4. Comparative advantage in freshwater fish farming

In this section we apply the RCA approach to a regional assessment of countries' comparative advantage in culturing three freshwater fish species.[19]

4.1 BACKGROUND

As a traditional and major aquaculture species group, freshwater finfish accounted for 38 percent of world aquaculture production by quantity and 34 percent by value in 2003. According to FAO, more than 120 freshwater finfish species have been cultured since 1950 (FAO, 2008). While many countries tend to focus on indigenous species, some species such as carp, catfish, and tilapia have generated truly global aquaculture industries.

Given limited resources, there are tradeoffs associated with the culture of these many different species: more resources allocated to farming one species means less resources for others. In the long run, a country's optimal aquaculture specialization pattern reflecting an efficient resource allocation can be shaped by market forces. In the short run, however, information about these patterns is important so that resources are not wasted on the "wrong" species. Governments and funding agencies also wish to have such information in order to avoid picking "losers". For society as a whole, such information can make aquaculture development more efficient and less painful.

While the future is unknown, history might help. In the spirit of the RCA approach, it would be informative to systematically compare countries' historical specialization patterns so as to "reveal" their comparative advantages and associated changes.

4.2 METHODOLOGY

This examination covers three regions: Asia, Latin America and the Caribbean (LAC), and sub-Saharan Africa (SSA). Three major freshwater finfish species are considered (carp, catfish, and tilapia).[20] Three separate RCA assessments are conducted, one for each region. In each assessment we used the "revealed comparative advantage" (RCA) index to compare countries' specialization patterns in the three species, and the "revealed comparative advantage variation" (RCAV) index to examine changes in these patterns.

While traditional RCA assessments are based on export data, in this analysis we used production data instead. That is, the RCA assessments in this study examine countries' *production* instead of *export* specialization patterns. Export data were not used primarily because they are not available – our attempts to obtain disaggregated export data on the three species were not fruitful.[21]

Export data are generally a better choice in RCA analysis because they are more comparable. While countries' exports compete in the same markets, their production may be significantly affected by domestic demand that tend to be quite different across

[19] "Fish" in this section includes only finfish.

[20] According to the International Standard Statistical Classification of Aquatic Animals and Plants (ISSCAAP), freshwater fishes are categorized into carp, tilapia, and miscellaneous freshwater fishes (in which catfish is a main species).

[21] Such data are not available in FAO's FishStat, UN Comtrade, or EUROSTAT. The "United States Foreign Trade" database maintained by the United States National Marine Fisheries Service provides data on tilapia and catfish exports to the United States market but no data are provided on carp.

countries. However, when the focus is on aquaculture's contribution to food supply and economic growth, production data may be able to provide useful information. For example, suppose a country has a relatively high specialization in tilapia production yet relatively low specialization in tilapia exports because most of the production is consumed by local consumers who favour the species. Under this situation, RCA indices calculated from trade data will be low for tilapia, which reflects that the country has a weak comparative advantage in exporting tilapia because of its high domestic preference for this species. However, the country's high specialization in tilapia production indicates that as far as farming is concerned, the country actually exhibits a strong comparative advantage. Therefore, even though tilapia may not be an export "shining star", it can still be considered a development priority because of its domestic contribution.[22]

4.2.1 Production RCA index

Similar to the trade RCA index defined in equation (4), we define the following production RCA index:

$$RCA_{ij} = \frac{c_{ij}}{c_j}, \tag{18}$$

where

$$c_{ij} = \frac{Q_{ij}}{\sum_j Q_{ij}}$$

is the ratio of country *i*'s production of species *j* (denoted as Q_{ij}) to its total production of all three species (i.e. $\sum_j Q_{ij}$).

Thus c_{ij}, as country *i*'s "specialization ratio" in culturing species *j*, measures the degree of concentration of country *i*'s freshwater fish farming on species *j*.

Similarly,

$$c_j = \frac{\sum_i Q_{ij}}{\sum_i \sum_j Q_{ij}}$$

represents the ratio between the production of species *j* by the entire region (i.e. $\sum_i Q_{ij}$) and the region's total production of all three species (i.e. $\sum_i \sum_j Q_{ij}$).

