Aquaculture Economics & Management, 9:195–215, 2005

ISSN: 1365-7305
DOI: 10.1080/13657300590961546

CHINA'S ACCESSION TO THE WTO AND ITS IMPLICATIONS FOR THE FISHERY AND AQUACULTURE SECTOR

Luping Li and Jikun Huang □ *Center for Chinese Agricultural Policy, Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, P. R. China*

□ *This paper reviews recent developments in China's fishery and aquaculture sectors, as well as the policies affecting rural households in general and fisheries households in particular. It explores how China's policies may change as a result of the nation joining the World Trade Organization (WTO) in December 2001 and the likely impacts of these changes on China's fishery and aquaculture sector. It was found that the domestic fish markets are gradually integrating, suggesting that fish price shifts in one area will affect prices in most parts of the country. It was also found that, compared with the prices of other agricultural commodities, the domestic prices of most aquatic products are well below world prices. This suggests that exports of aquatic products would be able to expand now that the nation has joined the WTO and that fishers would gain from this move.*

Keywords WTO, policy, fisheries and aquaculture, China

INTRODUCTION

While steady growth of grain production is at the core of China's food security policy, increasing the supply of aquatic products serves the purpose of improving the quality of diet of the Chinese people.[1] China's fisheries sector, as the largest producer of aquatic products in the world, has been the fastest growing subsector within Chinese agriculture over the past two decades, enjoying an average annual growth rate of more than 10% (NBS, 2001).[2] Whether or not this rapid growth is sustained in the future will largely depend on the policies implemented in the fisheries sector and on how China responds to its WTO accession.

The fisheries sector plays an increasingly important role in China's economy. It contributes not only to national income, foreign exchange earnings, and employment generation, but also to food security and the

Address correspondence to Luping Li, Center for Chinese Agricultural Policy, Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, P. R. China. E-mail: lupgli@hotmail.com

nutritional needs of the Chinese people. In 2002, the value of aquatic products accounted for more than 10% of the total value of agricultural output. In that year, the export earnings from the fisheries sector reached US$4.7 billion,[3] while 13.1 million people were employed in the sector and 20.4 million people were dependent on fishery and aquaculture (Fisheries Bureau, 2003).

Although agriculture has been at the centre of China's negotiations over its entry into the WTO, the concerns have been mainly focused on the cropping sector. Aquaculture and likely shifts in related policy in the future are not well understood. Debates on the sustainable development of China's aquaculture industry and on possible impacts of the shifts for both domestic and international markets are growing. Some (Wang, 2000; Yang, 2001) argue that the impacts of joining the WTO on China's aquaculture sector will be substantial. They argue that China's WTO accession will allow the country to exploit more fully its strong comparative advantage in aquaculture production. However, others believe that the impacts are likely to be modest or even adverse. This paper argues that the major reason underlining the debates is the limited understanding of potential policy changes that may result from China's WTO accession (Martin, 2002).

In general, policy responses to WTO accession are expected take one of two forms (Huang & Rozelle, 2002). One form sees the policy response being merely that which enables China to keep its commitments to WTO accession and to align existing domestic policies with WTO's rules. The other form is a response that will introduce new measures allowed under the new framework. This approach could boost China's economy and minimize adverse shocks that arise as part of the accession. Identifying the two kinds of policy changes is essential to understanding how China's WTO accession will affect the ways in which policy-makers respond.

The objectives of this paper are to review the existing policies in China's agriculture, particularly in fisheries; to explore the question of how China's agricultural policy will be likely to change as a result of the December 2001 accession to the WTO; and to determine the likely impacts of these changes on the fisheries sector. To do so, it is necessary to see those changes in the context of growth trends in the fisheries economy, and of structural changes in fishery production. The paper, therefore, begins with a brief summary of development in the fisheries industry since the initial reforms began in the late 1970s. The technique for testing market integration of aquatic products, and the sources of data are presented next describes international trade in aquatic products, and issues related to China's WTO accession. This is followed by a discussion on fish market integration. Section VI analyzes the existing policies affecting rural households in general and fishery households in particular, and the policy and institutional reforms that would be likely to help China boost its economy and minimize

any potential adverse shocks resulting from the WTO accession. The finally section of the paper presents the conclusions drawn.

OVERVIEW OF FISHERIES SECTOR DEVELOPMENT

Because aquatic products were considered as a nonstrategic food commodity in the nation's food security system, China's fishery and aquaculture sectors enjoyed the benefit of reform by way of market and price liberalization in early 1980s. In contrast to the declining role of the agricultural sector in the national economy, China's fisheries subsector keeps pace with the rate of overall economic growth, meeting the change in consumption pattern, and contributing to the improvement of the standard of living of the Chinese people. The share of the fisheries subsector in the gross value of agricultural output rose from less than 2% in 1980 to more than 5% in 1990 and reached 11% in 2000 (Table 1).[4] The average annual growth rate of the value of fishery output doubled from 5% in the pre-reform period of 1970–78 to more than 10% in 1996–2000. It has been the fastest growing sector within agriculture over the past two decades (Table 2). Indeed, the growth of the fisheries sector, particularly the development of inland fishery, has been accelerating since the reforms were initiated. Inland fish production started to increase dramatically in this period, with an average annual growth rate increasing from 2.2% in 1970–78 to 12.3% in 1979–84 and 12.5% in 1985–95 (Table 2). Over the period 1996–2000 the growth rates of the real value of output of marine and inland fisheries (10.1% and 11.6%, respectively) were both higher than those of the quantity of output (6.4% and 9.1%, respectively). This reflects the changing structure of aquatic products in favor of high quality and high value products. Both the expansion of areas for aquaculture production and rising aquacultural productivity have contributed to the rapid growth of the fisheries sector. The share of aquaculture fish production in total output of aquatic products has been increasing, providing opportunities for rural employment and increasing fishers' incomes—both of which have recently been of major concern to policymakers in China.

