# WATER FOOTPRINT OF SALMONES CAMANCHACA 2023

Date: March 2024

# Contents

1. Introduction ..... 3
1.1 About the Company ..... 3
1.2 Salmon ..... 3
1.3 Salmon Life Cycle ..... 3
2. Water Footprint ..... 4
2.1 Definition of the Objective and Scope of the Study ..... 5
2.1.1 Objective ..... 5
2.1.2 Data Collection and Quality ..... 5
2.1.3 Scope ..... 6
2.1.4 Exclusions ..... 6
2.1.5 Assumptions ..... 7
2.1.6 Environmental Impact Categories ..... 7
3. Water Use Inventory ..... 8
3.1 Raw Materials ..... 8
3.2 Freshwater Phase ..... 8
3.3 Seawater Phase ..... 8
3.4 Processing Plant ..... 8
4. Results ..... 9
4.1 ISO 14.046 Water Footprint ..... 9
4.1.1 Freshwater ..... 9
4.1.2 Seawater ..... 10
4.1.3 Processing ..... 11
5. Conclusion and Recommendations ..... 13
6. References ..... 14

# 1. Introduction

## 1.1 About the Company

Salmones Camanchaca S.A. is a subsidiary of Camanchaca S.A. with over 30 years of experience, a publicly traded company on the Santiago Stock Exchange and the Oslo Stock Exchange (Norway) since 2018. Vertically integrated, it includes freshwater installations, seawater facilities, primary processing plants, and value-added plants. Additionally, it has commercial offices in various markets around the world to provide real support to the supply chain for our customers.

Salmones Camanchaca seeks the sustainable development of salmon farming, was a founding member of the Global Salmon Initiative (GSI) and the Chilean Salmon Marketing Council; the first salmon producer to be awarded three stars in the Best Aquaculture Practices (BAP) certification, today achieving four stars, and was the first salmon company to commit to reducing its carbon emissions to zero by 2025.

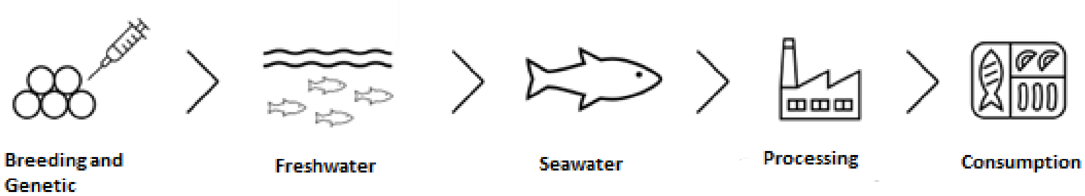
## 1.2 Salmon

Their main products are produced from Atlantic salmon and Coho salmon. Their presentations vary between fresh fish, whole chilled and frozen fish, fillets, and portions. This is one of the best sources of long-chain omega-3 fatty acids and a great source of vitamin D.

This study measures the water footprint impacts in the stages of Hatcheries, seawater farms, and processing of Camanchaca salmon for 1 kg.

## 1.3 Salmon Life Cycle

The life cycle of a salmon intended for human consumption is composed of various stages, which can be observed in Figure 1. In this study, only the freshwater (Hatchery), seawater (Grow-out farms), and processing (processing plants) stages will be considered based on 1 kg of salmon. Regarding energy, the use of diesel within the stages and the use of electricity and LPG are considered, in addition to the consumption of input and output water in the processes.



## 2. Water Footprint

Human activities' use of freshwater often leads to decreased resource availability (in a given area) or pollution of water bodies receiving discharges. In the first case, we talk about consumptive uses, which refer to uses where the extracted freshwater is not returned to the source basin and, therefore, is no longer available for other uses. Water is consumed by being evaporated, evapotranspired, incorporated into products, transferred between basins, or discharged into the sea. On the other hand, pollution of water bodies refers to uses that degrade water quality, related to the emission of pollutants into the environment that cause pollution in receiving bodies. Both water uses must be considered when analyzing the sustainability of the water resource.