Thus, c_j represents the region's average specialization ratio in culturing species *j*.

An $RCA_{ij} > 1$, which according to equation (18) implies that $c_{ij} > c_j$, indicates that country *i*'s freshwater fish farming is more specialized in species *j* than the region's average; therefore, this above-average specialization can be an evidential indication that the country has a "strong comparative advantage" in culturing species *j*. In other words, the observation that country *i*'s freshwater fish farming is more concentrated on species *j* than its neighbouring countries implies that the country may have special characteristics making it relatively more suitable to engage in the farming of species *j*. Conversely, $RCA_{ij} < 1$ indicates that country *i* has a lower-than-average specialization in culturing species *j*, which may reveal that it has a "weak comparative advantage" in culturing the species.

[22] As the progress of globalization and free trade reduces producers' advantages in domestic markets, the differences between domestic and export markets tend to diminish. Eventually all producers may need to compete in a global market where their performances are measured by their production.

The greater the RCA index, the stronger the comparative advantage is. For example, a production RCA_{ij} index of 2 implies that country *i*'s specialization ratio in farming species *j* is two times as high as the region's average.

4.2.2 Production RCAV index

According to equation (A.6.2) in Appendix B, a production "revealed comparative advantage variation" (RCAV) index can be defined as

$$RCAV_{ij} = \frac{c_{ij,t+1}}{c_{j,t+1}} - \frac{\tilde{c}_{ij,t+1}}{c_{j,t+1}}, \tag{19}$$

where the first term on the right hand side represents country *i*'s actual production RCA index for species *j* at time *t*+1 while the second term represents the same RCA index under the hypothetical situation that country *i* has experienced no comparative advantage variation between time *t* and *t*+1.

We simplify the RCAV index in equation (19) into

$$RCAV_{ij} = c_{ij,t+1} - \tilde{c}_{ij,t+1}. \tag{19'}$$

Since the denominator $c_{j,t+1}$ (i.e. the region's average specialization ratio in culturing species *j*) is constant for all the countries in the region, the two RCAV indices defined in equations (19) and (19') are equivalent for cross-country comparisons of comparative advantage variation. However, the RCAV index defined in equation (19') can be more revealing for comparative advantage shifts among species because when defined as such, the sum of a country's RCAV indices for all species is equal to zero, i.e.

$$\sum_j RCAV_{ij} = \sum_j c_{ij,t+1} - \sum_j \tilde{c}_{ij,t+1} = 1 - 1 = 0.$$

Therefore, the RCAV index defined in equation (19') is not only able to indicate whether country *i* has gained (or lost) comparative advantage in species *j* but also provide information about the sources (or destinations) and magnitude of the gain (or loss).

According to equation (19'), $RCAV_{ij} > 0$ implies that country *i*'s *actual* specialization ratio in culturing species *j* (i.e. $c_{ij,t+1}$) is greater than the corresponding constant-comparative-advantage benchmark ratio (i.e. $\tilde{c}_{ij,t+1}$) that represents country *i*'s specialization ratio in culturing species *j* under the hypothetical situation that it has experienced no comparative advantage variation between time *t* and *t*+1. Therefore, $RCAV_{ij} > 0$ can be taken as an indication that country *i* has increased its comparative advantage in culturing species *j*. The greater the RCAV index, the larger the comparative advantage gain is.

Stated plainly, given country *i*'s production specialization pattern at time *t*, its specialization ratio in culturing species *j* at time *t*+1 would have been $\tilde{c}_{ij,t+1}$ had it experienced no comparative advantage variation in freshwater fish farming between time *t* and *t*+1. Then, if its actual production specialization ratio $c_{ij,t+1}$ turns out to be greater than this constant-comparative-advantage benchmark $\tilde{c}_{ij,t+1}$, which according to equation (19') implies that $RCAV_{ij} > 0$, we can say that country *i* has increased its comparative advantage in culturing species *j* during the period; the magnitude of the gain can be measured by the difference between $c_{ij,t+1}$ and $\tilde{c}_{ij,t+1}$.

