i> / <i>O. niloticus</i> / <i>M. piceus</i>	<i>C. carpio</i>
3	<i>C. cirrhosus</i>	<i>C. auratus</i>	<i>C. carpio</i>	<i>C. batrachus</i>		<i>B. gonionotus</i>
4	<i>C. catla</i>	<i>C. carpio</i>	<i>C. idella</i>	<i>C. carpio</i>		<i>L. rohita</i>
5	<i>B. gonionotus</i>	<i>A. nobilis</i>	<i>C. cirrhosus</i>	<i>L. rohita</i> / <i>C. cirrhosus</i>		<i>C. cirrhosus</i>
6	<i>C. carpio</i>	<i>M. amblycephala</i>	<i>H. molitrix</i>	Chinese carps		<i>A. nobilis</i>
7	<i>C. idella</i>	<i>M. piceus</i>				<i>H. molitrix</i>
8	<i>L. calbasu</i>					

Source: WorldFish Center Field Survey (1998-99)

Reasons for preferences of carp species

The reasons given for carp species preference by the producers are listed in Table 2.6. Rapid growth, high market value and better meat quality were important reasons mentioned by farmers. In Bangladesh, *L. rohita* was preferred because of its higher market price, which reflects consumer preference. Farmers in Bangladesh also ranked *H. molitrix* highly, due to its rapid growth. In China, growth was the major factor for selecting *C. idella*, *H. molitrix* and *C. carpio*. The Chinese farmers also mentioned that better meat quality is a crucial factor for selecting *C. carassius* and

C. carpio. In India, a majority of the farmers preferred *C. catla* and *L. rohita* because of their higher market prices and *C. carpio* because of more rapid growth. Farmers in Thailand preferred *B. gonionotus* due to its higher growth and ease of culture. Farmers of northern Vietnam preferred *C. idella* due to its rapid growth. The reason for preferring *C. carpio* and *B. gonionotus* in southern Vietnam was their more rapid growth. Earlier studies in Indonesia revealed that preference varied across regions. People from central and east Java do not like red *C. carpio* (Ardiwinata 1981) while it is favored by the people in north Sumatera (Sumantadinata 1995).

Table 2.6. Reasons for preferring particular species

Countries	Species	Reasons
Bangladesh	<i>L. rohita</i>	Higher market price
	<i>H. molitrix</i>	Higher growth
	<i>B. gonionotus</i>	Good flavour/taste
China	<i>C. idella</i>	Higher growth
	<i>H. molitrix</i>	
	<i>C. carpio</i>	Better meat quality
	<i>C. auratus</i>	
India	<i>C. carpio</i>	Higher market price
	<i>C. catla</i>	
	<i>L. rohita</i>	
Thailand	<i>C. carpio</i>	Higher growth
	<i>B. gonionotus</i>	Ease of culture
	<i>C. carpio</i>	Higher growth
Southern Vietnam	<i>C. carpio</i>	Higher market price
	<i>B. gonionotus</i>	Higher growth
Northern Vietnam	<i>C. idella</i>	Higher market price
	<i>C. carpio</i>	Higher growth

Source: WorldFish Center Field Survey (1998-99).

Traits preferred by producers

Size, color and shape of the carps preferred by producers are shown in Table 2.7. In some cases, such as in Indonesia, it is known that there is a genetic basis to some of the variations observed in the color and shape of the common carp stocks. However, in most cases (e.g. Indian major carps), it is likely that rearing conditions influenced variations in color and shape.

Farmers in Bangladesh and India preferred fish of one kilogram in size, whereas Thai farmers were willing to grow fish to half that size. Farmers had differing preferences in color and shape. The preferred color for *L. rohita* by Bangladesh farmers was bright and reddish, but Indian farmers preferred brown fish. Thai farmers preferred white *L. rohita*. Farmers in India and Thailand preferred different shapes of *L. rohita*. Indian farmers favored long and thin fish bodies, but Thai farmers preferred shorter and thicker bodies.

