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REGIONAL REVIEW ON STATUS AND TRENDS IN AQUACULTURE DEVELOPMENT IN LATIN AMERICA AND THE CARIBBEAN – 2015

REGIONAL REVIEW ON STATUS AND TRENDS IN AQUACULTURE DEVELOPMENT IN LATIN AMERICA AND THE CARIBBEAN – 2015

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PREPARATION OF THIS DOCUMENT

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ABSTRACT

With a land surface of 21 million square kilometers and a population of 634 million (2015), Latin America and the Caribbean (LAC) has drastically diminished its capture fish production, from 19.8 to 10.8 million tonnes between 2000 and 2014, as a result of decaying pelagic fisheries off Peru and Chile and a decline in catches in several coastal areas. In contrast, aquaculture evolved from 0.8 to 2.8 million tonnes and values from US$3.8 to US$15.9 billion in the same period. These facts have allowed aquaculture to increase its contribution to total regional landings from 4.1 percent in 2000 to 20.5 percent in 2014.The region also contributed 3.8 percent to world aquaculture production in volume but to a more substantial 10.7 percent in value terms, and 11.6 percent to total wild catches, in 2014. The region is second only to Oceania in the average value per kilogram of its farmed production.

Regional aquaculture production is progressing at rates above world averages in recent years. However, rate of growth in the region is diminishing – even though market prospects are bright and open – as a reflection of complicated governance issues, increasing environmental concerns, poor planning, disease outbreaks and other reasons. Farmed production is highly concentrated in a few countries: Chile, Brazil and Ecuador account for 77 percent of aquaculture volumes and 78 percent of the values during 2012–2014. As well, farmed outputs depend on a very limited number of species (salmonids, shrimp, tilapia and mussels account for 86 percent of these products in 2012–2014). Even though current statistics show that over 90 species are being farmed in recent years, most of them contribute negligible quantities.

Regional consumption of fish is very limited (it is the lowest among continents) and therefore domestic demand has not been a good driver for aquaculture, which depends more on export possibilities and its ability to create employment opportunities, particularly in rural areas. Exports have allowed creation of a modern, efficient and globally competitive processing industry in many LAC countries, while others rely more on small and medium-scale primary and secondary producers which supply mainly local markets. Countries such as Brazil and Mexico are large importers of seafood, even though they still have plenty of opportunities for further aquaculture development. Chile is the most important aquaculture producer and exporter within the region, being the second world producer of salmonids and mussels.

Until recently, regional aquaculture production was based mainly on introduced species (salmon, trout, tilapia, shrimp), for which technology was widely available. Currently, however, most diversification efforts are concentrated on native species, a fact that requires more consistent and focused R&D, and longer periods to develop the necessary technologies for these purposes. This strategy also imposes severe market challenges, as native species are not necessarily well known the world over, and therefore require substantial financial and managerial efforts to become established in foreign destinations; local demand in most cases is not high enough to allow for reaping the benefits of economies of scale in production and marketing.

Even if the region has plenty of room for aquaculture expansion in the coming decades, it still depends on foreign technologies and on governance, bureaucracies and planning schemes that need to be revised and dramatically improved to achieve sustainable progress and a larger contribution to societies. Until now, most regional expansion efforts have centered on the development of technologies and on environmental issues; lately it has become clear that management and governance issues, and the relations of aquaculture with local communities and populations are at the center of worries that need to be addressed to realize the full potential of this young industry.

More developed economies, the main consumers of seafood in the world, will continue being the main markets for fish in the coming decades. However, they do not necessarily have the conditions to produce the aquatic products they require. Therefore, they will continue to depend on seafood imports for their populations, and here the LAC region is extremely well suited to supplying their needs, as well as those of its own population. A well-planned and organized industry in this area has very attractive development prospects for the coming decades.

For complementary views on aquaculture in the Region, please see the Report from the COFI Sub-Committee on Aquaculture, Brasilia, Brazil, 3–9 October 2015, available at the following link: www.fao.org/cofi/43341-04a74a5d167de0034251e8eaf83de443e.pdf

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ABBREVIATIONS AND ACRONYMS

ACUINOR	Acuícola del Norte S.A., Chile
APR	Average cumulative annual rate (percent)
AREL	Resource-limited aquaculture
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO_2	Carbon dioxide emissions
CORFO	Corporación de Fomento de la Producción (Corporation for the Promotion of Production)
ERN	Esturiones del Río Negro S.A., Uruguay
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
IATTC	Inter-American Tropical Tuna Commission
IMARPE	Instituto del Mar del Perú
ISSCAAP	International Standard Statistical Classification of Aquatic Animals and Plants
LAC	Latin America and the Caribbean
NGOs	Non-Governmental Organizations
OECD	Organisation for Economic Co-operation and Development
OSPESCA	Central America Fisheries and Aquaculture Organization
R&D	Research and Development

1. SOCIAL AND ECONOMIC BACKGROUND OF THE REGION

1.1 Status and trends

1.1.1 Area and population of countries

Latin America and the Caribbean (LAC or LAC Region) is a region with over 21 000 000 square kilometres, accounting for over 14 percent of the earth's land surface. Population estimates as at 2015 of over 634 million represent 8.6 percent of world population (2015; United Nations, 2015a). About 66 percent live in South America; 27.2 percent live in Central America, and the remaining 6.8 percent in the Caribbean. For the purpose of this study, the area is comprised of the 46 countries and territories listed in Table 1.

The Argentine Republic, the Federative Republic of Brazil and the United Mexican States account for nearly 65 percent of the total surface area of this region, and for 60 percent of its population according to 2015 statistics. The population density of the region in 2014 was very low (31.5 persons per square km), and is about 56 percent of world averages. However, the Caribbean shows high population densities of 191.2 persons per km^2, while that of Central America rises to 70.4. South America's 20.4 persons/km^2 is the lowest of any continent.

Table 1. Countries and territories comprising Latin America and the Caribbean

CARIBBEAN	CARIBBEAN	CENTRAL AMERICA
Anguilla	Netherlands Antilles	Panama
Antigua and Barbuda	Puerto Rico	**SOUTH AMERICA**
Aruba	Saint Kitts and Nevis	Argentina
Bahamas	Saint Lucia	Bolivia
Barbados	Saint Vincent and the Grenadines	Brazil
British Virgin Islands	Trinidad and Tobago	Chile
Cayman Islands	Turks and Caicos Islands	Colombia
Cuba	United States Virgin Islands	Ecuador
Dominica	**CENTRAL AMERICA**	Falkland Islands (Malvinas)
Dominican Republic	Belize	French Guiana
Grenada	Costa Rica	Guyana
Guadeloupe	El Salvador	Paraguay
Haiti	Guatemala	Peru
Jamaica	Honduras	Suriname
Martinique	Mexico	Uruguay
Montserrat	Nicaragua	Venezuela

Source: FAO.

Latin America and the Caribbean have a high proportion of urban inhabitants (79.5 percent in 2014), the highest among developing nations and above the world average of 53.6 percent. South America has an even higher proportion of urban population (83 percent in 2014), compared to 73.5 percent in Central America and 69.8 percent in the Caribbean.

Until about 2010, population growth rates in the region exceeded world averages. However, they are now at 1.13 percent per year in 2010–2015, below world values (1.18 percent) and expected to continue diminishing to 0.72 percent by 2030. In the past, Central America has shown the highest population growth rates within this region and the Caribbean the smallest, situations likely to continue until 2030.

Population projections as of 2015 (United Nations, 2015a) indicate that, given these trends, LAC's population is likely to reach 695.6 million by 2025 and 721.1 million by 2030, where it should account for 8.5 percent of a world population of 8 500.8 million (Table 2).

Table 2. LAC population 2000–2015, projections to 2030 and comparisons (Number of inhabitants)

Year	Latin America and the Caribbean	Caribbean	Central America	South America	World
2000	526 890	38 314	138 780	349 796	6 126 622
2005	563 826	40 028	148 989	374 809	6 519 636
2010	599 823	41 621	161 117	397 085	6 929 725
2015	634 387	43 199	172 740	418 447	7 349 472
2020	666 502	44 552	183 824	438 126	7 758 157
2025	695 584	45 729	194 120	455 735	8 141 661
2030	721 067	46 700	203 401	470 966	8 500 766

Source: United Nations, 2015a.

1.1.2 Social and economic indicators

The LAC Region has also evolved in economic and social terms. Life expectancy in the region is above world averages, is constantly increasing and is comparable to that of more developed regions of the world. LAC countries are classified as 'developing nations' except for the Republic of Haiti, the only LAC country considered among the least developed countries of the world. Carbon dioxide emissions (CO_2) per capita in the region are well below world averages and those measured in developed economies, a fact that is correlated with the differences in economic development. However, growth rates are advancing more rapidly in the LAC region. It is relevant to note that food and livestock production have advanced in the LAC region since 2005, and the same applies to energy consumption per capita. As well, close to 50 percent of electricity production in the LAC region comes from hydroelectric sources, while in more developed countries that rate is only 12–13 percent.

The factor that explains part of LAC's underperformance in some fields is local per capita GDP levels. When compared with those in the developed world (North America and OECD countries) LAC countries average only 29 to 40 percent of the values in those economies in 2015. However, the growth of per capita GDP in Latin America and the Caribbean between 2005 and 2014 was 22 percent, compared to North America at 4 percent and OECD economies at 5.7 percent.

1.2 Important issues

The LAC region spends a similar percentage of its GDP on education to the other regions reviewed (OECD, United States of America, World). However, LAC countries invest much less in R&D – about a third, as percentages of GDP – than do more developed countries. The proportion of scientists is close to one-sixth of that in developed economies. In the case of expenditure on health, the LAC region lies below world averages. It is also interesting to note that this region is still among the most indebted areas of the world, when comparing the value of debt service to annual exports. Exports, then, should be highly regarded in the LAC Region, as they serve the purpose of supplying the necessary hard currency needed to repay external creditors.

1.3 The way forward

The LAC region shows many advances in social and economic terms and has ample physical space and good environmental and social conditions to further develop its economy and the production of food. There is, however, a lot of ground to cover to reach quality-of- life levels comparable to those in North America and in other OECD nations.

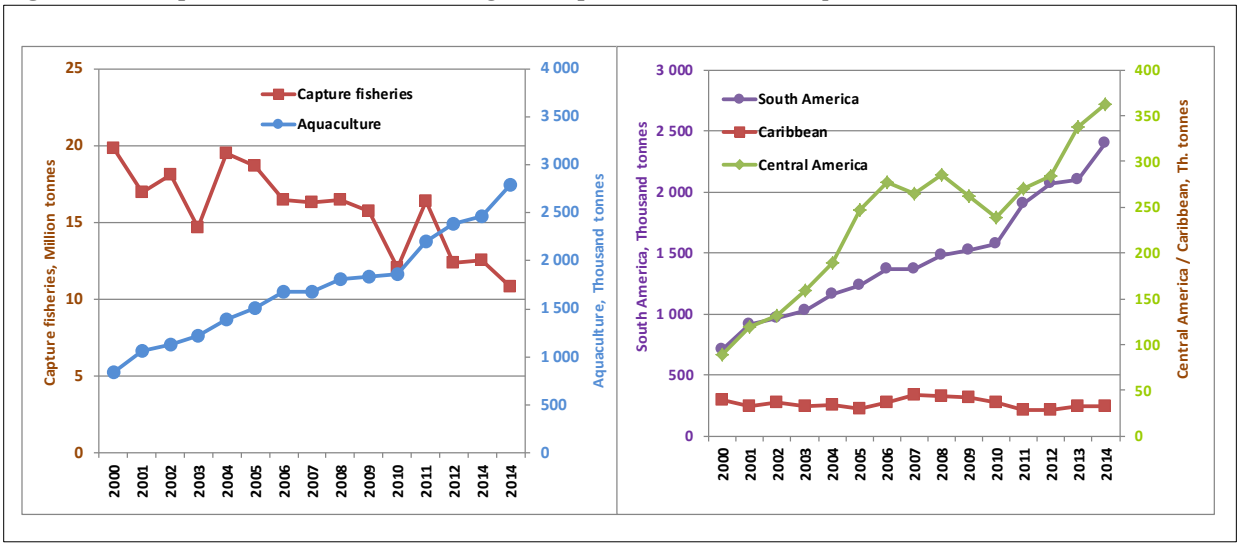
2. GENERAL CHARACTERISTICS OF THE AQUACULTURE SECTOR IN THE REGION

2.1 Status and trends

2.1.1 Capture production and aquaculture

Fish production in the LAC Region has drastically diminished in recent years, mainly as a result of decaying pelagic fisheries from Peru and Chile. Thus, wild catches are down from 19.8 million tonnes to 10.8 million tonnes (45.6 percent) in 2000–2014 (Table 3 and Figure 1). Aquaculture, in contrast, has substantially evolved during the same period, from 0.8 to 2.8 million tonnes (232.8 percent). Figures for 2014 indicate that the LAC region contributes 3.8 percent to world aquaculture production (2.6 percent in 2000) and 11.6 percent of capture fisheries (21.1 percent in 2000). As shown later in this review, the value of LAC's aquaculture is far more significant, accounting for 10.7 percent of world values in 2014 (5.5 percent in 2000).

Figure 1. Fish production in the LAC Region, capture fisheries and aquaculture, 2000–2014



Source: FAO FishStat, 2016.

Total marine and inland capture fisheries diminished at an average cumulative annual rate (APR) of -1.51 percent in 2002–2008 but at a notable -6.8 percent in 2008–2014. In contrast, regional aquaculture has grown 9 percent APR since 2000 (6.1 percent on world basis). The main contributor is South America, 7.5 percent APR in 2002–2008 and 8.3 percent in recent years. LAC's aquaculture growth (10.9 percent APR) is surpassed only by that for Africa in the last twenty years (15.4 percent), and compares favourably with world figures (7.0 percent APR) for the period 1992/1994 to 2012/2014. However, the LAC region diminished production at a rate of -2.7 percent APR, while Africa grew by 2.1 percent APR and the world progressed at a rate of 0.3 percent (APR) during the same time.

Diminishing wild catches and expanding harvests meant that aquaculture significance in the LAC region evolved from 4.1 percent of total landings in 2000 to 20.5 percent in 2014, doubling aquaculture's importance since 2009. As most wild fish stocks are already exploited at their maximum or have been overfished, the contribution of aquaculture and relevance of controlled harvests will continue growing in the near future.

Table 3. Capture fisheries and aquaculture production. World and LAC figures, 2000–2014 (thousand tonnes)

Year	LAC REGION												WORLD		
	Total landings				Capture fisheries				Aquaculture				Total production		
	Total	Caribbean	Central America	South America	Total	Caribbean	Central America	South America	Total	Caribbean	Central America	South America	Total	Capture Fisheries	Aquaculture
2000	20 681	244	1 786	18 650	19 842	204	1 697	17 940	839	40	89	710	125 947	93 529	32 418
2005	20 214	209	2 061	17 944	18 706	179	1 815	16 712	1 508	30	246	1 232	136 771	92 474	44 298
2010	13 899	278	2 481	11 140	12 044	241	2 242	9 560	1 855	37	239	1 579	148 103	89 130	58 973
2011	18 556	291	2 426	15 839	16 349	263	2 156	13 930	2 207	29	270	1 909	155 492	93 683	61 809
2012	14 713	214	2 352	12 147	12 329	185	2 068	10 075	2 385	29	284	2 072	157 777	91 311	66 466
2013	14 981	245	2 336	12 401	12 514	212	1 998	10 304	2 467	33	338	2 096	162 930	92 669	70 261
2014	13 588	331	2 284	10 973	10 796	297	1 922	8 577	2 792	33	363	2 396	167 229	93 445	73 784

Source: FAO FishStat, 2016.