TABLE 1 Composition (%) of the Value of Agricultural Output, China, 1980–2000

	1980	1985	1990	1995	2000
Farming	75.6	69.2	64.6	58.4	55.7
Forestry	4.3	5.2	4.3	3.5	3.8
Livestock	18.4	22.1	25.7	29.7	29.6
Fishery	1.7	3.5	5.4	8.4	10.9
Total	100	100	100	100	100

Source: NBS, China Statistical Yearbook, various issues.

TABLE 2 Average Annual Growth Rate (%) of the Agricultural Economy by Sector, China, 1970–2000

	Prereform 1970–78	Reform period 1979–84	1985–95	1996–2000
Agricultural output value[a]	2.3	7.5	5.6	4.3
Crop	2.0	7.1	3.8	3.1
Forestry	6.2	8.8	3.9	5.7
Livestock	3.3	9.0	9.1	4.1
Fishery	5.0	7.9	13.7	10.2
Marine[b]	5.8	2.5	12.2	6.4 (10.1)
Inland[b]	2.2	12.3	12.5	9.1 (11.6)

[a] Growth rates are computed using the regression method. Growth rates refer to output value in real terms using the general price index for all retail commodities as deflator.

[b] Growth rates of marine and inland fisheries are based on production (volume) data, but the figures in parentheses for 1996–2000 are based on the value of output in real terms.

Source: NBS, China Statistical Yearbook, various issues; Ministry of Agriculture, PRC, China Agriculture Yearbook, various issues; Fisheries Bureau, Ministry of Agriculture, PRC, China Fisheries Statistical Yearbook, 2001.

Table 3 presents the growth of fishery and aquaculture production by capture and culture, and by location (marine and inland).[5] Fishery production in all categories has shown an increasing growth rate over time. The growth of fishery and aquaculture production accelerated in the mid-1980s, when the fish market was liberalized. Postliberalisation and until 1995, the average annual growth rate exceeded 12%. Culture fish production started to dramatically out-pace capture fish production in this period, with the average annual growth rate of culture fish output increasing from 10.7% in 1979–84 to near 15% in 1985–95 (Table 3).

The growth in the fisheries sector has been accompanied by significant structural change in both fishery and aquaculture. Capture fish production accounted for 70–75% of the total production in 1970s, reduced to

TABLE 3 Annual Growth Rate (%) of Aquaculture Production by Categories, China, 1970–2000

	Prereform 1970–78	Reform period 1979–84	1985–95	1996–2000
Output of aquatic products	4.9	5.1	12.3	7.5
Capture	4.4	2.1	10.1	5.9
Marine	5.0	1.6	10.1	5.5
Inland	−0.8	6.6	9.9	8.4
Culture	6.4	10.7	14.6	8.7
Marine	9.9	6.1	17.0	7.8
Inland	3.7	14.3	13.0	9.3

Note: Growth rates are computed using regression method.

Source: Fisheries Bureau, Ministry of Agriculture, PRC, China Fisheries Statistical Yearbook, 2001.

TABLE 4 Changes in the Structure (%) of Fishery Production, China, 1970–2000

Year	Marine	Inland	Capture	Culture
1970	73.8	26.2	74.7	25.3
1975	78.0	22.0	75.2	24.8
1978	79.7	20.3	71.1	28.9
1980	75.4	24.6	67.5	32.5
1985	63.8	36.2	54.8	45.2
1990	62.8	37.2	48.8	51.2
1995	63.0	37.0	43.7	56.3
2000	59.3	40.7	40.0	60.0

Source: Fisheries Bureau, Ministry of Agriculture, PRC, China Fisheries Statistical Yearbook, 2001.

50–60% in the mid-1980s and remained about 40–45% after the mid-1990s (Table 4). The capture fish industry is dominated by marine fishing, which accounted for 87% of total capture fish production in 2000. In contrast to the declining share of capture fish production, culture fish production has substantially increased—from 25% in 1970 to 51% in 1990, and 60% in 2000.

In the 1960s, in response to the increasing scarcity of natural resources in fishery and a rising demand for fish, China's fisheries sector adopted the strategy of making culture fish production a priority. In the 1970s, inland culture fish production surpassed inland capture fish production, and, in 1988, total culture fish production out-paced capture fish production. At the end of 1998, in order to further protect fisheries resources and sustain the development of the fisheries economy, the program of zero growth of capture fishery was launched. That program focuses on the control of catch intensity, reducing the number of fishing vessels, and implementing non-catch season regulation. As a result, the rate of growth in output of marine capture fishery declined from 8% in 1998 to 0.06% in 1999, and experienced a negative growth (–1.4%) in 2000. Similar to marine capture fishery, the inland capture fishery experienced negative growth in 2000, with a growth rate of –2.3%.

METHODOLOGY AND DATA

The effects of China's WTO accession on fisheries will vary across regions of the country, but they will be especially experienced in coastal areas. To the extent that the WTO accession results in a rises in fish prices at the border/ports, traders will expand fish exports.