Since the water footprint is based on the Life Cycle Assessment approach, the study considers direct and indirect water uses in the corresponding value chain and correlates them to potential impacts. The water footprint analysis classifies raw materials, energies, and emissions related to water resources for the defined system. According to the standard, it must include both qualitative and quantitative aspects, and the database used must be transparent.

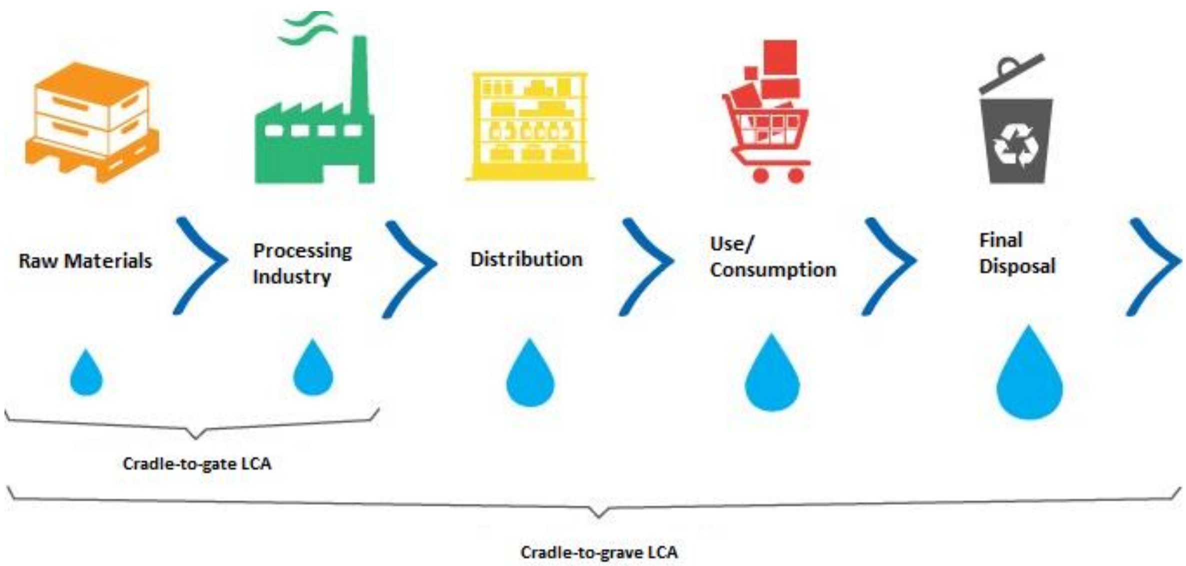



*Figure 2: Scheme of the life cycle analysis approach in the calculation of the water footprint.*

The ISO 14046 standard specifies the principles, requirements, and guidelines related to the water footprint assessment of products, processes, and organizations based on life cycle analysis (LCA) alone or as part of a more comprehensive environmental assessment. Therefore, the stages described above, which involve the use of raw materials, fattening centers, and processing, must be considered.

## 2.1 Definition of the Objective and Scope of the Study

### 2.1.1 Objective

To measure the water footprint of the company, specifically the processes aimed at salmon production, including hatcheries, Grow-out farms, and processing plants.

### 2.1.2 Data Collection and Quality

According to ISO 14046, data quality requirements must address temporal, geographical, and technological coverage, as well as include information on the completeness, representativeness, consistency, and reproducibility of the data.

The data quality requirements are presented below.

#### I. Declared Unit

The declared unit for this study (U.F.) is 1 kg of salmon.

#### II. Temporal Scope

Year 2023, corresponding to the production by Salmones Camanchaca from January to December.

#### III. Geographical Scope

Territory of Chile, Biobío, Los Lagos and Aysén regions. This includes both own installations and outsourced facilities with general consumption for the study.

#### IV. Reproducibility

Although the quality of the data and the type of methodology used allow this study to be reproduced, it is not recommended due to the confidentiality of the information.