Table 4. Aquaculture 'ex-farm' values. World and LAC figures, 2000–2014 (Million US$ of 2015 and percentages)

Year	LAC REGION												World values		
	Aquaculture values				Marine aquaculture				Continental aquaculture						
	Total	Caribbean	Central America	South America	Total	Caribbean	Central America	South America	Total	Caribbean	Central America	South America	Total	Marine Aquaculture	Continental Aquaculture
2000	3 800	84	550	3 166	3 072	24	460	2 588	728	60	90	577	50 464	27 607	22 857
2005	6 890	81	996	5 813	5 980	30	823	5 127	910	51	173	686	79 509	40 089	39 420
2010	8 515	68	897	7 550	6 616	23	683	5 910	1 899	45	214	1 640	123 561	52 212	71 349
2011	11 107	44	975	10 088	9 061	15	724	8 322	2 046	29	251	1 766	124 748	54 988	69 760
2012	10 729	41	1 002	9 685	8 621	14	709	7 897	2 108	27	293	1 788	130 948	55 446	75 502
2013	13 218	48	1 459	11 711	11 110	19	1 114	9 977	2 107	29	345	1 734	142 096	63 169	78 927
2014	15 934	48	1 260	14 625	13 357	20	902	12 435	2 577	29	358	2 190	148 564	66 151	82 414

Source: FAO FishStat, 2016.

Table 5. Average ex-farm prices for aquaculture products, by geographic region and environment, 2000–2014 (US$ dollars/kg of 2015)

Period	Continent					World	LAC					
	Africa	Americas	Asia	Europe	Oceania		LAC	Caribbean	Central America	South America	Marine	Continental
2000–2002	3.1	3.8	1.8	3.1	4.2	2.0	4.4	2.3	6.3	4.3	5.1	2.7
2003–2005	2.1	3.9	1.8	3.4	5.0	2.0	4.6	2.5	4.5	4.7	5.3	2.5
2006–2008	2.2	4.3	1.7	3.8	5.5	1.9	4.8	2.1	3.9	5.1	5.6	2.4
2009–2011	2.2	4.4	1.8	4.0	5.3	2.1	4.9	1.9	3.7	5.1	5.7	3.2
2012–2014	2.1	4.8	1.7	4.1	7.0	2.0	5.2	1.4	3.8	5.5	6.2	2.9

Source: FAO FishStat, 2016.

In the Republic of Colombia, the Republic of Costa Rica, the Republic of Cuba and the Republic of Honduras aquaculture accounted for over 50 percent of total fish landings in 2012–2014; in another five (the Federative Republic of Brazil, the Republic of Chile, the Republic of Ecuador, the Republic of Guatemala and the Republic of Nicaragua) it contributed between 30 percent and 49 percent. In the Plurinational State of Bolivia, the Dominican Republic, the Republic of Paraguay and the Bolivarian Republic of Venezuela it varied between 10–29 percent of totals, while in eleven countries/territories – including Belize, the Republic of El Salvador, the Republic of Haiti, Jamaica, the United Mexican States, the Republic of Panama, and the Republic of Peru – fish farming is still of relatively little importance (1–9 percent of total fish landings). In the remaining seventeen LAC countries recorded in FAO statistics, aquaculture contributes either negligibly to fish production or is altogether absent.

Even if these data indicate that different nations have unequal capacities for fish farming, there are cases, such as those of the United Mexican States, the Federative Republic of Brazil and the Republic of Peru, where the industry could and should grow substantially in the future. The Federative Republic of Brazil and the United Mexican States are the top importers of fish products in the region (over US$1.5 and U$ 1.1 billions respectively, in 2014), while having excellent prospects for farmed production. The Republic of Chile, a traditional capture-fisheries nation with over 1 million tonnes of farmed products in recent years, already ranks among the ten first producers in world aquaculture based on salmon, trout and mussels that already account for 34 percent of its landings. This country is the most important exporter of fishery products of the region.

South America leads in LAC's fish production, with 8.6 million tonnes of wild catch in 2014, or 79 percent of those totals (90 percent in 2000) and 2.4 million tonnes of farmed output in 2014 (86 percent of total; 85 percent in 2000). Central America captures 1.9 million tonnes, (18 percent of wild species in 2014 and 9 percent in 2000) and farms 0.36 million tonnes or 13 percent of the crops (11 percent in 2000), while the Caribbean augments its significance from 1 percent to 3 percent in 2000–2014 (0.3 versus 0.2 million tonnes) in capture production, and loses ground in aquaculture, diminishing from 40 000 to 33 000 tonnes during that period (down from 4.7 percent to 1.2 percent of farmed totals).

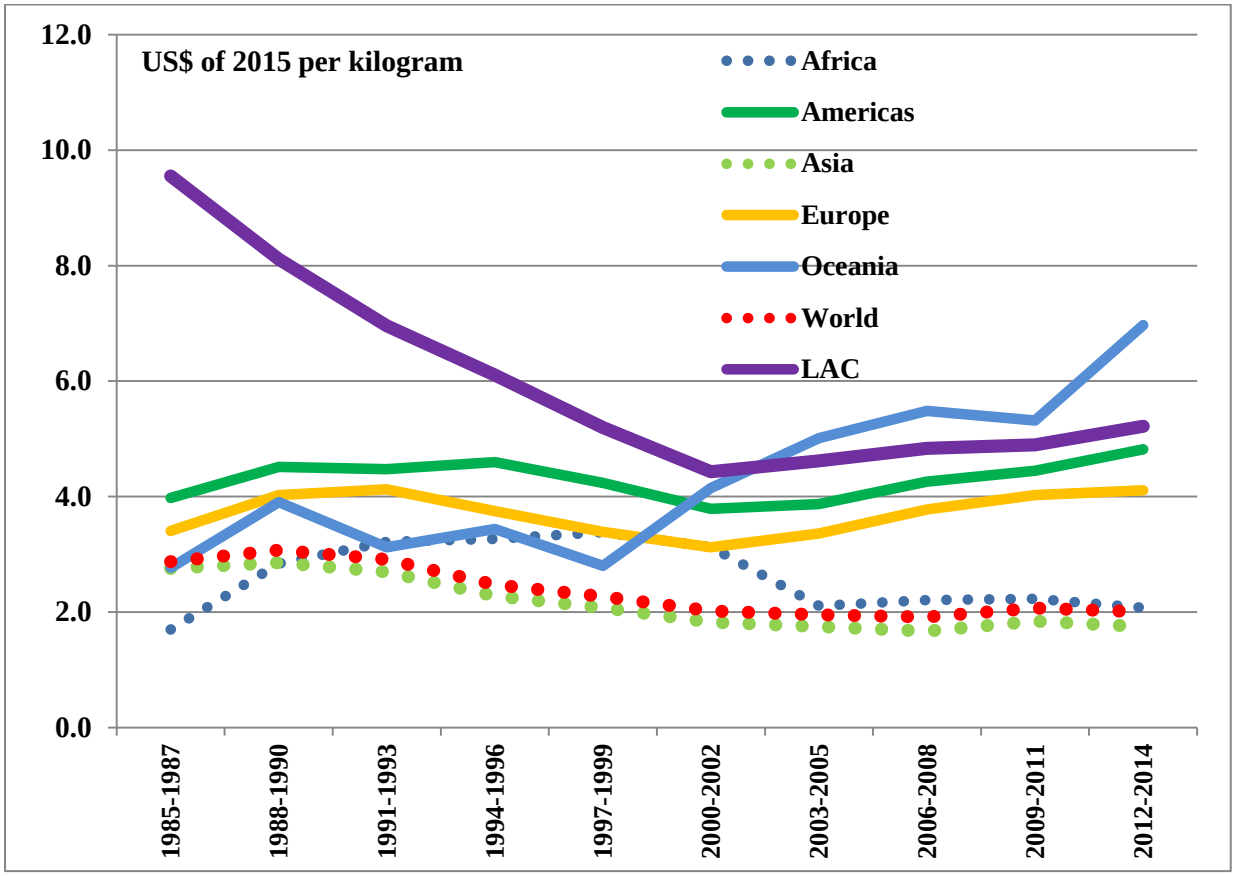
2.1.2 Aquaculture production value

The value of world aquaculture has risen from 68.5 billion to 148.6 billion US dollars of 2015 during 2000–2014 (116.9 percent or 5.7 percent APR), while in the LAC region it grew from 3.8 to 15.9 billion (319.4 percent in total, or 10.8 percent APR) in the same period (Table 4). Thus, local growth rates surpass world averages and those in other continents including Oceania (7.6 percent) and Africa (6.7 percent),[1] increasing LAC's representation in total aquaculture value to a meaningful 10.7 percent in 2000–2014.

The region excels not only in global production value but also in the *average value per kilogram harvested*, being only second to Oceania (Figure 2 and Table 5). In 2014, the average LAC value of aquaculture production was US$5.7/kg, while in Oceania it rose to US$7.0/kg, and was of US$2.0/kg on a world basis. This fact is due to the region's dedication to salmonids, shrimp and tilapia, with unit values exceeding by far those of carps, other fresh water fish and molluscs, the most widely available species in world aquaculture (excluding algae).

[1] Farm-gate (or 'ex-farm') values, as estimated by the FAO. Unless otherwise stated, all value figures cited in this paper have been converted into 2015 US$ dollars, using the US Producer Price Index for all commodities as deflator.

Figure 2. Average annual ex-farm prices per kilo, of aquaculture production, by continent/region, 1985–2014



Source: FAO FishStat, 2016.

2.1.3 Distribution of aquaculture production

As suggested in Table 6, there have not been substantial changes in the geographic distribution of aquaculture production volumes since 2000–2001 and up to 2013–2014 in LAC. South America leads in volumes and values and the Caribbean is losing ground, as conditions there are not as promising and competition with tourism and other high-valued activities substantially complicate obtaining farming licences and other related activities. In value terms, South America is gaining ground, currently accounting for 90.3 percent of totals (compared to 82.3 percent in 2000–2001).

Table 6. Percentages of total aquaculture volumes and values by Region

Period	Caribbean	Central America	South America	Total	Caribbean	Central America	South America	Total
2000–2001	3.8	10.9	85.3	100.0	1.9	15.8	82.3	100.0
2003–2004	2.6	13.4	84.1	100.0	1.3	14.0	84.7	100.0
2013–2014	1.3	13.3	85.4	100.0	0.3	9.3	90.3	100.0

Source: Prepared by the study on basic data from FAO FishStat, 2016.

The Republic of Chile accounted for 43 percent of the volume and 56 percent of the value of LAC aquaculture production in 2012–2014. Together with the Federative Republic of Brazil and the Republic of Ecuador, it accounted for 77 percent of the volume and 78 percent of the value of the region in the same period (Table 7). If the United Mexican States and the Republic of Peru are added, these countries contribute 87 percent of the volumes and 83 percent of the values of LAC aquaculture, showing a highly-concentrated production in a few countries. Farmed production is also focussed on a very limited number of species (basically salmon/trout, shrimp, tilapia and mussels). The Caribbean contributes little to LAC performance; its main farming countries, the Republic of Cuba and Jamaica, show clear production loses since 2006. In the Republic of Cuba, farmed carps and other freshwater fish have

decreased, partly compensated by north African catfish; in Jamaica, tilapia farming has drastically diminished while shrimp is at its lowest since 2008.

Table 7. Volumes and values of aquaculture; volumes of capture fisheries and incidence of aquaculture on total fish production volumes in the LAC region, by country producing 100 tonnes or over per year

Country/Region	Aquaculture volumes metric tonnes				Aquaculture values Million US$ 2015				Total landing volumes metric tonnes			Aquaculture/Total landings (%)		
	2006–2008	2009–2011	2012–2014	% total 2012–2014	2006–2008	2009–2011	2012–2014	% total 2012–2014	2006–2008	2009–2011	2012–2014	2006–2008	2009–2011	2012–2014
Caribbean	**41.8**	**36.2**	**31.6**	**1.2**	**87.7**	**68.7**	**45.7**	**0.3**	**185.3**	**199.4**	**185.6**	**22.6**	**18.2**	**17.0**
Cuba	33.8	30.7	28.4	1.1	47.9	39.3	35.3	0.3	62.4	56.3	50.5	54.2	54.5	56.2
Dominican Republic	1.0	1.6	1.5	0.1	7.9	9.4	5.5	0.0	15.1	15.8	15.1	6.9	9.8	10.2
Haiti	0.1	0.4	0.7	0.0	0.3	0.8	1.3	0.0	13.6	15.8	17.2	0.9	2.5	4.2
Jamaica	6.5	3.4	0.7	0.0	28.1	17.6	2.2	0.0	22.2	19.8	16.4	29.4	17.3	4.4
Other	0.3	0.2	0.1	0.0	3.5	1.7	1.4	0.0	72.0	91.7	86.4	0.5	0.2	0.2
Central America	**275.3**	**257.0**	**328.3**	**12.9**	**1 066.6**	**953.8**	**1 240.4**	**9.3**	**2 410.0**	**2 488.6**	**2 324.0**	**11.4**	**10.3**	**14.1**
Mexico	151.3	140.1	169.916	6.7	568.7	445.0	620.7	4.7	1 622.9	1 708.9	1 740.2	9.3	8.2	9.8
Honduras	52.4	35.6	66.6	2.6	205.9	153.0	281.4	2.1	70.2	47.4	77.5	74.7	74.9	85.9
Costa Rica	24.3	26.4	27.3	1.1	54.1	60.5	57.6	0.4	43.8	54.7	68.8	29.6	31.5	39.4
Nicaragua	12.9	17.2	27.1	1.1	54.1	60.5	57.6	0.4	43.8	54.7	68.8	29.6	31.5	39.4
Guatemala	17.1	20.3	18.5	0.7	78.8	104.5	84.1	0.6	36.7	41.1	39.9	46.6	49.4	46.4
Panama	8.6	6.7	8.7	0.3	40.4	31.6	38.5	0.3	246.9	203.6	187.7	3.5	3.3	4.6
Belize	5.1	6.1	6.7	0.3	23.8	22.7	23.1	0.2	290.3	333.3	101.0	1.8	1.8	6.7
El Salvador	3.5	4.6	3.4	0.1	8.0	10.6	10.1	0.1	53.9	52.0	59.8	6.6	8.8	5.7
South America	**1 406.6**	**1 670.5**	**2 188.0**	**85.9**	**7 180.4**	**8 591.8**	**12 007.3**	**90.3**	**15 489.2**	**13 911.9**	**11 840.2**	**9.1**	**12.0**	**18.5**
Chile	805.7	816.3	1 106.4	43.4	4 971.3	4 996.7	7 407.3	55.7	4 650.6	3 881.9	3 279.5	17.3	21.0	33.7
Brazil	297.3	403.7	506.3	19.9	684.0	1 307.7	1 341.6	10.1	1 082.1	1 195.7	1 290.5	27.5	33.8	39.2
Ecuador	171.2	267.1	340.9	13.4	829.5	1 253.4	1 631.7	12.3	632.4	735.4	904.8	27.1	36.3	37.7
Peru	37.0	75.2	104.4	4.1	267.0	546.3	663.2	5.0	7 244.5	6 568.0	4 863.3	0.5	1.1	2.1
Colombia	68.3	81.6	90.4	3.5	329.8	297.3	267.5	2.0	181.1	173.3	174.8	37.7	47.1	51.7
Venezuela	20.7	19.0	27.9	1.1	73.0	157.6	637.0	4.8	340.1	264.5	240.2	6.1	7.2	11.6
Paraguay	2.4	3.5	6.5	0.3	3.9	7.1	23.0	0.2	22.6	21.3	23.5	10.4	16.4	27.5
Argentina	2.7	2.8	3.6	0.1	16.8	14.1	23.2	0.2	1 053.6	825.2	816.5	0.3	0.3	0.4
Bolivia	0.6	0.9	1.2	0.0	1.9	3.6	5.6	0.0	6.8	7.9	8.2	8.2	10.9	14.4
Guyana	0.5	0.4	0.3	0.0	1.3	1.8	1.2	0.0	48.3	44.4	47.2	1.1	0.9	0.6
Uruguay	0.0	0.1	0.2	0.0	1.1	5.6	5.2	0.0	117.2	81.5	67.0	0.0	0.1	0.3
Other	0.2	0.1	0.1	0.0	0.9	0.5	0.6	0.0	109.9	112.7	124.7	0.1	0.1	0.1
Totals	**1 723.7**	**1 963.7**	**2 547.9**	**100.0**	**8 334.8**	**9 614.3**	**13 293.4**	**100.0**	**18 084.5**	**15 599.9**	**14 349.8**	**9.5**	**11.8**	**17.8**

Source: FAO FishStat, 2016.

