

**Establishment of aquaculture
consultancy and analytical
service in Chile
A pre-feasibility study**



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Abstract

Chile is the world's biggest salmon producer after Norway. The production efficiency is still far less in selected areas, and the impact of water quality is one of the main reasons. NIVA has unique competence in providing advisory services to the aquaculture industry, and identified Chile is a potential new market to be focus on. This report provides an overview of the results of a pre-feasibility study of establishing in Chile as a long term activity.

Establishment of an own analytical laboratory was considered essential at the beginning. However, new and promising initiatives appeared during the study making it possible to focus on providing advisory services. A limited liability company was formed to provide consultancy services and the establishment of an own analytical facility will be postponed. NIVA's accredited laboratory in Oslo will function as a temporary and back-up solution at the initial stage.

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Establishment of aquaculture consultancy and analytical service in
Chile

A pre-feasibility study

Preface

Innovation and business development is a new area of activity which NIVA has started to focus more on during the last few years. Following the successful initiatives in Norway, we are considering expansion in the international market.

Chile is the world's second biggest salmon producer and several Norwegian aquaculture companies are already heavily involved in Chile. Following NIVAs success in research based advisory services to these companies, we have decided to evaluate the potential of expanding our services to the Chilean aquaculture industry. This report presents and overview of the activities, analysis and conclusions.

Oslo, 20th June 2008

Harsha Ratnaweera

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Summary

Chile is the world's biggest salmon producer after Norway. The production efficiency is still far less in selected areas, and the impact of water quality is one of the main reasons. NIVA has unique competence in providing advisory services to the aquaculture industry, and identified Chile is a potential new market to be focus on.

One of our scientists relocated to Chile in January 2007 on an invitation of the leading salmon and trout egg producer in Norway. During the first half of 2007 we were involved in more than 15 projects for a value of over USD 200 000, which has indicated a considerable potential to establish in Chile. This report provides an overview of the results of a pre-feasibility study of establishing in Chile as a long term activity.

We have identified two major activities as the potential focus areas: (a) analytical and advisory services related to water quality requirements for the freshwater stage of salmonid species in aquaculture and (b) consulting and research related to critical factors, metal toxicity and water treatment techniques.

The need, market and competitors were evaluated for the two products and services intended to be provided by a subsidiary of NIVA in Chile. Access to analytical services with adequate quality and detection limits have been identified as crucial factors to provide the much required advisory services to the Chilean aquaculture industry. Since the existing analytical facilities in Chile seemed to be inadequate, it was decided to evaluate the feasibility of establishing a laboratory services integrated to the consultancy services.

A newly formed joint venture between the Hill Laboratories from New Zealand and the analytical laboratories of the Pontificia Universidad Católica de Chile in Santiago indicates a good possibility of providing adequate services. Although it seems to be feasible to obtain services from this joint-venture in Santiago, it will be necessary to use the NIVA laboratory in Oslo as the back up solution. Should the Joint Venture of Hill laboratories fail to deliver their services as promised, the need for establishment of an own laboratory should be seriously considered.

The company establishment procedure in Chile is demanding and takes time. Legal experts were consulted and frequent assistance was obtained. The Limited liability form was chosen as the company form. Good and professional relationships with the Chilean companies as well as the Norwegian companies established in Chile are important. NIVA Chile SA seems to have secured a very good position.

Several travels to Chile and local presence have been identified as important factors for the success in establishing in Chile. A lot of resources were allocated for this activity with good results.

After considering many factors, it was decided to establish NIVA Chile SA to focus on the consultancy services, mainly in the aquaculture industry.

1. Introduction

1.1 Background and motivation for the initiative

Chile is the world's biggest salmon producer after Norway. Norway has developed and optimized its production during several decades of experience, and thus the salmon production efficiency is comparatively higher in Norway. For example, the Chilean salmon industry uses up to six times the number of salmon eggs to reach the same level of slaughtered salmon, compared with Norway. This factor could be reduced by identifying the toxic conditions, improving water quality in freshwater as well as improving transport systems – provided the specialized knowledge and analytical facilities are available. Another issue is the increasing water quality pollution in rivers and lakes due to present salmon farming concepts with discharge to freshwater systems (lakes and rivers). According to various reports it has now come to a critical condition where the water quality has become severely polluted and restoration may be costly and difficult. These are issues Norway has experienced decades ago and efficiently solved after years of R&D. NIVA specializes in selected areas in this aspect and we see a great potential in contributing to the sustainability of the Chilean salmon industry.

One of our scientists relocated to Chile in January 2007 on an invitation of AquaGen Chile S.A., a subsidiary of the leading salmon and trout egg producer in Norway. During the first half of 2007 we were involved in more than 15 projects for a value of over USD 200 000. We recognized a huge demand for our services from the big, as well as the small salmon producers, and we see that it is not feasible to continue it in the current form for several reasons.

There are over 30 water quality laboratories in Chile and about 10 of them provide specialized services to the aquaculture industry. Although these services are satisfactory for general conditions, but for the specific issues like toxicity levels of trace pollutants none of these laboratories are able to provide the analysis of right quality in terms of both detection limits and reproducible results. This is due to the lack of advanced analytical instruments with adequate detection limits or dedicated professional services to the aquaculture industry. We have also identified that most laboratories provide analytical results to the salmon producers, but without interpretation of the results and how to use them in practice to solve their problems.

Chilean salmon production has multifolded during the last decade. We believe that the trend will continue and the demand for specialized services will increase to achieve a bigger market share at competitive prices. In this process we consider specialized advisory and research services on selected areas (where Chile currently lacks adequate competence) and a dedicated specialized analytical service as two important building blocks which are imperative in achieving the targets of the Chilean salmon production. R & D activities on the specific types of water qualities we have in Chile will also be important when designing good water treatment techniques for hatcheries. Our motivation is thus to provide these three services through a subsidiary of NIVA as NIVA Chile S.A.

