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## Plan Overview

*A Data Management Plan created using DMPonline*

**Title:** Interdisciplinary Education and Research Platform in Cold-Chain of Fish: From Norway to Japan

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**Template:** DMPOnline Template (NWU)

### Project abstract:

Norway and Japan are countries with a highly developed fish processing industry and a deep knowledge, practice and technology in cold chain. Japan has a high share of fish import, while Norway is oriented on fish export. Norway had direct exports of over 114,000 tonnes of seafood to Japan in 2017, with a value of NOK 4 billion. This made Japan the largest Asian market for Norwegian seafood exports. The Japanese market has much higher potential for further growth for Norwegian seafood. At the same time, the high competition on the global market and other players like USA, Russia, China, Scotland and Canada requires measures for further development and increased sustainability and efficiency of the cold-chain between Norway and Japan.

IntER-Cold will establish an education and research platform for knowledge exchange between researchers, students and industry between Norwegian and Japanese institutes for the seafood cold chain. The education and R&D will address the following complex challenges in the cold-chain development:

1. Decreasing of wastes during processing and handling of fish: Zero-Wastes approach;
2. Effective separation and utilization of rest-raw materials for human consumptions;
3. Efficient chilling, freezing and storage solutions, which satisfy the requirement to product quality, required high capacity, energy efficiency and sustainability;
4. Long high-quality shelf-life, which provide fresh and valuable products to consumers and increased flexibility in retail sector.

IntER-Cold is focused on the following target groups: students, young researchers, academic staff and industry.

In 2022-2023 IntER-Cold provided:

1. 2 interdisciplinary seminars on cold chains in Nagoya and Tokyo, where students industry and researches were involved, over 80 visitors in total.
  2. Guest lecturing of academics from NTNU at Nagoya Institute of technology and Tokyo University of Marine Science and Technology. The main topic was energy efficiency for fish processing and development of new green technologies.
  3. 2 digital workshops for project partners, students and industry
  4. Research related visits and internships of students and professors from Japan
  5. Joint supervision of master/bachelor diploma thesis, and joint publications on research results.
- The project activity will continue in 2024 with exchange of PhD and Postdoc for research both from Norway and Japan, internship of bachelor and master students from Nagoya Institute of technology and Tokyo University of Marine Science and Technology. The results of the project will be disseminated on the KIFEE 2024 (Kyoto International Forum for Environment and Agency) and 8th IIR Conference on Sustainability and the Cold Chain in Tokyo.

Due to the Covid 19 situation the planned activities are scheduled for for the period 2022-2024.

**ID:** 169072

**Start date:** 01-06-2020

**End date:** 31-12-2024

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**Grant number / URL:** <https://www.forskningsradet.no/utlysninger/2025/internasjonale-partnerskap-intpart/>

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# Interdisciplinary Education and Research Platform in Cold-Chain of Fish: From Norway to Japan

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## Data Collection

### What data will you be collecting ?

This is educational project aimed to increase network and collaboration between education and research units in Norway and Japan. The funding supports research and education mobility only. The main research activity will be funded by other internal and international projects.

The joint publications in peer-reviewed journals will be collected. This does not require any storage capacity.

Open access to project results is fundamental to the project's ethos. We recognize the importance and value of open access publishing. We have access to financial backing for full open access publications from NTNU. In cases where open access is not feasible, we will ensure that articles are self-archived in an open repository (green open access; a time delay may apply). Non-peer-reviewed project outcomes like presentations or software analysis tool documentations will be made publicly available on <https://dataverse.no>.

Link: <https://doi.org/10.18710/EBITHP>

### Who will be involved in your data collection ?

Norwegian University of Science and Technology

## Ethics

### Give a description of your Ethics

Ethical aspects connected to research data generated by the project will be considered as the work proceeds, we do currently not see any ethical issues that could have an impact on the sharing of research data.

## Planned Research Outputs

### Event - "Data set: Inter-COLD lectures and presentations"

The Pdf files of the presentations, courses and lectures done through the project.

Includes:

1. Guest lecturing
2. Inter-Cold seminars
3. Inter Cold workshops.

### Journal article - "A comprehensive investigation of the use of freeze concentration approaches for the concentration of fish protein hydrolysates"

### Journal article - "Optimizing Low-Temperature Three-Circuit Evaporative Cooling System for an Electric Motor by Using Refrigerants"