In Central America, the United Mexican States have good development potential but still hasn't found a clear route to further and sustained progress and remains the second-highest importer of fishery products in the LAC region. In the United Mexican States, shrimp and tilapia production, and that of other species such as clams, oysters, mussels, rainbow trout and carps can still increase substantially. Cobia and *Seriola* are among the new marine species produced, while others could be added. Pacific bluefin tuna is also raised in important quantities, and has good market potential. The Republic of Honduras continues to grow with tilapia (46 000 tonnes in 2014) and shrimp (30 000 tonnes in 2014), becoming an important supplier to the United States market. The Republic of Nicaragua is also emerging with larger shrimp production, which currently (31 000 tonnes) doubles the levels of 2008, while tilapia farming has practically disappeared from official statistics. In the case of the Republic of Costa Rica, while tilapia farming diminished to 16 000 ton in 2014, below the levels of 2008 and 2009, other species such as spotted rose snapper (*Lutjanus guttatus*) evolved consistently and shrimp production levels remained at about 3 000 tonnes per year (5 300 tonnes in 2008).

BOX 1. NOTES ON THE STATE OF AQUACULTURE IN CENTRAL AMERICA[2]

Aquaculture in Central American countries (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama) increased its production by 198 percent between 2004 (85 225 tonnes) and 2014 (168 380 tonnes), or by 202 percent in value (US$342.34 million for 2004 and US$690.77 for 2014), according to the FAO (Fishstat, 2016).

About 97.4 percent of production is of marine shrimp (*Litopenaeus vannamei*) and tilapia (*Oreochromis* spp.), activities which contribute substantially to the economies of these countries. Aquaculture production has supplemented domestic seafood supplies in the region and has been well integrated with agriculture, tourism and 'fish-and-pay' recreational activities.

According to OSPESCA (Organization of the Fisheries and Aquaculture Sector of Central America) rural aquaculture has also experienced a significant increase within the region, with an estimated 20 000 tonnes in 2015 compared with 10 000 tonnes in 2009, while numbers of projects advance from 4 000–5 000 to 7 800 in those years.

Production growth is based on the addition of new farming areas and better technologies, particularly in reproduction, genetics, feed formulation, and production systems.

Aquaculture infrastructure has also improved, through the introduction of circular tanks with geomembranes, concrete tanks, highly resistant plastics, cages, natural products and alternative energy systems for power aerators in small-scale projects. A major breakthrough for regional aquaculture is diversification, particularly related to mariculture, with cobia (*Rachycentron canadum*) in Panama; molluscs (*Crassostrea gigas* and *Anadara tuberculosa*) in Costa Rica and El Salvador; snappers (*Lutjanus* spp.) in Costa Rica, El Salvador and Panama and seaweed (*Gracilaria* spp. and *Euchuma isoforme*) in Belize and Panama.

Further sustainable growth of aquaculture in this region is envisaged, with improved technologies and seed, diversification, market creation and more domestic consumption.

The region is following the directives set in the framework of the Fisheries and Aquaculture 2015–2025 Integration Policy (OSPESCA, 2015) and the Regional Strategy for Aquaculture Development which include extension services, financial assistance schemes, improvements in R&D activities to obtain better seed, alternative farming systems and diets, promoting national associations and strengthening policy plans and new development strategies.

The Republic of Chile leads LAC's aquaculture production in volume and value. Salmon/sea trout and mussels account for 98 percent of production in volume terms. The Republic of Chile is among the two largest world producers of both species. It has a world-class aquaculture industry (among the 'top-ten' world farmers) but nevertheless faces sustainability problems that are probably linked to exceeding the carrying capacity of many ocean areas. Huge efforts are devoted to regain past levels of efficiency and environmental stability. In parallel, the government of Chile is helping to diversify aquaculture production, supporting culture of 'new' native species, the introduction of new technologies (submersible devices, recirculation, reseeding of coastal areas, aquaponics and others) and/or allocating new areas for aquaculture.

In the Federative Republic of Brazil, efforts relate mostly to freshwater fish and shrimp farming. Tilapia leads among the first, and this country should increase tilapia volumes in the future to become one of the largest producers of this species in the world. Shrimp production should also evolve in future years, and the Federative Republic of Brazil may shortly consider exporting this species again, after years in which most shrimp was consumed at home. The Federative Republic of Brazil should expand its efforts to marine aquaculture[3], as it is the largest importer of fishery products in the sub-continent (over US$1.5 billion in 2014, an amount likely to be surpassed soon).

[2] The analysis was provided by Mr Reinaldo Morales, Biologist and Senior Expert, OSPESCA, Fisheries and Aquaculture Organization for the Central American Isthmus, August 2016, personal communication.

[3] Marine aquaculture of commercial interest in Brazil is currently constrained almost exclusively to the production of mussels and oysters, with production of over 19 000 and 2 800 tonnes, respectively, in 2014, up from 11 000 and 2 000 tonnes, respectively, in 2008.

The Republic of Ecuador, the third-biggest aquaculture producer in the LAC region, concentrates on shrimp and tilapia, with trout also evolving at a lesser scale. The country was the fifth-biggest shrimp farmer in the world in 2014, (340 000 tonnes), after collapsing in 2000–2001 because of disease outbreaks. After those depressed years, the Republic of Ecuador converted many of its ponds to tilapia farming, turning into an important fish producer with production estimated at 48 000 tonnes in 2008, diminishing to about 24 000 tonnes in 2014.This country has shown that with good discipline and effort, the poor handling of environmental conditions and technology in the early years was converted into a more stable success.

In the Republic of Peru, a traditional and important fishing nation, aquaculture started modestly but things are improving, apparently motivated by the national development plan of 2010, which has permitted nearly a tripling of harvests since 2006–2008 based on scallop, freshwater trout, shrimp and tilapia. The country still has ample room for development.

2.1.4 Production volume and value by species, country or area, and environment

Global landings from capture fisheries remained unchanged from 2000 to 2014, with freshwater fish showing advances that compensate for loses in marine fish. Aquaculture increased by 6.1 percent annually (APR) in all ISSCAAP[4] divisions. By 2014, world aquaculture contributed 44.1 percent of landings and surpassed 50 percent of production in all ISSCAAP divisions except marine fish, where contribution is only of 3.5 percent. In LAC, capture fisheries diminished by some 9 million tonnes (45.6 percent) in 2000–2014 while aquaculture production grew by almost 2 million tonnes. The various fishing sectors have remained fairly stable since 2000, with only freshwater fish production increasing in relevance (8 to 11 percent) in the last three five-year periods ending in 2014, compensating decreases in marine fish production of the same order. In this fifteen-year period, world aquaculture grew by 29 million tonnes, 18 million of which were accounted for by freshwater fish.

A key seafood division in world aquaculture volumes is that of freshwater fish (Table 8), representing over 53 percent of total farmed production/year in all five-year periods since 2000, a proportion that is growing, and reaching 57 percent in 2010–2014. Molluscs follow, with close to 30 percent of total volume farmed in 2000–2004, but with decreasing importance (23 percent of production in 2010–2014).

Table 8. Capture fisheries and aquaculture by ISSCAAP division. World and LAC figures, 2000–2014. All figures are mean annual values for each five-year period

Five-year period	Crustaceans	Molluscs	Miscellaneous aquatic animals	Marine fishes	Freshwater fishes	Diadromous fishes	TOTAL
World							
Capture fisheries volumes, thousand tonnes per year							
2000–2004	5 939.9	7 223.9	535.3	68 995.1	7 044.2	1 565.7	91 304.1
2010–2014	6 457.1	6 911.8	536.0	66 173.8	10 168.9	1 800.0	92 047.6
Aquaculture volumes, thousand tonnes per year							
2000–2004	2 455.5	10 819.1	247.0	1 138.5	19 698.4	2 569.4	36 927.9
2010–2014	6 264.4	15 000.7	839.3	2 151.5	37 660.0	4 342.4	66 258.4
Aquaculture total values, million US$ 2015 per year							
2000–2004	15 353.9	12 725.9	1 087.2	8 408.5	27 792.6	9 628.1	74 996.1
2010–2014	30 165.5	15 717.3	3 229.3	8 895.4	57 003.5	18 972.5	133 983.4
Aquaculture values per kilogram, US$ 2015							
2000–2004	6.3	1.2	4.4	7.4	1.4	3.7	2.0
2010–2014	4.8	1.0	3.8	4.1	1.5	4.4	2.0

continues on next page

[4] ISSCAAP: International Standard Statistical Classification of Aquatic Animals and Plants.

Five-year period	Crustaceans	Molluscs	Miscellaneous aquatic animals	Marine fishes	Freshwater fishes	Diadromous fishes	TOTAL
LAC							
Capture fisheries volumes, thousand tonnes per year							
2000–2004	359.0	849.4	57.4	16 043.9	490.4	1.7	17 801.7
2010–2014	408.7	1 202.2	82.8	10 617.5	486.4	8.6	12 806.1
Aquaculture volumes, thousand tonnes per year							
2000–2004	242.1	93.4	0.7	2.8,	296.8	493.7	1 129.6
2010–2014	590.6	338.0	0.6	6.9	625.3	779.8	2 341.2
Aquaculture total values, million US$ 2015 per year							
2000–2004	1 525.1	373.6	5.7	38.0	730.9	2 445.7	5 119.0
2010–2014	3 130.4	2 013.6	3.9	43.9	1 642.7	5 066.2	11 900.5
Aquaculture values per kilogram, US$ 2015							
2000–2004	6.3	4.0	7.7	13.4	2.5	5.0	4.5
2010–2014	5.3	6.0	6.1	6.3	2.6	6.5	5.1

Source: FAO Fishstat, 2016.

In the LAC region, farmed production of diadromous fish prevails (44 percent of total volumes in 2000–2004), decreasing to only 33 percent of totals during 2010–2014 (Table 9). Freshwater fish rank second, with a fairly stable share of production volume through these periods (24–27 percent) while crustaceans and molluscs increased from 21 to 25 percent and from 8 to 14 percent respectively. However, in value terms, crustaceans' importance doubled that of freshwater fish. The production of high-valued diadromous species (salmon and trout) and crustaceans (basically *L.vannamei* or whiteleg shrimp), assigns to the LAC region a very high average value per kilo for its farmed production, second only to Oceania. In fact, local average values per kilo of aquaculture production are at least 122 percent higher than world averages in the last three five-year periods ending in 2014 (152 percent higher in 2010–2014).

According to the main groups of species for aquaculture, the LAC region has featured farmed fish since 2000, (nearly 800 000 tonnes in 2000–2004, rising to 1.4 million tonnes in 2010–2014), crustaceans (240 000 tonnes in the former period and 590 000 in the latter) and molluscs (from 94 000 tonnes to nearly 340 000 tonnes in 2010–2014). Production of amphibians and reptiles is fairly limited, with five-year averages of the order of 600–800 tonnes, and that of invertebrates is negligible throughout this 15-year period. An important part of growth in farmed fish is due to salmon, trout and tilapia; mollusc yields reflect important advances in mussel production in the Republic of Chile and in the Federative Republic of Brazil and crustaceans are mainly shrimp, especially those produced in the Republic of Ecuador.

South America leads in all ISSCAAP divisions of species farmed in the LAC region (Table 9) except for marine fish, where the very limited regional production is centred in Central America. South America produces two thirds of the crustaceans, almost 99 percent of the diadromous fish, over 82 percent of freshwater fish and 98 percent of all molluscs in this region.

Table 9. Aquaculture production in LAC countries, by main ISSCAAP division and geographic region, 2000–2014. ISSCAAP division categories in thousand tonnes*. Figures for geographic regions in percentages

ISSCAAP Division/Region	2000–2004	2005–2009	2010–2014
Crustaceans	**242.1**	**448.3**	**590.6**
Caribbean	1.1	1.0	0.6
Central America	34.9	40.3	32.6
South America	64.0	58.7	66.8
Diadromous fishes	**493.7**	**642.2**	**779.8**
Caribbean			
Central America	0.8	0.8	1.2
South America	99.2	99.2	98.8
Freshwater fish	**296.8**	**405.7**	**625.3**
Caribbean	10.6	8.2	4.2
Central America	15.5	18.1	13.5
South America	73.9	73.7	82.3
Marine fish	**2.8**	**4.7**	**6.9**
Caribbean	4.3	12.3	6.7
Central America	43.6	80.8	87.3
South America	52.0	6.9	5.9
Miscellaneous aquatic animals	**0.8**	**0.8**	**0.7**
Caribbean	7.2	7.4	9.6
Central America	8.8	17.2	17.7
South America	84.1	75.4	72.7
Molluscs	**93.4**	**199.9**	**338.0**
Caribbean	1.5	0.5	0.5
Central America	2.1	1.8	2.0
South America	96.4	97.6	97.6
Totals	**1 129.6**	**1 701.7**	**2 341.3**

*Ordered by volumes farmed in 2012–2014.
Source: FAO Fishstat, 2016.

Whiteleg shrimp is the single most important species farmed in the region in terms of volume, with over 627 000 tonnes per year in 2012–2014, followed by Atlantic salmon with 512 000 tonnes (Table10). Adding tilapias n.e.i, Chilean mussels and rainbow trout, these five species account for over 74 percent of the volumes and close to 81 percent of the values of LAC's aquaculture. If coho salmon, cachama and Nile tilapia are added, these eight species account for 89 percent of volumes and 91 percent of values, showing that the remaining species (numbering more than 90) have as yet little to add to the global performance of farmed production in the region, even if they are indicative of a massive diversification effort being undertaken throughout the sub-continent.

Of the main thirty species, nine are grown in marine environments, 18 in continental waters and three in both. The former account for 74 percent of these volumes and 87 percent of the values, while the rest are produced in fresh waters. As well, among those thirty species, 62 percent of the volume and 56 percent of the value can be attributed to fish; 25 percent and 26 percent, respectively to the whiteleg shrimp, while the remaining 13 percent of the volume and 18 percent of the value are attributable to molluscs.[5]

[5] Along this chapter, LAC mollusc values seem to be over-evaluated, particularly because a very high ex-farm value assigned to the Chilean mussel by FAO, a fact that has not been questioned further, to make comparisons with other FAO figures possible.