The largest proportion (82%) of the Chilean salmon production is currently undertaken in the Xth region, whereas about 17% is in the IXth region. We therefore plan to establish our office around Puerto Montt in the Xth region, and serve the IX region from this office. In the future, however, the expansion is expected further southwards to both the XI and also the XIIth region.

1.2 General project description

Chile has gained the position of second largest salmon producer in the world by multifolding its salmon production during the last few years. The environmental and natural conditions in Chile indicate a potential to further increase its salmon production. However it requires cost reduction to

increase competitiveness using innovative methods and improved logistics, as well as increasing the sustainability by reducing the impact on the environment.

NIVA represents Norway's leading competence centre on water related environment with a specialized competence on selected focal areas related to the aquaculture industry. Our experience with Chilean salmon producers indicate an overwhelming need of research-based services, and the limited inputs we have provided so far to the industry has been acknowledged with great interest and appreciation. We see a clear potential to increase our services, but acknowledge that it is impossible to realize this without being physically based in the salmon-producing regions.

To be able to provide the services in a scale to match the demand it is necessary to have a competent specialized and supporting staff, as well as specialized analytical services. A survey on the existing analytical laboratories in Chile reveals that none can provide the analysis of required quality - which is a critical factor – and also an important reason for why many essential and obvious abatement activities have never been used.

Rather than providing advisory services from specialists residing in Norway and analysis from our laboratory in Oslo, we find that it is (better/necessary)obvious to increase the capacity and the service level in Chile by establishing a permanent facility.

This subsidiary of NIVA is planned to be staffed by Norwegian research scientists and analytical specialists combined with local personnel. The local staff will be trained by NIVA both in Norway and by our Norwegian researchers present in Chile for shorter or longer periods.

1.3 General and specific objectives of the initiative

The objective of the initiative is to establish NIVA Chile S.A. to provide specialized research and research services to the salmon producers in Chile to improve their productivity and competitiveness, while minimizing the impact on the environment.

Specific objectives are:

- Establishment of NIVA Chile S.A. with adequate staffing, logistical routines and physical infrastructure
- Establish a specialized laboratory dedicated to aquaculture industry with specialized lab-personnel
- Training of local staff as key laboratory personnel, as well as to establish a local team of specialists
- Establish mutually beneficial relationships with the clients and collaborators
- Establish solid and sound marketing and management routines to increase efficiency and benefits to the clients and to the company

2. Market analysis

2.1 The Chilean salmon industry

The main producers in the farmed salmon industry continue to be Norway and Chile, with a market share of 42.3% and 37.2%, respectively. The other main competitors are the UK and Canada with participations of 8.2% and 7.0%, respectively, as of 2007, maintaining their contribution to this market compared to 2006. Chile's growth in salmon farming has been explosive, with annual production increasing from 33,000 tonnes (US\$159 million in exports) in 1991, to a total of 387,000 in 2006 for a value of US\$2.2 billion in exports, making Chile the second largest producer worldwide (León-Muñoz *et al.*, 2007).

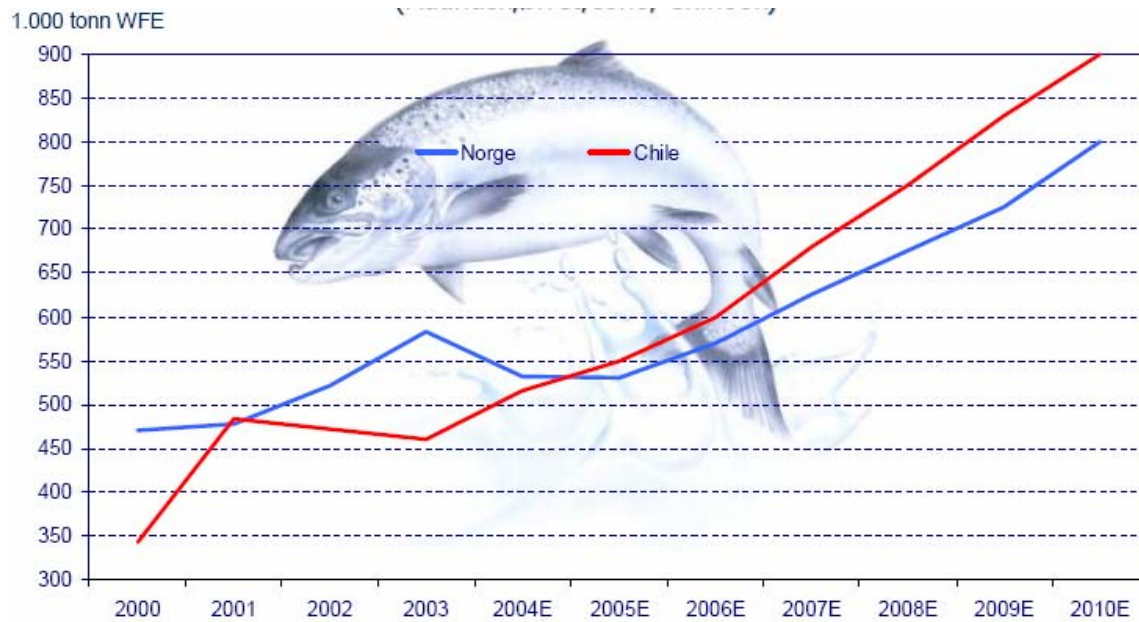


Figure 1: The development of slaughter volumes of salmon in Norway (blue) and Chile (red). (Kontali analyse, 2004)

Many indicators show intentions of further growth of the salmon production in Chile. Further optimization of the salmon production is required for two main reasons:

- Increase the cost competitiveness to gain higher market shares
- Reduce the impact on environment, which is already reaching critical conditions in some water bodies

While there are a number of competent Chilean R&D organizations which may contribute in achieving these goals, we see a number of specific competence areas which are not provided by any of these companies. Due to NIVA's long-term involvement in the Norwegian salmon production - probably the most modern and cost efficient salmon production in the world - NIVA can provide a unique advisory and R&D-service to the Chilean salmon industry, which can hardly be competed by other organisations in Chile - at least for the time being.

