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Deliverable report for

GAIN

Green Aquaculture Intensification in Europe

Grant Agreement Number 773330

GAIN Deliverable 4.5

B2C and B2B apps for smartphones and tablets

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WP 4 – Eco-Intensification of aquaculture
Task 4.5 – Setting the compass for good fish

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Summary

GAIN is an EU-funded research project that brings together partners from academia, industry and associations with the primary aim of supporting ecological intensification of aquaculture in the European Union (EU) and the European Economic Area (EEA). The core focus of GAIN is to increase production and competitiveness of the industry, while ensuring sustainability and compliance with EU regulations on food safety and the environment.

This report describes the broad technology and features of Business to Consumer (B2C) and Business to Business (B2B) apps developed in GAIN task 4.4. Deliverable 6.5 details the dissemination and exploitation efforts of the GoodFish (B2C) and SailFish (B2B) applications.

Introduction and objectives

The smartphone B2C and B2B applications are designed to integrate the knowledge acquired in previous work packages (WP4), disseminate it to different actors, and exploit the products further by connecting directly with target markets (WP6).

The applications described herein were both developed as mobile platforms. There are two key reasons why this option was selected: (i) if users scan QR codes at a supermarket fish counter, or follow a mobile browser link in the case of the B2B application, a potentially large part of those users will be reticent to download an app and only then be able to exploit the potential of what we offer e.g. for understanding more about a particular fish species. Since we aim to have the user immediately see the information we present, the best solution is for a user to scan a QR code—this is something that people have become very accustomed to during the COVID-19 pandemic—that directly opens the mobile site https://goodfi.sh; (ii) iOS and Android apps are coded in different languages, and although cross-platform offerings that use a common computer language codebase are starting to appear, we felt it was an unnecessary risk to deal with multiple code repositories in maintaining two app platforms, given Longline Environment is committed to support the apps as part of the (unfunded) GAIN legacy programme.

The development of the consumer tools was centred on promoting information and awareness about farmed aquatic products, using an easy-to-use and widespread platform, such as smartphones. The GoodFish app uses an image recognition technology, Quick Response (QR) codes, to provide information on four key elements:

a) Consumer experience: taste, texture, preparation and speciality;
b) Nutrition and health: nutrition, health and well-being;
c) Environmental sustainability: conservation status, biodiversity and pollution;
d) Animal welfare: type and form of culture and environmental conditions.

GoodFish is focused on differentiating farmed aquatic products and returns detailed information and aims to bring consumers closer to aquaculture products by increasing the connectivity between retailers and consumers. The app was designed to meet the following core objectives:

1. Provide consumers with greater awareness of cultivated species;

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2. Differentiate between European and other farmed aquatic products;

3. Furnish detailed information on consumer items (link to farms as possible);

4. Provide consumers with rich information on origin and history of the fish they buy;

5. Allow information sharing and rating of the item purchased, cooked, and eaten.

The business-oriented platform SailFish includes an integrated web-based smartphone application. It connects producers to retailers and it aims at reducing the 'stickiness' in the seafood market.

This lack of flexibility in the market poses a challenge particularly for small-scale producers that operate in limited regional scales. SailFish draws on pricing from statistical platforms (EUMOFA or FAO) with the objective to create a more level playing field for economic actors of the supply-chain.

Both these deliverables belong to the group *Websites, Patents filing, etc.*, and therefore this report provides summary information of GoodFish and Sailfish with respect to development and deployment, but of course does not constitute the deliverables themselves.

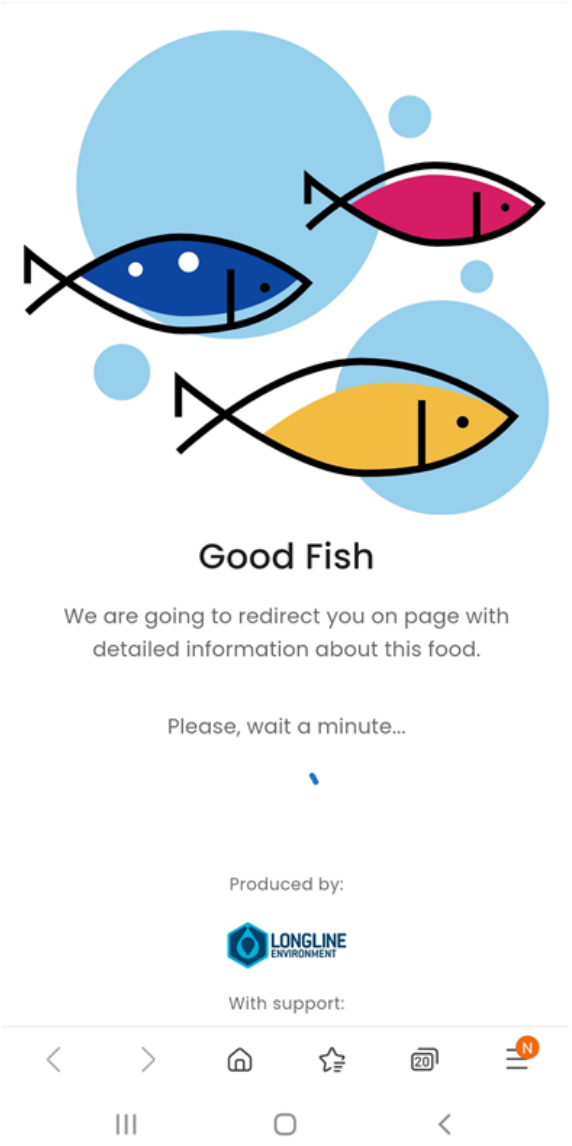

Figure 1. Intro screen for GoodFish. This can be accessed via a QR code on a product label.

