

## Fisheries and Aquaculture of the BRICS in the World Economy

The article addresses the role of fishery in the BRICS economy and its share in the world economy. Correlation between two sectors: fishery and aquaculture cultivation shows that the latter is rapidly growing in China and in India. These countries hold the dominant positions in the world fishery. This is reflected in the structure of nutrition in BRICS countries and in protein consumption which is traditionally very low in India. Development of fishery is playing an important role in BRICS countries as it covers the demand in protein rich food which has increased practically in all the countries in the last tree decades. The medical norms of protein daily consumption differ depending on climate and individual properties of consumers (weight, age, occupation) yet on average in the developed countries it reaches the value of 100 gram per person per day.

**Key words:** fishery, aquaculture cultivation, BRICS, Brazil, Russia, India, China, South African Republic, fish consumption, structure of nutrition, international trade in fish products

Development of fisheries and aquaculture plays an important role in the livelihood of the population and in the economy of BRICS. Primarily, it provides for the nutritional needs of the population in food, rich in protein. It has particular importance for such countries as China and India, where historically consumption of animal products was very low.

Consumption of proteins in the nutrition has increased in almost all the BRICS countries over the past 30 years. Although daily medical intake of protein per person depends on individual parameters (weight, age, occupation) and the climate, in developed countries it is above 100 grams per person per day. In 2011 the population of Russia consumed 101 grams of protein per day (see tab. 1). In other countries of the BRICS group in the 1980s, the amount of protein was significantly below normal – 48.3 grams per person per day in India, 54.0 per gram in China, 64.1 grams in Brazil. By 2011 Brazil and especially China that were gradually increasing the consumption of animal food (meat, milk, fish) have reached the standards of the developed countries. In these countries the consumption of protein in the diet was approximately 95 grams per day. However, India is still far from the norm. Only 60.1 grams of protein per day (see tab. 1) were consumed in the country in 2011.

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Table 1

**Protein in food consumption in BRICS, gram per capita per day**

	1980			2011		
	Total	From animal and fish products	From crops products	Total	From animal and fish products	From crops products
Brazil	64,1	25,7 (40%)	38,4	94,5	51,0 (54%)	43,5
Russia	91,6	45,9 (50%)	45,7	101,3	54,1 (53%)	47,2
India	48,3	6,6 (14%)	41,8	60,1	12,1 (20%)	48,1
China	54,0	7,5 (14%)	46,5	95,4	37,1 (39%)	57,7
South Africa	75,0	25,7 (34%)	49,3	83,5	34,3 (41%)	49,2
West Europe	101,3	65,4 (65%)	35,9	106,2	65,7 (62%)	40,5
North America	97,8	65,6 (67%)	32,2	108,6	69,4 (64%)	39,2
<b>From animal and fish products, %</b>						
	1980			2011		
	Meat products	Fish products	Milk products	Meat products	Fish products	Milk products
Brazil	22	3	12	33	3	14
Russia	23	7	12	22	7	17
India	3	2	8	2	3	13
China	8	3	0	19	9	3
South Africa	18	3	8	27	2	6
West Europe	31	4	21	27	6	23
North America	36	4	21	35	5	20

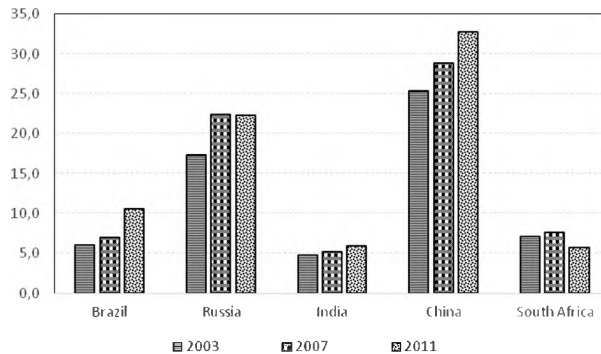
Sources: FAOSTAT // <http://faostat.fao.org/site/610/default.aspx#ancor>

The structure of proteins in the food coming either from animal products or from vegetables is very important for the countries where there is a shortage of protein in the diet of the population. In the developed countries of Europe and North America over 60 per cent of the protein comes from animal products; in Russia and Brazil – more than 50 per cent. In China due to the growth in consumption of meat and fish over the past 30 years the proportion of protein supplied from animal food has increased three times, and it is now close to 40 per cent. The worst

situation is in India, where due to religious prohibitions and poverty only 20 per cent of protein comes from animal products. Here the most optimal way to increase protein component in food would come through fish production.