#### V. Data Source

As mentioned above, the information used in this water footprint measurement comes directly from Salmones Camanchaca. For its collection, a questionnaire in Excel format was given to the company and its suppliers, where they had to report information on water characterization (freshwater and saltwater consumption), electricity use, fuels, amount of feed, and measurements of pollutant concentrations in effluent discharges.

For data modeling in SimaPro, the most recent versions of the Ecoinvent and Agri-footprint databases were used. The AWARE method was used for water footprint measurement.

## 2.1.3 Scope

This study, which corresponds to salmon production, will consider the uses and consumption of water in the freshwater phase (Hatcheries), seawater farms (Grow-out phase), and processing (both primary and secondary); also the water required for biomass transport during the various production stages.

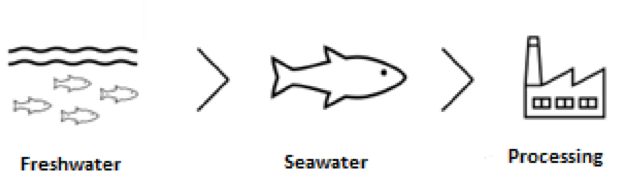



*Figure 3: Scope of the water footprint study.*

In the freshwater phase, in a controlled environment, incubation, fry rearing, and smoltification occur to reach a "Smolt" salmon with an average weight of 150 grams. Once the salmon has reached the corresponding weight, it is transported to a seawater facility responsible for growing the fish to a commercial size of 5 kg. This transport is carried out using special trucks that carry the fish and water inside until they reach wellboats to be taken to different seawater farms.

Finally, in the processing phase, the salmon is transformed into various products, either fresh or frozen, to then be distributed to customers and subsequently acquired by final consumers.

It should be noted that this methodology relates to water pollution because the SimaPro modeling software uses databases to analyze water components according to their location and corresponding natural concentrations based on parameters.

## 2.1.4 Exclusions

The following aspects were excluded from this quantification:

- Labor is not considered at any of the analyzed stages. Additionally, they do not have a relevant contribution to the environmental performance of the product.
- Impacts associated with the manufacture of machinery and equipment used in the salmon life cycle are excluded.
- Impacts from administrative activities, business trips, stationery, and lighting are not included.
- For modeling fish feed from various suppliers, only raw material consumption and origin were considered, not water or energy consumption from feed production processes.

### 2.1.5 Assumptions

Certain assumptions were considered in this study, which are mentioned below.

- The quantification of inputs by stage (freshwater, seawater, and processes) was considered without separating by installations due to the complexity in data collection due to the use of maquilas and external facilities.
- For fish feed, a list of raw materials and their consumption per supplier for the diets used by Salmones Camanchaca was provided, so the water footprint of the feed is adjusted to raw materials and not an actual impact.
- Water incorporated into the product in the processing plant.
- Water consumed (i.e., not returned to the water system from where it was withdrawn) during production, well water extraction, or sewer network.
- Grow-out farms were considered as a single installation due to differences in consumption and production due to production cycles.
- For the Rio Petrohué Hatchery, it is assumed that all the water captured from the well was consumed and released, as flowmeters in the wells were only installed in 2023. Therefore, there are no concrete measurement data.
- For maquila facilities, energy consumption was excluded, with water and raw material consumption data used for modeling.
- Regarding feed: The impact is quantified separately from the SimaPro software use, which impacts the analysis and could generate deviation in results when analyzed in detail. This is influenced by the area of raw material production and their water stress indices or the validity of the information provided by feed suppliers.
- Chile's water stress factor is 822 (WULCA, 2023).

### 2.1.6 Environmental Impact Categories

To obtain results, the impact methods and categories mentioned in Table 1 were used.