Business to Consumer: GoodFish

The core objective of GoodFish is to bring consumers closer to aquaculture products by using digital technologies to increase connectivity between retailer and consumer. It was developed to promote the vision of aquaculture eco-intensification. Part of that vision is to meet the following sectorial objectives:

- Provide consumers with greater awareness of cultivated species;
- Differentiate between European and other farmed aquatic products;
- Furnish detailed information on consumer items;
- Provide consumers greater traceability of the fish they buy;

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- Allow information sharing and rating of the item purchased, cooked, and eaten.

Focus

GoodFish is focused on consumers who purchase fish and shellfish at supermarket fresh counters or at fishmongers. It is only directed at present towards cultivated fish and is not targeting packaged products available on shelves. European consumers only have access to the following information at a fresh fish counter: species name, type of origin (aquaculture/capture) and geographic origin (country, ICES region).

This is limited information on the traceability of products. Specific questions are more interesting for the average consumer than general facts, hence GoodFish focused the categories and key indicators identified in Table 1.

Table 1. Categories and indicators for the GoodFish app.

Category	Indicators/keywords
Consumer experience	Taste: briny, fresh, mild, rich; Texture: buttery, delicate, flaky, succulent, velvety Preparation: baked, boiled, breaded, grilled, poached Specialty: ceviche, smoked, sashimi, sushi, tataki
Nutrition and health	Nutrition: Protein, Carbs, Fats, Minerals Health: Vitamins, PUFAs, cholesterol Well-being: Heart & Circulation, Blood sugar, Cholesterol level,
Environmental sustainability	Conservation status: If status a problem (e.g. NT, VU, EN etc), aquaculture is better for conservation Biodiversity: aggregates on artificial reefs, etc Pollution: impact on the sea bottom, impact on the water,
Animal welfare	Form of culture Water temperature Oxygen conditions

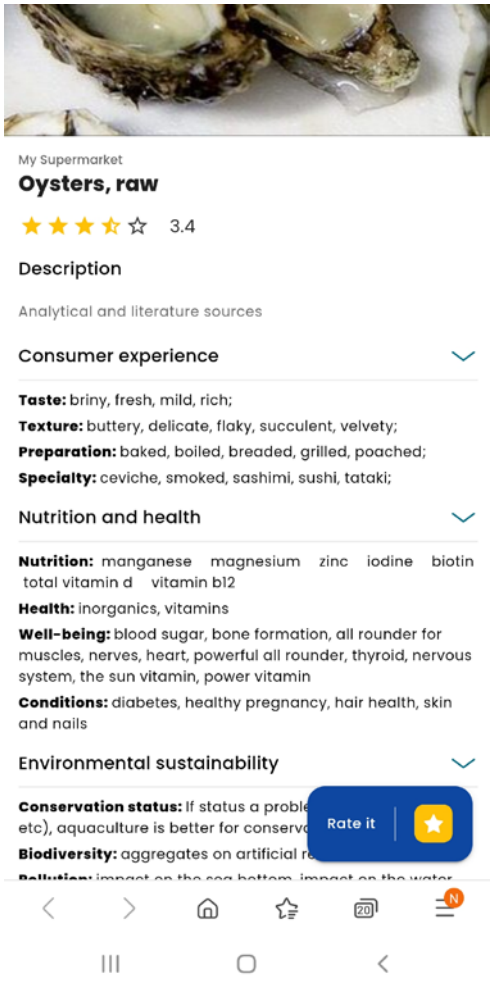

Figure 2. Product information screen.

Features and functionality

The GoodFish B2C app was developed for both Android and iOS. GoodFish is available in English but will have multilingual support—the next language to be supported is Portuguese. The app reads QR codes and provides the consumer with data associated with those codes, which allows the user to rate the product at three stages:

- A – Acquisition;
- C—Confection;

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- T – Consumption.

The ACT concept easily translates to southern European languages such as Italian into 3C, i.e. *Comprare Cucinare Consumare*.

The backend cloud server stores ratings and provides metadata on purchasing (date and time, location) and on customer experience. The domain goodfi.sh was registered for the backend dashboard. The backend hosts the databases, accessed by the app, and used to print the QR codes for product labelling.

The system deployed provides information for cultivated species at the point of sale by adding a QR code to the species identifier (i.e. the plastic tag listing the name and provenance), allowing a user to browse this information on a smartphone and have a richer shopping experience. The user accesses the system by reading the QR code on the plastic tag used to label the fish at a supermarket counter.