In 2000–2011, most of the BRICS countries have increased per capita consumption of fish and seafood. For example, in China it has increased from 25 up to 33 kg/capita per year, in Russia – from 17 up to 22 kg/capita, in Brazil – from 6 up to 11 kg/capita, in India – from 5 up to 6 kg/capita. In South Africa, it fell from 7 up to 6 kg/capita (see fig. 1). Compared with the global consumption of seafood, only per capita consumption in Norway and Japan is higher than in China. In 2011, it was about 54 kg/capita per year. Russia in its per capita consumption of fish products is comparable with the USA. In 2011, it was equal to 22 kg/capita<sup>2</sup>.

Figure 1. Consumption fish and seafood, kg/capita/year



Sources:FAOSTAT // <http://faostat.fao.org/site/610/DesktopDefault.aspx?PageID=610#ancor> (23.10.2014).

Fisheries and aquaculture create jobs; generate income (especially for the poorest layers of population employed in agriculture). This industry also forms basis for export receipts contributing to incomes coming from abroad.

Compared to most of the BRICS countries Brazil is lagging behind. The marine fisheries have dominant positions in the country (with about 60 per cent of the total share for such type of products). Nevertheless the landings in the inland waters of the country ranked 10th in the world. The freshwater fishing opportunities exist thanks to the Amazon River basin. However, on an industrial scale this pool is not been used effectively. Since the end of 2000-ies, the country has begun to actively increase the aquaculture production, but production volumes of Brazil still lag far behind the leaders of this industry.

2 FAOSTAT // <http://faostat.fao.org/site/610/DesktopDefault.aspx?PageID=610#ancor> (23.10.2014).

Russian marine fisheries sector has been mainly represented by fisheries, which in 2012 accounted for about 97 per cent of the total production of fisheries. Marine waters accounted for the bulk of the catch (93 per cent). The proportion of fish from inland (freshwater) ponds occupied only 6 per cent of all fish caught. The basis of the marine fisheries of Russia is the raw material base of 200-mile economic zone (up to 75 per cent of the total catch). In Russian fisheries sector, aquaculture plays a minimal role, accounting for only 3 per cent of seafood.

In the fisheries sector of India both fisheries and aquaculture are rapidly developing. In 2012, they accounted for approximately 50 per cent of the total fish production. India ranks third in the world fish products catch, and second in the world production of aquaculture. About 40 per cent of all existing freshwater ponds of India is concentrated in the West Bengal (in 2012 they produced 23 per cent of all aquaculture) and in Andhra Pradesh (which since the mid-2000s, has increased aquaculture production to 24 per cent of the national total). Also «fish» states were including Gujarat, Kerala, Karnataka, Tamil Nadu, Uttar Pradesh, Maharashtra and Bihar<sup>3</sup>.

China occupies a leading position (ahead by a large margin from the other countries) of the world, both by fishing and by aquaculture breeding. Priority is given to aquaculture production, which in 2012 has accounted for almost three-quarters of all products of the fisheries sector. More than 70 per cent of global aquaculture production is concentrated in China. Since the beginning of 2000-ies, this branch has grown almost twofold. China is a country where production of aquaculture has ancient roots. Arising before our era in the form of fish farming in the rice paddy fields aquaculture subsequently began to develop pond cultivation. There were different forms of fish farming in China. It was shown in the first known written source that is dated 5th century BC about the technology and organization of fisheries<sup>4</sup>. Currently there are a lot of technologies of aquaculture production in China, and in natural waters (rivers, lakes, water reservoirs, cages) the grow about 15–20 per cent of the fish catch<sup>5</sup>. Fish farming in artificial water basins with a closed cycle of water exchange (artificial ponds, pools, etc.) dominates in China. Fish farming in China is included in the list of government priorities and the slogan «In every pond must be fish» is being actively implemented. The Chinese model of aquaculture production is intended primarily for cheap objects of artificial cultivation, the majority species are Carp family fish and seaweeds<sup>6</sup>.

In South Africa, fisheries are not a significant sector of the economy. South Africa ranks 25th in the world on this indicator. The country essentially does not produce aquaculture. Fishing takes place mainly off the West coast of South Africa in the fishing zone of 200 miles (60 per cent of the catch) and in inland waters (40 per cent of the catch).

