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# FP7-IDREEM project Milestone 18.

## Part I: Review of the production parameters at the Oldervika salmon farm (Nordland, Norway).

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*Sammendrag:*

Denne rapporten er en studie av oppdrettslokaliteten Oldervika i Morsdalsfjorden i Gildeskål Kommune (Nordland, Norge). Studien fokuserer på miljø- og økologiske parametere registrert på lokaliteten siden 2007 av Gildeskål Forskningsstasjon AS (GIFAS). Lokaliteten har en total maksimal tillatt biomasse på 1560 tonn, og er nå i sin tredje produksjonssyklus. Lokaliteten ligger over et flatt basseng på 140 m dyp, og er eksponert for moderate tidevannsstrømmer (NV-SØ som dominerende strømretning). Temperatur og saltholdighet er registrert sporadisk i driftsperioden, og obligatoriske sedimentanalyser tyder på at lokaliteten er moderat påvirket av aktiviteten. Lokaliteten har derfor blitt valgt som demonstrasjonslokalitet for et tverrfaglig forskningsprosjekt (Increasing Industrial Resource Efficiency in European Mariculture – FP7 - IDREEM). Dette prosjektet vil ta for seg hindringer og utfordringer for IMTA, og på dette grunnlag utvikle økonomiske, miljømessige, tekniske, sosiale eller juridiske løsninger. IDREEM vil tilby verktøy og kunnskapsgrunnlag for tilpasning til IMTA i oppdrettsnæringen.

*Summary:*

The report is a study of the salmon farm at Oldervika in Morsdalsfjorden in Gildeskål Township (Nordland, Norway). The study focuses on the environmental and ecological parameters registered at the site since 2007 by Gildeskål Research Station AS (GIFAS). The salmon farm has a total maximum allowed biomass of 1560 tons and it is now in its third production cycle. The farm is located over a flat basin of 140 m depth, and is exposed with moderate tidal currents (NV-SE as dominating current directions). Temperature and salinity has been recorded discontinuously during the years of activity, and the mandatory sediment analyses indicate that the farm site is moderately affected by the activity. This site has therefore been chosen as demonstration site for an interdisciplinary research project (Increasing Industrial Resource Efficiency in European Mariculture – FP7 - IDREEM). This project will address the obstacles and challenges of IMTA, and on this basis develop economic, environmental, technical, social or legal solutions. IDREEM will provide tools and evidence based on knowledge to support adaptation to IMTA in the aquaculture industry.

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|---|---|
| *Land/Country:* | Norway |
| *Fylke/County:* | Nordland |
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Godkjent / Approved

Rolf Rødven

Prosjektleder / Project leader

Céline Rebours

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# 1. List of data reported by Gildeskål Research Station AS (GIFAS)

- First fish input: 15/01/07
- Excel file with record of biomass and feeding from June 2007 to July 2012
- Excel file with record of temperature during the production period from 2000 to 2012
- Report on the classification of the Oldervika site NR. 22995 (Seljeseth 2011).
- Report on survey of wave, current, wind, bottom topography, salinity, temperature, sediments studies as attachment to the concession application (Leknes 2002).
- Reports on sediments conditions (Leknes 2009, Meland 2011, 2012).

# 2. General organization of GIFAS

Gildeskål Research Station AS (GIFAS) is a privately owned aquaculture station based in Gildeskål in Nordland. The company has 17 employees and conducts research in aquaculture to solve technological and biological problems in both small-scale and full commercial scale. Two R&D licenses and a commercial license for salmon and trout ensure opportunities for both large and small R&D projects with considerable flexibility in problems solving. GIFAS disposes of five farming sites, equipped with 60 or/and 90 m cages for R&D projects on a commercial scale and 5x5m cages for small scale R&D projects. Typical issues in R&D projects are development and testing of raw materials and new commercial feeds, feeding regimes and aquaculture technology. Partners and customers are producers/ manufacturers of feed ingredients, universities and colleges, research institutes, livestock companies and pharmaceutical industry.

# 3. Summary of the production methods for the existing salmon farm at Oldervika site

The locality Oldervika (figure 1) is owned by GIFAS. The production on the site is based on Atlantic salmon since the first fish input January 2007.