In the context of market integration, the analyst's concern is usually with co-integration of order (1,1) between a pair of price series. The usual two-step, residual-based test for co-integration was developed by Engle and Granger (1987).

As the first step of the Engle-Granger procedure, the co-integrating regression is shown as follows:

$$P_{it} = \alpha + \beta P_{jt} + \gamma t + u_t,$$

Where P_{it} is the fish price at market i at time t; P_{jt} is the price of the same kind of fish at market j at time t; γ, α, β, are parameters to be estimated in equation (1); u_t is the error term.

The second step involves testing whether the residuals, $\hat{u}_t$, from the co-integrating regression are nonstationary using a modified version of the ADF test:

$$\Delta\hat{u}_t = \eta\,\hat{u}_{t-1} + \sum_{k=2}^{n} \theta_k\,\Delta\,\hat{u}_{t-k} + \varsigma_t,$$

where $\Delta\hat{u}_t = \hat{u}_t - \hat{u}_{t-1}$, $\Delta\hat{u}_{t-k} = \hat{u}_{t-k} - \hat{u}_{t-k-1}$;

$\hat{u}_t$, $\hat{u}_{t-1}$, $\hat{u}_{t-k}$, and $\hat{u}_{t-k-1}$ are, respectively, the residuals at time t, $t-1$, $t-k$, and $t-k-1$ from equation (2); η and θ_k are parameters to be estimated in equation (2); ζ_t is the error term.

The constant and time trend are now omitted from the ADF test because the residuals from the co-integrating regression will have a zero mean and be detrended. The null hypothesis that $\eta = 0$ is tested, but now this is a test of the stationary status of the residuals rather than the original time series. If the *t*-statistic on the η coefficient is less (i.e., more negative) than the relevant critical value, the null hypothesis may be rejected and two price series are said to be co-integrated of order (1,1). It follows that two markets are co-integrated if the coefficient is not different from one at a 5% level of significance.

The data on fish prices were obtained from China's State Administration for Industry and Commerce (SAIC), which has monitored the prices of various agricultural commodities, including major aquatic products, in 100 rural markets over the country. For the purpose of testing fish market integration, the data on silver carp, common carp, and crucian carp market prices, in 13, 15, and 13 provinces, respectively, from 1985 to 2001 were applied in this study. (For crucian carp the period was from 1986 to 2001.) The prices of fish by species were collected from three to five retail markets in a province on one day during each 10-day period. An arithmetic average is derived as that particular 10-day price of fish in a province based on the prices at these markets. It is far from perfect to use fish price by species and market. However, calculating the pattern of integration between all of them would be a huge job and beyond the scope of this paper.

INTERNATIONAL TRADE OF AQUATIC PRODUCTS

The export of aquatic products is an important foreign exchange earner for China. Fishery has been the largest exporter of the various subsectors in China's agriculture since 2000 (Chen, 2001).

China is also a net exporter of aquatic products in terms of the value of trade (Figure 1). The annual trade balance of aquatic products reached nearly US$2 billion in 1994–2000 and has been growing over time. In 2000, China was the second largest exporter of aquatic products in the world, only after Thailand (FAO, 2002). In that year, the total exports of aquatic products amounted to US$3.83 billion, with a volume of 1.53 million tons.

Frozen fish fillets, frozen fish, and frozen shrimp are the major aquatic products exported, while fishmeal, frozen fish (such as frozen cod, frozen hairtail, and frozen plaice), and live eel fry are the major imports of aquatic products. The species produced in China such as shrimp, tilapia, eel, crab, and shellfish are major exports. Shrimp is the largest exported specie with a total export value of US$0.75 billion, accounting for 16% of total value of aquatic products exported in 2002. The value of exported eel reached US$0.59 billion and accounted for 12.6% of total value of aquatic products exported in 2002. In addition to exporting aquatic commodities produced domestically, the country also processes imported raw material for re-exports and gains from a strong value-addition in processing. In 2002, China also bought about 600 thousand tons of fishery products from the world market for its domestic consumption, accounting for 24% of total fishery imports (including 936 thousand tons of imported raw material

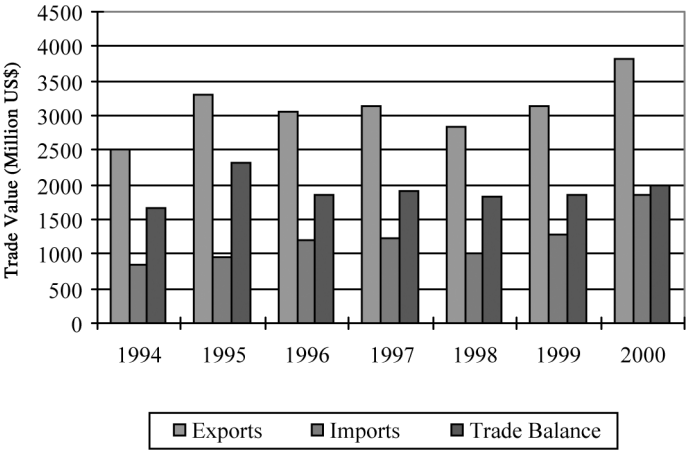

FIGURE 1 Exports, imports, and trade balance of aquatic products, China, 1994–2000.

for re-exports and 958 thousand tons of imported fishmeal for aquaculture and livestock).