Conversely, $RCAV_{ij} < 0$ is an indication that country *i* has reduced its comparative advantage in culturing species *j*. The smaller the negative RCAV index, the greater the comparative advantage decline is.

4.2.3 Two interpretations of RCA

As indicated by equations (3) and (4), there are two equivalent ways to interpret revealed comparative advantage. According to equation (3), revealed comparative advantage reflects a country's degree of dominance in a specific market as compared to its general dominance in the world market. On the other hand, according to equation (4), revealed comparative advantage reflects a country's degree of specialization in one product as compared to the world (or region) average specialization in the product.

A decision on which of these two equivalent interpretations should be adopted is contingent on the research perspective. In the shrimp export performance assessment presented in the previous section, we followed the "dominance" interpretation because we wanted to compare countries' shrimp export performance in different markets and identify the size and structural factors behind their performance changes. Yet in the freshwater fish farming comparative advantage assessment presented in this section, we will follow the "specialization" interpretation to compare countries' specialization patterns in culturing different species and how these patterns change over time. As discussed in section 4.1, the motivation of this study is to provide information useful for private and public decision makers regarding the structure of freshwater fish farming industries.

4.3 DATA

Freshwater fish farming production data from 1985 to 2003 were obtained from the FishStat database (FAO, 2008). The study period was divided into four sub-periods (1985–89, 1990–94, 1995–99, and 2000–03); data during each period were averaged to smooth away the impacts of transitory shocks on production.[23]

A total of 111 countries in the three regions reported freshwater finfish farming production during 1985 to 2003: 41 in Asia, 32 in LAC and 38 in SSA (Table 8). We divided the freshwater finfish category into four groups: carp, catfish, tilapia, and (miscellaneous) others. *Carp* includes all species in the ISSAAP group of "carps, barbells and other cyprinids"; *catfish* includes all species in the order of "siluriformes"; *tilapia* is the aggregate of all species in the ISSAAP group of "tilapias and other cichlids"; *miscellaneous others* include the remaining species.

4.4 RESULTS

According to FAO, world freshwater fish farming yielded 23 million tonnes of production in 2003. Carp, tilapia and catfish accounted for 74, 7 and 2 percent of this production, respectively.[24] Carp has always been the most dominant freshwater fish farming species (Figure 6), yet the carp farming specialization ratio (i.e. carp as a percentage of total freshwater fish farming production) in the world has declined from 80 percent in 1985–89 to 77 percent in 2000–03. As compared to carp, the specialization ratios for tilapia and catfish farming have been relatively small. While the ratio for tilapia increased from 4.8 percent in 1985–89 to 6.9 percent in 2000–03, the catfish ratio declined from 4.0 to 2.3 percent.

In sum, freshwater fish farming in the world has become more diversified during the study period (Figure 6). Rapid growth in the farming of tilapia and other miscellaneous species is the primary cause of this increasing diversification.