Although unit cost (hourly rates) of Norwegian (NIVA's) services could be somewhat higher than the local costs, due to the relative efficiency as well as the competence gained through decades of experience with the Norwegian aquaculture industry, our services often represents comparatively less overall costs to the industry. Our experience so far and the response from leading Chilean salmon producers confirm this.

Chilean salmon industry can, of course, find ways to optimize its' industry with own capacities, as the Norwegian industry did during the past decades. The business concept which NIVA Chile S.A. represents is to provide the most modern technological and innovative solutions which are proven in the Norwegian salmon industry, saving costly errors and lengthy procedures to the Chilean industry.

2.2 Analytical services: status, need and competitors

The number of salmon hatcheries in Chile is a good indicator for the need for water quality laboratories, as it shows the best economical potential related to the optimum water quality. Table 1 shows the current status.

Table 1. Number of Hatcheries of salmon industry, (Pessot, 2007)

Type of hatchery	Amount	Company
Recirculating	12	Marine Harvest 3 Camachaca 2 PLF 1 Aguas Claras 2 CMCH 1 Multiexport 1 GMT1
Recirculating (under construction)	4	Mainstream 1
Re-use of water	20	
Non-recirculating/re-using	80-100	

There are more than 30 relevant analytical laboratories in Chile, of which 7 can be considered strongly involved in the aquaculture sector (Table 2). Our own survey reveals that most salmon producers obtain services from these laboratories; however the results are not adequately appreciated or operationalised. Analyses are often carried out as a response to the regulatory requirements rather than process optimization. Results often represent a list of analysis which hardly give any advise to the client on usage, and are often less worth due to the low quality (too high detection limits = inability to measure the quantities which are toxic to the farms and hatcheries; and poor reproducibility), as mentioned before.

Table 2. Water quality laboratories in Chile

Description	Number of Laboratories
Santiago plus Puerto Montt area	31
Demanded from Aquaculture Industry	16
Demanded from Aquaculture Industry (Puerto Montt)	8
Demanded from Aquaculture Industry (Santiago)	8
Oriented to Aquaculture (Puerto Montt)	7
Laboratories with consultancy services	4

The 7 most relevant laboratories to our initiative have variable capacities and competence, and their services are widely spread and not only focused on water analysis. The following is a brief description of each of these laboratories, (Pessot, 2007).

- **Fundación Chile:** This is a private foundation with a section oriented to integrated service on fish pathologies, environment and quality. The head office is in Santiago together with certain laboratory services. They are covering aquaculture, production industries and environment.

Although they have a well qualified staff, the broad customer base do not satisfy the needs of specific customers like aquaculture industry. The facilities in Puerto Montt are located at Panamerica Sur N° 581.

- **CERAM (Regional centre for environmental analysis):** This laboratory belongs to the Universidad Austral de Chile. Their analyses are mainly focused on environmental requirements of water, related to the legislations in the aquaculture industry. This laboratory was created- and also known for- for supporting water analysis requirements from salmon industry, even though it does provide adequate consultancy services. Their facilities are located in Puerto Montt Los Pinos Pelluco.
- **Stirling:** This is a small private laboratory focused on environmental consultancies, which provides water and sediment analysis, monitoring of environmental and oceanographic parameters on salmon and molluscs production. They act mainly as consultants with a minor analytical service which consist of organic material, granulometry and sediments. Their facilities are in Puerto Montt.
- **SGS Aquatic Health:** This is an international company which has the certification as a core business. They have facilities in Puerto Varas and their water analysis laboratory services are placed in Santiago and Concepción. This company was started as a local one focused on health and productive needs in the salmon industry, though now they specialise on certification, laboratory analysis and experimental hatchery service. It has a small consultancy capacity.
- **Erwin Seron:** Very small company with low analytical capacity. Their facilities are located in Chiloe Island and the core of their analytical service is focused on ictiopathology.
- **CETECSAL:** Originally created as part of Salmofood and started with analysing quality parameters for salmon feed. In addition to that, they now provide services in antibiotic residue analysis on salmon feed and salmon muscle. Their facilities are located in Castro.
- **PLANCTON ANDINO:** Very small company with low analytical capacity. Facilities are in Puerto Varas, with water analysis specifically oriented to zoological analysis as the core business.

The following general comments can be made about these 7 laboratories in terms of which are their weakness regarding the present and future needs of the industry:

- They only (mostly) provide analytical services, and the lack of any (adequate) advisory services leave customers less satisfied.
- The focus of most laboratories is the compliance to environmental and administrative regulations rather than the enhancement of productivity of the industry.
- The low detection limits due to the lack of advanced analytical equipment and qualified staff is a clear weakness.
- The advisory services on optimum water quality with regards to the productivity improvements are very limited.

2.3 Capacity of the existing service:

The present requirement of the industry seems to be *in general* satisfied by the existing laboratories that perform water analysis. However, this is in terms of the *number of laboratories* and their capacities to perform the *number of analysis*. Yet, the quality is a different matter. Our opinion is that none of these laboratories can provide analysis of some of the crucially important parameters in adequate quality and detection limits.

Table 3. A list of laboratories and the services provided; Productivity and Environmental analysis, (Pessot, 2007)

	Aquachile	Marine Harvest	Mainstream	Camanchaca	Los Fiordos	Multiexport	Aqua Claras	Salmones Antarctica	Holding & Trading
Fundacion Chile		Prodctivity				Prodctivity			Env.
CERAM									
Cesmec	Env.			Env.		Env.	Productivity		Env.
Stirling			Env.				Env.		
Semageomin	Productivity				Productivity	Productivity			
SGS		Env.		Env.					
Univ. F.S. Maria			Env.	Productivity					
Analab						Env.			
UFRO									
Plancton Andino			Productivity						
Erwin Ceron	Env.		Productivity						
Essal									
Intesal			Productivity						
Inspectorate								Productivity	
G. Calidad Lab								Env.	
Cetecsai							Productivity		

2.4 New initiatives

We are also aware of an initiative from the Hill Laboratories of New Zealand to establish a modern water quality laboratory. We are in a dialogue with them to learn their plans and progress. Although this initiative may provide a very good laboratory - most probably in Santiago - for many industries in Chile, we are confident on that the need for a specialized laboratory for aquaculture industry based in Puerto Montt area still exists. The Hill laboratories have confirmed that they will only function as an “analytical factory”. However, the need in the aquaculture industry starts from the professional sampling in fields to the interpretation of the results leading to concrete actions described in a context so that clients can use it in the real life.