Unlike many other agricultural commodities, China imposes little protection on its fisheries industry and has very low tariffs and no quotas against imports. At the end of 2001, the average tariff on aquatic products was only 14.3%, much less than the average for the whole agricultural sector (21%). According to China's WTO Protocol of Accession, the average level of tariff on most kinds of aquatic products would be cut to 10–12% by the year 2004 (Table 5), requiring only a very moderate reduction in the current import tariff. As a result, no large import shock from China's WTO accession is expected for the fisheries sector as a whole. Indeed, exports are likely to surge in the coming years as China gains access to international markets.

While the fisheries sector as a whole is expected to gain from China's WTO accession, a few species may face significant challenge. For example, import tariffs on live prawns and fresh or chilled fish fillets were as high as 24% in 2001. This rate will have to be lowered to 12% by 2005. With tariff reduction of this scale, the domestic market for such aquatic products is likely to suffer from shocks resulting from the importing of similar products from other developing countries. Our market and trader interviews reveal that imports of several other species, such as soft-shelled turtles and prawn from Southeast Asia and sleeve fish from South Korea, are expected to grow in China's post-WTO era.[6]

TABLE 5 Import Tariff Rates (%) on Selected Aquatic Products in China

Aquatic products	Tariff rate (As of December 2001)	Final bound tariff rate	Date of final bound tariff rate[a]
Live eels	16	10	2004
Other live fish[b]	12	10.5	2002
Fresh or chilled fish			
Trout	12	12	2002
Pacific salmon	11.7	10	2002
Herrings	16	12	2003
Frozen fish			
Trout	12	12	2002
Eels	16	12	2003
Pacific salmon	16	10	2004
Fresh or chilled fish fillets	24	12	2005
Frozen fish fillets	23.3	10	2005
Frozen shelled shrimp and prawn	19	8	2003
Frozen unshelled shrimp and prawn	17.5	5	2003
Frozen crabs	23.3	10	2005

Note: [a]Date of implementation refers to 1 January of the year indicated.
[b]Other live fish exclude live eels, ornamental fish, and fish fry.
Source: China's WTO Protocol of Accession, November 2001.

MARKET INTEGRATION OF AQUATIC PRODUCTS

It is expected that fish prices will rise at country borders as a result of China's accession to the WTO, because fish traders would expand their exports into the higher-priced world markets and these higher export prices would be transmitted to nearby markets in border areas. Because markets in China are increasingly integrated, these higher border prices would eventually be transmitted to other domestic markets in inland areas. This market integration will allow some of China's fishers, including poor fishers in remote area, to benefit from the WTO. Since 1985, the Chinese government has implemented a series of reforms, moving toward liberalization of the economy in both rural and urban areas through market extension and price deregulation. In addition to price liberalization, infrastructure to support the marketing system (e.g., transportation, communication, and market facilities) has been gradually improved. As a result, there is a trend toward greater market integration and marketing efficiency.

The results of the co-integration analysis show that the domestic markets of silver, common, and crucian carps are gradually being integrated (Table 6). The percentage of co-integrated market pairs for the types of carp increased from about 34% in 1985–93 to 82% in 1994–2001. Although there were many market pairs in which the prices of carp did not move together during the period from the mid-1980s to the early 1990s, a time when the market of agricultural commodities was beginning to be liberalized, the situation in fish markets was better than that in markets for grain, such as rice and soybeans (Huang et al., 2003). Market liberalization in the fisheries sector progressed more quickly than it did in the rest of the agricultural economy. As a result, prices of fish market pairs have increasingly co-moved since the mid-1990s. In 86% of the possible market pairs, for instance, the change in price of silver carp in one market was transmitted to another market.

POLICY CHANGES AND THE LIKELY SHIFTS IN FISHERIES POLICIES

Agricultural Investment

A decline in the ratio of government expenditure on agriculture to agricultural gross domestic product (AGDP) in the 1980s and the early

TABLE 6 Percentage of Co-Integrated Market Pairs for Selected Aquatic Products in Rural China, 1985–2001

	Silver carp	Common carp	Crucian carp
1985–1993	34	32	35[a]
1994–2001	86	78	82

[a] For the period from 1986 to 1993.

1990s raised government concerns about the sustainability of growth in agricultural production and domestic supply of agricultural products. In 1978, 7.6% of AGDP was invested in the agriculture sector; by 1995 this had fallen to only 3.6% (NBS, 2001). In response, government investment policy was reviewed and the ratio of agricultural investment to AGDP has been increased since the mid-1990s. In general, government investment bias is determined by comparing the relative size of public expenditure in a sector of the economy with its contribution to national income.

In this case, we estimated the approximate agricultural investment (expenditure) bias by dividing the share of government expenditure in fishery compared with that in total agriculture by the value of fishery output as a proportion of the value of total agricultural output. If it is less than 100, there is an anti-fishery bias in agricultural investment policy. If it is greater than 100, there is a pro-fishery government investment policy. If the index equals 100, there is no bias and policy is neutral.

Within the agriculture sector, the contribution of the fisheries industry to the sector has steadily increased over time. The share of the value of fisheries output in agriculture as a whole steadily increased after 1980 (Table 7). But government expenditure in the fisheries sub-sector as a share of fixed assets investments in agriculture declined from 8% in 1995 to 4% in 1999 and 3% in 2000. Chinese fishery and aquaculture industries enjoyed a pro-fisheries agricultural investment policy in the mid-1980s, with an index of agricultural investment bias of 200 in 1985. The index of agricultural investment bias against fisheries fell to 56 in 1996 and to 27 in 2000, implying that there has been an anti-fisheries bias in investment policy within the agriculture sector since 1996 (Table 7).