**Figure 1: Salmon farm at Oldervika. Photo: GIFAS.**

The fish that is ongrown in the farm today is the third cycle of production since 2007, and the farm has been fallowed respectively 5 and 2 months between productions. The length of the production cycle depends on the start time and size of salmon, but generally the fish is put on site at 100 g and harvested at 4-5 kg. A fallow period is required between each production cycle. The maximal allowed biomass (MAB) at Oldervika site is 1560 tons. The total MAB at one location depends on the carrying capacity of the site, use of area and other activities in the area. The monthly biomass in Oldervika varies from zero to MAB (figure 2). The maximal feed input per month was 254 tons. A procedure of washing nets on site has recently been changed, because of accumulation of organic material below the farm.

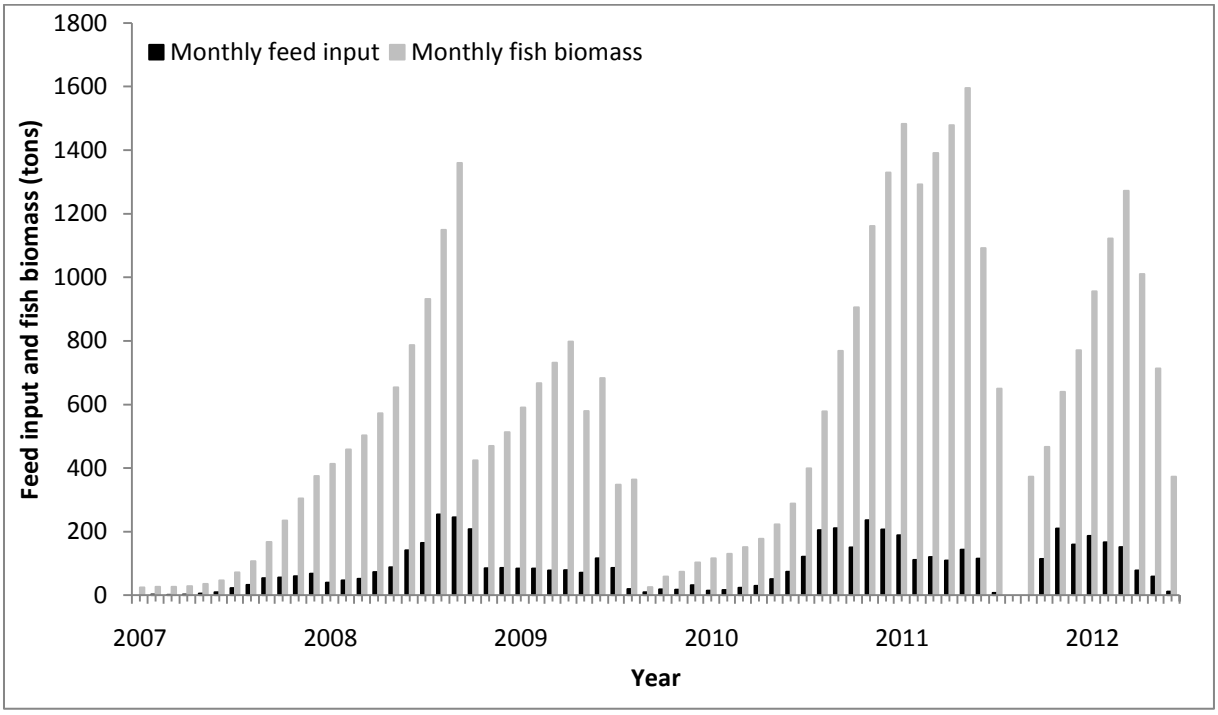


**Figure 2: Monthly biomass and feed input at Oldervika in the period from first fish input 1/2007 to 7/2012. Source: GIFAS.**

There are other fish farms in the fjord, the closest is the GIFAS site in Stigvika (figure 3), but as the current across the fjord is considered minimal, the farms are considered to be separated and not to impact each other. Other sites are Leirvik Nord and Sundsfjord Smolt (land based smolt production) (figure 3).