The current status of this initiative is that the Hill Laboratories have formed a Joint Venture with the Pontifical Catholic University of Chile in Santiago and are still in the starting process to provide services. We do have a very good dialogue with them; we are seriously considering them as a possible services provider in short-term.

In Chile, the present advisory service providers to the aquaculture industry have carried out several meetings to evaluate possibilities for collaboration and potential for competition. The established organizations like Fundacion Chile and the initiative which is under development for the establishment of a large research centre by AVS, Norway are examples where our services have identified jointly as largely supplementary indicating a good environment for collaboration rather than competition. In the mean time this situation will also create a healthy competition where all partners will benefit as the clients will get improved and expanded services, while the service providers will search for continuous improvement.

3. Scenario evaluation: NIVA Chile SA

In order to provide a competitive and meaningful service to the industry, NIVA Chile S.A. is dependent on access to the quality of analysis far higher than what is available in Chile. This can be satisfied either by upgrading an existing laboratory or establishing a dedicated laboratory from scratch. Our preliminary conclusion is that it is far more economical to establish an own laboratory with own equipment and staff trained with NIVA's professionals with routines and attitudes integrated from the beginning.

A preliminary survey of analytical prices among Chilean laboratories indicates that the analytical prices are comparable to the prices quoted at the NIVA's laboratory in Oslo. The latter prices include a conservative amortization of the latest analytical equipment and costly skilled labour in Norway in addition to the chemicals, consumables and other operational costs. Therefore we believe that a modern laboratory in Chile driven by NIVA Chile S.A. will be competitive and financially attractive.

During the pre-feasibility study period, our view on the Hill laboratories initiative has changed, and we are now more optimistic to consider them as a qualified partner - giving us the possibility to focus more on the consultancy services. However, we have carried out several scenarios with consultancy services in combination with an own laboratory which is presented below.

3.1 Potential products and services

3.1.1 Intended products at the initial stage:

- Analytical and advisory services related to water quality requirements for the freshwater stage of salmonid species in aquaculture
- consulting and research related to critical factors, metal toxicity and water treatment techniques

3.1.2 Intended products at the medium to long term

The following services which will be evaluated for further expansion according to NIVA-Group's products and services, as listed below:

- Basal Fish Ecophysiology
- Integrated Coastal Zone Management Planning (ICZM)
- Feasibility Studies for establishing sustainable fish farming
- Animal Welfare in relation to Water Quality
- Live fish transport and Water Quality
- Operations & Technology – fish production improvement
- Development Aid Projects within Aquaculture & Fisheries
- Marine and freshwater ecology
- Oceanography – remote sensing
- Algae monitoring
- Environmental effects and classification – habitat modelling
- Training of local staff / capacity building

As well as the services presently covered by Akvaplan-NIVA a.s.:

- Aquaculture planning including feasibility studies for sustainable farming
- Planning & design of fish farms, hatcheries, R&D facilities
- Design of new production concepts
- User controlled R&D, marine finfish farming (ongoing projects on seven different species)
- Management of aquaculture companies and projects
- Optimization of production

- Environmental site surveys for farmers and technical inspections according to national & international standards

3.2 Markets potential

Our experience is that there is a relatively small and concentrated group of actors with strong influence and visions for the Chilean aquaculture industry, which will be the potential clients of the proposed NIVA Chile s.a. Many of them have strong bonds to Norway either from their ownership side or from their own carrier and industrial development associated with the Norwegian aquaculture. Being a respected R&D organization with acknowledged capability of delivering the clients what they need, NIVA has observed a relatively easy access to the market in Chile. The experience from a 6-month activity reveals that we managed to enter in to business relationships with over 10 organizations in Chile with confirmation for continued and expanded collaboration with us.

However, to establish and to operate in Chile as an independent company it requires a multifold of our service volume compared with what we have achieved during a 6 months period. This represents expansion of our services with the time.

Without focused marketing or any substantial efforts, and having only one specialist, we have managed to secure about 100 000USD of consultancy services and 100 000USD of analytical services during a 6 months period. Therefore we believe that these volumes can be increased up to a total of 700 000 USD/year within one year of full operation of NIVA Chile S.A. This is based on access to an own laboratory and increased number of Norwegian and local staff.

Table 4. An example of a business unit.

Service / year	Year 1	Year 2	Year 3
Staff-Norwegian	2	2,5	3,5
Staff – Chilean	3	4	4
Consultancy & salary grants, USD	300 000	400 000	600 000
Analytical services, USD	200 000	300 000	500 000
Sum	500 000	700 000	1 100 000

3.3 Estimated investment and employment figures

The estimated investment is about 750 000 USD. The annual operational costs are about 530 000 USD, compared with an income of about 700 000 USD.

Table 5. Investment and operational costs

Description	USD	USD
Investment		
Laboratory instrumentation	600 000	
Field & sampling equipment	50 000	
Lab and office furniture	50 000	
Office equipment	50 000	750 000
Office facility rental (4-7 work places + lab)	10 000	
Consumables, electricity & services	40 000	
Communication & printing etc	10 000	
Marketing (meetings, travels, products, etc)	20 000	80 000
Staff salaries & costs (4 Chileans + 2 Norwegian man-years)	300 000	300 000
Miscellaneous and contingencies	50 000	50 000
Sum operational costs	430 000	430 000
Amortisation costs, 13% of investments	100 000	100 000
Sum Annual costs	530 000	530 000

3.4 Location alternatives

Business location is a key factor to the sustainability and growth of the operations. This depends on several factors:

- Easy access to and by clients and salmon production areas
- Possibility obtain samples and deliver analytical results
- Possibility to operate an integrated consultancy services
- Proximity to important collaborators
- Access to modern communication facilities as well as expatriate family needs

Figure 2 shows the main cities where the aquaculture industry is developed today. Considering the concentration and volume of salmon producers the preferable locations could be listed as following according to the priority: Puerto Montt, Aysen, Castro, Coyhaique, Ancud and Punta Arenas.