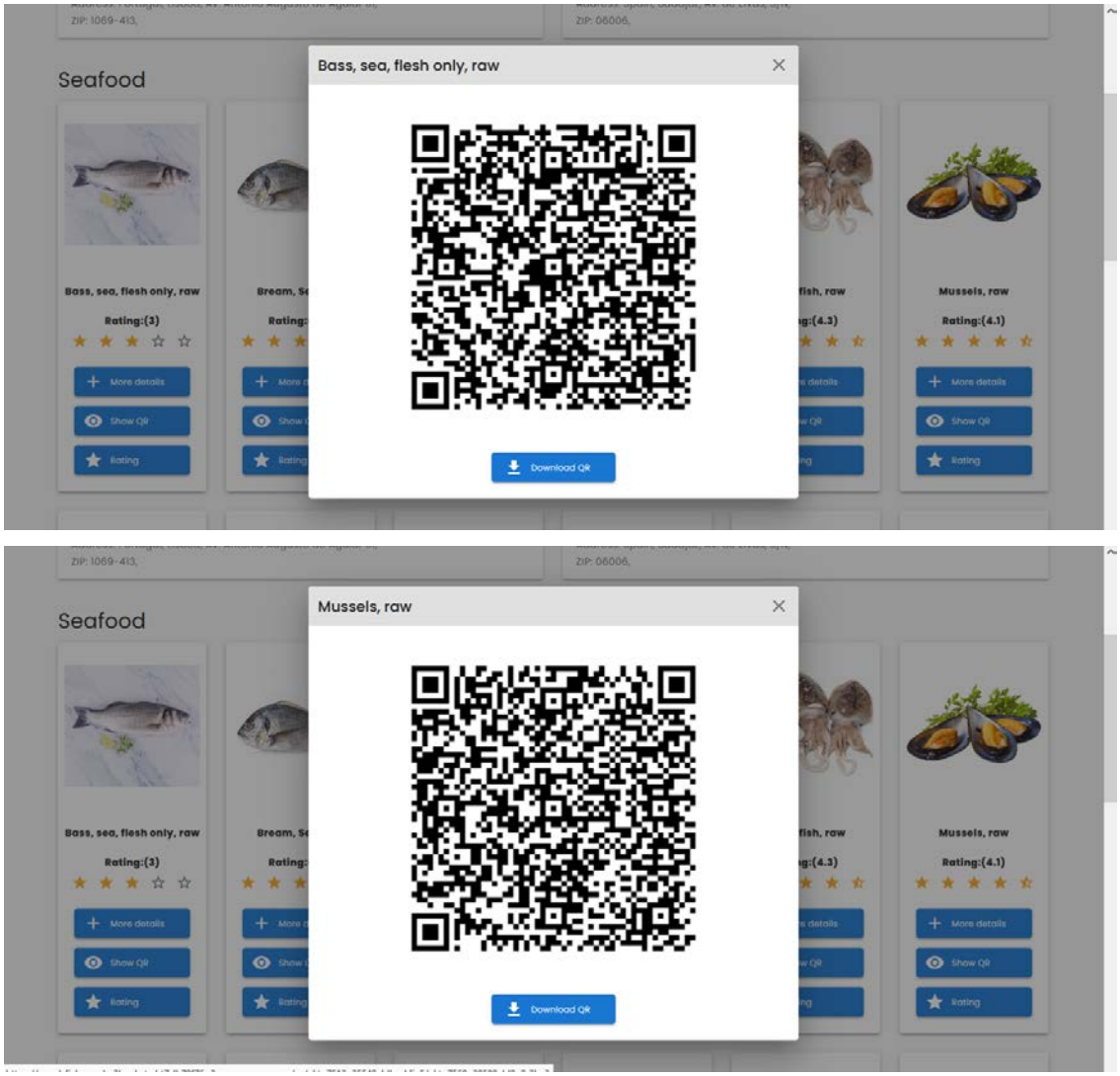

Figure 3. Example QR codes for two species listed on GoodFish. These can be directly scanned with a customer smartphone.

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When a customer is at the purchase stage (Acquisition) they can rate the product, based on the information they have read. After consumers buy the product, they can rate it (or modify their rating) for the A stage and are also given the opportunity to rate the C and the T stages. Users rate the products on a 5-star scale.

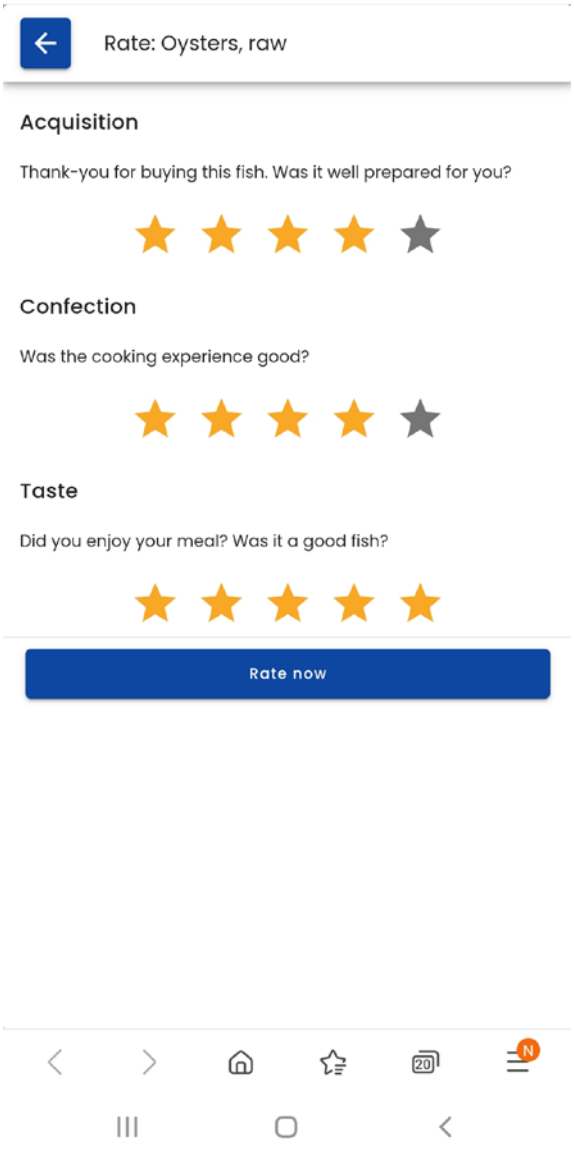

Figure 4. Rating system for aquatic products on the GoodFish app.

