Conquering Unknown Waters: Smart Specialization and the Evolution of the Chilean Salmon Industry

The policies facilitating the development and growth of the salmon industry in Chile provide an example of smart industrial specialization in a middle-income country. The first initiatives were launched in the 1970s, and the Chilean government, in collaboration with private institutions, continues to support the industry and assist its growth and international presence. The successful development of the industry is a result of a mixture of instruments involving technology importation and absorption, joint ventures and collaborations with foreign institutions, training programs, regulatory reforms, export support, and domestic capacity building.

By Evita Paraskevopoulou

Introduction

Chile is endowed with natural resources apt for salmon farming, and a favorable combination of economic and technological factors have contributed to the sector’s successful transformation from a quasi-artisan, family-based industry to a world-class, export-oriented one. Such a transformation required strong public efforts to regulate the industry, coordinate the main players, and support the development of technological skills and capabilities in firms.

As early as 1921, salmon fish were introduced into Chile by the Fisheries Development Institute (Instituto de Fomento Pesquero, IFOP), a nonprofit organization under the supervision of the Agency for Economic Development ( Corporación de Fomento de la Producción, CORFO). A number of international agreements were signed between the Chilean government and foreign
research centers, including Oregon State University, the University of Washington, and the Japanese International Cooperation Agency; these agreements resulted in studies that highlighted that while salmon farming was technically feasible in Chile, its economic viability remained unknown.

The government’s strong conviction that the emergence and growth of the domestic salmon-farming industry had high potential for success led to a number of policy actions to foster its development. Beginning in the late 1960s, the need for technology transfer and acquisition of external knowledge became increasingly apparent, and the government concentrated its efforts on locating such knowledge and creating the appropriate institutions to facilitate its adoption and absorption. In 1969, the introduction of the “Program to Introduce Coho Salmon in Chile,” in collaboration with the Japan International Cooperation Agency (JICA) and the Fisheries Association of Japan, led to the construction of salmon fish farms with egg incubation facilities and the training of a Chilean expert in Japan (Lizuka 2004). Public efforts alone were not sufficient to achieve the objectives, however; close collaboration with private institutions was deemed essential, leading to a series of coordinated public–private initiatives. The returns from these early efforts were low, and they were further diminished by poor weather conditions, which discouraged further investment and resulted in the venture’s gradual abandonment.

Around 1978, spurred by the successful commercial farming of trout by a Chilean firm (Lago Llanquihue Ltd.), which developed with the support of CORFO and managed to produce and export trout to Europe and the United States, salmon farming again became a priority. The beginning of the 1980s signaled another round of efforts to support the industry through targeted action by the government, in close collaboration with private institutions and industrial associations such as Fundación Chile and the Association of Producers of Salmon and Trout (APSTC). In 1981 Fundación Chile created Salmones Antartica, one of the present leaders of the industry. With salmon prices high, investment in this “high-risk/high-return” business became more attractive, leading to dramatic growth in the number of domestic firms in the farming business during the first half of the 1980s (Lizuka 2004). From the mid-1980s onward, the industry expanded even more,¹ and the supporting infrastructure for salmon production was built as related sectors including fish handling and cold chain management developed.

From the mid-1990s onward, the agglomeration of the industry in Region X (also known as Lake Region) and continued government support resulted in the emergence of a cluster where firms and other institutions undertook different aspects of salmon production, such as marketing, logistics, fish processing, and manpower development.

Contextual factors—that is, the generally weak economic position of the country and the consequent low resources devoted to technological development and training—erected at least temporary barriers to the development of the industry, however. In response, the government promoted joint ventures and public–private partnerships, looked for expertise across Chile’s borders, exposed its officials to external knowledge, and invested in training.