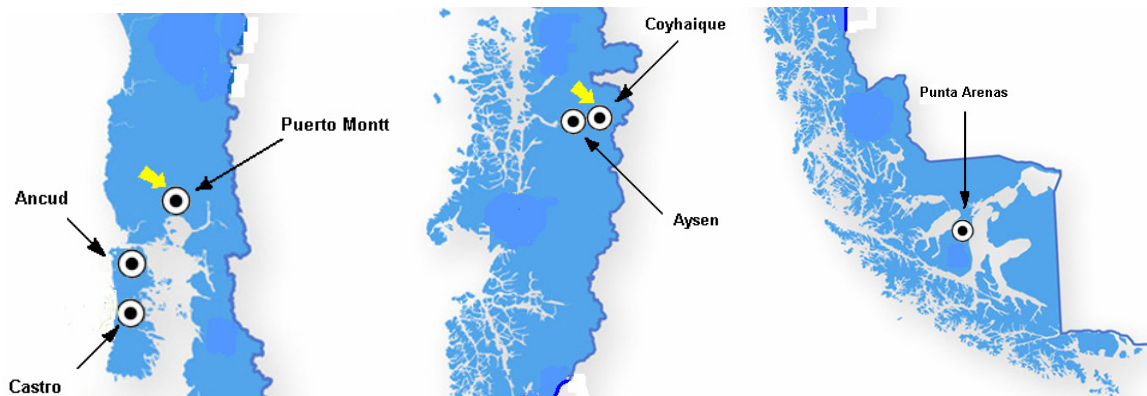


Figure 2. Location of main aquaculture sites in Chile

Considering the overall factors, NIVA Chile S.A. should preferably be located in Puerto Montt area, which is about 30 km from Puerto Montt. This is also the favourable location considering the access to raw materials for analytical service. Figure 3 is a map of Puerto Montt and surrounding areas.

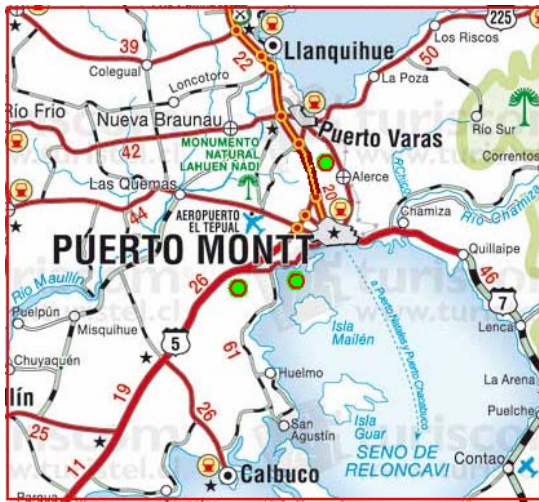


Figure 3. Map of Puerto Montt and Puerto Varas

The establishment in a secondary location could be important after few years of operation. Even though the fast growth of the industry and the current tendency to increase their production in southern waters, Coyhaique or Aysen are suggested for this purpose.

3.5 Internal and external target markets

The intention of the establishment of an analytical facility is not to provide stand alone analytical services, but integrated research and advisory services. For this purpose the analytical facilities will mostly be servicing the internal market, i.e. NIVA and NIVA Chile S.A.'s projects.

The research and consultancy services will mainly be focusing on the salmon producers, but also their suppliers who are interested in providing a added value service to their clients.

Being the national competence centre on all water related issues in Norway, and its activities in over 70 countries worldwide during the last 30 years, NIVA sees the opportunities to provide its services beyond the aquaculture sector in Chile in the near future. NIVA Chile S.A. may also consider providing its services to the other countries in the region. However, these services will not be especially focused on at the initiation.

3.6 Technological complexity

NIVA Chile S.A. will in the start be focusing on water quality requirements for the freshwater stage of salmonid species in aquaculture, as well as consulting and research related to critical factors, metal toxicity and water treatment techniques.

Providing a cost effective solution to clients using the state-of-the-art concepts and tools, as well as most modern analytical facilities, have been the core business activity of NIVA from its inception. The staff of NIVA is competent and dedicated to these services, and the operations in Chile do not seem to be of much difference to the normal activities at NIVA. Project identification, initiation, contract

negotiations, implementation, results presentation and discussion, quality assurance and post-contract services are normal project activities which do not represent any unknown complexity to NIVA.

However establishment of a competent local staff could be challenge. As an example, it has not been successful to find a person(s) with any knowledge of the key analytical instrument (ICP or ICP-MS) in Chile. Given the good technical background which the Chilean laboratory personnel generally possess, we believe that this could be overcome by specialized training.

The access to servicing of equipment is also a challenge, as there seem to be limited representation of such services in Chile or in the region. Table 6 represents a preliminary list of analytical parameters and the instrumentation required.