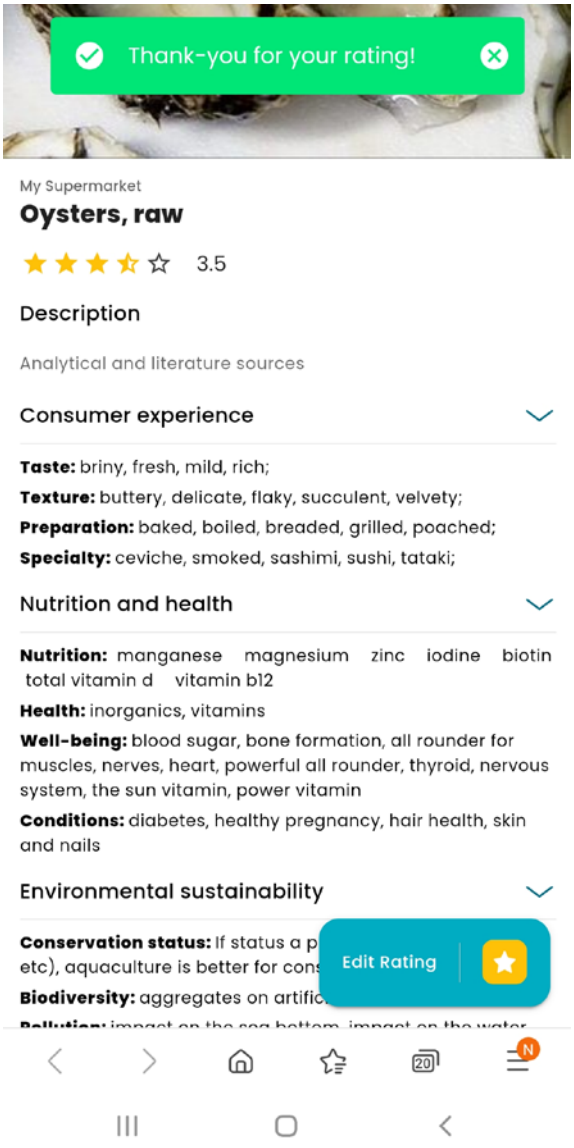

Figure 5. Product description screen displayed after a user attributes the rating.

Cloud backend

The GoodFish cloud backend, accessible to authorised users on the goodfi.sh url, is where the processing for the app is done. The backend stores information for the various aspects of the GoodFish classification, in particular for the nutritional composition database, which contains over three thousand records of food presentations. The UK government's integrated dataset food composition was selected for this purpose, since the European Food Safety authority

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does not make available data in a format accessible by third-party software, e.g. using webservices such as a REST interface.

The UK's database is available in spreadsheet form, and we therefore developed software to allow the import of the complete database into a relational database.

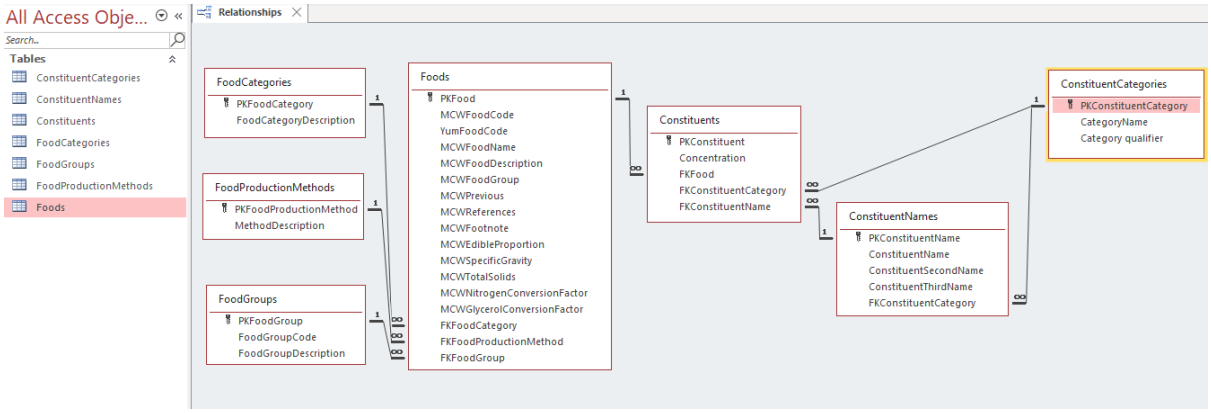
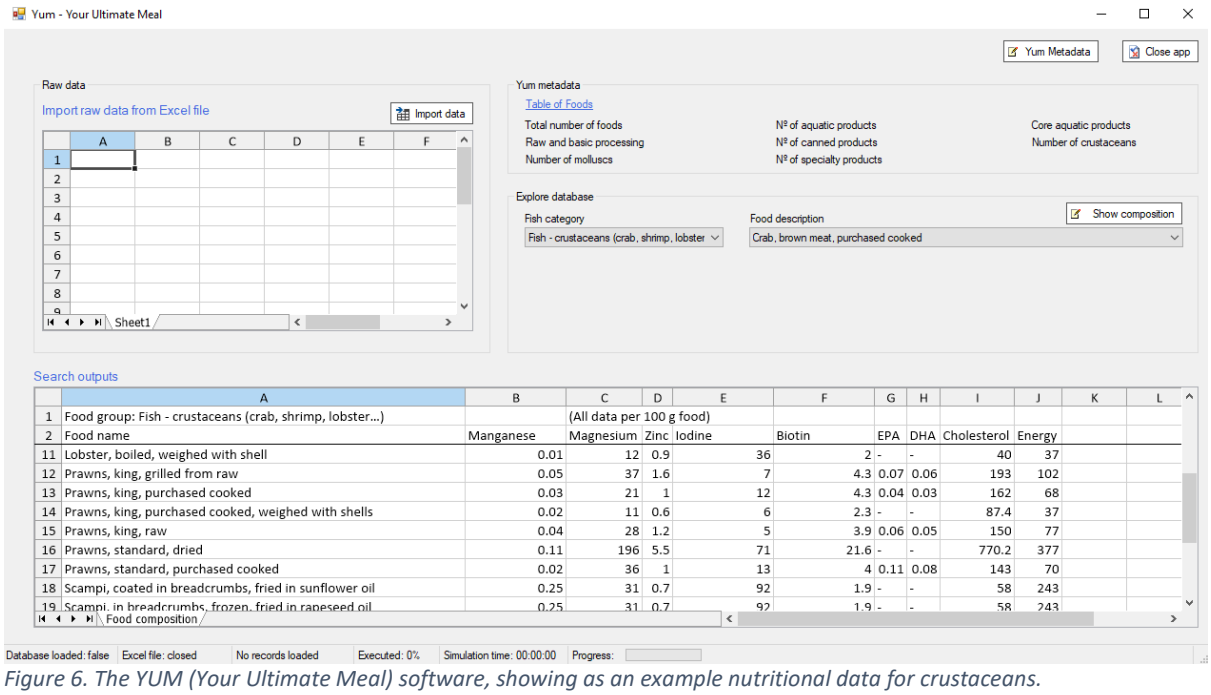