---

¹ This period of growth is marked by the expansion of the industry, which reached its peak in the late 1990s and early 2000s, before facing challenges such as low salmon prices and environmental concerns.
In addition, an unexpected outbreak of infectious salmon anemia (ISA) in 2007 placed the development of the industry at risk, despite its maturity at that stage. Atlantic salmon production—which formerly represented two-thirds of Chilean salmon output—was severely affected, and important secondary impacts affected employment, social welfare, and international market presence. The industry had grown more rapidly than the government regulations could cope with, which became evident as the disease revealed the following shortcomings related to the production process:

- High concentrations of sites in some farming areas
- Absence of zone management programs
- Poor sanitary control on farms
- Insufficient biosecurity, including frequent fish movement between farms

With public–private collaboration now critical for recovery, the government established a partnership with the industry, permitting companies—particularly those having previous experience with ISA control—to make technical contributions to the initial emergency control and contingency plans. In addition, the government established “la Mesa del salmon” (the Salmon Table) where all involved public sector agencies were represented. This group was asked to evaluate the industry’s practices and propose new laws and regulations to respond to the most pressing challenges.

The outcomes of the Salmon Table initiative include the following 2011 modifications to the Fishery and Aquaculture Law and regulations:

- **New licenses regime**: New licenses are granted for specific periods of time and are contingent on strict compliance with environmental and labor laws, with violation leading to termination of the lease permit.
- **Area management regime**: A system is in place that allows for more effective management of health and productivity issues.
- **Improvement and new control of environmental indicators**: Standards for farm equipment are set by the government and used to audit farms’ compliance. In addition, more rigorous environmental parameters have been established to measure and ensure the farms’ environmental sustainability.
- **Biosecurity throughout the value chain**: Also regulated are auxiliary industries whose activities—net cleaning and disinfection harvest practices, boat traffic between farms, and so forth—can affect fish health.
- **Institutional strengthening**: The Salmon Table established a panel of experts to make recommendations on scientific and technical matters relating to industry practices.
• Public access to industry information: Also established was a mechanism to make information on production processes and health issues available to individuals in the industry and report it to the general public.

Program design
The government viewed the salmon industry’s concentration in a historically deprived region (Region X) as an opportunity for more regionally balanced growth and economic stability. As local competencies were weak, technology transfer from abroad and the strengthening of local absorptive capacity were seen as essential policy actions. In addition, the entrance of the Chilean salmon industry into the global economy required the development of international networks and reduction in production costs—objectives that required new institutional structures. Indeed, a quite complex, yet solid, institutional context emerged through the close collaboration of public and private entities. Supporting institutions that either support or carry out technology development in the salmon industry include the following:

• Fisheries Development Institute (Instituto de Fomento Pesquero, IFOP): Created in 1965, IFOP is a nonprofit institute that conducts research and development (R&D) activities. Most of its work is focused on technology development and data analysis for the fishing industry. IFOP collects and prepares data needed by the government to design policies and receives funds from the Ministry of Economy’s Fund for Fisheries Research (FIP) for research into the conservation of marine resources and aquaculture.

• Chilean Economic Development Agency (Corporación de Fomento de la Producción, CORFO): This public agency manages funds for promoting scientific and technological development in areas with potential for developing new products and business opportunities. It also promotes and markets the technological products or outcomes of other agencies to attract private sector interest. As mentioned above, CORFO introduced salmon farming to Chile in 1921, and it later revitalized efforts by supporting the first company to produce and export trout in France. When the industry had been established, CORFO continued its collaboration with the private sector and supported the acquisition of quality certifications, either by providing funds or by facilitating technological schemes.

Three main governmental bodies have been evolving in terms of their involvement in the operations of the salmon industry:

• Undersecretary of Fisheries (Subsecretaría de Pesca, SUBPESCA): Created in 1976, SUBPESCA falls under the Ministry of Economy, Development, and Tourism and is responsible for developing regulations and rules governing aquatic animal resources.

• Fisheries and Protection Division: This was replaced in 1978 by the Fishing and Hunting Division under the Ministry of Agriculture.

• National Fisheries Service (Servicio Nacional de Pesca, SERNAPESCA): Falling under the Ministry of Economy, Development, and Tourism, SERNAPESCA is responsible for
monitoring compliance with the requirements and regulations provided in the General Law of Fishing and Aquaculture and issued by SUBPESCA.