Table 2.7. Preferred size, color and shape of the most popular species

Species/ Trait	Bangladesh	China	India	Indonesia		Thailand	Northern Vietnam
				RWS	Cages		
<i>L. rohita</i>							
Size (no/kg)	1		1			<2	
Color	Bright & reddish		Brown			White	Bright
Shape	Long & thick		Long & thin			Short & thick	Short & thick
<i>C. catla</i>							
Size (no/kg)	1		1				
Color	Bright & reddish		Brown				
Shape	Short & thick		Short & thick				
<i>C. cirrhosus</i>							
Size (no/kg)	1		1			<2	
Color	Bright		Brown			White	Black green
Shape	Long & thick		Long & thin			Long & thin	Short & thick
<i>C. carpio</i>							
Size (no/kg)	1	1	1	>2	<2		
Color	Bright & yellow	Reddish	Reddish	Greenish	Greenish	Silver/ Green/ Grey	Bright
Shape		Short & thick	Short & thick	Short & highback	Short & high back	Short & thick	Short & deep
<i>B. gonionotus</i>							
Size (no/kg)	3					2-3	
Color	White					White	Bright
Shape	Short & thick					Short & thick	Short & thick
<i>H. molitrix</i>							
Size (no/kg)	<1	2				<2	
Color	Silver white	Silver white				White	Silver
Shape	Long & thick	Short & thick				Short & thick	Short & thick

Source: WorldFish Center Field Survey (1998-99).

For all the species, the most preferred size was one kg/fish in Bangladesh and India, except for *B. gonionotus* in Bangladesh. Farmers using the running-water system in Indonesia preferred smaller sizes for *C. carpio* (> 2 pieces of fish/kg) compared to India and Thailand, where the preferred size was one to two/kg. Preferences of cage farmers in Indonesia were similar to those of farmers in Thailand and India. Farmers in Bangladesh and Thailand showed similar preferences for shape of *B. gonionotus* (short and thick).

2.5 Conclusions

Carp are by far the most important species for freshwater aquaculture of the countries under study, except in Thailand where tilapia and catfish topped the rankings. The major carp species grown in each country varied significantly. This could be due to the difference in production practices of these countries taking into account the bionomic characteristics of the species themselves. The Chinese carps have a long history of culture in China (the P.R. of China and Taiwan) but were less domesticated than *C. carpio* since captive breeding by induced spawning has been widespread only since the 1960s (Pullin 1986).

The ranking of producers' preferences showed that *L. rohita*, *C. catla*, *C. idella* and *H. molitrix* were some of the most preferred species in Asia. The reasons for this are rapid growth and better market prices. The top positions of Chinese carps in Asian production are due to the influence of production from China.

Nevertheless, many producers in Thailand, China and India showed a willingness to try new strains if made available. The majority of farmers in Thailand were willing to expand the area of carp farming and to continue the existing mode of operation. Results from the survey also indicated that attitudes toward continuing carp farming were positive in these countries.

Most of the countries cultured carps in a polyculture system. It is of interest to understand the biological and economic reasons for carp polyculture. The feeding niches of some component species are known, but the yield optimization and economic analyses and concepts of balance and competition between species are poorly understood.

The profile of carp producers and production systems varies among the countries. Farmers in China with better educational backgrounds and longer experience have a higher proportion of their income generated through fish farming. Although the average proportion of income from carp farming for Indian farmers is 79 per cent, income from carp farming varies considerably among states. The gross household income of the Chinese farmers is the highest, followed by Thai farmers. The area under fish culture as a proportion of the total farm area varies between 20-30 per cent among the countries. The average size of fishponds ranges from 0.2 ha in Bangladesh to 1.7 ha in China. Farms are mostly privately owned, except in China and northern Vietnam, where state ownership plays an important role.

The average stocking density varied between 5 432 fingerlings per ha in northern Vietnam to 66 927 fingerlings in Thailand. However, the proportion of carps in the total stocking constituted only about 60 per cent in Thailand and 49 per cent in southern Vietnam. Producer preferences for size, color and shape varied among countries. However, there is more uniformity among farmers in size preferences (1-2/kg).

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