Figure 5. Relational database schema for importing spreadsheet data from the UK integrated dataset.

A conceptual relational database model (Figure 6) was set up to archive the data, and software was developed in to import and search the database.



	A	B	C	D	E	F	G	H	I	J	K	L
1	Food group: Fish - crustaceans (crab, shrimp, lobster...)		(All data per 100 g food)									
2	Food name	Manganese	Magnesium	Zinc	Iodine	Biotin	EPA	DHA	Cholesterol	Energy		
11	Lobster, boiled, weighed with shell	0.01	12	0.9	36	2	-	-	40	37		
12	Prawns, king, grilled from raw	0.05	37	1.6	7	4.3	0.07	0.06	193	102		
13	Prawns, king, purchased cooked	0.03	21	1	12	4.3	0.04	0.03	162	68		
14	Prawns, king, purchased cooked, weighed with shells	0.02	11	0.6	6	2.3	-	-	87.4	37		
15	Prawns, king, raw	0.04	28	1.2	5	3.9	0.06	0.05	150	77		
16	Prawns, standard, dried	0.11	196	5.5	71	21.6	-	-	770.2	377		
17	Prawns, standard, purchased cooked	0.02	36	1	13	4	0.11	0.08	143	70		
18	Scampi, coated in breadcrumbs, fried in sunflower oil	0.25	31	0.7	92	1.9	-	-	58	243		
19	Scampi, in breadcrumbs, frozen, fried in rapeseed oil	0.25	31	0.7	92	1.9	-	-	58	243		

Figure 6. The YUM (Your Ultimate Meal) software, showing as an example nutritional data for crustaceans.

Bespoke software (see screenshot in Figure 7) was developed in C# which allowed us to verify data integrity against the original dataset, and the YUM database was then used to retrieve nutritional data after transferring to Postgres.

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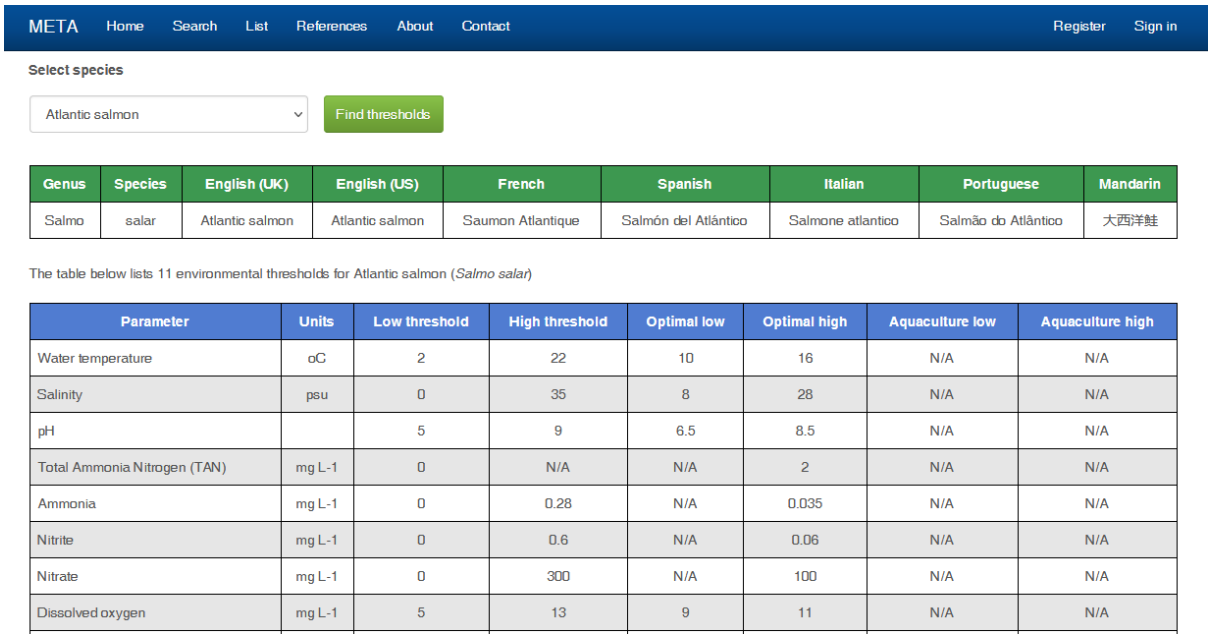
In parallel, materials were developed for use in GoodFish with respect to the other categories, in particular for taste, texture, and specialty products such as sushi, sashimi, and ceviche, and for well-being associated with different nutritional content (e.g. manganese, PUFAs, biotin).