TABLE 7 Share (%) of Investment and Output Value in Agriculture Sector, China, 1970–2000

	Share in infrastructure investment				Share in output value				
Year	Crop	Forestry	Livestock	Fisheries	Crop	Forestry	Livestock	Fisheries	Fisheries Bias (%)
1970	—	—	—	—	82	2	14	2	—
1980	—	—	—	—	76	4	18	2	—
1985	53	26	13	8	69	5	22	4	200
1990	—	—	—	—	65	4	26	5	—
1995	58	27	12	8	58	4	30	8	100
1996	64	25	7	4	61	3	27	9	44
1997	62	23	10	5	57	3	31	9	56
1998	53	35	8	4	56	3	31	10	40
1999	46	45	6	4	57	4	29	10	40
2000	35	57	6	3	56	4	29	11	27

—indicates that the data are not available.

Source: NBS, China Statistical Yearbook and China Rural Statistical Yearbook, various issues.

Now that China has joined the WTO, investment in technology, particularly biotechnology in aquaculture and the aqua-feed industry, is currently considered as one of the primary measures to improve China's national food security. The aim is to provide sufficient fish food, to raise aquaculture productivity, and to make the aquaculture industry competitive in international fish markets. Public investment in plant biotechnology has increased at a rate much faster than that of other research sectors (Huang et al., 2002). The government is seeking an efficient and better use of its *de minimis* investment policy. It is also expected that both public and private sector investment in aquaculture will increase with the expansion of the market for fish.

Land Tenure and Aquaculture Ownership

Land reform was initiated in rural China during the early stage of economic reform in 1979–85. Production teams distributed agricultural land to households, in accordance with family size and/or labour force, without changing the collective ownership of the land.

Renewal of the land contract system and the issue of the new Rural Land Contract Law were significant shifts of agricultural land institutional arrangements. The renewed land contract introduced in 1994/1995 offered 30- or 50-year extensions from the expiration of the original 15-year land contract. A survey on land tenure conducted in 2000–02 by the Center for Chinese Agricultural Policy in eight provinces across China indicates that efficient land and input use and increased farmer investments resulting from well-defined land use rights and tenure systems might increase agricultural production. In aquaculture, the village has ownership of the fishpond and rents it out to individual farm households specializing in aquaculture.

China's WTO accession has raised concerns about the competitiveness of China's small farms under trade liberalization. One of the main responses to this concern is the development of the new Rural Land Contract Law, which was approved by the Standing Committee of the National People's Congress in August 2002. According to this law, although the property rights over the ownership of the land remains unchanged with collective ownership, almost all other rights now accrue to the contract holder under a private property system. This system encourages farmers to use their land to increase short- and long-run productivity on their farms. As a subsector of agriculture, fishery faces tenure issues and is experiencing change in tenure policy. One of the new features in water surface tenure encourages joint ownership in order to promote investment in infrastructure for aquaculture production, storage, processing, and delivery, and to improve the ability to cope with market risk.

China's fisheries sector is generally divided into state-owned and non-state-owned subsectors. Until the late 1970s, the state-owned fisheries subsector dominated the supply side (production, procurement and rationing to consumers) of the fishery economy. The dominance of the state-owned fisheries sub-sector was broken after the economic reform, in favor of market development. Currently the market share of state-owned enterprises engaged in aquatic products is estimated to be less than 20%. The non-state-owned sub-sector includes individual households, cooperatives, and collectives, which are able to respond to market demand and increase supply at an incredible speed. As of 2000, the non-state-owned subsector produced more than 95% of total fish output, with a total labour force of 12.9 million people, including 6.3 million people specializing in fishery and aquaculture production. This was 27 times more than the number in state-owned aquaculture. Based on fisheries statistics in 2000 (Fisheries Bureau, 2001), the cultivated water area managed by non-state producers was more than 5 million hectares, nearly three times as large as that managed by the state-owned subsector. The growth of the non-state-owned subsector in the fisheries sector seems to have transformed the fisheries industry into a more labour-intensive one. It has certainly created higher water productivity.

Table 8 shows the size of freshwater aquaculture farms by ownership in the 1990s. The data were from a nationwide survey on aquatic production costs, conducted by the State Economic Planning Commission (SEPC). Due to the small size of the survey samples, farm size appears to have changed considerably over the survey years. Despite this limitation of the data, Table 8 does provide some background information on the size of aquaculture farms in China. For much of the 1990s, the average farm size of freshwater fish production was about 15 ha, ranging from almost 10 ha to

TABLE 8 Farm-size (ha) in Aquaculture by Ownership, China, 1992–99

Year	Average	Individual household specializing in aquaculture	State- and collective-owned aquaculture farm
1992	18.2	5.6	82.9
1993	26.1	1.9	71.1
1994	16.6	2.9	70.9
1995	14.1	1.8	35.5
1996	12.2	1.8	67.3
1997	13.6	2.2	98.7
1998	12.5	1.6	94.9
1999	9.8	1.7	96.4
1992–99	14.8	2.4	70.4

Source: SEPC, the Collection of National Agricultural Products Cost and Revenue Information, various issues.

26 ha per farm. The size of state- and collective-owned aquaculture farms (36–99 ha/farm), however, was much larger than that of individual households specializing in aquaculture production (1.6–5.6 ha/farm). (In general, there is 40–70 ha water area in a collective-owned aquaculture farm, which consists of several farm households.) The farm size of individual households specializing in aquaculture production averaged 2.4 ha for much of the 1990s and was much larger than that of individual households specializing in crop production (0.4 hectare/farm).