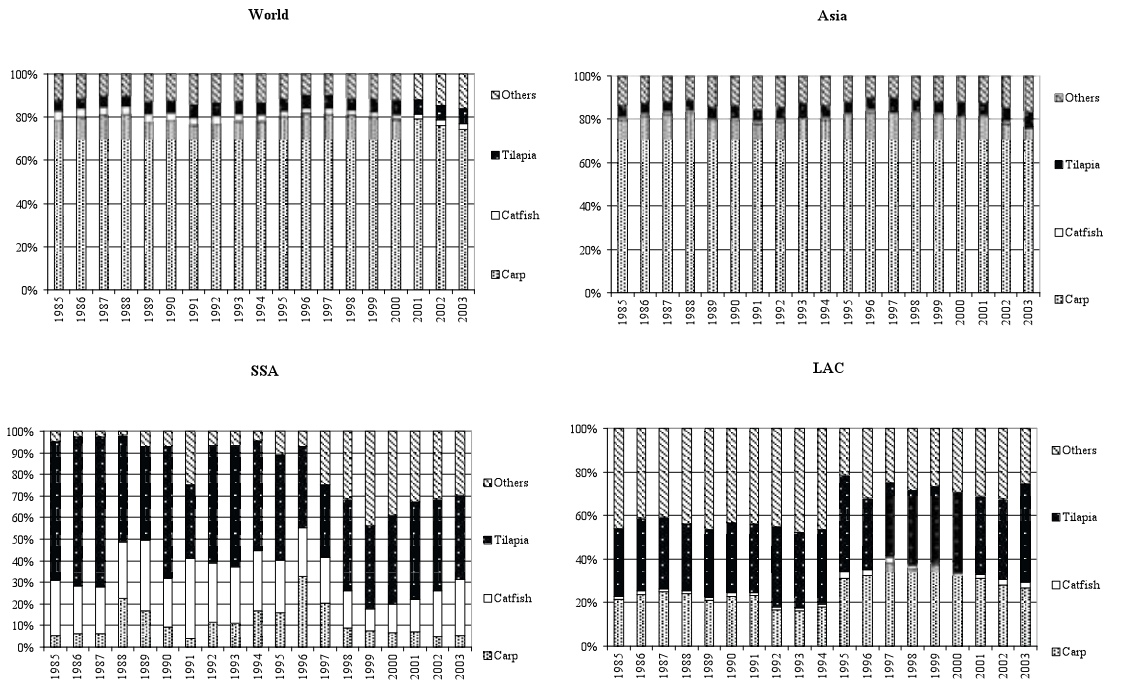
4.4.1 Freshwater fish farming comparative advantage in Asia

Asia is the largest freshwater fish farming region in the world, accounting for 95 percent of world production in 2003 (Table 8). Carp is Asia's most dominant freshwater fish

[23] Note that the time periods in this study are different from those used in the shrimp export performance analysis.

[24] Because some of these species might be included in the miscellaneous fishes category, the ratios tend to be understated.

FIGURE 6
Freshwater fish farming specialization patterns in the world



farming species, being cultured in more than 40 countries and accounting for 79 percent of the region's total freshwater fish farming production in 2003 (Figure 6).

Asia is also the largest catfish farming region in the world, accounting for 41 percent of world production in 2003. However, the region's specialization ratio in catfish farming has traditionally been the lowest among the three regions studied here (Figure 6): the ratio declined from 1.3 percent during 1985–89 to 0.9 percent during 2000–03. In addition, Asia is also the largest tilapia farming region in the world, accounting for 78 percent of world production in 2003. The region's average specialization ratio in tilapia farming was 6 percent in 2003, lower as compared to the other two regions (Figure 6).

In the following we discuss Asian countries' comparative advantage in the three species. We considered five Asian subregions including East Asia, Central Asia, the former Union of the Soviet Socialist Republics (the former USSR), Middle East, South Asia and Southeast Asia. We used two null hypotheses to guide the analysis of RCA and RCAV indices. First, we hypothesize that countries in the same subregion should have similar comparative advantage patterns. When this hypothesis is rejected, we identify the corresponding "outlier" patterns. We also hypothesize that countries in the same subregion tend to have similar comparative advantage variation in freshwater fish farming and identify outlier patterns accordingly.

East Asia

Table 9 lists 4 East Asian countries that have engaged in freshwater fish farming during the study period. China has been the largest freshwater fish farming country in the world, while the scale of fish farming in the other three countries (Japan, the Democratic People's Republic of Korea and the Republic of Korea) has been relatively small.