Our focus at this stage was on the most popular farmed species in Europe, viz. Atlantic salmon, rainbow trout, European sea bass, Gilthead seabream, and turbot, with respect to finfish, and Pacific oyster, blue mussel, Mediterranean mussel, and Manila clam, with respect to bivalves.

Environmental sustainability and animal welfare

The META platform (https://longline.co.uk/META) provides a rich data set on environmental parameters relevant to each cultivated species (Figure 8).



Genus	Species	English (UK)	English (US)	French	Spanish	Italian	Portuguese	Mandarin
Salmo	salar	Atlantic salmon	Atlantic salmon	Saumon Atlantique	Salmón del Atlántico	Salmone atlantico	Salmão do Atlântico	大西洋鮭

The table below lists 11 environmental thresholds for Atlantic salmon (*Salmo salar*)

Parameter	Units	Low threshold	High threshold	Optimal low	Optimal high	Aquaculture low	Aquaculture high
Water temperature	oC	2	22	10	16	N/A	N/A
Salinity	psu	0	35	8	28	N/A	N/A
pH		5	9	6.5	8.5	N/A	N/A
Total Ammonia Nitrogen (TAN)	mg L-1	0	N/A	N/A	2	N/A	N/A
Ammonia	mg L-1	0	0.28	N/A	0.035	N/A	N/A
Nitrite	mg L-1	0	0.6	N/A	0.06	N/A	N/A
Nitrate	mg L-1	0	300	N/A	100	N/A	N/A
Dissolved oxygen	mg L-1	5	13	9	11	N/A	N/A

Figure 7. The Maritime and Environmental Thresholds for Aquaculture (META) platform, which contains environmental information on all the main cultivated species.

This can be used to inform consumers on the acceptable environmental range for distribution of a species. Ancillary information on European aquaculture is also used—Europe is well regarded as a tightly regulated production environment, leading to high quality, nutritious, and reliable food. Aquaculture licensing is stringent, which is a downside in terms of permitting, but has an upside in terms of consumer confidence in European-produced goods.

Legislation conditioning depth at which farms may be sited, emissions from RAS and under land-based systems, and stringent environmental impact assessment for new developments, plays a relevant role in indirectly certifying the environmental credentials of European aquaculture.

A final area is aquaculture insurance—insurers tend to grant competitive premiums to high quality farms, and low quality farms are typically unable (or unwilling e.g. for price reasons) to purchase insurance. GAIN partner LLE is very active in the insurance space, and the data available for different European countries is reassuring in this regard, although shellfish farms

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as a sector are under-insured relative to their finfish counterparts. The insurance indicator can also be used to benchmark best management practices, environmental sustainability, risk, and welfare.

GoodFish ratings and processing

Figure 9 shows the average ratings given to various seafood products during application tests. These are visible only to the associated retailer. Data security is critical for both consumer and retailer, which required the development of a role-based data model with hierarchical credentials, allowing e.g. a supermarket to create branches and branch managers as app users.

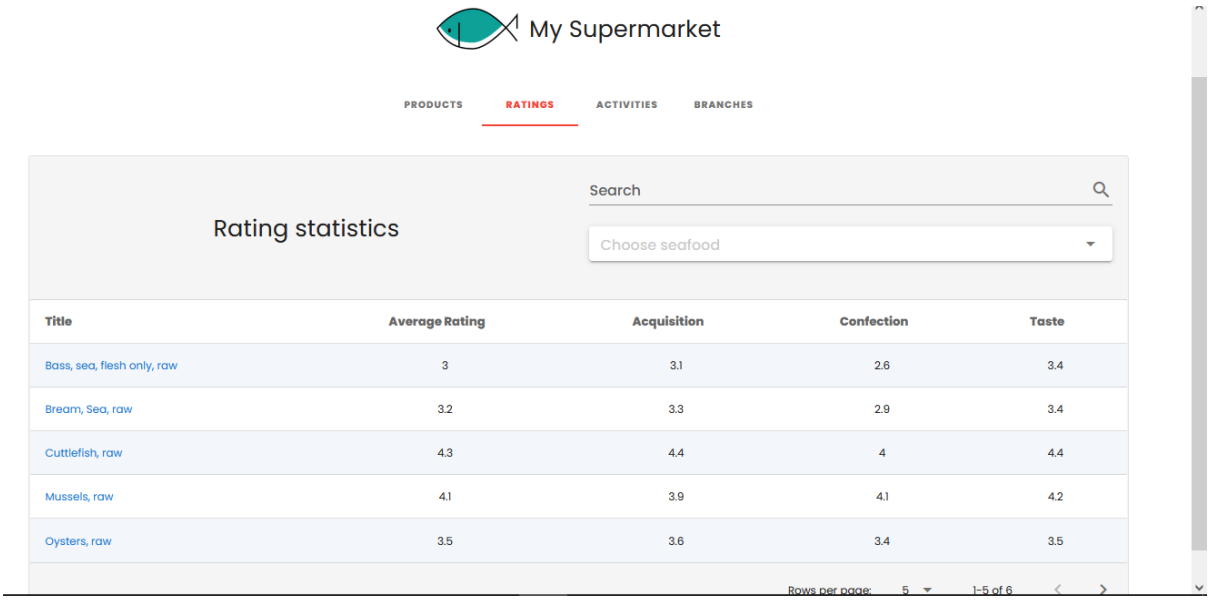

Figure 8. Ratings page for GoodFish, categorised by Acquisition, Confection, and Taste scores.