Agricultural Price and Marketing

Price and market reforms were key components of China's policy shift from a planned economy to a market-oriented one. Price deregulation and market liberalization began with nonstrategic commodities such as vegetables, fruit, meats, and aquatic products.

Agricultural price and market liberalization policies have had a sharp impact on the growth of the fisheries sector. In the mid-1980s, increased prices for aquatic products provided higher incentives for fishery and aquaculture production, although prices and incentives have gradually fallen since 1988.

Market liberalization of the fishery sector took off earlier and proceeded faster than it did in other sectors of the agricultural economy. By 1985, all forms of economic entity—individuals, private firms, collective firms, and state enterprises—were allowed to procure and deliver fishery products to the market. At the same time, the rationing of fish to consumers was abandoned. Increasing competition raised the efficiency of markets, making them more responsive to consumer demands, and reducing transaction costs.

Market liberalization has resulted in a prosperous aquatic products market. The total domestic trade volume of aquatic products has increased dramatically, and the share of the state-run trading agency has decreased rapidly. According to a survey in 1998 (YJLZJC, 1998), the total domestic trade volume of aquatic products reached 20 million tons, 27 times greater than in 1979. The share of the state-run trading agency, however, fell to 18% (3.6 million tons) of the total volume of aquatic products marketed. In contrast, the volume of aquatic products traded by cooperative enterprises and individual private traders accounted for 20% (4 million tons) and 34% (6.8 million tons), respectively. Moreover, the marketed aquatic products procured by processing enterprises and delivered directly by producers accounted for 12% (2.4 million tons) and 16% (3.2 million tons) of the total domestic trade volume, respectively. The emergence of private trading is one of the main factors accounting for market expansion over the past two decades. In 2000, 19.6 million tons of aquatic products,

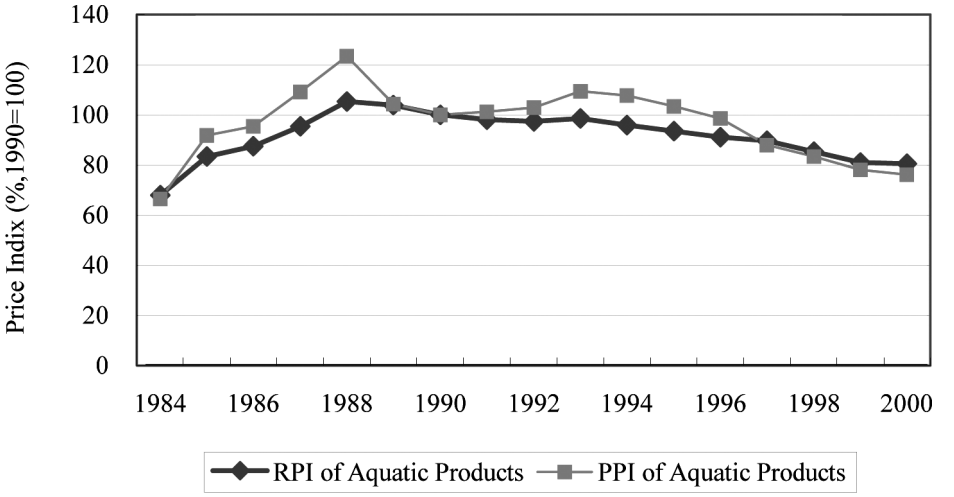

FIGURE 2 Real retail and procurement price indices of aquatic products, China, 1984–2000.

accounting for 46% of the total fish output, were traded on the domestic market, with a total value of US$25 billion (Fisheries Bureau MOA, 2001).

During the period 1984–88, price deregulation resulting from market liberalization and increases in demand for aquatic products led to substantial rises in the real price of aquatic products (Fig. 2). However, the real retail price of aquatic products has gradually fallen since 1988. The real retail price of aquatic products in 2000 was 25% lower than it was in 1988. In contrast to retail price, the real procurement price of aquatic products, which before market liberalization was largely controlled by the government, increased even faster during 1984–88 and fell even further after 1993.

What have the price and marketing policies meant for nominal protection rates for agriculture in general and aquaculture in particular in China? Table 9 shows recent estimates of selected agricultural commodities based on wholesale market prices. Wheat and maize, the nation's main imported farm commodities, received relatively favorable treatment when compared with rice. In contrast, fish and pork producers appear to have received less than what they would have received if they could have sold their products at international prices. The average price farmers received for living common carp was one-third lower than the border price in 1998–2001. In general, there is negative protection on major aquatic products. The domestic prices of major aquatic products are below international prices, suggesting that the country would be able to export more aquatic products after the WTO accession than it could before.

Domestic marketing policy response to the nation's WTO accession has been substantial and will continue (Huang & Rozelle, 2002). Major

TABLE 9 Nominal Protection Rate (NPR) (%) for Selected Grain, Livestock and Aquatic Products, China, 1998–2001

	Rice	Wheat	Maize	Pork	Live common carp	Live eels
1998	−4	21	40	−25	−42	−16
1999	−9	30	33	−17	−31	−0.1
2000	−2	18	22	−25	−40	−2
2001	−3	12	32	−32	−40	−4

Note: Export prices (rice, pork, and aquatic products) and imports prices (wheat and maize) are used as border prices subject to the comparability (adjusted for quality difference from domestic produced products). Domestic prices are prices at urban wholesale markets near the border. Official exchange rates are used to convert border prices.