*Table 1: Impact methods and evaluated categories.*

| Method | Impact Category Used | Description |
|---|---|---|
| AWARE | Water Use | Represents the relative available water remaining per area in a region/basin once human and aquatic ecosystem demands are met. |

# 3. Water Use Inventory

The information used in the freshwater, harvesting, production, and transport stages corresponds to primary data provided by Camanchaca, while secondary data were obtained from Ecoinvent 3.8 and Agri-footprint 5 databases.

## 3.1 Raw Materials

The main raw material considered in this study is presented below.

**I. Fish Feed**

During the freshwater and seawater phases of salmon, feed from different suppliers is used. A different type of feed was modeled depending on each supplier based on a list of raw materials provided by them, where Ecoinvent 3.8 and Agri-footprint 5 data were used.

## 3.2 Freshwater Phase

The production cycle of farmed salmon begins in a controlled freshwater environment where it reaches a weight of approximately 120 to 150 grams before being transported to the seawater phase. Six freshwater facilities, located between the Araucanía Region and the Los Lagos Region, were considered. This phase included the consumption of electricity, food, fuel for internal transport, and machinery.

*Table 2: Inputs for the freshwater stage.*

| Feed (kg) | Electricity (kWh) | Fuel (Diesel) (L) | Water (m3) |
|---|---|---|---|
| 1.4 | 2.88 | 0.156 | 7.96 |

## 3.3 Seawater Phase

Once the salmon has reached the required weight, it is transported to a seawater facility responsible for Grow-out fish up to an average size of 5.6 kg. This study included 27 seawater facilities located in the Los Lagos and Aysén regions. This phase encompassed electricity consumption, food consumption, fuel for internal transport, and machinery.

*Table 3: Inputs for the seawater stage.*

| Feed (kg) | Fuel (L) | Water (m3) | Electricity (kWh) |
|---|---|---|---|
| 1.19 | 166 | 0.19 | 2.02 |

## 3.4 Processing Plant

When the salmon reaches the commercial weight of approximately 5.6 kg, it is transported to the processing plant to be transformed into the final product.

Salmons Camanchaca has 1 primary processing plants and 2 secondary processing plants located in the Biobío Region (Tomé processing plant and Pesca Sur) and the Los Lagos Region (San José, Abick, and Caleta Bay plants). This includes the electricity consumption, fuel usage, and generation of organic waste for each plant.

*Table 3: Inputs for the Processing stage.*

| Electricity (kWh) | NCRE (kWh) | Fuel (L) | Water (m3) |
|---|---|---|---|
| 0.026 | 0.213 | 0.19 | 0.01 |

# 4. Results

## 4.1 ISO 14.046 Water Footprint

Para this quantification, SimaPro 9.3.0.3 software and the AWARE impact method were used. The results are presented for the declared unit: 1 kg of salmon.

*Table 5: Potential environmental impacts per declared unit*

| Category | Unity | Freshwater | Seawater | Processing | Total |
|---|---|---|---|---|---|
| Water Use | $m^3$ | 1.3 | 1.46 | 1.03 | 3.79 |