Prior to the development of Chile’s salmon industry, these agencies had few personnel with experience in aquaculture and fish health management. Since the development of salmon farming, however, departmental structures have been reorganized and personnel significantly increased (for instance, SERNAPESCA’s staff grew from 200 in 2007 to 729 in 2009, primarily in response to the ISA crisis and the new government regulations).

Finally, some prominent private players promote the development of firms and technologies:

- **Fundación Chile**: Fundación Chile is a private association created in 1976 by the Chilean government and the United States’ Technology Transfer Institute (ITT Corporation) to develop ways of diversifying the Chilean economy by creating new companies based on natural resources and to facilitate innovation and technology transfer.

- **SalmonChile**: Established in 2002, SalmonChile is a private association that replaced the Association of Producers of Salmon and Trout (established in 1986) to include supplier firms.

- **Salmon Technology Institute (Instituto Tecnológico del Salmón, Intesal)**: Intesal was created in 1994 by SalmonChile to develop and diffuse food safety and quality control technologies in the salmon industry, as well as to represent the views of producers. The institute monitors the technology needs of the industry and provides technical assistance; it also provides training on quality control and issues certificates on firms’ waste treatment practices.

The gradually built institutional design assisted the growth of the salmon industry through different developmental stages (see Table 1). Initially, the government acted as a catalyst by starting the first commercial salmon farming operation in the country with the help of CORFO and Fundación Chile. The evolution of Salmones Antartica into one of the biggest players in the industry revealed foreign interest in Chilean salmon production, and the government welcomed foreign initiatives. Nichiro, for example, a Japanese firm, began cultivating salmon in Chile for the Japanese market, using genetic material imported from the United States and many institutions, both domestic and foreign—such as the University of Washington, IFOP, and the Fishing and Hunting Division—contributed to the industry’s development.

As the industry grew and economic and social benefits became apparent, the government developed and implemented the National Aquaculture Policy in 2002, which aimed to double aquaculture production by 2012. This goal was reached earlier than anticipated (in 2005), demonstrating the intensity of support and the speed with which this industry was permitted to grow. Nevertheless, the lack of restrictions and control and the limited environmental considerations brought about negative effects (the salmon disease outbreak was one) that demanded a reorientation of the support instruments, the creation of new institutional structures, and a new round of intense public–private collaboration.
### Table 1: Evolution of the Salmon Industry Support Institutions

<table>
<thead>
<tr>
<th>Year</th>
<th>Government Policy</th>
<th>Major Actors' Initial Involvement</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960–73</td>
<td>International cooperation</td>
<td>Agency for Economic Development (CORFO)</td>
<td>The theoretical design described above served as the basis for implementing a mixture of instruments needed to support the salmon industry. Rapid industry growth was accompanied by institutional restructuring and support from specific organizations that are discussed below. Regulatory enhancements relevant to the development of the industry include:</td>
</tr>
<tr>
<td>1974–84</td>
<td>Development of industries and public institutions</td>
<td>Undersecretary for Fisheries</td>
<td>- The Fishery and Aquaculture Law with its three major sectoral regulatory bodies: the Environmental Regulation for Aquaculture (RAMA), the Sanitary Regulation for Aquaculture (RESA), and the Regulation for Aquaculture Licenses</td>
</tr>
<tr>
<td>1985–95</td>
<td>Positioning the industry in the global market; regulatory framework</td>
<td>Fishing and Hunting Division</td>
<td>- The general basis for the Environment Law, with several aspects relevant to aquaculture, particularly environmental impact assessment regulations</td>
</tr>
<tr>
<td>1996–2004</td>
<td>Seeking new markets and industrial sustainability; regulatory framework</td>
<td>Association of Producers of Salmon and Trout</td>
<td>- The Navigation Law, relevant principally in aspects related to coastal waters and land use and pollution control</td>
</tr>
<tr>
<td>2005–now</td>
<td>Safeguarding quality and maintaining the international share; regulatory framework</td>
<td>National Fisheries Service</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Salmon Technology Institute</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Salmon Table</td>
<td></td>
</tr>
</tbody>
</table>

Source: Adapted from Lizuka 2004 in UNCTAD 2006.