Table 10. LAC: Main species farmed 2000–2014

Rank	Species	Scientific name	Volumes, Thousand tonnes and percentages						Values, Million US$ of 2015 and percentages					
			2000–2002	2006–2008	2009–2011	2012–2014	% of Totals 2012–2014	%, cumu-lative	2000–2002	2006–2008	2009–2011	2012–2014	% of Totals 2012–2014	%, cumu-lative
1	Whiteleg shrimp	*Penaeus vannamei*	186.9	459.4	514.5	627.4	24.62	24.62	1 331.9	2 171.2	2 524.3	3 460.4	26.03	26.03
2	Atlantic salmon	*Salmo salar*	228.8	365.5	207.0	512.2	20.10	44.73	1 105.4	2 757.3	1 561.4	3 492.6	26.27	52.30
3	Tilapias nei	*Oreochromis (=Tilapia) spp*	70.3	125.2	203.2	271.4	10.65	55.38	230.8	303.9	540.5	588.5	4.43	56.73
4	Chilean mussel	*Mytilus chilensis*	33.3	155.8	225.7	241.4	9.47	64.85	52.9	470.7	723.1	1 750.0	13.16	69.90
5	Rainbow trout	*Oncorhynchus mykiss*	116.9	175.2	253.3	236.0	9.26	74.11	496.1	1 092.7	1 786.1	1 461.5	10.99	80.89
6	Coho(=Silver) salmon	*Oncorhynchus kisutch*	110.9	105.3	146.4	155.2	6.09	80.20	500.9	457.3	888.3	721.1	5.42	86.31
7	Cachama	*Colossoma macropomum*	23.0	47.5	65.8	113.5	4.46	84.66	70.0	121.5	193.6	306.4	2.30	88.62
8	Nile tilapia	*Oreochromis niloticus*	35.2	82.0	105.2	99.0	3.88	88.54	108.1	209.2	349.0	308.5	2.32	90.94
9	Peruvian calico scallop	*Argopecten purpuratus*	22.1	34.4	54.4	54.2	2.13	90.67	169.3	380.0	516.3	508.8	3.83	94.77
10	Tambacu, hybrid	*P. mesopotamicus x C. macropomum*	12.4	12.4	22.3	36.2	1.42	92.09	35.6	28.5	59.0	81.0	0.61	95.38
11	Pirapatinga	*Piaractus brachypomus*	10.1	2.9	13.8	22.8	0.89	92.98	37.6	8.1	41.9	64.7	0.49	95.86
12	Cyprinids nei	*Cyprinidae*	0.0	11.3	27.5	22.0	0.87	93.85	0.0	31.2	78.2	51.5	0.39	96.25
13	South American rock mussel	*Perna perna*	10.6	11.7	13.6	18.9	0.74	94.59	7.6	9.5	20.8	27.3	0.21	96.46
14	Pacu	*Piaractus mesopotamicus*	6.1	13.4	18.1	16.1	0.63	95.23	21.5	38.2	59.5	48.4	0.36	96.82
15	Freshwater siluroids nei	*Siluroidei*			3.3	15.7	0.62	95.84			14.5	56.6	0.43	97.25
16	Silver carp	*Hypophthalmichthys molitrix*	14.4	17.4	16.1	15.6	0.61	96.46	15.1	18.8	16.6	14.6	0.11	97.36
17	Tambatinga, hybrid	*C. macropomum x P. brachypomus*	0.1	2.9	6.2	10.7	0.42	96.88	0.4	6.7	16.4	30.2	0.23	97.58
18	Brycon amazonicus	*Brycon amazonicus*			2.1	8.1	0.32	97.19			7.4	24.7	0.19	97.77
19	Freshwater fishes nei	*Osteichthyes*	21.1	14.0	13.0	7.7	0.30	97.50	24.8	15.7	28.2	28.6	0.21	97.99
20	North African catfish	*Clarias gariepinus*	0.4	1.8	5.7	6.6	0.26	97.76	1.3	2.4	6.4	6.2	0.05	98.03
21	Arapaima	*Arapaima gigas*		0.0	0.9	5.8	0.23	97.98		0.1	5.9	25.8	0.19	98.23
22	Pacific bluefin tuna	*Thunnus orientalis*	0.3	2.4	2.9	5.4	0.21	98.20	6.8	21.0	17.3	38.6	0.29	98.52
23	Cortez oyster	*Crassostrea corteziensis*	0.4	0.6	0.9	4.8	0.19	98.39	0.6	0.9	1.3	2.3	0.02	98.53
24	Common carp	*Cyprinus carpio*	67.4	39.1	3.5	4.6	0.18	98.56	97.6	46.3	5.8	7.6	0.06	98.59
25	Leporinus spp	*Leporinus spp*			0.0	3.0	0.12	98.68			0.1	9.0	0.07	98.66
26	Cupped oysters nei	*Crassostrea spp*	1.6	2.3	2.1	2.7	0.11	98.79	3.4	5.1	4.9	3.9	0.03	98.69
27	Prochilods nei	*Prochilodus spp*	2.9	3.2	4.1	2.7	0.11	98.90	6.7	4.6	13.1	8.2	0.06	98.75
28	Pacific cupped oyster	*Crassostrea gigas*	6.4	2.9	2.3	2.7	0.11	99.00	12.0	6.6	3.6	2.9	0.02	98.77
29	Netted prochilod	*Prochilodus reticulatus*	1.0	4.1	2.0	2.5	0.10	99.10	3.7	11.5	5.9	6.9	0.05	98.82
30	Cholga mussel	*Aulacomya ater*	0.8	1.1	2.3	2.3	0.09	99.19	1.8	2.6	7.5	2.0	0.02	98.84
31	Other	*Other*	28.3	29.8	25.4	20.6	0.81	100.00	141.6	113.5	117.5	154.4	1.16	100.00
		Totals	1 011.9	1 723.7	1 963.7	2 547.9	100.00		4 483.7	8 334.8	9 614.3	13 293.4	100.00	

Source: FAO FishStat, 2016.

Although marine capture fisheries contribute 95 percent of wild landings in the LAC region (2014; 87 percent on a world basis), marine aquaculture accounts for only 68 percent of farmed volume (37 percent, globally) (Table 11). Marine aquaculture accounts for 20 percent of all volume farmed in the Caribbean, for 61 percent in Central America, and for 70 percent in South America (2014). The proportion of marine aquaculture volume has diminished in South America since 2000, while the opposite occurs in the Caribbean and Central America. In the Caribbean, contributions have moved from 12 to 20 percent of farmed production, while in Central America the drop in the relative contribution of marine farming volumes between these dates is from 64 to 61percent. In South America, it goes from 71 to 70 percent, indicating that growth rates of production have been higher in freshwater compared to marine species.

Table 11. LAC Aquaculture per sub-region and environment, 2000–2014 (in thousand tonnes)

LAC Aquaculture					Marine aquaculture				Continental aquaculture			
Year	Total	Carib-bean	Central America	South America	Total	Carib-bean	Central America	South America	Total	Carib-bean	Central America	South America
2000	839	40	89	710	568	5	57	506	271	35	32	204
2005	1 508	30	246	1 232	1 133	6	160	967	376	24	86	265
2010	1 855	37	239	1 579	1 254	6	177	1 071	601	31	62	508
2011	2 207	29	270	1 909	1 557	5	194	1 358	650	24	76	551
2012	2 385	29	284	2 072	1 662	5	194	1 463	723	24	91	609
2013	2 467	33	338	2 096	1 734	6	240	1 487	733	26	98	609
2014	2 792	33	363	2 396	1 902	6	220	1 675	890	27	142	721

Source: Fishstat, 2016.
Note: Marine include brackish waters.

BOX 2. PRODUCTION (FATTENING) OF BLUEFIN TUNA IN MEXICO[6]

Fattening bluefin tuna (Thunnus orientalis) juveniles caught in the wild began in Mexico in the late 1990s but really took off from 2000. The activity currently takes place only in Ensenada, Baja California. Juveniles are caught in the wild along the Baja California peninsula during the months of June to August. Catches of this species in this part of the world are regulated by the Inter-American Tropical Tuna Commission (IATTC), of which Mexico and the United States are members. This activity is not prohibited on the Pacific coast and in the Pacific Island Region of the United States of America, although regulatory issues affect its development; it has so far not been authorized in American waters of the Gulf of Mexico (S. Bunsick, C. Sandoval, NOAA, personal communication 2016). The Pacific Island Region includes American Samoa, Guam, Hawaii, the Northern Mariana Islands, and other U.S. Pacific islands.

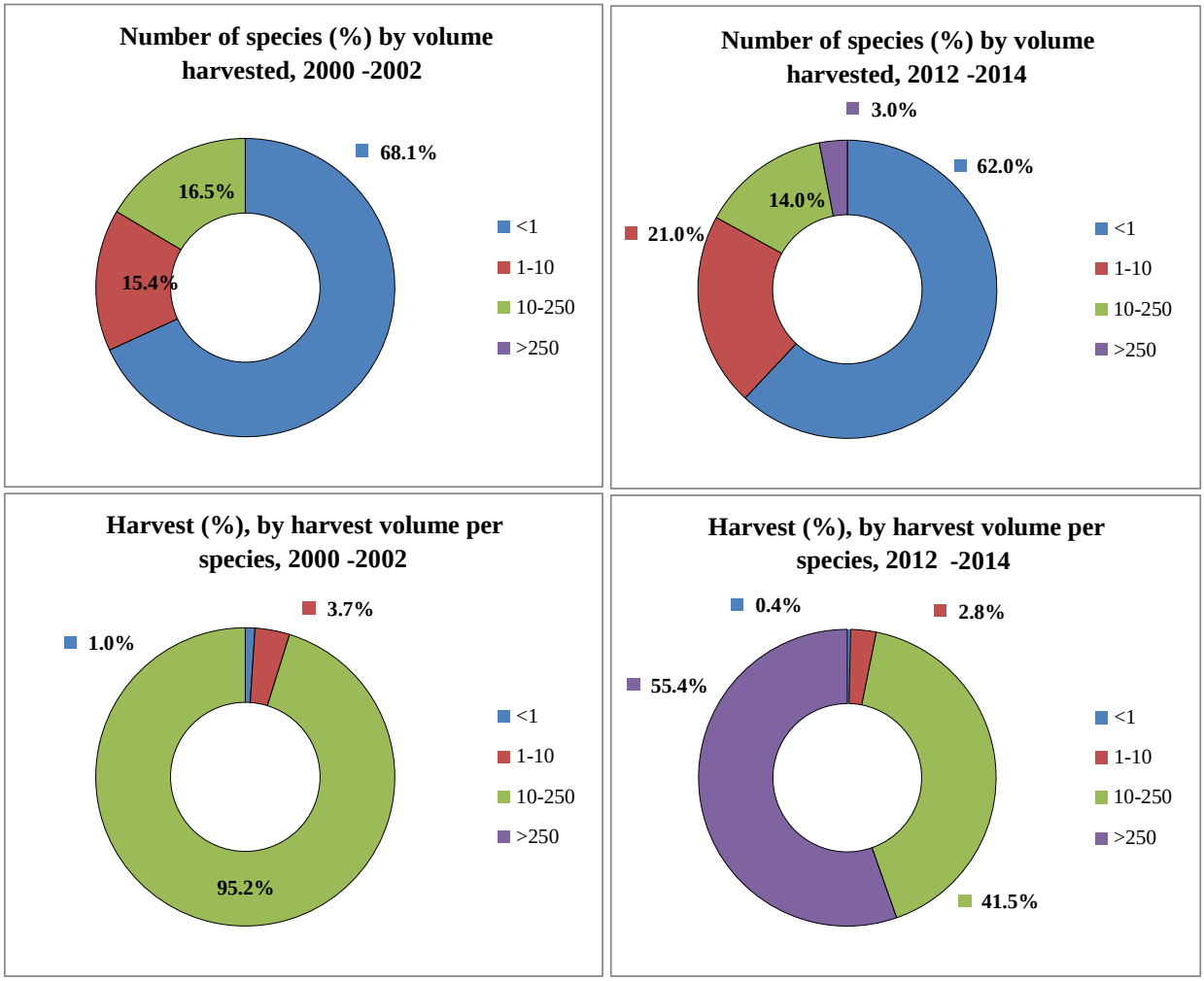
Three companies participated in 2015 in the fattening process using tuna cages, with a total production of 1 797 tonnes in 2010 and 7 251 tonnes in 2015. Harvests are mainly exported to Japan and to the United States of America market, while a portion also remains in Mexico. The product sent to Japan is shipped by air from Los Angeles airport, fresh gutted and without gills. In the same presentation it is also sold in Ensenada to Japanese traders who freeze the fish on board hired Japanese vessels. Growth of production of fattened bluefin tuna in Mexico can be explained partly by longer fattening periods, leading to weights of over 30 kg, allowing for better market prices. Factors contributing to success include restricted entrance to this industry, capture of juveniles with higher weights, better towing and feeding techniques, farming areas with suitable temperatures for fish growth, and appropriate management measures to control catch quotas and sizes. Additional mariculture activities are taking place in Mexico's Pacific region, for cobia, yellowtail, white sea bass, stripped sea bass, and sea trout (steelhead), among others. Because tuna – together with spotted sea bass (Costa Rica) – are the most important marine fish farming operations in the LAC region it seems important to allocate more R&D resources to these species. There is a need to find alternative food sources for tuna, to further develop the artificial production of juveniles in laboratories, to expand market options and to develop new products.

The number of species farmed in LAC has grown from 80 to 96 (20 percent) from 2000 to 2014, with the Caribbean showing no advances (20 species in both years), Central America moving from 31 to 36 species (16 percent) and South America progressing from 55 to 68 species (24 percent). The youth of LAC's aquaculture industry is evident: since 2000/2002 the majority of species farmed in this subcontinent (62–69 percent) were produced in total annual volumes below 1 000 tonnes per year and

[6] Analysis provided by Dr Jeronimo Ramos, Ph.D. Applied Economics, First National Commissioner on Fisheries and Aquaculture in Mexico, former Director General and Vice President of Maricultura del Norte (Mexican tuna farmer), Consultant in Fisheries, Aquaculture and Tourism and currently Chief, Post-Graduate Studies and Research in Tourism, and Post-Graduate Professor, Instituto Politecnico Nacional, Mexico. Personal communication.

83–87 percent below 10 000 tonnes per year. This being so, the former group accounts for only 0.4 to 1.0 percent of the volumes cropped, while the latter accounts for 3.1 to 4.8 percent of the volumes. The remaining species (13–17 percent), harvested in volumes in excess of 10 000 tonnes per year in the region, account for most production. In fact, the few species exceeding 250 000 tonnes per year are responsible for 39–55 percent of total farmed volumes (Figure 3).

Figure 3. Average number of species farmed and average volumes harvested per year, by range of harvest per species in LAC countries, 2000–2002 and 2012–2014. Percentages of respective totals



Source: FAO Fishstat, 2016.

On a global basis 10.3 percent of the species farmed in 2012–2014 show mean annual harvest of over 250 000 tonnes (only 3 percent in LAC countries; Figure 3). Those species account for 89.4 percent of total harvests during that period, while the equivalents in LAC contribute only 55.4 percent of volume. Additionally, 68.5 percent of the species farmed globally show annual production below 10 000 tonnes, while in the LAC region this figure is of 83 percent (2012–2014), indicating again that local farmed production is still in its infancy.

2.2 Important issues

Marine fish, a neglected category of farmed seafood, has yet to prove itself in the LAC region. After decades of trials and an immense sum spent on R&D in several countries, only a few species are advancing; they include spotted rose snapper, Pacific bluefin tuna and cobia. Turbot farming has been discontinued in the Republic of Chile and not much more of commercial interest is occurring in the sub-continent. Cobia has been tried in several countries but by 2014 only the Republic of Panama was farming meaningful quantities (about 1 500 tonnes), while the Republic of Colombia produced only 150 tonnes. The Federative Republic of Brazil is also advancing very slowly with cobia, but the only

meaningful project to grow this species in cages near Sao Paulo has recently been discontinued, as farming authorizations were not granted.

2.3 The way forward

Because of the high value of aquaculture products and limited domestic consumption in the LAC region, aquaculture exports are very important to many countries such as the Republic of Chile, the Republic of Ecuador and the Republic of Honduras and provide fairly stable jobs in an array of activities ranging from primary production to services, R&D, etc. The evolution of aquaculture production worldwide and an increasing availability of seafood products in recent decades has increased fish consumption but has decreased average ex-farm unit values over several years in the LAC region. This downward trend prevailed between 1985–1987[7] and 2000–2002; thereafter, unit prices have started to move upwards as a result of many factors including higher demand, rising costs of feed and labour, better and costlier post-harvest handling, difficulties in getting farming licences and disease outbreaks. Lower unit prices have allowed fish products to reach new consumers, and have challenged production and management practices, resulting in higher efficiency and better productivity all along the value chain. It is unlikely that per unit ex-farm prices will decline substantially in the near future, and chances are that they should stay even or increase slightly. However, market competition with alternative sources of animal protein (particularly pork and chicken) mean there is much work to be done regarding prices, standardization, continuing supplies, regular quality, level of processing, packaging, ease of cooking etc.

Opportunities for future growth are apparent not only in LAC's main producing countries, but also in other countries which still have ample space for growth. In general, it should be expected that the bulk of future production will remain focused on salmon/trout, tilapia, shrimp and mussels in the near and mid-terms, while a growing and more meaningful influence of native species will become apparent from 2025. The story of sturgeon farming in Uruguay shows that there are also opportunities for other innovative undertakings and the farming of additional high-value and introduced species.

2.3.1 Sturgeon and caviar production in Uruguay – a novelty in LAC aquaculture[8]

Esturiones del Río Negro S.A. (ERN), with its brand "Black River Caviar" (www.blackrivercaviar.com.uy), is the pioneer in fish farming in Uruguay and also the first and most important sturgeon and sturgeon caviar producer in Latin America. ERN produces Oscietra type caviar from Siberian sturgeon (*Acipenser baerii*) and true Oscietra caviar from Russian sturgeon (*Acipenser gueldenstaedtii*). Caviar processing follows the traditional Russian malossol (lightly salted) recipe and has a shelf life of twelve months under refrigeration temperatures of -2°C to +2°C.

Sturgeon farming is capital-intensive, and requires a long maturation period, as there is a seven to eight-year lead-time between hatching and the harvesting of females for roe.