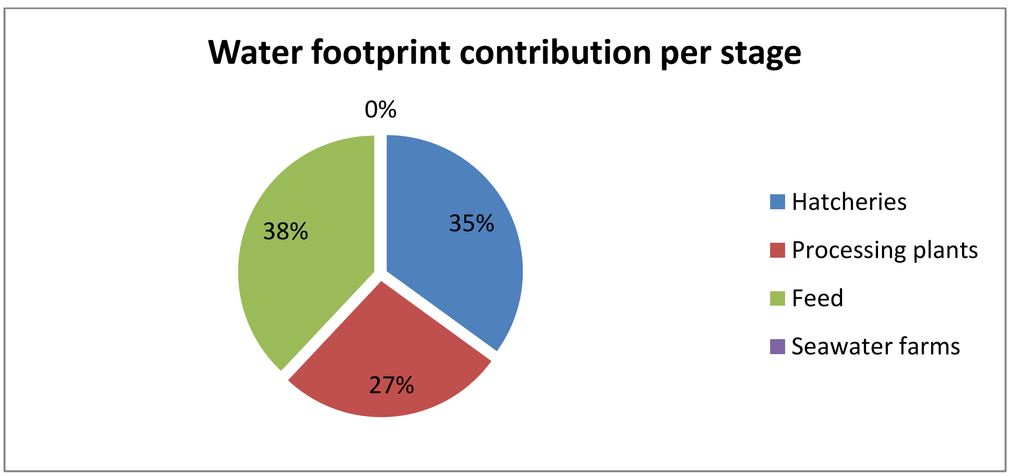



*Figure 4: Water Footprint contribution per stage*

### 4.1.1 Freshwater

For the Hatchery stage, a water footprint of 1.3 m3 was obtained, where the greatest impact comes from the use of groundwater at the Rio Petrohué Hatchery (0.66 m3/kg) and Playa Maqui (0.47 m3/kg) facilities. This perspective focuses on consumptive water use, where extracting water from wells, using it, and discharging it into a different watershed than its origin causes a greater impact on the water resource of a particular ecosystem, which is altered by the water extraction.

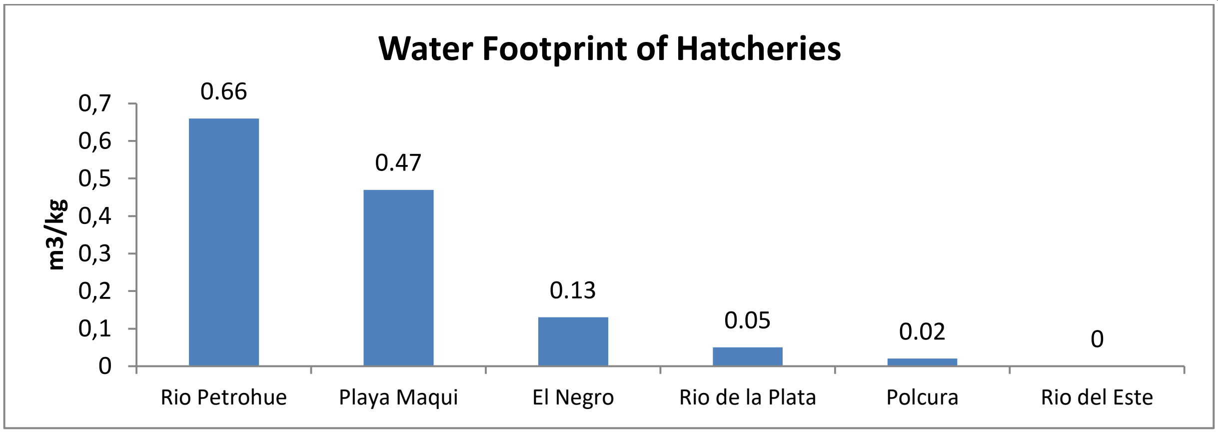



*Figure 5: Water footprint and its contribution by fish farm installation*

Subsequently, the largest contribution to the water footprint of fish farms is due to the use of groundwater and/or river water at 1.19 m3/kg, primarily for the operational needs of the facilities. This is followed by electricity usage at 0.106 m3/kg.