Table 6. Proposed analytical parameters and the instrumentation required

Parameters /Product	Details	Vendors
Water Quality (WQ)	pH, Conductivity, Alkalinity, Turbidity, (determined in robotic analyzer)	Metrohm or ManTech
WQ	pH, Conductivity, Alkalinity, Turbidity, Manual systems (0.02 + 0.02 + 0.2 + 0.04)	
WQ, cations	Ca, Mg, Na, K, NH ₄ -N,	IC Dionex or similar
WQ, anions	SO ₄ , NO ₃ , NO ₂ (nitrite), (Cl)	IC
Total C N (P)	Tot-N, TOC, (Tot P) CO ₂ -gas can be determined in C – N analyser in unpreserved samples	Autoanalyser Skalar (NL) or OiA (US)
WQ, Anions	Instead of Anion IC (low SO ₄ and Cl difficult)	Autoanalyser
Metals	ICP-MS	Several
	ICP-AES	Several
Gill metals	Freeze drier, laboratory oven Micro balance	
Ferric iron	Spektrofotometer	
Sampling systems	DGT and SCF (NOK 100-200 per unit)	
Water purification	Filtration and Reverse osmosis Deioniser	Needed Basic package
Digestion system	Microwave, Lab oven or autoclave can be used for gills?	May not be needed
LAF bench	To work with DGTs, gill metals etc	Needed
Low cost clean room	Depends on environment in lab and General Lab VVS conditions (TOS: prefilters EN 90??)	To be considered
Misc lab equipment	Glass and plastic ware Micropipettes (0.01) Dispensers (0.01)	Basic start package
Water cooling system	Chiller for ICPMS or Water cooling system based on tap water or a in-house cool water	
Gasses	Argon supply, 12 bottle Ar rack, Nitrogen, oxygen, pressurised air	

3.7 Critical Factors for the project's success.

The following factors can be listed as critical factors:

- Secure competent and dedicated specialized staff – both Norwegian and Chilean
- Access to short and medium term service agreements with major clients
- Ability to demonstrate a unique value added service to the major clients
- Access to functional laboratory facilities
- State laws and regulation enabling feasible operations in Chile
- Political and administrative stability in the country as well as aquaculture related administration
- Collaboration with major service providers to the aquaculture industry
- A very good relationship with the Norwegian service providers
- A cost-efficient and customer-friendly operational structure

3.8 Description of the financing sources

The costs can be divided in to three segments:

- Investment costs
- Training costs
- Operational costs

We anticipate that 40% of investment will be provided by CORFO HT4 grant.

Through the On-the-job training (HT3) and Specialized training & recruitment (HT6= we anticipate about 40% of the training costs will be covered.

The remaining financial needs will be covered through a loan from the mother company (NIVA) to NIVA Chile S.A. We will also consider a Norwegian State Loan for foreign investments (Eksportfinans or/and GIEK) to share the loan.

The operational costs shall mainly be covered through the projects for Chilean consultants. Through the Long Term Property leasing grant (HT5) we assume 40% of the facility leasing will be covered.

4. Legal aspects of company establishment in Chile

4.1 Chilean legislation on company types

In Chilean legislation different types of companies exist, which can be developed by either mercantile or civil businesses. Among the companies dedicated to carry out mercantile businesses, there are two types: (a) anonymous society (also referred as S.A.) and the (b) society of limited responsibility or limited liability (also referred as S.R.L.). These types of companies do not represent much complexity and they adapt better to commercial activities. A brief description of these company forms are given below (Cuadrado, 2007).

4.1.1 Differences and Similarities among the S.A. (Anonymous Society) and SRL (Limited Liability Society).

1. - Classes of Societies.

- S.A.: It is a capital company where the partner's person does not influence the life of the society; the events that affect the person of the partners would not directly affect the life of the company.
- S.R.L.: It is commonly known as a "People Company". The person of the partners constitutes a decisive requisite for the establishment and survival of the company. In this class of companies the change of partners requires the unanimous consent of all the partners. It does not consider the capital contributed by the partner; but the decisions for changes are made with the agreement of all partners.

2. - In relation to the maximum number of partners.

The Chilean legislation establishes that a society is a contract between two or more people, so the legal demanded minimum to constitute a company belongs to two people or entities.

- S.A.: no maximum limit on number of partners.
- S.R.L. : Maximum 50 partners.

3. - The Contributions.

The contributions in both companies can consist in money or in goods. If the stock capital is contributed in money, a reference in the bylaws of the total amount in Chilean pesos must be declared. Also the amount that each partner contributes must be pointed out; if it is in money; or if it is in goods (individualise and value them), and the term of payment of the contribution (terms of payment) need to be defined.

- S.A.: At least one third of the initial capital must be paid at the moment of establishing the company. The initial stock capital must be paid within a 3 years period. If this doesn't occur at the expiration of this period, the stock capital will be reduced to the amount effectively paid. The stock capital will be divided in to shares of the same value.
- S.R.L.: There is no time limit to pay the initial capital, generally what is stated in the bylaws of the company in these cases, is that the capital will be paid as required by the needs of the company.

4. - The name or firm name or trade name.

- S.A.: It should include the words Anonymous Society or the abbreviation S.A.

- S.R.L.: It must contain the name of one or more partners or a reference to the corporate purpose, and it should end with the word "limited" or the abbreviation "Ltda.". A mixed name can be specified, so that it contemplates the name of partners and a reference to the corporate purpose.

5. - Administration.

- S.R.L.: The company managers can be one or several. In case that they are several administrators these can act jointly or separately. For example, the legal representative and the General Manager can be two different persons. The decisions on the management acts are made by all the partners of common agreement independent of their contributions.
- S.A.: The management of the anonymous society is executed by the board of directors elected in the General Assembly. The bylaws of the anonymous societies will establish an invariable number of members of the board. The board members are pointed for three years, in the end of this period; a new board of directors must be designated for a new period.

The board of directors of the anonymous societies should have 3 or 5 members.

The bylaws will establish the existence of substitute members for the board of directors. The substitute directors will always be able to participate in the board meetings with right to speak, but they will only be entitled to vote when a regular board member is in absence.

If a regular board member and his deputy are leaving the board, it must be totally re-elected. This must be done by the General Assembly. In the meantime the board of directors will be able to name an alternate one.

The bylaws will determine if the directors will be remunerated for their work and, in that event, the quantity of the remuneration will be fixed, annually, by the General Assembly.

The board of directors will give the managers their responsibilities and duties.

The judicial representation of the company will be given to the Manager or General Manager.

Manager's position is incompatible with that of president (chairman of the board), auditor or accountant of the company.

General Assembly.