During 1985–89, all four East Asian countries had above-unity carp RCA indices (Table 9), implying a strong revealed comparative advantage in carp farming. For

TABLE 8
Annual freshwater finfish farming production (tonnes)

Region	Country	1985–89	2000–03	Region	Country	1985–89	2000–03	Region	Country	1985–89	2000-03
East Asia	China	3 517 070	15 660 142	South America	Brazil	12 400	152 867	Western SSA	Nigeria	10 864	27 864
South Asia	India	782 800	1 981 740	South America	Colombia	968	39 586	Western SSA	Ghana	372	4 836
South Asia	Bangladesh	143 708	687 855	Caribbean	Cuba	4 136	24 898	Eastern SSA	Zambia	895	4 473
Southeast Asia	Indonesia	196 116	477 501	Central America	Mexico	11 616	20 458	Eastern SSA	Uganda	36	3 399
Southeast Asia	Viet Nam	109 910	447 463	Central America	Costa Rica	109	11 220	Central SSA	Dem. Rep. of the Congo	622	2 688
Southeast Asia	Thailand	82 759	270 357	South America	Ecuador	59	7 791	Eastern SSA	The Madagascar	224	2 433
Southeast Asia	Myanmar	5 787	163 415	Caribbean	Jamaica	2 055	4 379	Eastern SSA	Zimbabwe	45	2 255
Southeast Asia	Philippines	73 251	130 517	South America	Venezuela (Bolivarian Republic of)	176	4 336	Northern SSA	Sudan	52	1 300
Southeast Asia	Taiwan, Province of China	86 488	93 628	Central America	Guatemala	109	2 497	Western SSA	Togo	17	991
Southeast Asia	Lao People's Democratic Republic	6 000	54 171	Caribbean	Dominican Republic	9	2 207	Western SSA	Côte d'Ivoire	168	974
Middle East	Iran, Islamic Republic of	22 307	46 534	Central America	Honduras	244	1 920	Eastern SSA	Kenya	244	709
Southeast Asia	Malaysia	5 898	45 454	Central America	Panama	430	677	Western SSA	Mali	13	637
South Asia	Nepal	4 965	16 593	South America	Argentina	0	449	Eastern SSA	Malawi	194	594
Middle East	Israel	12 746	15 450	South America	Guyana	17	446	Eastern SSA	Rwanda	52	586
Southeast Asia	Cambodia	3 568	14 871	South America	Peru	327	353	Southern SSA	South Africa	89	297
South Asia	Pakistan	8 401	13 291	Central America	El Salvador	14	290	Eastern SSA	Tanzania	100	286
East Asia	Japan	24 850	10 304	Caribbean	Puerto Rico	9	132	Central SSA	Cameroon	139	216
Middle East	Syrian Arab Republic	2 613	6 471	South America	Paraguay	41	107	Central SSA	Gabon	2	210
East Asia	Republic of Korea	5 182	5 996	South America	Bolivia (Plurinational State of)	21	83	Eastern SSA	Burundi	19	138
Former USSR	Uzbekistan	20 723	4 862	South America	Suriname	0	79	Central SSA	Central African	146	123
South Asia	Sri Lanka	4 400	3 848	Central America	Nicaragua	3	44	Northern SSA	Libyan Arab Jamajiriya	37	100
East Asia	North Korea	5 000	3 700	South America	French Guiana	0	21	Eastern SSA	Réunion	0	73

TABLE 8 (Continued)
Annual freshwater finfish farming production (tonnes)