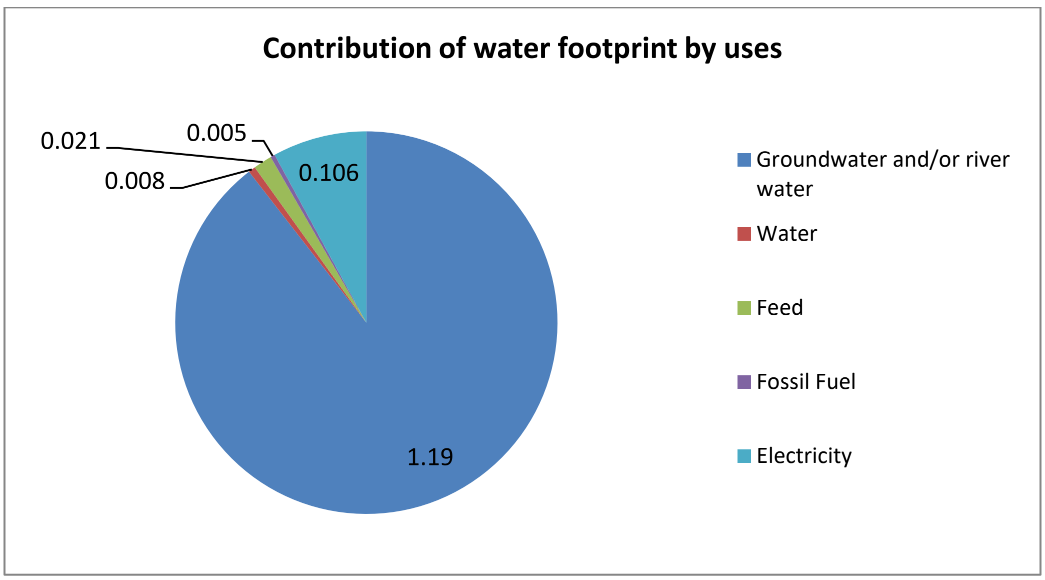



*Figure 6: Water footprint of fish farms according to their contributions by source*

### 4.1.2 Seawater

For the Seawater stage, a water footprint of 1.46 m3/kg was obtained, of which 0.01 m3/kg is attributed to the consumption of saltwater for desalination, bottled water consumption, and contributions from energy consumption.

The food used for salmon, as an indirect water footprint of Camanchaca Salmones, accounts for the highest contribution within the total quantification of the seawater stage, at 99% (1.445 m3/kg). This is mainly due to the raw materials used in its production, such as soybean, both as meal and oil, and to a lesser extent, fish derivatives.

### 4.1.3 Processing

Within these processing plant facilities, the transformation of salmon into the final product takes place. Each plant includes energy consumption, waste generation, and consumptive water use. The water footprint is 1.02 m3, with 0.12 m3 from the primary plant and 0.906 m3 from the secondary plant.

In the primary plant, the San José facility contributes the highest water footprint at 92.8% of the total, which is attributed to its own plant operations, compared to Abick with 1.8% of the impact. In the secondary plant, Caleta Bay has the highest impact due to contract manufacturing; this is driven by the use of groundwater and sewage network, leading to higher water consumption.

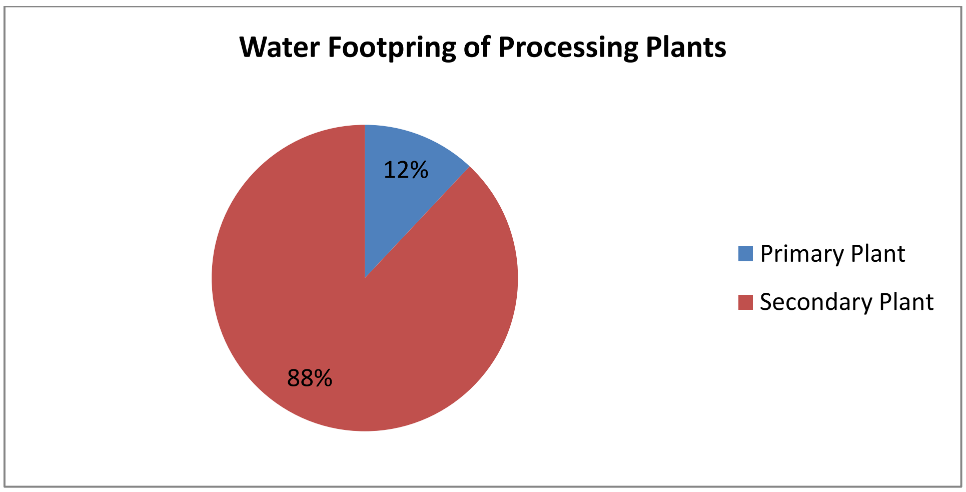



*Figure 7: Water footprint by contribution from primary and secondary processing plants*

The identification of a negative water footprint is due to there being more effluent than influent. Therefore, when conducting the water balance, the value results in a "positive" impact.