More information of the client-facing aspects of the GoodFish application, as well as the initiatives to adopt the software at commercial level are dealt with in the dissemination and exploitation section of GAIN and discussed in the relevant section of Work Package 6, which is reported in Deliverable 6.5 – Tools that Connect Stakeholders.

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Business to Business: SailFish

The SailFish business-oriented platform was designed to connect producers and retailers with the aim of reducing 'stickiness' in the seafood market, which poses a challenge for producers that operate at limited regional scales such as small coastal towns.

Focus

The difficulties of small-scale fish and shellfish farmers in overcoming the seafood market 'stickiness', are due to a limited regional operating space. In order to expand their operations and reach a larger number of markets and consumers, they require updated pricing data, that allows them to compete by providing their aquatic products at more competitive prices at a broader scale.

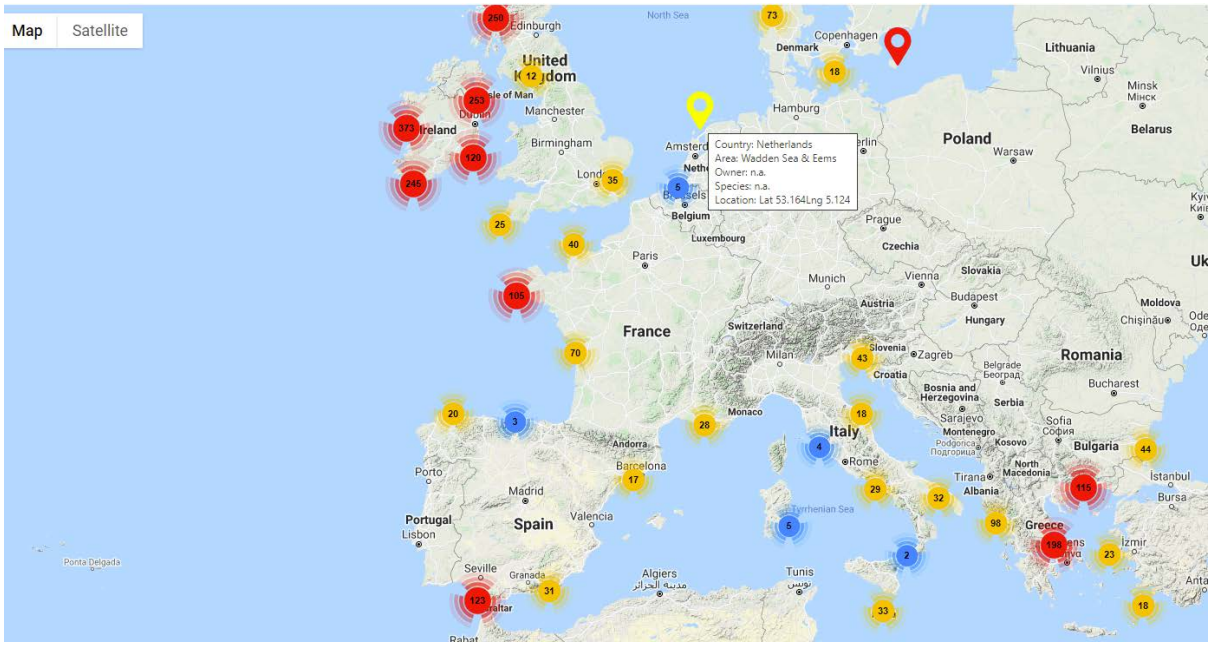

Figure 9. View of the supply-side map of SailFish. The numbers inside the circles represent the number of farms in a region.

To do this, it is necessary to design tools that can reach these producers and enable them to make their products available to a larger market, at the level of the European Economic Area. The objectives of SailFish were to:

1. Map European aquaculture farms (producers);
2. List updated prices for fish products;
3. Allow a seller to place an offer on the Sailfish market;
4. Allow a buyer to place a request on the Sailfish market;
5. Enable contact between two interested parties.

Features and functionality

The domain name aquamart.tech was registered to run the SailFish application and mobile platform. In order to accomplish the different objectives, access to relevant data sources was required, either via metadata files or web services.

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Mapping of European aquatic production

The mapping of European aquaculture farms was obtained via metadata files with details on aquaculture farms. These files, obtained through EUMOFA; contain the following information:

- Farm name;
- Country;
- Cultivated species;
- Location (latitude and longitude).

This farm location database allowed the development of the map feature of SailFish (Figure 10). The site was deployed using Amazon Web Services (AWS), and each farm is represented by a location pin. Different pin shapes and colours distinguish between shellfish and finfish. The dataset is not always complete, occasionally missing details on company names, species farmed, etc. Nevertheless, it provides a baseline for the supply-side of the market.

Non-logged in users can only access part of the information (location and species farmed) and after creating a login they can view more information and filter their search to display only a selected species or country.

Pricing data

Pricing data varies with high frequency (i.e. daily to weekly). EUMOFA lists a number of national sites that provide first-sale real-time pricing data, that can be used for informing the demand side of SailFish.

The application focus is on species listed in the producer database, and the key farmed species in the EU:

- Fish:
    - Atlantic salmon;
    - Rainbow trout;
    - European seabass;
    - Gilthead seabream;
    - Turbot.
- Shellfish:
    - Oysters;
    - Mussels (further subdivided into blue mussel and Mediterranean mussel where possible);
    - Clams.