The farm is located in the town of Baygorria, on the Rio Negro. It is a natural environment, free of contaminants, where sturgeons are grown in a controlled open-flow system. The project was begun in 1992 with the first incursions into international caviar markets in 2001. To date, ERN has established itself as one of the main sturgeon breeding farms in the world, with caviar productions in excess of 6 000 kg per year and exports of over US$3 Million (2014). Caviar exports are destined for the United States of America, EU, Switzerland, Japan, Russia, neighbouring countries and other destinations. Since all species of sturgeon are protected (listed in Appendices I or II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, CITES), international trade in caviar is regulated by governments through a system of permits that guarantee their legal origin. Caviar produced and exported by ERN is controlled and labelled accordingly. ERN is a vertically integrated company with its own breeding stock, a hatchery, on-growing facilities and a processing plant. It also produces its own balanced diets, which eventually may be certified as organic.

[7] FAO does not record aquaculture values for years previous to 1984.

[8] Personal communication, Daniel Conijeski, Aquaculture Engineer, Chief Operations Officer, Esturiones del Río Negro, Uruguay, November 2016.

Among the most significant achievements of ERN, the following are noteworthy: (1) production scale, which places the company among the 10 largest farmed-caviar producers in the world; (2) its farming system has reduced sturgeon sexual maturation cycles by one to two years compared to other producers; (3) diversification of Uruguay's sales abroad and expansion of the economic potential of the aquaculture sector in the country, where ERN is the largest undertaking so far; and (4) international recognition.

3. RESOURCES, SERVICES AND TECHNOLOGIES

3.1 Status and trends

Several factors determine the way aquaculture evolves in Latin America and the Caribbean. To start, fish farming is still a new activity in the region, with only a limited number of countries producing meaningful volumes. Reasons include poor governance, lack of technical knowledge, increased competition for land and water, growing environmental concerns to degrading environmental conditions, unqualified labour forces, limited economic and/or community benefits. Other factors, such as low R&D effort, lack of basic services and/or raw materials and equipment and financial limitations, are also relevant.

Some among the above-mentioned factors prevail in some countries, while other factors might have effects that are more decisive in other countries. While aquaculture production has evolved unevenly in the Caribbean since 2000, growing 6.2 percent APR between 1992/94 and 2002/04 and decreasing by 1 percent in 2002/04–2012/14, in South America production has grown at 15.3 percent and 7.6 percent in those decades, and Central America by 12.5 percent and 7.4 percent. Trends seem to indicate that the development process is slowing down, even though growth rates are still better than world averages and those for other continents except Africa. However, in the LAC region the decline in growth rates was relatively more severe than in other parts of the world.

The length/format of the present review does not allow for a detailed review of each individual LAC country; however, the following comments capture some of the most important issues that determine the current state of aquaculture in some countries/territories in LAC and are indicative of their future prospects.

In the Argentine Republic, not much has happened in terms of production except for pacu and other related freshwater species. There is a wide variety of species being farmed at negligible levels. This diversification effort could pay off in the future, but a lack of critical mass in R&D, trained personnel and governance issues may be limiting, together with a lack of clear indication of support to promote further investment.

In the Federative Republic of Brazil, aquaculture potential is huge, but there are organizational problems that hinder development, and even if this industry is progressing in farm production and the availability of services, there is a need for better legislation and governance, for strong political will, and for much better and focused applied R&D to promote production. Small-scale farming can solve employment and food availability problems in several parts of the country and help reverse the trend of increasing seafood imports that surpassed US$1.5 billion in 2014. Large-scale production projects are almost non-existent or have little influence on a domestic market that pays high prices for seafood because of poor competition, lack of technology, lack of economies of scale and many unsolved logistic problems that affect the distribution of fish and make production costly. Marine aquaculture is still very limited (except for farmed shrimp, mussels and oysters), especially in a country with over 8 000 kilometres of coastline.

The Republic of Ecuador relies almost exclusively on farmed shrimp, outstanding in global terms, while tilapia production has decreased and any efforts toward diversification are basically limited to pirapitinga (1 000 tonnes in 2014). In the Republic of Ecuador, the economy progresses faster than in other countries in LAC, but has shown a downward trend since 2011, worrying private investors. This country showed its strength with a swift recovery of its shrimp industry following severe disease

outbreaks in 2000–2001. The Republic of Ecuador turned into an important tilapia farmer rapidly, with an estimated 48 000 tonnes produced in 2010 and 2011 respectively, to become an important exporter to the American market for fresh tilapia fillets. Production of 24 000 tonnes in 2014 represents losing ground to the Republic of Honduras and the Republic of Costa Rica. Redesign of shrimp farming operations enabled record production levels. However, R&D efforts of the past have not yielded good results, and much more will have to be done to promote and diversify production. In the Republic of Ecuador, a good proportion of the population works directly or indirectly in fisheries and aquaculture, and therefore political support and improved governance will probably become available whenever needed. This country has fairly well developed services, raw materials and equipment; future growth can be expected.

The Republic of Colombia, with a decreasing shrimp farming sector (current production is one-sixth or less of the levels observed in 2005–2009) has also shown interesting results with freshwater fish, particularly tilapias, pirapatinga, cachama, netted prochilodids and rainbow trout, a fact indicative of a variety of suitable climatic conditions for aquaculture. Efforts should focus on promoting more and better R&D to strengthen cobia farming, and improved governance should make a difference in future years, while logistics will continue to be challenging in a country with a complex geography. The recent ceasefire in the Colombian armed conflict will also facilitate sustainable economic growth in all sectors.

The Republic of Chile, LAC's main aquaculture producer, faces a difficult phase. The production model and public-private arrangements that dominated the scene for the last 35–40 years are in crisis and new alternatives have to be devised to keep this industry healthy and prosperous. Based on exports, this industry is mainly composed of large-scale and sophisticated modern production units that can deliver competitive salmon, trout and mussel products. However, salmon farmers face diseases and it is evident that the carrying capacities of various water bodies have been surpassed, leading to more stringent and expensive regulations which make costs rise. Local production has become far more expensive while, only ten years ago, the Republic of Chile was the most competitive global salmon producer. Longer mussel farming cycles and market problems that have penalized local salmon production with lower prices compared to Norwegian products call for a revision of successes and failures. Now under way, this revision should produce good results in the medium term. The Republic of Chile also needs to diversify and make use of the central, northern and extreme-south regions for aquaculture; it needs more and better R&D, the upgrading of its service sector and the incorporation of small-scale producers to supply the domestic market. Overall, it is crucial to shape a renewed governance and to create the social capital necessary to reach new sustainability levels in order to regain competitiveness and efficiency.

The United Mexican States have good development prospects but the aquaculture sector has not yet found a path to sustained progress. Seafood imports continue to be very high, while there are good environmental conditions that can justify further growth, which can in turn create work opportunities in several rural areas. Governance and poor R&D efforts, together with social insecurity in several parts of the country are some of the key obstacles; there is also a lack of a realistic and aggressive development planning and of incentives for private industry. New strategies for aquaculture development could enable future aquaculture growth. A growing domestic demand and proximity to markets in the United States of America strongly suggest that any serious development effort in the United Mexican States will pay off.

The Republic of Peru also faces interesting prospects, probably limited by logistic issues, R&D needs and better governance. However, its aquaculture development plan seems to have encouraged sectoral expansion, as aquaculture is evolving much better than in past years. A newly elected government has also shown interest in promoting aquaculture development. Here, the main factors required to promote further growth are well identified and only need further attention.

Aquaculture is an important economic activity in the Republic of Costa Rica, the Republic of Honduras and the Republic of Panama, with the Republic of Nicaragua also showing some progress. These countries could also expand in the future given good public policies, better R&D and logistics/services. Central America has a common aquaculture policy for 2015–2025 (OSPESCA, 2015), and progress in their joint efforts should be expected for shrimp and marine and freshwater fish.

In the Caribbean, aquaculture production has decreased during the last decade (2004–2014), mainly in the Republic of Cuba and Jamaica, countries that need to review their strategies and action plans, improve governance, R&D, logistics, human resources, technology and address market issues. The Caribbean is highly dependent on tourism and has water shortage problems in many areas, constraints that will probably affect aquaculture prospects unless a common regional policy is devised for division of activities, so that every partner makes the best use of its natural resources. Small population, small economies, and limitations with land and water could restrict future growth prospects. Common policy issues need further attention and financial backing to expand production and create employment opportunities, particularly for small to medium size or highly specialized enterprises such as those related to ornamental fish. Local conditions are not adequate to promote high volumes of aquaculture production. However, improvements to aquaculture technology including brood stock production, disease-free juveniles and seed, and genetic programs are promising, as they do not imply excessive needs for scarce local resources.

3.2 Important issues

The LAC region is highly dependent on foreign farming technologies, equipment and even raw materials but not much is being done to become less dependent. Most species currently farmed in large volumes have been introduced to most countries in LAC (e.g. tilapia, shrimp, trout/salmon, oysters) and depend on foreign technology and equipment. Europe, Japan and the United States of America are among the main sources of technology/equipment for this industry and they themselves lack the inshore space or governance to substantially expand their own aquaculture production. Therefore, they are bound to remain the main importers of seafood in the world. Under these circumstances, joint venture agreements with LAC countries appear logical, and it should therefore be expected that many international agreements will be put in place in coming years.

The region also faces another challenge in that, mainly because of environmental constraints, it has changed the direction of its diversification efforts by placing greater emphasis on the culture of native species for which there are not necessarily technical systems in place. This calls for more and better R&D. Restricted market prospects for many of the new species for fish farming are added to this new technical challenge,[9] as they are not necessarily well known in foreign destinations and can only be initially sold in local markets, thus limiting production volumes and the achievement of economies of scale. Renewed technical and marketing efforts are required if this diversification effort is to succeed. The acceptance of these new species in foreign or distant destinations can take many years and will require significant financial resources and good managerial abilities.

Countries like the Republic of Chile are realizing that their services sector already includes well over 1 000 small and medium size enterprises, many of which already have the capacity (though not necessarily the means) to develop their own products, equipment and/or processes and services. Provided they receive external backing, they can become established as suppliers on a more global basis. Therefore, government is planning to support those firms and help them become world-class suppliers in the medium term, not only of fish and fish products but also of equipment and knowledge.

3.3 Success story: A private-public partnership to foster aquaculture development in northern Chile[10]

Acuícola del Norte S.A. (ACUINOR) is currently validating technology for the cultivation of hiramasa or yellowtail kingfish *Seriola lalandi*, a prized pelagic fish with excellent export prospects. This is the first large-scale trial with marine fish in northern Chile, and its success is considered instrumental in promoting marine fish farming in a part of the country that currently has no commercial marine fish aquaculture.

[9] The development of a complete 'technical package' to commercially produce any one species, for which there is no proper or sufficient scientific/technologic background could very well take between 5 to 10 years, in the case of fresh water fish, and anything between 10-20 years in the case of more complex or marine species.

[10] Personal communication, Juan Lacámara A., Business Administrator, MBA, Director, ACUINOR, November 2016.

This company is trying inland, state-of-the-art recirculation systems, while at the same time experimenting with the fattening stage in cages at sea for comparison. These first large-scale trials with marine fish in northern Chile have received important governmental financial support.

ACUINOR was established in 2006 in the city of Caldera. Farming operations started in 2008, when the first juvenile fish were produced, (second country after Australia to achieve this milestone at a commercial level). In 2009 and 2010, ACUINOR started providing juveniles to Holland, Germany, the United States of America and the United Mexican States, and became the first company to export *Seriola* juveniles worldwide. High quality juveniles are now exported throughout the year. A productive and efficient species-specific recirculation technology is currently being considered for the final inland fattening stage.

R&D financial support, aimed at helping the Chilean aquaculture diversification process, particularly for the northern part of the country, has facilitated working with leaders in genetics, health, environment, R&D bioassays, process, product and market development. Results will be available to interested parties in the near future, and should ease the diversification process.

ACUINOR's Seriola has been rated "Best Choice" in the "Green List" by Seafood Watch (Monterey Bay Aquarium). The company is currently exporting fish (fresh, whole round) to the European market on a weekly basis, with pilot-level volumes of some 30 tonnes per year. The cooperative effort between ACUINOR and CORFO sets the standard for partnerships that can help diversify Chilean aquaculture in terms of species and geographic zones.

3.4 The way forward

There is great potential for further development of the aquaculture industry in many countries in LAC. Most countries face governance, organizational and/or sustainability problems; R&D efforts may be insufficient, more and better human capital is needed, and operations are not necessarily well accepted by the community. Most regional public services are not well equipped with adequately trained personnel and lack a long-term vision to direct future development efforts and to promote investment, employment and further production of food. These concerns need to be addressed to realize LAC’s promise in relation to aquaculture.

4. AQUACULTURE AND THE ENVIRONMENT

4.1 Status and trends

Commercial aquaculture of any significance is less than 50 years old in most parts of the LAC region. Up to now, most achievements have been based on the introduction of aquatic species, foreign technology, efforts to produce hard currency and the wish to enhance economic activity, employment and food security, particularly in rural areas. A good part of the process has been based on trial-and-error managerial schemes, on copied foreign ‘recipes’, or simply on improvisation. In many cases, authorities were (and some still are) not well informed on aquaculture and what was needed to frame, support, promote and control it. While production levels were still limited, environmental impacts were not necessarily noticed. This region has now come to terms with the basic principle that there is no such thing as ‘sustainable aquaculture’ unless appropriate management measures are in place to make sure that the environment, social conditions and economic viability are duly considered.

Different countries have applied different environmental strategies. The Federative Republic of Brazil and the Argentine Republic have established very strict procedures for obtaining aquaculture licenses; in both countries, restrictions may go beyond what is needed and have become an obstacle to aquaculture development. Despite environmental regulations, the Federative Republic of Brazil has been unable to avoid the spread of viral diseases that seriously affected shrimp production in the past, and the same has happened in the United Mexican States, the Republic of Ecuador and other countries. In the Republic of Chile, on the contrary, salmon farming operated initially without many regulatory

restrictions, to the point when grave disease outbreaks were faced, several lakes were contaminated and unsustainable production patterns affected crop levels, costs, competitiveness and market prospects.

4.2 Important issues

Environmental issues are often difficult to define and manage. For instance, is it acceptable to produce seeds or juveniles in one region and transport them to another for further growth, where the species can or cannot be naturally available? Should exotic species be introduced? Under what criteria? Can imports of fresh, live or frozen products be allowed in countries that farm native populations of those species? Should the transportation of live products/species be subject to controls? Should antibiotics, chemical products, and/or genetically modified species be allowed?

Several producer associations have already developed their own best practice manuals, as have NGOs and international organizations like FAO and others. There are some basic principles to adhere to, and LAC countries generally take note of this fact. However, there are a number of specific situations to be addressed specifically by each country. Among these are the rules for authorizing production sites and becoming officially recognized producers. In the Republic of Peru and partly in the Federative Republic of Brazil, governments select the areas where aquaculture production can take place and grant permissions to farm in those sites. In countries such as the Republic of Chile, each newcomer has to prepare an environmental impact assessment report where intentions are stated and the eventual environmental effects of production analysed. Here, comprehensive reports have to be filed with the environmental agencies, and only after lengthy consultations with the community, technical bodies, etc. can those requests be approved, in a process that might take two or more years. Even if there are special procedures applicable to small farmers, they do not always have the expertise, the money or the time to complete these lengthy procedures, and therefore either decide to work illegally or not proceed. Small-scale production needs specific governance to make small farmers as eligible as large-scale producers who have the resources and can pay for the expertise required to tackle these requirements.

Aquaculture in LAC increasingly is conceived as a possible source of seed or juveniles to replenish water bodies that have been depleted through overfishing, and where artisanal fishers can no longer make a living. Fish stocking, as done for decades in several Asian countries, might be explored locally as a new way to exploit marine resources. Many environmental concerns are still attached to this idea, and their implications need to be considered before these initiatives become established.

4.3 A success story: Shrimp farming in the Republic of Peru helps recovery after El Niño and the white spot virus[11]

Modern Peruvian aquaculture dates back more than 40 years, and has now become an important development alternative for exports and to meet food security needs in the country. The main species cultivated for export are shrimp and scallops, while trout, Amazonian species and tilapia are currently consumed at the national level.