Region	Country	1985–89	2000–03	Region	Country	1985–89	2000–03	Region	Country	1985–89	2000-03
Middle East	Saudi Arabia	431	3 168	Caribbean	Trinidad and Tobago	2	11	Southern SSA	Swaziland	22	65
Southeast Asia	China, Hong Kong SAR	5 541	1 927	Caribbean	Martinique	5	8	Eastern SSA	Mozambique	12	50
Middle East	Iraq	4 451	1 811	South America	Uruguay	3	7	Western SSA	Sierra Leone	16	30
Former USSR	Kazakhstan	7 878	676	Caribbean	Dominica	0	3	Western SSA	Niger	14	29
Former USSR	Armenia	4 280	670	Caribbean	Guadeloupe	0	2	Eastern SSA	Mauritius	4	28
Middle East	Turkey	1 837	658	Caribbean	Saint Lucia	0	2	Central SSA	Congo	139	26
Southeast Asia	Singapore	0	647	Caribbean	Grenada	0	1	Western SSA	Liberia	4	16
Middle East	Jordan	61	569	Caribbean	Bahamas	35	0	Western SSA	Senegal	5	14
Former USSR	Azerbaijan	1 633	158	Central America	Belize	0	0	Southern SSA	Namibia	0	13
Former USSR	Tajikistan	3 246	124	Caribbean	Virgin Islands	4	0	Southern SSA	Lesotho	24	8
Middle East	Lebanon	0	90					Western SSA	Benin	74	7
Former USSR	Kyrgyzstan	1 062	77					Western SSA	Burkina Faso	23	5
Southeast Asia	Brunei	2	71					Southern SSA	Mayotte	0	3
Former USSR	Georgia	780	63					Eastern SSA	Ethiopia	20	0
Former USSR	Turkmenistan	2 422	43					Western SSA	Gambia	0	0
South Asia	Bhutan	14	30					Western SSA	Guinea	2	0
Middle East	Kuwait	0	20								
Middle East	Cyprus	1	0								
Middle East	United Arab Emirates	0	0								
Asia		**5 158 179**	**20 164 960**	**Latin America and Caribbean**		**32 793**	**274 869**	**Sub-Saharan Africa**		**14 688**	**55 469**

Sorted by 2000–03 average production

TABLE 9
Freshwater fish farming comparative advantage (East Asia)

Country	Species	Production quantity (tonnes)				RCA		RCAV		
		1985–89	1990–94	1995–99	2000–03	1985–89	2000–03	Sub-period I[1]	Sub-period II	Sub-period III
China	Carp	3 282 199	5 158 350	10 307 442	13 037 102	1.18	1.05	-2.4%	-4.6%	-1.9%
	Catfish	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Tilapia	43 315	162 071	456 477	703 323	0.27	0.79	1.4%	1.2%	0.1%
	Others	191 556	332 808	933 438	1 919 717	0.36	0.88	0.9%	3.4%	1.8%
Japan	Carp	19 885	15 972	13 213	9 674	1.01	1.18	-0.8%	11.4%	5.9%
	Catfish	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Tilapia	4 592	4 420	1 165	434	4.12	0.74	0.4%	-12.3%	-4.9%
	Others	374	355	324	196	0.10	0.14	0.4%	0.9%	-1.0%
Democratic People's Republic of Korea	Carp	4 140	4 760	2 203	2 200	1.04	0.75	4.0%	-32.7%	8.9%
	Catfish	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Tilapia	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Others	860	640	1 594	1 500	1.14	2.90	-4.0%	32.7%	-8.9%
Republic of Korea	Carp	4 683	11 779	9 946	2 552	1.14	0.54	-10.8%	-11.8%	-26.9%
	Catfish	0	1 615	2 502	2 324	0.00	41.42	10.9%	8.3%	22.4%
	Tilapia	144	506	821	717	0.62	2.10	0.2%	2.5%	5.3%
	Others	354	882	799	404	0.45	0.48	-0.2%	1.0%	-0.8%

[1] Sub-period I goes from the second half of the 1980s (1985–89) to the first half of the 1990s (1990–1994); sub-period II goes from the first half of the 1990s (1990–94) to the second half of the 1990s; and sub-period III goes from the second half of the 1990s (1995–99) to the early 2000s (2000–03).

example, China's carp RCA index of 1.18 implied that China's specialization ratio in carp farming was 1.18 times as high as the Asia's average. This relatively structural bias towards carp farming serves as an evidential indication of China's strong comparative advantage in the activity. During 2000–03, while China and Japan still maintained their strong comparative advantage in carp farming, the two Koreas reduced theirs to a condition of weak advantage.