**Implementation**

The institutional design described above served as the basis for implementing a mixture of instruments needed to support the salmon industry. Rapid industry growth was accompanied by institutional restructuring and support from specific organizations that are discussed below. Regulatory enhancements relevant to the development of the industry include:

- The *Fishery and Aquaculture Law* with its three major sectoral regulatory bodies: the Environmental Regulation for Aquaculture (RAMA), the Sanitary Regulation for Aquaculture (RESA), and the Regulation for Aquaculture Licenses
- The general basis for the *Environment Law*, with several aspects relevant to aquaculture, particularly environmental impact assessment regulations
- The *Navigation Law*, relevant principally in aspects related to coastal waters and land use and pollution control
In general, regulations affecting the operation of the industry proliferated in Chile from the 1990s onward. Figure 1 shows the evolution of principal aquaculture regulations as the industry grew in terms of its export volumes.

Figure 1: Evolution of Aquaculture Regulations in Chile

![Aquaculture Regulations Chart]

Source: Alvial et al. 2012.

Supporting Organizations and Schemes

The plethora of organizations documented above supported the industry via various channels, such as financing, incubation of technologically intensive firms, commercialization in the global market, attraction of foreign direct investment (FDI) and human resource development.

Financial support came from commercial banks offering credit that remained stable even when the disease outbreak placed the industry at risk. The banks assisted the industry’s recovery by extending the terms of existing loans, reassuring financing for most companies.

The incubation of new firms falls within the tasks of Fundación Chile. The organization acts as an incubator for the creation of firms to demonstrate new technologies and serve as vehicles for technology transfer. When the firms grow, they are sold to the private sector, and Fundación Chile recoups its investment and moves on to the next sector or stage of development. Fundación Chile has also worked closely with the Regional Planning Agency to perform salmon farming trials and promote feasibility studies and performance evaluations of salmon activity at small-, medium- and large-scale levels.

Initially, the main role of supporting institutions main role was to identify the best geographical areas for salmon farming and to establish sanitary regulations. From the mid-2000s onward, their primary objective became commercialization in the global market. Toward this objective,
SalmonChile focuses on representing the interests of the salmon industry in national and international trade and promoting the Chilean trademark abroad. The association submits proposals to the authorities on ways to improve regulations (such as the license-granting system) and facilitate the operation of firms. It also provides trade information to its members and cooperates with other international salmon-farming firms and authorities in providing information on production techniques.

The commercialization process is further supported by ProChile, the Chilean Trade Commission within the Ministry of Foreign Affairs, which seeks to identify effective commercialization channels for Chilean goods abroad. More specifically, ProChile's mandate includes the following:

- Support and advance Chilean business interests in the global marketplace
- Facilitate exports by providing data and identifying export regulations
- Develop international business relationships
- Facilitate formation of strategic alliances
- Provide information on international trade
- Stimulate diversification of Chile's exports

The willingness of the government to collaborate with foreign institutions early on was beneficial for the importation and assimilation of technology and set the basis for attracting FDI. Although FDI's role in the early development phases of the industry was marginal, from the 1990s onward the entry of large foreign firms into the Chilean salmon industry facilitated the introduction of new technologies and the expansion of production, fostered vertical integration, and increased the average size of firms.

In general, the support and collaboration among various public and private institutions was beneficial for the development and expansion of the salmon industry. Roles were allocated on the basis of function rather than type of entity, with one of the most prominent examples being the capacity-building support provided by Intersal, which works at the cross-section of public and private organizations. Not only did the institution provide the industry with qualified personnel through its training programs, but it also enhanced the educational level of a traditionally deprived region in Chile and aided its socioeconomic development.

**Implementation Challenges**

As mentioned before, the rapid expansion of the salmon industry did not come without challenges. While the industry was performing well economically, insufficient consideration of the limitations of the biological system and the weakness of regulations and controls placed the industry at risk. In spite of the successful cooperation between government and the industry and the mechanisms in place to ensure effective public–private dialogue, several difficult issues remain unresolved.
The industry also faced economic challenges in the late 1990s, as the world price of salmon fell and the structure of the industry changed significantly. Larger firms with technologically more complex operations emerged from mergers and integration, both horizontal and vertical, combining hatchery, cultivation, and processing. Although it has performed well over the last few decades, the industry now faces the challenge of improving production and handling methods to meet international levels of efficiency.