Experiments with several other species, such as penaeid shrimp *(Litopenaeus vannamei)* began in the 1970s, when the Instituto del Mar del Perú (IMARPE) decided to expand into aquaculture. A research center was implemented in the northern part of the Peruvian coast, where climate conditions and limitations of space dictated obtaining the highest possible yields per unit-area using semi-intensive farming systems.

Production was sustained until the end of the 1990s, when a devastating El Niño event occurred, destroying almost all infrastructure. In addition, the dreaded ‘white spot’ disease made local production collapse. These events forced a re-definition of the industry in a joint effort involving producers and Peruvian state institutions to improve bio-security and production standards, with very good results in promoting sustainable production. Heavy investments improved all farming phases, allowing local production to compete successfully with many other tropical countries where farming areas exceed by

[11] Personal communication, Christian Berger, Biologist, Post Graduate, Biologic Oceanography, Director/Coordintor Aquaculture Engineering career, Universidad Científica del Sur, Lima, Peru Oceanography.

far those used in this country. In 2015, harvests exceeded 22 000 tonnes, without a significant increase in cultivation area. Much care is applied to the quality and safety of the products sold, which have come to serve the most demanding markets. Specialized institutions in research, health and trade, are also involved, suggesting a promising future for Peruvian shrimp farming.

4.4 The way forward

No single solution can be adequate for the whole sub-continent, but clearly, no public servant responsible for aquaculture development in the region should overlook environmental sustainability when talking about future production prospects. Public and private administrators have to be careful not to overburden industry with unnecessary or difficult-to-implement management measures that complicate production, increase cost and deter newcomers. A balanced solution will probably be arrived at the hard way. It is important, though, to be aware that the environmental dimension of aquaculture, including economic and social aspects, should be an integral part of any development scheme.

5 MARKETS AND TRADE

5.1 Status and trends

5.1.1 Seafood production and end products

Aquatic products originating from aquaculture contribute to food security, social and economic development. Recent FAO estimates indicate that fish farming accounts for over 50 percent of total fish production intended for human consumption. As well, a relatively high proportion of all products landed (30–40 percent) enter international trade; even if aquaculture products cannot be duly identified in trade statistics, it is known that they play a relevant role.

There will be many opportunities for further growth in aquaculture production within the LAC region during the coming decades, particularly because growth in demand for seafood products for human consumption will continue as urban population grows, incomes advance and educational levels improve. There is little chance that countries in Europe or in the United States of America can solve their substantial trade deficits in fishery products in the near future through domestic production alone, so the LAC region will continue to be a part of the world from which more and better seafood products can be exported. For this reason, the following sections focus on seafood regardless of its origin as farmed or wild-caught, in the understanding that aquaculture will keep increasing its share in domestic supplies and international trade of seafood and seafood products during the coming decades.

Seafood products amounted to some 5.5 million tonnes in LAC and 58 million tonnes globally in 2013 (FAO Fishstat, 2016). These volumes are equivalent to 37 percent of total landings in the LAC region, and 36 percent on a world basis. That ratio has remained fairly stable on a world basis, but in the LAC region has grown from 26 percent in 1976 to 31 percent in 2000, meaning that less fish is being sold whole or that post-harvest losses have diminished or that both factors have jointly influenced the outcome. Thirty-five percent of the end-products (volumes) in LAC during 2002–2003 were for human consumption (Table 12), a proportion that has grown to 61.8 percent in 2012–2013, basically by lower fishmeal production, which accounted for 58 percent of goods produced in 2002–2003 and only 32 percent of totals by 2012–2013.

LAC's production accounted for 14.5 percent of world products in 1992–1993 and diminished to 9.4 percent in 2012–2013, mainly as a result of severe declines in pelagic landings, the main raw material used to produce fish meals and oil (Table 12). It is also worth noting that the proportion of dried, salted or smoked fish also declined. The opposite occurred with fresh/chilled and frozen fish, the predominant preparations in 2012–2013 (29 percent of production), a category followed by crustaceans and molluscs fresh/chilled or frozen, accounting for 22 percent of LAC's end-products (2012–2013).

Table 12. End products elaborated in the LAC region, and comparisons, 1992–2013

FAO Main products	1992–1993	2002–2003	2012–2013
	Volumes, Thousand tonnes, end-products		
Aquatic plants	–	–	5.6
Crustaceans and molluscs, live, fresh, chilled, etc.	426.7	590.5	1 202.4
Crustaceans and molluscs, prepared or preserved	19.1	30.7	27.2
Fish, dried, salted, or smoked	79.3	62.8	42.4
Fish, fresh, chilled or frozen	877.3	1 460.7	1 535.7
Fish, prepared or preserved	395.3	620.2	513.1
Meals	2 999.6	2 530.0	1 691.4
Oils	404.1	362.2	357.3
Sponges, corals, shells	–	–	–
Total LAC	5 201.6	5 657.2	5 375.0
World	35 964.3	42 784.9	57 020.9
LAC/World percent	14.5	13.2	9.4
LAC landings, whole fish	18 789.7	17 538.3	14 847.1
World Landings, whole fish	102 491.5	127 534.2	160 353.2
LAC end-products/LAC Landings percent	27.7	32.3	36.2
World end-products/World landings percent	35.1	33.5	35.6
	Percentage of totals		
Aquatic plants	–	–	0.1
Crustaceans and molluscs, live, fresh, chilled, etc.	8.2	10.4	22.4
Crustaceans and molluscs, prepared or preserved	0.4	0.5	0.5
Fish, dried, salted, or smoked	1.5	1.1	0.8
Fish, fresh, chilled or frozen	16.9	25.8	28.6
Fish, prepared or preserved	7.6	11.0	9.5
Meals	57.7	44.7	31.5
Oils	7.8	6.4	6.6
Sponges, corals, shells	–	–	–
Total	100.0	100.0	100.0
End-products for human consumption	***34.6***	***48.9***	***61.8***

Source: FAO Fishstat, 2016.

Use of fish for direct human consumption within the LAC region is also a reflection of world trends (81.5 percent of world landings in 2005–2006; 87.2 percent in 2013–2014, Table 13), as the global use of fish as raw material for fish meals, oils and other purposes has steadily diminished in recent years. As well, the proportion of fresh, chilled or frozen seafood as well as cured products is increasing, while canned items diminish in relevance. It is interesting that seafood marketed fresh accounts for 40 percent of world landings (37 percent in 2005–2006). However, this situation varies according to the level of economic development of the countries. In developed nations, fish marketed fresh accounted for only 2.5 percent of the catch (3.4 percent in 2005–2006), compared with 45.4 percent for frozen fish, while in developing nations 47.5 percent of the landings were consumed fresh, with only 21.9 percent being frozen (figures for 2013–2014). Even if this last proportion is growing, it is evident that fish processing in LAC countries has a lot of room for growth, even if fresh products make sense in countries whose main urban population tend to live near the coast. It is also true that preserving seafood in different forms adds shelf life and prevents loses.

Table 13. Disposition of world fish landings. Thousand tonnes, whole fish equivalents and percentages

Category	Values				
	2005–2006	**2007–2008**	**2009–2010**	**2011–2012**	**2013–2014**
Total production	**137 155**	141 920	146 995	156 635	**165 080**
For human consumption	**111 739**	118 946	125 951	133 841	**143 899**
Marketing fresh	50 677	53 391	57 986	60 068	65 483
Freezing	31 619	34 390	36 161	39 537	42 853
Curing	12 218	13 177	15 055	16 034	16 740
Canning	17 226	17 988	16 749	18 203	18 824
		–	–	–	
For other purposes	**25 417**	22 975	21 044	22 793	**21 181**
Reduction	20 722	18 386	16 133	17 482	16 005
Other purposes	4 695	4 589	4 911	5 312	5 177
Percentages of total production					
For human consumption	*81.5*	*83.8*	*85.7*	*85.4*	*87.2*
For other purposes	*18.5*	*16.2*	*14.3*	*14.6*	*12.8*
Developed countries					
Total production	29 244	28 523	28 416	28 351	28 702
% Human consumption	78.4	79.5	81.1	79.8	79.8
% Other uses	21.6	20.5	18.9	20.2	20.2
Developing countries					
Total production	107 879	113 374	118 552	128 264	136 358
% Human consumption	82.3	84.9	86.8	86.7	88.7
% Other uses	17.7	15.1	13.2	13.3	11.3
Total exports	54 212	53 268	54 824	58 616	59 591
Exports/Production %	39.5	37.5	37.3	37.4	36.1
Indexes 2005–06=100					
Production	100	103	107	114	120
Human consumption	100	106	113	120	129
Other uses	100	90	83	90	83
Exports	100	98	101	108	110

Source: Calculated for this study, based on figures from FAO's Yearbook of Fishery Statistics 2014, 2016.

LAC's end-product volumes have increased modestly in the last twenty years (Table 14), reaching 5.4 million tonnes per year in 2012–2013, or 9.4 percent of world totals. This figure is fairly similar to the volumes produced in 1992–1993 (5.2 million tonnes), but in that period that amount accounted for 14.5 percent of world production. The major part of LAC's fishery production (end-products) since 1992–1993 is attributed to South America (4.6 million tonnes or 86 percent of totals, in 2012–2013, down from 4.8 million tonnes in 1992–1993, or 92.4 percent of totals). Most loses can be attributed to declining pelagic fisheries off the Republic of Chile and the Republic of Peru. Fish production in the Caribbean is still very limited and declining, while losses attributed to the southern region are recovered by a growing participation of Central America, currently contributing with 13.5 percent of volumes produced in 2012–2013, figures more than doubling those for 1992–1993.

Table 14. Seafood products produced in the LAC region and comparisons. Thousand tonnes (end-products) and percentages

Geographic region	1992–1993	2002–2003	2012–2013
Caribbean	49.2	13.8	27.0
Central America	345.7	658.5	724.4
South America	4 806.7	4 984.9	4 623.6
LAC	5 201.6	5 657.2	5 375.0
World	35 964.3	42 784.9	57 020.9
Lac/World percent	14.5	13.2	9.4
Contribution to LAC totals, percentages			
Caribbean	0.9	0.2	0.5
Central America	6.6	11.6	13.5
South America	92.4	88.1	86.0
LAC	**100.0**	**100.0**	**100.0**

Source: FAO Fishstat, 2016.

5.1.2 Apparent consumption

The LAC region has always been an area where, despite the high volumes caught and increasing quantities of farmed seafood, fish availability per person[12], a proxy for apparent fish consumption, has been low (some 10.1 kg per person in 2013, compared with a world average of 19.7 kg). LAC figures are decreasing in the Caribbean, show mixed behaviour with a downward trend in Central America and are moving upwards only in South America as from 2005. The opposite occurs with world averages and apparent consumption in Europe, Asia and Africa, which trend upwards, while in Oceania figures have started a downturn move in recent years as well. The Americas as a whole show a fairly flat behaviour with a slight increase in more recent years. Countries such as the Argentine Republic, the Republic of Chile, the Republic of Guyana, the Republic of Paraguay and the Bolivarian Republic of Venezuela in South America, and the Republic of Cuba and Dominica in the Caribbean show a downward trend in apparent seafood consumption since 1995, while the remaining countries of the region are either stable or have increased per capita seafood intake from that same year.

The low apparent consumption figures of the LAC region are due mainly to historic habits, which reflect a preference for red meats. In fact, apparent red meat consumption in countries such as the Argentine Republic, the Plurinational State of Bolivia, the Republic of Guatemala, the Republic of Honduras and the Republic of Paraguay was 39 times the level of fish consumption in 2011. In another eleven countries, red meat consumption is between five and ten times that of seafood; in 17 more, between one and 5 times. The Republic of Peru is the only LAC country where fish apparent consumption exceeds that of all red meats put together. Therefore, domestic demand has not been a decisive driver for aquaculture production in LAC countries. Export prospects and the need to generate good-quality employment in rural areas appear to be better incentives for fish farming growth in several parts of this region.

5.1.3 International trade

The local fishing industry contributes substantially to a trade surplus of US$10.8 billion in 2013 (Table 15). The main contributor to export is South America (84.4 percent of total values), followed by Central America (14.2 percent) and the Caribbean, with 1.4 percent. The southern region imports 67.4 percent of the US$4.7 billion bought abroad by LAC countries in 2013, followed by Central America (23.2 percent) and the Caribbean (9.4 percent).

Table 15. Foreign trade in fishery products. LAC region and comparisons, 1998–2013

	Imports							
	Volumes in Thousand metric tonnes				**Values in million US$ of 2015**			
Geographic region	**1998**	**2003**	**2008**	**2013**	**1998**	**2003**	**2008**	**2013**
Caribbean	111	139	170	134	318	329	444	438
Central America	120	181	299	355	290	451	798	1 088
South America	452	543	883	1 123	1 253	712	2 093	3 162
LAC	**682**	**863**	**1 352**	**1 612**	**1 861**	**1 492**	**3 336**	**4 688**
World	**22 483**	**28 590**	**33 278**	**35 203**	**85 704**	**94 398**	**110 021**	**126 812**
LAC/World percent	**3.0**	**3.0**	**4.1**	**4.6**	**2.2**	**1.6**	**3.0**	**3.7**
	Exports							
Caribbean	29	31	28	36	318	306	224	216
Central America	318	439	516	503	2 421	2 119	1 914	2 204
South America	3 052	4 227	5 052	4 134	7 791	8 148	10 616	13 100
LAC	**3 400**	**4 698**	**5 596**	**4 673**	**10 529**	**10 574**	**12 754**	**15 521**
World	**22 493**	**28 406**	**32 479**	**36 833**	**79 723**	**89 529**	**104 099**	**131 943**
LAC/World percent	**15.1**	**16.5**	**17.2**	**12.7**	**13.2**	**11.8**	**12.3**	**11.8**

Source: FAO Fishstat, 2016.

In 2013, regional seafood export values accounted for 11.8 percent of world exports of fishery products, a share that stays reasonably stable over the years but is down from 13.2 percent in 1998. The region

[12] Fish availability for human consumption is calculated as follows: Local fish landings, less fish destined to feed and other uses, plus imports less exports, all figures expressed in whole fish equivalents.

also contributes 12.7 percent of world seafood volumes exported, down from 15.1 percent in 1998, when fishmeal and oil still played a very large role. LAC imports accounted for 3.7 percent of total world seafood import value and 4.6 percent of the volume in 2013. Both the value and volume share of LAC imports have increased by nearly 50 percent since 1998.

The Caribbean shows a permanent deficit in seafood trade – some 98 000 tonnes and US$222 million of 2015 in 2013 (Table 15). The opposite occurs with South and Central America, where seafood exports surpass imports by far. Surpluses in value terms are growing in South America, but they diminish in Central America. The Federative Republic of Brazil and the United Mexican States have a definite influence on these trade figures. Both have enormous populations, and imports have grown substantially there.

As can be calculated from figures in Table 16, about 85 percent of the volumes and 92 percent of the values imported in the LAC region during 2013 correspond to products for human consumption. Fish, chilled or frozen, have an enormous and increasing participation in total imports, accounting for 53 percent of the volumes and 47 percent of the values in 2013.[13] The importance of prepared or preserved fish, even though ranking second among import items, is diminishing, to about 20 percent of the volumes and 25 percent of the values in 2013. Other seafood products are much less important as import categories.