3 Agricultural Statistics at a Glance 2014. Govt. of India. New Delhi, 2015. P. 392, 393.

4 In 473 BC Fun Li wrote the book about Fish Farming // <http://aquadaria2.ru/node/12195>.

5 Fisheries and Aquaculture Technical Paper (China). FAO. ROME, 2010. P. 58.

6 <http://top.rbc.ru/retail/30/08/2006/88624.shtml>

Until the early 1990-ies, fishery products had been absolutely dominating in the global production of the fisheries sector and had been showing a steadily increasing trend.

Table 2

### Fisheries and Aquaculture statistics, mln.ton

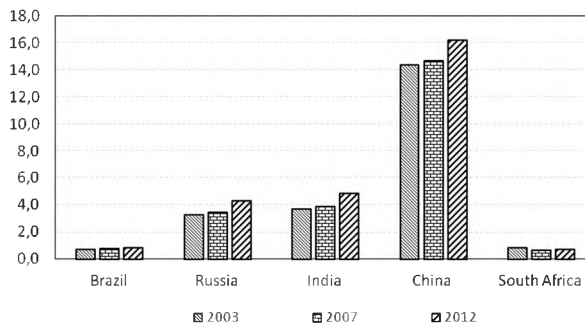
	2003 г.	2005 г.	2007 г.	2010 г.	2012 г.
<b>Capture production (fish, crustaceans, mollusks, etc.)</b>					
Brazil	0,7	0,8	0,8	0,8	0,9
Russia	3,3	3,2	3,5	4,1	4,3
India	3,7	3,7	3,9	4,7	4,9
China	14,3	14,6	14,7	15,4	16,2
South Africa	0,8	0,8	0,7	0,6	0,7
BRICS total	22,9	23,0	23,5	25,6	26,9
World total	88,3	92,5	90,8	89,1	91,3
Share of BRICS,	26	25	26	29	29
Share of China,	16	16	16	17	18
<b>Aquaculture production (fish, crustaceans, mollusks, etc.)</b>					
Brazil	0,2	0,3	0,3	0,5	0,7
Russia	0,1	0,1	0,1	0,12	0,14
India	2,3	3,0	3,1	3,8	4,2
China	25,1	28,1	31,4	36,7	41,1
South Africa					
BRICS total	27,8	31,5	34,9	41,1	46,2
World total	38,9	44,3	49,9	59,0	66,6
Share of BRICS,	71	71	70	70	69
Share of China,	64	63	63	62	62
<b>Capture and Aquaculture production (fish, crustaceans, mollusks, etc.)</b>					
Brazil	1,0	1,0	1,1	1,3	1,6
Russia	3,4	3,3	3,6	4,2	4,5
India	6,0	6,7	7,0	8,5	9,1
China	39,4	42,7	46,1	52,1	57,3
South Africa	0,8	0,8	0,7	0,6	0,7
BRICS total	50,7	54,5	58,4	66,7	73,1
World total	127,2	136,8	140,7	148,1	158,0
Share of BRICS,	40	40	41	45	46
Share of China,	31	31	33	35	36

Sources: Fishery and Aquaculture Statistics 2012. FAO. Rome, 2014. P. 9, 28;  
FAOSTAT // <http://faostat.fao.org/site/610/DesktopDefault.aspx?PageID=610#ancor>

However, from the beginning of the 1990-ies, the global fisheries had come to nearly a standstill, stuck at around 83–93 million tons. The growth of the global fish production had been carried out by the aquaculture production, which in 2012 has reached 66.6 million tons compared to 91.3 million tons by the fisheries<sup>7</sup>. The main increase in aquaculture production was observed in Asia and, particularly, in China. In 2012, Chinese aquaculture accounted for over 70 per cent of all products of the total fisheries sector in the country (see tab. 2). Exclusively at the expense of Chinese aquaculture, the BRICS countries together have increased their share in the global fisheries sector from 40 per cent in 2000 to 46 per cent in 2012 (see tab. 2).

Dynamics and ratio in the fisheries sector (actually, fisheries and aquaculture) in the BRICS countries is significantly different. Because of the historical lack of proteins in the diet structure, and due to an upward dynamics of the world prices BRICS countries in the Asian region (China and India) began to increase rapidly their aquaculture production. In other BRICS countries (Russia, South Africa, and Brazil) where the population's consumption of protein is sufficient enough similar trend was not observed.