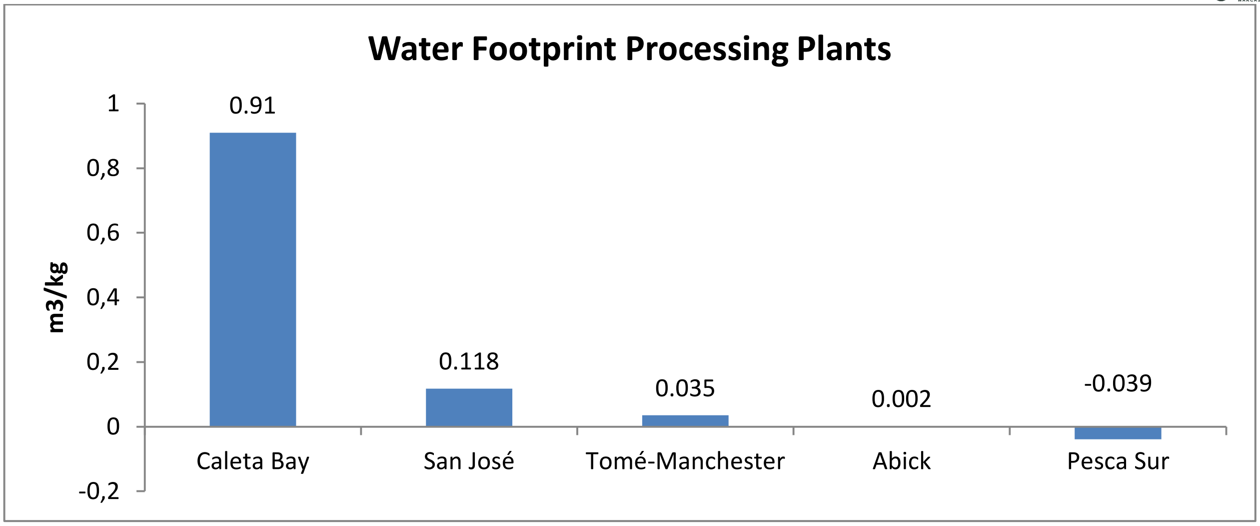



*Figure 8: Water footprint and its contribution by installation in processing plants*

## 5. Conclusion and Recommendations

The ISO 14046 standard establishes that water use is measured as consumed, evaporated, evapotranspired, incorporated into products, transferred between basins, or discharged into the sea (ISO 14046, 2014). The measurement conducted by Camanchaca will establish the basis for developing short, medium, and long-term strategies regarding water and climate resources.

According to the measurement under ISO 14046, the water footprint of 1 kg of salmon produced by Camanchaca is 3.79 m3.

From the gaps identified in both water footprint and water use quantification:

- Monitor groundwater consumption by efficiently managing this resource, considering that higher environmental impact results from water stress.
- Request water footprint information for feed from suppliers, analyzing raw materials and/or;
- Incorporate detailed analysis of raw materials, including their origins and production technologies, to reduce uncertainty in information capture, while initiating water management practices.
- Efficiently monitor fuel use, particularly electricity for aquaculture operations, to reduce the impact on water footprint and water use.
- Identify unconventional renewable energy sources from electricity providers to refine results accordingly: mini-hydro, solar photovoltaic, wind, or other sources.
- Enhance information identifying Camanchaca's indirect water footprint.

In a world with increasingly limited resources, efforts to minimize water use throughout the food cycle will reduce the company's water footprint and benefit its products and customers. Transparency and accuracy of information from the company and its supply chain are crucial.

Continuing to gather information will enable the company to make informed decisions considering water resource risks. Engaging the supply chain, identifying and tracing major water footprint demands in the food cycle, and communicating these efforts to stakeholders are key steps in improving environmental performance.

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