Prices are shown on a separate page, which can be reached in the sidebar. Logged in users are able to filter their search by country and species, using the dropdown menu.

Contact between buyers and sellers

The three final objectives (3,4, and 5) are interconnected. A buyer can post a message on the platform by filling in the fields on the form. By using pre-formatted messages, spam is avoided

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and the platform is as unmoderated as possible. This is key to maintain the free-of-charge nature of the platform on its basic setup.

At present, SailFish *is not intended* to act as a broker, and does not therefore levy commissions on transactions or mediate a transaction in any way, including any form of financial services, provision of insurance, or guarantees. Its sole purpose is to facilitate contact between parties that would otherwise only normally connect through intermediary buyers and distributors.

Posts are made by buyers/sellers on the dropdown menu and users can select:

- Country: any or checkbox selection of specific countries;
- Species: any or checkbox selection of specific species;
- Volume: exact quantity or a range;
- Price: exact or a range;
- Time: duration of a buy or sell offer.

Offers are then posted on the platform. Only logged in users can access the marketplace, and a valid phone number and email is mandatory upon registration and used for validation of credentials, since this is a self-registration platform, like Amazon or eBay.

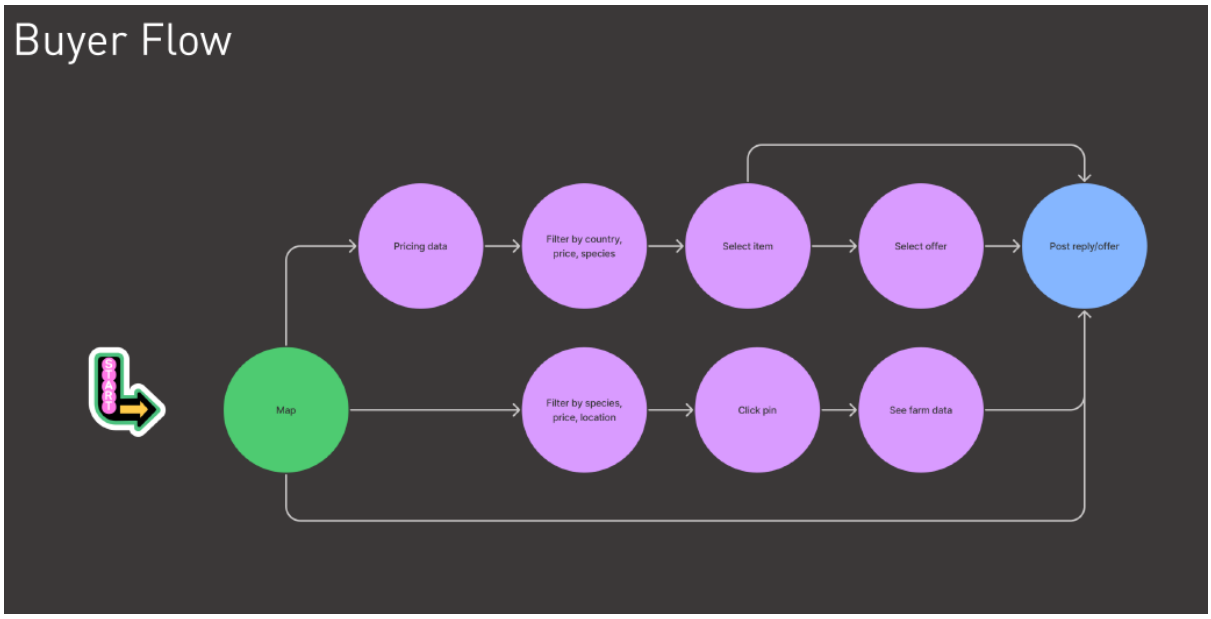

Figure 10. Flow of information for a SailFish buyer. Accurate and comprehensive specifications are key to good design.

Users are registered as either buyer or seller, but not both, because the aim of SailFish is to shorten the supply chain—we therefore discourage intermediaries to go on to the application and play both roles. Since only registered users can buy or sell, a request is automatically emailed to relevant supplier(s) when inserted by a buyer. When a supplier posts an offer, buyers are notified based on personal profile definitions. Users can select on their profile page for which species/countries they would like to be notified.

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The datasets from objectives 1 (map of European aquatic production) and 2 (fish products pricing) where used to list producers for particular species or countries and to display pricing data.

As the application increasingly attracts registered buyers and sellers, it will be possible to inform a seller that there is one or more registered buyers that have previously expressed interest in the same or similar products.

More information of the dissemination and exploitation of the SailFish application at commercial level are dealt with in the dissemination and exploitation section of GAIN and discussed in the relevant section of Work Package 6, which is reported in Deliverable 6.5 – Tools that Connect Stakeholders.

Conclusion

It is expected that the B2B and B2C tools developed within GAIN contribute positively to the project's objectives and become part of the legacy plan for future exploitation of GAIN results.

GoodFish has the capability to promote the European Union's farmed aquatic products and enables consumers to learn more about their seafood options and choices. It increases the traceability of aquaculture products and informs consumers on four key elements of seafood.

SailFish aims at levelling the playing field for small-scale aquatic products farmers that operate at local scale and aim at expanding their businesses, by reduction the 'stickiness' in the seafood market and shortening the supply-chain, ultimately resulting in improved connectivity, and gains to the consumer.

Together, the two apps cover key aspects of eco-intensification by promoting improved access to markets and products, and more consumer information and understanding about cultivated fish and shellfish.

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