This article presents modeling results and a comprehensive analysis of evaporative cooling systems designed for electric motors using the refrigerants R744 (trans-critical), R134a, R600a, and R290. This study aims to determine the most suitable refrigerant for use in a cooling system, optimize the system design, and calculate the maximum achievable motor power while adhering to specified temperature constraints. The modeling was validated by an experimental setup, which had the cooling system's configuration featuring three circuits for motor housing, stator, and rotor cooling, respectively. The modeling of an evaporative system was used to present the cooling efficiency under varying loads and external temperature conditions. Mathematical modeling encompasses complex algorithms to simulate heat transfer phenomena, accounting for fluid dynamics and refrigeration cycle dynamics. The analyses revealed trends in winding temperature, rotor temperature, air temperature inside the motor, heat transfer coefficient, coefficient of performance (COP), and motor power across different operating conditions while using different cooling refrigerants. The maximal heat transfer coefficients were calculated for all the refrigerants for winding temperatures in the range from 32 to 82 °C, while air temperature and rotor temperatures were between 42 and 105 °C and 76 and 185 °C, respectively. Lowering the evaporation temperature of the coolant to −35 °C resulted in a significant decrease in the winding temperature to 15 °C, air temperature to 38 °C, and maximum rotor temperature to 118 °C at a motor power of 90 kW. Refrigerant R744 emerged as a promising option, offering high heat transfer coefficients and achieving high motor power within temperature limits. At the same time, the COP was lower when compared with other working fluids because of the high ambient temperature on the gas cooler side.

### Conference paper - "Physicochemical and rheological properties of COD hydrolysates."

### Conference paper - "Solid-liquid phase transition process of water-based ferrofluid"

### Conference paper - "Survey of freeze concentration methods for the concentration of fish protein hydrolysates."

### Conference paper - "Solidification and Melting Process of Water-based Magnetic Fluid"

### Journal article - "CO<sub>2</sub>-equivalent emissions and quality evaluation of chilled and frozen Atlantic salmon transported from Norway to Japan"

[Atlantic salmon](#) (*Salmo salar*) is the top imported fish in Japan. It is usually shipped in chilled form by [air cargo](#) to preserve its freshness but posts a high environmental impact. As a sustainable alternative, ocean freight can be implemented if the salmon is frozen. However, the question arises as to whether the quality of the frozen and thawed salmon is comparable. Therefore, the aim of this study is to evaluate the environmental impact and quality of Norwegian [Atlantic salmon](#) in chilled and frozen form. The CO<sub>2</sub> equivalent emissions of the key life-cycle stages were calculated, and the quality assessment was carried out by [colorimetry](#) and [sensory evaluation](#) with careful preparation and execution. The results showed that the CO<sub>2</sub> equivalent emissions of the packaging, transport, and overall cycle of the frozen salmon were 35 %, 90 %, and 60 % lower than those of the chilled salmon. Color measurements using digital imaging show that the frozen salmon is slightly redder, with a higher *a\** value and a lower *b\** value. Panelist ratings indicated that there was no statistically significant difference in perceived color, glossiness, fishy smell, texture, [umami](#), and juiciness between chilled and frozen salmon. The study provides preliminary results that demonstrate the potential of frozen seafood and ocean freight transportation as a sustainable cold chain solution.

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## Planned research output details

| Title  | DOI                                | Type             | Release date | Access level | Repository(ies) | File size | License        | Metadata standard(s) | May contain sensitive data? | May contain PII? |
|--|------------------------------------|------------------|--------------|--------------|-----------------|-----------|----------------|----------------------|-----------------------------|------------------|
| Data set: Inter-COLD lectures and presentations        |                                    | Event            | 2025-01-27   | Open         | None specified  |           | None specified | None specified       | No                          | No               |
| A comprehensive investigation of the use of freeze ... | 10.1016/j.foodchem.2024.139559 ... | Journal article  | 2024-09-01   | Open         | None specified  |           | None specified | None specified       | No                          | No               |
| Optimizing Low-Temperature Three-Circuit Evaporati ... | 10.3390/en17163942 ...             | Journal article  | 2024-08-09   | Open         | None specified  |           | None specified | None specified       | No                          | No               |
| Physicochemical and rheological properties of COD ...  | 10.18462/iir.iccc2024.1069 ...     | Conference paper | 2024-01-01   | Open         | None specified  |           | None specified | None specified       | No                          | No               |
| Solid-liquid phase transition process of water-bas ... |                                    | Conference paper | 2024-09-16   | Open         | None specified  |           | None specified | None specified       | No                          | No               |
| Survey of freeze concentration methods for the con ... | 10.18462/iir.iccc2024.1065 ...     | Conference paper | 2024-01-01   | Open         | None specified  |           | None specified | None specified       | No                          | No               |
| Solidification and Melting Process of Water-based ...  |                                    | Conference paper | 2024-06-09   | Open         | None specified  |           | None specified | None specified       | No                          | No               |
| CO2-equivalent emissions and quality evaluation of ... | 10.1016/j.ijrefrig.2024.05.034 ... | Journal article  | 2024-09-01   | Open         | None specified  |           | None specified | None specified       | No                          | No               |