Figure 2. Capture production (fish, crustaceans, mollusks, etc.), *mln. ton*



Sources: Table 2.

Since the beginning of 21<sup>st</sup> century, the share of BRICS in the total world fish catch has slightly increased from 26 per cent (2003) to 29.5 per cent (2012). Leaders of the group were China, where it has increased by 1.9 million tons for 9 years, India (by 1.2 million tons) and Russia (by 1 million tons). In 2003–2012 in all BRICS countries fisheries rose from 22.9 to 26.9 million tons. In China the rise was from 14.3 to 16.2 million tons; in India – from 3.7 to 4.9 million tons; in Russia – from 3.3 million tons to 4.3 million tons; in Brazil — from 0.7 to 0.8 million tons. In South Africa this indicator showed a slight decrease – from 0.8 to 0.7 million tons (see fig. 2, tab. 2).

7 Fishery and Aquaculture Statistics 2012. FAO. Rome, 2014. P. 9, 28; The State of World Fisheries and Aquaculture 2014. Opportunities and challenges. FAO. Rome, 2014. P. 3.

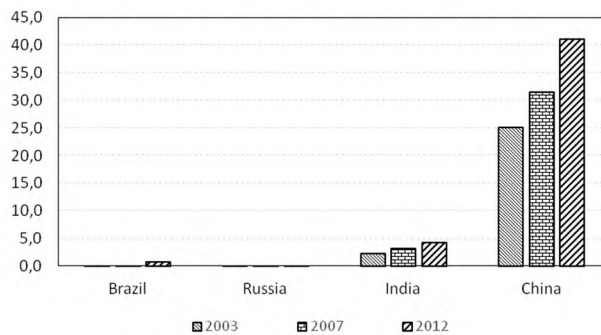
In the world ranking of fisheries China takes the first place, India – the fourth, Russia – the sixth<sup>8</sup>.

Seafood industry products have absolutely dominant positions in the BRICS's fisheries. In 2012, the catch in inland waters accounted for 5 per cent in Russia, 15 per cent in China and 30 per cent in Brazil and India. Only India has increased the yields from its inland waters. Fisheries are predominant in the Pacific Ocean that accounted for more than 55 per cent of all seafood caught in 2012. The share of the Atlantic was around 25 per cent in, and the Indian Ocean accounted for 15 per cent<sup>9</sup>.

In 2003–2012, world aquaculture production (fish, crustaceans, mollusks) has increased from 38.9 to 66.6 million tons, and the output of aquatic plants culture rose from 11.4 to 23.8 million tons<sup>10</sup>. The absolute leader in the aquaculture of BRICS countries is China. In 2012, it produced 62 per cent of world production of aquaculture and 54 per cent of culture of aquatic plants (see tab. 2).

Only two of the BRICS countries are on the top of the list in the world ranking of aquaculture manufacturers – China and India (see fig. 3). China ranks first and India is ranking second (but lagging behind by a large margin).

Figure 3. Aquaculture production (fish, crustaceans, mollusks, etc.), mln. ton



Sources: Table 2.

In 2003–2012, the share of BRICS's aquaculture (fish, crustaceans, mollusks) in the global aquaculture production has slightly declined from 71 per cent to 69 per cent. That change was determined by a decrease of China's share from 64 per cent to 62 per cent. This happened because of the expansion of aquaculture production in other Asian countries such as Vietnam, Indonesia, and Bangladesh. In 2003–2012,

8 Fishery and Aquaculture Statistics 2012. FAO. Rome, 2014. P. 9.

9 The State of World Fisheries and Aquaculture 2014. Opportunities and challenges. FAO. Rome, 2014. P. 11, 12, 19.

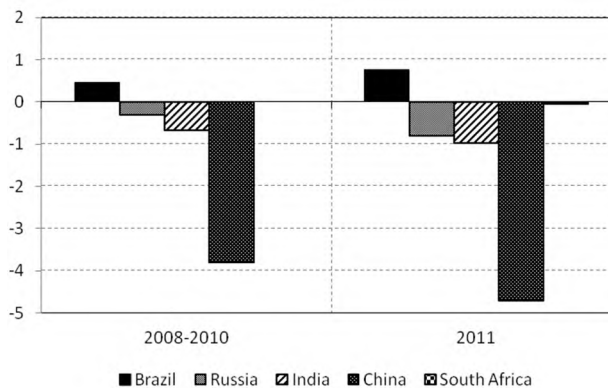
10 Fishery and Aquaculture Statistics 2012. FAO. Rome, 2014. P. 27, 28.