## 4. Description of the environmental and ecological parameters at Oldervika site

The Oldervika fish farm is located in a Southern exposed bay in the north east part of Morsdalsfjorden in Gildeskål Township, Nordland (figure 3). The Oldervika farm covers an area of 450x90 meters in surface, in addition to anchors in rock and sand (figure 4).The topography, current direction and current speed was described by Seljeseth 2011 and earlier by Leknes 2002. The topography is relatively steep from the shore, and the depth under the farm is between 90-138 m. Most of the farm is located over a flat basin at 140 m depth (figure 4).

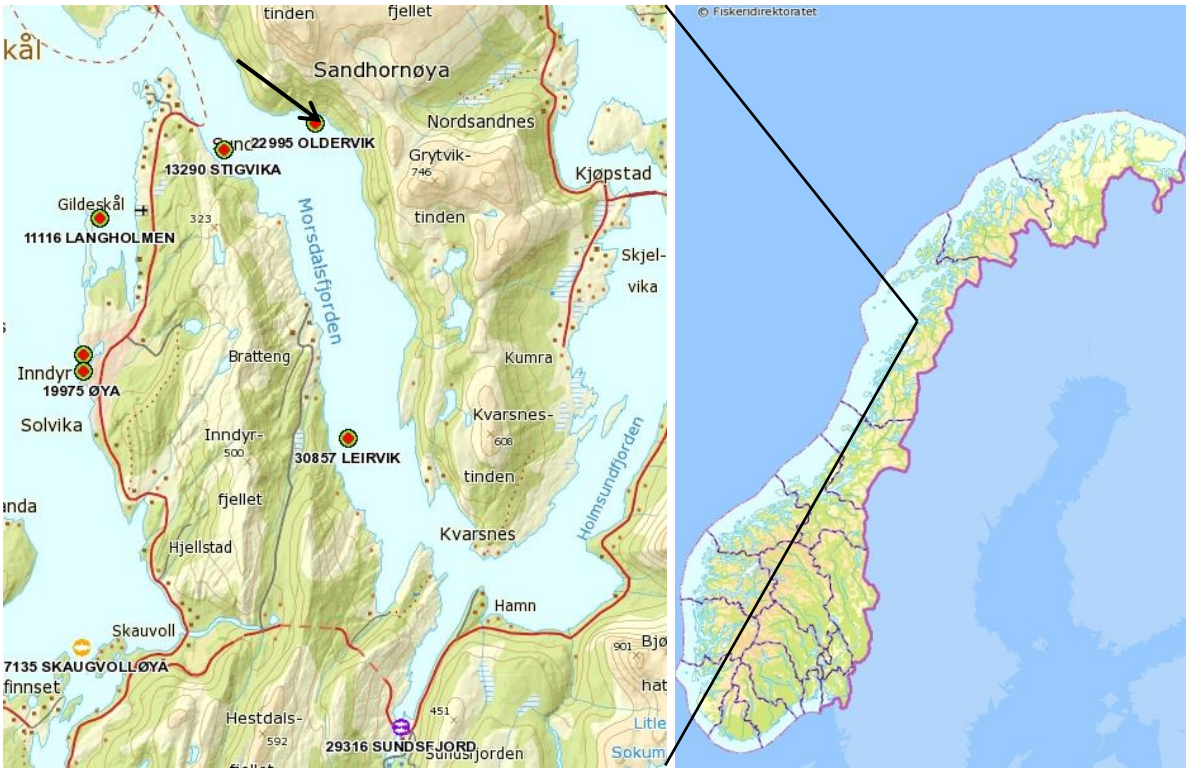


**Figure 3: Location of the farm site Oldervika (indicated with black arrow), in Morsdalsfjorden. Map source: Directory of Fisheries 2013.**