Table 16. LAC foreign trade in seafood products, 1998–2013

	Volumes in thousand tonnes				Values in million US$ of 2015			
	1998	2003	2008	2013	1998	2003	2008	2013
Major FAO group	**Imports**							
Aquatic plants	4	8	9	11	14	16	24	34
Crustaceans and molluscs, live, fresh, chilled, etc.	42	45	87	87	134	155	265	349
Crustaceans and molluscs, prepared or preserved	5	8	17	26	39	53	86	146
Fish, dried, salted, or smoked	73	56	83	88	442	231	437	419
Fish, fresh, chilled or frozen	290	379	657	853	617	556	1 446	2 214
Fish, prepared or preserved	163	145	251	318	483	326	778	1 174
Inedible	9	36	29	41	22	19	37	32
Meals	76	85	123	127	83	63	114	187
Oils	20	100	95	61	25	73	147	132
Sponges, corals, shells	1	1	1	0	3	1	2	1
Total	**682**	**863**	**1 352**	**1 612**	**1 861**	**1 492**	**3 336**	**4 688**
World	22 483	28 590	33 278	35 203	85 704	94 398	110 021	126 812
	Exports							
Aquatic plants	55	70	80	116	85	88	112	212
Crustaceans and molluscs, live, fresh, chilled, etc.	629	606	859	1 002	4 666	3 544	3 208	4 847
Crustaceans and molluscs, prepared or preserved	23	48	158	153	259	298	433	495
Fish, dried, salted, or smoked	27	33	26	25	216	188	167	191
Fish, fresh, chilled or frozen	1 018	1 303	1 421	1 395	3 185	3 868	4 863	5 582
Fish, prepared or preserved	297	331	354	363	851	848	1 283	1 659
Inedible	5	8	13	11	14	13	18	13
Meals	1 291	2 079	2 308	1 375	1 205	1 590	2 124	2 024
Oils	54	218	375	232	44	134	544	495
Sponges, corals, shells	1	2	1	2	4	3	2	3
Total	**3 400**	**4 698**	**5 596**	**4 673**	**10 529**	**10 574**	**12 754**	**15 521**
World	22 493	28 406	32 479	36 833	79 723	89 529	104 099	131 943

Source: FAO Fishstat, 2016.

Figures for 2005–2007 and 2012–2014 indicate that between 51 and 53 percent of the value of seafood imported by LAC countries originate in this same region. On the other hand, 9 percent of the values exported in 2005–2007 and 14 percent of those in 2012–2014 are related to purchases in other LAC countries, while the major part of those sales take place outside this region.[14]

[13] Figures available do not permit to discriminate in detail between purchases from outside the LAC region, from those imported by LAC countries from other LAC countries. The ones currently available refer to 2005–2007 and 2012–2014, and only refer to totals and not to particular categories.

[14] Figures are calculated from tables available in FAO's Yearbook of Fishery Statistics of 2014 and other years.

Fishmeal was the main LAC export product in 1998, with 38 percent of the volume and 11.4 percent of the value sold abroad. However, its contribution decreased in volume terms to 29.4 percent, while due to higher prices, amounts to 13 percent of the values exported in 2013. Fresh, chilled and frozen fish constitute the most important export products with 29.9 percent of the volumes and 36 percent of the values in 2013, while live, fresh or frozen crustaceans rank second, with contributions of 21.4 percent of the volumes and 31.2 percent of the values of seafood exported by the region. Other categories have a lesser importance in LAC seafood exports.

On a global basis, the LAC region stands out as importer of dried, salted or smoked fish, with 10.5 percent of the total volumes and 7.7 percent of world values of those products in 2013. It also stands out with prepared fish or preserved imports, accounting for 9.2 percent of world volumes and 7.6 percent of the values of that line of products. In term of exports, LAC countries contribute 47.4 percent of all fish meal export volumes and 48.9 percent of world export values, and 18.9 percent of the volumes and 15.1 percent of world values of, live, fresh, chilled or frozen crustaceans and molluscs.

5.2 Important issues

The low consumption of seafood in in most LAC countries[15] compared to other meats is also related to the attributes of fish products. In some instances, the quality and level of standardization are poor, quantities available for massive distribution through supermarkets might be difficult to get and/or prices might be higher than those for chicken or pig. Therefore, formulation and implementation of strategies to stimulate the incorporation of technology and to improve marketing and consumption of fishery and aquaculture products are necessary in this region because those actions, together with mass processing of products, are the means to standardize production, to lower prices and to compete more favourably with other meats.

5.3 The way forward

With the exception of the Federative Republic of Brazil, the United Mexican States and a few other countries that have important levels of seafood imports–which call for future aquaculture production – it is clear that even if domestic demand grows, exports will still be one of the most important drivers for further expansion. A more competitive, rationalized and large-scale production is desirable and should be considered a strategic goal. A move toward a better-organized and competitive large-scale seafood industry throughout the LAC region can have the double effect of positively increasing domestic consumption figures while facilitating exports. This idea does not compete with strengthening small scale production and processing, which play an important social role in most LAC countries and which deserve full attention to complement domestic supplies, particularly in rural and small-to medium size urban areas.

The LAC region has already developed an interesting aquaculture industry in several countries, but further progress is still necessary in most to reach meaningful economic and social benefits. Exports seem to have played a particularly important role as a driver of aquaculture development in recent decades, while food supplies for domestic use, self-consumption and the creation of good employment opportunities in rural areas for small-scale farmers have also justified several of the most important achievements in this field.

Even if the LAC region shows surpluses in its external trade in fishery products that provide much-wanted hard currency to many countries, aquaculture contribution to food security in this area is still relatively modest. Employment might be a more relevant issue to many countries, particularly in rural areas.

[15] Almost certainly, average figures hide in many countries the important contribution of fish to human nutrition in several rural areas and for innumerable communities. That is the case of several areas in the Brazilian Amazon, where fish consumption is much more significant to local populations than what averages suggest.

6. CONTRIBUTION OF AQUACULTURE TO FOOD SECURITY, SOCIAL AND ECONOMIC DEVELOPMENT

6.1 Status and trends

Until recently, aquaculture has been poorly developed in many parts of the LAC region and not many social and economic effects could have been expected in most countries and areas. Exceptions are the Republic of Chile, the Federative Republic of Brazil, the Republic of Ecuador, the United Mexican States, the Republic of Peru, the Republic of Colombia and the Republic of Honduras, where fish farming already has critical mass and production rose above 60 000 tonnes per year in 2012–2014. In another five countries (the Republic of Cuba, the Bolivarian Republic of Venezuela, the Republic of Costa Rica, the Republic of Nicaragua and the Republic of Guatemala), annual production averaged between 30 000 and 10 000 tonnes in 2012–2014. All the remaining countries and territories produce below 10 000 tonnes per year.

6.1.1 Employment

As aquaculture progresses in this region, it already shows important effects on direct and indirect employment. The latest FAO statistics, referring only to primary activities in fishing and aquaculture, indicate that total employment in these activities amount to about 56.6 million people worldwide (2014), with 67 percent engaged in capture fisheries and the remaining 33 percent in aquaculture. Out of 18.8 million people working in global aquaculture in 2014 (including part-time, occasional or seasonal), 18 million are in Asia (96.2 percent of totals), while the LAC region ranks second, with 356 000 persons employed (Table 17).

Table 17. Primary employment in aquaculture by Geographic Area in thousands of positions, including part-time, occasional and seasonal jobs

Geographic region	2000	2005	2010	2012	2013	2014	% of Totals 2014
Africa	91	140	231	298	279	284	**1.5**
Asia	12 211	14 630	17 915	18 175	18 098	18 032	**96.2**
Europe	103	91	102	103	77	66	**0.4**
LAC	214	239	248	269	350	356	**1.9**
North America	6	10	9	9	9	9	**0.0**
Oceania	5	5	5	6	5	6	**0.0**
WORLD	**12 632**	**15 115**	**18 512**	**18 861**	**18 818**	**18 753**	**100.0**

Source: Calculation of the study, based on SOFIA 2016 figures, FAO, 2016.

In the Republic of Chile, for example, the number of employees in fish processing, in services required by both farmers and processors (suppliers of feed, other raw materials, engineering/production services, equipment, R&D, insurance, transportation, education, warehousing, etc.) can easily equal the amount of primary jobs in Table 17, a fact that makes aquaculture an important undertaking in countries where it already has a significant volume. Figures in Table 17 also suggest that technologies used in different parts of the world vary substantially, therefore production per person varies widely between different locations. [16]

6.1.2 Employment in rural areas

Aquaculture provides employment opportunities in rural areas where other meaningful economic activities are not plentiful or where small-scale activities can provide the food that producers and local populations need. Often, small-scale farming complements other agricultural activities and in this way could become an important source of livelihood throughout the LAC region. However, these family-based activities require support ranging from supplies of juveniles and/or seed from third parties, technical assistance (e.g. capacities to prevent and manage fish diseases), financial support to buy feed, intermediaries to market their produce, etc. Even if employment opportunities arise because demand grows and can no longer be supplied through capture fisheries, small-scale farming activities do not

[16] No formal calculations will be made, as employment figures are very imprecise, and they are not expressed in values that are comparable, such as the equivalent to full-time-job employees or other meaningful and standardized indicator.

offer an open-ended opportunity to aqua farmers, whose dependence on these external factors limit their ability to make an adequate profit.

In many countries in LAC, small-scale farming is generally intended to satisfy local demand for seafood in rural and small urban areas, while high-volume needs, such as those deriving from supermarket chains in large urban centers, are preferably fulfilled by large scale operators. In countries such as the Federative Republic of Brazil, large-scale aquaculture is still poorly developed, and a good proportion of supplies to large urban areas still come from individuals or cooperatives. In the Republic of Chile, an outstanding producer of wild and farmed seafood, local demand is poorly serviced because industry devotes most efforts to exports. Here, small-scale farming should expand in the near future to supply local needs.

Most coastal fisheries in LAC have decreased in recent decades, and small-scale fishers are losing their traditional source of livelihood, creating social and political problems that might mean thousands of people will migrate to large urban centers. This situation is irreversible in most cases, but it could be an opportunity for small-scale aquafarming, whether inland or through fish stocking in coastal areas, to enhance the restoration of valuable fishery resources in the long or medium term. This stocking strategy, used in several Asian countries (e.g. Japan and Korea) could become a solution to re-employ part of these coastal fishers but, to be realistic, it may be more applicable 15–20 years from now and should not be regarded as a solution to coastal fisher's short-term unemployment in LAC. However, should these activities receive proper governmental attention, they may solve part of the problem given consistent efforts, investments, subsidies, and training of local communities, both in production and organizational matters.

Growing domestic demand, a need to create employment opportunities for small farmers and fishers and an increasing demand for seafood suggest promising possibilities to expand small-scale aquaculture operations all over the LAC region. Additionally, other novel undertakings such as aquaponics, combining fish and vegetable farming, are opening new avenues in LAC countries like the Federative Republic of Brazil, the Republic of Chile and the United Mexican States and are also enhancing small-scale fish farming employability in this region. This being the region where demand for fish is lowest in world terms, there are also opportunities for aquaculture development linked to further fish consumption beyond traditional trends.

6.2 Important issues

Seafood consumption in the region ranks at the low end among all geographic regions in the world (Table 18). In 2013, local apparent consumption per person was about half of world levels, equaled only by Africa, the difference being that Africa gets to that level through net imports, while the LAC region is a net exporter. As well, LAC's seafood contribution to protein availability in the average diet is also minimal at only 3.4 percent of the total intake (4.3 percent in Africa, and 6.6 percent as a world average). Fish performs better as a share of total animal protein in the average diets (16.8 percent at world level; 6.7 percent in the LAC region and a variable performance in other continents).

These indicators suggest that aquaculture contributes moderately to food security in the LAC region. However, in several Caribbean nations/territories and in the Republic of Peru, its role is fairly significant, as their share in total protein availability in the average diets surpasses 20 percent. At the opposite end, in most South American countries, seafood's contribution to average protein intake is very low, a situation that will have to be addressed by local authorities through promotional policies aimed at increasing aquaculture production. Also, seafood contribution to the supply of calories in LAC's and world's diets is extremely limited.

Table 18. World consumption of seafood and their contribution to human nutrition in the LAC region and comparisons, 2013

	Production	Non-food uses	Food Balance sheet of fish and fishery products in live weight and fish contribution to protein supply									FAO-FIAS
			Imports	Exports	Total food supply	Population	Per capita supply	Fish proteins	Animal proteins	Total proteins	Fish/ Animal proteins	Fish Total proteins
Region	Tonnes in live weight					Thousands	Kg/year	Grams per capita per day			%	%
World	**162 646 576**	**21 459 583**	**44 397 334**	**45 113 801**	**141 444 492**	**7 162 118**	**19.7**	**5.4**	**32.1**	**81**	**16.8**	**6.6**
Africa	9 458 639	609 574	3 881 139	2 156 721	10 974 625	1 110 636	9.9	2.9	15.9	67.6	18.1	4.3
Asia	113 294 522	8 948 440	14 612 093	19 790 156	99 370 752	4 298 727	23.1	6.2	27.1	78.1	22.9	7.9
Europe	16 435 139	2 660 039	17 294 005	15 057 147	16 296 232	742 450	21.9	6.6	57.8	102	11.4	6.4
LAC	15 007 081	7 245 834	2 381 405	4 047 484	6 152 203	616 641	10.0	2.9	42.6	83.5	6.7	3.4
North America	6 974 421	1 633 553	5 556 879	3 199 297	7 699 600	355 361	21.7	5.1	68.3	109	7.5	4.7
Oceania	1 393 499	278 867	671 815	862 996	951 080	38 303	24.8	6.5	62.2	95	10.4	6.8

Source: Yearbook of Fishery Statistics 2014, FAO, 2016.

Table 19. Growth rates in LAC fisheries and aquaculture production volumes and comparisons. Mean cumulative annual rates for each period, percentage

	LAC Region						World figures						
			Aquaculture				Totals			Capture fisheries		Aquaculture	
Period	Total landings	Capture fisheries	Total	Caribbean	Central America	South America	Total	Capture fisheries	Aquaculture	Marine	Continental	Marine	Continental
1985/89-1990/94	4.1	3.9	18.9	15.5	14.0	20.3	1.6	0.5	9.3	0.4	1.4	10.0	8.8
1990/94-1995/99	0.1	-0.3	17.4	19.5	9.6	18.5	3.0	1.1	11.2	0.9	3.6	10.9	11.4
1995/99-2000/04	-0.2	-0.8	12.5	-2.3	15.0	13.0	1.5	0.0	6.1	-0.2	2.2	6.5	5.8
2000/04-2005/09	-0.5	-1.2	8.5	2.2	14.2	7.8	1.9	-0.1	6.3	-0.5	3.2	5.1	7.1
2005/09-2010/14	-3.9	-5.2	6.6	-4.1	2.3	7.6	2.4	0.3	5.8	-0.1	2.8	4.3	6.8
1992/94-2002/04	-1.0	-1.6	14.5	6.2	12.5	15.3	2.1	0.3	8.1	0.1	2.8	8.0	8.1
2002/04-2012/14	-2.5	-3.7	7.4	-1.0	7.4	7.6	2.3	0.2	6.0	-0.2	3.2	4.6	7.0
1992/94-2012/14	-1.8	-2.7	10.9	2.5	9.9	11.4	2.2	0.3	7.0	-0.0	3.0	6.3	7.5

Source: FAO Fishstat, 2016.

Note: Each period starts with the average of the figures for the years concerned, and ends likewise. For instance, the growth figure for the period 1985/89–1990/94 should be understood as the cumulative average annual rate between the average figures for 1985 up to 1989, and those of 1990 up to 1994, that is, for a period of five years among those averages.

6.3 The way forward

Aquaculture development in the LAC region in recent decades can be well correlated with the export trade and good environmental conditions, availability of space and water sources, etc. Yet it is also true that, particularly in cases where small-scale undertakings prevail or are well managed, governments have been important catalysers of this process, and without their help much of what has happened until now would have been delayed or might not have taken place at all. Thus, a good part of aquaculture contribution to local economies has been induced, in many occasions with still preliminary contributions, but with promising future offerings.

In countries such as the Republic of Chile, aquaculture's contribution to the regional and the national economy and to employment is substantial. Salmonids are the second most important export commodity of the country (after copper), and two southern regions (Los Lagos and Aysén) depend heavily on aquaculture and related activities. A few decades ago, these regions were among the least developed in the Republic of Chile and were known for emigration, while nowadays they are thriving, with negligible unemployment. They offer good work opportunities for young people and import manpower permanently or on seasonal basis. Similar results can be observed in several parts of the Federative Republic of Brazil, the United Mexican States, the Republic of Ecuador, the Republic of Honduras and other large producers, where growing production of shrimp and tilapia – to mention the most important ones – have very meaningful effects in terms of employment, exports and food production for local consumption. Nevertheless, aquaculture still needs to be better understood by local populations. The industry has related poorly to them and to the public at large, a situation that increasingly affects growth prospects and needs to be remedied.