the products of aquaculture have risen in China from 25.1 to 41.1 million (64 per cent). During this period, Indian aquaculture production increased from 2.3 to 4.2 million tons (by 83 per cent). Aquaculture in Brazil began to expand gradually – its production has increased from 0.3 to 0.7 million tons (2.3 times). Russia almost does not develop its aquaculture now. In 2012, it produced 144 thousand tons of fish – 40 thousand tons less than in the 1980-ies. This is due to the climatic features of the country and, consequently, due to the seasonal nature of fish production, as well as by high (relatively to other products containing protein) value of seafood in the domestic market.

Fish dominates the structure of BRICS's aquaculture. In 2012, it accounted for 60 per cent of aquaculture in China, 92 per cent in India, and 86 per cent in Brazil. Fish production is concentrated almost entirely in the inland waters, marine fish farming is at most accounting for 1–4 per cent. China also specializes in breeding of mollusks (30 per cent of all aquaculture) and crustaceans (9 per cent). In 2012, the share of India and Brazil accounted for only 8 per cent and 10 per cent respectively of the total share<sup>11</sup>.

Like all agriculture in China and India, aquaculture production has very low labor productivity. In China it is in the range of 7 tons per farmer, and India 1 ton per farmer (not including women's employment). In Norway, the figure is 195 tons per farmer<sup>12</sup>.

Figure 4. Net Import (+), Net Export (-) fishery commodities, *mln. ton*



Sources: Table 3.

The main purpose of aquaculture production in BRICS countries is in ensuring domestic demand. However, Russia in 2011 had exported 2 million tons (about 45 per cent of production), but also imported 1.2 million tons (nearly 40 per cent of

11 The State of World Fisheries and Aquaculture 2014. Opportunities and challenges. FAO. Rome, 2014. P. 22.

12 Ibid. P. 31.



domestic consumption) (see tab. 3, fig. 4). In 2013–2014, the fish export from Russia decreased to 1.7 million tons and imports – to 0.9 million tons<sup>13</sup>.

China, India and Russia in the global market have the position of seafood net exporters; while Brazil is a net importer (see fig. 4). However, in 2011, the share of exports in the total production of China and India was low – 15 per cent and 11 per cent, respectively (see tab. 2, 3). At the turn of the 2010s, the import of seafood in Brazil has increased from 0.45 to 0.75 million tons. This accounted for 35 per cent of domestic consumption (see tab. 3).

Table 3

### International trade in fishery commodities, mln. ton

	2008–2010	2011
	<b>Export</b>	
Brazil	0,05	0,05
Russia	1,6	2,0
India	0,7	1,0
China	6,8	8,3
South Africa	0,2	0,2
BRICS total	9,35	11,55
World total	40,2	44,5
Share of BRICS, %	23,3	26
Share of China, %	16,9	18,7
	<b>Import</b>	
Brazil	0,5	0,8
Russia	1,3	1,2
India	0,02	0,03
China	3,0	3,6
South Africa	0,2	0,2
BRICS total	5,02	5,78
World total	41,9	45,3
Share of BRICS, %	12,0	12,8

Sources: Fishery and Aquaculture Statistics 2012. FAO. Rome, 2014. P. 63–68; Fish and fishery products: world apparent consumption statistics based on food balance sheets. FAO Yearbook 2011. Rome, 2013. Appendix I. P. 217–221.

The growth rate of aquaculture production in Asian BRICS countries is surprising. In the last five years of the 1990s, the annual growth rate of aquaculture production was 9 per cent in China; the same indicator was in India in the

13 <http://ab-centre.ru/news/eksport-ryby-iz-rossii-v-2014-godu-sokratilsya-na-95> (10.02.2015).

first five years of 2000-ies. Despite the fact that growth rate fell to about 5 per cent the intensive economic growth in fish farming has been supported by the state<sup>14</sup>. Moreover, in China the growth rate of aquaculture production was 3–4 percentage points higher than the growth rate of meat production. One may ask what endogenous forces have led China and India to expand their aquaculture production?