The shareholders will meet in ordinary or extraordinary assemblies, called by the board of Directors. The ordinary meetings will take place once a year, at the time determine by the bylaws. The extraordinary meetings will take place, in any time, when the company necessities demand them.

6. - External Audit.

- S.A.: They are obligated to have external auditors, for the revision of the company documentation. These external auditors are designated annually by the General Assembly.
- S.R.L.: This requirement is not necessary for the SRL.

4.1.2 The procedure to establish an Anonymous Society.

1. - Content of the bylaws of a S.A.

A. - Name, profession and domicile of all the shareholders.

- B. - Name and domicile of the company.
- C. - Company Purposes.
- D. - Life term of the company.
- E. - Stock Capital of the company, divided in shares.
- F. - Organization and Formalities of the management of the company (Designation of the members of the board of directors and the number of the meetings that the boards of Directors will carry out every year) .

2. - Procedure in the Foreigner Country.

- A. - Copies of the Bylaws of the foreign company, (in the foreign language and its translation to Spanish). (This can be made in the Consulate).
- B. - Certificate of Registry.
- C.- In case that a partner cannot come to Chile to sign the bylaws he/she should send a power of attorney in English and Spanish to a person of his/her confidence to sign the papers in Chile.

These documents (a, b, c) should be signed by a Notary, and then taken to the consulate of Chile in Oslo and to the Norwegian Ministry of Foreign Affairs to legalize them. In Chile they need to be taken to the Ministry of Foreign Affairs for the same effect.

3. - Procedure in Chile.

- A. - Signature of the bylaws in the Notary.
- B. - Publication in the Official Newspaper.
- C. - Inscription of the society in the Commerce Registry.

4. – Time.

The necessary time to have legally constituted the company in Chile is approximately of three weeks, since the signature of the documents in the Chilean Notary (step 2A). The necessary time to have the papers require in the foreign country is approximately of one month.

5. - Expenses.

The management expenses for the constitution of a company in Chile are the expenses generated by:

- A. - Notary (the cost is a percentage of the stock capital, approximately 0,2 %),
- B. - Official Newspaper announcement (about \$100.000 (a hundred thousand) pesos)
- C. – Commercial Registration (the cost is a percentage of the stock capital, approximately 0,2 %),
- D. - Attorney's honoraries. The estimated cost is of \$1.000.000 (one million) pesos.

4.2 Employment conditions for Norwegian citizens

4.2.1 The Chilean pension and social security

When a Norwegian citizen or a resident leaves Norway for a more than one year period, the obligatory social security contribution to the Norway will also be ceased. This is the case independently on whether the person is paid from a Norwegian or from a Chilean company. However, for the countries with special agreements with Norway, there could be exceptions. Chile is such a country.

The Norway-Chile social security agreement requires that the persons should be included in the social security system in the country where they reside. However, for persons who are temporally stationed in the other country for up to a maximum of 5 years, this rule can be exempted for. In such cases, the

Norwegian company should be in taxable position to Norway and is responsible for the employer tax to the Norwegian government.

It is necessary to obtain special permission from NAV in this case.

We have carried out a detailed study on the possibilities and limitations related temporary placement of NIVA employees in NIVA Chile SA, as well as direct employment in NIVA Chile SA. The analysis was done by Ernst & Young Co Ltd (Killengreen and Blakkisrud, 2007)

5. The Results

5.1 Evaluation of alternatives

The NIVA Chile initiative was based on two focus areas related to the Salmon industry:

- Analytical and advisory services related to water quality requirements for the freshwater stage of salmonid species in aquaculture
- consulting and research related to critical factors, metal toxicity and water treatment techniques

Both services were considered as necessary until the Hill laboratories established a Joint-Venture laboratory with the willingness to provide services on required parameters, with required quality and detection limits. We have also identified the challenges in finding qualified people in Chile to be employed as laboratory technicians/specialist with experience on advanced instruments. On the other hand, we have identified the large potential in specialising and providing advisory services to the industry, which is both economically and professionally rewarding.

The establishment of a laboratory service in Chile was also dependent on financial assistance from the Chilean CORFO foundation. Despite a very promising start, the concrete results seemed to requiring lot of resources and delays making the process somewhat uncertain.

Considering all these factors, and also not to loose more time on the process, we have decided to establish NIVA Chile SA mainly as a consultancy company. The analytical services will be provided by NIVA's laboratory in Oslo until the Hill laboratory starts their services.

5.2 Establishment of NIVA Chile SA

The formal agreements were made through a Chilean lawyer to formally establish the company. NIVA Chile SA was established with NIVA and NIVATECH AS as equal owners. The process was started in August 2007, and the official registration was completed in April 2008.

The following board of directors were appointed:

- Odd Skogheim (Chairman of the governing board)
- Harsha Ratnaweera (Board member of the governing board)
- Oscar Cornejo (Board member of the governing board)
- Åse Åtland (Substitute Board member of the governing board)
- Jarle Nygaard (Substitute Board member of the governing board)
- Trond Rosten (Substitute Board member of the governing board)

The NIVA Chile has the following staff at present:

- Åse Åtland (Managing Director)
- Pilar Martines, Project Specialist
- Linda Skyrseth, Project Officer
- Magda Rios, Secretary
- Pablo Opitz, part-time accountant

NIVA Chile has its offices located at Oficina 208, Del Salvador 264, Puerto Varas.

5.3 Representation at AquaNor (Norway) and AquaSur (Chile)

There are two major international events related to the aquaculture industry. NIVA Chile together with NIVA and Akvaplan-NIVA AS was represented at the AquaNor exhibition in Trondheim in August 2007. The Aqua Sur exhibition was held in Puerto Montt in March 2008, where NIVA Chile was present with its own stand.