Finally, despite the country’s early interest in acquiring technologies, Chile lacks advanced technology, especially for the production and harvesting phases, which prevents the industry from meeting the requirement to produce "bio-salmon" (that is, salmon produced without excessive use of hormones, antibiotics, or other drugs). The production of "bio-salmon" would require, above all, the use of waste-handling, water treatment, and recycling techniques that are still unavailable or just emerging in Chile—a deficiency that points to the need for continuous technological advancements to keep up with the rate of industrial growth.

Efforts are already turning in this direction through collaborations among the government, the industry, researchers, and other private sector participants. Examples of such actions were noted by Alvial et al. (2012) and include:

- **SUBPESCA’s appointment of a panel of experts in March 2011 charged with the following:**
  - Preparing the health regulations for aquaculture
  - Analyzing the potential for creating “macrozones”
  - Reviewing methods for the smoltification of salmon and trout
  - Complementing the technical and health vision of the Ministry of Economy while looking at the economic and social effects of the measures proposed

- **The Salmon Table’s reconstitution to include subcommittees that will develop recommendations for the following areas:**
  - *Industry governance*: addressing issues involving information management, enforcement, transparency, and timely communication and coordination within government, especially relating to the diagnostic and surveillance work it carries out
  - *Production model*: revising and setting goals and controls for future production
  - *Zoning*: accurately defining production zones (neighborhoods) and their uses, including relocating concessions where necessary and setting limits on production
  - *Research and development*: identifying research priorities, funding sources and methods, and coordination among industry, universities, and research centers—for example, improving the efficacy of vaccines and compliance with food safety and other standards in foreign markets
Infrastructure: making improvements to facilitate farming in remote areas and to reduce biosecurity risks from infrastructure shared by neighborhoods

Results
The development of the Chilean salmon industry provides an interesting example of public planning in collaboration with private actors. The industry’s trajectory has been accompanied by positive results in terms of production volumes, exports, employment, FDI, firm creation, and human resource development. These indicators are briefly described below.

Production volumes
Chile’s salmon production grew about 17-fold between 1990 and 2002, while the country’s share in global salmon and trout production increased from about 1.5 percent in 1987 to 35 percent in 2002. Chile’s salmon farming growth coincided with a large growth in global production, from 136,000 to 1,439,000 tons—a confirmation that within two decades, Chile has evolved from being a learner to a major player in the production and marketing of salmon fish products (Alivial 2003). The challenges posed by the disease outbreak have more or less been tackled; estimates indicate the recovery of the industry started in 2011 and should be complete sometime between 2013 and 2015 (Asche et al. 2009).

Exports
Chilean salmon and trout exports rose from less than $50 million in 1989 to around $1.4 billion in 2004, amounting to an increase of approximately 500 percent in a decade and a conversion of salmon and trout farming into the fourth main export sector of the country. The market for Chilean farmed salmon has also evolved over the last decade to include Asia and Eastern Europe, while Japan remains the main export market for Chilean salmon products, accounting for about half of the total (up to the year 2000), followed by the United States (about a third) and the European Union (less than one-tenth).

Employment
In 2002 the salmon industry employed about 24,800 workers (directly), while supplier firms employed 12,000 additional workers. Total employment by the sector in the region increased almost threefold between 1992 (10,200 workers) and 2002 (40,500 workers). The 2004 employment estimates by SalmonChile suggest about 45,000 workers are directly or indirectly employed by the sector. The increase in employment may partly explain the improvement in the social indicators of the region. Between 1990 and 2000, the poverty index in Region X decreased from 40 percent to 24 percent and the index of extreme poverty from 13 percent to 7 percent. In 2007, the industry provided around 25,000 direct jobs and 20,000 indirect jobs, associated with a nucleus of approximately 40 companies and more than 1,200 affiliated suppliers. Much salmon production was concentrated in the coastal areas of Region X, most notably on the central and east coasts of Chiloé Island, where approximately 40 percent of the total production was concentrated.
Firm creation
Since its inception, Fundación Chile has established more than 40 enterprises, of which about 30 have been sold to the private sector.