As a fair proportion of LAC's seafood exports currently stay in this region, there is an opportunity to enhance intra-regional trade. Moreover, the main importing countries such as the Federative Republic of Brazil and the United Mexican States should strengthen their farming efforts to diminish buying abroad what can easily be produced within their boundaries. Jamaica, whose aquaculture has been losing ground while competing with imports, can review its strategies to assess if further domestic production is worth the effort. Reviewing sustainability issues and the way each country approaches the technical issues of farming is also a must. A better understanding of this concept is required to align local and regional strategies with sustainable production, using best practices and understanding local communities' needs and expectations to further develop sectoral models that are self-supporting and durable.

7. EXTERNAL PRESSURES ON THE SECTOR

7.1 Status and trends

Climate change, social conflicts with local communities, increased authorization requirements for aquaculture licenses or permits and relatively poor organization by small and large-scale enterprises and individual farmers severely complicate aquaculture development in the LAC region. Greater environmental awareness, better-educated citizens and seafood consumers, and civil servants with limited understanding of industry are additional factors to consider.

Droughts near Sao Paulo, hurricanes in the Caribbean, volcanic eruptions in southern Chile, floods in many parts of the continent, red tides, algae blooms and unusually high temperatures in 2015 have challenged farm managers all over the region, confronting them with stressed fish, high mortalities, interrupted production cycles, massive economic losses, unemployment and supply interruptions that affect markets and prices.

Aquatic animal diseases are often caused by poor husbandry practices all over the world, while poorly financed R&D initiatives and inadequate regulations, institutions and governance add up to a challenging environment for future development. Aquaculture growth rates in LAC have declined (Table 19), and the same happened to capture fisheries, because of overfishing, poor governance and

changing environmental conditions. Aquaculture prospects rely on a permanently growing demand for seafood as world population increases, so the industry is facing these challenges and using its best abilities to improve technologies, management, competitiveness, governance and market opportunities.

7.2 Important issues

Public campaigns by traditional fishers trying to 'defend' their trade against an emerging aquaculture sector, conservationists, native populations demanding their ancestral rights, small-scale fishers affected by decreasing catches, fierce competition with other users of continental water sources and marine coastal areas (e.g. tourism, ports, local fishers, and urban developers), together with political and social unrest and insecurity (the Republic of Colombia, the United Mexican States, the Republic of Guatemala, the Republic of Honduras) have to be recognized as common threats and impairments to fish farming in LAC. This is a complicated panorama, which results in a noticeable loss of dynamism in the industry, as reflected in diminishing global and regional growth rates in recent years. Some observers speculate about even poorer prospects in years to come if these difficulties are not addressed.

7.3 The way forward

No single organism or technical body can deal with the above-mentioned circumstances on its own. Global and LAC aquaculture are challenging activities in need of international cooperation and serious improvements in management in all dimensions, to cope with the difficulties that impair, delay and make more expensive further expansion. However, increasing market demand, adequate natural conditions suitable for culture and the need to contribute to food security, social and economic development should strengthen the will of producers, workers and public/private administrators to strive for a wider and more successful aquaculture industry, in an environment in which exchanging experiences and cooperation on complex problems are now possible.

8. GOVERNANCE AND MANAGEMENT

8.1 Status and trends

8.1.1 The role of government

Aquaculture governance through sound policy, planning and supporting mechanisms is inefficient or lacking in the LAC region. Not many governments understand the dynamics of aquaculture or have developed appropriate institutional arrangements and/or regulations to manage their industries. In most cases, aquaculture is considered an extension of fisheries, a troubled and declining activity with different actors and problems while aquaculture, a novel and growing undertaking needs more resources, space and attention to facilitate expansion. Management strategies for fisheries and aquaculture are different but authorities usually do not recognize this; aquaculture suffers most, making it imperative to create proper approaches to accommodate to its circumstances and needs.

In most cases these new mechanisms and strategies have yet to be devised and/or implemented. Therefore, it is not surprising that governments like those of the Federative Republic of Brazil and the Argentine Republic have a conservationist approach to production, implementing barriers that make fish farming progress difficult. Other countries like the Republic of Chile do not make a sufficiently clear distinction between small and large-scale producers, requiring small scale farmers to adhere to norms and regulations which make it difficult for them to start new projects or become legally established. Bureaucracies are slow and complicated and formalities take a long time, are generally expensive and often difficult to comply with. Governments are not prone to plan long-term and the limited financial support for R&D and other critical needs is mostly assigned without a proper sense of priorities and comprehensiveness. Little is understood regarding the sustained efforts needed to produce tangible results with new and appropriate technologies applicable to local species and environments. Financing does not generally extend for the 8–15 years required to produce those new farming technologies, nor does it cover the most important factors (nutrition, reproduction, health issues, work

densities, etc.) simultaneously. Hence when R&D produces promising results in any one area, there will almost always remain outstanding issues, not properly addressed, that will limit application of the new developments.

8.1.2 Industry organizations

In most cases industry itself is not well-organized to represent their members and their needs to local authorities. Small-scale producers either work individually or become members of cooperatives or other organizations that are poorly managed. They are almost universally incapable of managing fish sales and therefore are exploited by intermediaries who end up keeping a very high proportion of profits, limiting producers' abilities to progress, to introduce technology, and to give a better return to their memberships.

Licensing is an increasing problem in the LAC region. Authorization arrangements such as those related to licenses and permits vary a lot from country to country but generally may take several years to be completed; they are expensive and require expertise that is mostly available through external consultants. Corruption can enter the scene. Moreover, governmental agents do not necessarily communicate well with industry; there is no venue for discussion and arbitration. Proposed norms and regulations and administrative procedures are not the product of participatory agreement but instead are impositions that end up being divisive.

8.2 Important issues

Negative public perception and a general lack of awareness of aquaculture in local and rural communities has also been the cause of concern and conflict, as aquaculture has become established in generally traditional environments, bringing employment policies, requirements and conditions which are often alien to people and disrupt their way of life. Conversion from self-employment to employee status has been traumatic for many rural inhabitants and the cause of social conflict and instability of operations. Rural people invited to work by formal enterprises do not necessarily read or write and need to be trained to handle technical procedures and equipment. In the case of small farmers accessing fish farming on their own land or elsewhere, technical advice and guidance is not always available or might not be properly implemented.

8.3 The way forward

In the 1970s and 1980s aquaculture technology was a limiting factor for development before environmental and market concerns became relevant to LAC's fish-farming industry. It is now time to recognize that improved governance to facilitate aquaculture sustainability and development is now a high-ranking priority in this region. Little will be achieved if governance is not addressed and mechanisms put in place to strengthen aquaculture by integrating the environmental, social and economic objectives of sustainable development. With better regulations, better-trained and focused bureaucracies, stronger political will and appropriate macro-economic and social environments aquaculture can regain its dynamism and past growth rates, allowing not only higher domestic consumption, but also facilitating substantial growth in exports. Good environmental conditions, such as high quality water and physical space, are available. The region can now improve its performance as a well-organized, efficient, competitive and significant player on the world scene while providing good quality employment and social and economic benefits, especially to local communities. However, there will be a need for more and stronger political support, which in turn needs industry to relate better to the relevant social actors. More cooperation within the region is also most desirable for future action, as well as increased collaboration and coordination on R&D projects or programs.

BOX 3. CHILE REVIEWS ITS AQUACULTURE PRODUCTION STRATEGIES: THE SALMON STRATEGIC PROGRAM

After over 30 years of hard work, the Republic of Chile became one of the top-ten aquaculture producers in the world. The sector has improved the living conditions of the population in various regions and contributed to food security, social and economic development. The Republic of Chile made salmon/trout into its second-biggest export commodity. However, the industry has deviated from its successful path. It has faced severe disease outbreaks, algae blooms, loses in competitiveness and market reputation in several destinations, such as the United States of America market. In recent years, the Republic of Chile has been surpassed in efficiency by Norway (the leading world producer, with which it competes globally) and has also lost ground to Scotland and Canada.

Spatially unplanned aquaculture development caused by a lack of appropriate regulations and inadequate environmental assessments led to overcrowding of cage farms in several areas and has caused severe disease outbreaks. New regulations imposed to solve these problems have not been effective– they are complex and expensive to put in place – and large sums of money have been spent to solve biosecurity problems with limited results, subsequent massive losses of fish, severe economic damage, fluctuating production levels and unemployment.

To address these problems and to enable a sustainable future according to the real potential of salmon farming in the Republic of Chile, CORFO (Corporation for the Promotion of Production, Ministry of Economics) has set a Strategic Program to deal with salmon/trout, and support sectoral activities to 2030. This program will re-consider the geographic allocation of fish farms, consider moving operations to deeper and more exposed sites, reshape sectoral objectives according to a long-term vision and foster better relations with communities. It will also support new efforts to improve the image of the products in foreign markets, to use 'best practices' all along the value chain, augment and produce more effective R&D, increase innovation, improve relations with suppliers, etc. This new approach to salmon farming will probably result in lower production during 2017–2019 to improve farming results; thereafter, production should start to increase, modestly but sustainably, to not less than 1.2 to 1.3 million tonnes by 2030, with exports in excess of US$6.5 to 7 billion (including sales of services and equipment), and employment of 70 000 to 90 000 workers in the southernmost regions of the Republic of Chile. This new long-term view of salmon farming in the Republic of Chile, with its renewed consideration of environmental, social, economic and governance objectives, should result in a sustainable and more profitable industry with fewer conflicts and steadier performance.

9. AQUACULTURE CONTRIBUTION TO THE FAO STRATEGIC OBJECTIVES

9.1 Status and trends

Aquaculture sustainability ranks high among sectoral priorities in the LAC region, and FAO's strategic objectives (www.fao.org/about/en/) should also receive further attention in this subcontinent. Having experienced extended and severe diseases, being aware of overloaded environments, having suffered from unemployment and conflicts with local communities and having lived under poor governance, this industry needs better plans and development strategies prepared by more mature regional actors who are aware of the consequences of unsustainable actions that might have good short term payoffs but medium and long term negative consequences for the majority of stakeholders.

The process of adapting aquaculture governance and long-term planning to these aims will take time in LAC. Many bureaucracies cannot handle this set of ideas, particularly those where fish farming is beginning and/or those where aquaculture is still considered a direct derivative of fisheries. However, Regional Conferences in LAC, recent FAO meetings[17] and governmental actions in several countries have recently placed greater emphasis on aquaculture as a means to eliminate hunger and to deal with food insecurity and malnutrition. A few already use fish farming to address unemployment or poor quality employment and poverty in rural areas, understanding the need to better integrate small producers in aquaculture development.

Climatic change conditions or algae blooms, more common these days, are also commonly neglected until disasters occur and local populations force action by governments. This is the case in the Republic

[17] See for instance reporting on the Eight Session of the Sub-Committee on Aquaculture, held in Brasilia, 5–9 October 2015, at: www.fao.org/cofi/43341-04a74a5d167de0034251e8eaf83de443e.pdf

of Chile, where a strong and extended algae bloom occurred at the beginning of 2016 in the southern part of the country (around Chiloe Island) caused massive damage and local communities were left without work for several weeks.[18]

'Blue growth', as proposed by FAO, also requires further attention. Most LAC coastal fisheries have dramatically declined in recent decades because of poor or non-existent management. Additionally, there is a learning process for aquaculture so that countries are responsible for maintaining natural resources and their biodiversity, handling solid and/or liquid residuals, controlling diseases and limiting lake eutrophication. Producers and authorities alike are now becoming increasingly aware of environmental issues, and only in the last 10–15 years has progress been made on regulating pressures on the sector (climate change, etc.). Overly stringent regulation can make aquaculture unviable or extremely costly. The LAC region has a long way to go to generate favourable conditions for 'blue growth', and much better governance is needed to enable this goal over the subcontinent.

Long-term planning is still not regarded as essential and has not been fully implemented in the region. However, the Republic of Peru has in place its aquaculture development plan to 2021, put into practice in 2009–2010; Central American States under the auspices of OSPESCA do the same with guidelines for 2015–2025; the Republic of Chile is tackling its development problems and its growth perspectives with sectoral plans to 2030 or 2035. All these undertakings are conceptually based on environmental, social and economic sustainability views that coincide with the aims of the 2030 Sustainable Development Goals agreed on by the United Nations in 2015 and intended to achieve seventeen ambitious objectives and 169 goals. They include conservation and sustainable use of the oceans, seas and marine resources for sustainable development, improving living conditions, eradicating extreme poverty, achieving food security and improved nutrition, promoting sustained economic growth and decent work for all, fostering innovation, achieving responsible consumption and production and acting to combat climate change and its effects. These goals are also at the core of responsible aquaculture development.

Perhaps the most important conclusion regarding the orientation of future action in relation to aquaculture development in the LAC region is highlighted in paragraph 21 of the report of the Committee on Fisheries – Sub-committee on Aquaculture (COFI-SCA) recommendations for aquaculture in LAC, developed at the 2015 meeting of the COFI in Brasilia (FAO, 2015):

> **The promotion of "sustainable aquaculture development and expansion in Latin America and the Caribbean with significant positive impacts on poverty alleviation and food security"** *is the clear regional goal resulting from the collection, analysis and synthesis of all relevant key regional documents regarding regional assessments, decisions, agreements and recommendations from relevant fishery bodies.*

Unfortunately, very little is still being done to upgrade the working conditions and opportunities for small-scale, AREL (resource-limited aquaculture) producers in LAC countries. Only countries such as the Federative Republic of Brazil have in place meaningful institutional arrangements to support rural producers; even there, the cost-efficiency of the system is probably lower than it should be. Before committing resources to support small-scale farmers, it is necessary to solve other cultural, social and organizational problems. In reality a large proportion of the available resources need to be devoted to these limiting factors, which often take a long time to remediate. Despite these unsolved cultural, social and organizational problems, efforts are still concentrated on production (capacity building, training, donation of equipment and infrastructure), a strategy that has proven to be ineffective. At the end of technical assistance programs, most of what had been gained during the process is lost. The cost-benefit ratio of most of those actions – almost never appraised by the donors or support institutions – is extremely low.

[18] Local population invaded roads and prevented boats and land transport to move in or out of the island until help and long-term solutions were proposed and accepted. Consequently, monetary help was given to those most affected (mollusc collectors, mussel farmers and others) until the event passed, and a commission to propose what should be done with future algae blooms, and how to predict them in advance, should produce its final proposals in the coming months.

In most cases there is much to be gained by prioritizing basic socio-educational-organizational support, even if they are lengthy, expensive and politically unattractive. Alternatively, agencies should focus on small-scale farming communities that already have in place the basic conditions to absorb, retain and make good use of capacity building exercises.

In LAC it is also common to see a confrontation between policies aimed at enhancing AREL activities and those that support medium and large size operations. Yet the latter are generally responsible for the incorporation of state-of-the-art technology, more competitive products in the domestic markets, ample supplies for important urban areas that otherwise are poorly served, and most exports. Therefore, regional policies have to reflect the reality that both production sectors are needed for sustainable growth.

9.2 Important issues

A paternalistic attitude toward helping small-scale producers is still common in the LAC region, which has led to unsustainable development and frustration for decades. Much work is still needed to change governmental attitudes that have commonly resulted in poor and ineffective solutions. Declarations of principles are not sufficient. Actual support and meaningful work with small-scale producers is needed, and more and specific help is required to enhance medium and large-scale activities.

9.3 The way forward

While many countries with developed aquaculture sectors will need to adapt several procedures, norms and legislation to reflect the Blue Growth Initiative and the 2030 Sustainable Goals, they will almost certainly include sustainability objectives in their medium or long-term goals. Markets in developed nations are already demanding proofs that aquaculture procedures are clean and sustainable, that animal welfare is being considered, that fair treatment of employees and ancillary enterprises is applied, and that best practices are used along the value chain of aquaculture production. In turn, those countries in which aquaculture is a new activity have the opportunity to start their own industries in a fashion that adopts these principles from the beginning.

In the Federative Republic of Brazil and the Republic of Peru, governments have led assessments of where aquaculture can be located in many states, establishing precise areas and considering their maximum carrying capacities. In the Republic of Chile, carrying capacity studies are now being considered before re-locating part of its salmon industry. Many countries in the LAC region recognize that the aquaculture industry should better address public perception and opinion and accommodate its behaviour with local communities and society as a whole. These visions will certainly help correct past mistakes that damaged the credibility and long term prospects of aquaculture in the region.

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