During 1985–89, Japan was the only East Asian country that had a strong revealed comparative advantage in tilapia farming with an RCA index of 4.12. Yet the index had declined to 0.74 by 2000–03. In contrast, the Republic of Korea raised its tilapia RCA index from 0.62 in 1985–89 to 2.1 in 2000–03. Another special feature of the Republic of Korea's fish farming as compared to its East Asian peers is catfish farming. While the other three countries have not reported any substantial catfish farming production during the study period, the Republic of Korea had developed catfish farming as much as tilapia farming by 2000–03 (Table 9). In fact, the country's catfish RCA index at the time was above 40, which implies that its specialization ratio in catfish farming was 40 times higher than the Asia's average.

Dynamically, China and the Republic of Korea are two countries that have been shifting their comparative advantage in freshwater fish farming from carp to other species. For example, China's carp RCAV index for sub-period I (between 1985–89 and 1990–94) is a negative 2.4 percent, which implies that compared to Asian countries in general, China's comparative advantage shifted 2.4 percent from carp farming to other species (specifically 1.4 percent to tilapia and 0.9 percent to miscellaneous others. See Table 9). Similar declines in China's comparative advantage in carp farming also occurred during sub-period II (between 1990–94 and 1995–99) and sub-period III (between 1995–99 and 2000–03).

The Republic of Korea's experience of declining comparative advantage in carp farming is similar to that of China; the difference is that it has occurred to a greater

TABLE 10
Freshwater fish farming comparative advantage (Central Asia)

Country	Species	Production quantity (tonnes)				RCA		RCAV		
		1985–89	1990–94	1995–99	2000–03	1985–89	2000–03	Sub-period I[1]	Sub-period II	Sub-period III
Armenia	Carp	4 280	2 445	392	670	1.26	1.26	-1.6%	-3.7%	6.6%
	Catfish	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Tilapia	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Others	0	41	21	0	0.00	0.00	1.6%	3.7%	-6.6%
Azerbaijan	Carp	1 633	1 447	327	158	1.26	1.26	-1.3%	-0.4%	1.9%
	Catfish	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Tilapia	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Others	0	19	5	0	0.00	0.00	1.3%	0.4%	-1.9%
Georgia	Carp	780	998	87	59	1.26	1.19	-2.7%	-6.4%	5.5%
	Catfish	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Tilapia	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Others	0	27	8	4	0.00	0.40	2.7%	6.4%	-5.5%
Kazakhstan	Carp	7 878	5 928	1 478	676	1.26	1.26	-1.5%	-4.8%	7.7%
	Catfish	0	5	2	0	0.00	0.00	0.1%	0.1%	-0.1%
	Tilapia	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Others	0	82	90	0	0.00	0.00	1.4%	4.7%	-7.6%
Kyrgyzstan	Carp	1 062	561	151	77	1.26	1.26	0.0%	0.0%	0.0%
	Catfish	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Tilapia	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Others	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
Tajikistan	Carp	3 246	2 522	121	124	1.26	1.26	0.0%	0.0%	0.0%
	Catfish	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Tilapia	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Others	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
Turkmenistan	Carp	2 422	2 179	643	43	1.26	1.26	0.0%	0.0%	0.0%
	Catfish	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Tilapia	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Others	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
Uzbekistan	Carp	20 723	19 709	7 065	4 862	1.26	1.26	0.0%	0.0%	0.0%
	Catfish	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Tilapia	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%
	Others	0	0	0	0	0.00	0.00	0.0%	0.0%	0.0%

[1] Sub-period I goes from the second half of the 1980s (1985–89) to the first half of the 1990s (1990–1994); sub-period II goes from the first half of the 1990s (1990–94) to the second half of the 1990s; and sub-period III goes from the second half of the 1990s (1995–99) to the early 2000s (2000–03).

extent (Table 9). Japan's experience is, however, just the opposite. Its RCAV indices show that it has gained comparative advantage in carp farming against tilapia for both sub-periods II and III (Table 9).

Central Asia

Table 10 lists eight former USSR members in Central Asia that have undertaken freshwater fish farming during the study period. Most of these eight countries (except Georgia) had completely specialized in carp farming during the early 2000s; even Georgia was highly specialized. In fact, carp has always been virtually the only freshwater fish species cultured in the region. Although five countries (Armenia,