Source: Authors' estimates and Huang and Rozelle (2001).

changes are aimed at improving the efficiency of domestic markets and minimizing the adverse shocks that may arise from external trade liberalization. In response to WTO accession, the government also has ambitious plans to increase investment in the infrastructure needed to establish an effective national marketing information network. The Ministry of Agriculture is attempting to standardize the quality of farm products and to promote domestic marketing of aquatic products.

Foreign Exchange and International Trade

China's policies governing the external economy have played a highly influential role in shaping the growth and structure of agriculture for many decades. Before economic reform, to support the "import substitution" industrialization strategy, China adopted a state-monopolized unified foreign exchange management system. Under this system, the government strictly controlled the earning and allocation of all foreign exchange and adopted a fixed official exchange rate system. Since economic reform, China has gradually changed its foreign exchange management system and established a foreign exchange swap market.

While the official exchange rate of the Chinese currency – the Renminbi (RMB) – was overvalued over the past several decades, the reform in the foreign exchange system has seen the real exchange rate of the RMB depreciated by 400% during the period 1978 to 1994. It is believed that the official exchange rate approximated the real exchange rate in 1994. However, the RMB started to appreciate gradually after 1994 (Huang & Rozelle, 2001; NBS, 2001). Therefore, in general, except for the late 1990s, adjustments in the exchange rates throughout most of the reform period have increased export competitiveness and contributed to China's export growth.

Liberalization has also been experienced in tariff and nontariff trade policy. During the past two decades, China's foreign trade regime has

gradually changed from a highly centralized and planned regime to a more open and liberalized one (Huang & Chen, 1999). Significant progress has been made since liberalization of the foreign trade regime, but further reforms are needed to move China toward a more open and liberalized economy.

As of the date of China's WTO accession, December 2001, the tariffs for 5300 items (75% of all items with tariffs) were cut by a greater or lesser amount. The import tariff on aquatic products has been reduced to an average level of 14.3% in 2001. Specifically, tariffs on live fish (excluding live eels, ornamental fish, and fish fry) and fresh or chilled pacific salmon were cut to 10.5% and 10%, respectively, in January 2002 (Table 5). Compared with the trend of tariff reduction in the past decade, the tariff changes resulting from China's WTO accession should present relatively few problems. Significant reforms will, however, be required in the area of nontariff measures. China will undoubtedly make great efforts to create a fully transparent and open trade regime with respect to nontariff barriers. The measures for technical barriers to trade (TBT) and sanitary and phytosanitary (SPS) as well as institutional arrangements to fulfill the agreement on Trade-Related Intellectual Property Rights (TRIPS) are the other important issues which China has to deal with. More and more enterprises and the government at various levels have paid great attention to fish quality and safety issues as well as anti-dumping action by many importing countries, which has become a major problem faced by China's fisheries and aquaculture sector.

Research and Technology Development

China has a strong agriculture research system that has generated technologies that have been adopted by millions of farmers to meet the increasing demand for food and agricultural products in the most populous country in the world (Stone, 1988). All previous studies consistently show that research-led technological change is the main engine of agricultural growth (Huang & Rozelle, 1996; Fan & Pardey, 1997).

Although China's agricultural research system functioned well and addressed many important problems in past years, its expenditures have been tied to public budgets and now face considerable challenges. Currently, there is much concern about the decline in agricultural research investment intensity since the early 1980s. By 1999, the ratio of investment in agricultural research to agricultural GDP was only 0.44 (Huang & Hu, 2002).

Fishery research is generally conducted in public institutions. The number of public aquatic research institutions increased from 185 in 1990 to 217 in 2000, when there were about 4,000 professionals engaged in aquatic

research at aquatic research institutes nationwide. The Chinese Academy of Fishery Sciences, the leading institution engaged in fishery research, was established in 1978. Fishery technology extension work is usually coordinated by the Ministry of Agriculture. The number of extension offices doubled during the period from 1990 to 2000, by which time there were 2,451 aquatic technology extension offices with 15,636 staff members. The National Extension and Service Center of Aquatic Technology was set up in 1990 and is designed to provide assistance with extension systems, professional training, information exchange, disease control, breeding and introduction of fry, etc. To some extent, fisheries university or college facilities are also involved in extension work on fisheries.

The result of enormous progress in aquatic technology is clearly shown by yield increase. For example, the average yield of aquatic products doubled from 1,712 kg/ha in 1990 to 3,953 kg/ha in 2000. Inland aquaculture enjoyed even more remarkable growth in yields, growing by 700% over the past two decades.

In response to WTO accession, China is now focusing on control and prevention of disease in aquaculture by identifying the appropriate number and density of sea cages, improvement of water quality and seawater systems for indoor tanks, and development of effective vaccines.

Changes in Institutions

Laws and Regulations

Many of the most important changes resulting from China's WTO accession will be the changes in laws and regulations. China reserved the right to use a transitional period of one year from the date of accession to amend or repeal any institution, regulation, law, or legal stipulation in its current economic policies in order to make them consistent with the spirit of non-discrimination and transparency. The government had recognized this, and had already started to make a concentrated effort to rectify existing laws and regulations in the late 1990s (Huang & Rozelle, 2002). For example, in January 2000, to provide a general guidance for ministerial and local government authorities to amend or repeal the relevant regulations, laws and policies, the State Council decreed two important regulations—the Regulations on Formulation Process of Laws, and the Regulations on Formulation Process of Administrative Laws. Essentially, these new regulations aim to transfer government functions to the market economy and direct the government to take a more indirect role in commerce and trade activities. They try to limit government intervention and emphasize that the role of government is primarily to provide social and public services. The regulations also seek to simplify administrative processes and increase the transparency of regulations and policies.