FDI
FDI flows into the fishing and aquaculture sector of the economy increased substantially between 1993 and 1996 and between 1999 and 2000 (see Figure 2). Consequently, the number of firms grew from 5 in 1985 to 22 in 1997 and then fell to 17 in 1999 (Katz 2004). The increase in acquisitions and mergers that characterized the late 1990s led to a reduction in the number of firms but an increase in the average firm size.

Figure 12: Cumulative FDI in Fishing and Aquaculture (in $000, 1974–2004)

Source: UNCTAD 2006.

University graduates/human resources
Since the 1990s, universities have supplied the labor market with professionals in aquaculture production and business administration. Most are graduates of universities located in the region, such as Universidad Austral en Valdivia and Universidad Los Lagos. In addition, Intesal joined the national training system in 1996 and has since become the main institution for human capital development in the region, especially for training in quality control management. The number of students trained has increased substantially: in 2002, Intesal graduated 2,060 workers, an increase of 18 percent over the previous year.

The positive results of such initiatives can be explained by three developments:

- **The successful public–private cooperation.** The close cooperation between government agencies and the salmon producers played a vital role in the growth of the industry, especially in the development of licensing regulations, sanitary standards, and supporting research and development activities (R&D). Similarly, R&D institutions have worked closely with the national fishing agency, the National Commission for Science and Technology, and the salmon industry.
The early importation and assimilation of technologies. The industry has also been successful in absorbing foreign technologies and developing indigenous technological capability. Major accomplishments include the acquisition and development of technologies used in the production of well-boats (boats having a well in which fish can be kept alive), the sequencing of salmon pathogen genomes, the development of vaccines to control some salmon infections, and the replacement of fishmeal ingredients by vegetable-derived alternatives in the formulation of salmon feed. Furthermore, the emergence of foreign firms in the salmon-farming business stimulated interest among local entrepreneurs and firms in the commercial viability of the industry.

The general collective learning process that intensified with the emergence of the cluster. As industrial development progressed, networks and linkages formed among key local authorities, domestic firms, and foreign partners and facilitated the process of acquiring, adapting, and disseminating new technologies. The collective learning process was enhanced by the existence of local support institutions that worked closely with industry and universities and assisted in the management of complex technical requirements and the generation of the necessary human capacities and institutions.

In addition to these direct results, the development of the industry had secondary implications. Development gains expanded to other sectors (egg producers, feed manufacturers, and providers of services) that attracted young professionals seeking employment opportunities in the once-rural community. The industry increased the education levels of both workers and the regional population. Migration to the region increased and helped boost the supply of educated workers and economic activities. Attracted by the employment opportunities in the salmon industry and the supplier firms, a number of young professionals (aquaculture-related engineers, architects, veterinarians, biochemists, and technicians, as well as medical practitioners, among others) and their families have moved to the area.

The economic impact is also evident in terms of infrastructure improvements—for instance, road investments aimed at connecting the region with the north of the country, including the construction of a bridge to link Chiloé Island to the continent, and the modernization of the regional airport. The city of Puerto Montt is now an economic and cultural center, and banks and insurance companies, consultancy and engineering services, and research centers and universities have developed in the region to support the salmon industry.

Finally, the outbreak of the salmon disease and the resolution mechanisms used also yielded secondary effects (Alvial et al. 2012):

- The measures affected the industry favorably in the short term and established the basis for better performance in the long term, founded on adequate regulation and voluntary agreements. The effects of the changes were first apparent in seawater production in the second part of 2009 (lower mortalities and improved growth rates), and, in 2011, companies were ready to stock more product.
The perception of the industry among investors and the banks has improved significantly and such reputational improvement has assisted in safeguarding financing for the industry.

Employment rates were also affected: the ISA crisis resulted in a reduction of workers following the closure of many farms and hatcheries, especially in 2008. In the second half of 2009, however, new facilities were built and regional unemployment rates decreased, positioning regions X and XI among those with lowest unemployment in Chile.