First, as was already noted, the main purpose of the development of aquaculture in Asian BRICS countries is the food supply of the population with high protein products. Export orientation is less the motivation for the development of aquaculture farms – because 89 per cent of fish production in India and 85 per cent in China are consumed domestically. It should be noted that at the end of the 20<sup>th</sup> century special government programs for aquaculture development were adopted in China and in India.

Historical experience of fish farming has allowed the maximum use of limited land and water resources for aquaculture production in China. In this regard, there are multiple technologies for cultivation of aquaculture in artificial water reservoirs. Moreover, such technologies are practiced in small and smallest agrarian households. For example, the slogan «in every pond there must be fish» works out very effectively. Almost every farm has a pond for aquaculture production (the area of such pond may be less than 0.05 ha). Also mixed technology are practiced widely, – fish farming in the rice paddy fields, carp-duck farms are being built, two story buildings that combine the cultivation of fish and pigs in the same ground are widely used. They give an opportunity to increase production not only of aquaculture, but also of meat. This also, involves standard technology of cultivation of fish in natural waters (rivers, lakes, reservoirs, etc.). However, the total production of aquaculture in these areas is less than the volume of production in the small agrarian households. Consequently, most of the aquaculture output is produced for personal consumption. Thanks to this policy the problem of low protein consumption was eliminated in China.

In India unlike China nutritional demand for getting protein from animal products is very low. Historically religious and national factors limited the consumption of meat in this country; and fish could be practically the only source of animal protein. Therefore leguminous crops (i.e. products of plant origin) remain to be the major protein source in the diet of Indian population. Although fish farming is growing rapidly in India, it is not as widely spread as in China. It is limited to a few states. Aquaculture is cultivated mainly in natural waters (rivers, lakes, ponds), it is also produced (though on a limited scale) in rice paddy fields. Currently the technology of fish production in the «tanks» (closed reservoirs) is being introduced. If in China a large part of aquaculture is produced in small (mainly non-specialized) farms, in India fish farming is market specialized especially in the new «fish» Indian

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14 Fishery and Aquaculture Statistics. FAO. Rome, 2005–2014 // <http://www.fao.org/fishery/statistics/global-aquaculture-production/en>

States<sup>15</sup>. As the result, fish misses the everyday food ration of a large share of the Indian population with low incomes. Moreover, India where consumption of protein is traditionally very low makes a stake on export-oriented policy in relation to fish products.

No limit on further growth of aquaculture production in China and India can have a negative ecological impact on the biosphere. This impact is getting higher with the more intensive production, which requires more feed, fertilizer and energy per unit of water areas. First, aquaculture production that is concentrated in artificial reservoirs requires fresh water. However, a huge fresh water deficit has built up in India and China. Now in India 85 per cent of the total water amount is consumed for irrigation. There is one way for the ecologically safe expansion of aquaculture production. It is based on production in water reservoirs with a recyclable water exchange, but this requires transition to a new expensive water treatment technologies. Secondly, the production of aquaculture generates the additional requirements in the special fertilizer (falling directly into water), fish feed, and the high cost of energy. Third, the aggressive impact on the biosphere influences wastes and bacteria of fish production as they create emission of gases into the atmosphere. Particularly high emissions accompany shrimp cultivation.

Great potential for expansion of aquaculture exists in Brazil and Russia, where huge water resources are located. However, there is no protein deficit in nutrition of the population of these countries, and they choose to prefer meat and dairy products.

BRICS countries pay special attention to the increase of efficiency and security of aquaculture production. In 2011 BRICS Ministers of Agriculture and Agrarian Development adopted the «Action Plan on Agricultural Cooperation of the BRICS countries for the period of 2012–2016». It was noted that fisheries and especially aquaculture production is under control of the Ministers of agriculture and Agrarian Development annual meetings. The cooperation in development of technologies with low carbon (CO<sub>2</sub>) emissions and water recirculation systems in aquaculture production is chosen as the main trend for the coming years.

Summary: despite the serious environmental, industrial and economic problems, production of aquaculture can become a real alternative to livestock in the provision of protein food in the Asian BRICS countries such as China and India. Fish production doesn't compete with the crop production that is a major sector of agriculture in these countries. At the same time the increase of livestock production requires the land resources needed for the formation of the forage base (forage crops, pastures), which is competitive with food consumption.

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15 National Aquaculture Sector Overview. India. FAO Fisheries and Aquaculture Department. 2014 // [http://www.fao.org/fishery/countrysector/naso\\_india/en](http://www.fao.org/fishery/countrysector/naso_india/en)

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