Farm Organization

The creation of farmer organizations used to be a politically sensitive issue. The government was concerned with the rise of any organization outside its authority. Recognising that government investment in creating such farm organizations as agricultural technology and marketing groups will not be counted as part of the nation's aggregate measurement of support (AMS), the government has now officially thrown its support behind self-organized farmer groups that focus on agricultural technology and marketing. Perhaps most importantly, the government is going to need these farmer organizations to lead the fight against the imposition of trade barriers on China's agricultural exports and to protect the interests of domestic agricultural exporters and producers (Huang & Rozelle, 2002).

Tax Reform

Tax cuts would increase the competitiveness of China's domestic products in international markets. To make the rural economy more competitive and to remove a set of institutions that has historically caused a lot of frustration among rural residents, the government has begun to experiment with rural tax reform. The boldest experiment to date is based on a movement that seeks to "convert fees into taxes." The earliest experiments began in Anhui province in 2000. The reform was designed to reduce the burden of various fees imposed on farmers to a maximum level of 5% of the farmer's income. Definitely, fishers would benefit from such tax reform.

CONCLUSIONS

As the largest producer of fishery products and aquaculture in the world, China's industry is one of the few subsectors that has been maintaining rapid growth, in line with overall economic development. It has become the largest exporter within China's agriculture sector.

Reform in the fishery sector out-paced that of the rest of the rural economy, and this contributed to the sector's growth. Although China only joined WTO in December 2001, it has already started to adjust to the environment of a post-WTO regime. Tariff reduction, amendment of laws and regulations, and changes in policies have all helped China meet its commitment to WTO accession and helped its farmers operate in a changing world. However, the government still has many policy options to choose and it can play an active role in helping agriculture as well as aquaculture.

In this research, it was found that the domestic fish markets are gradually integrating, meaning that fish price shifts in one area will affect prices in most parts of the country. As a result of China's accession to the WTO, expanded exports of aquatic products will be likely to increase the

fish prices in border markets and this will be transmitted to other markets. This suggests that fishers may benefit from the nation's accession to the WTO.

Recent increases in the government's support of agricultural productivity growth indicate that China has already begun to respond to the challenges posed by the WTO regime. It is likely that productivity-enhancing investments will play an important role in making China's farmers more competitive. As aquaculture is one of the sectors with a comparative advantage in the rural economy and one in which future exports are likely to grow, it is likely that both public and private investment in fisheries sector will increase.

Compared with prices of other agricultural commodities, the domestic prices of most aquatic products are well below world prices. This suggests that exports of aquatic products would be able to expand as a result of China joining the WTO.

Not only raising productivity-enhancing investment in, for example, agricultural research and extension expenditures, and investing in rural infrastructure, but also setting up marketing and price reporting information networks, standardizing agricultural products, and enhancing China's capacity to deal with TBT and SPS issues under the WTO rules are critically important. China is expected to increasingly focus on control and prevention of aquaculture fish disease, with studies into the appropriate number and density of sea cages, improvement of seawater systems for indoor tanks, and the development of effective vaccines.

On the other hand, China still has some room to adjust the structure of its agricultural investment by identifying priorities for investment and allocating limited fiscal resource to the promotion and acceleration of sectors in which the country has a comparative advantage, such as horticulture, fruit, livestock, and aquaculture. The implication of this is that the likely shift of agricultural policy should stimulate structural change in the rural and agricultural economies. Successful strategic adjustment of its agricultural structure in line with its position as a new member of the WTO will contribute to farm incomes in China. The limited AMS funds should be spent on supporting appropriate sectors such as aquaculture.

Most fundamentally, the government's response to WTO really involves an entire shift of its policies—from directly intervening in the economy to playing an indirect, regulatory and fostering role. The government is expected to set up institutions to create and manage public goods. The current tax reforms in rural China should be implemented and expanded. Furthermore, for efficient use of land and water resources, a well-defined landuse rights and tenure system will facilitate the transfer of landuse rights and encourage farmers to increase investment in agriculture in general and in aquaculture in particular.

ACKNOWLEDGEMENTS

The paper has benefited from research assistance from Haomiao Liu and comments from Madan Dey. Financial support from Asian Development Bank (through ICLARM) and from the National Science Foundation of China (70024001) are gratefully acknowledged.

NOTES

1. The data and information relates to food aquatic products only, unless otherwise specified as fishmeal or/and ornamental fish.
2. The official production data over-report the real situation. A preliminary result from a study by the Center for Chinese Agricultural Policy in 2000–02 reveals that, over the past two decades, the annual growth rate of the fisheries sector was 7.4% instead of over 10%.
3. The official exchange rate of Chinese currency—the Renminbi (RMB) to USD is 8.27 in 2002.
4. The data and information in this paper refers to Mainland China only. For a discussion of the situation of the Hongkong Special Economic Zone, see *Aquaculture Economics and Management* Vol. 6, Nos. 3 and 4.
5. Production data prior to 1997 were adjusted by using a number of the conversion factors, which were first applied in 1996. The conversion factors are 1.11, 1.75, and 1.02 for marine capture fish, marine culture fish, and inland freshwater fish (both capture and culture), respectively.
6. This is confirmed by comparing the cost of production for these species. For example, the production cost of soft-shelled turtles per kilogram was less than US$5 in Southeast Asia in the late 1990s, while it was about US$7 in China.

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