Lessons learned

The Chilean salmon industry underwent an incremental process of technological upgrading, from the technology transfer, imitation, and adaptation stages to the development of endogenous innovation capabilities. Notwithstanding the value of technological achievements, the most important asset in this case of successful industrial development has been the collective learning path that has influenced and led to a new business management approach towards a complex system and the production of high value-added salmon products (UNCTAD 2006). Following closely the dynamic trajectory of the salmon industry, governmental support has remained relevant to its needs through the continuous revision and redesign of policy instruments. For three decades, the government has worked in close collaboration with other stakeholders while maintaining a flexible structure with regard to the supporting institutions. Such a long tradition of joint action has aided the development of capabilities to solve problems and handle crises.

The openness to collaborating not only with local but also foreign institutions signaled the country’s willingness to enter global markets and such attributes constructed a sound base for the attraction of foreign direct investment. Although FDI’s contribution to the emergence of the sector was marginal, in later stages it endorsed the growth and globalization of the industry.

Chile developed a set of support measures critical to developing technology, improving production, and marketing salmon fish products. Among these were a friendly regulatory framework, promotion of standards and international networks, facilitation of the emergence of a producer association, and enhancement of cooperation between technology development institutions and industry. For example, the licensing system opened up the market to foreign and domestic investors.

The establishment of a new industry often requires the development of various support subsectors, such as production, processing, distribution, and marketing channels that are vital to its success. Each subsector has different technological, financial, and regulatory needs, and the overall performance of the industry may depend on their efficiency and productivity. The development of the Chilean salmon industry provides a good example of the course and the technological needs of these subsectors during their development process.

The sustainability of the salmon industry points to the following lessons (Alvial et al. 2012):
• Government and industries should develop national and local R&D programs to provide timely information supportive of effective regulations and enforcement.

• A biosecurity system covering all sectors of the value chain should be developed.

• Controls and management programs should be in place and provide the basis for coordinated actions among users.

• Long-term farming sustainability and market acceptance of the products should be improved.

• Good communication among industry stakeholders and government must be maintained to ensure issues are dealt with early and all parties involved are kept abreast of the situation.

Overall, the Chilean case highlights the importance of certain policy “attitudes and practices.” More specifically, it shows how results at each of the stages of industrial development were used as inputs to improve management practices, in both public and private circles. The use of results-based management methods (that is, consulting with stakeholders to develop goals and design programs, collecting program data, monitoring progress, and adjusting programs) assists the monitoring and evaluation process through various channels:

• Building common expectations by consulting with stakeholders

• Improving accountability by collecting evidence

• Continuously adjusting and improving public intervention

The Chilean example confirms how the continuous adaptation of policy actions to changing conditions facilitates policy learning and builds a sound problem-solving capacity in both public and private sectors.

End notes
1 In 1985, 36 firms were already operating in salmon farming. This rapidly increased to 56 in 1987, with 117 farm sites. During 1985-6, salmon exports reached over US $1 million, allowing Chile to be recognized as a salmon producer in the world for the first time (Technopress, 2003 in Lizuka, 2004).

References


**Agencies**

Chilean Economic Development Agency (Corporación de Fomento de la Producción, CORFO), [http://www.corfo.cl/](http://www.corfo.cl/)

Fisheries Development Institute (Instituto de Fomento Pesquero, IFOP), [http://www.ifop.cl/?lang=en](http://www.ifop.cl/?lang=en)

Fishing and Hunting Division of the Directorate General of Fisheries and Aquaculture (Secretaría de Agricultura y Ganadería, SAG), [http://digpesca.sag.gob.hn/](http://digpesca.sag.gob.hn/)

FONDEF, [http://www.conicyt.cl/fondef/](http://www.conicyt.cl/fondef/)


The National Fisheries Service, Servicio Nacional de Pesca (SERNAPECASCA), [http://www.sernapesca.cl/](http://www.sernapesca.cl/)

The Undersecretariat of Fisheries - SUBPESCA in the Ministry of Economy, [http://www.subpesca.cl/controls/neochannels/neoch593/neochn593.aspx](http://www.subpesca.cl/controls/neochannels/neoch593/neochn593.aspx)