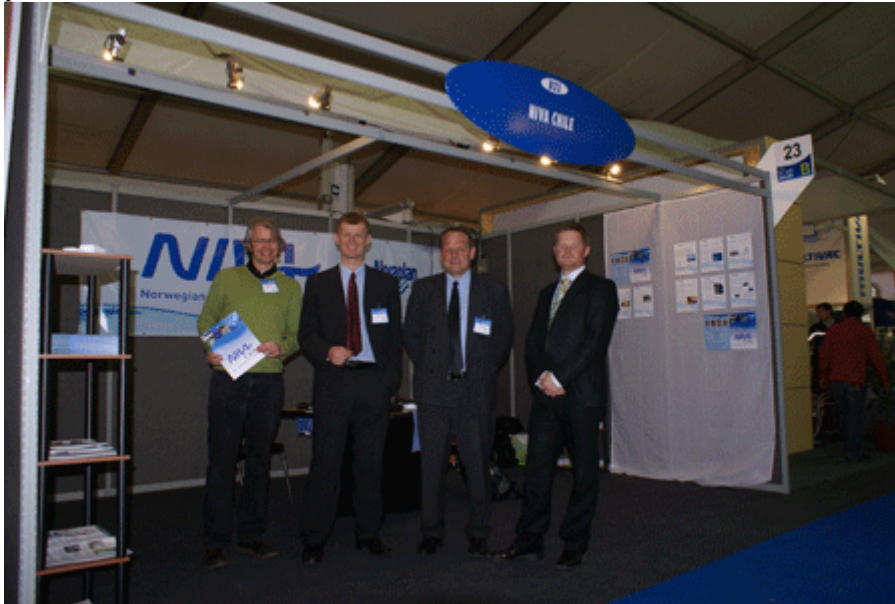


Figure 4. NIVA stand at the AquaSur exhibition, Puerto Montt, Chile

The response was extremely good, and several concrete project initiatives were established. The Managing Director of NIVA – Odd Skogheim and the Managing Director of NIVA TECH AS – Harsha Ratnaweera took part in the Aqua Sur, together with 3 other Norwegian specialists in addition to the NIVA Chile staff. Three important presentations were made by NIVA / NIVA Chile specialists which resulted in a very good response.

5.4 Norwegian state delegation to Chile

The Norwegian minister for higher education, Ms Tora Aasland visited Chile and Aqua Sur together with a group of administrators and universities. NIVA Chile team participated in meetings and receptions arranged in Santiago, Puerto Montt and Puerto Varas, marketing its establishment and progress.



Figure 5. Norwegian delegation to Chile in 2008. from left: Ms Tora Aasland, Minister of higher education and research, Pål Moe, Norwegian ambassador to Chile, Odd Skogheim, Managing Director NIVA, Prof. Carlos Williamson, Prorector, Prof. Juan A. Correa, Pontificia Universidad Católica de Chile, Director, Center for Advanced Studies in Ecology and Biodiversity, Chile.

5.5 R&D agreement with universities



Figure 6. Signing of the collaboration agreement between Pontificia Universidad Católica de Chile and NIVA-Chile SA by Prof. Juan A. Correa and Dr Åse Åtland.

The Pontificia Universidad Católica de Chile in Santiago is one of the leading universities in Chile. Center for advanced studies in ecology and biodiversity (CASEB) is a Center of Excellence established within this university. NIVA and NIVA Chile SA have signed a collaboration agreement to promote research collaboration.

5.6 Relationship with Chilean and Norwegian Aquaculture companies

Strong professional relationships with leading aquaculture companies are extremely important for the success of NIVA Chile SA. We have been quite engaged in this process and are glad to note our success in this process. The following is a list of our successful clients so far:

- Salmones Itata SA
- Invertec Pesquera
- Granja Marina Tornagaleones
- Pesquera Antares SA
- Salmones Captren SA
- Billund Acuaculture
- Pisc. Aquasan
- Solvtrans Chile SA
- Salmones Humboldt
- Australis
- Salmones Itata SA 1/3 of Phase II
- Nutreco (Skretting)
- Pesquera El Golfo
- Aqua Gen Chile SA

We have a very good relationship with the AVS Chile SA, which has also initiated its activities during the last year. We have frequent discussions with AVS Chile on the current and planned activities. We see AVS Chile as a collaborating partner in our activities in Chile.

5.7 Marketing visits to Chile from NIVA

NIVA employees have carried out several visits to Chile during the prefeasibility study period.

- Odd Skogheim, July 2007
- Harsha Ratnaweera, July 2007
- Åse Åtland, Feb-August 2007
- Åse Åtland, October 2007
- Trine Dale: Decmber 2007
- Odd Skogheim, March 2008
- Harsha Ratnaweera, March 2008
- Trond Rosten, March 2008
- Arild Sundfjord, March 2008

- Åse Åtland, stationed in Chile since February 2008
- Linda Skyrseth, stationed in Chile since March 2008

6. Conclusions

The need, market and competitors were evaluated for the two products and services intended to be provided by a subsidiary of NIVA in Chile. After considering many factors, it was decided to establish NIVA Chile SA to focus on the consultancy services, mainly for the aquaculture industry.

Access to reliable analytical services with adequate quality and detection limits are essential for the success in Chile as a consultant to the Aquaculture industry. A newly formed joint venture between the Hill Laboratories from New Zealand and the analytical laboratories of the Pontificia Universidad Católica de Chile in Santiago indicates a good possibility of providing adequate services. Although we have decided to use the services from this joint-venture in Santiago, we will be using the NIVA laboratory in Oslo as the back up solution. Should the Joint Venture of Hill laboratories fail to deliver their services as promised, the need for establishment of an own laboratory will be seriously considered.

The company establishment procedure in Chile is demanding and takes time. Legal experts were consulted and frequent assistance was obtained. The Limited liability form was chosen as the company form.

Competent Norwegian legal assistance was obtained regarding employing Norwegian citizens in Chile for short periods. There seems to be several possibilities and limitations regarding the social security, pension and unemployment benefits, which needs to be considered carefully.

Good and professional relationships with the Chilean companies as well as the Norwegian companies established in Chile are important. NIVA Chile SA seems to have secured a very good position.

Several travels to Chile and local presence have been identified as important factors for the success in establishing in Chile. A lot of resources were allocated for this activity with good results.

7. References

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