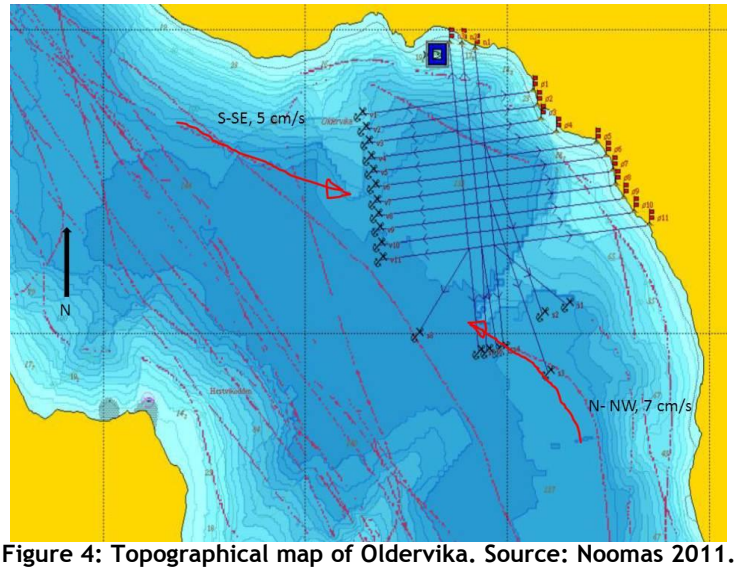


**Figure 4: Topographical map of Oldervika. Source: Noomas 2011.**

## 4.1 Hydrological conditions at Oldervika site

Tidal currents dominate at the Oldervika site, and the difference on low- and high tide is normally 2,5-3 m. The main current direction is alternating between 120 to 300 degrees, in S-SE or N-NW direction. The maximal current at 1 m depth varies between 26 and 44 cm/s (in 120 and 330 direction) (Seljeseth 2011). On average the current speed at 7 m depth is 7 cm/s towards NW and 5 cm/s towards SE (Leknes 2002). The wind effect on the currents is minimal when the wind is from E-SE in longer periods. There are several fresh water runoffs into the fjord, the most important is the Sundsfjordelva River. Both the wind and fresh water impact in melting periods is diminished due to the two openings of the fjord.

The highest waves come from SW, around 90 degrees on the main current direction (Seljeseth 2011). There are also several circular currents in the area which complicates the currents patterns. The seawater temperature varies between 3 and 12,6 degrees, the coldest period in the year is March and the warmest is August (figure 5). Temperature profile for January 2002 is described by Leknes 2002, between 10-20 m the temperature rises with one degree. Salinity extremes varies between 18,1 (August) and 34,2 (March). Monthly average salinity is between 21,2 in August and 33,7 in March (figure 6). In January 2002 the salinity varies between 31 and 32,5 in the uppermost 20 m (Leknes 2002). The salinity and temperature are very closely connected to the fresh water runoff in Sundsfjord, south of the farm site. The low values of salinity (figure 6) are probably explained by the presence of a dam which regulates the load of freshwater to Morsdalsfjorden. The measurements were done during the construction period when large amounts of fresh water were released during periods and affected strongly the salinity of the fjord. Today the situation is stabilized (J. Johansen pers.comm.).

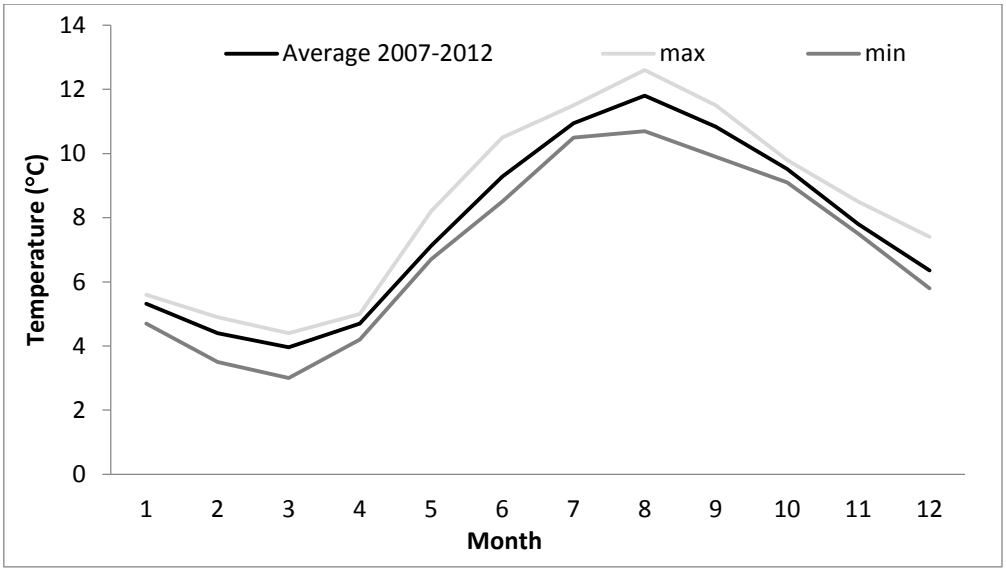


**Figure 5: Monthly average temperature (1, 3 and 5 m depth) at Oldervika calculated for the period 2007-2012. Source: GIFAS.**

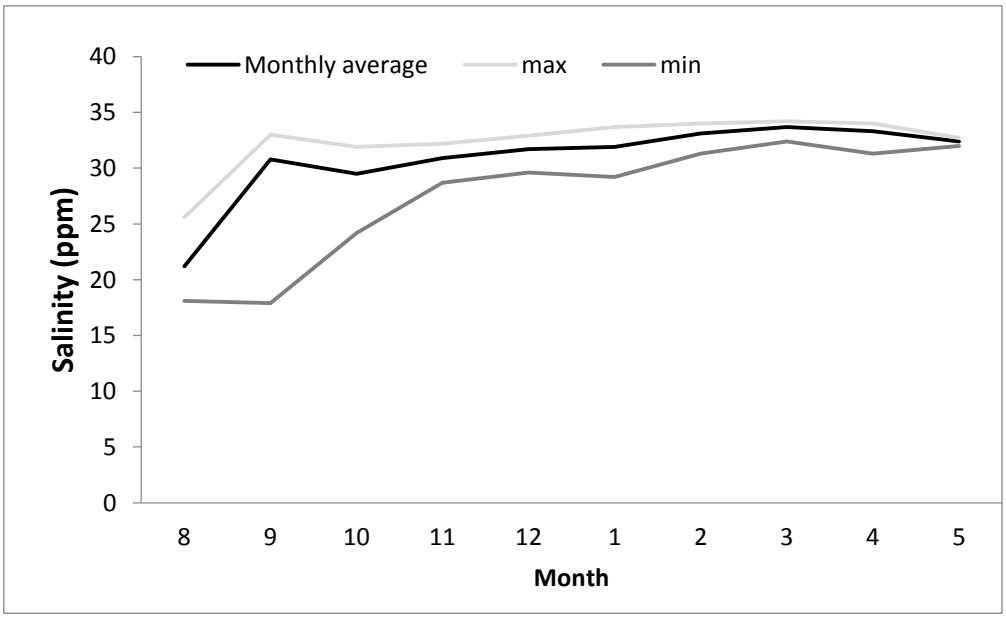


**Figure 6: Monthly average salinity at 3 m depth at Oldervika August 2008 to May 2009. Source: GIFAS.**

## 4.2 Sediments conditions at Oldervika site

Most of the farm is situated above a flat area with fine sediments which consist of mud and clay. In the slope in the northern part of the farm, sand and silt are more present, as well as rocks, which cause difficulties while achieving sediments sampling. The sediments are not as thick in the slope as in the flat area where they accumulate more easily. The sediments have been classified in several reports (Leknes 2002, 2009, Meland 2011 and 2012). The Norwegian standard NS:9410 lays down criteria for classification of sediments based on pH and redox measurements, sensoric parameters and presence of fauna. According to this standard, level 1 is the best level and indicates no effects of the aquaculture on the sediments conditions, while level 4 indicates that the aquaculture has a serious negative effect on the environment, and where consequences will be immediate close down. Based on this classification, the site is classified level 2 and is therefore considered to be moderately affected by aquaculture. pH and redox measurements indicate reduced sediments, but few animals are found in the sediments, with Polychaetes as dominating group. Over the years of activity, the sediment conditions in Oldervika are stable at level 2, with slightly better conditions after fallow periods.

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